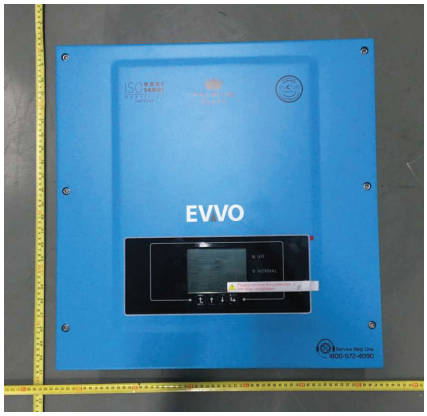
Produkte
Products

TÜVRheinland®

Prüfbericht - Nr.: *Test Report No.:*	50261005 001	**Auftrags-Nr.:** *Order No.:*	168117572	**Seite 1 von 70** *Page 1 of 70*
Kunden-Referenz-Nr.: *Client Reference No.:*	696875	**Auftragsdatum:** *Order date:*	May. 29th, 2019	

Auftraggeber: *Client:*	**EVOLVE ENERGY GROUP CO., LIMITED** RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK
Prüfgegenstand: *Test item:*	PV grid inverter
Bezeichnung / Typ-Nr.: *Identification / Type No.:*	EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P
Auftrags-Inhalt: *Order content:*	TÜV Rheinland TUV mark approval CE-LVD approval
Prüfgrundlage: *Test specification:*	EN 62109-1: 2010, EN 62109-2: 2011, IEC 62109-1: 2010, IEC 62109-2: 2011
Wareneingangsdatum: *Date of receipt::*	May. 29th, 2019
Prüfmuster-Nr.: *Test sample No.:*	SF1ES012H38001
Prüfzeitraum: *Testing period:*	29th, Mar., 2019 -10th, June., 2019
Ort der Prüfung: *Place of testing:*	CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd.
Prüflaboratorium: *Testing Laboratory:*	TÜV Rheinland (Shanghai) Co., Ltd.
Prüfergebnis*: *Test result*:*	Pass



geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
Jun. 12th, 2019	Corney Zhang/ PE		Jun. 12th, 2017	Dean Cao/ TC	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges/ *Other Aspects:*

1. For issuing TÜV mark certificate.
2. This test report consists of testing results according to standard IEC/EN 62109-1:2010 and IEC/EN 62109-2:2011.

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

Prüfmuster vollständig und unbeschädigt
Test item complete and undamaged

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

TUV Rheinland (Shanghai) Co., Ltd.
TÜV Rheinland Building, No. 177, Lane 777, West Guangzhong Road, Jingan District,Shanghai 200072, P.R. China
Tel. : +86 21 61081188 □ Fax : +86 21 61081199 □ Mail: service@cn.tuv.com □ Web: www.tuv.com

Test Report issued under the responsibility of:

TÜVRheinland®

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

Report Number.....:	50261005 001
Date of issue.....:	See cover page
Total number of pages	See cover page
Name of Testing Laboratory preparing the Report .....:	**TÜV Rheinland (Shanghai) Co., Ltd.** TÜV Rheinland Building, No. 177, Lane 777, West Guangzhong Road, Jingan District,Shanghai 200072, P.R. China
Applicant's name .....:	**EVOLVE ENERGY GROUP CO., LIMITED**
Address.....:	RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK
Test specification:	
Standard .....:	IEC 62109-1:2010 (First Edition)
Test procedure.....:	TÜV mark approval
Non-standard test method .....:	N/A
Test Report Form No. .....:	IEC62109_1B
Test Report Form(s) Originator ....:	VDE Testing and Certification Institute
Master TRF .....:	Dated 2016-04

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

This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

Test item description ..... :	Grid-tied PV Inverter
Trade Mark ..... :	EVVO
Manufacturer ..... :	Same as applicant
Model/Type reference ..... :	EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P
Ratings ..... :	See page 5-10 for details.

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**CB Testing Laboratory:**	See cover page	
Testing location/ address ..... :		See cover page	
☐	**Associated CB Testing Laboratory:**		
Testing location/ address ..... :			
Tested by (name, function, signature)..... :			
Approved by (name, function, signature)... :			
☐	**Testing procedure: CTF Stage 1:**		
Testing location/ address ..... :			
Tested by (name, function, signature)..... :			
Approved by (name, function, signature)... :			
☐	**Testing procedure: CTF Stage 2:**		
Testing location/ address ..... :			
Tested by (name + signature)..... :			
Witnessed by (name, function, signature) . :			
Approved by (name, function, signature)... :			
☐	**Testing procedure: CTF Stage 3:**		
☐	**Testing procedure: CTF Stage 4:**		
Testing location/ address ..... :			
Tested by (name, function, signature)..... :			
Witnessed by (name, function, signature) . :			
Approved by (name, function, signature)... :			
Supervised by (name, function, signature) :			

List of Attachments (including a total number of pages in each attachment):

- ATTACHMENT 1 – Test report of IEC/EN 62109-2: 2011 (15 pages)
- ATTACHMENT 2 – Photo Documentation (11 pages)

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
The critical tests were performed for this equipment included clauses 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 5.1.2, 6.3, 6.4, 7.3.2.2, 7.3.2.3, 7.3.4.2.3, 7.3.7.4, 7.3.7.5, 7.3.9, 7.5.1, 7.5.2, 7.5.4, 8.2, 8.5, 10.2, 13.6.2.1, 13.7 in scope of this standard, for temperature test the thermocouples method used, regarding fault condition test simulated faults applied.	**CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd.** Electronic Testing Building Shahe Road Xili Nanshan District, Shenzhen 518055 P.R.China

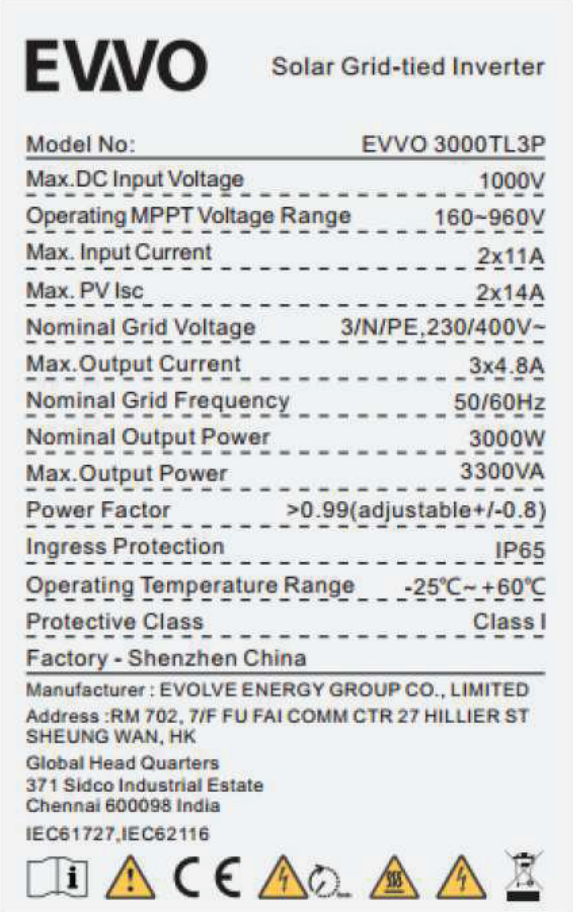
Summary of compliance with National Differences (List of countries addressed):

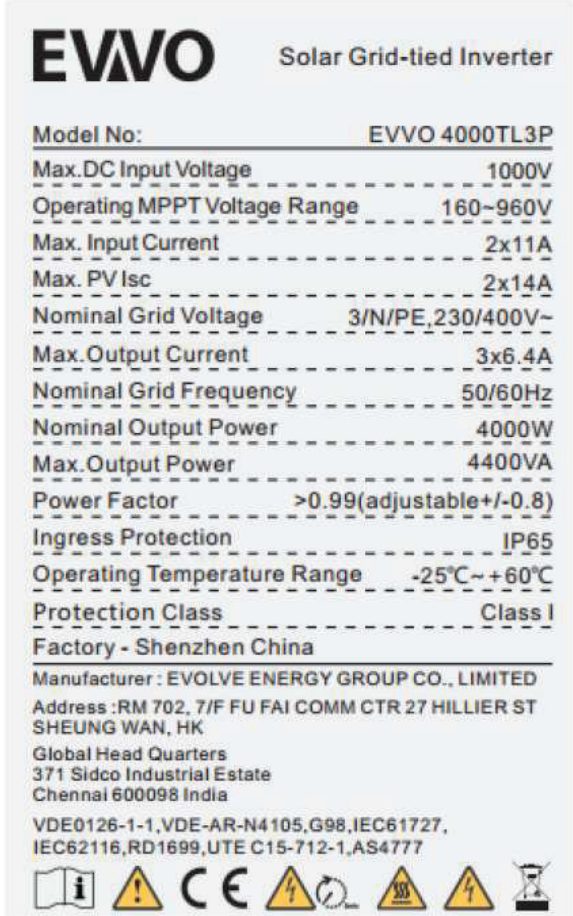
N/A

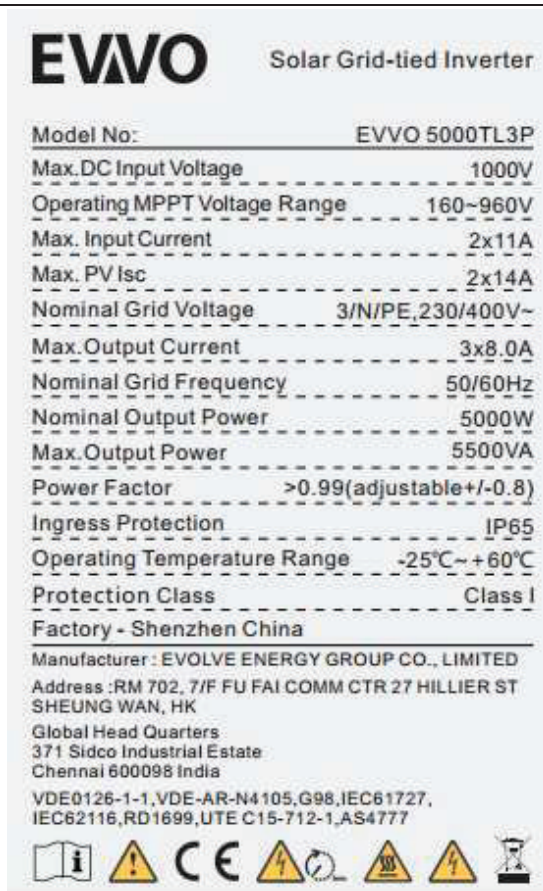
☒ The product fulfils the requirements of IEC/EN 62109-1: 2010 and IEC/EN 62109-2: 2011.

