

**APPLICATION FOR TEST REPORT**

On Behalf of

**SHENZHEN MUST ENERGY TECHNOLOGY CO.,LTD  
INVERTER CHARGER**

**Model: PV35-8K DC48V MPK, PV35-10K DC48V MPK, PV35-12K DC48V MPK**

**Prepared For : SHENZHEN MUST ENERGY TECHNOLOGY CO.,LTD  
4-5F, Building A11, Yusheng Industrial Park, NO.467,  
Section XiXiang, National Highway 107, XiXiang,Baoan  
District, Shenzhen, China**

**Prepared By : Shenzhen Anbotek Compliance Laboratory  
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**Date of Test: Jul. 07, 2016 to Aug. 24, 2016**

**Date of Report: Aug. 24, 2016**

**Report Number: R011607243S**

**TEST REPORT****IEC 62109-1:2010****Safety of power converters for use in photovoltaic power systems –  
Part 1: General requirements**

Reference No.....: R011607243S  
 Tested by (+ signature).....: Elaiven Zhuang  
 Approved by (+ signature).....: Summer Yan  
 Date of issue.....: Aug. 24, 2016  
 Contents.....: 27 pages report (including 3 pages of photo)

**Testing laboratory**

Name.....: Shenzhen Anbotek Compliance Laboratory Limited  
 Address.....: 1/F., Building 1, SEC Industrial Park, No.0409 Qianhai Road,  
 Nanshan District, Shenzhen, Guangdong, China  
 Testing location.....: Same as above

**Client**

Name.....: SHENZHEN MUST ENERGY TECHNOLOGY CO.,LTD  
 Address.....: 4-5F, Building A11, Yusheng Industrial Park, NO.467, Section  
 XiXiang, National Highway 107, XiXiang, Baoan District, Shenzhen,  
 China

**Test specification**

Standard.....: IEC 62109-1:2010  
 Test procedure.....: Compliance with IEC 62109-1:2010  
 Procedure deviation.....: N.A.  
 Non-standard test method.....: N.A.

**Test item**

Description.....: INVERTER CHARGER  
 Trademark.....: MUST  
 Model and/or type reference.....: PV35-8K DC48V MPK, PV35-10K DC48V MPK, PV35-12K DC48V  
 MPK  
 Manufacturer.....: SHENZHEN MUST ENERGY TECHNOLOGY CO.,LTD  
 Address.....: 4-5F, Building A11, Yusheng Industrial Park, NO.467, Section  
 XiXiang, National Highway 107, XiXiang, Baoan District, Shenzhen,  
 China  
 Rating.....: See page 4 for marking

**Test case verdicts**

Test case does not apply to the test object ..... : N(.A.)

Test item does meet the requirement ..... : P(ass)

Test item does not meet the requirement ..... : F(ail)

**Testing**

Date of receipt of test item ..... : Jul. 07, 2016

Date(s) of performance of test ..... : Jul. 07, 2016 to Aug. 24, 2016

**General remarks**

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

The test results presented in this report relate only to the item tested.

"(see remark #)" refers to a remark appended to the report.

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

Throughout this report a dot is used as the decimal separator.

According to the EU directives which have been aligned with EU NLF (new legislative framework), both of manufacturer and importer' s name and address shall be affixed on the product or, where that is not possible, on

its packaging or in a document accompanying the product before the product is placed on the EU market.

Copy of marking:

**INVERTER CHARGER**

**Model: PV35-10K DC48V MPK**

**AC INPUT: 230VAC, 50/60Hz, 80A MAX**

**ACOUTPUT: 230VAC, 50/60Hz, 12000W**

**DC INPUT: 48V**

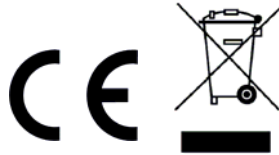
**MPPT Voltage range:64-130VDC**

**MAX Solar Voltage:145VDC**

**Rated Current:60A/120V**

**Importer: XXX**

**Address: XXX**



**Made In China**

**SHENZHEN MUST ENERGY TECHNOLOGY CO.,LTD**

4-5F, Building A11, Yusheng Industrial Park, NO.467,  
Section XiXiang, National Highway 107, XiXiang, Baoan  
District, Shenzhen, China

IEC 62109-1			
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°C , 48%, 98kPa	P
4.2.2.2	State of equipment		P
4.2.2.3	Position of equipment		P
4.2.2.4	Accessories		P
4.2.2.5	Covers and removable parts		P
4.2.2.6	Mains supply		P
4.2.2.7	Supply ports other than the mains		P
4.2.2.7.1	Photovoltaic supply sources		P
4.2.2.7.2	Battery inputs		N
4.2.2.8	Conditions of loading for output ports		P
4.2.2.9	Earthing terminals		N
4.2.2.10	Controls		P
4.2.2.11	Available short circuit current		P
4.3	Thermal testing		P
4.3.1	General		P
	Normal load condition		---
4.3.2	Maximum temperatures	(see appended table 4.3)	P
4.3.2.1	General		P
4.3.2.2	Touch temperatures	(see appended table 4.3)	P
4.3.2.3	Temperature limits for mounting surfaces	(see appended table 4.3)	P
4.4	Testing in single fault condition		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	(see appended table 4.4.4.1)	P
4.4.4.2	Equipment or parts for short-term or intermittent operation		P
4.4.4.3	Motors		P
4.4.4.4	Transformer short circuit tests		P
4.4.4.5	Output short circuit		P

