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TEST REPORT

Product Name : DC & Solar Charge Controller

Model Numer : MD1250N05, MD1230N05

Prepared for : SRNE Solar Co., Ltd.
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Report : ENS2205300011P001
Number

Date(s) of Tests : June 08, 2022 to June 23, 2022
Date of issue : July 05, 2022



TEST REPORT IEC 62109-1, EN 62109-1 Safety of Power Converter for use in Photovoltaic Power Systems Part 1: General requirements	
Report Reference No.....	ENS2205300011P001
Compiled by (name + signature) ...	Youlv Lee 
Approved by (name + signature) ...	Paladin Hu 
Date of issue.....	July 05, 2022
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Testing Laboratory name.....	EMTEK (SHENZHEN) CO., LTD.
Address.....	Bldg 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China
Testing location/ address.....	Same as above
Applicant's name.....	SRNE Solar Co., Ltd.
Address.....	4-5F,Building13A,Taihua Wutong Industrial Park ,Gushu Development Zone ,Hangcheng Street,Baoan, Shenzhen, China PR
Test specification:	
Standard	IEC 62109 1:2010 (First Edition), EN 62109-1:2010
Test procedure	LVD
Non-standard test method.....	N/A
Test Report Form No.....	IEC62109_1B
Test Report Form(s) Originator	VDE Testing and Certification Institute
Master TRF	Dated 2016-04
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Test item description	DC & Solar Charge Controller
Trade Mark	 SRNE 硕日
Manufacturer	SRNE Solar Co., Ltd.

Address..... : 4-5F,Building13A,Taihua Wutong Industrial Park ,Gushu Development Zone ,Hangcheng Street,Baoan, Shenzhen, China PR
 Model/Type reference..... : MD1250N05, MD1230N05
 Ratings..... : See the rating labels.

Summary of testing:

The product has been tested according to standard IEC 62109-1: 2010, EN 62109-1: 2010.

- Tested for moderate conditions
- EUT is designed for altitudes not exceeding 3000m.

Test item particulars

Equipment mobility : movable hand-held stationary
 fixed transportable for building-in
 Environmental category..... : outdoor indoor unconditional
 indoor conditional
 Over voltage category PV : OVC I OVC II OVC III OVC IV
 Mains supply tolerance (%)..... : ±10 %
 Tested for power systems : TT system
 IT testing, phase-phase voltage (V) : N/A
 Class of equipment..... : Class I Class II Class III
 Not classified
 Mass of equipment (kg)..... : 2.18Kg
 Pollution degree..... : PD2
 Operation ambient temperature : -35°C ~ +65°C
 IP protection class : IP32

Possible test case verdicts:

- test case does not apply to the test object : N(/A, Not applicable)
- test object does meet the requirement : P (Pass)
- test object does not meet the requirement : F (Fail)

Testing

Date of receipt of test item : January 05, 2022
 Date (s) of performance of tests : January 05, 2022 to January 20, 2022

General remarks:

"(see Attachment #)" refers to additional information appended to the report.
 "(see appended table)" refers to a table appended to the report.
 The tests results presented in this report relate only to the object tested.
 This report shall not be reproduced except in full without the written approval of the testing laboratory.
 List of test equipment must be kept on file and available for review.
 Additional test data and/or information provided in the attachments to this report.
 Throughout this report a comma / point is used as the decimal separator.

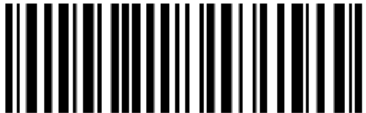

General product information:

- 1) It's intended for professional incorporation into PV systems, and it is assessed on a component test basis;
- 2) The PCE shall be used at specified ambient temperature range: -35°C ~ +65°C.
- 3) Model differences:

All models have the same constructions, circuit diagram and PCB layout. Only model name, appearance and output Control software to charging current limiting value and PV overvoltage protection voltage are different. Unless otherwise stated, all tests were performed on model MD1250N05 which means the typical model

Copy of marking plate:

Rating label:

MD1250N05	DG
<p>DC-DC & MPPT Solar Charge Controller</p> <p>Battery Voltage(DC): 12V</p> <p>Max.Charging Current(DC): 50A</p> <p>Max. Voltage of PV(DC): 55V Max.Input current (DC): 45A</p> <p>Max. Power of PV: 700W MPPT operating voltage range: 17V ~ 36V</p> <p>DC Input Voltage Range: 12V ~ 16V or 24V ~ 32V</p> <p>DC Max.Input Power: 700W DC Max.Input current: 60A</p>	
V010101	 <small>225500091234</small>
Date:2022.05	
IP32	MADE IN CHINA

MD1230N05

DG

DC-DC & MPPT Solar Charge Controller

Battery Voltage(DC): 12V

Max.Charging Current(DC): 30A

Max. Voltage of PV(DC): 55V Max.Input current (DC): 27A

Max. Power of PV: 400W MPPT operating voltage range: 17V ~ 36V

DC Input Voltage Range: 12V ~ 16V or 24V ~ 32V

DC Max.Input Power: 400W DC Max.Input current: 35A

V010101



Date:2022.05



IP32

MADE IN CHINA

IEC 62109-1: 2010, EN 62109-1:2010			
Clause	Requirement – Test	Result - Remark	Verdict
4	General testing requirements		P
4.1	General		P
4.2	General conditions for testing		P
4.2.1	Sequence of tests		P
4.2.2	Reference test conditions		P
4.2.2.1	Environmental conditions		P
	Unless otherwise specified, the following ambient environmental conditions shall exist in the test location: a) temperature of -35 °C to 65 °C b) a relative humidity of not more than 75 % and not less than 5% c) an air pressure of 75 kPa to 106 kPa. d) no frost, dew, percolating water, rain, solar radiation, etc.		P
4.2.2.2	State of equipment		P
4.2.2.3	Position of equipment	The equipment were installed in accordance with the manufacturer's instructions, in the configuration that results in the worst-case test conditions	P
4.2.2.4	Accessories	No accessories or operator interchangeable parts	N
4.2.2.5	Covers and removable parts	No	P
4.2.2.6	Main supply		N
4.2.2.7	Supply ports other than the mains	PV and battery	P
4.2.2.7.1	Photovoltaic supply sources		P
4.2.2.7.2	Battery inputs		P
4.2.2.8	Conditions of loading for output ports	DC-DC	P
4.2.2.9	Earthing terminals	Protective conductor terminal was connected to earth. No functional earth terminal.	P
4.2.2.10	Controls		P
	Controls which the operator can adjust shall be set to any position except that	Control is set to max. DC output power.	P
	a) mains selection devices shall be set to the correct value unless otherwise noted in this standard;	No mains selection devices.	N
	b) Combinations of settings shall not be made if they are prohibited by the manufacturer's instructions provided with the equipment.	No combinations of settings devices	N
4.2.2.11	Available short circuit current		N

4.3	Thermal testing		P
4.3.1	General		P
4.3.2	Maximum temperature	Tests of equipment rated for use in ambient temperatures up to 65°C	P
4.3.2.1	General		P
	Materials and components shall be selected so that under the most severe rated operating conditions, the temperatures do not exceed the temperature limits.		P
	Conformity is verified by measuring temperatures under the conditions given in 4.2 for each rated operating condition or mode of the PCE that could affect the resulting temperatures.		P
	The temperature limits specified below are total temperature limits (not temperature rise limits).		P
	Tests of equipment rated for use in ambient temperatures up to 45°C may be conducted at any ambient temperature in the range given in 4.2.2.1, in which case the difference between the maximum rated ambient temperature and the test ambient is to be subtracted from or added to (as appropriate) the measured temperatures for comparison to the limits specified below.		N
	PCE rated for use in ambient temperatures more than 60°C shall be tested at the maximum rated ambient temperature +/- 5°C. the difference between the maximum rated ambient temperature and the test ambient is to be subtracted from or added to the measured temperatures for comparison to the limits specified.		P
	PCE with different output ratings or with automatic derating for different ambient temperatures shall be tested under as many conditions as are necessary to record worst-case temperatures, including at least the maximum ambient before derating, and the maximum ambient with derating.		N
	During thermal testing within NORMAL CONDITIONS protective devices shall not operate.		P
Temperatures are to be measured by thermocouples, except that for coils the change of resistance method may be used.		Method of thermocouples is used, including transformers, inductors, and other coils. Multiple embedded thermocouples, where the thermocouples are attached during winding of the part, are more likely to record hot-spot temperatures.	P

	Limits: - for coils and their insulation systems, the temperature limits in Table 1 apply.		P
	- for other components the measured temperatures shall not exceed the lower of:	(see appended table)	P
	- the applicable IEC component standards		P
	- the component or material's rated manufacturer's operating temperature		P
	- if neither of the above exists, temperature limits are given in Table 2.		P
4.3.2.2	Touch temperatures		P
	The maximum temperature for accessible parts of the PCE shall be in compliance with table 3	(see appended table)	P
	It is permitted that accessible parts that are required to get hot as part of their intended function (for example heatsinks) may have temperatures up to 100 °C, if the parts are marked with the hot surface marking of symbol 14 of Annex C. For products only for use in a closed electrical operating area the 100 °C limit does not apply.	For metal enclosure, heatsinks, the limit 100 °C apply and hot surface marking is used.	P
4.3.2.3	Temperature limits for mounting surfaces		P
	In order to protect against long-term degradation of building materials, surfaces of the PCE that will be in contact with the mounting surface shall not exceed a maximum total temperature of 90 °C.		P
4.4	Testing in single fault condition		P
4.4.1	General		P
	Testing in single fault conditions is done to determine that no hazards result from reasonably expected fault conditions that may arise in normal service or from reasonably expected misuse.		P
	Fault testing shall be done unless it can be conclusively demonstrated that no hazards could arise from a particular fault condition, or unless alternative methods of checking conformity are specified in this standard in place of fault testing.		P
4.4.2	Test conditions and duration for testing under fault conditions		P
4.4.2.1	General		P
	The equipment shall be operated under the combination of conditions in 4.2, which is least favourable for the particular fault test being performed.		P
	Fault conditions are to be applied only one at a time and shall be applied in turn in any		P