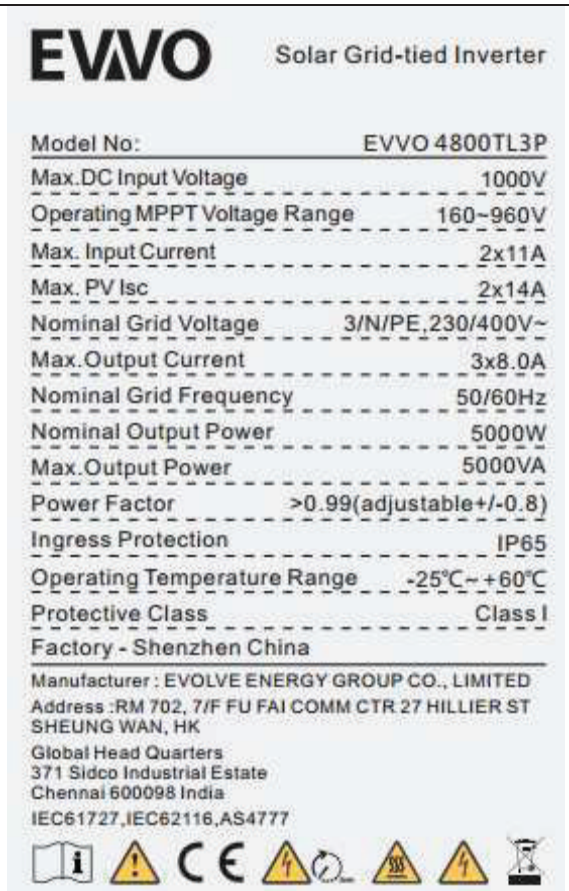
Copy of marking plate:

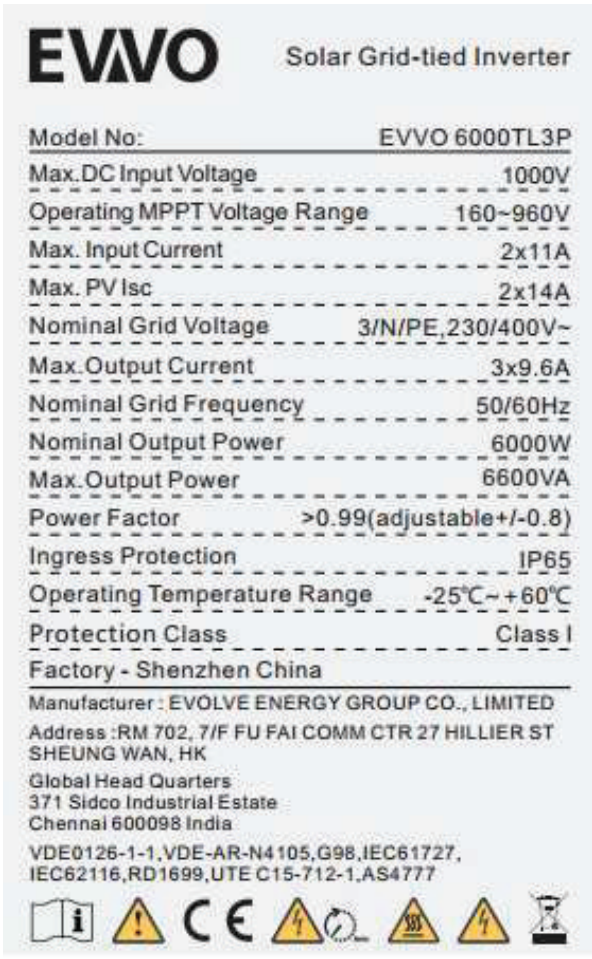
The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.






EVVO
Solar Grid-tied Inverter
Model No: EVVO 5000TL3P
Max.DC Input Voltage 1000V
Operating MPPT Voltage Range 160~960V
Max. Input Current 2x11A
Max. PV Isc 2x14A
Nominal Grid Voltage 3/N/PE,230/400V~
Max.Output Current 3x8.0A
Nominal Grid Frequency 50/60Hz
Nominal Output Power 5000W
Max.Output Power 5500VA
Power Factor >0.99(adjustable+/-0.8)
Ingress Protection IP65
Operating Temperature Range -25℃~+60℃
Protection Class Class I
Factory - Shenzhen China
Manufacturer : EVOLVE ENERGY GROUP CO., LIMITED
Address :RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK
Global Head Quarters
371 Sidco Industrial Estate
Chennai 600098 India
VDE0126-1-1,VDE-AR-N4105,G98,IEC61727, IEC62116,RD1699,UTE C15-712-1,AS4777


EVVO
Solar Grid-tied Inverter
Model No: EVVO 4800TL3P
Max.DC Input Voltage 1000V
Operating MPPT Voltage Range 160~960V
Max. Input Current 2x11A
Max. PV Isc 2x14A
Nominal Grid Voltage 3/N/PE,230/400V~
Max.Output Current 3x8.0A
Nominal Grid Frequency 50/60Hz
Nominal Output Power 5000W
Max.Output Power 5000VA
Power Factor >0.99(adjustable+/-0.8)
Ingress Protection IP65
Operating Temperature Range -25℃~+60℃
Protective Class Class I
Factory - Shenzhen China
Manufacturer : EVOLVE ENERGY GROUP CO., LIMITED
Address :RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK
Global Head Quarters
371 Sidco Industrial Estate
Chennai 600098 India
IEC61727,IEC62116,AS4777



EVVO Solar Grid-tied Inverter

Model No:	EVVO 6000TL3P
Max.DC Input Voltage	1000V
Operating MPPT Voltage Range	160~960V
Max. Input Current	2x11A
Max. PV Isc	2x14A
Nominal Grid Voltage	3/N/PE,230/400V~
Max.Output Current	3x9.6A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	6000W
Max.Output Power	6600VA
Power Factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25℃~+60℃
Protection Class	Class I

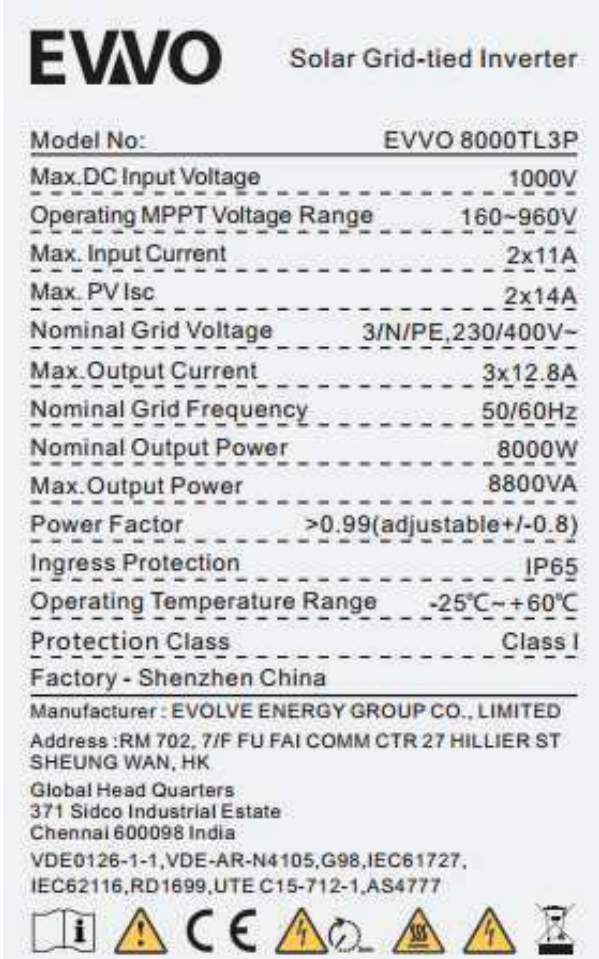
Factory - Shenzhen China

Manufacturer : EVOLVE ENERGY GROUP CO., LIMITED

Address :RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK

Global Head Quarters
371 Sidco Industrial Estate
Chennai 600098 India

VDE0126-1-1,VDE-AR-N4105,G98,IEC61727, IEC62116,RD1699,UTE C15-712-1,AS4777



EVVO Solar Grid-tied Inverter

Model No:	EVVO 8000TL3P
Max.DC Input Voltage	1000V
Operating MPPT Voltage Range	160~960V
Max. Input Current	2x11A
Max. PV Isc	2x14A
Nominal Grid Voltage	3/N/PE,230/400V~
Max.Output Current	3x12.8A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	8000W
Max.Output Power	8800VA
Power Factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25℃~+60℃
Protection Class	Class I