IEC 62109-1			
Clause	Requirement + Test	Result - Remark	Verdict
4.4.4.6	Backfeed current test for equipment with more than one source of supply		P
4.4.4.7	Output overload	(see appended table 4.4.4.7)	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		P
4.4.4.12	Voltage selector mismatch		P
4.4.4.13	Mis -wiring with incorrect phase sequence or polarity		P
4.4.4.14	Printed wiring board short-circuit test		P
4.4.4.15 of 62109-2	Fault-tolerance of protection for grid - interactive inverters		P
4.4.4.15.1 of 62109-2	Fault-tolerance of residual current monitoring		N
4.4.4.15.2 of 62109-2	Fault-tolerance of automatic disconnecting means		N
4.4.4.15.2.1 of 62109-2	General		N
4.4.4.15.2.2 of 62109-2	Design of insulation or separation		N
4.4.4.15.2.3 of 62109-2	Automatic checking of the disconnect means		N
4.4.4.16 of 62109-2	Stand - alone inverters – Load transfer test	(see appended table 4.4.4.1)	N
4.4.4.17 of 62109-2	Cooling system failure – Blanketing test	(see appended table 4.4.4.1)	N
4.5 of 62109-2	Humidity preconditioning		P
4.5.1 of 62109-2	General		P
4.5.2 of 62109-2	Conditions	Humidity:93%,Temperature:40°C	P
4.6 of 62109-2	Backfeed voltage protection		P
4.6.1 of 62109-2	Backfeed tests under normal conditions		P
4.6.2 of 62109-2	Backfeed tests under single-fault conditions		P
4.6.3 of 62109-2	Compliance with backfeed tests	(see appended table 4.6.3)	P
4.7 of 62109-2	Electrical ratings tests		P
4.7.1 of 62109-2	Input ratings	(see appended table 4.7)	P
4.7.1.1 of 62109-2	Measurement requirements for DC input ports		P
4.7.2 of 62109-2	Output ratings	(see appended table 4.7)	P
4.7.3 of 62109-2	Measurement requirements for AC output ports for stand- alone inverters	(see appended table 4.7)	P
4.7.4 of 62109-2	Stand - alone Inverter AC output voltage and frequency	(see appended table 4.7)	P
4.7.4.1 of 62109-2	General		
4.7.4.2 of 62109-2	Steady state output voltage at nominal DC input	>90%,<110%	P
4.7.4.3 of 62109-2	Steady state output voltage across the DC input range	>85%,<110%	N
4.7.4.4 of 62109-2	Load step response of the output voltage at nominal DC input	>85%,<110%	P



IEC 62109-1			
Clause	Requirement + Test	Result - Remark	Verdict
4.7.4.5 of 62109-2	Steady state output frequency	>- 6 %, <+4 %	P
4.7.5 of 62109-2	Stand - alone inverter output voltage waveform		P
4.7.5.1 of 62109-2	General		P
4.7.5.2 of 62109-2	Sinusoidal output voltage waveform requirements	THD<6%	P
4.7.5.3 of 62109-2	Non- sinusoidal output waveform requirements		N
4.7.5.3.1 of 62109-2	General		N
4.7.5.3.2 of 62109-2	Total harmonic distortion	THD<40%	N
4.7.5.3.3 of 62109-2	Waveform slope	<10 V/ μ s	N
4.7.5.3.4 of 62109-2	Peak voltage	<1, 414 X110% X Urms	N
4.7.5.4 of 62109-2	Information requirements for non-sinusoidal waveforms		N
4.7.5.5 of 62109-2	Output voltage waveform requirements for inverters for dedicated loads		N
4.8 of 62109-2	Additional tests for grid- interactive inverters		N
4.8.1 of 62109-2	General requirements regarding inverter isolation and array grounding		N
4.8.2 of 62109-2	Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays		N
4.8.2.1 of 62109-2	Array insulation resistance detection for inverters for ungrounded arrays		N
4.8.2.2 of 62109-2	Array insulation resistance detection for inverters for functionally grounded arrays		N
4.8.3 of 62109-2	Array residual current detection		N
4.8.3.1 of 62109-2	General		N
4.8.3.2 of 62109-2	30 mA touch current type test for isolated inverters		N
4.8.3.3 of 62109-2	Fire hazard residual current type test for isolated inverters		N
4.8.3.4 of 62109-2	Protection by application of RCD's		N
4.8.3.5 of 62109-2	Protection by residual current monitoring		N
4.8.3.5.1 of 62109-2	General		N
4.8.3.5.2 of 62109-2	Test for detection of excessive continuous residual current	<0.3s	N
4.8.3.5.3 of 62109-2	Test for detection of sudden changes in residual current		N
4.8.3.6 of 62109-2	Systems located in closed electrical operating areas		N
5	Marking and documentation		P
5.1	Marking		P
5.1.1	General		P
5.1.2	Durability of markings	(see appended table 5.1.2)	P
5.1.3	Identification		P
	a) the name or trade mark of the manufacturer or supplier;	(See page 3)	P