	convenient order. Multiple simultaneous faults shall not be applied, but a subsequent fault may arise as a consequence from an applied fault. Separate samples of the EUT may be used for each separate fault test applied, or the same sample may be used for many tests if damage from previous fault tests has been repaired or will not affect the results of further tests.		
4.4.2.2	Duration of tests		P
	The equipment shall be operated until further change as a result of the applied fault is unlikely, as determined by (for example) opening of a device that removes the influence of the fault, stabilization of temperatures, etc.		P
	If a non-resettable, manual, or automatically resetting protective device or circuit operates in such a way as to interrupt or mitigate the fault condition, the test duration is as follows:		P
	- automatic reset devices or circuits: allow the protection to cycle on and off until no further change as a result of the applied fault is likely, until the ultimate result is obtained, or until temperatures stabilize		P
	- manual reset devices or circuits: three cycles, with the device or circuit reset as soon as possible after tripping		N
	- non-resettable devices or circuits: one cycle		P
4.4.3	Pass/fail criteria for testing under fault conditions		P
4.4.3.1	Protection against shock hazard		P
	Compliance with requirements for protection against electric shock is checked after the application of single faults as follows:	(see appended table)	P
	a) by making measurements to check that no accessible DVC-A circuits have become shock hazardous using the steady state limits for DVC-A in Table 6 and the short-term limits of 7.3.2.3, and that such circuits remain separated from live parts at voltages greater than DVC A with at least basic insulation. Compliance is checked by the test of 7.5.2 (without humidity preconditioning) for basic insulation; and		P
	b) by performing a dielectric strength test as per 7.5.2 (without humidity preconditioning) in the following cases:		P
	i) on reinforced or double Insulation, using the test level for Basic insulation, and		P
	ii) on basic insulation in Protective Class I equipment, using the test level for Basic insulation, unless it can be determined that the fault did not result in any damage to the		P

	protective earthing conductor or terminal, or to protective bonding means; and		
	c) by inspection to ensure a fuse connected between the protective earthing terminal and the protective earthing conductor in the test setup has not opened; the enclosure is not to be contacting earth in any other location during the testing;		P
	d) by inspection of the enclosure to ensure that no damage has resulted that allows access to parts that are hazardous live.		P
4.4.3.2	Protection against the spread of fire		P
	Compliance with requirements for protection against the spread of fire is checked by placing the equipment on white tissue-paper covering a soft-wood surface and covering the equipment with cheesecloth or surgical cotton during the fault test- ing. As an alternative, the cheesecloth or surgical cotton may be placed only over the openings of large equipment.		P
	There shall be no emission of molten metal, burn- ing insulation, or flaming or glowing particles from the fire enclosure, and there shall be no charring, glowing, or flaming of the tissue paper, cheese- cloth, or glowing or flaming of surgical cotton.		P
4.4.3.3	Protection against other hazards		P
	Conformity with requirements for protection against other HAZARDS after application of the fault tests is checked as specified elsewhere in this standard.		P
4.4.3.4	Protection against parts expulsion hazards		P
	Failure of any component within the PCE shall not release parts outside the PCE enclosure with suffi- cient energy to lead to a hazard, for example, ex- pulsion of material into an area occupied by per- sonnel.		P
4.4.4	Single Fault conditions to be applied		P
4.4.4.1	Component fault tests	(see appended table)	P
	The following faults are simulated:		P
	a) Short circuit or open circuit of relevant compo- nents		P
	b) Short circuit or open circuit of any components or insulation where failure could adversely affect supplementary insulation or reinforced insulation.		P
	c) In addition, where required by Method 2 of 9.1.1, components that could result in a fire hazard are to be overloaded unless they comply with the re- quirements of 9.1.3		P

4.4.4.2	Equipment or parts for short-term or intermittent operation	Not for short-term or intermittent operation	N
	Components such as motors, relays, other electromagnetic devices and heaters, which are normally operated only intermittently, shall be operated continuously if continuous operation could occur in a single fault conditions.	No components normally operated only intermittently	P
4.4.4.3	Motors		N
	Motors shall be stopped while fully energized or prevented from starting, whichever is less favourable.		N
4.4.4.4	Transformer short circuit tests	(see appended table)	P
	The output windings of transformers shall be short-circuited one at a time. A transformer damaged during one test may be repaired or replaced before the next test.		P
4.4.4.5	Output short circuit		P
	Testing is required to be performed on all combinations of terminals for the port under consideration, two at a time, including neutral and earth terminals, and one test with all current-carrying terminals of the port shorted together at once.	(1) Line and Line (2) Line and PE Above four combinations of output terminals are tested one a time.	P
	the short-circuit currents are to be recorded and if they exceed the maximum rated current of the circuit, the maximum measured current shall be provided in the installation manual for the purpose of coordination of overcurrent protection of the external circuit conductors.	The values are recorded and stated in the installation manual.	P
4.4.4.6	Backfeed current test		P
	For equipment intended to be connected simultaneously to more than one source of supply, each input of the PCE shall be tested one at a time, to determine if hazardous conditions can result from current from one source of supply flowing into the wiring for another source under fault conditions.	DC consider as source of supply	P
	With the PCE operating under normal conditions, a short circuit shall be applied at the field wiring terminals of the circuit under consideration, with all intended other sources connected to the PCE through the over current protective devices (if any) intended to be present in the installation.		P
	the short-circuit currents are to be recorded and if they exceed the maximum rated current for the port, the maximum measured current shall be provided in the installation manual for the purpose of coordination of overcurrent protection of the external circuit conductors	The values are recorded and stated in the installation manual for the purpose of coordination of over-current protection of the external circuit conductors.	P
4.4.4.7	Output overload		P

	Each output of the PCE, and each section of a tapped output, shall be overloaded in turn, one at a time. The other windings are loaded or not loaded, whichever load condition of normal use is less favorable. Overloading is carried out by connecting a variable resistor across the winding. The resistor is adjusted as quickly as possible and readjusted, if necessary, after 1 min to maintain the applicable overload. No further readjustments are then permitted.	For high frequency transformer used for SMPS, each section of a tapped output can't be overload. Software protection is bypassed when process this overload test. (see appended table)	P
	If overcurrent protection is provided by a current-sensitive device or circuit, the overload test current is the maximum current which the overcurrent protection device is just capable of passing for 1 h. If this value cannot be derived from the specification, it is to be established by test. Before the test, the device is made inoperative or replaced by a link with negligible impedance.	Overload protected rely to current fuse link if software protection was bypassed. (see appended table)	P
	For equipment in which the output voltage is designed to collapse when a specified overload current is reached, the overload is slowly increased to the point of maximum output power before the point which causes the output voltage to collapse.	The PCE is overload to the maximum output power before the point voltage collapse.	P
	In all other cases, the loading is the maximum power output obtainable from the output.		P
4.4.4.8	Cooling system failure	Cooling fans was stopped.	P
4.4.4.9	Heating devices	No heating devices used	N
	In equipment incorporating heating devices, the following faults shall be applied one at a time: a) timers which limit the heating period shall be overridden to energize the heating circuit continuously; b) temperature control devices or circuits shall have single fault conditions applied such that control over the heater is lost. Over-temperature protection devices meeting the requirements of 14.3 are left operational during the test.		N
4.4.4.10	Safety interlock	No safety interlock	N
4.4.4.11	Reverse d.c. connections	the unit cannot start-up, no input power, no damage, no hazard.	P
4.4.4.12	Voltage selector mismatch	No voltage selector	N
4.4.4.13	Mis-wiring with incorrect phase sequence or polarity	(see appended table)	P
4.4.4.14	PWB short-circuit test	Functional insulation less than required spacing is simulated by short-circuit test. Two location of printed wiring board track are	P

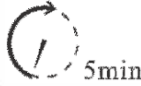
		performed. (see appended table)	
4.5	Humidity preconditioning		P
4.5.1	General		P
4.5.2	Conditions		P
	Relative humidity (%), temperature (°C)	95% RH., 40 °C, 48 h	P
4.6	Voltage Backfeed protection		P
4.6.1	Backfeed tests under normal conditions	See Clause 4.6.3	P
4.6.2	Backfeed tests under single-fault condtions		P
4.6.3	Compliance with backfeed tests	Backfeed voltage and energy protection.	P
	The PCE is compliant with the requirements if during the tests in 4.6.1 and 4.6.2 no hazardous voltage or energy is present on the PCE terminals for the source under test. Measurements are taken 15 s or 1 s after the source is de-energized or disconnected, as follows:	4 s after the indication lamp goes out. Voltage and energy on the AC terminal is 16 V _{peak} , 0,1 Joules energy. Voltage and energy on the DC terminal is 22,1 V _{dc} , 0,68 Joules energy. Warning marking "after disconnection 5 minutes can touch with the PCE terminal"	P
	- 15 s for sources that are connected by fixed wiring	See above	P
	- 1 s for sources that are cord-connected or use connectors that can be opened without the use of a tool		N
4.7	Electrical ratings tests		P
4.7.1	Input ratings	(see appended table)	P
4.7.1.1	Measurement requirements for DC input ports		P
4.7.2	Output ratings		P
5	MARKING AND DOCUMENTATION		P
5.1	Marking		P
5.1.1	General		P
	Equipment shall bear markings as specified in 5.1 and 5.2	Label are marked on the PCE and graphic symbol is explained in user manual	P
	Graphic symbols may be used and shall be in accordance with Annex C or IEC 60417 as applicable.		P
	Graphic symbols shall be explained in the documentation provided with the PCE.		P
5.1.2	Durability of markings		P

	<p>Markings required by this clause to be located on the PCE shall remain clear and legible under conditions of NORMAL USE and resist the effects of cleaning agents specified by the manufacturer</p>	<p>The label was subjected to the permanence of marking test. The label was rubbed with cloth soaked with water for 30 sec. And then again for 30 sec. With the cloth soaked with petroleum spirit. After this test there was no damage to the label. The marking on the label did not fade. There was no curling or lifting of the label edge.</p>	P
5.1.3	Identification		P
	The equipment shall, as a minimum, be permanently 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	See below	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.), frequency, and max. continuous current for each input	Refer to the marking label	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	Refer to the marking label	P
	- the ingress protection (IP) rating as in 6.3 below	IP32	P
5.1.5	Fuse identification		P
	Marking shall be located adjacent to each fuse or fuseholder, or on the fuseholder, or in another location provided that it is obvious to which fuse the marking applies, giving the fuse current rating and where fuses of different voltage rating value could be fitted, the fuse voltage rating.		P
	Where fuses with special fusing characteristics such as time delay or breaking capacity are necessary, the type shall also be indicated		P
	For fuses not located in operator access areas and for soldered-in fuses located in operator access areas, it is permitted to provide an		P

	unambiguous cross-reference (for example, F1, F2, etc.) to the servicing instructions which shall contain the relevant information.		
5.1.6	Terminals, Connections, and Controls	DC input, and communication interface	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.	Symbol 9 are marked on the PCE and user manual indicate the installation and safety of connection of connector, control and indicator	P
	Push-buttons and actuators of emergency stop devices, and indicator lamps used only to indicate a warning of danger or the need for urgent action shall be coloured red.	No emergency stop	N
	A multiple-voltage unit shall be marked to indicate the particular voltage for which it is set when shipped from the factory. The marking is allowed to be in the form of a paper tag or any other nonpermanent material.	The PCE is not intended to connect to multiple-voltage and there is no voltage setting device	N
	A unit with d.c. terminals shall be plainly marked indicating the polarity of the connections, with:	See below	P
	- the sign "+" for positive and "-", for negative; or	The input PV terminals for each module and whole unit are moulded with sign "+" for positive and "-" for negative	P
	- a pictorial representation illustrating the proper polarity where the correct polarity can be unambiguously determined from the representation	Not provided	N
5.1.6.1	Protective Conductor Terminals		P
	The means of connection for the protective earthing conductor shall be marked with:	The PE terminal is connected via AC output cable	N
	symbol 7 of Annex C; or		P
	the letters "PE"; or		N
	the colour coding green-yellow.		P
5.1.7	Switches and circuit-breakers	No such devices	N
	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
5.1.8	Class II Equipment	Class I	N
	Equipment using Class II protective means throughout shall be marked with symbol 12 of		N