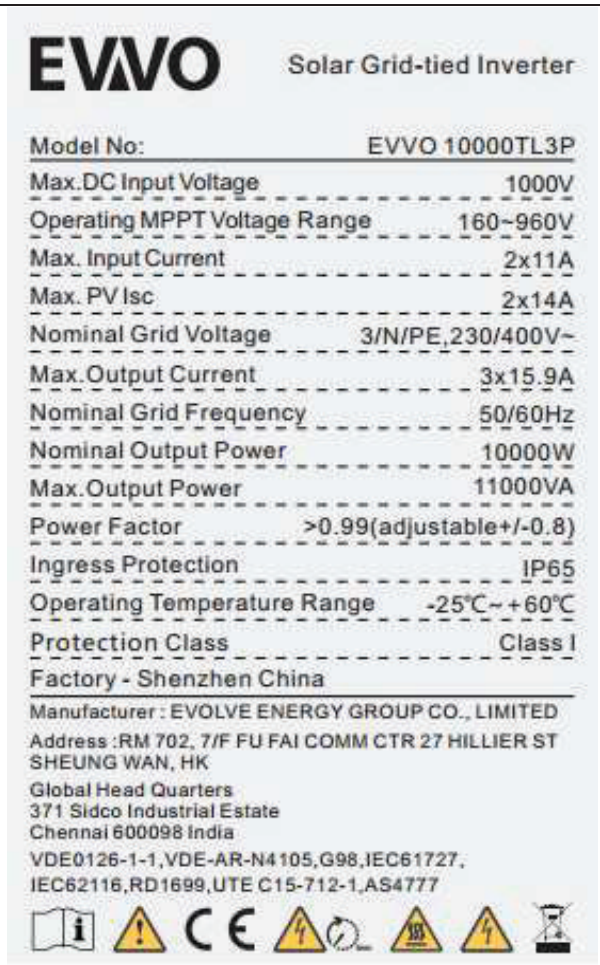
Factory - Shenzhen China

Manufacturer : EVOLVE ENERGY GROUP CO., LIMITED

Address :RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK

Global Head Quarters
371 Sidco Industrial Estate
Chennai 600098 India

VDE0126-1-1,VDE-AR-N4105,G98,IEC61727, IEC62116,RD1699,UTE C15-712-1,AS4777


EVVO
Solar Grid-tied Inverter
Model No: EVVO 10000TL3P
Max.DC Input Voltage 1000V
Operating MPPT Voltage Range 160~960V
Max. Input Current 2x11A
Max. PV Isc 2x14A
Nominal Grid Voltage 3/N/PE,230/400V~
Max.Output Current 3x15.9A
Nominal Grid Frequency 50/60Hz
Nominal Output Power 10000W
Max.Output Power 11000VA
Power Factor >0.99(adjustable+/-0.8)
Ingress Protection IP65
Operating Temperature Range -25℃~+60℃
Protection Class Class I
Factory - Shenzhen China
Manufacturer : EVOLVE ENERGY GROUP CO., LIMITED
Address :RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK
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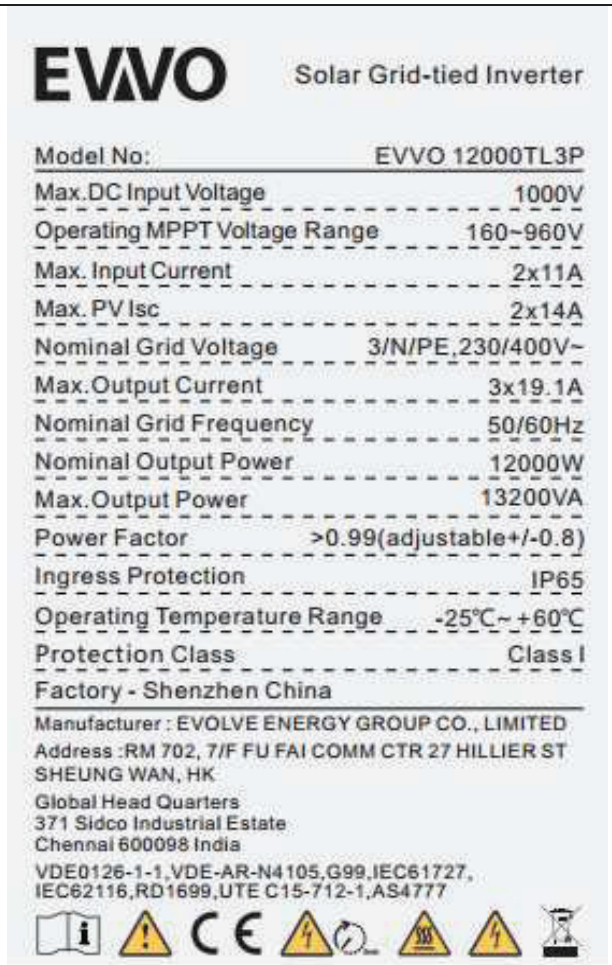
IEC62116,RD1699,UTE C15-712-1,AS4777


EVVO
Solar Grid-tied Inverter
Model No: EVVO 12000TL3P
Max.DC Input Voltage 1000V
Operating MPPT Voltage Range 160~960V
Max. Input Current 2x11A
Max. PV Isc 2x14A
Nominal Grid Voltage 3/N/PE,230/400V~
Max.Output Current 3x19.1A
Nominal Grid Frequency 50/60Hz
Nominal Output Power 12000W
Max.Output Power 13200VA
Power Factor >0.99(adjustable+/-0.8)
Ingress Protection IP65
Operating Temperature Range -25℃~+60℃
Protection Class Class I
Factory - Shenzhen China
Manufacturer : EVOLVE ENERGY GROUP CO., LIMITED
Address :RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK
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Chennai 600098 India
VDE0126-1-1,VDE-AR-N4105,G99,IEC61727,
IEC62116,RD1699,UTE C15-712-1,AS4777

Test item particulars.....:	
Equipment mobility .....:	☐ movable ☐ hand-held ☐ stationary ☒ fixed ☐ transportable ☐ for building-in
Connection to the mains .....:	☐ pluggable equipment ☐ direct plug-in ☒ permanent connection ☐ for building-in
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
IT testing, phase-phase voltage (V).....:	- - -
Class of equipment.....:	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg) .....:	See page 14 for details.
Pollution degree.....:	☐ PD 1 ☐PD 2 ☒ PD 3 (internal reduced to PD 2)
IP protection class.....:	IP65
.....:	
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test object does meet the requirement.....:	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 .....:	See cover page
Date (s) of performance of tests.....:	See cover page

General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **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** ☒ **Not applicable**
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies) ..... :	**Dongguan SOFAR SOLAR Co., Ltd.** 1F-6F, Building E, No.1, JinQi Road, Bihu Industrial Park, Wulian Village, Fengang Town, Dongguan City, Guangdong Province, China.

General product information:

The equipment with model names EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P and EVVO 12000TL3P are single phase un-isolated type PV grid inverter which will be installed and connected to the grid network after installation. In final installation the equipment shall be fixed to suitable manner as specified in the installation instruction. See table 1 below for the detailed information of the models.

For the models EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P and EVVO 6000TL3P, they are identical on hardware except the rated power changed by the software, and the models EVVO 8000TL3P, EVVO 10000TL3P and EVVO 12000TL3P are identical on hardware except the rated power changed by the software.

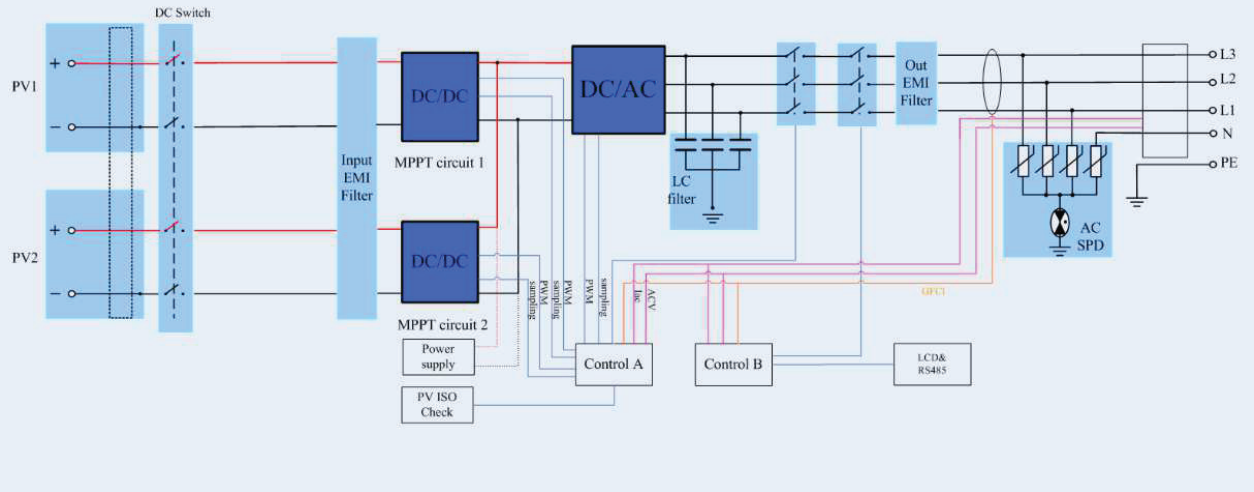
The only differences on hardware between the models EVVO 6000TL3P and EVVO 12000TL3P are those
1. There is only 2 BUS cap of 75uF/600V for model EVVO 6000TL3P while there are 4 used for model EVVO 12000TL3P.
2. The main output inductor is NPS226060*2 2.2Φ*1P*67Ts L=1.24mH for model EVVO 6000TL3P while it's NPS226060*2+NPF226060*1 2.0Φ*2P*42Ts L=0.73mH for model EVVO 12000TL3P.

There is a LCD screen to monitor the status of the inverter by proprietary software, meanwhile a communication RS485 to the computer also can monitor the status of the inverter by proprietary and control the PCE.
The maximum ambient temperature permitted by the manufacturer's specification is 60°C and derate the output power from 45°C.

Table 1.

MODELS LIST		EVVO 3000TL 3P	EVVO 4000TL 3P	EVVO 4800TL 3P	EVVO 5000TL 3P	EVVO 6000TL 3P	EVVO 8000TL 3P	EVVO 10000T L3P	EVVO 12000T L3P
PV INPUT	V_{MAX} PV [Vdc]	1000	1000	1000	1000	1000	1000	1000	1000
	I_{SC} PV [A]	14A/14A	14A/14A	14A/14A	14A/14A	14A/14A	14A/14A	14A/14A	14A/14A
	MPPT Voltage Range V_{MPP} [Vdc]	160-960	160-960	160-960	160-960	160-960	160-960	160-960	160-960
	Max. Input Current I_{MAX} [A] (A/B) (each MPPT if more than 1)	11A/11A	11A/11A	11A/11A	11A/11A	11A/11A	11A/11A	11A/11A	11A/11A
	MPPT Full Power Voltage Range [Vdc]	160-850	190-850	240-850	240-850	290-850	380-850	480-850	575-850
	Overvoltage Category (OVC)	II	II	II	II	II	II	II	II
AC OUTPUT	Rated Output Voltage Ur [Vac]	3/N/PE 400	3/N/PE 400	3/N/PE 400	3/N/PE 400	3/N/PE 400	3/N/PE 400	3/N/PE 400	3/N/PE 400
	Operating Voltage Adjustable Range Un [Vac]	184-275	184-275	184-275	184-275	184-275	184-275	184-275	184-275
	Rated Output Frequency F_{NETZ} [Hz]	50	50	50	50	50	50	50	50
	Rated Output Power P_E [kW]	3	4	5	5	6	8	10	12
	Max. Output Power P_{Emax} [kW]	3.3	4	5	5	6	8	10	12
	Max. Apparent power S_{Emax} [VA]	3.3	4.4	5	5.5	6.6	8.8	11	13.2
	PGS S_{Emax} [kVA]	No limit	No limit	No limit	No limit	No limit	No limit	No limit	No limit
	Rated Output Current Ir [A]	4.8	6.4	8.0	8.0	9.6	12.8	15.9	19.1
	Max. Output Current Imax [A]	4.8	6.4	8.0	8.0	9.6	12.8	15.9	19.1

	Power Factor cosφ [λ]	$0.8_{under-excited}$ - $0.8_{over-excited}$							
	Efficiency max. η_{max}	98%	98%	98%	98%	98%	98.3%	98.3%	98.3%
	Night Power Consumption [W]	<1	<1	<1	<1	<1	<1	<1	<1
	THD [V / I] (100% full power)	<3%	<3%	<3%	<3%	<3%	<3%	<3%	<3%
	Acoustic Noise [dB]	<35	<35	<35	<35	<35	<35	<35	<35
	Overvoltage Category (OVC)	III							
PV & GRID CONNECTION	Array Insulation Resistance Detection [Ω]	100k (> V_{MAX} PV/30mA)							
	The accuracy of resistance measurement [%/Ω]	1%							
CONSTRUCTION	Type of inverter	Non-insulated							
	Type of NS Protection	Integrated							
	Separated by	Transformerless							
	MPPT strings	2							
	MPPT tracking	2							
	Protective Class	I							
	Enclosure Protection (IP)	IP65							
	Operating Temperature Range [ºC]	-25 to 60 (> 45 derating)							
	Pollution degree (PD)	PD 2(inside), PD3(outside)							
	Altitude [m]	2000							
	Size [mm]	483*452 *200	483*452 *200	483*452 *200	483*452 *200	483*452 *200	483*452 *200	483*452 *200	483*452 *200
	Weight [kg]	21	21	21	21	21	22	22	22
Note:									



Block diagram

1) Definition of circuits inside of the PV inverter

I. PV input circuits

PV input circuits are directly connected to the PV array and the voltage can be up to 1000Vdc.
Decisive voltage C considered for the PV voltage side.

II. AC output to the AC mains

AC output will be 230Vac.
Decisive voltage C considered for the AC voltage side.

III. Communication

The communication terminal (RS485) can be connected to COM-port (RS485) of a PC or laptop for monitoring via the host monitoring software.
Decisive voltage A considered for the communication side.

2) Isolation used in the product

Protective separation applied between decisive voltage A and decisive voltage C with corresponding overvoltage category.

3) Cooling method

Physical cooling by metal heat sink.

4) Isolation between decisive voltage A and decisive voltage C

Reinforced insulation provided in the product to separate those two parts.