<b>IEC 62109-1</b>			
Clause	Requirement + Test	Result - Remark	Verdict
	b) a 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 manufacturing batch or date within a three month time period.	(See page 3)	P
5.1.4&5.1.4 of 62109-2	Equipment ratings		P
	PV input ratings, a.c. input ratings, d.c. input (other than PV) ratings	(see page 3)	P
	a.c. output ratings	(see page 3)	P
	Protective class (I, II, or III)	(see page 3)	P
	the ingress protection (IP) rating as in 6.3 below.	(see page 3)	P
5.1.5	Fuse identification		P
5.1.6	Terminals, connections and controls		P
5.1.6.1	Protective conductor terminals		P
5.1.7	Switches and circuit-breakers		P
5.1.8	Class II equipment		P
5.1.9	Terminal boxes for external connections		P
5.2	Warning markings		N
5.2.1	Visibility and legibility requirements for warning markings		P
5.2.2	Content for warning markings		N
5.2.2.1	Ungrounded heatsinks and similar parts		N
5.2.2.2	Hot surfaces		N
5.2.2.3	Coolant		P
5.2.2.4	Stored energy		P
5.2.2.5	Motor guarding		P
5.2.2.6 of 62109-2	Inverters for closed electrical operating areas		P
5.2.3	Sonic hazard markings and instructions		P
5.2.4	Equipment with multiple sources of supply		N
5.2.5	Excessive touch current		P
5.3	Documentation		P
5.3.1	General		P
	a) explanations of equipment markings, including symbols used;		P
	b) location and function of terminals and controls;		P
	c) all ratings or specifications that are necessary to safely install and operate the PCE, including the following environmental ratings along with an explanation of their meaning and any resulting installation requirements:		P
	- Environmental category as per 6.1		P



IEC 62109-1			
Clause	Requirement + Test	Result - Remark	Verdict
	- Wet locations classification as per 6.1		P
	- Pollution degree classification for the intended external environment as per 6.2		P
	- Ingress protection rating as per 6.3		P
	- Ambient temperature and relative humidity ratings		P
	- Maximum altitude rating		P
	- Overvoltage category assigned to each input and output port as per 7.3.7.1.2, accompanied by guidance regarding how to ensure that the installation complies with the required overvoltage categories;		P
	d) a warning that when the photovoltaic array is exposed to light, it supplies a d.c. voltage to the PCE.		P
5.3.1.1	Language	English	P
5.3.1.2	Format		P
5.3.2	Information related to installation		P
5.3.2.1 of 62109-2	Ratings		P
5.3.2.2 of 62109-2	Grid- interactive inverter setpoints		N
5.3.2.3 of 62109-2	Transformers and isolation		N
5.3.2.4 of 62109-2	Transformers required but not provided		N
5.3.2.5 of 62109-2	PV modules for non- isolated inverters		N
5.3.2.6 of 62109-2	Non-sinusoidal output waveform information		N
5.3.2.7 of 62109-2	Systems located in closed electrical operating areas		P
5.3.2.8 of 62109-2	Stand-alone inverter output circuit bonding		P
5.3.2.9 of 62109-2	Protection by application of RCD's		N
5.3.2.10 of 62109-2	Remote indication of faults		N
5.3.2.11 of 62109-2	External array insulation resistance measurement and response		P
5.3.2.12 of 62109-2	Array functional grounding information		P
5.3.2.13 of 62109-2	Stand - alone inverters for dedicated loads		P
5.3.2.14 of 62109-2	Identification of firmware version(s)		P
5.3.3	Information related to operation		P
5.3.4	Information related to maintenance		P
5.3.4.1	Battery maintenance		N
6	Environmental requirements and conditions		N
	- Environmental category, as in 6.1 below		N
	- Suitability for wet locations or not		N
	- Pollution degree rating, as in 6.2 below		N

