CE LVD REPORT

Prepared For:	Zhongshan Harui Trading Co.,Ltd. Room411,4FL,NO.14HUAXINGSQUARE,SHUNCHENGYILUGUER ZHONGSHAN GUANGDONG,CHINA
Manufacturer :	Zhongshan Harui Trading Co.,Ltd Room411,4FL,NO.14HUAXINGSQUARE,SHUNCHENGYILUGUER ZHONGSHAN GUANGDONG,CHINA
Trade Mark:	N/A
Product Name:	Solar power station
Main Test Model:	HAR-AL-300HAR-AL-500
Additional Models :	HAR-AL-300HAR-AL-500, HAR-AL-600, HAR-AL-1000, HAR-AL-1200, HAR-AL-1500, HAR-AL-2000, HAR-AL-3000, HAR-AL-4000, HAR-AL-5000, HAR-AL-6000, HAR-AL-8000, HAR-AL-10000, HAR-AL-12000, HAR-AL-15000, HAR-AL-20000, HAR-AL-30000
Prepared By:	Dongguan True Safety Testing Co., Ltd. Room 201, No.20, East of Houjie Avenue, Houjie, Dongguan, Guangdong, China
Test Date:	Aug. 07, 2023 To Aug. 10, 2023
Date of Report:	Aug. 10, 2023
Report No.:	TST20230880152-1SR

Test Report

IEC 62109-1 & IEC 62109-2

Safety of Power Converter for use in Photovoltaic Power Systems

Part 1: General requirements

Testing laboratory ……..	:	Dongguan True Safety Testing Co., Ltd.
Address ……..	:	Room 201, No.20, East of Houjie Avenue, Houjie, Dongguan, Guangdong, China
Testing location ……..	:	Dongguan True Safety Testing Co., Ltd.
Applicant ……	:	Zhongshan Harui Trading Co.,Ltd.
Address ……..	:	Room411,4FL,NO.14HUAXINGSQUARE,SHUNCHENGYILUGUERZ HONGSHAN GUANGDONG,CHINA
Standard ……	:	IEC 62109-2: 2011 used in conjunction with IEC 62109-1:2010
Procedure deviation ……	:	N/A.
Non-standard test method ……	:	N/A.
Type of test object ……..	:	Solar power station
Trademark ……	:	N/A
Model/type reference ……..	:	HAR-AL-300HAR-AL-500
Rating ……	:	DC INPUT:51.2VDC AC INPUT:220VAC,50Hz AC OUTPUT:5KW.220VAC.50Hz SOLAR CHARGE CURRENT:512VDC 60A INTERNAL BATTERY BANK:1*100AH
Manufacturer ……	:	Zhongshan Harui Trading Co.,Ltd
Address ……..	:	Room411,4FL,NO.14HUAXINGSQUARE,SHUNCHENGYILUGUERZ HONGSHAN GUANGDONG,CHINA
Test item particulars:		
Equipment mobility …… :		Portable equipment
Operation condition …… :		Continuous
Class of equipment …… :		Class I
Protection against ingress of water . :		N/A.

Possible test case verdicts :		
test case does not apply to the test object ……..	:	N(.A.)
test object does meet the requirement …….……	:	P(ass)
test object does not meet the requirement …….	:	F(ail)

General remarks:	
"(see remark #)" refers to a remark appended to the report. "(see appended table)" refers to a table appended to the report. Throughout this report a comma is used as the decimal separator. The test 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.	Attached with: A. photo documentation

Copy of marking plate

Solar power station
Model: HAR-AL-300HAR-AL-500
Rated: DC INPUT:51.2VDC
AC INPUT:220VAC,50Hz
AC OUTPUT:5KW.220VAC.50Hz
SOLAR CHARGE CURRENT:512VDC 60A
INTERNAL BATTERY BANK:1*100AH

Zhongshan Harui Trading Co.,Ltd.

Name and address of the testing laboratory : **Dongguan True Safety Testing Co., Ltd.**
Room 201, No.20, East of Houjie Avenue, Houjie, Dongguan, Guangdong, China

Test by : Grace — Aug. 10, 2023
Signature / Date

Technician
Title

Reported by : Apple Li — Aug. 10, 2023
Signature / Date

Project Engineer
Title

Approved by : Andy — Aug. 10, 2023
Signature / Date

Andy/ Manager

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
5	MARKING AND DOCUMENTATION		--
5.1	Marking		--
5.1.1	General		P
	Equipment shall bear markings as specified in 5.1 and 5.2		P
	Graphic symbols may be used and shall be in ac- cordance with Annex C or IEC 60417 as applicable.		P
	Graphic symbols shall be explained in the docu- mentation provided with the PCE.		P
5.1.2	Durability of markings		P
	Markings required by this clause to be located on the PCE shall remain clear and legible under condi- tions of NORMAL USE and resist the effects of cleaning agents specified by the manufacturer		P
5.1.3	Identification		P
	The equipment shall, as a minimum, be permanent- ly marked with:		P
	a) the name or trade mark of the manufacturer or supplier		P
	b) model number, name or other means to identify the equipment		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.		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:		P
	input voltage, type of voltage (a.c. or d.c.), fre- quency, and max. continuous current for each input		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		P
	– the ingress protection (IP) rating as in 6.3 below	IP20	P
5.1.5	Fuse identification		P

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
	Marking shall be located adjacent to each fuse or fuseholder, or on the fuseholder, or in another loca- tion 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.		P
	Where fuses with special fusing characteristics such as time delay or breaking capacity are neces- sary, the type shall also be indicated		P
	For fuses not located in operator access areas and for soldered-in fuses located in operator access ar- eas, it is permitted to provide an unambiguous cross-reference (for example, F1, F2, etc.) to the servicing instructions which shall contain the rele- vant information.		P
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.		P
	Push-buttons and actuators of emergency stop de- vices, and indicator lamps used only to indicate a warning of danger or the need for urgent action shall be coloured red.		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 nonper- manent material.		N/A
	A unit with d.c. terminals shall be plainly marked in- dicating the polarity of the connections, with:		P
	the sign “+“ for positive and “-„ for negative; or		P
	a pictorial representation illustrating the proper polarity where the correct polarity can be un- ambiguously determined from the representa- tion		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		P
	the letters “PE“; or		N/A
	the colour coding green-yellow.		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
5.1.7	Switches and circuit-breakers		N/A
	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.		N/A
5.1.8	Class II Equipment		N/A
	Equipment using Class II protective means throughout shall be marked with symbol 12 of An- nex C. Equipment which is only partially protected by DOUBLE INSULATION or REINFORCED INSULATION shall not bear symbol 12 of Table Annex C.		N/A
	Where such equipment has provision for the con- nection of an earthing conductor for functional rea- sons (see 7.3.6.4) it shall be marked with symbol 6 of Annex C		N/A
5.1.9	Terminal boxes for External Connections		P
	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 be- side the terminal before connection, of either:		P
	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 in- stallation instruction. Symbol 9 of Annex C is an acceptable marking		P
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 colour with the back- ground		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 colour from the background, shall have a depht or raised height of at least 0,5 mm.		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 ad-jacent to symbols that are explained in the manual		N/A
5.2.2	Content for warning markings		P
5.2.2.1	Ungrounded heatsinks and similar parts		N/A
	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 disas- sembled to the extent that a risk of contact with the heatsink exists.		N/A
5.2.2.2	Hot Surfaces	Temperature not exceeded.	N/A
	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.	Symbol 14 of annex C also marked.	N/A
5.2.2.3	Coolant	Air cool unit	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:		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 other- wise 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.	5 minutes	P
5.2.2.5	Motor guarding		P
	Where required by 8.2 a marking shall be provided where it is visible to service personnel before re- moval of a guard, warning of the hazard and giving instructions for safe servicing (for example discon- nection of the source before removing the guard).		P
5.2.3	Sonic hazard markings and instructions	< 40dBA	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	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 in- structions shall include the measured sound pressure level, and shall identify readily availa- ble 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 re- quired in 5.3.4.		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.		P
5.2.5	Excessive touch current		N/A
	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.	No excessive touch current	N/A
5.3	Documentation		P
5.3.1	General		P
	The documentation provided with the PCE shall provide the information needed for the safe opera- tion, installation, and (where applicable) mainte- nance of the equipment. The documentation shall include the items required in 5.3.2 through 5.3.4, and the following:		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 result- ing installation requirements:		P
	– ENVIRONMENTAL CATEGORY as per 6.1		P
	– WET LOCATIONS classification fort he in- tended external environment as per 6.1		P

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Clause	Requirement – Test	Result – Remark	Verdict
	– 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 re- garding how to ensure that the installation complies with the required overvoltage cat- egories;		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 equip- ment is to be installed.		P
5.3.1.2	Format		P
	In general, the documentation must be provided in printed form and is to be delivered with the equip- ment.		P
	For equipment which requires the use of a comput- er for both installation and operation, documenta- tion may be provided in electronic format without accompanying printed format.		N/A
5.3.2	Information related to installation		P
	The documentation shall include installation and where applicable, specific commissioning instruc- tions and, if necessary for safety, warnings against hazards which could arise during installation or commissioning of the equipment. The information provided shall include:		P
	a) assembly, location, and mounting require- ments:		P
	b) ratings and means of connection to each source of supply and any requirements related to wiring and external controls, colour coding of leads, disconnection means, or overcurrent pro- tection needed, including instructions that the installation position shall not prevent access to the disconnection means;		P