General Test Conditions are:

All tests are conducted on models EVVO 6000TL3P and EVVO 12000TL3P to represent all the models.
The tests of PV inverter were carried out under the most unfavorable combination within the manufacturer's operating specifications of the following parameters:

-DC input voltage Max. 1000Vd.c.
-operating temperature, Max. Ambient temperature 60°C declared by the client.
-operating mode: continuous.
- AC output: the AC output: the highest output is 100% of rated voltage.
The input voltage range of MPPT with full load see table 1 for detail.

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	Considered.	P
4.2.2	Reference test conditions	Considered.	P
4.2.2.1	Environmental conditions		P
4.2.2.2	State of equipment		P
4.2.2.3	Position of equipment		P
4.2.2.4	Accessories	Considered.	P
4.2.2.5	Covers and removable parts		P
4.2.2.6	Mains supply a) Voltage: b) Frequency: c) Polarity: d) Earthing: e) Over-current Protection:	(see appended table 4.2.2.6)	P
4.2.2.7	Supply ports other than the mains	Considered.	P
4.2.2.7.1	Photovoltaic supply sources a) Open circuit voltage: b) Short-circuit current:	(see appended table 4.2.2.7)	P
4.2.2.7.2	Battery inputs	No battery input.	N/A
4.2.2.8	Conditions of loading for output ports		P
4.2.2.9	Earthing terminals		P
4.2.2.10	Controls		P
4.2.2.11	Available short circuit current	Considered.	P
4.3	Thermal testing	(see appended table 4.3)	P
4.3.1	General		P
4.3.2	Maximum temperatures		P
4.3.2.1	General	Maximum environment temperature of EUT is 60°C.	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	Considered.	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		P
4.4.4.3	Motors	No such device.	N/A
4.4.4.4	Transformer short circuit tests		P
4.4.4.5	Output short circuit		P
4.4.4.6	Backfeed current test for equipment with more than one source of supply		P
4.4.4.7	Output overload		P
4.4.4.8	Cooling system failure		P
4.4.4.9	Heating devices	No such device.	N/A
4.4.4.10	Safety interlock systems	No such device.	N/A
4.4.4.11	Reverse d.c. connections		P
4.4.4.12	Voltage selector mismatch	No such device.	N/A
4.4.4.13	Mis-wiring with incorrect phase sequence or polarity	Single phase.	N/A
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	(see appended table 4.2.2.6)	P
4.7.1	Input ratings		P
4.7.1.1	Measurement requirements for DC input ports		P
4.7.2	Output ratings		P

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Clause	Requirement – Test	Result – Remark	Verdict

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.		P
	Graphic symbols shall be explained in the documentation provided with the PCE.		P
5.1.2	Durability of markings		P
	Markings required by this clause to be located on the PCE shall remain clear and legible under conditions of NORMAL USE and resist the effects of cleaning agents specified by the manufacturer	The label was subjected to the permanence of marking test. The label was rubbed with cloth soaked with water for 30 sec. And then again for 30 sec. With the cloth soaked with petroleum spirit. After this test there was no damage to the label. The marking on the label did not fade. There was no curling or lifting of the label edge.	P
5.1.3	Identification		P
	The equipment shall, as a minimum, be permanently marked with:		P
	a) the name or trade mark of the manufacturer or supplier	See copy of marking plate	P
	b) model number, name or other means to identify the equipment	See copy of marking plate	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 copy of marking plate	P
5.1.4	Equipment ratings		P
	Unless otherwise specified in another part of IEC 62109, the following ratings, as applicable shall be marked on the equipment:	See copy of marking plate	P
	– input voltage, type of voltage (a.c. or d.c.), frequency, and max. continuous current for each input	See copy of marking plate	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 copy of marking plate	P

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Clause	Requirement – Test	Result – Remark	Verdict
	– the ingress protection (IP) rating as in 6.3 below	IP65	P
5.1.5	Fuse identification		P
	Marking shall be located adjacent to each fuse or fuseholder, or on the fuseholder, or in another location provided that it is obvious to which fuse the marking applies, giving the fuse current rating and where fuses of different voltage rating value could be fitted, the fuse voltage rating.	No such device.	N/A
	Where fuses with special fusing characteristics such as time delay or breaking capacity are necessary, the type shall also be indicated		N/A
	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.	Fuses used and not located in operator access areas. The fuse information contain in the maintenance manual	N/A
5.1.6	Terminals, Connections, and Controls		P
	If necessary for safety, an indication shall be given of the purpose of Terminals, connectors, controls, and indicators, and their various positions, including any connections for coolant fluids such as water and drainage. The symbols in Annex C may be used, and where there is insufficient space, symbol 9 of Annex C may be used.		P
	Push-buttons and actuators of emergency stop devices, and indicator lamps used only to indicate a warning of danger or the need for urgent action shall be coloured red.	Emergency stop device will be supplied by the final installation and the requirements are specified in the user manual.	N/A
	A multiple-voltage unit shall be marked to indicate the particular voltage for which it is set when shipped from the factory. The marking is allowed to be in the form of a paper tag or any other non-permanent material.		N/A
	A unit with d.c. terminals shall be plainly marked indicating the polarity of the connections, with:		P
	– the sign “+“ for positive and “-„ for negative; or		P
	– a pictorial representation illustrating the proper polarity where the correct polarity can be unambiguously determined from the representation	See only above.	N/A
5.1.6.1	Protective Conductor Terminals		P
	The means of connection for the protective earthing conductor shall be marked with:		P
	– symbol 7 of Annex C; or	The colour coding green-yellow.	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	– the letters “PE“; or		N/A
	– the colour coding green-yellow.		P
5.1.7	Switches and circuit-breakers		P
	The on and off-positions of switches and circuits breakers shall be clearly marked. If a push-button switch is used as the power switch, symbols 10 and 16 of Annex C may be used to indicate the on-position, or symbols 11 and 17 to indicate the off-position, with the pair of symbols (10 and 16, or 11 and 17) close together.	The DC breaker has marked the “ON” position denote for running mode, “OFF” position denote for stopping mode.	P
5.1.8	Class II Equipment	Class I equipment	N/A
	Equipment using Class II protective means throughout shall be marked with symbol 12 of Annex C. Equipment which is only partially protected by DOUBLE INSULATION or REINFORCED INSULATION shall not bear symbol 12 of Table Annex C.		N/A
	Where such equipment has provision for the connection of an earthing conductor for functional reasons (see 7.3.6.4) it shall be marked with symbol 6 of Annex C		N/A
5.1.9	Terminal boxes for External Connections		P
	Where required by note 1 of Table 2 as a result of high temperatures of terminals or parts in the wiring compartment, there shall be a marking, visible beside the terminal before connection, of either:	No such high temperature of terminals or parts	N/A
	a) the minimum temperature Rating and size of the cable to be connected to the TERMINALS; or		N/A
	b) a marking to warn the installer to consult the installation instruction. Symbol 9 of Table D-1 is an acceptable marking		N/A
5.2	Warning markings		P
5.2.1	Visibility and legibility requirements for warning markings		P
	Warning markings shall be legible, and shall have minimum dimensions as follows:		P
	– Printed symbols shall be at least 2,75 mm high	Considered.	P
	– Printed text characters shall be at least 1.5 mm high and shall contrast in colour with the background	Considered.	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.	Considered.	P

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Clause	Requirement – Test	Result – Remark	Verdict
	If it is necessary to refer to the instruction manual to preserve the protection afforded by the equipment, the equipment shall be marked with symbol 9 of Annex C	Considered.	P
	Symbol 9 of Annex C is not required to be used adjacent to symbols that are explained in the manual		P
5.2.2	Content for warning markings		P
5.2.2.1	Ungrounded heat sinks and similar parts		P
	An ungrounded heat sink or other part that may be mistaken for a grounded part and involves a risk of electric shock in accordance with 7.3 shall be marked with symbol 13 of Annex C, or equivalent. The marking may be on or adjacent to the 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.	Marked with symbol 13 of Annex C	P
5.2.2.2	Hot Surfaces		P
	A part of the PCE that exceeds the temperature limits specified in 4.3.2 shall be marked with symbol 14 of Annex C or equivalent.	Symbol 14 of Annex C used.	P
5.2.2.3	Coolant	No coolant used inside.	N/A
	A unit containing coolant that exceeds 70 °C shall be legibly marked externally where readily visible after installation with symbol 15 of Annex C. The documentation shall provide a warning regarding the risk of burns from hot coolant, and either:		N/A
	a) statement that coolant system servicing is to be done only by SERVICE PERSONNEL, or		N/A
	b) instructions for safe venting, draining, or otherwise working on the cooling system, if these operations can be performed without OPERATOR access to HAZARDS internal to the equipment		N/A
5.2.2.4	Stored energy		P
	Where required by 7.3.9.2 or 7.4.2 the PCE shall be marked with Symbol 21 of Annex C and the time to discharge capacitors to safe voltage and energy levels shall accompany the symbol.	Marked with symbol 21 of Annex C and the time to discharge capacitors to safety voltage and energy levels.	P
5.2.2.5	Motor guarding	No motor used in the appliance.	N/A
	Where required by 8.2 a marking shall be provided where it is visible to service personnel before removal of a guard, warning of the hazard and giving instructions for safe servicing (for example disconnection of the source before removing the guard).		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
5.2.3	Sonic hazard markings and instructions	No sonic hazard	N/A
	If required by 10.2.1 a PCE shall:		N/A
	a) be marked to warn the operator of the sonic pressure hazard; or		N/A
	b) be provided with installation instructions that specify how the installer can 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/A
5.2.4	Equipment with multiple sources of supply		P
	A PCE with connections for multiple energy sources shall be marked with symbol 13 of Annex C and the manual shall contain the information required in 5.3.4.	 used and related information specified.	P
	The symbol shall be located on the outside of the unit or shall be prominently visible behind any cover giving access to hazardous parts.		P
5.2.5	Excessive touch current		N/A
	Where required by 7.3.6.3.7 the PCE shall be marked with symbol 15 of Annex C. See also 5.3.2 for information to be provided in the installation manual.	Test of touch current result is maximum 1.71mA<3.5mA	N/A
5.3	Documentation		P
5.3.1	General		P
	The documentation provided with the PCE shall provide the information needed for the safe operation, installation, and (where applicable) maintenance of the equipment. The documentation shall include the items required in 5.3.2 through 5.3.4, and the following:		P
	a) explanations of equipment makings, including symbols used		P
	b) location and function of terminals and controls		P
	c) all ratings or specifications that are necessary to safely install and operate the PCE, including the following environmental ratings along with an explanation of their meaning and any resulting installation requirements:		P
	– ENVIRONMENTAL CATEGORY as per 6.1		P
	– WET LOCATIONS classification fort he intended external environment as per 6.1		P