IEC 62109-1			
Clause	Requirement + Test	Result - Remark	Verdict
	- Ingress protection (IP) rating, as in 6.3 below		N
	- Ultraviolet (UV) exposure rating, as in 6.4 below		N
	- Ambient temperature and relative humidity ratings, as in 6.5 below		N
6.1	Environmental categories and minimum environmental conditions		P
6.1.1	Outdoor		P
	-- Pollution degree	Min. PD3	--
	-- Wet location	Yes	--
	--Ingress protection	Min. IP34	--
	-- Ambient service temperature range	0 °C to +55 °C	--
	-- Relative humidity range	4 % to 100 % (Condensing)	--
	-- UV exposure	Required	--
6.1.2	Indoor, unconditioned		N
	-- Pollution degree	Min. PD3	--
	-- Wet location	No	--
	--Ingress protection	Min. IP20	--
	-- Ambient service temperature range		--
	-- Relative humidity range	5 % to 95 % ( Non condensing)	--
	-- UV exposure	Not required	--
6.1.3	Indoor, conditioned		N
	-- Pollution degree	Min. PD2	--
	-- Wet location	No	--
	--Ingress protection	Min. IP20	--
	-- Ambient service temperature range		--
	-- Relative humidity range	5 % to 85 % ( Non condensing)	--
	-- UV exposure	Not required	--
6.2	Pollution degree	Pollution degree II	P
6.3	Ingress protection	Comply with Table 4 of this standard and be verified in accordance with IEC 60529.	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		P
7.3	Protection against electric shock		P
7.3.1	General		P
7.3.2	Decisive voltage classification		P
7.3.2.1	Use of decisive voltage class (DVC)		P

IEC 62109-1			
Clause	Requirement + Test	Result - Remark	Verdict
7.3.2.2	Limits of DVC		P
7.3.2.3	Short-term limits of accessible voltages under fault conditions		P
7.3.2.4	Requirements for protection		P
7.3.2.5	Connection to PELV and SELV circuits		P
7.3.2.6	Working voltage and DVC		P
7.3.2.6.1	General		P
7.3.2.6.2	AC working voltage		P
7.3.2.6.3	DC working voltage		P
7.3.2.6.4	Pulsating working voltage		P
7.3.3	Protective separation		P
7.3.4	Protection against direct contact		P
7.3.4.1	General		P
7.3.4.2	Protection by means of enclosures and barriers		P
7.3.4.2.1	General		P
7.3.4.2.2	Access probe criteria		P
7.3.4.2.3	Access probe tests		P
	a) Inspection		P
	b)Tests with the test finger (Figure D.1) and test pin (Figure D.2) of Annex D		P
	c)Further tested by means of a straight unjointed test finger (Figure D.3 of Annex D), applied with a force of 30 N		P
	d)tested with the IP3X probe of IEC 60529		P
7.3.4.2.4	Service access areas		P
7.3.4.3	Protection by means of insulation of live parts		P
7.3.4.3	Protection by means of insulation of live parts		P
7.3.5	7.3.5 Protection in case of direct contact		P
7.3.5.1	General		P
7.3.5.2	Protection using decisive voltage class A		P
7.3.5.3	Protection by means of protective impedance		P
7.3.5.3.1	Limitation of current through protective impedance		P
7.3.5.3.2	Limitation of discharging energy through protective impedance		P
7.3.5.4	Protection by means of limited voltages		P
7.3.6	Protection against indirect contact		P
7.3.6.1	General		P
7.3.6.2	Insulation between live parts and accessible conductive parts		P
7.3.6.3	Protective class I - Protective bonding and earthing		N
7.3.6.3.1	General		N

IEC 62109-1			
Clause	Requirement + Test	Result - Remark	Verdict
7.3.6.3.2	Requirements for protective bonding		N
7.3.6.3.3	Rating of protective bonding		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 $\Omega$ during or at the end of the test below.	(see appended table 7.3.6.3)	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.	(see appended table 7.3.6.3)	N
7.3.6.3.3.1	Test current, duration, and acceptance criteria	(see appended table 7.3.6.3)	N
7.3.6.3.4	Protective bonding impedance (routine test)	(see appended table 7.3.6.3)	N
7.3.6.3.5	External protective earthing conductor		N
7.3.6.3.6	Means of connection for the external protective earthing conductor		N
7.3.6.3.6.1	General		N
7.3.6.3.7	Touch current in case of failure of the protective earthing conductor		N
7.3.6.4	Protective class II - Double or reinforced insulation		P
7.3.7	Insulation including clearance and creepage distances		P
7.3.7.1	General		P
7.3.7.1.1	Pollution degree	Pollution degree II	P
7.3.7.1.2	Overvoltage category and Impulse withstand voltage rating		P
7.3.7.1.3	Supply earthing systems		N
	TN system:		N
	TT system:		N
	IT system:		N
7.3.7.1.4	Insulation voltages		P
7.3.7.2	Insulation between a circuit and its surroundings		P
7.3.7.2.1	General		P
7.3.7.2.2	Circuits connected directly to the mains		P
7.3.7.2.3	Circuits other than mains circuits		P
7.3.7.2.4	Insulation between circuits		P
7.3.7.3	Functional insulation		P
7.3.7.4	Clearance distances	(see appended table 7.3.7)	P
7.3.7.4.1	Determination	(see appended table 7.3.7)	P
7.3.7.4.2	Electric field homogeneity	(see appended table 7.3.7)	P
7.3.7.4.3	Clearance to conductive enclosures	(see appended table 7.3.7)	P
7.3.7.5	Creepage distances	(see appended table 7.3.7)	P