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Clause	Requirement – Test	Result – Remark	Verdict
	c) ratings and means of connection of any outputs from the PCE, and any requirements related to wiring and externals controls, colour coding of leads, or overcurrent protection needed;		P
	d) explanation of the pin-out of connectors for ex- ternal 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;		P
	g) instructions and information relating to sound pressure level if required by 10.2.1;		N/A
	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;		P
	i) tightening torque to be applied to wiring termi- nals;	For all four connections	P
	j) values of backfeed short-circuit currents availa- ble from the PCE on input and output conduc- tors under fault conditions, if those currents ex- ceeds the max. rated current of the circuit, as per 4.4.4.6;		N/A
	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;		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 instruc- tions shall include the following or equivalent wording:		N/A
	“This product can cause a d.c. current in the ex- ternal 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 sup- ply side of this product.“		N/A
	o) for PCE intended to charge batteries, the bat- tery nominal voltage rating, size, and type		P

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Clause	Requirement – Test	Result – Remark	Verdict
	p) PV array configuration information, such as rat- ings, whether the array is to be grounded or floating, any external protection devices need- ed, etc.		P
5.3.3	Information related to operation		P
	Instructions for use shall include any operating in- structions necessary to ensure safe operation, in- cluding the following, as applicable:		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;		N/A
	Warnings regarding the risk of burns from sur- faces permitted to exceed the temperature lim- its of 4.3.2 and required operator actions to re- duce the risk; and	No exceeded temperature. Symbol 14 of annex C also marked.	N/A
	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 follow- ing:		P
	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 are- as, if any are present, including a warning not to enter other areas of the equipment;		N/A
	Part numbers and instructions for obtaining any required operator replaceable parts;		N/A
	Instructions for safe cleaning (if recommended)		P
	Where there is more than one source of supply energizing the PCE, information shall be pro- vided in the manual to indicate which discon- nect device or devices are required to be oper- ated in order to completely isolate the equip- ment.		P
5.3.4.1	Battery maintenance		P
	Where required by 14.8.5, the documentation shall include the applicable items from the following list of instructions regarding maintenance of batteries:		P

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Clause	Requirement – Test	Result – Remark	Verdict
	Servicing of batteries should be performed or supervised by personnel knowledgeable about batteries and the required precautions		P
	When replacing batteries, replace with the same type and number of batteries or battery packs		P
	General instructions regarding removal and in- stallation of batteries		P
	CAUTION: Do not dispose of batteries in a fire. The batteries may explode.		P
	CAUTION: Do not open or damage batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.		P
	CAUTION: A battery can present a risk of elec- trical shock and high short-circuit current. The following precautions should be observed when working on batteries:		P
	a) Remove watches, rings, or other metal objects.		P
	b) Use tools with insulated handles.		P
	c) Wear rubber gloves and boots.		P
	d) Do not lay tools or metal parts on top of batter- ies		P
	e) Disconnect charging source prior to connecting or disconnecting battery terminals		P
	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 likeli- hood of such shock can be reduced if such grounds are removed during installation and maintenance (applicable to equipment and re- mote battery supplies not having a grounded supply circuit).		P
6	ENVIRONMENTAL REQUIREMENTS AND CONDITIONS		--
	The manufacturer shall rate the PCE for the follow- ing environmental conditions:		P
	– ENVIRONMENTAL CATEGORY, as in 6.1 be- low	Indoor	P
	– Suitability for WET LOCATIONS or not	Not suitable for wet location	N/A
	– POLLUTION DEGREE rating in 6.2 below		P
	– INGRESS PROTECTION (IP) rating, as in 6.3 below		P

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Clause	Requirement – Test	Result – Remark	Verdict
	– Ultraviolet (UV) exposure rating, as in 6.4 below		N/A
	– Ambient temperature and relative humidity ratings, as in 6.5 below		P
6.1	Environmental categories and minimum environmental conditions		P
6.1.1	Outdoor		N/A
6.1.2	Indoor, unconditioned		N/A
6.1.3	Indoor, conditioned		P
6.2	Pollution degree	PD2	P
6.3	Ingress Protection	IP20	P
6.4	UV exposure		N/A
6.5	Temperature and humidity	0-40℃	P

7	PROTECTION AGAINST ELECTRIC SHOCK AND ENERGY HAZARDS		--
7.1	General		P
7.2	Fault conditions		P
7.3	Protection against electric shock		P
7.3.1	General		P
7.3.2	Decisive voltage classification		P
7.3.2.1	Use of decisive voltage class (DVC)		P
7.3.2.2	Limits of DVC (according table 6)		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)		P
7.3.2.5	Connection to PELV and SELV circuits	Communication circuits	P
7.3.2.6	Working voltage and DVC		P
7.3.2.6.1	General		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		P
	Protective separation shall be achieved by:		P
	double or reinforced insulation, or		P

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
	protective screening, i.e. by a conductive screen connected to earth by protective bond- ing in the PCE, or connected to the protective earth conductor itself, whereby the screen is separated from live parts by at least basic insu- lation, 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 effec- tively maintained under all conditions of intended use of the PCE		P
7.3.4	Protection against direct contact		P
7.3.4.1	General		P
	Protection against direct contact is employed to prevent persons from touching live parts that do not meet the requirements of 7.3.5 and shall be provid- ed by one or more of the measure given in 7.3.4.2 (enclosures and barriers) and 7.3.4.3 (insulation).		P
	Open type sub-assemblies and devices do not re- quire 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		P
	The following requirements apply where protection against contact with live parts is provided by enclo- sures 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 pro- tection 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 require- ments shall also meet the requirements of 13.6	The LCD display window plas- tic part	P
7.3.4.2.2	Access probe criteria		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:		P

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Clause	Requirement – Test	Result – Remark	Verdict
	a) decisive voltage classification A, (DVC A) - the probe may touch the live parts		P
	b) decisive voltage classification B, (DVC B) - the probe must not touch bare live parts		P
	c) decisive voltage classification C, (DVC C) – the probe must have adequate clearance to live parts, based on the clearance for Basic insula- tion using the recurring peak working voltage involved,		P
7.3.4.2.3	Access probe tests		P
	Compliance with 7.3.4.2.1 is checked by all of the following:		P
	a) Inspection; and		P
	b) Tests with the test finger (Figure D.1) and test pin (Figure D.2) of 0E, the results of which shall comply with the requirements of 7.3.4.2.1 a), b), and c) as applicable. Probe tests are performed on openings in the enclosures after removal of parts that can be detached or opened by an operator without the use of a tool, including fuseholders, and with operator access doors and covers open. It is permitted to leave lamps in place for this test. Connectors that can be separated by an operator without use of a tool, shall also be tested during and after disconnec- tion. Any movable parts are to be put in the most unfavorable position.		P
	The test finger and the test pin are applied as above, without appreciable force, in every pos- sible position, except that floor-standing equip- ment having a mass exceeding 40 kg is not tilt- ed.		P
	Equipment intended for building-in or rack mounting, or for incorporation in larger equip- ment, is tested with access to the equipment limited according to the method of mounting de- tailed in the installation instructions.		P
	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 en- ters, the test with the jointed finger is repeated except that the finger is applied using any nec- essary force up to 30 N.		P

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Clause	Requirement – Test	Result – Remark	Verdict
	d) In addition to a) – c) above, top surfaces of en- closure 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.		P
7.3.4.2.4	Service access areas	Not allow of installation or maintenance during PCE en- ergized	N/A
7.3.4.3	Protection by means of insulation of live parts		N/A
	Where the requirements of 7.3.4.2 are not met, live parts shall be provided with insulation if:		N/A
	– their working voltage is greater than the maxi- mum limit of decisive voltage class A, or		N/A
	– for a DVC A or B circuit, protective separation from adjacent circuit of DVC C is not provided (see note "‡" under Table 7)		N/A
7.3.5	Protection in case of direct contact		P
7.3.5.1	General		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 sepa- rated 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	Communication circuits	P
	– is provided with protective impedance accord- ing 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		P
7.3.5.3	Protection by means of protective impedance		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	Circuits and conductive parts do not require protec- tion against direct contact if any connection to cir- cuits of DVC-B or DVC-C is through protective im- pedance, and the accessible circuit or part is oth- erwise provided with protective separation from cir- cuits of DVC-B or DVC-C according 7.3.3.		N/A
7.3.5.3.1	Limitation of current through protective impedance		N/A
	The current available through protective impedance to earth and between simultaneously accessible parts, measured at the accessible live parts, shall not exceed a value of 3,5 mA a.c. or 10 mA d.c. under normal and single-fault conditions.		N/A
7.3.5.3.2	Limitation of discharging energy through protective impedance		N/A
	The discharging energy available between simulta- neously accessible parts protected by protective impedance shall not exceed the charging voltage and capacitance limits given in Table 9, which ap- plies 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		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 re- quire 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 protec- tive earthing), class II (double or reinforced insula- tion) or class III (limitation of voltages)		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		P

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Clause	Requirement – Test	Result – Remark	Verdict
	That part of a PCE meets the requirements of 7.3.6.4 is defined as protective class II.	Class II construction	P
	That part of PCE which meets the requirements of decisive voltage class A and in which no hazardous voltages are derived, is defined as protective class III. No shock hazard is present in such circuits.	Class III construction	P
	Where protection against indirect contact is de- pendent on means provided during installation, the installation instructions shall provide details of the required means and shall indicate the associated hazards.		N/A
7.3.6.2	Insulation between live parts and accessible con- ductive parts		P
	Accessible conductive parts of equipment shall be separated from live parts by insulation meeting the requirements of Table 7 or by clearances as speci- fied in 7.3.7.4 and creepages as specified in 7.3.7.5		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 bond- ing 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:		P
	a) accessible conductive parts that are protected by one of the measures in 7.3.5.2 to 7.3.5.4, or	Class III construction	P
	b) accessible conductive parts are separated from live parts of DVC-B or -C using double or rein- forced insulation.	Class II construction	P
7.3.6.3.2	Requirements for protective bonding		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;		P
	b) through other conductive parts which are not removed when the PCE or sub-units are used as intended ;		P
	c) through a dedicated protective bonding conduc- tor;		P
	d) through other metallic components of the PCE		P