	Annex C. Equipment which is only partially protected by DOUBLE INSULATION or REINFORCED INSULATION shall not bear symbol 12 of Table Annex C.		
	Where such equipment has provision for the connection of an earthing conductor for functional reasons (see 7.3.6.4) it shall be marked with symbol 6 of Annex C		N
5.1.9	Terminal boxes for External Connections	No such terminal box	N
	Where required by note 1 of Table 2 as a result of high temperatures of terminals or parts in the wiring compartment, there shall be a marking, visible beside the terminal before connection, of either:	The wiring used inside the PCE is within the rating	N
	a) the minimum temperature Rating and size of the cable to be connected to the TERMINALS; or		N
	b) a marking to warn the installer to consult the installation instruction. Symbol 9 of Table D-1 is an acceptable marking		N
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:	The markings are printed out	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 background		P
	- Symbols or text that are moulded, stamped or engraved in a material shall have a character height of at least 2,0 mm, and if not contrasting in colour from the background, shall have a depth or raised height of at least 0,5 mm.	The symbols are printed out	N
	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	The manual provide necessary information for the warning marking	P
	Symbol 9 of Annex C is not required to be used adjacent to symbols that are explained in the manual		P
5.2.2	Content for warning markings		P
5.2.2.1	Ungrounded heatsinks and similar parts	Grounded heatsink and metal enclosure	N
	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		N

	the PCE is disassembled to the extent that a risk of contact with the heatsink exists.		
5.2.2.2	Hot Surfaces		P
	A part of the PCE that exceeds the temperature limits specified in 4.3.2 shall be marked with symbol 14 of Annex C or equivalent.		P
5.2.2.3	Coolant	Coolant is not used	N
	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
	statement that coolant system servicing is to be done only by SERVICE PERSONNEL, or		N
	instructions for safe venting, draining, or otherwise working on the cooling system, if these operations can be performed without OPERATOR access to HAZARDS internal to the equipment		N
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.		P
5.2.2.5	Motor guarding		N
	Where required by 8.2 a marking shall be provided where it is visible to service personnel before removal of a guard, warning of the hazard and giving instructions for safe servicing (for example disconnection of the source before removing the guard).		N
5.2.3	Sonic hazard markings and instructions	No sonic hazard	N
	If required by 10.2.1 a PCE shall:		N
	a) be marked to warn the operator of the sonic pressure hazard; or		N
	b) be provided with installation instructions that specify how the installer can ensure that the sound pressure level from equipment at its point of use after installation, will not reach a value, which could cause a hazard. These instructions shall include the measured sound pressure level, and shall identify readily available and practicable protective materials or measures which may be used.		N
5.2.4	Equipment with multiple sources of supply		N
	A PCE with connections for multiple energy sources shall be marked with symbol 13 of		N

	Annex C and the manual shall contain the information required in 5.3.4.		
	The symbol shall be located on the outside of the unit or shall be prominently visible behind any cover giving access to hazardous parts.		N
5.2.5	Excessive touch current		N
	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.		N
5.3	Documentation		P
5.3.1	General		P
	The documentation provided with the PCE shall provide the information needed for the safe operation, installation, and (where applicable) maintenance of the equipment. The documentation shall include the items required in 5.3.2 through 5.3.4, and the following:		P
	a) explanations of equipment makings, including symbols used		P
	b) location and function of terminals and controls		P
	c) all ratings or specifications that are necessary to safely install and operate the PCE, including the following environmental ratings along with an explanation of their meaning and any resulting installation requirements:		P
	- ENVIRONMENTAL CATEGORY as per 6.1	Indoor	P
	- WET LOCATIONS classification for the intended external environment as per 6.1	Suitable for wet location	P
	- POLLUTION DEGREE classification for the intended external environment as per 6.2	PD2	P
	- INGRESS PROTECTION rating as per 6.3	IP32	P
	- Ambient temperature and relative humidity ratings	Max.65°C and 95%RH	P
	- MAXIMUM altitude rating	Up to 3000 m	P
	- OVERVOLTAGE CATEGORY assigned to each input and output port as per 7.3.7.1.2, accompanied by guidance regarding how to ensure that the installation complies with the required overvoltage categories;	OVC II (PV)	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	English	P
	Instructions related to safety shall be in a language that is acceptable in the country where the equipment is to be installed.	For other country language, further evaluation is needed	P

5.3.1.2	Format		P
	In general, the documentation must be provided in printed form and is to be delivered with the equipment.	Printed form provided and is to be delivered with equipment	P
	For equipment which requires the use of a computer for both installation and operation, documentation may be provided in electronic format without accompanying printed format.		P
5.3.2	Information related to installation		P
	The documentation shall include installation and where applicable, specific commissioning instructions and, if necessary for safety, warnings against hazards which could arise during installation or commissioning of the equipment. The information provided shall include:		P
	a) assembly, location, and mounting requirements;		P
	b) ratings and means of connection to each source of supply and any requirements related to wiring and external controls, colour coding of leads, disconnection means, or overcurrent protection needed, including instructions that the installation position shall not prevent access to the disconnection means;		P
	c) ratings and means of connection of any outputs from the PCE, and any requirements related to wiring and external controls, colour coding of leads, or overcurrent protection needed;		P
	d) explanation of the pin-out of connectors for external connections, unless the connector is used for a standard purpose (e.g. RS 232)		P
	e) ventilation requirements;		P
	f) requirements for special services, for example cooling liquid;	No cooling liquid or other special service	N
	g) instructions and information relating to sound pressure level if required by 10.2.1;	<45 dBA	P
	h) where required by 14.8.1.3, instructions for the adequate ventilation of the room or location in which PCE containing vented or valve-regulated batteries is located, to prevent the accumulation of hazardous gases;	No such battery	N
	i) tightening torque to be applied to wiring terminals;		P
j) values of backfeed short-circuit currents available from the PCE on input and output conductors under fault conditions, if those		P	

	currents exceeds the max. rated current of the circuit, as per 4.4.4.6;		
	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;	Internal RCM is used	N
	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:	Touch current does not exceed limit	N
	n) where required by 7.3.8, the installation instructions shall include the following or equivalent wording:	Internal RCM is used	N
	“This product can cause a d.c. current in the external protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in a case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product.”		N
	o) for PCE intended to charge batteries, the battery nominal voltage rating, size, and type		N
	p) PV array configuration information, such as ratings, whether the array is to be grounded or floating, any external protection devices needed, etc.		P
5.3.3	Information related to operation		P
	Instructions for use shall include any operating instructions necessary to ensure safe operation, including the following, as applicable:		P
	- Instructions for adjustment of controls including the effects of adjustment;		P
	- Instructions for interconnection to accessories and other equipment, including indication of suitable accessories, detachable parts and any special materials;		P
	- Warnings regarding the risk of burns from surfaces permitted to exceed the temperature limits of 4.3.2 and required operator actions to reduce the risk; and		P
	- Instructions, that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.		P
5.3.4	Information related to maintenance		P
	Maintenance instructions shall include the following:		P
	- Intervals and instructions for any preventive maintenance that is required to maintain safety		P

	(for example air filter replacement or periodic re-tightening of terminals);		
	- Instructions for accessing operator access areas, if any are present, including a warning not to enter other areas of the equipment;		P
	- Part numbers and instructions for obtaining any required operator replaceable parts;	No replaceable parts	N
	- Instructions for safe cleaning (if recommended)		P
	- Where there is more than one source of supply energizing the PCE, information shall be provided in the manual to indicate which disconnect device or devices are required to be operated in order to completely isolate the equipment.		P
5.3.4.1	Battery maintenance	No energy storage battery inside	N
	Where required by 14.8.5, the documentation shall include the applicable items from the following list of instructions regarding maintenance of batteries:		N
	- Servicing of batteries should be performed or supervised by personnel knowledgeable about batteries and the required precautions		N
	- When replacing batteries, replace with the same type and number of batteries or battery packs		N
	- General instructions regarding removal and installation of batteries		N
	- CAUTION: Do not dispose of batteries in a fire. The batteries may explode.		N
	- CAUTION: Do not open or damage batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.		N
	- CAUTION: A battery can present a risk of electrical shock and high short-circuit current. The following precautions should be observed when working on batteries:		N
	a) Remove watches, rings, or other metal objects.		N
	b) Use tools with insulated handles.		N
	c) Wear rubber gloves and boots.		N
	d) Do not lay tools or metal parts on top of batteries		N
	e) Disconnect charging source prior to connecting or disconnecting battery terminals		N
	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		N

	likelihood of such shock can be reduced if such grounds are removed during installation and maintenance (applicable to equipment and remote battery supplies not having a grounded supply circuit).		
6	Environmental requirements and conditions		P
	The manufacturer shall rate the PCE for the following environmental conditions:		P
	- ENVIRONMENTAL CATEGORY, as in 6.1 below	Indoor use	P
	- Suitability for WET LOCATIONS or not	Suitability for wet locations	P
	- POLLUTION DEGREE rating in 6.2 below	PD2	P
	- INGRESS PROTECTION (IP) rating, as in 6.3 below	IP32	P
	- Ultraviolet (UV) exposure rating, as in 6.4 below		P
	- Ambient temperature and relative humidity ratings, as in 6.5 below		P
6.1	Environmental categories and minimum environmental conditions		P
6.1.1	Outdoor		P
6.1.2	Indoor, unconditioned		P
6.1.3	Indoor, conditioned		P
6.2	Pollution degree	PD2	P
6.3	Ingress Protection	IP32	P
6.4	UV exposure		P
6.5	Temperature and humidity		P
7	Protection against electric shock and energy hazards		P
7.1	General		P
7.2	Fault conditions	Normal and single fault condition are considered	P
7.3	Protection against electric shock		P
7.3.1	General	In the PCE the earthed metal enclosure is evaluated by means of basic insulation from DVC C circuit. DVC A circuit and unearthed accessible parts are evaluated by means of reinforce insulation from DVC C. DVC C: The PV input and mains output. DVC A: the communication interface	P

