中国认可
国际互认
检测
TESTING
CNAS L4595

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

| | |
|---|---|
| **Report Number.....:** | LCSA03274042S |
| **Date of issue.....:** | 2024-05-06 |
| **Total number of pages .....** | 52 |
| **Name of Testing Laboratory preparing the Report .....:** | Shenzhen LCS Compliance Testing Laboratory Ltd. |
| **Applicant's name .....:** | Shenzhen Depowersupply Electrical Co.,Ltd |
| **Address.....:** | Building A4, Zone B, Songbai Industrial Park, Gongming Street, Guangming area, Shenzhen, China |
| **Test specification:** | |
| **Standard .....:** | IEC 62109-1:2010 |
| **Test procedure .....:** | Type test |
| **Non-standard test method .....:** | N/A |
| **Test Report Form No. .....:** | IEC62109_1 |
| **Test Report Form(s) Originator ....:** | VDE Testing and Certification Institute |
| **Master TRF .....:** | Dated 2022-10 |

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LCS TESTING APPR

| | |
|---|---|
| **Test item description..... :** | Solar Charge Controller With Step-up LED Driver |
| **Trade Mark..... :** | N/A |
| **Manufacturer ..... :** | Same as applicant |
| **Model/Type reference ..... :** | M2415, M2410, M1280, P1230, P1240, P2410, P2410S, P1230A, P1240A |
| **Ratings..... :** | See rating Labelling for details |

**Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):**

| | | | |
|---|---|---|---|
| ☒ | **Testing Laboratory:** | Shenzhen LCS compliance testing laboratory Ltd. | |
| **Testing location/ address .....:** | | Room 101, 201, Building A and Room 301, Building C, Juji Industrial Park, Yabianxueziwei, Shajing Street, Bao'an District, Shenzhen, Guangdong, China | |
| **Prepared by.....:** | | Terry Zhu<br>Project Handler | |
| **Checked by.....:** | | Benson Kuai<br>Reviewer | |
| **Approved by.....:** | | Hart Qiu<br>Technical Director | |

| | |
|---|---|
| **List of Attachments (including a total number of pages in each attachment):**<br>- Attachment No.1: Photo documentation | |
| **Summary of testing:** | |
| **Tests performed (name of test and test clause):**<br>**Electrical safety:**<br>➢ IEC 62109-1:2010; | **Testing location:**<br>Shenzhen LCS Compliance Testing Laboratory Ltd.<br>Room 101, 201, Building A and Room 301, Building C, Juji Industrial Park, Yabianxueziwei, Shajing Street, Bao'an District, Shenzhen, Guangdong, China |
| **Summary of compliance with National Differences (List of countries addressed):**<br><br>N/A | |

**Copy of marking plate:**

**The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.**

**Solar Charge Controller With Step-up LED Driver**

**Model: M2415**

**PV Input: Vmax PV(Vdc) :55V**

**DC output voltage range(Vdc): 16-55V(12V)；32-55V(24V);**
**Max cont. Input Current : 4A**
**Max cont. Power : 120W(12V);200W(24V)**

**Battery: 12V/24V**

**Others**
**Ingress protection (IP) : IP67**
**Protective class : Class III**
**Temperature : -35℃ to 60℃**
Overvoltage category : OVC II

**Made In China**

Notes:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.

| | |
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| **Test item particulars.....:** | |
| **Equipment mobility .....:** | ☐ movable ☐ hand-held ☐ stationary<br>☒ fixed ☐ transportable ☐ for building-in |
| **Connection to the mains .....:** | ☐ pluggable equipment ☐ direct plug-in<br>☒ permanent connection ☐ for building-in |
| **Environmental category .....:** | ☐ outdoor ☒ indoor unconditional ☐ indoor conditional |
| **Over voltage category Mains .....:** | ☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV |
| **Over voltage category PV.....:** | ☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV |
| **Mains supply tolerance (%).....:** | According to the specified supply range. |
| **Tested for power systems.....:** | ☐ TN ☐ TT ☐ IT - _ $V_{L-L}$ ☐ dc mains<br>☒ N/A |
| **IT testing, phase-phase voltage (V).....:** | -- |
| **Class of equipment.....:** | ☐ Class I ☐ Class II ☒ Class III<br>☐ Not classified |
| **Mass of equipment (kg) .....:** | 0.46 max |
| **Pollution degree.....:** | 3 (internal reduced to PD2) |
| **IP protection class.....:** | IP67 |
| **.....:** | |
| **Possible test case verdicts:** | |
| **- test case does not apply to the test object.....:** | N |
| **- test object does meet the requirement.....:** | P (Pass) |
| **- test object was not evaluated for the requirement .....:** | N/E |
| **- test object does not meet the requirement.....:** | F (Fail) |
| **Testing.....:** | |
| **Date of receipt of test item .....:** | 2024-03-27 |
| **Date (s) of performance of tests.....:** | From 2024-03-27 to 2024-04-25 |

| **General remarks:** | |
|---|---|
| "(See Enclosure #)" refers to additional information appended to the report.<br>"(See appended table)" refers to a table appended to the report.<br><br>**Throughout this report a ☐ comma / ☒ point is used as the decimal separator.** | |
| **Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:** | |
| The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... : | ☐ **Yes**<br>☒ **Not applicable** |
| **When differences exist; they shall be identified in the General product information section.** | |
| **Name and address of factory (ies) ..... : Same as manufacturer** | |
| **General product information:**<br>1. The unit is control the energy generated by the solar panel to the battery through the controller during the day, and at night the controller releases the energy in the battery to drive the LED light.<br>2. The product was submitted and tested for use at the manufacturer's recommended ambient temperature (Tma) of 60°C.<br>3. All models are identical to each other except for the model names and the external dimension, model: M2415 was selected for all tests. | |