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Clause	Requirement – Test	Result – Remark	Verdict
	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.		P
	Metal ducts of flexible or rigid construction and me- tallic sheaths shall not be used as protective bond- ing 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		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 conduc- tive 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 re- moves power from the part.		P
	Protective bonding shall meet following require- ments:		P
	a) For PCE with an overcurrent protective device rating of 16 A or less, the impedance of the pro- tective 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.		P
	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.		N/A
	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 overcur- rent protection for the equipment or part of the equipment under consideration, as follows:		P

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Clause	Requirement – Test	Result – Remark	Verdict
	a) For pluggable equipment type A, the overcur- rent 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 overcur- rent protective device specified in the equip- ment installation instructions to be provided ex- ternal to the equipment;		P
	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 per- mitted 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.		P
	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 protec- tive 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 con- ductor. Otherwise the impedance of the protective bonding conductor between the separate units is to be included, by measuring to the protective earth- ing 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		P
	The test current, duration of the test and ac- ceptance criteria are as follows:		P
	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 im- pedance of the protective bonding means dur- ing and at the end of the test shall not exceed 0,1 Ω.		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	b) For PCE with an overcurrent protective device rating of more than 16 A, the test current is 200% of the overcurrent protective device rat- ing and the duration of the test is as shown in Table 10 below. The voltage drop in the protec- tive bonding means, during and at the end of the test, shall not exceed 2,5 V.		P
	c) During and after the test, there shall be no melting, loosening, or other damage that would impair the effectiveness of the protective bond- ing means.		P
	The test current is derived from an a.c or d.c supply source, the output of which is not earthed.		P
	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 ei- ther 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 dura- tion 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 fol- lowing:		N/A
	the test current may be reduced to any conven- ient 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
	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

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Clause	Requirement – Test	Result – Remark	Verdict
	A protective earthing conductor shall be connected at all times when power is supplied to PCE of pro- tective 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.		P
	If the external protective earthing conductor is rout- ed 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.		N/A
	The cross-sectional area of every external protec- tive earthing conductor which does not form part of the supply cable or cable enclosure shall, in any case, be not less than:		N/A
	2,5 mm² if mechanical protection is provided;		N/A
	4 mm² if mechanical protection is not provided.		N/A
	For cord-connected equipment, provisions shall be made so that the external protective earthing con- ductor 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
	The means of connection for the external protective earthing conductor shall be located near the termi- nals for the respective live conductors. The means of connections shall be corrosion-resistant and shall be suitable for the connection of cables ac- cording to 7.3.6.3.5. The means of connection for the protective earthing conductor shall not be used as a part of the me- chanical 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 de- signed that their current-carrying capacity is not im- paired 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 elec- trolytic corrosion.		P
	The means of connection for the protective earthing conductor shall be permanently marked with:		P
	symbol 7 of Annex C; or		P

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Clause	Requirement – Test	Result – Remark	Verdict
	the colour coding green-yellow		N/A
	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 satis- fied to maintain safety in case of damage to or dis- connection of the protective earthing conductor.		P
	For pluggable equipment type A, the touch current measured in accordance with 7.5.4 shall not ex- ceed 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.	Not exceed 3,5mA a.c. or 10mA d.c.	P
	a) Permanently connected wiring, and:		N/A
	a cross-section of the protective earthing conductor of at least 10 mm² Cu or 16 mm² Al; or		N/A
	automatic disconnection of the supply in case of discontinuity of the protective earth- ing conductor; or		N/A
	provision of an additional terminal for a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor and installa- tion instruction requiring a second protec- tive earthing conductor to be installed or		N/A
	b) Connection with an industrial connector accord- ing to IEC 60309 and a minimum protective earthing conductor cross-section of 2,5 mm² as part of a multi-conductor power cable. Ade- quate 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 require- ments apply to the maximum number of the PCEs to be connected in parallel, unless one of the measures in a)		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	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 Insula- tion		P
	Equipment or parts of equipment designed for pro- tective class II shall have insulation between live parts and accessible surfaces in accordance with 7.3.4.3. The following requirements also apply:		P
	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 earth- ing 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 acces- sible surface of the equipment and from circuits that employ protective separation, extra-low voltage, protective impedance and limited dis- charging 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 conduc- tor;		N/A
	equipment of protective class II may have pro- vision for the connection of an earthing conduc- tor 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 Dis- tance		P
7.3.7.1	General		P
	This subclause gives minimum requirements for in- sulation, based on the principles of IEC 60664.		P
	Manufacturing tolerances shall be taken into ac- count 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		P

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Clause	Requirement – Test	Result – Remark	Verdict
	overvoltage category		P
	supply earthing system		P
	insulation voltage		P
	location of insulation		P
	type of insulation		P
	Compliance of insulation, creepage distances, and clearance distances, shall be verified by measure- ment or visual inspection, and the tests of 7.5.		P
7.3.7.1.3	Supply earthing systems		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 con- ductor.	Tested for TN system	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 pow- er system;	Not check	N/E
	IT sytem: has all live parts isolated from earth or one point connected to earth through an im- pedance, the accessible conductive parts of the installation being earthed independently or col- lectively to the earthing system.	Not check	N/E
7.3.7.1.4	Insulation voltages		P
	Table 12 makes use of the circuit system voltage and overvoltage category to define the impulse withstand voltage and the temporary overvoltage.		P
7.3.7.9	Insulation requirements above 30 kHz		P
7.3.8	Residual Current-operated protective (RCD) or monitoring (RCM) device compatibility	Max d.c. component in output current 4mA	P
	RCD and RCM are used to provide protection against insulation faults in some domestic and in- dustrial installations, additional to that provided by the installed equipment.		P
7.3.9	Capacitor discharge		P
7.3.9.1	Operator access area		P

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Clause	Requirement – Test	Result – Remark	Verdict
	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.		P
7.3.9.2	Service access areas		P
	Capacitors located behind panels that are remova- ble for servicing, installation, or disconnection shall present no risk of electric shock or energy hazard from charge stored on capacitors after disconnec- tion of the PCE.	Warning symbol 21 of annex C used to indicate 5 minutes need for the discharge The residual voltage on the capacitor bank after 5 min measured <1V	P
7.4	Protection against energy hazards		--
7.4.1	Determination of hazardous energy level		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, cal- culated 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 ac- cessible circuits.		P
7.4.3	Services Access Areas		P
	Energy storage devices located behind panels that are removable for servicing, installation or discon- nection shall present no risk of electric energy haz- ard from charge stored after disconnection of the PCE.		P
	Energy storage devices within a PCE shall be dis- charged to an energy level less than 20 J, as in 7.4.1, within 10 s after the removal	Warning symbol 21 of annex C used	P
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.	Measured: max. 3.0mA a.c. 2.2mA d.c.	P
	For type tests on PCE for which wet locations re- quirements apply according to 6.1, the humidity pre- conditioning of 4.5 shall be performed immedi- ately prior to the touch current test.		P
7.5.5	Equipment with multiple sources of supply		P

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Clause	Requirement – Test	Result – Remark	Verdict
8	PROTECTION AGAINST MECHANICAL HAZARDS		--
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 op- erator shall be smooth and rounded so as not to cause injury during normal use of the equipment.		P
	Conformity is checked as specified in 8.2 to 8.6.		P
8.2	Moving parts		P
	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 in- jury, shall be so arranged, enclosed or guarded as to provide adequate protection against the risk of personal injury.		P
8.2.1	Protection of service persons		N/A
	Protection shall be provided such that unintentional contact with hazardous moving parts is unlikely dur- ing servicing operations. If a guard over a hazard- ous moving part may need to be removed for ser- vicing, the marking of symbol 15 of Annex C shall be applied on or near the guard.		N/A
8.3	Stability		N/A
	Equipment and assemblies of equipment not se- cured to the building structure before operation shall be physically stable in NORMAL USE.	Fixed installed equipment	N/A
8.4	Provisions for lifting and carrying		
	If carrying handles or grips are fitted to, or supplied with, the equipment, they shall be capable of with- standing a force of four times the weight of the equipment.	No handles or grips for lifting and carrying	N/A
	Equipment or parts having a mass of 18 kg or more shall be provided with a means for lifting and carry- ing or directions shall be given in the manufactur- er's documentation.		N/A
8.5	Wall mounting		
	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.	Weight 15.6kg, 612N force test	P
8.6	Expelled parts		

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Clause	Requirement – Test	Result – Remark	Verdict
	Equipment shall contain or limit the energy of parts that could cause a HAZARD if expelled in the event of a fault.	No expelled part	N/A

9	PROTECTION AGAINST FIRE HAZARDS		--
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.		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 af- fect materials, wiring, wound components and elec- tronic components such as integrated circuits, tran- sistors, thyristors, diodes, resistors and capacitors.	Use fire enclosure,	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.		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 sup- plied by power sources which exceed the limits for a LIMITED POWER SOURCE as specified in 9.2;		P
	– components in SECONDARY CIRCUITS sup- plied 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 as- sembly having a limited power output comply- ing with the criteria for a LIMITED POWER SOURCE as specified in 9.2, including overcur- rent protective devices, limiting impedances, regulating networks and wiring, up to the point where the LIMITED POWER SOURCE output criteria are met;		P