7.3.2	Decisive voltage classification		P
7.3.2.1	Use of decisive voltage class (DVC)	Working voltage and protective measures are considered.	P
7.3.2.2	Limits of DVC (according table 6)	Wet location is considered for PCE outside only	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)	Single fault condition is considered. Accessible earthed conductive parts are separated from DVC-C circuits by basic insulation. Accessible unearthed conductive parts separated from DVC C circuit by Reinforced insulation	P
7.3.2.5	Connection to PELV and SELV circuits	The external signal communication interface are considered as SELV	P
7.3.2.6	Working voltage and DVC		P
7.3.2.6.1	General	Transients and voltage fluctuations are disregarded. And worst case normal operating condition is considered	P
7.3.2.6.2	AC working voltage (see Figure 2)		N
7.3.2.6.3	DC working voltage (see Figure 3)	Max. DC input voltage: 55V	P
7.3.2.6.4	Pulsating working voltage (see Figure 4)		N
7.3.3	protective separation	See description in Cl. 7.3.1	P
	Protective separation shall be achieved by:		P
	• double or reinforced insulation, or		P
	• protective screening, i.e. by a conductive screen connected to earth by protective bonding in the PCE, or connected to the protective earth conductor itself, whereby the screen is separated from live parts by at least basic insulation, or		P
	• protective impedance comprising limitation of current per 7.3.5.3 and of discharged energy per 7.3.5.4, or		P
	• limitation of voltage according to 7.3.5.4.		N
	The protective separation shall be fully and effectively maintained under all conditions of intended use of the PCE		P
7.3.4	Protection against direct contact		P
7.3.4.1	General		P
	Protection against direct contact is employed to prevent persons from touching live parts that do	Enclosure provided	P

	not meet the requirements of 7.3.5 and shall be provided by one or more of the measure given in 7.3.4.2 (enclosures and barriers) and 7.3.4.3 (insulation).		
	Open type sub-assemblies and devices do not require protective measures against direct contact but the instruction provided with the equipment must indicate that such measures must be provided in the end equipment or in the installation.	End use product	N
	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.	No use under this condition	N
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 enclosures or barriers, not by insulation in accordance with 7.3.4.3.	Enclosure provided to prevent access to inside live parts	P
7.3.4.2.1	General		P
	Parts of enclosures and barriers that provide protection in accordance with these requirements shall not be removable without the use of a tool (see 7.3.4.2.3).	Secured by screws	P
	Polymeric materials used to meet these requirements shall also meet the requirements of 13.6		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:	The communication interface is considered as DVC A	P
	a) decisive voltage classification A, (DVC A) - the probe may touch the live parts	The DVC B circuit is not accessible by probe	P
	b) decisive voltage classification B, (DVC B) - the probe must not touch bare live parts	The DVC C circuit is not accessible by probe	P
	c) decisive voltage classification C, (DVC C) – the probe must have adequate clearance to live parts, based on the clearance for Basic insulation using the recurring peak working voltage involved,		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		P

	<p>performed on openings in the enclosures after removal of parts that can be detached or opened by an operator without the use of a tool, including fuseholders, and with operator access doors and covers open. It is permitted to leave lamps in place for this test. Connectors that can be separated by an operator without use of a tool, shall also be tested during and after disconnection. Any movable parts are to be put in the most unfavorable position.</p>		
	<p>The test finger and the test pin are applied as above, without appreciable force, in every possible position, except that floor-standing equipment having a mass exceeding 40 kg is not tilted.</p>		P
	<p>Equipment intended for building-in or rack mounting, or for incorporation in larger equipment, is tested with access to the equipment limited according to the method of mounting detailed in the installation instructions.</p>		N
	<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 enters, the test with the jointed finger is repeated except that the finger is applied using any necessary force up to 30 N.</p>		P
	<p>d) In addition to a) – c) above, top surfaces of enclosure shall be tested with the IP32 probe of IEC 60529. The test probe shall not penetrate the top surface of the enclosure when probed from the vertical direction $\pm 5^\circ$ only.</p>		P
7.3.4.2.4	<p>Service access areas</p>	<p>Inside PCE are not intentionally touched with energized parts when installation and maintenance. Symbol 21 of Annex C are marked on PCE and explained in user manual.</p>	P
7.3.4.3	<p>Protection by means of insulation of live parts</p>	<p>The earthed enclosure is with basic insulation from the live parts inside</p>	P
	<p>Where the requirements of 7.3.4.2 are not met, live parts shall be provided with insulation if:</p>		P
	<p>their working voltage is greater than the maximum limit of decisive voltage class A, or</p>		P
	<p>for a DVC A or B circuit, protective separation from adjacent circuit of DVC C is not provided (see note “†” under Table 7)</p>		P

7.3.5	Protection in case of direct contact	The communication interface are direct contact and evaluated with reinforce insulation from live parts	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 separated from other circuits according to 7.3.2.3, and:	Considered	P
	- is of decisive voltage class A and complies with 7.3.5.2, or	The communication interface is DVC A and reinforce insulation from the live parts by means of isolation transformer and opto-coupler	P
	- is provided with protective impedance according to 7.3.5.3, or		N
	- is limited in voltage according to 7.3.5.4		N
	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.	Considered	P
Conformity is checked by visual inspection and trial insertion.		P	
7.3.5.2	Protection using decisive voltage class A	The communication interface is DVC A and reinforce insulation from the live parts by means of isolation transformer and opto-coupler	P
7.3.5.3	Protection by means of protective impedance	Sampling resistors in series connected between PV and PE considering as protective impedance.	P
7.3.5.3.1	Limitation of current through protective impedance		P
	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.	Touch current less than 3,5 mA at normal and single fault conditions	P
7.3.5.3.2	Limitation of discharging energy through protective impedance		P

	The discharging energy available between simultaneously accessible parts protected by protective impedance shall not exceed the charging voltage and capacitance limits given in Table 9, which applies to both wet and dry locations, under normal and single fault conditions. Refer to figure 8.		P
7.3.5.4	Protection by means of limited voltages	No such design	N
	That portion of a circuit that has its voltage reduced to DVC-A by a voltage divider that complies with the following requirements, and that is otherwise provided with protective separation from circuits of DVC-B or DVC-C according to 7.3.3, does not require protection against direct contact.		N
	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
	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
7.3.6	Protection against indirect contact		P
7.3.6.1	General		P
	Protection against indirect contact is required to prevent shock- hazardous current being accessible from conductive parts during an insulation failure. This protection shall comply with the requirements for protective class I (basic insulation plus protective earthing), class II (double or reinforced insulation) or class III (limitation of voltages)	Class I also with reinforce insulation design inside PCE	P
	That part of a PCE meets the requirements of 7.3.6.2 and 7.3.6.3 is defined as protective class I	The earthed metal enclosure meet this requirement	P
	That part of a PCE meets the requirements of 7.3.6.4 is defined as protective class II.	The communication interface is reinforce insulated from live parts inside	P
	That part of PCE which meets the requirements of decisive voltage class A and in which no hazardous voltages are derived, is defined as protective class III. No shock hazard is present in such circuits.		N
	Where protection against indirect contact is dependent on means provided during installation, the installation instructions shall provide details of the required means and shall indicate the associated hazards.	The manual require the PCE must be securely earthed	P

7.3.6.2	Insulation between live parts and accessible conductive parts	See Cl. 7.3.7.4 and Cl. 7.3.7.5	P
	Accessible conductive parts of equipment shall be separated from live parts by insulation meeting the requirements of Table 7 or by clearances as specified in 7.3.7.4 and creepages as specified in 7.3.7.5		P
7.3.6.3	Protective class I – Protective bonding and earthing		P
7.3.6.3.1	General		P
	Equipment of protective class I shall be provided with protective earthing, and with protective bonding to ensure electrical contact between accessible conductive parts and the means of connection for the external protective earthing conductor, except bonding is not required for:		P
	a) accessible conductive parts that are protected by one of the measures in 7.3.5.2 to 7.3.5.4, or		N
	b) accessible conductive parts are separated from live parts of DVC-B or -C using double or reinforced insulation.		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 ;		N
	c) through a dedicated protective bonding conductor;		P
	d) through other metallic components of the PCE		N
	Where direct metallic contact is used and one or both of the parts involved is painted or coated, the paint or coating shall be removed in the area of contact, or reliably penetrated, to ensure metal to metal contact.		P
	For moving or removable parts, hinges or sliding contacts designed and maintained to have a low resistance are examples of acceptable means if they comply with the requirements of 7.3.6.3.3.		N
	Metal ducts of flexible or rigid construction and metallic sheaths shall not be used as protective bonding conductors, unless the device or material has been investigated as suitable for protective bonding purposes.		N
7.3.6.3.3	Rating of protective bonding		P

<p>Protective bonding shall withstand the highest thermal and dynamic stresses that can occur to the PCE item(s) concerned when they are subjected to a fault connecting live parts to accessible conductive parts.</p> <p>The protective bonding shall remain effective for as long as a fault to the accessible conductive parts persists or until an upstream protective device removes power from the part.</p>		P
<p>Protective bonding shall meet following requirements:</p>		P
<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.</p>	<p>Protective bonding wire size is same as output cable</p>	P
<p>The impedance of protective bonding means shall be checked by passing a test current through the bond for a period of time as specified below. The test current is based on the rating of the overcurrent protection for the equipment or part of the equipment under consideration, as follows:</p>		P
<p>a) For pluggable equipment type A, the overcurrent protective device is that provided external to the equipment (for example, in the building wiring, in the mains plug or in an equipment rack);</p>		N
<p>b) For pluggable equipment type B and fixed equipment, the maximum rating of the overcurrent protective device specified in the equipment installation instructions to be provided external to the equipment;</p>		N
<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.</p>		P
<p>Voltages are measured from the protective earthing terminal to all parts whose protective bonding means are being considered. The impedance of the protective earthing conductor is not included in the measurement. However, if the protective earthing conductor is supplied with the equipment, it is permitted to include the conductor in the test circuit but the measurement of the voltage drop is made only from the main protective earthing terminal to the accessible part required to be earthed.</p>	<p>Measured from the farthest part of earthed metal enclosure to the input earth terminal</p>	P
<p>On equipment where the protective earth connection to a subassembly or to a separate unit is part of a cable that also supplies power to that subassembly or unit, the resistance of the protective bonding conductor in that cable is not</p>	<p>Figure 11 used</p>	P

	included in the protective bond impedance measurements for the subassembly or separate unit, as shown in Figure 11. However, this option is only permitted if the cable is protected by a suitably rated protective device that takes into account the size of the conductor. Otherwise the impedance of the protective bonding conductor between the separate units is to be included, by measuring to the protective earthing terminal where the power source enters the first unit in the system, as shown in Figure 12.		
7.3.6.3.3.1	Test current, duration, and acceptance criteria	Protective bonding size is same as output cable	P
	The test current, duration of the test and acceptance criteria are as follows:		P
	During and after the test, there shall be no melting, loosening, or other damage that would impair the effectiveness of the protective bonding means.		P
	The test current is derived from an a.c or d.c supply source, the output of which is not earthed.	DC supply	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 either provided in the equipment or fully specified in the installation instructions, the test duration may be based on that specific device's time-current characteristic,. The tests are conducted for a duration corresponding to the 200% current value on the time-current characteristic.		P
7.3.6.3.4	Protective bonding impedance (routine test)		N
	If the continuity of the protective bonding is achieved at any point by a single means only (for example a single conductor or single fastener), or if the PCE is assembled at the installation location, then the impedance of the protective bonding shall also be tested as a routine test. The test shall be as in 7.3.6.3.3, except for the following:	Declared by Manufacturer and working instruction checked during factory inspection	N
	the test current may be reduced to any convenient value greater than 10 A sufficient to allow measurement or calculation of the impedance of the protective bonding means:		N
	the test duration may be reduced to no less than 2 s		N
	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