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|---|---|---|---|
| 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 | 25℃，48%RH，98KPa | 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 worst-case test conditions. | P |
| 4.2.2.4 | Accessories | Accessories and operator interchangeable parts available from or recommended by the manufacturer according to the installation manual required. | P |
| 4.2.2.5 | Covers and removable parts | No such covers and removable parts | N |
| 4.2.2.6 | Mains supply<br>a) Voltage:<br>b) Frequency:<br>c) Polarity:<br>d) Earthing:<br>e) Over-current Protection: | Not connected to the mains directly. | N |
| 4.2.2.7 | Supply ports other than the mains | | P |
| 4.2.2.7.1 | Photovoltaic supply sources<br>a) Open circuit voltage:<br>b) Short-circuit current: | (see appended table 4.2.2.7) | P |
| 4.2.2.7.2 | Battery inputs | | N/A |
| 4.2.2.8 | Conditions of loading for output ports | | P |
| 4.2.2.9 | Earthing terminals | | N/A |
| 4.2.2.10 | Controls | | N/A |
| 4.2.2.11 | Available short circuit current | | N/A |
| 4.3 | Thermal testing | (see appended table 4.3) | P |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| 4.3.1 | General | | P |
| 4.3.2 | Maximum temperatures | | P |
| 4.3.2.1 | General | | P |
| 4.3.2.2 | Touch temperatures | | P |
| 4.3.2.3 | Temperature limits for mounting surfaces | | P |
| 4.4 | Testing in single fault condition | (see appended table 4.4) | P |
| 4.4.1 | General | | P |
| 4.4.2 | Test conditions and duration for testing under fault conditions | | P |
| 4.4.2.1 | General | | P |
| 4.4.2.2 | Duration of tests | | P |
| 4.4.3 | Pass/fail criteria for testing under fault conditions | | P |
| 4.4.3.1 | Protection against shock hazard | | P |
| 4.4.3.2 | Protection against the spread of fire | | P |
| 4.4.3.3 | Protection against other hazards | | P |
| 4.4.3.4 | Protection against parts expulsion hazards | | P |
| 4.4.4 | Single fault conditions to be applied | | P |
| 4.4.4.1 | Component fault tests | | P |
| 4.4.4.2 | Equipment or parts for short-term or intermittent operation | | N |
| 4.4.4.3 | Motors | | N |
| 4.4.4.4 | Transformer short circuit tests | | N |
| 4.4.4.5 | Output short circuit | | P |
| 4.4.4.6 | Backfeed current test for equipment with more than one source of supply | | N |
| 4.4.4.7 | Output overload | | P |
| 4.4.4.8 | Cooling system failure | | N |
| 4.4.4.9 | Heating devices | | N |
| 4.4.4.10 | Safety interlock systems | | N |
| 4.4.4.11 | Reverse d.c. connections | (see appended table 4.4) | P |
| 4.4.4.12 | Voltage selector mismatch | | N |
| 4.4.4.13 | Mis-wiring with incorrect phase sequence or polarity | Special terminals cannot be reversed | N |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| 4.4.4.14 | Printed wiring board short-circuit test | | P |
| 4.5 | Humidity preconditioning | (see appended table 7.5) | P |
| 4.5.1 | General | | P |
| 4.5.2 | Conditions | | P |
| 4.6 | Backfeed voltage protection | | P |
| 4.6.1 | Backfeed tests under normal conditions | | P |
| 4.6.2 | Backfeed tests under single-fault conditions | | P |
| 4.6.3 | Compliance with backfeed tests | | P |
| **4.7** | **Electrical ratings tests** | | P |
| 4.7.1 | Input ratings | | 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 | | P |
| | Graphic symbols may be used and shall be in accordance with Annex C or IEC 60417 as applicable. | All graphic symbols accordance with Annex C or IEC 60417 | P |
| | Graphic symbols shall be explained in the documentation provided with the PCE. | All graphic symbols explained in t manufacturer's documentation | P |
| 5.1.2 | Durability of markings | (See appended table 5.1.2) | 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 |
| 5.1.3 | Identification | | P |
| | The equipment shall, as a minimum, be permanently marked with: | (See page 3) | P |
| | a) the name or trade mark of the manufacturer or supplier | (See page 3) | P |
| | b) model number, name or other means to identify the equipment | (See page 3) | P |
| | c) a serial number, code or other marking allowing identification of manufacturing location and the | | P |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | manufacturing batch or date within a three month time period. | | |
| 5.1.4 | Equipment ratings | | P |
| | Unless otherwise specified in another part of IEC 62109, the following ratings, as applicable shall be marked on the equipment: | See above. | P |
| | - input voltage, type of voltage (a.c. or d.c.), frequency, and max. continuous current for each input | See above. | P |
| | - output voltage, type of voltage (a.c. or d.c.), frequency, max. continuous current, and for a.c. outputs, either the power or power factor for each output | See above. | P |
| | - the ingress protection (IP) rating as in 6.3 below | See clause 6.3 | P |
| 5.1.5 | Fuse identification | | N |
| | 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. | | N |
| | Where fuses with special fusing characteristics such as time delay or breaking capacity are necessary, the type shall also be indicated | | N |
| | For fuses not located in operator access areas and for soldered-in fuses located in operator access areas, it is permitted to provide an unambiguous cross-reference (for example, F1, F2, etc.) to the servicing instructions which shall contain the relevant information. | | N |
| 5.1.6 | Terminals, Connections, and Controls | | N |
| | 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. | | N |
| | 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 such push-button | N |
| | A multiple-voltage unit shall be marked to indicate the particular voltage for which it is set when | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | shipped from the factory. The marking is allowed to be in the form of a paper tag or any other non-permanent material. | | |
| | A unit with d.c. terminals shall be plainly marked indicating the polarity of the connections, with: | | P |
| | – the sign “+“ for positive and “-„ for negative; or | | P |
| | – a pictorial representation illustrating the proper polarity where the correct polarity can be unambiguously determined from the representation | | P |
| 5.1.6.1 | Protective Conductor Terminals | | N |
| | The means of connection for the protective earthing conductor shall be marked with: | | N |
| | – symbol 7 of Annex C; or | | N |
| | – the letters “PE“; or | | N |
| | – the colour coding green-yellow. | | N |
| 5.1.7 | Switches and circuit-breakers | | 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 III Equipment. | N |
| | Equipment using Class II protective means throughout shall be marked with symbol 12 of Annex C. Equipment which is only partially protected by DOUBLE INSULATION or REINFORCED INSULATION shall not bear symbol 12 of Table Annex C. | | N |
| | 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 | | 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: | | N |
| | a) the minimum temperature Rating and size of | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | the cable to be connected to the TERMINALS; or | | |
| | 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: | | 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. | | 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 | | P |
| | Symbol 9 of Annex C is not required to be used adjacent to symbols that are explained in the manual | | N |
| 5.2.2 | Content for warning markings | | P |
| 5.2.2.1 | Ungrounded heat sinks and similar parts | | 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 heat sink and shall be clearly visible when the PCE is disassembled to the extent that a risk of contact with the heat sink exists. | | N |
| 5.2.2.2 | Hot Surfaces | | N |
| | 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. | | N |
| 5.2.2.3 | Coolant | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | 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: | No such part | N |
| | a) statement that coolant system servicing is to be done only by SERVICE PERSONNEL, or | | N |
| | b) instructions for safe venting, draining, or otherwise working on the cooling system, if these operations can be performed without OPERATOR access to HAZARDS internal to the equipment | | N |
| 5.2.2.4 | Stored energy | | N |
| | 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. | | N |
| 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 | | 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 Annex C and the manual shall contain the information required in 5.3.4. | | N |
| | The symbol shall be located on the outside of the | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | unit or shall be prominently visible behind any cover giving access to hazardous parts. | | |
| 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. | Au, Min 10 $mm^2$ | N |
| 5.3 | Documentation | | N |
| 5.3.1 | General | | N |
| | 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: | | N |
| | a) explanations of equipment makings, including symbols used | | N |
| | b) location and function of terminals and controls | | N |
| | 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: | | N |
| | – ENVIRONMENTAL CATEGORY as per 6.1 | indoor | N |
| | – WET LOCATIONS classification fort he intended external environment as per 6.1 | | N |
| | – POLLUTION DEGREE classification for the intended external environment as per 6.2 | | N |
| | – INGRESS PROTECTION rating as per 6.3 | | N |
| | – Ambient temperature and relative humidity ratings | | N |
| | – MAXIMUM altitude rating | Up to 2000m | N |
| | – 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 |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| 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. | | N |
| 5.3.2 | Information related to installation | See the manual | 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 externals 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; | | N |
| | 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- | No such battery | P |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | regulated batteries is located, to prevent the accumulation of hazardous gases; | | |