IEC 62109-1			
Clause	Requirement + Test	Result - Remark	Verdict
7.3.7.5.1	General	(see appended table 7.3.7)	P
7.3.7.5.2	Voltage	(see appended table 7.3.7)	P
7.3.7.5.3	Materials	Insulating material group IIIa 400 > CTI ≥ 175	P
7.3.7.6	Coating		P
7.3.7.7	PWB spacings for functional insulation		P
7.3.7.8	Solid insulation		P
7.3.7.8.1	General		P
7.3.7.8.2	Requirements for electrical withstand capability of solid insulation		P
7.3.7.8.2.1	Basic, supplemental, reinforced, and double insulation		P
7.3.7.8.2.2	Functional insulation		P
7.3.7.8.3	Thin sheet or tape material		P
7.3.7.8.3.1	General		P
7.3.7.8.3.2	Material thickness not less than 0,2 mm		P
7.3.7.8.3.3	Material thickness less than 0,2 mm		P
7.3.7.8.3.4	Compliance		P
7.3.7.8.4	Printed wiring boards (PWBs)		P
7.3.7.8.4.1	General		P
7.3.7.8.4.2	Use of coating materials		P
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 Detection (RCD) or Monitoring (RCM) device compatibility		N
7.3.9	Protection against shock hazard due to stored energy		P
7.3.9.1	Operator access area	The discharge time<1S	P
7.3.9.2	Service access areas	The discharge time<1S	P
7.3.10 of 62109-2	Additional requirements for stand- alone inverters		
7.3.11 of 62109-2	Functionally grounded arrays		
7.4	Protection against energy hazards		P
7.4.1	Determination of hazardous energy level	(see appended table 7.4.1)	P
7.4.2	Operator access areas		P
7.4.3	Service access areas		P
7.5	Electrical tests related to shock hazard		P
7.5.1	Impulse voltage test (type test)		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	(see appended table 7.5.2)	P
7.5.2.3	Humidity pre-conditioning		P
7.5.2.4	Performing the voltage test	(see appended table 7.5.2)	P
7.5.2.5	Duration of the a.c. or d.c. voltage test	60s	P

IEC 62109-1			
Clause	Requirement + Test	Result - Remark	Verdict
7.5.2.6	Verification of the a.c. or d.c. voltage test	No electrical breakdown occurs and no abnormal current flow	P
7.5.3	Partial discharge test (type test or sample test)	<10pC	P
7.5.4	Touch current measurement (type test)	(see appended table 7.5.4)	P
7.5.5	Equipment with multiple sources of supply		N
8	Protection against mechanical hazards		P
8.1	General		P
8.2	Moving parts		N
8.2.1	Protection of service persons		N
	a) access is not possible without the use of a tool;		N
	b) the instructions for the responsible body include a statement that operators must be trained before being allowed to perform the hazardous operation;		N
	c) there are warning markings (see 5.2) on any covers or parts which have to be removed to obtain access, prohibiting access by untrained operators.		N
	test finger of Figure D.1 of Annex D	Can not touch hazardous moving part	N
8.3	Stability		P
	a) Equipment other than hand-held equipment, is tilted in each direction to an angle of 10° from its normal position.		P
	b) Equipment which has both a height of 1 m or more and a mass of 25 kg or more, and all floor-standing equipment, has a force applied at its top, or at a height of 2 m if the equipment has a height of more than 2 m. The force is 250 N, or 20 % of the weight of the equipment, whichever is less, and is applied in all directions except upwards. Jacks used in normal use, and doors, drawers, etc., intended to be opened by an operator, are in their least favourable positions.		N
	c) Floor-standing equipment has a force of 800 N applied downwards at the point of maximum moment to		N
	1) all horizontal working surfaces;		N



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Clause	Requirement + Test	Result - Remark	Verdict
	2) other surfaces providing an obvious ledge and which are not more than 1 m above floor level.		N
8.4	Provisions for lifting and carrying	(see appended table 8.4)	N
8.5	Wall mounting	(see appended table 8.5)	N
8.6	Expelled parts		P
9	Protection against fire hazards		P
9.1	Resistance to fire		P
9.1.1	Reducing the risk of ignition and spread of flame		P
9.1.2	Conditions for a fire enclosure		P
9.1.2.1	Parts requiring a fire enclosure		P
9.1.2.2	Parts not requiring a fire enclosure		P
9.1.3	Materials requirements for protection against fire hazard		P
9.1.3.1	General		P
9.1.3.2	Materials for fire enclosures		P
9.1.3.3	Materials for components and other parts inside fire enclosures		P
9.1.3.4	Materials for air filter assemblies		P
9.1.4	Openings in fire enclosures		N
9.1.4.1	General		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
9.1.4.4	Equipment for use in a closed electrical operating area		N
9.1.4.5	Doors or covers in fire enclosures		N
9.1.4.6	Additional requirements for openings in transportable equipment		N
9.2	Limited power sources		P
9.2.1	General		P
9.2.2	Limited power source tests	(see appended table 9.2.2)	P
9.3	Short-circuit and overcurrent protection		P
9.3.1	General		P
9.3.2	Number and location of overcurrent protective devices		P
9.3.3	Short-circuit co-ordination (backup protection)		P
9.3.4 of 62109-2	Inverter backfeed current onto the array		N
10	Protection against sonic pressure hazards		P
10.1	General		P
10.2	Sonic pressure and sound level		P
10.2.1	Hazardous noise levels		P
11	Protection against liquid hazards		P
11.1	Liquid containment, pressure and leakage		N
11.2	Fluid pressure and leakage		N
11.2.1	Maximum pressure		N