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Clause	Requirement – Test	Result – Remark	Verdict
	– POLLUTION DEGREE classification for the intended external environment as per 6.2		P
	– INGRESS PROTECTION rating as per 6.3		P
	– Ambient temperature and relative humidity ratings		P
	– MAXIMUM altitude rating	2000m	P
	– OVERVOLTAGE CATEGORY assigned to each input and output port as per 7.3.7.1.2, accompanied by guidance regarding how to ensure that the installation complies with the required overvoltage categories;	OVC III for AC connection. OVC II for DC connection.	P
	d) a warning that when the photovoltaic array is exposed to light, it supplies a d.c. voltage to the PCE	Provided in the instruction manual.	P
5.3.1.1	Language	English version specification and instruction provided	P
	Instructions related to safety shall be in a language that is acceptable in the country where the equipment is to be installed.		P
5.3.1.2	Format		P
	In general, the documentation must be provided in printed form and is to be delivered with the equipment.	Paper version and electronic version will be sent to the customer once sold to end client.	P
	For equipment which requires the use of a computer for both installation and operation, documentation may be provided in electronic format without accompanying printed format.		P
5.3.2	Information related to installation	Provided in the instruction 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		P

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Clause	Requirement – Test	Result – Remark	Verdict
	from the PCE, and any requirements related to wiring and externals controls, colour coding of leads, or overcurrent protection needed;		
	d) explanation of the pin-out of connectors for external connections, unless the connector is used for a standard purpose (e.g. RS 232)	Standard connector used.	N/A
	e) ventilation requirements;		N/A
	f) requirements for special services, for example cooling liquid;	No such special services.	N/A
	g) instructions and information relating to sound pressure level if required by 10.2.1;		N/A
	h) where required by 14.8.1.3, instructions for the adequate ventilation of the room or location in which PCE containing vented or valve-regulated batteries is located, to prevent the accumulation of hazardous gases;		N/A
	i) tightening torque to be applied to wiring terminals;		P
	j) values of backfeed short-circuit currents available from the PCE on input and output conductors under fault conditions, if those currents exceed the max. rated current of the circuit, as per 4.4.4.6;		N/A
	k) for each input to the PCE, the max value of short-circuit current available from the source, for which the PCE is designed; and		P
	l) compatibility with RCD and RCM;	Integrated RCMUs.	N/A
	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:	Second protective earthing conductor not used.	N/A
	n) where required by 7.3.8, the installation instructions shall include the following or equivalent wording:		N/A
	“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/A
	o) for PCE intended to charge batteries, the battery nominal voltage rating, size, and type	Instruction provided.	P
	p) PV array configuration information, such as ratings, whether the array is to be grounded or floating, any external protection devices needed, etc.		N/A
5.3.3	Information related to operation	All below related informations	P

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Clause	Requirement – Test	Result – Remark	Verdict
		provided in the user's manual.	
	Instructions for use shall include any operating instructions necessary to ensure safe operation, including the following, as applicable:		P
	– Instructions for adjustment of controls including the effects of adjustment;		P
	– Instructions for interconnection to accessories and other equipment, including indication of suitable accessories, detachable parts and any special materials;		P
	– Warnings regarding the risk of burns from surfaces permitted to exceed the temperature limits of 4.3.2 and required operator actions to reduce the risk; and	Symbol 14 of Annex C used.	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	All below related informations provided in the service manual.	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;		P
	– Instructions for safe cleaning (if recommended)		N/A
	– Where there is more than one source of supply energizing the PCE, information shall be provided in the manual to indicate which disconnect device or devices are required to be operated in order to completely isolate the equipment.		P
5.3.4.1	Battery maintenance		N/A
	Where required by 14.8.5, the documentation shall include the applicable items from the following list of instructions regarding maintenance of batteries:		N/A
	– Servicing of batteries should be performed or supervised by personnel knowledgeable about batteries and the required precautions		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	– When replacing batteries, replace with the same type and number of batteries or battery packs		N/A
	– General instructions regarding removal and installation of batteries		N/A
	– CAUTION: Do not dispose of batteries in a fire. The batteries may explode.		N/A
	– CAUTION: Do not open or damage batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.		N/A
	– CAUTION: A battery can present a risk of electrical shock and high short-circuit current. The following precautions should be observed when working on batteries:		N/A
	a) Remove watches, rings, or other metal objects.		N/A
	b) Use tools with insulated handles.	DVC-A circuit.	N/A
	c) Wear rubber gloves and boots.	DVC-A circuit.	N/A
	d) Do not lay tools or metal parts on top of batteries		N/A
	e) Disconnect charging source prior to connecting or disconnecting battery terminals		N/A
	f) Determine if battery is inadvertently grounded. If inadvertently grounded, remove source from ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock can be reduced if such grounds are removed during installation and maintenance (applicable to equipment and remote battery supplies not having a grounded supply circuit).	DVC-A circuit.	N/A
6	**ENVIRONMENTAL REQUIREMENTS AND CONDITIONS**		P
	The manufacturer shall rate the PCE for the following environmental conditions:		P
	– ENVIRONMENTAL CATEGORY, as in 6.1 below		P
	– Suitability for WET LOCATIONS or not		P
	– POLLUTION DEGREE rating in 6.2 below	See clause 6.2 below	P
	– INGRESS PROTECTION (IP) rating, as in 6.3 below	See clause 6.3 below	P
	– Ultraviolet (UV) exposure rating, as in 6.4 below	See clause 6.4 below	P
	– Ambient temperature and relative humidity ratings, as in 6.5 below	See clause 6.5 below	
6.1	Environmental categories and minimum environmental conditions		P
6.1.1	Outdoor	Outdoor use.	P

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Clause	Requirement – Test	Result – Remark	Verdict
6.1.2	Indoor, unconditioned		N/A
6.1.3	Indoor, conditioned		N/A
6.2	Pollution degree	Pollution degree 2	P
6.3	Ingress Protection	IP65	P
6.4	UV exposure		P
6.5	Temperature and humidity	-25-60°C, 4%-100% humidity	P
7	**PROTECTION AGAINST ELECTRIC SHOCK AND ENERGY HAZARDS**		P
7.1	General		P
7.2	Fault conditions	Suitable protection provided against electric shock under fault conditions.	P
7.3	Protection against electric shock		P
7.3.1	General	See below	P
7.3.2	Decisive voltage classification	Considered.	P
7.3.2.1	Use of decisive voltage class (DVC)		P
7.3.2.2	Limits of DVC (according table 6)	DVC-C for >50Vrms/71Vpeak. DVC-C for >120Vdc. DVC-A for <25Vrms or 35.4Vpeak. DVC-A for <60Vdc.	P
7.3.2.3	Short-terms limits of accessible voltages under fault conditions	No parts were exceed DVC-A level.	P
7.3.2.4	Requirements for protection (according table 7)		P
7.3.2.5	Connection to PELV and SELV circuits	Considered.	P
7.3.2.6	Working voltage and DVC	DVC-A and DVC-C circuits within PCE.	P
7.3.2.6.1	General		P
7.3.2.6.2	AC working voltage (see Figure 2)	Max. 275 Va.c. for all models	P
7.3.2.6.3	DC working voltage (see Figure 3)	Max. 1000 Vd.c.	P
7.3.2.6.4	Pulsating working voltage (see Figure 4)		P
7.3.3	protective separation		P
	Protective separation shall be achieved by:		P
	▪ double or reinforced insulation, or	Protective separation applied between decisive voltage C and accessible unearthed parts with corresponding overvoltage category.	P
	▪ protective screening, i.e. by a conductive screen connected to earth by protective bonding in the PCE, or connected to the protective earth conductor itself, whereby the screen is separated from live parts by at least	Protective separation applied between decisive voltage C and accessible earthed metal enclosure with corresponding overvoltage category.	P

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Clause	Requirement – Test	Result – Remark	Verdict
	basic insulation, or		
	▪ protective impedance comprising limitation of current per 7.3.5.3 and of discharged energy per 7.3.5.4, or	Controlled high impedance resistors used.	P
	▪ limitation of voltage according to 7.3.5.4.		P
	The protective separation shall be fully and effectively maintained under all conditions of intended use of the PCE		
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).	Earthed metal enclosure used.	P
	Open type sub-assemblies and devices do not require protective measures against direct contact but the instruction provided with the equipment must indicate that such measures must be provided in the end equipment or in the installation.		N/A
	Product intended for installation in CLOSED ELECTRICAL OPERATING AREAS, (see 3.9) need not have protective measures against direct contact, except as required by 7.3.4.2.4.		N/A
7.3.4.2	Protection by means of enclosures and barriers		P
	The following requirements apply where protection against contact with live parts is provided by enclosures or barriers, not by insulation in accordance with 7.3.4.3.		P
7.3.4.2.1	General		P
	Parts of enclosures and barriers that provide protection in accordance with these requirements shall not be removable without the use of a tool (see 7.3.4.2.3).	Barrier can't be removed without use of tools	P
	Polymeric materials used to meet these requirements shall also meet the requirements of 13.6	Approved plastic material used as part of the fire enclosure.	P
7.3.4.2.2	Access probe criteria		P
	Protection is considered to be achieved when the separation between the test probes and live parts, when tested as described below, is as follows:		P
	a) decisive voltage classification A, (DVC A) - the probe may touch the live parts	Considered.	P
	b) decisive voltage classification B, (DVC B) - the probe must not touch bare live parts	Considered.	P

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Clause	Requirement – Test	Result – Remark	Verdict
	c) decisive voltage classification C, (DVC C) – the probe must have adequate clearance to live parts, based on the clearance for Basic insulation using the recurring peak working voltage involved,	Considered.	P
7.3.4.2.3	Access probe tests	No access with test finger and test pin to any hazardous parts.	P
	Compliance with 7.3.4.2.1 is checked by all of the following:	IP65 appliance.	P
	a) Inspection; and		P
	b) Tests with the test finger (Figure D.1) and test pin (Figure D.2) of 0E, the results of which shall comply with the requirements of 7.3.4.2.1 a), b), and c) as applicable. Probe tests are performed on openings in the enclosures after removal of parts that can be detached or opened by an operator without the use of a tool, including fuseholders, and with operator access doors and covers open. It is permitted to leave lamps in place for this test. Connectors that can be separated by an operator without use of a tool, shall also be tested during and after disconnection. Any movable parts are to be put in the most unfavourable position.		P
	The test finger and the test pin are applied as above, without appreciable force, in every possible position, except that floor-standing equipment having a mass exceeding 40 kg is not tilted.		P
	Equipment intended for building-in or rack mounting, or for incorporation in larger equipment, is tested with access to the equipment limited according to the method of mounting detailed in the installation instructions.		N/A
	c) Openings preventing the entry of the jointed test finger (Figure E-1 of 0E) during test b) above, are further tested by means of straight unjointed test finger (Figure E-3 of 0E), applied with a force of 30 N. If the unjointed finger enters, the test with the jointed finger is repeated except that the finger is applied using any necessary force up to 30 N.	No such openings	N/A
	d) In addition to a) – c) above, top surfaces of enclosure shall be tested with the IP3X probe of IEC 60529. The test probe shall not penetrate the top surface of the enclosure when probed from the vertical direction ±5 ° only.		P
7.3.4.2.4	Service access areas	PCE is not energized since DC input and AC output are	P