	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
7.3.6.3.5	External protective earthing conductor		N
	A protective earthing conductor shall be connected at all times when power is supplied to PCE of protective class I. Unless local wiring regulations state otherwise, the protective earthing conductor cross-sectional area shall be determined from Table 11 or by calculation according to IEC 60364-5-54.		N
	If the external protective earthing conductor is routed through a plug and socket or similar means of disconnection, it shall not be possible to disconnect it unless power is simultaneously removed from the part to be protected.		N
	The cross-sectional area of every external protective earthing conductor which does not form part of the supply cable or cable enclosure shall, in any case, be not less than:	External protective earthing conductor is integrated with output cable	N
	<ul style="list-style-type: none"> • 2,5 mm² if mechanical protection is provided; 		N
	<ul style="list-style-type: none"> • 4 mm² if mechanical protection is not provided. 		N
	For cord-connected equipment, provisions shall be made so that the external protective earthing conductor in the cord shall, in the case of failure of the strain-relief mechanism, be the last conductor to be interrupted.		N
7.3.6.3.6	Means of connection for the external protective earthing conductor		P
7.3.6.3.6.1	General		P
	<p>The means of connection for the external protective earthing conductor shall be located near the terminals for the respective live conductors. The means of connections shall be corrosion-resistant and shall be suitable for the connection of cables according to 7.3.6.3.5.</p> <p>The means of connection for the protective earthing conductor shall not be used as a part of the mechanical assembly of the equipment or for other connections.</p> <p>A separate means of connection shall be provided for each external protective earthing conductor.</p> <p>Connection and bonding points shall be so designed that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influences. Where enclosures and/or conductors of aluminium or aluminium</p>		P

	alloys are used, particular attention should be given to the problems of electrolytic corrosion.		
	The means of connection for the protective earthing conductor shall be permanently marked with:		P
	symbol 7 of Annex C; or		N
	the colour coding green-yellow		P
	Marking shall not be done on easily changeable parts such as screws.		N
7.3.6.3.7	Touch current in case of failure of the protective earthing conductor		P
	The requirements of this sub-clause shall be satisfied to maintain safety in case of damage to or disconnection of the protective earthing conductor.		P
	For pluggable equipment type A, the touch current measured in accordance with 7.5.4 shall not exceed 3,5 mA a.c. or mA d.c.		N
	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.		P
	a) Permanently connected wiring, and:	Not exceed 3,5 mA a.c.	N
	<ul style="list-style-type: none"> a cross-section of the protective earthing conductor of at least 10 mm² Cu or 16 mm² Al; or 		N
	<ul style="list-style-type: none"> automatic disconnection of the supply in case of discontinuity of the protective earthing conductor; or 		N
	<ul style="list-style-type: none"> provision of an additional terminal for a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor and installation instruction requiring a second protective earthing conductor to be installed or 		N
	b) Connection with an industrial connector according to IEC 60309 and a minimum protective earthing conductor cross-section of 2,5 mm ² as part of a multi-conductor power cable. Adequate strain relief shall be provided.		N
	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
	When it is intended and allowed to connect two or more PCEs in parallel using one		N

	common PE conductor, the above touch current requirements apply to the maximum number of the PCEs to be connected in parallel, unless one of the measures in a)		
	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
7.3.6.4	Protective Class II – Double or Reinforced Insulation	Communication interface is evaluated with Reinforced insulation from live part inside. Comply with clause 7.3.4.3	P
	Equipment or parts of equipment designed for protective class II shall have insulation between live parts and accessible surfaces in accordance with 7.3.4.3. The following requirements also apply:		N
	equipment designed to protective class II shall not have means of connection for the external protective earthing conductor. However this does not apply if the external protective earthing conductor is passed through the equipment to equipment series-connected beyond it. In the latter event, the external protective earthing conductor and its means for connection shall be insulated with basic insulation from the accessible surface of the equipment and from circuits that employ protective separation, extra-low voltage, protective impedance and limited discharging energy, according to 7.3.5. This basic insulation shall correspond to the rated voltage of the series-connected equipment;		N
	<ul style="list-style-type: none"> metal-encased equipment of protective class II may have provision on its enclosure for the connection of an equipotential bonding conductor; 		N
	<ul style="list-style-type: none"> equipment of protective class II may have provision for the connection of an earthing conductor for functional reasons or for damping of overvoltages; it shall, however, be insulated as though it is a live part; 		N
	<ul style="list-style-type: none"> equipment employing protective class II shall be marked according to 5.1.8. 		N
7.3.7	Insulation Including Clearance and Creepage Distance		P
7.3.7.1	General		P
	This subclause gives minimum requirements for insulation, based on the principles of IEC 60664.		P
	Manufacturing tolerances shall be taken into account during measurement of creepage, clearance, and insulation distance in the PCE.		P

	Insulation shall be selected after consideration of the following influences:		P
	<ul style="list-style-type: none"> • pollution degree 	PD2	P
	<ul style="list-style-type: none"> • overvoltage category 	PV (OVC II)	P
	<ul style="list-style-type: none"> • supply earthing system 	TT	P
	<ul style="list-style-type: none"> • insulation voltage 	PV input: max 100 Vd.c	P
	<ul style="list-style-type: none"> • location of insulation 	See table 7.3.7.4 and 7.3.7.5 for detail	P
	<ul style="list-style-type: none"> • type of insulation 	See table 7.3.7.4 and 7.3.7.5 for detail	P
	Compliance of insulation, creepage distances, and clearance distances, shall be verified by measurement 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
	<ul style="list-style-type: none"> • TN system: has one point directly earthed, the accessible conductive parts of the installation being connected to that point by protective conductors. Three types of TN systems, TN-C, TN-S and TN-C-S, are defined according to the arrangement of the neutral and protective conductor. 		N
	<ul style="list-style-type: none"> • TT system: has one point directly earthed, the accessible conductive parts of the installation being connected to earth electrodes electrically independent of the earth electrodes of the power system; 		P
	<ul style="list-style-type: none"> • IT system: has all live parts isolated from earth or one point connected to earth through an impedance, the accessible conductive parts of the installation being earthed independently or collectively to the earthing system. 		N
7.3.7.1.4	Insulation voltages	See table 7.3.7.4 and 7.3.7.5 for detail	P
	Table 12 makes use of the circuit system voltage and overvoltage category to define the impulse withstand voltage and the temporary overvoltage.		P
7.3.7.2	Insulation between a circuit and its surroundings		P
7.3.7.2.1	General Basic, supplementary and reinforced insulation between a circuit and its surroundings shall be designed according to: Impulse voltage; temporary overvoltage;	48V, (500 V impulse voltage, no temporary overvoltage) for the DC output terminal and 55V, OVC II (2500 V impulse voltage, no temporary	P

	working voltage of the circuit;	overvoltage) for the PV input terminal	
7.3.7.2.2	<p>Circuit connected directly to the mains</p> <p>Clearance and solid insulation between circuit connected directly to the mains and their surroundings shall be designed according to the impulse voltage, temporary overvoltage, or working voltage, whichever gives the most severe requirement</p>		N
7.3.7.2.3	<p>Circuit other than mains circuit</p> <p>Clearance and solid insulation between circuit other than the mains and their surroundings shall be designed according to impulse voltage and recurring peak voltage</p>		N
7.3.7.2.4	<p>Insulation between circuits</p> <p>a) For clearances and insulation, the requirements are determined by the circuit having the higher impulse voltage;</p> <p>b) For creepages, r.m.s. working voltage across the insulation determines the requirements.</p>	The PV circuit isolated from the grid is considered overvoltage OVC II, but the minimum pulse voltage should be 2500V, and the system voltage should take the maximum rated PV open circuit voltage 100V.	P
7.3.7.3	<p>Functional insulation</p> <p>For parts or circuit in OVC I, functional insulation shall be designed according to the working voltage across the insulation</p> <p>For parts or circuit in OVC III, functional insulation shall be designed according to the applicable impulse voltage as determined by 7.3.7.1.4</p>		P
7.3.7.4	Clearance distances		P
7.3.7.4.1	<p>Determination</p> <p>Table 13 defines the minimum clearance distances required to provide functional, basic, or supplementary insulation</p>		P
	<p>Clearance for use in altitudes above 2000 m shall be calculated with correction factor according to Table A.2 of IEC 60664-1</p>		P
	<p>For reinforced insulation, the value corresponding to the next higher impulse voltage, or 1.6 times the temporary overvoltage, or 1.6 times the working voltage shall be used, whichever results in the most severe requirement</p>		P
7.3.7.4.2	<p>Electric field homogeneity</p> <p>For homogeneous electric field and impulse voltage is equal to or greater than 6000V for a circuit connected directly to the mains or 4000V within a circuit, the clearance may be reduced to the requirement by Table F.2 Case B of IEC</p>	Inhomogeneous electric field is considered for PCE	N

	60664-1. In this case, im- pulse voltage test shall be performed on the clear- ance		
7.3.7.4.3	Clearance to conductive enclosures Clearance shall be measured following the deformation test of 13.7 for conductive enclosures		P
7.3.7.5	Creeage distances		P
7.3.7.5.1	General Creepage distances shall be large enough to pre- vent long-term degradation of the surface of solid insulators. For reinforced insulation, the value is doubled. If less than clearance, it shall be increased to that clearance	PV Maximum 150V system voltage is used for the RMS voltage across insulation	P
7.3.7.5.2	Voltage r.m.s. value of working voltage is used. In- terpolation is permitted		P
7.3.7.5.3	Materials	Certified PWB used. Other ma- terial are considered IIIb The inside parts are considered pol- lution degree 2	P
7.3.7.6	Coating	No coating provided insulation	N
7.3.7.7	PWB spacings for functional insulation		P
7.3.7.8	Solid insulation		P
7.3.7.8.1	General Material for solid insulation shall be able to withstand mechanical, electrical, thermal and climatic stresses in normal use and ageing during the expected life- time. Compliance is evaluated by test and inspection.		P
7.3.7.8.2	Requirements for electrical withstand capability of solid insulation		P
7.3.7.8.2.1	Basic and supplementary, reinforced, and double in- sulation. Solid insulation shall withstand the impulse voltage test 7.5.1 and voltage test 7.5.2.		P
	In addition, if recurring peak working voltage across the insulation is greater than 700 V and voltage stress on insulation is greater than 1kV/mm, double and reinforced insulation shall withstand the partial discharge test according to 7.5.3		N
7.3.7.8.2.2	Functional insulation		N
7.3.7.8.3	Thin sheet or tape material		P
7.3.7.8.3.1	General Insulation of thin sheet or tape less than 0,7 mm is subject to this requirement		P
7.3.7.8.3.2	Material thickness not less than 0,2 mm		P