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Clause	Requirement + Test	Result - Remark	Verdict
11.2.2	Leakage from parts		N
11.2.3	Overpressure safety device		N
11.3	Oil and grease		N
12	Chemical hazards		P
12.1	General		P
13	Physical requirements		P
13.1	Handles and manual controls	(see appended table 13.1)	P
	a)The shape of these parts is such that an axial pull is unlikely to be applied in normal use, the force is:		P
	- 15 N for the operating means of electrical components		P
	- 20 N in other cases		P
	b)the shape is such that an axial pull is likely to be applied, the force is:		N
	- 30 N for the operating means of electrical components		N
	- 50 N in other cases		N
13.1.1	Adjustable controls		P
13.2	Securing of parts		P
13.3	Provisions for external connections		P
13.3.1	General		P
13.3.2	Connection to an a.c. mains supply		N
13.3.2.1	General		N
13.3.2.2	Permanently connected equipment		N
13.3.2.3	Appliance inlets		N
13.3.2.4	Power supply cords		N
13.3.2.5	Cord anchorages and strain relief	(see appended table 13.3.2.5)	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		P
13.3.5	Wire bending space for wires 10 mm <sup>2</sup> and greater		N
13.3.6	Disconnection from supply sources		P
13.3.7	Connectors, plugs and sockets		P
13.3.8	Direct plug-in equipment	≤0.25Nm	N
13.4	Internal wiring and connections		P
13.4.1	General		P
13.4.2	Routing		P
13.4.3	Colour coding		P

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Clause	Requirement + Test	Result - Remark	Verdict
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	<5 mm in any dimension; <1 mm in width regardless of length	N
13.6	Polymeric materials	Metal 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	(see appended table 13.6.2)	N
13.6.3	Polymers serving as solid insulation		N
13.6.3.1	Resistance to arcing		N
13.6.4	UV resistance		N
13.7	Mechanical resistance to deflection, impact, or drop		N
13.7.1	General		P
13.7.2	250 N deflection test for metal enclosures	(see appended table 13.7.2)	N
13.7.3	7 J impact test for polymeric enclosures	(see appended table 13.7.3)	N
13.7.4	Drop test	(see appended table 13.7.4)	N
13.8	Thickness requirements for metal enclosures		N
13.8.1	General		N
13.8.2	Cast metal		N
13.8.3	Sheet metal		N
13.9	Fault indication		N
14	Components	Components, which are certified to IEC or national standards, are applied correctly within their ratings. Components not covered by IEC standards are tested under the conditions present in the equipment.	P
14.1	General		P
14.2	Motor overtemperature protection		P
14.3	Overtemperature protection devices	No overtemperature protection devices	P
14.4	Fuse holders		P
14.5	Mains voltage selecting devices		P
14.6	Printed circuit boards		P
14.7	Circuits or components used as transient overvoltage limiting devices		P
14.8	Batteries		N
14.8.1	Battery enclosure ventilation		N
14.8.1.1	Ventilation requirements		N
14.8.1.2	Ventilation testing		N

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Clause	Requirement + Test	Result - Remark	Verdict
14.8.1.3	Ventilation instructions		N
14.8.2	Battery mounting		N
14.8.3	Electrolyte spillage		N
14.8.4	Battery connections		N
14.8.5	Battery maintenance instructions		N
14.8.6	Battery accessibility and maintainability		N
15	Software and firmware performing safety functions		N
B	Annex B , Programmable equipment		N
B.1	Software or firmware that performs safety critical functions		N
B.2	Evaluation of controls employing software		N
B.2.1	Risk analysis		N
G	Annex G , Clearance and creepage distance determination for frequencies greater than 30 kHz		N
G.1	Clearances	(see appended table 7.3.7)	N
G.2	Creepage distances :	(see appended table 7.3.7)	N
J	Annex J , Ultraviolet light conditioning test(see 13.6.4)		N
J.1	General		N
J.2	Mounting of test samples:		N
J.3	Carbon-arc light-exposure apparatus		N
J.4	Xenon-arc light-exposure apparatus		N