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Clause	Requirement – Test	Result – Remark	Verdict
		disconnected before servicing	
7.3.4.3	Protection by means of insulation of live parts		P
	Where the requirements of 7.3.4.2 are not met, live parts shall be provided with insulation if:	Considered.	P
	– their working voltage is greater than the maximum limit of decisive voltage class A, or		P
	– for a DVC A or B circuit, protective separation from adjacent circuit of DVC C is not provided (see note "‡" under Table 7)		P
7.3.5	Protection in case of direct contact		P
7.3.5.1	General		P
	Protection in case of direct contact is required to ensure that contact with live parts does not produce a shock hazard.		P
	The protection against direct contact according to 7.3.4 is not required if the circuit contacted is separated from other circuits according to 7.3.2.3, and:		P
	– is of decisive voltage class A and complies with 7.3.5.2, or		P
	– is provided with protective impedance according to 7.3.5.3, or		P
	– is limited in voltage according to 7.3.5.4		N/A
	In addition to the measures as given in 7.3.5.2 to 7.3.5.4, it shall be ensured that in the event of error or polarity reversal of connectors no voltages that exceed DVC A can be connected into a circuit with protective separation. This applies for example to plug-in-sub-assemblies or other plug-in devices which can be plugged-in without the use of a tool (key) or which are accessible without the use of a tool.		P
	Conformity is checked by visual inspection and trial insertion.		P
7.3.5.2	Protection using decisive voltage class A	For communication terminal applied.	P
7.3.5.3	Protection by means of protective impedance	Protection used as voltage detecting circuit.	P
	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.		P
7.3.5.3.1	Limitation of current through protective impedance		P
	The current available through protective impedance		P

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	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.		
7.3.5.3.2	Limitation of discharging energy through protective impedance		P
	The discharging energy available between simultaneously accessible parts protected by protective impedance shall not exceed the charging voltage and capacitance limits given in Table 9, which applies to both wet and dry locations, under normal and single fault conditions. Refer to figure 8.		P
7.3.5.4	Protection by means of limited voltages		N/A
	That portion of a circuit that has its voltage reduced to DVC-A by a voltage divider that complies with the following requirements, and that is otherwise provided with protective separation from circuits of DVC-B or DVC-C according to 7.3.3, does not require protection against direct contact.		N/A
	The voltage divider shall be designed so that under normal and single fault conditions, including faults in the voltage division circuit, the voltage across the output of the voltage divider does not exceed the limit for DVC-A.		N/A
	This type of protection shall not be used in case of protective class II or unearthed circuits, because it relies on protective earth being connected.		N/A
7.3.6	Protection against indirect contact		P
7.3.6.1	General		P
	Protection against indirect contact is required to prevent shock- hazardous current being accessible from conductive parts during an insulation failure. This protection shall comply with the requirements for protective class I (basic insulation plus protective earthing), class II (double or reinforced insulation) or class III (limitation of voltages)		P
	That part of a PCE meets the requirements of 7.3.6.2 and 7.3.6.3 is defined as protective class I	See cl. 7.3.6.2 and 7.3.6.3	P
	That part of a PCE meets the requirements of 7.3.6.4 is defined as protective class II.	See cl. 7.3.6.4	P
	That part of PCE which meets the requirements of decisive voltage class A and in which no hazardous voltages are derived, is defined as protective class III. No shock hazard is present in such circuits.		N/A
	Where protection against indirect contact is dependent on means provided during installation, the installation instructions shall provide details of the required means and shall indicate the		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	associated hazards.		
7.3.6.2	Insulation between live parts and accessible conductive parts		P
	Accessible conductive parts of equipment shall be separated from live parts by insulation meeting the requirements of Table 7 or by clearances as specified in 7.3.7.4 and creepages as specified in 7.3.7.5	Basic insulation used to such parts except those covered by 7.3.6.3.	P
7.3.6.3	Protective class I – Protective bonding and earthing	Earthed metal enclosure used.	P
7.3.6.3.1	General		P
	Equipment of protective class I shall be provided with protective earthing, and with protective bonding to ensure electrical contact between accessible conductive parts and the means of connection for the external protective earthing conductor, except bonding is not required for:		P
	a) accessible conductive parts that are protected by one of the measures in 7.3.5.2 to 7.3.5.4, or		P
	b) accessible conductive parts are separated from live parts of DVC-B or -C using double or reinforced insulation.		P
7.3.6.3.2	Requirements for protective bonding		P
	Electrical contact with the means of connection of the external protective earthing conductor shall be achieved by one or more of the following means:		P
	a) through direct metallic contact;		P
	b) through other conductive parts which are not removed when the PCE or sub-units are used as intended ;	Applied for connection of top, front, and back of enclosure	P
	c) through a dedicated protective bonding conductor;	Green/Yellow wire used	P
	d) through other metallic components of the PCE		N/A
	Where direct metallic contact is used and one or both of the parts involved is painted or coated, the paint or coating shall be removed in the area of contact, or reliably penetrated, to ensure metal to metal contact.		P
	For moving or removable parts, hinges or sliding contacts designed and maintained to have a low resistance are examples of acceptable means if they comply with the requirements of 7.3.6.3.3.	See cl. 7.3.6.3.3	P
	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.	No such parts used	P

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7.3.6.3.3	Rating of protective bonding		P
	Protective bonding shall withstand the highest thermal and dynamic stresses that can occur to the PCE item(s) concerned when they are subjected to a fault connecting live parts to accessible conductive parts. The protective bonding shall remain effective for as long as a fault to the accessible conductive parts persists or until an upstream protective device removes power from the part.		P
	Protective bonding shall meet following requirements:		P
	a) For PCE with an overcurrent protective device rating of 16 A or less, the impedance of the protective bonding means shall not exceed 0,1 Ω during or at the end of the test below.		N/A
	b) For PCE with an overcurrent protective device rating of more than 16 A, the voltage drop in the protective bonding test shall not exceed 2,5 V during or at the end of the test below.		N/A
	As alternative to a) and b) the protective bonding may designed according to the requirements for the external protective earthing conductor in 7.3.6.3.5, in which case no testing is required.	The cross-sectional area of phase conductors S is at least 5.26mm^2 cross-sectional area the protective earthing conductor as required is min. 5.26mm^2 (S)	P
	The impedance of protective bonding means shall be checked by passing a test current through the bond for a period of time as specified below. The test current is based on the rating of the overcurrent protection for the equipment or part of the equipment under consideration, as follows:		N/A
	a) For pluggable equipment type A, the overcurrent protective device is that provided external to the equipment (for example, in the building wiring, in the mains plug or in an equipment rack);		N/A
	b) For pluggable equipment type B and fixed equipment, the maximum rating of the overcurrent protective device specified in the equipment installation instructions to be provided external to the equipment;		N/A
	c) For a circuit or part of the equipment for which an overcurrent protective device is provided as part of the equipment, the rating of the provided overcurrent device.		N/A
	Voltages are measured from the protective earthing terminal to all parts whose protective bonding means are being considered. The impedance of the protective earthing conductor is not included in the		N/A

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

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Clause	Requirement – Test	Result – Remark	Verdict
	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.		
7.3.6.3.4	Protective bonding impedance (routine test)		P
	If the continuity of the protective bonding is achieved at any point by a single means only (for example a single conductor or single fastener), or if the PCE is assembled at the installation location, then the impedance of the protective bonding shall also be tested as a routine test. The test shall be as in 7.3.6.3.3, except for the following:	Considered.	P
	▪ 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:	Considered.	P
	▪ the test duration may be reduced to no less than 2 s	Considered.	P
	For equipment subject to the type test in 7.3.6.3.3.1a), the impedance during the routine test shall not exceed 0,1Ω.		N/A
	For equipment subject to the type test in 7.3.6.3.3.1b) the impedance during the routine test shall not exceed 2,5 V divided by the test current required by 7.3.6.3.3.1b).		P
7.3.6.3.5	External protective earthing conductor	External protective earthing terminal with symbol 7 of Annex C.	P
	A protective earthing conductor shall be connected at all times when power is supplied to PCE of protective class I. Unless local wiring regulations state otherwise, the protective earthing conductor cross-sectional area shall be determined from Table 11 or by calculation according to IEC 60364-5-54.		P
	If the external protective earthing conductor is routed through a plug and socket or similar means of disconnection, it shall not be possible to disconnect it unless power is simultaneously removed from the part to be protected.		N/A
	The cross-sectional area of every external protective earthing conductor which does not form part of the supply cable or cable enclosure shall, in any case, be not less than:		P
	▪ 2,5 mm² if mechanical protection is provided;		P
	▪ 4 mm² if mechanical protection is not provided.		N/A
	For cord-connected equipment, provisions shall be		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	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.		
7.3.6.3.6	Means of connection for the external protective earthing conductor		P
7.3.6.3.6.1	General		P
	The means of connection for the external protective earthing conductor shall be located near the terminals for the respective live conductors. The means of connections shall be corrosion-resistant and shall be suitable for the connection of cables according to 7.3.6.3.5. The means of connection for the protective earthing conductor shall not be used as a part of the mechanical assembly of the equipment or for other connections. A separate means of connection shall be provided for each external protective earthing conductor. Connection and bonding points shall be so designed that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influences. Where enclosures and/or conductors of aluminium or aluminium alloys are used, particular attention should be given to the problems of electrolytic corrosion.		P
	The means of connection for the protective earthing conductor shall be permanently marked with:		P
	• symbol 7 of Annex C; or		P
	• the colour coding green-yellow		P
	Marking shall not be done on easily changeable parts such as screws.	Not marked on changeable parts.	P
7.3.6.3.7	Touch current in case of failure of the protective earthing conductor	Maximum 1.71mA<3.5mA	P
	The requirements of this sub-clause shall be satisfied to maintain safety in case of damage to or disconnection of the protective earthing conductor.		P
	For pluggable equipment type A, the touch current measured in accordance with 7.5.4 shall not exceed 3,5 mA a.c. or mA d.c.	Permanently connected equipment.	N/A
	For all other PCE, one or more of the following measure shall be applied, unless the touch current measured in accordance with 7.5.4 using the test network of IEC 60990 test figure 4 shall not exceed 3,5 mA a.c. or 10 mA d.c.	Not exceed 3,5 mA a.c.	N/A
	a) Permanently connected wiring, and:		N/A
	• a cross-section of the protective earthing		N/A

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	conductor of at least 10 mm² Cu or 16 mm² Al; or		
	• automatic disconnection of the supply in case of discontinuity of the protective earthing conductor; or		N/A
	• provision of an additional terminal for a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor and installation instruction requiring a second protective earthing conductor to be installed or		N/A
	b) Connection with an industrial connector according to IEC 60309 and a minimum protective earthing conductor cross-section of 2,5 mm² as part of a multi-conductor power cable. Adequate strain relief shall be provided.		N/A
	In addition, the caution symbol 15 of Annex C shall be fixed to the product and the installation manual shall provide details of the protective earthing measures required in the installation as required in 5.3.2.		N/A
	When it is intended and allowed to connect two or more PCEs in parallel using one common PE conductor, the above touch current requirements apply to the maximum number of the PCEs to be connected in parallel, unless one of the measures in a)		N/A
	or b) above is used. The maximum number of parallel PCEs is used in the testing and has to be stated in the installation manual.		N/A
7.3.6.4	Protective Class II – Double or Reinforced Insulation	Class I equipment.	N/A
	Equipment or parts of equipment designed for protective class II shall have insulation between live parts and accessible surfaces in accordance with 7.3.4.3. The following requirements also apply:		N/A
	• 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		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	shall correspond to the rated voltage of the series-connected equipment;		
	• metal-encased equipment of protective class II may have provision on its enclosure for the connection of an equipotential bonding conductor;		N/A
	• equipment of protective class II may have provision for the connection of an earthing conductor for functional reasons or for damping of overvoltages; it shall, however, be insulated as though it is a live part;		N/A
	• equipment employing protective class II shall be marked according to 5.1.8.		N/A
7.3.7	Insulation Including Clearance and Creepage Distance		P
7.3.7.1	General		P
	This subclause gives minimum requirements for insulation, based on the principles of IEC 60664.		P
	Manufacturing tolerances shall be taken into account during measurement of creepage, clearance, and insulation distance in the PCE.		P
	Insulation shall be selected after consideration of the following influences:		P
	• pollution degree	Pollution degree 2 internally	P
	• overvoltage category	For DC input circuits: Overvoltage Category II - For AC output circuits: Overvoltage Category III	P
	• supply earthing system	TN system considered.	P
	• insulation voltage	Considered	P
	• location of insulation	Considered	P
	• type of insulation	Considered	P
	Compliance of insulation, creepage distances, and clearance distances, shall be verified by measurement or visual inspection, and the tests of 7.5.		P
7.3.7.1.3	Supply earthing systems		P
	Three basic types of earthing system are described in IEC 60364-1. They are:		P
	• 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		P