| | i) tightening torque to be applied to wiring terminals; | | N |
| | j) values of backfeed short-circuit currents available from the PCE on input and output conductors under fault conditions, if those currents exceed the max. rated current of the circuit, as per 4.4.4.6; | | P |
| | k) for each input to the PCE, the max value of short-circuit current available from the source, for which the PCE is designed; and | | P |
| | l) compatibility with RCD and RCM; | | 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: | | N |
| | n) where required by 7.3.8, the installation instructions shall include the following or equivalent wording: | | 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. | | N |
| 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 |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | 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 (for example air filter replacement or periodic re-tightening of terminals); | | P |
| | – Instructions for accessing operator access areas, if any are present, including a warning not to enter other areas of the equipment; | | P |
| | – Part numbers and instructions for obtaining any required operator replaceable parts; | No such 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 | | 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 |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | – 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 likelihood of such shock can be reduced if such grounds are removed during installation and maintenance (applicable to equipment and remote battery supplies not having a grounded supply circuit). | | N |
| **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 dry locations | P |
| | – POLLUTION DEGREE rating in 6.2 below | | P |
| | – INGRESS PROTECTION (IP) rating, as in 6.3 below | | P |
| | – Ultraviolet (UV) exposure rating, as in 6.4 below | Indoor use | N |
| | – Ambient temperature and relative humidity ratings, as in 6.5 below | | P |
| 6.1 | Environmental categories and minimum environmental conditions | | P |
| 6.1.1 | Outdoor | | N |
| 6.1.2 | Indoor, unconditioned | | N |
| 6.1.3 | Indoor, conditioned | | P |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| 6.2 | Pollution degree | PD2 | P |
| 6.3 | Ingress Protection | | P |
| 6.4 | UV exposure | Not required | N |
| 6.5 | Temperature and humidity | Specified by manufacturer. | 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 | In the PCE, only DVC A circuit exist. | P |
| 7.3.1 | General | | P |
| 7.3.2 | Decisive voltage classification | Working voltage and protective measures are considered | P |
| 7.3.2.1 | Use of decisive voltage class (DVC) | | P |
| 7.3.2.2 | Limits of DVC (according table 6) | | P |
| 7.3.2.3 | Short-terms limits of accessible voltages under fault conditions | | P |
| 7.3.2.4 | Requirements for protection (according table 7) | Single fault condition is considered. | 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) | 60VDC considered | 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 | N |
| | Protective separation shall be achieved by: | | N |
| | ▪ double or reinforced insulation, or | | N |
| | ▪ protective screening, i.e. by a conductive screen connected to earth by protective | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | 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 | | |
| | ▪ protective impedance comprising limitation of current per 7.3.5.3 and of discharged energy per 7.3.5.4, or | | N |
| | ▪ 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 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). | Enclosure provided | P |
| | Open type sub-assemblies and devices do not require protective measures against direct contact but the instruction provided with the equipment must indicate that such measures must be provided in the end equipment or in the installation. | 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. | | P |
| 7.3.4.2.1 | General | | P |
| | Parts of enclosures and barriers that pro vide 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 | | N |
| 7.3.4.2.2 | Access probe criteria | | P |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | Protection is considered to be achieved when the separation between the test probes and live parts, when tested as described below, is as follows: | | P |
| | a) decisive voltage classification A, (DVC A) - the probe may touch the live parts | The communication interface is considered as DVC A | P |
| | b) decisive voltage classification B, (DVC B) - the probe must not touch bare live parts | | N |
| | 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, | | N |
| 7.3.4.2.3 | Access probe tests | | N |
| | Compliance with 7.3.4.2.1 is checked by all of the following: | | N |
| | a) Inspection; and | | N |
| | b) Tests with the test finger (Figure D.1) and test pin (Figure D.2) of 0E, the results of which shall comply with the requirements of 7.3.4.2.1 a), b), and c) as applicable. Probe tests are performed on openings in the enclosures after removal of parts that can be detached or opened by an operator without the use of a tool, including fuseholders, and with operator access doors and covers open. It is permitted to leave lamps in place for this test. Connectors that can be separated by an operator without use of a tool, shall also be tested during and after disconnection. Any movable parts are to be put in the most unfavourable position. | | N |
| | 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. | | N |
| | 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. | | N |
| | 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 | No openings. | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | enters, the test with the jointed finger is repeated except that the finger is applied using any necessary force up to 30 N. | | |
| | d) In addition to a) – c) above, top surfaces of enclosure shall be tested with the IP3X probe of IEC 60529. The test probe shall not penetrate the top surface of the enclosure when probed from the vertical direction ±5 ° only. | | N |
| 7.3.4.2.4 | Service access areas | | N |
| 7.3.4.3 | Protection by means of insulation of live parts | | N |
| | Where the requirements of 7.3.4.2 are not met, live parts shall be provided with insulation if: | | N |
| | – their working voltage is greater than the maximum limit of decisive voltage class A, or | | N |
| | – for a DVC A or B circuit, protective separation from adjacent circuit of DVC C is not provided (see note "‡" under Table 7) | | N |
| 7.3.5 | Protection in case of direct contact | | N |
| 7.3.5.1 | General | | N |
| | Protection in case of direct contact is required to ensure that contact with live parts does not produce a shock hazard. | | N |
| | 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 | N |
| | – is of decisive voltage class A and complies with 7.3.5.2, or | | N |
| | – 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. | | N |
| | Conformity is checked by visual inspection and trial insertion. | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| 7.3.5.2 | Protection using decisive voltage class A | | N |
| 7.3.5.3 | Protection by means of protective impedance | | N |
| | Circuits and conductive parts do not require protection against direct contact if any connection to circuits of DVC-B or DVC-C is through protective impedance, and the accessible circuit or part is otherwise provided with protective separation from circuits of DVC-B or DVC-C according 7.3.3. | | N |
| 7.3.5.3.1 | Limitation of current through protective impedance | | N |
| | The current available through protective impedance to earth and between simultaneously accessible parts, measured at the accessible live parts, shall not exceed a value of 3,5 mA a.c. or 10 mA d.c. under normal and single-fault conditions. | | N |
| 7.3.5.3.2 | Limitation of discharging energy through protective impedance | | N |
| | The discharging energy available between simultaneously accessible parts protected by protective impedance shall not exceed the charging voltage and capacitance limits given in Table 9, which applies to both wet and dry locations, under normal and single fault conditions. Refer to figure 8. | | N |
| 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 | | N |
| 7.3.6.1 | General | | N |
| | 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 | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | for protective class I (basic insulation plus protective earthing), class II (double or reinforced insulation) or class III (limitation of voltages) | | |
| | That part of a PCE meets the requirements of 7.3.6.2 and 7.3.6.3 is defined as protective class I | | N |
| | That part of a PCE meets the requirements of 7.3.6.4 is defined as protective class II. | | N |
| | 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. | | N |
| 7.3.6.2 | Insulation between live parts and accessible conductive parts | | N |
| | 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 | | N |
| 7.3.6.3 | Protective class I – Protective bonding and earthing | | N |
| 7.3.6.3.1 | General | | N |
| | 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: | | N |
| | 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. | | N |
| 7.3.6.3.2 | Requirements for protective bonding | | N |
| | Electrical contact with the means of connection of the external protective earthing conductor shall be achieved by one or more of the following means: | | N |
| | a) through direct metallic contact; | | N |
| | b) through other conductive parts which are not | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | removed when the PCE or sub-units are used as intended ; | | |
| | c) through a dedicated protective bonding conductor; | | N |
| | 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. | | N |
| | 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 | | N |
| | 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.<br>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. | | N |