Table

4.3	Table:THERMAL TEST (NORMAL OPERATION)			P
VOLTAGE (V)	A	24		
DURATION				
test until steady condition – temperature change not more than +/-1K/hour				
Supply voltage within ±1% of the test voltage.				
OPERATION MODE / TEST CONDITION:				
1.It shall not vary by more than ±1 °C during measurements and during a preceding period long enough to affect the results.				
2. Measurements shall not be taken until the luminaire has stabilized thermally, i.e. temperatures are changing at a rate less than 1 °C per hour.				
3. a) Supplied by photovoltaic supply sources				
b) Supplied by other d.c sources				
c) The test voltage is 0.9 and 1.1 times the rated voltage range if supplied at mains supply.				
4 Performed under the least favorable loading conditions.				
AMB. TEMP.	t1 = 25.1 °C (before test)	t2 = 25.0 °C	(after test)	
Location / Part (by thermocouple)	Temp. (°C)		Limit(°C)	Result
	A	B		
PCB near D1	110.8	108.9	130	
PCB near BG2	120.7	118.7	130	
Transformer coil	100.4	98.6	110	
Transformer core	98.7	96.3	Ref	
C1 body	92.3	93.2	105	
C2 body	94.5	95.3	105	
Switch	58.9	57.2	85	
C8 body	82.7	82.7	85	
L1 body	117.3	115.3	130	
Input terminal	63.7	62.7	Ref	
Output terminal	69.8	68.9	Ref	

Table

4.4.4.1	TABLE: Component fault tests					P
	Ambient temperature (°C) :				25.0	
Component No.	Fault	Supply voltage (V)	Test time	Fuse current (A)	Observation	
Output	SC	24	3min	--	Unit shut down ,no hazard	
C8	SC	24	3min	--	Unit shut down ,no hazard	
L1	SC	24	3min	--	Unit shut down ,no hazard	
C2	SC	24	3min	--	Unit shut down ,no hazard	
C1	SC	24	3min	--	Unit shut down ,no hazard	
Supplementary information: After fault condition, all output voltage comply with DVC A requirement;						

4.4.4.7	TABLE: Output overload						N
Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation	
Ouput L Output N	Short	24V	10 Min	F1	--	Unit shut down ,no hazard	
Ouput L Output N	Overload	24V	5H	F1	--	The output current: 6.2 A, The maximun temperature were: T1 core= 141.4 °C, T1 coil= 149.9 °C, Ambient= 25.0 °C,	

Supplementary information:  
Following each test, an Electric Strength (ES) potential was applied between the points, noted below, for one minute after the insulation cooled to room temperature.

	Location		Potential Used (V)	
	From	To	[ x ] ac	[ ] dc
A	Primary	Secondary	---	--
B	Primary	Enclosure with metal foil	---	--

4.6.3	TABLE: Compliance with backfeed test				P
PCE terminals (V)	Condition	Time(s)	Result		
V+to V-	Normal	1	10.3V		
V+to V-	Abnormal	1	11.4V		
Remark :					
a)15 s for sources that are permanently connected;					
b) 1 s for sources that are cord-connected or use connectors that can be opened without the use of a tool					

4.7.1	TABLE: Input ratings (in normal conditions)									P
P rated input (W)	P input (W)	U input(V/ D.C)	I input (A/D.C)	U Rated output (V/A.C)	U output (V/A.C)	I output( A/ A.C)	P OUPUT( W/AC)	F rated (Hz)	F (Hz)	condition
--	--	24	25.02	230	230.4	13.44	12000	50	50.1	



Table

--	--	24	25.03	230	230.1	13.40	12000	50	50.1	under maximum normal load
--	--	24	25.03	230	230.4	13.44	12000	50	50.1	
--	--	24	25.01	230	229.5	13.43	12000	50	49.8	
--	--	24	25.03	230	230.1	13.44	12000	50	50.1	
--	--	24	25.01	230	230.4	13.42	12000	60	50.2	
--	--	24	25.03	230	230.4	13.40	12000	50	50.1	
		24	25.07	230	230.8	13.44	12000	60	50.3	
--	--	24	25.01	230	229.7	13.41	12000	50	49.8	No load

Remark:

- a) The steady- state AC output voltage was not be less than 90 % or more than 110 % of the rated nominal voltage with the inverter supplied with its nominal value of DC input voltage
- b) The steady- state AC output frequency did not vary from the nominal value by more than +4 % or – 6 %.

5.1.2	TABLE: durability of marking test				P
Location	Checked by	Time	Result		
External enclosure	isopropyl alcohol	30s	Clearly legible, not have worked loose or become curled at the edges.		

7.3.6.3.3	Table: Rating of protective bonding				N
A current from an a.c. source of 16A is passed for 2min between the earthing terminal or earthing contact via the track on the printed board and each of the accessible metal parts in turn.					
Location between earthing terminal and		Test current (A)	Earthing resistance ( $\Omega$ )	Time (s)	Max. limit
		16		120	0.1 $\Omega$
During and after the test, there shall be no melting, loosening, or other damage that would impair the effectiveness of the protective bonding means.					