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Clause	Requirement – Test	Result – Remark	Verdict
	– 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
9.1.2.2	Parts not requiring a fire enclosure		P
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 mate- rials, that the propagation of fire is limited.		P
9.1.3.2	Materials for fire enclosures		P
	If an enclosure material is not classified as speci- fied 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 peri- odic SAMPLE testing.	Metal enclosure LCD display window plastic rated V-0 Window max. dimension < 100mm	P
9.1.3.3	Materials for components and other parts inside fire enclosures		P
	Except as otherwise noted below, materials for components and other parts (including MECHANICAL ENCLOSURES, ELECTRICAL ENCLOSURES and DECORATIVE PARTS); locat- ed outside FIRE ENCLOSURES, shall be of FLAMMABILITY CLASS HB.		P
9.1.3.4	Materials for components and other parts inside fire enclosures		P
9.1.3.5	Materials for air filter assemblies		P
9.1.4	Openings in fire enclosures		P
9.1.4.1	General		P
	For equipment that is intended to be used or in- stalled in more than one orientation as specified in the product documentation, the following require- ments 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		P

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Clause	Requirement – Test	Result – Remark	Verdict
9.1.4.3	Openings in the bottom of a fire enclosure		P
	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.		P
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		N/A
9.1.4.6	Additional requirements for openings in transporta- ble equipment		N/A
9.2	LIMITED POWER SOURCES	No exception used for limited power source	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, includ- ing phase-to-phase, phase-to-earth and phase-to- neutral, and adequate information shall be provided to allow proper selection of external wiring and ex- ternal protective devices.		P
9.3.2	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.		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
9.3.3	Protective devices provided or specified shall have adequate breaking capacity to interrupt the maxi- mum short circuit current specified for the port to which they are connected. If protection that is pro- vided 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.		P

10	PROTECTION AGAINST SONIC PRESSURE HAZARDS		--
10.1	General		P
	The equipment shall provide protection against the effect of sonic pressure. Conformity tests are car- ried out if the equipment is likely to cause such HAZARDS.		P
10.2	Sonic pressure and Sound level		P
10.2.1	Hazardous Noise Levels	< 40dBA	P

11	PROTECTION AGAINST LIQUID HAZARDS		--
11.1	Liquid Containment, Pressure and Leakage	No liquid	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		--
12.1	General		P

13	PHYSICAL REQUIREMENTS		--
13.1	Handles and manual controls		P

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Clause	Requirement – Test	Result – Remark	Verdict
	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		P
13.2	Securing of parts		P
13.3	Provisions for external connections		P
13.3.1	General		P
13.3.2	Connection to an a.c. Mains supply		P
13.3.2.1	General		P
	For safe and reliable connection to a MAINS sup- ply, equipment shall be provided with one of the fol- lowing:		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 con- nection to the supply by means of a plug		N/A
	– an appliance inlet for connection of a detacha- ble 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		P
13.3.2.3	Appliance inlets		N/A
13.3.2.4	Power supply cord		N/A
13.3.2.5	Cord anchorages and strain relief		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		N/A
13.3.3	Wiring terminals for connection of external conduc- tors	Certified terminal	P
13.3.3.1	Wiring terminals		P

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Clause	Requirement – Test	Result – Remark	Verdict
13.3.3.2	Screw terminals		P
13.3.3.3	Wiring terminal sizes		P
13.3.3.4	Wiring terminal design		P
13.3.3.5	Grouping of wiring terminals		P
13.3.3.6	Stranded wire		P
13.3.4	Supply wiring space		P
13.3.5	Wire bending space for wires 10 mm² and greater		N/A
13.3.6	Disconnection from supply sources	Disconnection can be made by terminal and externally cir- cuit breaker shall be provided is stated in the installation in- struction	P
13.3.7	Connectors, plugs and sockets		N/A
13.3.8	Direct plug-in equipment		N/A
13.4	Internal wiring and connections		P
13.4.1	General		P
13.4.2	Routing		P
13.4.3	Colour coding		P
13.4.4	Splices and connections		P
13.4.5	Interconnections between parts of the PCE		N/A
13.5	Openings in enclosures		P
13.5.1	Top and side openings		P
	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 haz- ards by contacting bare conductive parts.		P
13.6	Polymeric Materials		P
13.6.1	General		P
13.6.1.1	Thermal index or capability	LCD window plastic RTI 125	P
13.6.2	Polymers serving as enclosures or barriers prevent- ing access to hazards		P
13.6.2.1	Stress relief test		P
13.6.3	Polymers serving as solid insulation		P
13.6.3.1	Resistance to arcing	No unenclosed arcing parts	N/A
13.6.4	UV resistance		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		P
13.7.2	250-N deflection test for metal enclosures		P
13.7.3	7-J impact test for polymeric enclosures	Test for the LCD window	P
13.7.4	Drop test		N/A
13.8	Thickness requirements for metal enclosures		P
13.8.1	General	Comply with 13.7	N/A
13.8.2	Cast metal		N/A
13.8.3	Sheet metal		N/A

14	COMPONENTS		--
14.1	General		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 require- ments of the component standard is not re- quired. If necessary for the application, compo- nents shall be subjected to the test of this standard, except that it is not necessary to car- ry out identical or equivalent tests already per- formed 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
	c) if there is no relevant IEC standard, the re- quirements 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

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Clause	Requirement – Test	Result – Remark	Verdict
	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 previ- ously 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		P
	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 require- ments of 14.3.		P
14.3	Overtemperature protection devices	No such device	N/A
14.4	Fuse holders	No such device	N/A
14.5	MAINS voltage selecting devices	No such device	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.	V-0 rating	P
	This requirements does not apply to thin-film flexi- ble 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 rel- evant parts.		P
14.7	Circuits or components used as transient overvoltage limiting devices		N/A
	If control of transient overvoltage is employed in the equipment, any overvoltage limiting component or circuit shall be tested with the applicable impulse withstand voltage of Table 7-10 using the test method from 7.5.1 except 10 positive and 10 nega- tive impulses are to be applied and may be spaced up to 1 min apart.		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.		N/A
14.8.1	Battery Enclosure Ventilation		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
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 op- erating 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 bat- tery 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
	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 equip- ment in which battery maintenance is performed by the operator, or in the service manual if battery maintenance is to be performed by service person- nel only.		N/A
14.8.6	Battery accessibility and maintainability		N/A
	Battery terminals and connectors shall be accessi- ble for maintenance with the correct TOOLS. Bat- teries 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	Redundant controls was adapted Two separate MCU used, each control a pair of relays in output circuit Real time communication be-tween the two MCUs, in case any fault in one MCU, the oth- er one will actuate the relay and disconnection from the AC mains	P

4.2.2.6	TABLE: mains supply electrical data in normal condition					P
Type	U (V) DC	I (A) DC	P (kW) DC	U (V) grid	I (A) AC	P (kW) AC
HAR-AL-300HAR-AL-500	51.2	60	5000	220.1	16	5KW
Remark: 1.5KVA for battery charging and 3.0KVA for output load Appliance not exceed the reated current and reated power by more than 10% under normal load						

4.3	TABLE: heating temperature rise measurements						P
	Supply voltage (V) .....:	51.2V					
	t1 (C) .....:	40.0					
	t2 (C) .....:	40.0					
Maximum measured temperature T of part/at:		T (C)					Allowed Tmax (C)
Metal enclsoure, outside		46.8					70
Output wire		46.4					105
Input terminal		49.4					125
Output terminal		46.6					125
PCB		63.3					130
Supplementary information:							
Temperature T of winding:	t1 (°C)	R1 ( )	t2 (°C)	R2 ( )	T (C)	Allowed Tmax (C)	Insulation class
Supplementary information: "*" Temperature test of transformer winding is determined by thermocouples, the limited values are reduced by 10 C							

4.4	TABLE: fault condition tests						N/a
	ambient temperature (C) ..... :	25					
No.	component No.	fault	test voltage (V)	test time	fuse No.	fuse cur-rent (A)	result

supplementary information							

7.3.7.8.3.2 to 7.3.7.8.3.3	TABLE: distance through insulation measurement				N/A
distance through insulation di at/of:		U r.m.s. (V)	test voltage (V)	required di (mm)	di (mm)
Remark: For reinforced insulation, triple insulation wire winding was used in the safety isolating transformer for communication circuits supplying.					

7.5	TABLE: electric strength measurements, impulse voltage test and partial dis- charge test				N/A
test voltage applied between:		test voltage (V)	impulse with-stand voltage (V)	partial dis-charge extinc-tion voltage (V)	result

14	TABLE: list of critical components				P
object/part No.	manufacturer/ trade-mark	type/model	technical data	standard	mark(s) of conformity1)
Metal enclo-sure	Various	Various	Thickness: 1.2mm	EN 62109-1 EN 62109-2	Tested with appliance
Terminal block for battery	Various	Various	600V, 100A, E163737	EN 62109-1 EN 62109-2	Tested with appliance
AC connector	Various	Various	30A 300VAC	EN 61984	TUV R 50235418
PV connector	Various	Various	32A 1000VDC	EN 50521	TUV R 50228419
Internal wire	Various	Various	300Vac; 105°C; 12 AWG; E189529	EN 62109-1 EN 62109-2	Tested with appliance
PCB	Various	Various	V-0, 130°C Min. Thickness: 1.6mm, E307994	EN 62109-1 EN 62109-2	Tested with appliance
1) an asterisk indicates a mark which assures the agreed level of surveillance					

IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
4	General testing requirements		--
4.4	Testing in single fault condition		P
4.4.4	Single fault conditions to be applied		P
4.4.4.15	Fault-tolerance of protection for grid-interactive inverters		P
4.4.4.15.1	Fault-tolerance of residual current monitoring		P
	Where protection against hazardous residual currents according to 4.8.3.5 is required, the residual current monitoring system must be able to operate properly with a single fault applied, or must detect the fault or loss of operability and cause the inverter to indicate a fault in accordance with 13.9, and disconnect from, or not connect to, the mains, no later than the next attempted re-start.		P
	Compliance is checked by testing with the grid-interactive inverter connected as in reference test conditions in Part 1. Single faults are to be applied in the inverter one at a time, for example in the residual current monitoring circuit, other control circuits, or in the power supply to such circuits.		P
	For each fault condition, the inverter complies if one of the following occurs:		P
	a) the inverter ceases to operate, indicates a fault in accordance with 13.9, disconnects from the mains, and does not re-connect after any sequence of removing and reconnecting PV power, AC power, or both,	For some fault condition, the inverter ceases to operate and disconnects from the mains, and does not re-connect.	P
	b) the inverter continues to operate, passes testing in accordance with 4.8.3.5 showing that the residual current monitoring system functions properly under the single fault condition, and indicates a fault in accordance with 13.9	For the other fault condition, continues to operate and passes testing in accordance with 4.8.3.5.	P
	c) the inverter continues to operate, regardless of loss of residual current monitoring functionality, but does not re-connect after any sequence of removing and reconnecting PV power, AC power, or both, and indicates a fault in accordance with 13.9.		N/A
4.4.4.15.2	Fault-tolerance of automatic disconnecting means		P
4.4.4.15.2.1	General		P
	The means provided for automatic disconnection of a grid-interactive inverter from the mains shall:		P
	-disconnect all grounded and ungrounded current-carrying conductors from the mains, and	Disconnect live and neutral conductors by relays at the same time	P

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Clause	Requirement – Test	Result – Remark	Verdict
	- be such that with a single fault applied to the disconnection means or to any other location in the inverter, at least basic insulation or simple separation is maintained between the PV array and the mains when the disconnecting means is intended to be in the open state.	The separation is maintained by two relays in the ungrounded AC connector (line) and another 2 relays in the grounded conductor (neutral)	P
4.4.4.15.2.2	Design of insulation or separation		P
	The design of the basic insulation or simple separation referred to in 4.4.4.15.2.1 shall comply with the following:		P
	– the basic insulation or simple separation shall be based on the PV circuit working voltage, impulse withstand voltage, and temporary over-voltage, in accordance with 7.3.7 of Part 1;		P
	– the mains shall be assumed to be disconnected;		P
	– the provisions of 7.3.7.1.2 g) of Part 1 may be applied if the design incorporates means to reduce impulse voltages, and where required by 7.3.7.1.2 of Part 1, monitoring of such means;	No means to reduce impulse voltages	N/A
	– in determining the clearance based on working voltage in 7.3.7 of Part 1, the values of column 3 of Table 13 of Part 1 shall be used.		P
4.4.4.15.2.3	Automatic checking of the disconnect means		P
	For a non-isolated inverter, the isolation provided by the automatic disconnection means shall be automatically checked before the inverter starts operation. After the isolation check, if the check fails, any still-functional disconnection means shall be left in the open position, at least basic insulation or simple separation shall be maintained between the PV input and the mains, the inverter shall not start operation, and the inverter shall indicate a fault in accordance with 13.9.	The disconnection means were automatically checked before the inverter starts operation. If the check fails, two series relays would be disconnected.	P
	Compliance with 4.4.4.15.2.1 through 4.4.4.15.2.3 is checked by inspection of the PCE and schematics, evaluation of the insulation or separation provided by components, and for nonisolated inverters by the following test:		P

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Clause	Requirement – Test	Result – Remark	Verdict
	With the non-isolated grid-interactive inverter connected and operating as in reference test conditions in Part 1, single faults are to be applied to the automatic disconnection means or to other relevant parts of the inverter. The faults shall be chosen to render all or part of the disconnection means inoperable, for example by defeating control means or by shortcircuiting one switch pole at a time. With the inverter operating, the fault is applied, and then PV input voltage is removed or lowered below the minimum required for inverter operation, to trigger a disconnection from the mains. The PV input voltage is then raised back up into the operational range. After the inverter completes its isolation check, any still-functional disconnection means shall be in the open position, at least basic insulation or simple separation shall be maintained between the PV input and the mains, the inverter shall not start operation, and the inverter shall indicate a fault in accordance with 13.9.		P
	In all cases, the non-isolated grid-interactive inverter shall comply with the requirements for basic insulation or simple separation between the mains and the PV input following application of the fault.	Relays provided in output circuit. All conductors of mains disconnected and basic insulation maintained when single fault applied.	P
4.4.4.16	Stand-alone inverters – Load transfer test		P
	A stand-alone inverter with a transfer switch to transfer AC loads from the mains or other AC bypass source to the inverter output shall continue to operate normally and shall not present a risk of fire or shock as the result of an out-of-phase transfer.		P
	Compliance is checked by the following test. The bypass a.c. source is to be displaced 180° from the a.c. output of a single-phase inverter and 120° for a 3-phase supply. The transfer switch is to be subjected to one operation of switching the load from the a.c. output of the inverter to the bypass a.c. source. The load is to be adjusted to draw maximum rated a.c.power.		P
	For an inverter employing a bypass switch having a control preventing switching between two a.c. sources out of synchronization, the test is to be conducted under the condition of a component malfunction when such a condition could result in an out-of-phase transfer between the two a.c. sources of supply.		N/A
4.4.4.17	Cooling system failure – Blanketing test		P

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Clause	Requirement – Test	Result – Remark	Verdict
	In addition to the applicable tests of subclause 4.4.4.8 of Part 1, inadvertent obstruction of the air-flow over an exposed external heatsink shall be one of the fault conditions considered. No hazards according to the criteria of subclause 4.4.3 of Part 1 shall result from blanketing the inverter in accordance with the test below.		P
	This test is not required for inverters restricted to use only in closed electrical operating areas.		N/A
	Compliance is checked by the following test, performed in accordance with the requirements of subclause 4.4.2 of Part 1 along with the following.		P
	The inverter shall be mounted in accordance with the manufacturer's installation instructions. If more than one position or orientation is allowed, the test shall be performed in the orientation or position that is most likely to result in obstruction of the heatsink after installation. The entire inverter including any external heatsink provided shall be covered in surgical cotton with an uncompressed thickness of minimum 2 cm, covering all heatsink fins and air channels. This surgical cotton replaces the cheesecloth required by subclause 4.4.3.2 of Part 1. The inverter shall be operated at full power. The duration of the test shall be a minimum of 7 h except that the test may be stopped when temperatures stabilize if no external surface of the inverter is at a temperature exceeding 90 °C.	Max. 56.5°C	P
4.7	Electrical ratings tests		P
	Additional subclauses:		P
4.7.3	Measurement requirements for AC output ports for stand-alone inverters		P
	Measurements of the AC output voltage and current on a stand-alone inverter shall be made with a meter that indicates the true RMS value.		P
4.7.4	Stand-alone Inverter AC output voltage and frequency		P
4.7.4.1	General		P
	The AC output voltage and frequency of a stand-alone inverter, or multi-mode inverter operating in stand-alone mode, shall comply with the requirements of 4.7.4.2 to 4.7.4.5.		P
4.7.4.2	Steady state output voltage at nominal DC input		P
	The steady-state AC output voltage shall not be less than 90 % or more than 110 % of the rated nominal voltage with the inverter supplied with its nominal value of DC input voltage.		P

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Clause	Requirement – Test	Result – Remark	Verdict
	Compliance is checked by measuring the AC output voltage with the inverter supplying no load, and again with the inverter supplying a resistive load equal to the inverters rated maximum continuous output power in stand-alone mode. The AC output voltage is measured after any transient effects from the application or removal of the load have ceased.		P
4.7.4.3	Steady state output voltage across the DC input range		P
	Compliance is checked by measuring the AC output voltage under four sets of conditions: with the inverter supplying no load and supplying a resistive load equal to the inverters rated maximum continuous output power in stand-alone mode, both at the minimum rated DC input voltage and at the maximum rated DC input voltage. The AC output voltage is measured after any transient effects from the application or removal of the load have ceased.		P
4.7.4.4	Load step response of the output voltage at nominal DC input		P
	The AC output voltage shall not be less than 85 % or more than 110 % of the rated nominal voltage for more than 1,5 s after application or removal of a resistive load equal to the inverter's rated maximum continuous output power in stand-alone mode, with the inverter supplied with its nominal value of DC input voltage.		P
	Compliance is checked by measuring the AC output voltage after a resistive load step from no load to full rated maximum continuous output power, and from full power to no load. The RMS output voltage of the first complete cycle coming after t = 1,5 s is to be measured, where t is the time measured from the application of the load step change.		P
4.7.4.5	Steady state output frequency		P
	The steady-state AC output frequency shall not vary from the nominal value by more than +4 % or – 6 %.		P
	Compliance is checked by measuring the AC output frequency under four sets of conditions: with the inverter supplying no load and supplying a resistive load equal to the inverters rated maximum continuous output power in stand-alone mode, at both the minimum rated DC input voltage and at the maximum rated DC input voltage. The AC output frequency is measured after any transient effects from the application or removal of the load have ceased.		P