| | Protective bonding shall meet following requirements: | | N |
| | a) For PCE with an overcurrent protective device rating of 16 A or less, the impedance of the protective bonding means shall not exceed 0,1 Ω during or at the end of the test below. | | N |
| | b) For PCE with an overcurrent protective device rating of more than 16 A, the voltage drop in the protective bonding test shall not exceed 2,5 V during or at the end of the test below. | | N |
| | As alternative to a) and b) the protective bonding may designed according to the requirements for the external protective earthing conductor in 7.3.6.3.5, in which case no testing is required. | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | The impedance of protective bonding means shall be checked by passing a test current through the bond for a period of time as specified below. The test current is based on the rating of the overcurrent protection for the equipment or part of the equipment under consideration, as follows: | | N |
| | a) For pluggable equipment type A, the overcurrent protective device is that provided external to the equipment (for example, in the building wiring, in the mains plug or in an equipment rack); | | N |
| | b) For pluggable equipment type B and fixed equipment, the maximum rating of the overcurrent protective device specified in the equipment installation instructions to be provided external to the equipment; | | N |
| | c) For a circuit or part of the equipment for which an overcurrent protective device is provided as part of the equipment, the rating of the provided overcurrent device. | | N |
| | Voltages are measured from the protective earthing terminal to all parts whose protective bonding means are being considered. The impedance of the protective earthing conductor is not included in the measurement. However, if the protective earthing conductor is supplied with the equipment, it is permitted to include the conductor in the test circuit but the measurement of the voltage drop is made only from the main protective earthing terminal to the accessible part required to be earthed. | | N |
| | On equipment where the protective earth connection to a subassembly or to a separate unit is part of a cable that also supplies power to that subassembly or unit, the resistance of the protective bonding conductor in that cable is not included in the protective bond impedance measurements for the subassembly or separate unit, as shown in Figure 11. However, this option is only permitted if the cab le is protected by a suitably rated protective device that takes into account the size of the conductor. Otherwise the impedance of the protective bonding conductor between the separate units is to be included, by measuring to the protective earthing terminal where the power source enters the first unit in the system, as shown in Figure 12. | | N |
| 7.3.6.3.3.1 | Test current, duration, and acceptance criteria | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | The test current, duration of the test and acceptance criteria are as follows: | | N |
| | a) For PCE with an overcurrent protective device rating of 16 A or less, the test current is 200% of the overcurrent protective device rating, but not less than 32 A, applied for 120s. The impedance of the protective bonding means during and at the end of the test shall not exceed 0,1 Ω. | | N |
| | b) For PCE with an overcurrent protective device rating of more than 16 A, the test current is 200% of the overcurrent protective device rating and the duration of the test is as shown in Table 10 below. The voltage drop in the protective bonding means, during and at the end of the test, shall not exceed 2,5 V. | | N |
| | c) During and after the test, there shall be no melting, loosening, or other damage that would impair the effectiveness of the protective bonding means. | | N |
| | The test current is derived from an a.c or d.c supply source, the output of which is not earthed. | | N |
| | As an alternative to Table 10, where the time-current characteristic of the overcurrent protective device that limits the fault current in the protective bonding means is known because the device is either provided in the equipment or fully specified in the installation instructions, the test duration may be based on that specific device's time-current characteristic,. The tests are conducted for a duration corresponding to the 200% current value on the time-current characteristic. | | N |
| 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.<br>The test shall be as in 7.3.6.3.3, except for the following: | | 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 |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | ▪ 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: | | N |
| | ▪ 2,5 mm² if mechanical protection is provided; | | N |
| | ▪ 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 | | N |
| 7.3.6.3.6.1 | General | | N |
| | 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.<br>The means of connection for the protective earthing | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | conductor shall not be used as a part of the mechanical assembly of the equipment or for other connections.<br>A separate means of connection shall be provided for each external protective earthing conductor.<br>Connection and bonding points shall be so designed that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influences. Where enclosures and/or conductors of aluminium or aluminium alloys are used, particular attention should be given to the problems of electrolytic corrosion. | | |
| | The means of connection for the protective earthing conductor shall be permanently marked with: | | N |
| | • symbol 7 of Annex C; or | | N |
| | • the colour coding green-yellow | | N |
| | 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 | | N |
| | The requirements of this sub-clause shall be satisfied to maintain safety in case of damage to or disconnection of the protective earthing conductor. | | N |
| | 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. | | N |
| | a) Permanently connected wiring, and: | | N |
| | • a cross-section of the protective earthing conductor of at least 10 mm² Cu or 16 mm² Al; or | | N |
| | • automatic disconnection of the supply in case of discontinuity of the protective earthing conductor; or | | N |
| | • 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 | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | protective earthing conductor to be installed or | | |
| | b) Connection with an industrial connector according to IEC 60309 and a minimum protective earthing conductor cross-section of 2,5 mm² as part of a multi-conductor power cable. Adequate strain relief shall be provided. | | N |
| | 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 common PE conductor, the above touch current requirements apply to the maximum number of the PCEs to be connected in parallel, unless one of the measures in a) | | N |
| | 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 | | N |
| | 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 |
| | • metal-encased equipment of protective class II may have provision on its enclosure for the connection of an equipotential bonding | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | conductor; | | |
| | • 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 |
| | • equipment employing protective class II shall be marked according to 5.1.8. | | N |
| 7.3.7 | Insulation Including Clearance and Creepage Distance | | N |
| 7.3.7.1 | General | | N |
| | This subclause gives minimum requirements for insulation, based on the principles of IEC 60664. | | N |
| | Manufacturing tolerances shall be taken into account during measurement of creepage, clearance, and insulation distance in the PCE. | | N |
| | Insulation shall be selected after consideration of the following influences: | | N |
| | • pollution degree | PD2 | P |
| | • overvoltage category | PV(OVC II) | P |
| | • supply earthing system | Not connected to the mains directly. | N |
| | • insulation voltage | | N |
| | • location of insulation | | N |
| | • type of insulation | | N |
| | Compliance of insulation, creepage distances, and clearance distances, shall be verified by measurement or visual inspection, and the tests of 7.5. | | N |
| 7.3.7.1.3 | Supply earthing systems | | N |
| | Three basic types of earthing system are described in IEC 60364-1. They are: | | N |
| | • 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 |
| | • TT system: has one point directly earthed, the | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| | accessible conductive parts of the installation being connected to earth electrodes electrically independent of the earth electrodes of the power system; | | |
| | • 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 | | N |
| | Table 12 makes use of the circuit system voltage and overvoltage category to define the impulse withstands voltage and the temporary overvoltage. | | N |
| 7.3.7.2 | Insulation between a circuit and its surroundings | | N |
| 7.3.7.2.1 | General | | N |
| 7.3.7.2.2 | Circuits connected directly to the mains | | N |
| 7.3.7.2.3 | Circuits other than mains circuits | | N |
| 7.3.7.2.4 | Insulation between circuits | | N |
| 7.3.7.3 | Functional insulating | | N |
| 7.3.7.4 | Clearance distances | | N |
| 7.3.7.4.1 | Determination | | N |
| 7.3.7.4.2 | Electric field homogeneity | | N |
| 7.3.7.4.3 | Clearance to conductive enclosures | | N |
| 7.3.7.5 | Creepage distances | | N |
| 7.3.7.5.1 | General | | N |
| 7.3.7.5.2 | Voltage | | N |
| 7.3.7.5.3 | Materials | | N |
| 7.3.7.6 | Coating | | N |
| 7.3.7.7 | PWB spacings for functional insulating | | N |
| 7.3.7.8 | Solid insulating | | N |
| 7.3.7.8.1 | General | | N |
| 7.3.7.8.2 | Requirements for electrical withstand capability of solid insulation | | N |
| 7.3.7.8.2.1 | Basic, supplemental, reinforced, and double insulation | | N |
| 7.3.7.8.2.2 | Functional insulation | | N |