7.3.7	TABLE: working voltage measurement			P
Location	Peak Voltage (V)	RMS Voltage (V)	Comments1)	
Transformer pin 1 to pin 6	342	228		
Transformer pin 1 to pin 7	356	230		
Transformer pin 2 to pin 6	420	233		
Transformer pin 2 to pin 7	362	231		
Transformer pin 3 to pin 6	342	229		
Transformer pin 3 to pin 7	404	235		
Transformer pin 5 to pin 6	256	226		
Transformer pin 5 to pin 7	256	220		
Remark: Input:				

7.3.7	TABLE: clearance and creepage distance measurements				P
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Table

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)
L to N	336	230	2	5.5	2.5	5.5
Pri. to sec. of transformers	420	223	4	5.2	5	5.2
Pri. to sec.by PCB	352	226	4	5.9	5	5.9
Remark:						

7.3.9 TABLE: Protection against shock hazard due to stored energy						N
Condition	Voltage after disconnection 1s (V)	Voltage after disconnection 1s (V)	Voltage after disconnection 1s (V)	Voltage after disconnection 1s (V)	Comments	
Normal operating						
Remark:						
Input:						

7.4.1 TABLE: Determination of hazardous energy level				N
Output	Voltage (Max.) (V)	Current (Max.) (A)	VA (Max.) (VA)	
Remark:				
Input: a)Operating under normal operating conditions				
b)the voltage is 2 V or more, and power available after 60 s did not exceeds 240 VA				

7.5.2 TABLE: Voltage test (dielectric strength test) (type test and routine test)				P
Test voltage applied between: From/To	System voltage	Test voltage (V/AC)	Breakdown Yes / No	
Live parts to Output	<71	230	No	
Transformer primary to secondary	<71	230	No	
Transformer core to secondary	<71	230	No	
One layer film tape	<71	120	No	
Remark:				
Test time is 60s				

7.5.4 TABLE: Touch current measurement (type test)							P
Terminal A (Switch "s") of Measuring Instrument Connected to:	Switch "e" Position	Test voltage (V)	Touch Current (mA r.m.s.)				
			Polarity P1/Primary Switch Condition				
			Normal/On	Normal/Off	Reverse/On	Reverse/Off	
Output terminal	closed	24	0.17	--	0.18	--	
The touch current did not be greater than 3,5 mA a.c. or 10 mA d.c							

8.4 Table: Provisions for lifting and carrying				N
Equipment or parts having a mass of 18 kg or more shall be provided with a means for lifting and carrying or directions: A constant evenly distributed load equal to four times the weight of the equipment shall be added to the equipment in the normal direction of the load for a period of 1min.				
Weight of equipment (kg)	Load (kg)	Time (min)	Result	

Table

The handles or grips did not break loose from the equipment and there shall not be any permanent distortion, cracking or other evidence of failure.

8.5	Table: 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 for 1min.				
Weight of equipment (kg)	Load (kg)	Time (min)	Result	
there was be no damage to the bracket or the mounting surface.				

9.2.2	TABLE: limited power source measurement			N
Condition	Output voltage (Uoc) (V)	Output current (Isc) (A)	Apparent power (S) (VA)	
V+ to V-	24.2	13.3	321.8	
1) U <sub>oc</sub> : Output voltage measured with all load circuits disconnected. Voltages are for substantially sinusoidal a.c. and ripple free d.c. For non-sinusoidal a.c. and d.c. with ripple greater than 10 % of the peak, the peak voltage shall not exceed 42,4 V.				
2) I <sub>sc</sub> : Maximum output current with any non-capacitive load, including a short circuit, measured 60 s after application of the load.				
3) S (VA): Maximum output VA with any non-capacitive load measured 60 s after application of the load				
Remark:				

13.1	Handles and manual control			P
operating means of electrical components	Force(N)	30	P	
in other cases	Force(N)	50	P	

13.3.2.5	TABLE: Cord anchorages and strain relief				N
Mass(Kg)	Pull force(N)	Duration	Times	Displaced (≅2mm)	
0.125	30	1s per time	25	0.5	
Remark:					

13.6.2.1	TABLE: Stress relief tes			N
Temperature (°C)	Duration		Result	
96	7H		No soften	

13.7.2	TABLE: 250 N deflection test for metal enclosure				N
Test part	Push force(N)	Duration	Result	Breakdown (Y/N)	
Top	250	5s	No damage	N	
Side	250	5s	No damage	N	
Bottom	250	5s	No damage	N	

13.7.3	TABLE: 7 J impact test for polymeric enclosures				N
Test part	method		Result	Breakdown (Y/N)	
Vertical surfaces of enclosure	Φ 50 steel ball	1300mm	P	N	

Table

Horizontal surfaces of enclosure	Φ50 steel ball	1300 mm	P	N
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13.7.4	TABLE: Drop test			N
Test part	Height (m)	Result		
Top	1.0	No damage		
Side	1.0	No damage		
Bottom	1.0	No damage		

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**Photo Documentation**



**Photo 3**



**Photo 4**





Photo 5



Photo 6