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Clause	Requirement – Test	Result – Remark	Verdict
4.7.5	Stand-alone inverter output voltage waveform		P
4.7.5.1	General		P
	The AC output voltage waveform of a stand-alone inverter, or multi-mode inverter operating in stand-alone mode, shall comply with the requirements in 4.7.5.2 for sinusoidal outputs, or 4.7.5.3 and 4.7.5.4 for intentionally non-sinusoidal outputs, or with the dedicated load requirements in 4.7.5.5.		P
4.7.5.2	Sinusoidal output voltage waveform requirements		P
	The AC output waveform of a sinusoidal output stand-alone inverter shall have a total harmonic distortion (THD) not exceeding of 10 % and no individual harmonic at a level exceeding 6 %.		P
	Compliance is checked by measuring the THD and the individual harmonic voltages with the inverter delivering 5 % power or the lowest continuous available output power greater than 5 %, and 50 % and 100 % of its continuous rated output power, into a resistive load, with the inverter supplied with nominal DC input voltage. The limits above are relative to the magnitude of the fundamental component at each of the load levels above. The THD measuring instrument shall measure the sum of the harmonics from n=2 to n=40 as a percentage of the fundamental (n=1) component.		P
4.7.5.3	Non-sinusoidal output waveform requirements		N/A
4.7.5.3.1	General		N/A
	The AC output voltage waveform of a non-sinusoidal output stand-alone inverter shall comply with the requirements of 4.7.5.3.2 to 4.7.5.3.4.		N/A
4.7.5.3.2	Total harmonic distortion		N/A
	The total harmonic distortion (THD) of the voltage waveform shall not exceed 40 %.		N/A
4.7.5.3.3	Waveform slope		N/A
	The slope of the rising and falling edges of the positive and negative half-cycles of the voltage wave form shall not exceed 10 V/μs measured between the points at which the waveform has a voltage of 10 % and 90 % of the peak voltage for that half-cycle.		N/A
4.7.5.3.4	Peak voltage		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	The absolute value of the peak voltage of the positive and negative half-cycles of the waveform shall not exceed 1,414 times 110 % of the RMS value of the rated nominal AC output voltage.		N/A
	Compliance with 4.7.5.3.2 through 4.7.5.3.4 is checked by measuring the THD, slopes, and peak voltages of the output voltage waveform with the inverter delivering 5 % power or the lowest continuous available output power greater than 5 %, and 50 % and 100 % of its continuous rated output power, into a resistive load. Each test shall be performed at the DC input voltage, within the rated range for the inverter, that creates the worst-case condition for that test. The THD measuring instrument shall measure the sum of the harmonics from n=2 to n=40 as a percentage of the fundamental (n=1) component.		N/A
4.7.5.4	Information requirements for non-sinusoidal waveforms		N/A
	The instructions provided with a stand-alone inverter not complying with 4.7.5.2 shall include the information in 5.3.2.6.		N/A
4.7.5.5	Output voltage waveform requirements for inverters for dedicated loads		P
	For an inverter that is intended only for use with a known dedicated load, the following requirements may be used as an alternative to the waveform requirements in 4.7.5.2 to 4.7.5.3.		P
	The combination of the inverter and dedicated load shall be evaluated to ensure that the output waveform does not cause any hazards in the load equipment and inverter, or cause the load equipment to fail to comply with the applicable product safety standards.		P
	Compliance is checked through testing and analysis. Tests as required by this standard and the standard applicable to the dedicated load equipment, shall be performed to determine if the inverter output waveform causes a failure to comply with the applicable requirements. A particular test may be omitted if analysis shows that the output waveform would not have any possible effect on safety relevant parameters.		P
	The inverter shall be marked with symbols 9 and 15 of Table C.1 of Part 1.		P
	The installation instructions provided with the inverter shall include the information in 5.3.2.13.		P
4.8	Additional tests for grid-interactive inverters		P

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Clause	Requirement – Test	Result – Remark	Verdict
4.8.1	General requirements regarding inverter isolation and array grounding		P
	Inverters may or may not provide galvanic isolation from the mains to the PV array, and the array may or may not have one side of the circuit grounded. Inverters shall comply with the requirements in Table 30 for the applicable combination of inverter isolation and array grounding.		P
4.8.2	Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays		P
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays		P
	Inverters for use with ungrounded arrays shall have means to measure the DC insulation resistance from the PV input (array) to ground before starting operation, or shall be provided with installation instructions in accordance with 5.3.2.11.		P
	If the insulation resistance is less than R = (VMAX PV/30 mA) ohms, the inverter:		P
	– 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;		N/A
	– 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.		P
	The measurement circuit shall be capable of detecting insulation resistance below the limit above, under normal conditions and with a ground fault in the PV array.		P
	Compliance is checked by analysis of the design and by testing, as follows:		P
	Compliance with the values of current shall be determined using an RMS meter that responds to both the AC and DC components of the current, with a bandwidth of at least 2 kHz.		P

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Clause	Requirement – Test	Result – Remark	Verdict
	The inverter shall be connected to PV and AC sources as specified in the reference test conditions in Part 1, except with the PV voltage set below the minimum operating voltage required for the inverter to attempt to start operating. A resistance 10 % less than the limit above shall be connected between ground and each PV input terminal of the inverter, in turn, and then the PV input voltage shall be raised to a value high enough that the inverter attempts to begin operation. The inverter shall indicate a fault in accordance with 13.9 and take the action (operating or not operating as applicable) required above.	(see appended table)	P
	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.		P
4.8.2.2	Array insulation resistance detection for inverters for functionally grounded arrays		N/A
	Inverters that functionally ground the array through an intentional resistance integral to the inverter, shall meet the requirements in a) and c), or b) and c) below:		N/A
	a) The value of the total resistance, including the intentional resistance for array functional grounding, the expected insulation resistance of the array to ground, and the resistance of any other networks connected to ground (for example measurement networks) must not be lower than R = (VMAX PV/30 mA) ohms. The expected insulation resistance of the array to ground shall be calculated based on an array insulation resistance of 40 MΩ per m2, with the surface area of the panels either known, or calculated based on the inverter power rating and the efficiency of the worst-case panels that the inverter is designed to be used with.		N/A
	The installation instructions shall include the information required in 5.3.2.12.		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	b) As an alternative to a), or if a resistor value lower than in a) is used, the inverter shall incorporate means to detect, during operation, if the total current through the resistor and any networks (for example measurement networks) in parallel with it, exceeds the residual current values and times in Table 31 and shall either disconnect the resistor or limit the current by other means. If the inverter is a non-isolated inverter, or has isolation not complying with the leakage current limits in the minimum inverter isolation requirements in Table 30, it shall also disconnect from the mains.		N/A
	The inverter may attempt to resume normal operation if the array insulation resistance has recovered to a value higher than the limit in 4.8.2.1.		N/A
	Compliance with a) or b) is checked by analysis of the design and for case b) above, by the test for detection of sudden changes in residual current in 4.8.3.5.3.		N/A
	c) The inverter shall have means to measure the DC insulation resistance from the PV input to ground before starting operation, in accordance with 4.8.2.1.		N/A
4.8.3	Array residual current detection		P
4.8.3.1	General		P
	Ungrounded arrays operating at DVC-B and DVC-C voltages can create a shock hazard if live parts are contacted and a return path for touch current exists. In a non-isolated inverter, or an inverter with isolation that does not adequately limit the available touch current, the connection of the mains to earth (i.e. the earthed neutral) provides a return path for touch current if personnel inadvertently contact live parts of the array and earth at the same time. The requirements in this section provide additional protection against this shock hazard through the application of residual current detectors (RCD's) per 4.8.3.4 or by monitoring for sudden changes in residual current per 4.8.3.5, except neither is required in an isolated inverter where the isolation provided limits the available touch current to less than 30 mA when tested in accordance with 4.8.3.2.		P
	Ungrounded and grounded arrays can create a fire hazard if a ground fault occurs that allows excessive current to flow on conductive parts or structures that are not intended to carry current. The requirements in this section provide additional protection against this fire hazard by application of RCD's per 4.8.3.4 or by monitoring for continuous excessive residual current per 4.8.3.5,		P