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| Clause | Requirement – Test | Result – Remark | Verdict |
| 7.3.7.8.3 | Thin sheet or tape material | | N |
| 7.3.7.8.3.1 | General | | N |
| 7.3.7.8.3.2 | Material thickness not less than 0,2 mm | | N |
| 7.3.7.8.3.3 | Material thickness less than 0,2 mm | | N |
| 7.3.7.8.3.4 | Compliance | | N |
| 7.3.7.8.4 | Printed wiring boards | | N |
| 7.3.7.8.4.1 | General | | N |
| 7.3.7.8.4.2 | Use of coating materials | | N |
| 7.3.7.8.5 | Wound components | | N |
| 7.3.7.8.6 | Potting materials | | N |
| 7.3.7.9 | Insulation requirements above 30 kHz | | N |
| 7.3.8 | Residual Current-operated protective (RCD) or monitoring (RCM) device compatibility | | N |
| | 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 | | N |
| 7.3.9.1 | Operator access area | | N |
| | 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. | | N |
| 7.3.9.2 | Service access areas | | N |
| | 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. | | N |
| 7.4 | Protection against energy hazards | | N |
| 7.4.1 | Determination of hazardous energy level | | N |
| | A hazardous energy level is considered to exist if | | N |
| | a) The voltage is 2 V or more, and power available after 60 s exceeds 240 VA. | | N |
| | b) The stored energy in a capacitor is at a voltage. U of 2 V or more, and the stored energy. E, calculated from the following equation, exceeds 20J: | | N |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| | E = 0,5 CU² | | |
| 7.4.2 | Operator Access Areas | | N |
| | Equipment shall be so designed that there is no risk of energy hazard in operator access areas from accessible circuits. | | N |
| 7.4.3 | Services Access Areas | | N |
| 7.5 | Electrical tests related to shock hazard | | N |
| 7.5.1 | Impulse voltage test (type test) | | N |
| 7.5.2 | Voltage test (dielectric strength test) | | N |
| 7.5.2.1 | Purpose of test | | N |
| 7.5.2.2 | Value and type of test voltage | | N |
| 7.5.2.3 | Humidity pre-conditioning | | N |
| 7.5.2.4 | Performing the voltage test | | N |
| 7.5.2.5 | Duration of the a.c. or d.c. voltage test | | N |
| 7.5.2.6 | Verification of the a.c. or d.c. voltage test | | N |
| 7.5.3 | Partial discharge test | | N |
| 7.5.4 | Touch current measurement (type test) | | N |
| | 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. | | N |
| | 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. | | N |
| 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 HAZARD in NORMAL CONDITION or SINGLE FAULT CONDITION.<br>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 |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| 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. | Fan is blade is protected By barriers | 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 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. | | N |
| 8.3 | Stability | | N |
| | Equipment and assemblies of equipment not secured to the building structure before operation shall be physically stable in NORMAL USE. | | 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. | | P |
| 8.5 | Wall mounting | | N |
| | 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. | | N |
| 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** | | P |
| 9.1 | Resistance to fire | | P |
| | This subclause specifies requirements intended to reduce the risk of ignition and the spread of flame, both within the equipment and to the outside, by the | | P |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| | appropriate use of materials and components and by suitable construction. | | |
| 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 risk of ignition and, therefore, require a FIRE ENCLOSURE: | | P |
| | – components in PRIMARY CIRCUITS | | P |
| | – components in SECONDARY CIRCUITS supplied by power sources which exceed the limits for a LIMITED POWER SOURCE as specified in 9.2; | | P |
| | – components in SECONDARY CIRCUITS supplied by a LIMITED POWER SOURCE as specified in 9.2, but not mounted on a material of FLAMMABILITY CLASS V-1; | | 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 | Certified relay with fire enclosure | 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 |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| 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. | 1. V-0 PCB as part of fire enclosure.<br>2. V-0 barrier used. | 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. | | P |
| 9.1.3.4 | Materials for components and other parts inside fire enclosures | FLAMMABILITY CLASS V- 0 or better used. | P |
| 9.1.3.5 | Materials for air filter assemblies | | N |
| 9.1.4 | Openings in fire enclosures | | N |
| 9.1.4.1 | General | The equipment is intended to be used one orientation. | 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 | | N |
| | The bottom of a FIRE ENCLOSURE or individual | | N |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| | 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. | | |
| 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 be provided to allow proper selection of external wiring and external protective devices. | | P |
| 9.3.2 | Protection against short-circuits and overcurrents shall be provided for all input circuits, and for output circuits that do not comply with the requirements for limited power sources in 9.2, except for circuits in which no overcurrent hazard is presented by short-circuits and overloads. | | 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 | | P |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| | 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. | | |
| **10** | **PROTECTION AGAINST SONIC PRESSURE HAZARDS** | | N |
| 10.1 | General | | N |
| | 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. | | N |
| 10.2 | Sonic pressure and Sound level | | N |
| 10.2.1 | Hazardous Noise Levels | | N |
| **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 |
| | a) Normal operation, including condensation; | | N |
| | b) Servicing of the equipment; or | | N |
| | c) 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** | | N |
| 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 self-hardening 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 | | N |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| | not be possible to fix them in a wrong position if this might result in hazard. | | |
| 13.1.1 | Adjustable controls | | N |
| 13.2 | Securing of parts | | P |
| 13.3 | Provisions for external connections | | P |
| 13.3.1 | General | Appropriate provisions for external connections applied. | P |
| 13.3.2 | Connection to an a.c. Mains supply | | 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 | | N |
| 13.3.3.3 | Wiring terminal sizes | | N |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| 13.3.3.4 | Wiring terminal design | | N |
| 13.3.3.5 | Grouping of wiring terminals | | N |
| 13.3.3.6 | Stranded wire | | N |
| 13.3.4 | Supply wiring space | | N |
| 13.3.5 | Wire bending space for wires 10 mm² and greater | | N |
| 13.3.6 | Disconnection from supply sources | Not connected to the mains directly. | N |
| 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 | | P |
| 13.4.3 | Colour coding | | P |
| 13.4.4 | Splices and connections | | P |
| 13.4.5 | Interconnections between parts of the PCE | | P |
| 13.5 | Openings in enclosures | | N |
| 13.5.1 | Top and side 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 | | N |
| 13.6.1 | General | | N |
| 13.6.1.1 | Thermal index or capability | | N |
| 13.6.2 | Polymers serving as enclosures or barriers preventing access to hazards | | N |
| 13.6.2.1 | Stress relief test | | N |
| 13.6.3 | Polymers serving as solid insulation | | N |
| 13.6.3.1 | Resistance to arcing | | N |
| 13.6.4 | UV resistance | | N |
| | Polymeric parts of an OUTDOOR ENCLOSURE required for compliance with this standard shall be sufficiently resistance to degradation by ultra-violet (UV) radiation | | N |
| 13.7 | Mechanical resistance to deflection, impact, or drop | | P |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| 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 | | 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 | | P |
| 13.8.3 | Sheet metal | | P |
| **14** | **COMPONENTS** | | P |
| 14.1 | General | (see appended table 14) | 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 component has been approved to the non-IEC standard by a recognized testing authority. | | P |
| | Components such as optocouplers, capacitors, transformers, and relays connected across basic, supplemental, reinforced, or double insulation shall comply with the requirements applicable for the grade of insulation being bridged, and if not previously certified to the applicable component safety standard shall be subjected to the voltage | | P |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| | test of 7.5.2 as routine test. | | |
| 14.2 | Motor Over temperature Protection | | N |
| | Motors which, when stopped or prevented from starting (see 4.4.4.3), would present an electric shock HAZARD, a temperature HAZARD, or a fire HAZARD, shall be protected by an over temperature or thermal protection device meeting the requirements of 14.3. | | N |
| 14.3 | Over temperature 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 requirement 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. | | P |
| 14.7 | Circuits or components used as transient overvoltage limiting devices | | N |
| | 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. | | N |
| 14.8 | Batteries | | P |
| | Equipment containing batteries shall be designed to reduce the risk of fire, explosion and chemical leaks under normal conditions and after a single fault in the equipment including a fault in circuitry within the equipment battery pack. | | P |
| 14.8.1 | Battery Enclosure Ventilation | | P |
| 14.8.1.1 | Ventilation requirements | | P |
| 14.8.1.2 | Ventilation testing | | P |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| 14.8.1.3 | Ventilation instructions | | P |
| 14.8.2 | Battery Mounting | | P |
| | 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 non-metallic rack or tray shall be tested at the highest normal condition operating temperature. | | P |
| 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 | | P |
| | 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. | | P |
| 14.8.6 | Battery accessibility and maintainability | | P |
| | 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. | | P |
| 15 | Software and firmware performing safety functions | | P |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |

| 4.2.2.6 | TABLE: : electrical data Output side (Grid connection) | | | | | P |
|---|---|---|---|---|---|---|
| Type | U ac (V) | I acmax (A) | P (W) | f (HZ) | -- | -- |
| M2415 | 55Vdc | 4 | 120W(12V), 200W(24V) | -- | -- | -- |
| Supplementary information: | | | | | | |

| 4.2.2.7 | TABLE: electrical data Input side (PV – Generator) | | | | | P |
|---|---|---|---|---|---|---|
| Type | U dcmax (V) | U dcmin (V) | U mppmin (V) | U mppmax (V) | I dcmax (A) | Pmax (W) |
| M2415 | 55Vdc | 15 | 15 | 55 | 15 | 360 |
| Supplementary information: | | | | | | |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |

| | | | |
|---|---|---|---|
| **4.3** | **TABLE: heating temperature rise measurements** | | P |
| | test voltage (V) .....: | See below | — |
| | t1 (°C).....: | See below | — |
| | t2 (°C) .....: | See below | — |

| Thermocouple Locations | Max. temperature measured (°C) | | | | | Max. temperature limit, (°C) |
|---|---|---|---|---|---|---|
| | A | -- | -- | -- | -- | -- |
| Enclosure –Bottom | 67.3 | -- | -- | -- | -- | 70 |
| Enclosure –Front | 65.2 | -- | -- | -- | -- | 70 |
| Enclosure –Rear | 66.4 | -- | -- | -- | -- | 70 |
| Enclosure –Left | 64.7 | -- | -- | -- | -- | 70 |
| Enclosure –Right | 65.8 | -- | -- | -- | -- | 70 |
| Internal lead wire | 68.5 | -- | -- | -- | -- | 80 |
| L1 winding | 73.3 | -- | -- | -- | -- | 130 |
| E. Cap (C1) body | 76.5 | -- | -- | -- | -- | 105 |
| E. Cap (C2) body | 75.4 | -- | -- | -- | -- | 105 |
| PCB near Q2&Q1 | 77.3 | -- | -- | -- | -- | 130 |
| PCB near Q3 | 71.1 | -- | -- | -- | -- | 130 |
| PCB near U6 | 69.8 | -- | -- | -- | -- | 130 |
| Tma | 60.0 | -- | -- | -- | -- | / |