	Basic or supplementary insulation shall consist of at least one layer of material, and shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic or supplementary insulation.		P
	Double insulation shall consist of at least two layers of material. Each layer shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic insulation, and the partial discharge requirements of 7.3.7.8.2.1. The two or more layers together shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for double insulation.		P
	Reinforced insulation shall consist of a single layer of material, which will meet the impulse, a.c. or d.c. voltage, and partial discharge test requirements 7.3.7.8.2.1 for reinforced insulation.		P
7.3.7.8.3.3	Material thickness less than 0,2 mm		N
	Basic or supplementary insulation shall consist of at least one layer of material, and shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic or supplementary insulation.		N
	Double insulation shall consist of at least three layers of material. Each layer shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic insulation any two layers together shall meet the impulse, a.c. or d.c. voltage, and partial discharge test requirements of 7.3.7.8.2.1 for double insulation.		N
	Reinforced insulation consisting of a single layer of material less than 0,2 mm thick is not permitted.		N
7.3.7.8.3.4	Compliance Component, sub-assembly, or material is checked by applicable tests 7.5.1 to 7.5.3 according to 7.3.7.8.		P
7.3.7.8.4	Printed wiring boards (PWBs)		P
7.3.7.8.4.1	General Insulation between conductor layers in double-sided single-layer PWBs, multi-layer PWBs and metal core PWBs, shall meet the requirements for solid insulation in 7.3.7.8.		P
	For the inner layers of multi-layer PWBs, the insulation between adjacent tracks on the same layer shall be treated as either:		P

	a creepage distance for pollution degree 1 and a clearance as in air (see Annex A, figure A.13); or		P
	as solid insulation, in which case it shall meet the requirements of 7.3.7.8.		P
7.3.7.8.4.2	Use of coating materials		N
7.3.7.8.5	Wound components		P
	Varnish or enamel insulation of wires shall not be used for basic, supplementary, double or reinforced insulation.	Varnish are not considered as insulation and voltage test performed as routine test. See also Cl.7.3.7.8.1 to Cl.7.3.7.8.2	P
	Wound components shall meet the requirements of 7.3.7.8.1 and 7.3.7.8.2.	Triple insulation wire used	P
	The component itself shall pass the requirements given in 7.3.7.8.1 and 7.3.7.8.2. If the component has reinforced or double insulation, the voltage test in 7.5.2 shall be performed as a routine test.		P
7.3.7.8.6	Potting materials		N
	A potting material may be used to provide solid insulation or to act as a coating to protect against pollution. If used as solid insulation, it shall comply with the requirements of 7.3.7.8.1 and 7.3.7.8.2. If used to protect against pollution, the requirements for Type 1 protection in 7.3.7.8.4.2 apply.	Potting materials used in boost inductor and filter inductor was not intended to provide solid insulation or to act a coating to protect against pollution.	N
7.3.7.9	Insulation requirements above 30 kHz		P
	Where voltages across insulation have fundamental frequencies greater than 30 kHz, further considerations apply. Requirements for this are provided in IEC 60664-4, and the more severe of these and the requirements of 7.3.7.1 to 7.3.7.8 shall be applied.		N
	Annex G contains flow-charts for the determination of clearance and creepage distances under these circumstances. For convenience, Tables 1 and 2 of IEC 60664-4 are also included in Annex G.		N
7.3.8	Residual Current-operated protective (RCD) or monitoring (RCM) device compatibility	Internal RCM is used. An external built RCD is not necessary	P
	RCD and RCM are used to provide protection against insulation faults in some domestic and industrial installations, additional to that provided by the installed equipment.		N
7.3.9	Capacitor discharge		P
7.3.9.1	Operator access area	Internal RCM is used. An external built RCD is not necessary	P

	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 removable for servicing, installation, or disconnection shall present no risk of electric shock or energy hazard from charge stored on capacitors after disconnection of the PCE.		P
	For energy storage devices (such as batteries or ultracapacitors) the intended function of which is to maintain charge even with the PCE off and disconnected from external sources, a barrier or insulation shall be provided so that unintentional contact with hazardous live parts is prevented. The warning symbol 21 of Annex C shall be placed in a clearly visible position on or adjacent to the barrier or insulation, where it will be seen before removal of the barrier or insulation.	Warning symbol 21 of Annex C is marked on PCE	P
7.4	Protection against energy hazards		P
7.4.1	Determination of hazardous energy level		P
	A hazardous energy level is considered to exist if	Condition b is considered	P
7.4.2	Operator Access Areas	No energized parts accessible by user	P
	Equipment shall be so designed that there is no risk of energy hazard in operator access areas from accessible circuits.		P
7.4.3	Services Access Areas		P
	Energy storage devices located behind panels that are removable for servicing, installation or disconnection shall present no risk of electric energy hazard from charge stored after disconnection of the PCE.		P
	Energy storage devices within a PCE shall be discharged to an energy level less than 20 J, as in 7.4.1, within 10 s after the removal of power from the PCE.	Warning symbol 21 of Annex C is marked	P
7.5	Electrical tests related to shock hazard		P
7.5.1	Impulse voltage test(type test)		P
	The impulse voltage test is performed with a voltage having a 1.2/50 μ s waveform(see Figure 6 of IEC 60060-1) and is intended to simulate overvoltages induced by lightning or due to switching of equipment. See Table 15 for conditions of the impulse voltage test.		P
	Tests on clearances smaller than required by Table 13(as allowed by 7.3.7.4.2) and on solid		P

	insulation are performed as type tests using appropriate voltages from Table 16.		
	Tests on components and devices for protective separation are performed as atype test before they are assembled into the PCE, unless the test can be performed on the completed PCE without reducing the stress applied to the protective separation. Testing is performed using the impulse withstand voltages listed in column 3 or column 5 of Table 16.		P
7.5.2	Voltage test (dielectric strength test) (type test and routine test)		P
7.5.2,1	Purpose of test		P
7.5.2.2	Value and type of test voltage		P
	The value of the test voltage are determined from column 2 or 3 of Table 17 or Table 18 depending upon whether the circuit under test is mains connected or not mains connected.		P
	The test voltage from column 2 is used for testing circuits with basic insulation.		P
	Between circuits with protective separation (double or reinforced insulation), the test voltage of column 3 shall be applied for type tests. For routine tests between circuits with protective separation the value from column 2 shall be applied, to prevent damage to the solid insulation due to causing partial discharge within the solid insulation.		P
	The values of column 3 shall apply to circuit with protective separation, and between circuits and accessible surfaces of PCE, which are non-conductive or conductive but not connected to the protective earthing conductor.		P
	The voltage test shall be performed with a sinusoidal voltage at 50 Hz or 60 Hz. If the circuit contains capacitors the test may be performed with a d.c. voltage of a voltage of a value equal to the peak value of the specified a.c. voltage.		P
7.5.2.3	Humidity pre-conditioning		P
	For type tests on PCE for which wet locations requirements apply, according to 6.1, the humidity pre-conditioning of 4.5 shall be performed immediately prior to the voltage test.		P
7.5.2.4	Performing the voltage test		P
7.5.2.5	Duration of the a.c. or d.c. voltage test		P
	The duration of the test shall be at least 60s for the type test and 1 s for the routine test. The test voltage may be applied with increasing and/or decreasing ramp voltage, and the ramp times are not specified, but regardless of the ramp		P

	time, the dwell time at full voltage shall be 60s and 1 s respectively for type and routine tests.		
7.5.2.6	Verification of the a.c. or d.c. voltage test		P
	The test is successfully passed if no electrical breakdown occurs and there is no abnormal current flow during the test.		P
7.5.3	Partial discharge test (type test or sample test)		P
	Where required by 7.3.7.8.2, the partial discharge test shall confirm that the solid insulation used within devices applied for protective separation of electrical circuits remains partial-discharge-free within the specified voltage range (see Table 19)		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 touch current is 2.5mA	P
	For type tests on PCE for which wet locations requirements apply according to 6.1, the humidity pre-conditioning of 4.5 shall be performed immediately prior to the touch current test.		P
7.5.5	Equipment with multiple sources of supply		N
8	Protection against mechanical Hazards		P
8.1	General		P
	Operation shall not lead to a mechanical Edges, projections, corners, openings, guards, handles and the like, that are accessible to the operator shall be smooth and rounded so as not to cause injury during normal use of the equipment.		P
	Conformity is checked as specified in 8.2 to 8.6.		P
8.2	Moving parts		N
	Moving parts shall not be able to crush, cut or pierce parts of the body of an OPERATOR likely to contact them, nor severely pinch the OPERATOR's skin. Hazardous moving parts of equipment, that is moving parts which have the potential to cause injury, shall be so arranged, enclosed or guarded as to provide adequate protection against the risk of personal injury.		N
8.2.1	Protection of service persons		N
	Protection shall be provided such that unintentional contact with hazardous moving parts is unlikely during servicing operations. If a		N

	guard over a hazardous moving part may need to be removed for servicing, the marking of symbol 15 of Table D-1 shall be applied on or near the guard.		
8.3	Stability		N
	Equipment and assemblies of equipment not secured to the building structure before operation shall be physically stable in NORMAL USE.	Wall mounted	N
8.4	Provisions for lifting and carrying		P
	If carrying handles or grips are fitted to, or supplied with, the equipment, they shall be capable of withstanding a force of four times the weight of the equipment.		P
	Equipment or parts having a mass of 18 kg or more shall be provided with a means for lifting and carrying or directions shall be given in the manufacturer's documentation.		N
8.5	Wall mounting		P
	Mounting brackets on equipment intended to be mounted on a wall or ceiling shall withstand a force of four times the weight of the equipment.	It is intended to be mounted on concrete wall	P
8.6	Expelled parts		N
	Equipment shall contain or limit the energy of parts that could cause a HAZARD if expelled in the event of a fault.		N
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.	Components are witnessed at normal condition and abnormal tests are verified	P
9.1.1	Reducing the risk of ignition and spread of flame		P
	For equipment or a portion of equipment, there are two alternative methods of providing protection against ignition and spread of flame that could affect materials, wiring, wound components and electronic components such as integrated circuits, transistors, thyristors, diodes, resistors and capacitors.	Method 1 used	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		P