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Clause	Requirement – Test	Result – Remark	Verdict
	except neither is required in an isolated inverter where the isolation provided limits the available current to less than:		N/A
	– 300 mA RMS for inverters with rated continuous output power ≤ 30 kVA, or		N/A
	– 10 mA RMS per kVA of rated continuous output power for inverters with rated continuous output power rating > 30 kVA.		N/A
	when tested in accordance with 4.8.3.3		N/A
4.8.3.2	30 mA touch current type test for isolated inverters	Not isolated inverters	N/A
	Compliance with the 30 mA limit in 4.8.3.1 is tested with the inverter connected and operating under reference test conditions, except that the DC supply to the inverter must not have any connection to earth, and the mains supply to the inverter must have one pole earthed. It is acceptable (and may be necessary) to defeat array insulation resistance detection functions during this test. The touch current measurement circuit of IEC 60990, Figure 4 is connected from each terminal of the array to ground, one at a time. The resulting touch current is recorded and compared to the 30 mA limit, to determine the requirements for array ground insulation resistance and array residual current detection in Table 30.		N/A
4.8.3.3	Fire hazard residual current type test for isolated inverters	Not isolated inverters	N/A
	Compliance with the 300 mA or 10 mA per kVA limit in 4.8.3.1 is tested with the inverter connected and operating under reference test conditions, except that the DC supply to the inverter must not have any connection to earth, and the mains supply to the inverter must have one pole earthed. It is acceptable (and may be necessary) to defeat array insulation resistance detection functions during this test. An ammeter is connected from each PV input terminal of the inverter to ground, one at a time. The ammeter used shall be an RMS meter that responds to both the AC and DC components of the current, with a bandwidth of at least 2 kHz.		N/A
	The current is recorded and compared to the limit in 4.8.3.1, to determine the requirements for array ground insulation resistance and array residual current detection in Table 30.		N/A
4.8.3.4	Protection by application of RCD's		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	The requirement for additional protection in 4.8.3.1 can be met by provision of an RCD with a residual current setting of 30 mA, located between the inverter and the mains. The selection of the RCD type to ensure compatibility with the inverter must be made according to rules for RCD selection in Part 1. The RCD may be provided integral to the inverter, or may be provided by the installer if details of the rating, type, and location for the RCD are given in the installation instructions per 5.3.2.9.		N/A
4.8.3.5	Protection by residual current monitoring		P
4.8.3.5.1	General		P
	Where required by Table 30, the inverter shall provide residual current monitoring that functions whenever the inverter is connected to the mains with the automatic disconnection means closed. The residual current monitoring means shall measure the total (both a.c. and d.c. components) RMS current.		P
	As indicated in Table 30 for different inverter types, array types, and inverter isolation levels, detection may be required for excessive continuous residual current, excessive sudden changes in residual current, or both, according to the following limits:		P
	a) Continuous residual current: The inverter shall disconnect within 0,3 s and indicate a fault in accordance with 13.9 if the continuous residual current exceeds:		P
	– maximum 300 mA for inverters with continuous output power rating ≤ 30 kVA;		P
	– maximum 10 mA per kVA of rated continuous output power for inverters with continuous output power rating > 30 kVA.		N/A
	The inverter may attempt to re-connect if the array insulation resistance meets the limit in 4.8.2.		N/A
	b) Sudden changes in residual current: The inverter shall disconnect from the mains within the time specified in Table 31 and indicate a fault in accordance with 13.9, if a sudden increase in the RMS residual current is detected exceeding the value in the table.		P
	Exceptions:		N/A
	– monitoring for the continuous condition in a) is not required for an inverter with isolation complying with 4.8.3.3;		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	– monitoring for the sudden changes in b) is not required for an inverter with isolation complying with 4.8.3.2.		N/A
	The inverter may attempt to re-connect if the array insulation resistance meets the limit in 4.8.2.		N/A
	Compliance with a) and b) is checked by the tests of 4.8.3.5.2 and 4.8.3.5.3 respectively. Compliance with the values of current shall be determined using an RMS meter that responds to both the AC and DC components of the current, with a bandwidth of at least 2 kHz. An example of a test circuit is given in Figure 21 below.		P
4.8.3.5.2	Test for detection of excessive continuous residual current		P
	An external adjustable resistance is connected from ground to one PV input terminal of the inverter. The resistance shall be steadily lowered in an attempt to exceed the residual current limit in a) above, until the inverter disconnects. This determines the actual trip level of the sample under test, which shall be less than or equal to the continuous residual current limit above. To test the trip time, the test resistance is then adjusted to set the residual current to a value approximately 10 mA below the actual trip level. A second external resistance, adjusted to cause approximately 20 mA of residual current to flow, is connected through a switch from ground to the same PV input terminal as the first resistance. The switch is closed, increasing the residual current to a level above the trip level determined above. The time shall be measured from the moment the second resistance is connected until the moment the inverter disconnects from the mains, as determined by observing the inverter output current and measuring the time until the current drops to zero.		P
	This test shall be repeated 5 times, and for all 5 tests the time to disconnect shall not exceed 0,3 s.	(see appended table)	P
	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.		P
4.8.3.5.3	Test for detection of sudden changes in residual current		P
	This test shows that the residual current sudden change function operates within the limits for residual current and trip time, even when the sudden change is superimposed over a preexisting baseline level of continuous residual current.	(see appended table)	P

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Clause	Requirement – Test	Result – Remark	Verdict
	a) Setting the pre-existing baseline level of continuous residual current: An adjustable capacitance is connected to one PV terminal. This capacitance is slowly increased until the inverter disconnects by means of the continuous residual current detection function. The capacitance is then lowered such that the continuous residual current is reduced below that disconnection level, by an amount equal to approximately 150 % of the first residual current sudden change value in 4.8.3.5.1 b) to be tested (e.g. 45 mA for the 30 mA test) and the inverter is restarted.		P
	b) Applying the sudden change in residual current: An external resistance, pre-adjusted to cause 30 mA of residual current to flow, is connected through a switch from ground to the same PV input terminal as the capacitance in step a) above. The time shall be measured from the moment the switch is closed (i.e. connecting the resistance and applying the residual current sudden change) until the moment the inverter disconnects from the grid, as determined by observing the inverter output current and measuring the time until the current drops to zero. This test shall be repeated 5 times, and all 5 results shall not exceed the time limit indicated in the 30 mA row of Table 31.		P
	Steps a) and b) shall then be repeated for the 60 mA and 150 mA values and times in Table 31.		P
	The above set of tests shall then be repeated for each PV 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.		P
	If the inverter topology is such that the AC component of the voltage on the PV terminals is very small, a very large amount of capacitance may be needed to perform step a) of this test. In this case it is allowable to use resistance in place of or in addition to the capacitance to achieve the required amount of residual current. This method may not be used on inverter topologies that result in an AC component on the PV terminals that is equal to or greater than the RMS value of the half-wave rectified mains voltage		P

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Clause	Requirement – Test	Result – Remark	Verdict
	For inverters with high power ratings, because the limit increases with power rating, a very large amount of capacitance may be needed to perform step a) of this test. In cases where this is impractical, it is allowable to use resistance in place of or in addition to the capacitance to achieve the required amount of residual current. This method may only be used if analysis of the detection method and circuitry proves that the detection system can accurately measure resistive, capacitive, and mixed types of current.		N/A
4.8.3.6	Systems located in closed electrical operating areas		P
	For systems in which the inverter and a DVC-B or DVC-C PV array are located in closed electrical operating areas, the protection against shock hazard on the PV array in subclauses 4.8.2.1, 4.8.2.2, 4.8.3.2, 4.8.3.4, and 4.8.3.5.1 b) is not required if the installation information provided with the inverter indicates the restriction for use in a closed electrical operating area, and indicates what forms of shock hazard protection are and are not provided integral to the inverter, in accordance with 5.3.2.7. The inverter shall be marked as in 5.2.2.6.		N/A
5	Marking and documentation		--
	This clause of Part 1 is applicable with the following exceptions:		P
5.1	Marking		P
5.1.4	Equipment ratings		P
	Replacement:		P
	In addition to the markings required in other clauses of Part 1 and elsewhere in this Part 2, the ratings in Table 32 shall be plainly and permanently marked on the inverter, where it is readily visible after installation. Only those ratings that are applicable based on the type of inverter are required.		P
	An inverter that is adjustable for more than one nominal output voltage shall be marked to indicate the particular voltage for which it is set when shipped from the factory. It is acceptable for this marking to be in the form of a removable tag or other non-permanent method.	Not adjustable for more than one nominal output voltage	N/A
5.2	Warning markings		P
5.2.2	Content for warning markings		P
	Additional subclause:		P
5.2.2.6	Inverters for closed electrical operating areas		P

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Clause	Requirement – Test	Result – Remark	Verdict
	Where required by 4.8.3.6, an inverter not provided with full protection against shock hazard on the PV array shall be marked with a warning that the inverter is only for use in a closed electrical operating area, and referring to the installation instructions.	Comply with Cl. 4.8.2.1 4.8.3.5.1 b)	N/A
5.3	Documentation		P
5.3.2	Information related to installation		P
	Additional subclauses:		P
5.3.2.1	Ratings		P
	Subclause 5.3.2 of Part 1 requires the documentation to include ratings information for each input and output. For inverters this information shall be as in Table 33 below. Only those ratings that are applicable based on the type of inverter are required.		P
5.3.2.2	Grid-interactive inverter setpoints		N/A
	For a grid-interactive unit with field adjustable trip points, trip times, or reconnect times, the presence of such controls, the means for adjustment, the factory default values, and the limits of the ranges of adjustability shall be provided in the documentation for the PCE or in other format such as on a website	Not adjustable	N/A
	The settings of field adjustable setpoints shall be accessible from the PCE , for example on a display panel, user interface, or communications port.		N/A
5.3.2.3	Transformers and isolation		P
	An inverter shall be provided with information to the installer regarding whether an internal isolation transformer is provided, and if so, what level of insulation (functional, basic, reinforced, or double) is provided by that transformer. The instructions shall also indicate what the resulting installation requirements are regarding such things as earthing or not earthing the array, providing external residual current detection devices, requiring an external isolation transformer, etc.		P
5.3.2.4	Transformers required but not provided	Not required an external isolation transformer	N/A
	An inverter that requires an external isolation transformer not provided with the unit, shall be provided with instructions that specify the configuration type, electrical ratings, and environmental ratings for the external isolation transformer with which it is intended to be used.		N/A
5.3.2.5	PV modules for non-isolated inverters		P

IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
	Non-isolated inverters shall be provided with installation instructions that require PV modules that have an IEC 61730 Class A rating. If the maximum AC mains operating voltage is higher than the PV array maximum system voltage then the instructions shall require PV modules that have a maximum system voltage rating based upon the AC mains voltage.		P
5.3.2.6	Non-sinusoidal output waveform information		N/A
	The instruction manual for a stand-alone inverter not complying with 4.7.5.2 shall include a warning that the waveform is not sinusoidal, that some loads may experience increased heating, and that the user should consult the manufacturers of the intended load equipment before operating that load with the inverter. The inverter manufacturer shall provide information regarding what types of loads may experience increased heating, recommendations for maximum operating times with such loads, and shall specify the THD, slope, and peak voltage of the waveforms as determined by the testing in 4.7.5.3.2 through 4.7.5.3.4.		N/A
5.3.2.7	Systems located in closed electrical operating areas		P
	Where required by 4.8.3.6, an inverter not provided with full protection against shock hazard on the PV array shall be provided with installation instructions requiring that the inverter and the array must be installed in closed electrical operating areas, and indicating which forms of shock hazard protection are and are not provided integral to the inverter (for example the RCD, isolation transformer complying with the 30 mA touch current limit, or residual current monitoring for sudden changes).		N/A
5.3.2.8	Stand-alone inverter output circuit bonding		P
	Where required by 7.3.10, the documentation for an inverter shall include the following:		P
	– if output circuit bonding is required but is not provided integral to the inverter, the required means shall be described in the installation instructions, including which conductor is to be bonded and the required current carrying capability or cross-section of the bonding means;		P
	– if the output circuit is intended to be floating, the documentation for the inverter shall indicate that the output is floating.		N/A
5.3.2.9	Protection by application of RCD's		N/A

IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
	Where the requirement for additional protection in 4.8.3.1 is met by requiring an RCD that is not provided integral to the inverter, as allowed by 4.8.3.4, the installation instructions shall state the need for the RCD, and shall specify its rating, type, and required circuit location.		N/A
5.3.2.10	Remote indication of faults		P
	The installation instructions shall include an explanation of how to properly make connections to (where applicable), and use, the electrical or electronic fault indication required by 13.9.		P
5.3.2.11	External array insulation resistance measurement and response		P
	The installation instructions for an inverter for use with ungrounded arrays that does not incorporate all the aspects of the insulation resistance measurement and response requirements in 4.8.2.1, must include:	The inverters have the insulation resistance detection function for ungrounded arrays. Refer to table 4.8.2.1.	N/A
	– for isolated inverters, an explanation of what aspects of array insulation resistance measurement and response are not provided, and an instruction to consult local regulations to determine if any additional functions are required or not;		N/A
	– for non-isolated inverters: • an explanation of what external equipment must be provided in the system, and • what the setpoints and response implemented by that equipment must be, and • how that equipment is to be interfaced with the rest of the system.		N/A
5.3.2.12	Array functional grounding information		N/A
	Where approach a) of 4.8.2.2 is used, the installation instructions for the inverter shall include all of the following:		N/A
	a) the value of the total resistance between the PV circuit and ground integral to the inverter;		N/A
	b) the minimum array insulation resistance to ground that system designer or installer must meet when selecting the PV panel and system design, based on the minimum value that the design of the PV functional grounding in the inverter was based on;		N/A
	c) the minimum value of the total resistance R = VMAX PV/30 mA that the system must meet, with an explanation of how to calculate the total;		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	d) a warning that there is a risk of shock hazard if the total minimum resistance requirement is not met.		N/A
5.3.2.13	Stand-alone inverters for dedicated loads		P
	Where the approach of 4.7.5.5 is used, the installation instructions for the inverter shall include a warning that the inverter is only to be used with the dedicated load for which it was evaluated, and shall specify the dedicated load		P
5.3.2.14	Identification of firmware version(s)		P
	An inverter utilizing firmware for any protective functions shall provide means to identify the firmware version. This can be a marking, but the information can also be provided by a display panel, communications port or any other type of user interface.		P
7	Protection against electric shock and energy hazards		--
	This clause of Part 1 is applicable with the following exceptions:		P
7.3	Protection against electric shock		P
	Additional subclauses:		P
7.3.10	Additional requirements for stand-alone inverters		P
	Depending on the supply earthing system that a stand-alone inverter is intended to be used with or to create, the output circuit may be required to have one circuit conductor bonded to earth to create a grounded conductor and an earthed system.		P
	The means used to bond the grounded conductor to protective earth may be provided within the inverter or as part of the installation. If not provided integral to the inverter, the required means shall be described in the installation instructions as per 5.3.2.8.		P
	The means used to bond the grounded conductor to protective earth shall comply with the requirements for protective bonding in Part 1, except that if the bond can only ever carry fault currents in stand-alone mode, the maximum current for the bond is determined by the inverter maximum output fault current		P
	Output circuit bonding arrangements shall ensure that in any mode of operation, the system only has the grounded circuit conductor bonded to earth in one place at a time. Switching arrangements may be used, in which case the switching device used is to be subjected to the bond impedance test along with the rest of the bonding path.		P

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Clause	Requirement – Test	Result – Remark	Verdict
	Inverters intended to have a circuit conductor bonded to earth shall not impose any normal current on the bond except for leakage current.		P
	Outputs that are intentionally floating with no circuit conductor bonded to ground, must not have any voltages with respect to ground that are a shock hazard in accordance with Clause 7 of Parts 1 and 2. The documentation for the inverter shall indicate that the output is floating as per 5.3.2.8.		P
7.3.11	Functionally grounded arrays	No functionally grounded	N/A
	All PV conductors in a functionally grounded array shall be treated as being live parts with respect to protection against electric shock.		N/A
9	Protection against fire hazards		--
	This clause of Part 1 is applicable with the following exceptions:		P
9.3	Short-circuit and overcurrent protection		P
	Additional subclause:		P
9.3.4	Inverter backfeed current onto the array		P
	The backfeed current testing and documentation requirements in Part 1 apply, including but not limited to the following.		P
	Testing shall be performed to determine the current that can flow out of the inverter PV input terminals with a fault applied on inverter or on the PV input wiring. Faults to be considered include shorting all or part of the array, and any faults in the inverter that would allow energy from another source (for example the mains or a battery) to impress currents on the PV array wiring. The current measurement is not required to include any current transients that result from applying the short circuit, if such transients result from discharging storage elements other than batteries.		P
	This inverter backfeed current value shall be provided in the installation instructions regardless of the value of the current, in accordance with Table 33.		P
13	Physical requirements		--
	This clause of Part 1 is applicable with the following exception:		P
	Additional subclause:		P
13.9	Fault indication		P
	Where this Part 2 requires the inverter to indicate a fault, both of the following shall be provided:		P

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Clause	Requirement – Test	Result – Remark	Verdict
	a) a visible or audible indication, integral to the inverter, and detectable from outside the inverter, and		P
	b) an electrical or electronic indication that can be remotely accessed and used.		P
	The installation instructions shall include information regarding how to properly make connections (where applicable) and use the electrical or electronic means in b) above, in accordance with 5.3.2.10.		P

4.7.4.2	TABLE: Steady state output voltage at nominal DC input						P
U (V) in	I (A) in	P (W) in	U (V) out	I (A) out	P (kW) out	Frequency (Hz)	Condition/status Type
51.2	60	5000	220.3	16	5	49.99	Max. normal load
Remark: Max. normal load: 1.5KVA for battery charging and 3.0KVA for output load							

4.7.4.3 & 4.7.4.5	TABLE: Steady state output voltage and output frequency across the DC input range						P
U (V) in	I (A) in	P (W) in	U (V) out	I (A) out	P (kW) out	Frequency (Hz)	Condition/status Type
51.2	60	5000	220.3	16	5	49.99	Max. normal load
Remark: Max. normal load: 1.5KVA for battery charging and 3.0KVA for output load							

4.7.4.4	TABLE: Load step response of the output voltage at nominal DC input						P
U (V) in	I (A) in	P (W) in	U (V) out	I (A) out	P (kW) out	Frequency (Hz)	Condition/status Type
51.2	60	5000	220.3	16	5	49.99	Max. normal load
Remark: Max. normal load: 1.5KVA for battery charging and 3.0KVA for output load							

4.7.5	TABLE: Harmonics distortion		N/A
	Output .....:	151	
Harmonics order N	Maximum permissible (%)	Measured (%)	
Odd harmonics			
Total harmonics			

ANNEX A:

Photo-documentation

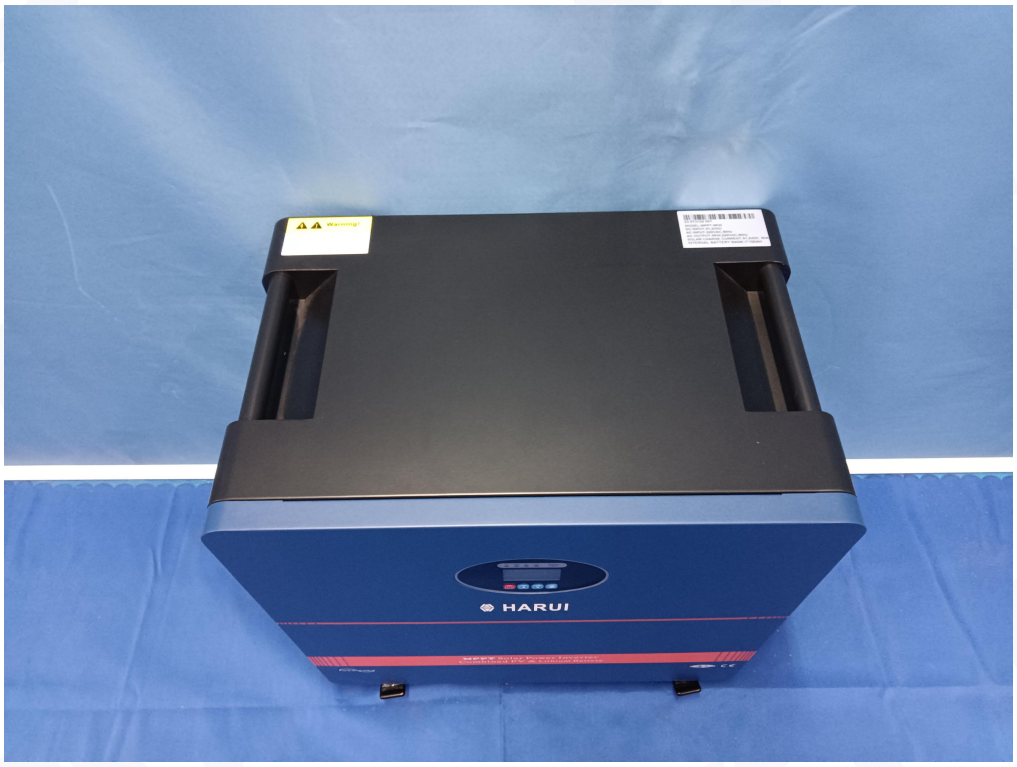
Photo 1 General appearance of the EUT

Photo 2 General appearance of the EUT

Photo 3 General appearance of the EUT

Photo 4 General appearance of the EUT

Photo 5 General appearance of the EUT



*****End of report*****