Supplementary information:
A: PV input 55Vdc，DC output load 200W, charging empty battery;

| | | | |
|---|---|---|---|
| | **TABLE: Heating test, resistance method** | | N |
| | **Test voltage (V) .....:** | / | — |
| | **Ambient, $t_1$ (°C) .....:** | / | — |
| | **Ambient, $t_2$ (°C) .....:** | / | — |

| **Temperature rise of winding** | **$R_1$ (Ω)** | **$R_2$ (Ω)** | **ΔT (K)** | **Max. dT (K)** | **Insulation class** |
|---|---|---|---|---|---|
| / | / | / | / | / | / |

Supplementary information:

| | | |
|---|---|---|
| **4.4** | **TABLE: fault condition tests** | P |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |
| | ambient temperature (°C) .....: | | — |

| No. | component No. | fault | test voltage (V) | test time | fuse No. | fuse current (A) | result |
|---|---|---|---|---|---|---|---|
| 1 | DC output | SC | 55Vdc | 10mins | / | / | Unit shut down immediately and can recoverable. No damaged, No hazard. |
| 4 | C1 | SC | 55Vdc | 10mins | / | / | Unit shut down immediately and can recoverable. No damaged, No hazard. |
| 5 | C2 | SC | 55Vdc | 10mins | / | / | Unit shut down immediately and can recoverable. No damaged, No hazard. |
| 7 | Q3 pin 1-3 | SC | 55Vdc | 10mins | / | / | Unit shut down immediately and can recoverable. No damaged, No hazard. |
| 8 | Q1 pin 1-3 | SC | 55Vdc | 10mins | / | / | Unit shut down immediately and can recoverable. No damaged, No hazard. |
| 9 | Q2 pin 1-3 | SC | 55Vdc | 10mins | / | / | Unit shut down immediately and can recoverable. No damaged, No hazard. |
| Supplementary information:<br>SC= Short circuit; OL= overload; OC= open circuit | | | | | | | |
| See technical documentation. | | | | | | | |

| 7.3.6.3.3 | **TABLE: protective equipotential bonding ;** | N |
|---|---|---|

| Measured between: | Test current (A) | Voltage drop (V) | Resistance (mΩ) | result |
|---|---|---|---|---|
| / | / | / | / | / |
| / | / | / | / | / |
| / | / | / | / | / |
| / | / | / | / | / |

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|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |

| 7.3.6.3.3 | TABLE: protective equipotential bonding ; | N |
|---|---|---|
| supplementary information | | |

| 7.3.6.3.7 | TABLE: touch current measurement | P |
|---|---|---|

| Measured between: | Measured (mA) | Limit (mA) | Comments/conditions |
|---|---|---|---|
| PV terminal-metal enclosure | 0.05 | 0.25 mA a.c | / |
| supplementary information | | | |

| 7.3.7 | TABLE: clearance and creepage distance measurements | | | | | N/A |
|---|---|---|---|---|---|---|
| clearance cl and creepage distance dcr at / of: | Up (V) | U r.m.s. (V) | required cl (mm) | cl (mm) | required dcr (mm) | dcr (mm) |
| | | | | | | |

| 7.5 | TABLE: electric strength measurements, impulse voltage test and partial discharge test | | | N |
|---|---|---|---|---|
| test voltage applied between: | test voltage (V) | impulse withstand voltage (V) | partial discharge extinction voltage (V) | result |
| | | | | |

| 9.2 | TABLE: Limited power sources | N |
|---|---|---|

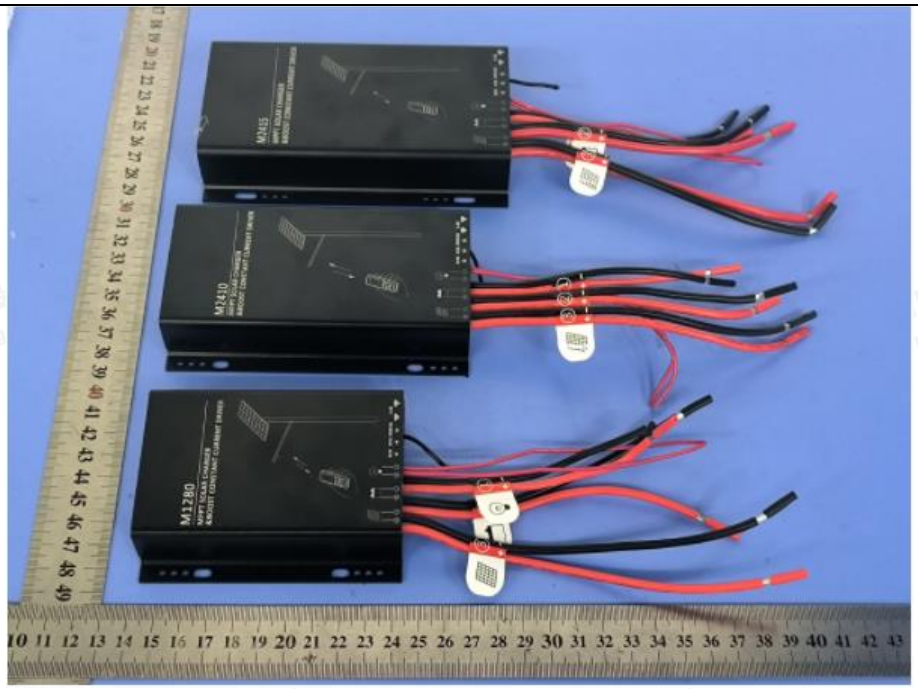
| Circuit output tested: | | | | | | |
|---|---|---|---|---|---|---|
| Note: Measured Uoc (V) with all load circuits disconnected: | | | | | | |
| Components | Sample No. | Uoc (V) | $I_{sc}$ (A) | | VA | |
| | | | Meas. | Limit | Meas. | Limit |
| -- | -- | -- | -- | -- | -- | -- |
| supplementary information: | | | | | | |
| Sc=Short circuit, Oc=Open circuit | | | | | | |

| EN 62109-1 | | | |
|---|---|---|---|
| Clause | Requirement – Test | Result – Remark | Verdict |

| 14 | TABLE: list of critical components | | | | P |
|---|---|---|---|---|---|
| object/part No. | manufacturer/ trademark | type/model | technical data | standard | mark(s) of conformity[1]) |
| Metal enclosure frame | Interchangeable | Interchangeable | Aluminium alloy, Min. thickness: 2.0mm | IEC62109-1 | Tested with appliance |
| PCB | HUIZHOU HOSOND PCB CO LTD | HSD-ML | V-0, 130°C | UL 796 | UL E256286 |
| (Alternative) PCB | HUIZHOU TAISHENG ELECTRONICS CO LTD | TS-M(ASP1) | V-0, 130°C | UL 796 | UL361828 |
| Lead wire | GUANGDONG HAERKN NEW ENERGY CO LTD | 3135 | 200°C, 600Vac, 16AWG,14AWG, 12AWG | UL 758 | UL E300956 |
| [1]) an asterisk indicates a mark which assures the agreed level of surveillance | | | | | |