	risk of ignition and, therefore, require a FIRE ENCLOSURE:		
	- components in PRIMARY CIRCUITS		P
	- components in SECONDARY CIRCUITS supplied by power sources which exceed the limits for a LIMITED POWER SOURCE as specified in 9.2;		P
	- components in SECONDARY CIRCUITS supplied by a LIMITED POWER SOURCE as specified in 9.2, but not mounted on a material of FLAMMABILITY CLASS V-1;		N
	- components within a power supply unit or assembly having a limited power output complying with the criteria for a LIMITED POWER SOURCE as specified in 9.2, including overcurrent protective devices, limiting impedances, regulating networks and wiring, up to the point where the LIMITED POWER SOURCE output criteria are met;		P
	- components having unenclosed arcing parts, such as open switch and relay contacts and commutators, in a circuit at HAZARDOUS VOLTAGE or at a HAZARDOUS ENERGY LEVEL; and		N
	- insulated wiring, except as permitted in 9.1.2.2.	PVC wire	N
9.1.2.2	Parts not requiring a fire enclosure	Fire enclosure used	N
9.1.3	Materials requirements for protection against fire hazard		P
9.1.3.1	General		P
	ENCLOSURES, components and other parts shall be so constructed, or shall make use of such materials, that the propagation of fire is limited.		P
9.1.3.2	Materials for fire enclosures		P
	If an enclosure material is not classified as specified below, a test may be performed on the final enclosure or part of the enclosure, in which case the material shall additionally be subjected to periodic SAMPLE testing.		P
9.1.3.3	Materials for components and other parts outside fire enclosures	At least V-1 material used inside fire enclosure, PCB rated V-0 and internal wire rated VW-1	P
	Except as otherwise noted below, materials for components and other parts (including MECHANICAL ENCLOSURES, ELECTRICAL ENCLOSURES and DECORATIVE PARTS); located outside FIRE ENCLOSURES, shall be of FLAMMABILITY CLASS HB.		N
9.1.3.4	Materials for components and other parts inside fire enclosures		N

9.1.3.5	Materials for air filter assemblies		N
9.1.4	Openings in fire enclosures		N
9.1.4.1	General		N
	For equipment that is intended to be used or installed in more than one orientation as specified in the product documentation, the following requirements apply in each orientation.		N
	These requirements are in addition to those in the following sections:		N
	- 7.3.4, Protection against direct contact;		N
	- 7.4, Protection against energy hazards;		N
	- 13.5, Openings in enclosures		N
9.1.4.2	Side openings treated as bottom openings		N
9.1.4.3	Openings in the bottom of a fire enclosure	No openings	N
	The bottom of a FIRE ENCLOSURE or individual barriers, shall provide protection against emission of flaming or molten material under all internal parts, including partially enclosed components or assemblies, for which Method 2 of 9.1.1 has not been fully applied and complied with.		N
9.1.4.4	Equipment for use in a CLOSED ELECTRICAL OPERATING AREA	Not intend use at this area	N
	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
	WARNING: FIRE HAZARD SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY		N
9.1.4.5	Doors or covers in fire enclosures	No door or cover operated by user	N
9.1.4.6	Additional requirements for openings in transportable equipment		N
9.2	LIMITED POWER SOURCES		N
9.2.1	General		N
9.2.2	Limited power source tests		N
9.3	Short-circuit and overcurrent protection		P
9.3.1	General		P
	The PCE shall not present a hazard, under short-circuit or overcurrent conditions at any port, including phase-to-phase, phase-to-earth and phase-to-neutral, and adequate information shall		P

	be provided to allow proper selection of external wiring and external protective devices.		
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.		P
9.3.3	Protective devices provided or specified shall have adequate breaking capacity to interrupt the maximum short circuit current specified for the port to which they are connected. If protection that is provided integral to the PCE for an input port is not rated for the short-circuit current of the circuit in which it is used, the installation instructions shall specify that an upstream protective device, rated for the prospective short-circuit current of that port, shall be used to provide backup protection.		N
10 Protection Against Sonic Pressure Hazards			
10	Protection Against Sonic Pressure Hazards		P
10.1	General		P
	The equipment shall provide protection against the effect of sonic pressure. Conformity tests are carried out if the equipment is likely to cause such HAZARDS.	< 45 dBA	P
10.2	Sonic pressure and Sound level		N
10.2.1	Hazardous Noise Levels		N
11 Protection Against Liquid Hazards			
11	Protection Against Liquid Hazards		N
11.1	Liquid Containment, Pressure and Leakage		N
	The liquid containment system components shall be compatible with the liquid to be used.		N
	There shall be no leakage of liquid onto live parts as a result of:		N
	Normal operation, including condensation;		N
	Servicing of the equipment; or		N
	Inadvertent loosening or detachment of hoses or other cooling system parts over time.		N
11.2	Fluid pressure and leakage		N
11.2.1	Maximum pressure		N
11.2.2	Leakage from parts		N
11.2.3	Overpressure safety device		N
11.3	Oil and grease		N

12	Chemical Hazards		N
12.1	General		N
13	Physical Requirements		P
13.1	Handles and manual controls		N
	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.		N
13.1.1	Adjustable controls		N
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		N
13.3.2.1	General		N
	For safe and reliable connection to a MAINS supply, equipment shall be provided with one of the following:		N
	- terminals or leads or a non-detachable power supply cord for permanent connection to the supply; or		N
	- a non-detachable power supply cord for connection to the supply by means of a plug		N
	- an appliance inlet for connection of a detachable power supply cord; or		N
	- a mains plug that is part of direct plug-in equipment as in 13.3.8		N
13.3.2.2	Permanently connected equipment		N
13.3.2.3	Appliance inlets		N
13.3.2.4	Power supply cord		N
13.3.2.5	Cord anchorages and strain relief		N
	For equipment with a non-detachable power supply cord, a cord anchorage shall be supplied such that:		N
	- the connecting points of the cord conductors are relieved from strain; and		N

	- the outer covering of the cord is protected from abrasion.		N
13.3.2.6	Protection against mechanical damage		N
13.3.3	Wiring terminals for connection of external conductors		P
13.3.3.1	Wiring terminals		P
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		N
13.3.5	Wire bending space for wires 10 mm ² and greater		N
13.3.6	Disconnection from supply sources		P
13.3.7	Connectors, plugs and sockets		N
13.3.8	Direct plug-in equipment		N
13.4	Internal wiring and connections		P
13.4.1	General		P
13.4.2	Routing	Internal wires are routed to avoid sharp edges and overheating.	P
13.4.3	Colour coding	Green-yellow wire used as protective bonding only	P
13.4.4	Splices and connections		P
13.4.5	Interconnections between parts of the PCE		N
13.5	Openings in enclosures		N
13.5.1	Top and side openings	No openings	N
	Openings in the top and sides of ENCLOSURES shall be so located or constructed that it is unlikely that objects will enter the openings and create hazards by contacting bare conductive parts.		N
13.6	Polymeric Materials		P
13.6.1	General		P
13.6.1.1	Thermal index or capability		P
13.6.2	Polymers serving as enclosures or barriers preventing access to hazards	Polymers serving as barriers preventing access to hazards	P
13.6.2.1	Stress relief test	For top enclosure and LCD cover	P

13.6.3	Polymers serving as solid insulation		P
13.6.3.1	Resistance to arcing		N
13.6.4	UV resistance		P
	Polymeric parts of an OUTDOOR ENCLOSURE required for compliance with this standard shall be sufficiently resistance to degradation by ultra-violet (UV) radiation	Top enclosure and LCD cover tested with appliance according to UV resistance. For other outdoor use polymeric parts material, UL approved.	P
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	Top enclosure, fan guard and LCD cover are all tested at lowest temperature -35 °C	P
13.7.4	Drop test		N
13.8	Thickness requirements for metal enclosures		P
13.8.1	General		P
13.8.2	Cast metal	Thickness >2,5 mm	P
13.8.3	Sheet metal		N
14	Components		P
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 requirements of the component standard is not required. If necessary for the application, components shall be subjected to the test of this standard, except that it is not necessary to carry out identical or equivalent tests already performed to check conformity with the component standard;		P
	b) the requirements of this standard and, where necessary for the application, any additional applicable safety requirements of the relevant IEC component standard;		P
	c) if there is no relevant IEC standard, the requirements of this standard;		P
d) applicable safety requirements of a non-IEC standard which are at least as high as those of the applicable IEC standard, provided that the		P	

	component has been approved to the non-IEC standard by a recognized testing authority.		
	Components such as optocouplers, capacitors, transformers, and relays connected across basic, supplemental, reinforced, or double insulation shall comply with the requirements applicable for the grade of insulation being bridged, and if not previously certified to the applicable component safety standard shall be subjected to the voltage test of 7.5.2 as routine test.		P
14.2	Motor Overtemperature Protection		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 requirements of 14.3.		N
14.3	Overtemperature protection devices		N
14.4	Fuse holders		N
14.5	MAINS voltage selecting devices		N
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	P
	This requirements does not apply to thin-film flexible printed circuit boards that contain only circuits powered from limited power sources meeting the requirements of 9.2.		N
	Conformity of the flammability RATING is checked by inspection of data on the materials. Alternatively, conformity is checked by performing the V-1 tests specified in IEC 60707 on three samples of the relevant parts.		N
14.7	Circuits or components used as transient overvoltage limiting devices		P
	If control of transient overvoltage is employed in the equipment, any overvoltage limiting component or circuit shall be tested with the applicable impulse withstand voltage of Table 7-10 using the test method from 7.5.1 except 10 positive and 10 negative impulses are to be applied and may be spaced up to 1 min apart.		P
14.8	Batteries		N
	Equipment containing batteries shall be designed to reduce the risk of fire, explosion and chemical leaks under normal conditions and after		N

	a single fault in the equipment including a fault in circuitry within the equipment battery pack.		
14.8.1	Battery Enclosure Ventilation		N
14.8.1.1	Ventilation requirements		N
14.8.1.2	Ventilation testing		N
14.8.1.3	Ventilation instructions		N
14.8.2	Battery Mounting		N
	Compliance is verified by the application of the force to the battery's mounting surface. The test force is to be increased gradually so as to reach the required value in 5 to 10 s, and is to be maintained at that value for 1 min. A nonmetallic rack or tray shall be tested at the highest normal condition operating temperature.		N
14.8.3	Electrolyte spillage		N
	Battery trays and cabinets shall have an electrolyte-resistant coating.		N
	The ENCLOSURE or compartment housing a VENTED BATTERY shall be constructed so that spillage or leakage of the electrolyte from one battery will be contained within the ENCLOSURE and be prevented from:		N
	a) reaching the PCE outer surfaces that can be contacted by the USER		N
	b) contaminating adjacent electrical components or materials; and		N
	c) bridging required electrical distances		N
14.8.4	Battery Connections		N
	Reverse battery connection of the terminals shall be prevented if reverse connection could result in a hazard within the meaning of this Standard		N
14.8.5	Battery maintenance instructions		N
	The information and instructions listed in 5.3.4.1 shall be included in the operator manual for equipment in which battery maintenance is performed by the operator, or in the service manual if battery maintenance is to be performed by service personnel only.		N
14.8.6	Battery accessibility and maintainability		N
	Battery terminals and connectors shall be accessible for maintenance with the correct TOOLS. Batteries with liquid electrolyte, requiring maintained shall be so located that the battery cell caps are accessible for electrolyte tests and readjusting of electrolyte levels.		N
15	Software and firmware performing safety functions	Refer to annex B for details	P