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Clause	Requirement – Test	Result – Remark	Verdict
	conductor.		
	• TT system: has one point directly earthed, the accessible conductive parts of the installation being connected to earth electrodes electrically independent of the earth electrodes of the power system;		N/A
	• IT 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/A
7.3.7.1.4	Insulation voltages	Considered	P
	Table 12 makes use of the circuit system voltage and overvoltage category to define the impulse withstands voltage and the temporary overvoltage.		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	Considered	P
7.3.7.2.3	Circuits other than mains circuits	Considered	P
7.3.7.2.4	Insulation between circuits	Considered	P
7.3.7.3	Functional insulating	Considered	P
7.3.7.4	Clearance distances	(see appended table 7.3.7)	P
7.3.7.4.1	Determination		P
7.3.7.4.2	Electric field homogeneity		P
7.3.7.4.3	Clearance to conductive enclosures		P
7.3.7.5	Creepage distances	(see appended table 7.3.7)	P
7.3.7.5.1	General		P
7.3.7.5.2	Voltage		P
7.3.7.5.3	Materials	Considered	P
7.3.7.6	Coating	No such coating used.	N/A
7.3.7.7	PWB spacings for functional insulating		P
7.3.7.8	Solid insulating	(see appended table 7.3.7)	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	Approved plastic material used as basic.	P
7.3.7.8.2.2	Functional insulation		N/A
7.3.7.8.3	Thin sheet or tape material		N/A
7.3.7.8.3.1	General		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
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		N/A
7.3.7.8.3.4	Compliance		N/A
7.3.7.8.4	Printed wiring boards		N/A
7.3.7.8.4.1	General		N/A
7.3.7.8.4.2	Use of coating materials		N/A
7.3.7.8.5	Wound components		N/A
7.3.7.8.6	Potting materials	No such material.	N/A
7.3.7.9	Insulation requirements above 30 kHz	Considered.	P
7.3.8	Residual Current-operated protective (RCD) or monitoring (RCM) device compatibility		P
	RCD and RCM are used to provide protection against insulation faults in some domestic and industrial installations, additional to that provided by the installed equipment.	RCM used for detection.	P
7.3.9	Capacitor discharge		P
7.3.9.1	Operator access area		P
	Equipment shall be so designed that there is no risk of electric shock in operator access areas from charge stored on capacitors after disconnection of the PCE.		P
7.3.9.2	Service access areas		P
	Capacitors located behind panels that are removable for servicing, installation, or disconnection shall present no risk of electric shock or energy hazard from charge stored on capacitors after disconnection of the PCE.	Symbol 21 of Annex C and an indication of the discharge time used in a clearly visible position.	P
7.4	Protection against energy hazards	No such kind of hazard.	N/A
7.4.1	Determination of hazardous energy level		P
	A hazardous energy level is considered to exist if		P
	a) The voltage is 2 V or more, and power available after 60 s exceeds 240 VA.		P
	b) The stored energy in a capacitor is at a voltage. U of 2 V or more, and the stored energy. E, calculated from the following equation, exceeds 20J: $E = 0,5\ CU^2$		P
7.4.2	Operator Access Areas	No risk of energy hazard in operator access areas from accessible circuits	N/A
	Equipment shall be so designed that there is no risk of energy hazard in operator access areas from accessible circuits.		

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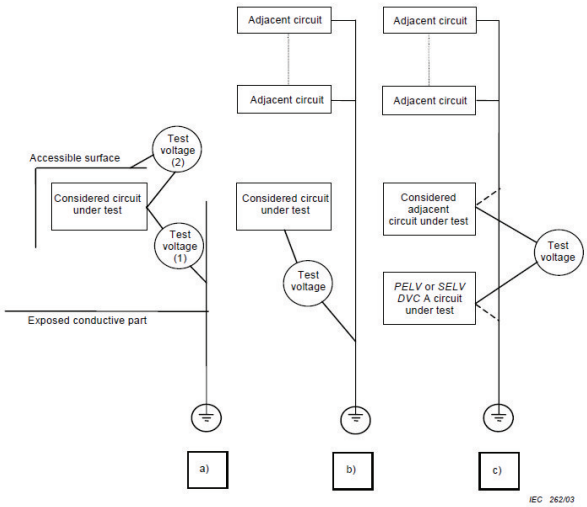
Clause	Requirement – Test	Result – Remark	Verdict
7.4.3	Services Access Areas	Symbol 21 of Annex C and an indication of the discharge time used in a clearly visible position.	P
7.5	Electrical tests related to shock hazard	(see appended table 7.5)	P
7.5.1	Impulse voltage test (type test)		P
7.5.2	Voltage test (dielectric strength test)		P
7.5.2.1	Purpose of test		P
7.5.2.2	Value and type of test voltage		P
7.5.2.3	Humidity pre-conditioning		P
7.5.2.4	Performing the voltage test The test shall be applied as follows, according to Figure 13:  **Figure 13 – Voltage test procedures**		P
7.5.2.5	Duration of the a.c. or d.c. voltage test The duration of the test shall be at least 60 s for the type test and 1 s for the routine test. The test voltage may be applied with increasing and/or decreasing ramp voltage, and the ramp times are not specified, but regardless of the ramp time, the dwell time at full voltage shall be 60 s and 1 s respectively for type and routine tests.		P
7.5.2.6	Verification of the a.c. or d.c. voltage test		P
7.5.3	Partial discharge test	(see appended table 7.5)	P
7.5.4	Touch current measurement (type test)	Maximum 1.74mA<3.5mA	P
	The touch current shall be measured if required by 7.3.6.3.7 and shall not be greater than 3.5 mA a.c. or 10 mA d.c. or special measures of protection as given in 7.3.6.3.7 are required.	(see appended table 7.3.6.3.7)	P
	For type tests on PCE for which wet locations		P

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Clause	Requirement – Test	Result – Remark	Verdict
	requirements apply according to 6.1, the humidity pre-conditioning of 4.5 shall be performed immediately prior to the touch current test.		
7.5.5	Equipment with multiple sources of supply	Considered.	P
8	**PROTECTION AGAINST MECHANICAL HAZARDS**		P
8.1	General		P
	Operation shall not lead to a mechanical HAZARD in NORMAL CONDITION or SINGLE FAULT CONDITION. Edges, projections, corners, openings, guards, handles and the like, that are accessible to the operator shall be smooth and rounded so as not to cause injury during normal use of the equipment.		P
	Conformity is checked as specified in 8.2 to 8.6.		P
8.2	Moving parts		P
	Moving parts shall not be able to crush, cut or pierce parts of the body of an OPERATOR likely to contact them, nor severely pinch the OPERATOR's skin. Hazardous moving parts of equipment, that is moving parts which have the potential to cause injury, shall be so arranged, enclosed or guarded as to provide adequate protection against the risk of personal injury.	No moving part.	P
8.2.1	Protection of service persons		P
	Protection shall be provided such that unintentional contact with hazardous moving parts is unlikely during servicing operations. If a guard over a hazardous moving part may need to be removed for servicing, the marking of symbol 15 of Table D-1 shall be applied on or near the guard.		P
8.3	Stability		N/A
	Equipment and assemblies of equipment not secured to the building structure before operation shall be physically stable in NORMAL USE.	Fixed appliance.	N/A
8.4	Provisions for lifting and carrying		N/A
	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.	Fixed appliance.	N/A
	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.	Fixed appliance.	N/A
8.5	Wall mounting		P
	Mounting brackets on equipment intended to be mounted on a wall or ceiling shall withstand a force		P

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Clause	Requirement – Test	Result – Remark	Verdict
	of four times the weight of the equipment.		
8.6	Expelled parts		N/A
	Equipment shall contain or limit the energy of parts that could cause a HAZARD if expelled in the event of a fault.		N/A
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 appropriate use of materials and components and by suitable construction.		P
9.1.1	Reducing the risk of ignition and spread of flame	Considered.	P
	For equipment or a portion of equipment, there are two alternative methods of providing protection against ignition and spread of flame that could affect materials, wiring, wound components and electronic components such as integrated circuits, transistors, thyristors, diodes, resistors and capacitors.		P
9.1.2	Conditions for a fire enclosure	Fire enclosure is required	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;		P
	– components within a power supply unit or assembly having a limited power output complying with the criteria for a LIMITED POWER SOURCE as specified in 9.2, including overcurrent protective devices, limiting impedances, regulating networks and wiring, up to the point where the LIMITED POWER SOURCE output criteria are met;		P