**Attachment No.1**

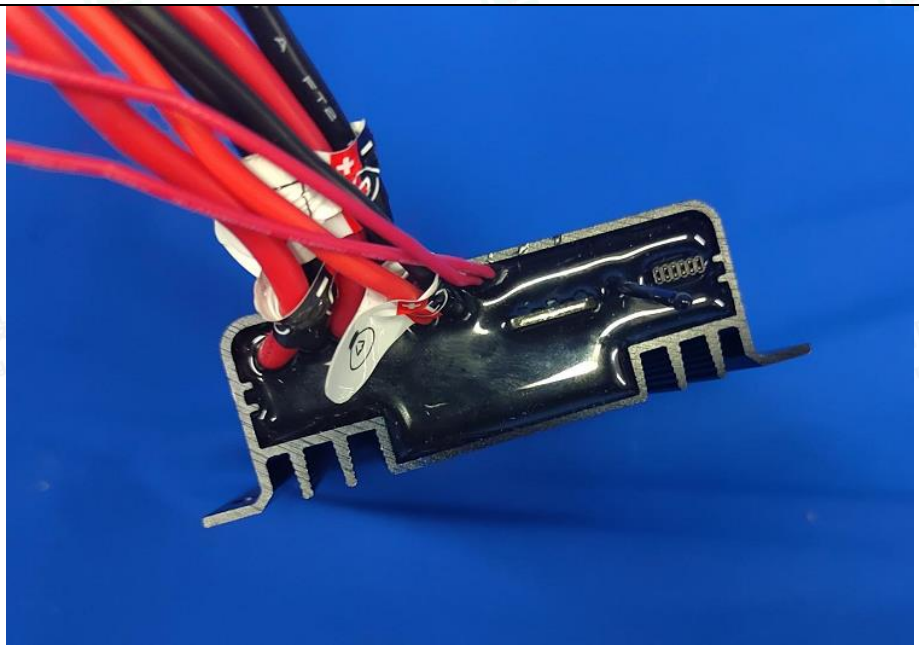
Details of: Overall view



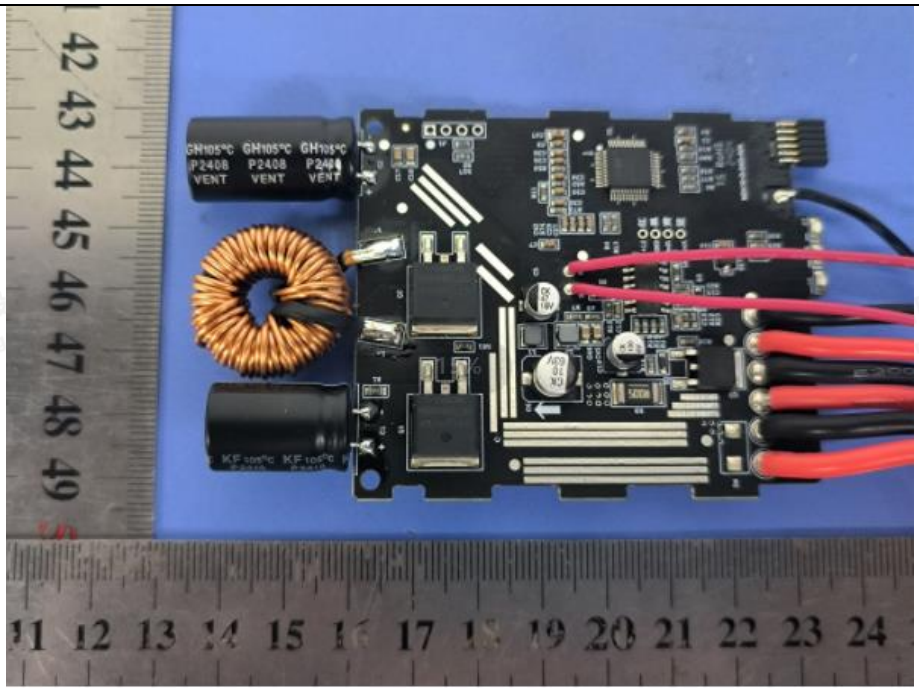

Details of: External view

**Attachment No.1**

Details of: External view

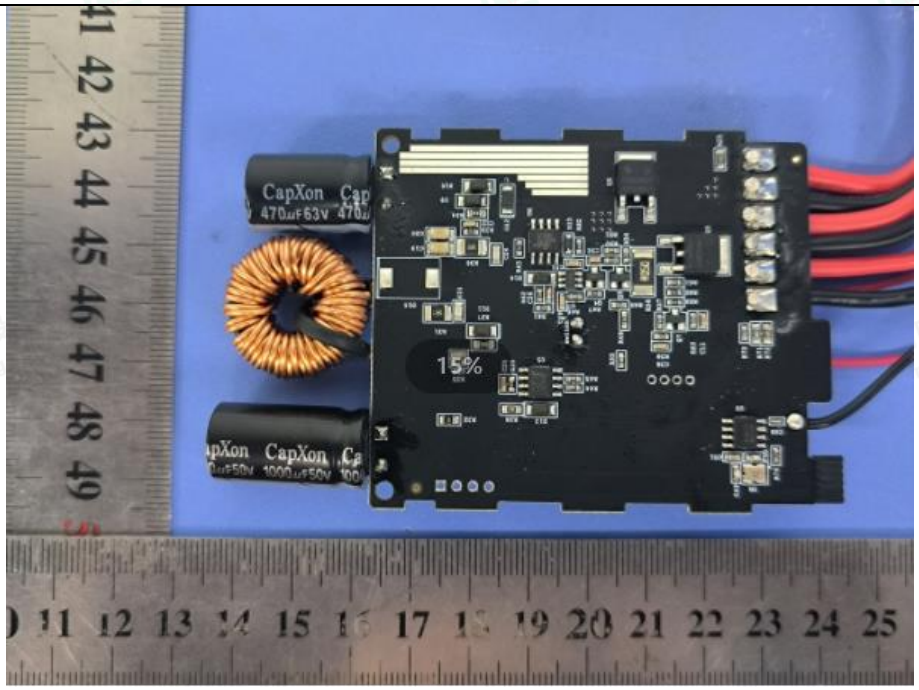


Details of: Internal view



**Attachment No.1**

Details of: Internal view




--- END OF TEST REPORT ---