Annex A	Measurement of clearances and creepage distances (see 7.3.7.4 and 7.3.7.5)		P
Annex B	Programmable Equipment		P
B.1	Software or firmware that perform safety critical functions		P
B.1.1	Firmware or software that performs a critical safety function/s, the failure of which can result in a risk of fire, electric shock or other hazard as specified by this standard, shall be evaluated by one of the following means.		P
	a) All software or firmware limits or controls shall be disabled before the test to evaluate the hardware circuitry during the abnormal test condition related to the safety function.		N
	b) Protective controls employing software or firmware to perform their function(s), shall be so constructed that they comply with IEC 60730-1 Annex H to address the risks identified in B.2.1.	See functional safety evaluation report.	P
B.2	Evaluation of controls employing software		P
Annex C	Symbols to be used in equipment markings		P
Annex D	Test Probes for Determining Access		P
Annex E	RCDs		P
Annex F	Altitude correction for clearances		P
Annex G	Clearance and creepage distance determination for frequencies greater than 30 kHz	Only clock for IC	P
Annex H	Measuring Instrument for Touch Current Measurements		P
H.1	Measuring instrument		P
H.2	Alternative measuring instrument		N
Annex I	Examples of Protection, Insulation, and Overvoltage Category Requirements for PCE		P

Annex J	Ultraviolet light conditioning test	LCD cover tested with appliance according to UV resistance. For other outdoor use polymeric parts material, UL approved.	P
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4.3	TABLE: heating temperature rise measurements					P
	test voltage (V) Input Voltage	17VDC	36VDC	--	—	
	t1 (°C) the initial ambient temperature...	45.0°C	45.0°C	--	—	
	t2 (°C) the end ambient temperature	45.1°C	45.1°C	--	—	
Maximum measured temperature T of part/at::		T (°C)			Permitted T _{max} (°C)	
Model: MD1250N05						
1	Varistor	56.5	57.6	--	85	
2	External Enclosure	42.8	46.1		Ref.	
3	Internal enclosure near to the Transformer T1	43.6	46.8		Ref.	
4	Capacitor C5	45.4	48.8	--	65	
5	Capacitor C60	44.7	48.5	--	65	
6	MOSFET Q2	74.7	75.4	--	150	
7	MOSFET Q1	77	77.7	--	150	
8	MOSFET Q3	75.9	76.2	--	150	
9	E-Cap.	64.1	67	--	105	
10	DIODE Module	72.1	74.8	--	110	
11	PCB	66.8	72.2	--	105	
12	Input connector	59.3	59.9	--	85	
13	Input wire	58.3	58.4	--	105	
14	output connector	50.4	54.7	--	85	
15	output wire	50.8	55.6	--	105	
16	LED screen	53.8	58	--	90	
17	Plastic buttons	46.1	47.8	--	60	
18	Plastic enclosure	45.5	47.2	--	60	
19	Ambient	45.0	45.0	--	--	
Supplementary information: Tests of equipment rated for use in ambient temperatures up to 45 °C may be conducted at any ambient temperature in the range given in 4.2.2.1. PCE rated for use in ambient temperatures more than 45 °C shall be tested at the maximum rated ambient temperature ± 5 °C						

4.4	TABLE: fault condition tests			P
	Ambient temperature (°C)	See below.		—

No.	Component no.	Fault	Test voltage (V)	Test time	Fuse no.	Fuse current (A)	Result
1	Output	Short circuit	55Vdc	5S	—	—	EUT shut down immediately. No hazards.
2	Ventilation hole	Blocked	55Vdc	350min	—	—	EUT work normally, no hazard.
3	All fans	Blocked	55Vdc	35min	—	—	After 20mins,EUT worked at lower power. No hazards.
4	Output	Overload	55Vdc	4h	—	—	EUT limit output power by software overload is impossible.

7.3.7	TABLE: clearance and creepage distance measurements						P
clearance cl and creepage distance dcr at / of:	U r.m.s. (V)	U impulse (V)	required cl (mm)	cl (mm)	required dcr (mm)	dcr (mm)	
PV circuit to Ground	55Vdc	2500V	3.0	>3.0	3.0	>3.0	
PV circuit to non-earth accessible	55Vdc	2500V	3.0	>3.0	3.0	>3.0	
PV circuit to SELV circuit	55Vdc	2500V	3.0	>3.0	3.0	>3.0	

Supplementary information:

- For PV circuit, system voltage is 55V and overvoltage category is OVC II, impulse voltage correspond to PV circuit is 2500 V;
- The PV circuit isolated from the grid is considered overvoltage OVC II, but the minimum pulse voltage should be 2500V, and the system voltage should take the maximum rated PV open circuit voltage;
- The disconnection devices are two relays, clearance between contacts of each relay rated min.4 mm. Each relay with two contact gaps together to withstand the PV impulse voltage according to IEC 62109-2 Clause 4.4.4.15.2.2. Thus the clearance requirement for each contact is half of the requirement.

7.3.7.8.3.2 to 7.3.7.8.3.3	TABLE: distance through insulation measurement				P
distance through insulation di at/of:	U r.m.s. (V)	test voltage (V)	required di (mm)	di (mm)	
Triple insulation wire of transformer winding	55V	2500 Vpeak	--	Certified	
Communication isolated optocoupler	55V	2500 Vpeak	--	Certified	

7.5	TABLE: electric strength measurements, impulse voltage test and partial discharge test			P
test voltage applied between:	test voltage (V)	impulse withstand voltage (V)	partial discharge extinction voltage (V)	result
DC circuit to Ground	800Vac	2500V	N/A	No breakdown
DC circuit to non-earth accessible part	800Vac	2500V	N/A	No breakdown
DC circuit to SELV circuit	800Vac	2500V	N/A	No breakdown
PV circuit to Ground	800Vac	2500V	N/A	No breakdown
PV circuit to non-earth accessible part	800Vac	2500V	N/A	No breakdown
PV circuit to SELV circuit	800Vac	2500V	N/A	No breakdown

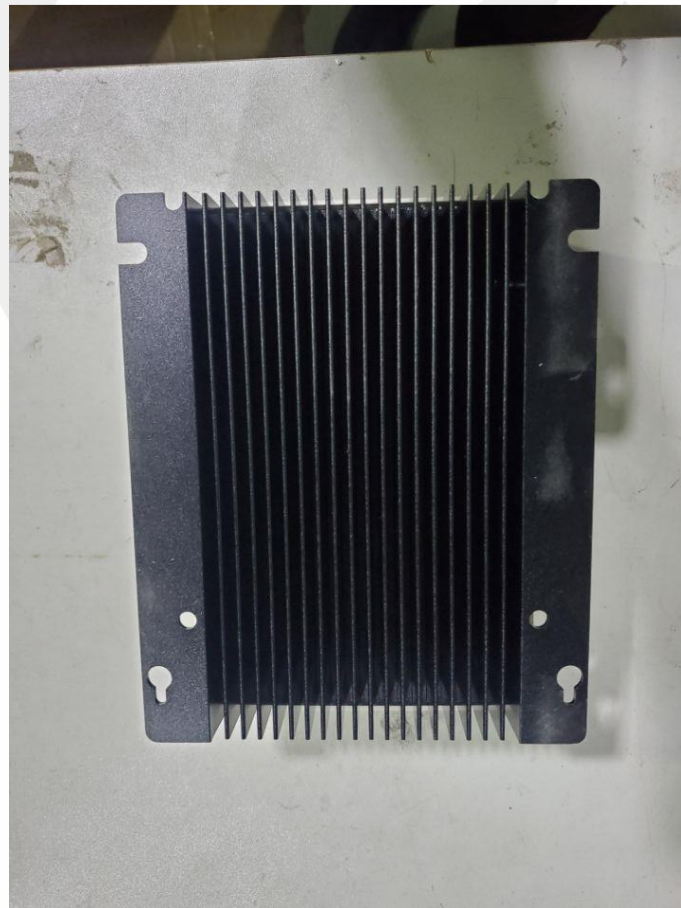
14	TABLE: list of critical components				P
Critical Components Material: e.g. external enclosure, PCB, closed-end connector, sleeves, cord anchorage etc Components with winding: e.g. motor, transformer, magnetic coil etc. Other components: e.g. switch, thermostat, heater, plug, internal wire, capacitor, relay, varistor etc.					
Object/part No.	Manufacturer/trademark	Type/ model	Technical data	Standard	Mark(s) of conformity
Display panel cover	FORMOSA CHEMICALS & FIBRE CORP PLASTICS DIV	AC310(+)	5VA, 90°C, Thickness: 3.0mm	ANSI/UL 94	E162823
Upper enclosure	FORMOSA CHEMICALS & FIBRE CORP PLASTICS DIV	AC310(+)	5VA, 90°C, Thickness: 3.0mm	ANSI/UL 94	E162823
Silicon sheet	Shenzhen 3KS Electronic Materials Co. LTD	3KS	V-0, 105°C, Thickness: 3mm	ANSI/UL 94	E499942
Terminal	NINGBO DEGSON ELECTRICAL CO LTD	DG137T-15.0	600V/115A, PA66, V-0, 105°C	ANSI/UL 1059	E228872
Inductance L4, L5	Shenzhen Jin Yitai Xin Electronic CO., LTD	PQ3225	15uH		
Wire	Guangdong Jinyan Electrotechnics Joint Stock Co Ltd	xEIW	180 °C	ANSI/UL 1446	E238500
PCB	Shenzhen Longteng Circuit Technology Co. LTD	LTM08	V-0, 130°C, Thickness: 1.6mm	ANSI/UL 796	E467745

Alternative PCB	Various	Various	V-0, 130°C, Thickness: 1.6mm	ANSI/UL 796	UL
Fuse	ADLER ELEKTROTECH NIK LEIPZIG GMBH	BF2230030 0	30A/32V	UL 248-14	E499007
Alternative Fuse	Various	Various	30A/32V	UL 248-14	UL



Pictures







*** End of Report ***

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