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Clause	Requirement – Test	Result – Remark	Verdict
	– components having unenclosed arcing parts, such as open switch and relay contacts and commutators, in a circuit at HAZARDOUS VOLTAGE or at a HAZARDOUS ENERGY LEVEL; and		P
	– insulated wiring, except as permitted in 9.1.2.2.		P
9.1.2.2	Parts not requiring a fire enclosure		N/A
9.1.3	Materials requirements for protection against fire hazard		P
9.1.3.1	General		P
	ENCLOSURES, components and other parts shall be so constructed, or shall make use of such materials, that the propagation of fire is limited.		P
9.1.3.2	Materials for fire enclosures	Metal enclosure used.	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.		N/A
9.1.3.3	Materials for components and other parts outside fire enclosures		N/A
	Except as otherwise noted below, materials for components and other parts (including MECHANICAL ENCLOSURES, ELECTRICAL ENCLOSURES and DECORATIVE PARTS); located outside FIRE ENCLOSURES, shall be of FLAMMABILITY CLASS HB.		N/A
9.1.3.4	Materials for components and other parts inside fire enclosures	Internal components except small parts are V-2, HF-2 or better.	P
9.1.3.5	Materials for air filter assemblies	No such materials used	N/A
9.1.4	Openings in fire enclosures	IP65 appliance, no openings.	N/A
9.1.4.1	General		N/A
	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/A
	These requirements are in addition to those in the following sections:		N/A
	– 7.3.4, Protection against direct contact;		N/A
	– 7.4, Protection against energy hazards;		N/A
	– 13.5, Openings in enclosures		N/A
9.1.4.2	Side openings treated as bottom openings		N/A
9.1.4.3	Openings in the bottom of a fire enclosure		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	The bottom of a FIRE ENCLOSURE or individual barriers, shall provide protection against emission of flaming or molten material under all internal parts, including partially enclosed components or assemblies, for which Method 2 of 9.1.1 has not been fully applied and complied with.		N/A
9.1.4.4	Equipment for use in a CLOSED ELECTRICAL OPERATING AREA		N/A
	The requirements of 9.1.4.3 do not apply to FIXED EQUIPMENT intended only for use in a CLOSED ELECTRICAL OPERATING AREA and to be mounted on a concrete floor or other non-combustible surface. Such equipment shall be marked as follows:		N/A
	WARNING: FIRE HAZARD SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY		N/A
9.1.4.5	Doors or covers in fire enclosures		N/A
9.1.4.6	Additional requirements for openings in transportable equipment		N/A
9.2	LIMITED POWER SOURCES		N/A
9.2.1	General		N/A
9.2.2	Limited power source tests	(see appended table 9.2)	N/A
9.3	Short-circuit and overcurrent protection		N/A
9.3.1	General		N/A
	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.		N/A
9.3.2	Protection against short-circuits and overcurrents shall be provided for all input circuits, and for output circuits that do not comply with the requirements for limited power sources in 9.2, except for circuits in which no overcurrent hazard is presented by short-circuits and overloads.		N/A
9.3.3	Protective devices provided or specified shall have adequate breaking capacity to interrupt the maximum short circuit current specified for the port to which they are connected. If protection that is provided integral to the PCE for an input port is not rated for the short-circuit current of the circuit in which it is used, the installation instructions shall specify that an upstream protective device, rated for the prospective short-circuit current of that port, shall be used to provide backup protection.		N/A

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Clause	Requirement – Test	Result – Remark	Verdict

10	**PROTECTION AGAINST SONIC PRESSURE HAZARDS**		P
10.1	General		P
	The equipment shall provide protection against the effect of sonic pressure. Conformity tests are carried out if the equipment is likely to cause such HAZARDS.	Sound pressure less than 80dBA, no hazards	P
10.2	Sonic pressure and Sound level	See above.	P
10.2.1	Hazardous Noise Levels		P
11	**PROTECTION AGAINST LIQUID HAZARDS**	No liquid used.	N/A
11.1	Liquid Containment, Pressure and Leakage		N/A
	The liquid containment system components shall be compatible with the liquid to be used.		N/A
	There shall be no leakage of liquid onto live parts as a result of:		N/A
	a) Normal operation, including condensation;		N/A
	b) Servicing of the equipment; or		N/A
	c) Inadvertent loosening or detachment of hoses or other cooling system parts over time.		N/A
11.2	Fluid pressure and leakage		N/A
11.2.1	Maximum pressure		N/A
11.2.2	Leakage from parts		N/A
11.2.3	Overpressure safety device		N/A
11.3	Oil and grease		N/A
12	**CHEMICAL HAZARDS**		N/A
12.1	General		N/A
13	**PHYSICAL REQUIREMENTS**		P
13.1	Handles and manual controls		N/A
	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 not be possible to fix them in a wrong position if this might result in hazard.	No such device.	N/A
13.1.1	Adjustable controls		N/A
13.2	Securing of parts		P
13.3	Provisions for external connections		P
13.3.1	General		P

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Clause	Requirement – Test	Result – Remark	Verdict
13.3.2	Connection to an a.c. Mains supply		P
13.3.2.1	General		P
	For safe and reliable connection to a MAINS supply, equipment shall be provided with one of the following:		P
	– terminals or leads or a non-detachable power supply cord for permanent connection to the supply; or		P
	– a non-detachable power supply cord for connection to the supply by means of a plug		N/A
	– an appliance inlet for connection of a detachable power supply cord; or		N/A
	– a mains plug that is part of direct plug-in equipment as in 13.3.8		N/A
13.3.2.2	Permanently connected equipment		P
13.3.2.3	Appliance inlets		N/A
13.3.2.4	Power supply cord	No such device.	N/A
13.3.2.5	Cord anchorages and strain relief		N/A
	For equipment with a non-detachable power supply cord, a cord anchorage shall be supplied such that:		N/A
	– the connecting points of the cord conductors are relieved from strain; and		N/A
	– the outer covering of the cord is protected from abrasion.		N/A
13.3.2.6	Protection against mechanical damage		P
13.3.3	Wiring terminals for connection of external conductors	Sizes specified in instruction manual	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 mm² and greater		N/A
13.3.6	Disconnection from supply sources	Approved DC switch supplied by the manufacture in the final installation.	P
13.3.7	Connectors, plugs and sockets	Approved standard connectors used.	P

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Clause	Requirement – Test	Result – Remark	Verdict
13.3.8	Direct plug-in equipment		N/A
13.4	Internal wiring and connections		P
13.4.1	General	Internal wiring is PVC insulated, rated VW-1. Internal wiring gauge is suitable for current intended to be carried.	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/A
13.5.1	Top and side openings	No openings.	N/A
	Openings in the top and sides of ENCLOSURES shall be so located or constructed that it is unlikely that objects will enter the openings and create hazards by contacting bare conductive parts.		N/A
13.6	Polymeric Materials		P
13.6.1	General		P
13.6.1.1	Thermal index or capability		P
13.6.2	Polymers serving as enclosures or barriers preventing access to hazards		N/A
13.6.2.1	Stress relief test		P
13.6.3	Polymers serving as solid insulation		N/A
13.6.3.1	Resistance to arcing		N/A
13.6.4	UV resistance		P
	Polymeric parts of an OUTDOOR ENCLOSURE required for compliance with this standard shall be sufficiently resistance to degradation by ultra-violet (UV) radiation	Considered and approved material used.	P
13.7	Mechanical resistance to deflection, impact, or drop		P
13.7.1	General	Metal and approved plastic used enclosure used.	P
13.7.2	250-N deflection test for metal enclosures	Applied for external of metal enclosure	P
13.7.3	7-J impact test for polymeric enclosures	Complied.	P
13.7.4	Drop test		N/A
13.8	Thickness requirements for metal enclosures		P
13.8.1	General		P
13.8.2	Cast metal	2.0mm	P
13.8.3	Sheet metal		N/A

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Clause	Requirement – Test	Result – Remark	Verdict

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 test of 7.5.2 as routine test.		P
14.2	Motor Over temperature Protection	No motor used.	N/A
	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.		
14.3	Over temperature protection devices		P
14.4	Fuse holders	No fuse holder used.	N/A
14.5	MAINS voltage selecting devices	No such device.	N/A
14.6	Printed circuit boards		P
	Printed circuit boards shall be made of material with a flammability classification of V-1 of IEC 60707 or		P

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Clause	Requirement – Test	Result – Remark	Verdict
	better.		
	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/A
	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.	V-0 min. PCB used	P
14.7	Circuits or components used as transient overvoltage limiting devices		P
	If control of transient overvoltage is employed in the equipment, any overvoltage limiting component or circuit shall be tested with the applicable impulse withstand voltage of Table 7-10 using the test method from 7.5.1 except 10 positive and 10 negative impulses are to be applied and may be spaced up to 1 min apart.	Certified components used	P
14.8	Batteries	No batteries.	N/A
	Equipment containing batteries shall be designed to reduce the risk of fire, explosion and chemical leaks under normal conditions and after a single fault in the equipment including a fault in circuitry within the equipment battery pack.		N/A
14.8.1	Battery Enclosure Ventilation		N/A
14.8.1.1	Ventilation requirements		N/A
14.8.1.2	Ventilation testing		N/A
14.8.1.3	Ventilation instructions		N/A
14.8.2	Battery Mounting		N/A
	Compliance is verified by the application of the force to the battery's mounting surface. The test force is to be increased gradually so as to reach the required value in 5 to 10 s, and is to be maintained at that value for 1 min. A non-metallic rack or tray shall be tested at the highest normal condition operating temperature.		N/A
14.8.3	Electrolyte spillage		N/A
	Battery trays and cabinets shall have an electrolyte-resistant coating.		N/A
	The ENCLOSURE or compartment housing a VENTED BATTERY shall be constructed so that spillage or leakage of the electrolyte from one battery will be contained within the ENCLOSURE and be prevented from:		N/A
	a) reaching the PCE outer surfaces that can be contacted by the USER		N/A

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	b) contaminating adjacent electrical components or materials; and		N/A
	c) bridging required electrical distances		N/A
14.8.4	Battery Connections	No batteries.	N/A
	Reverse battery connection of the terminals shall be prevented if reverse connection could result in a hazard within the meaning of this Standard		N/A
14.8.5	Battery maintenance instructions		N/A
	The information and instructions listed in 5.3.4.1 shall be included in the operator manual for equipment in which battery maintenance is performed by the operator, or in the service manual if battery maintenance is to be performed by service personnel only.		N/A
14.8.6	Battery accessibility and maintainability		N/A
	Battery terminals and connectors shall be accessible for maintenance with the correct TOOLS. Batteries with liquid electrolyte, requiring maintained shall be so located that the battery cell caps are accessible for electrolyte tests and readjusting of electrolyte levels.		N/A
15	Software and firmware performing safety functions	Single fault tests simulated for equipment, no critical hazard listed in this standard occur.	P

4.2.2.6/4.2.2.7	TABLE: electrical data					P
Input			Output			
U (V)	I (A)	P (W)	U (V)	I (A)	P (W)	PF
EVVO 3000TL3P						
160.6	20.02	3216	230.0	4.455	1019	0.994
			230.09	4.441	1019	0.997
			230.10	4.435	1016	0.996
600.01	5.24	3143	230.2	4.44	1019	0.997
			230.0	4.46	1021	0.997
			230.0	4.47	1023	0.995
230.1	4.46	1021	230.0	4.48	1027	0.997
			230.0	4.48	1027	0.996
			230.1	4.46	1022	0.997
959.2	2.99	2868	230.0	4.05	924	0.992
			230.1	4.09	936	0.996
			230.0	4.06	929	0.995
EVVO 4000TL3P						
189.9	22.10	4198	230	5.83	1342	0.998
			230	5.82	1341	0.998
			230	5.83	1344	0.998
600	6.82	4095.8	230	5.79	1328	0.998
			230	5.81	1333	0.998
			230	5.81	1334	0.998
850.1	4.84	4112.1	230	5.77	1322	0.997
			230	5.83	1336	0.997
			230	5.82	1334	0.997
958.4	4.35	4163.7	230	5.81	1331	0.997
			230	5.89	1350	0.997
			230	5.87	1347	0.997
EVVO 4800TL3P						
240	21.66	5196.2	230	7.252	1668	0.998
			230	7.242	1666	0.998
			230	7.232	1664	0.998
600	8.701	5196.2	230	7.327	1686	0.998
			230	7.329	1686	0.998

			230	7.314	1683	0.999
850.2	6.082	5175.0	230	7.322	1684	0.998
			230	7.355	1691	0.998
			230	7.324	1685	0.998
958.4	4.379	4197	230	5.923	1359	0.996
			230	5.969	1371	0.997
			230	5.939	1364	0.997
EVVO 5000TL3P						
240	21.58	5179.5	230	7.23	1660	0.998
			230	7.25	1667	0.998
			230	7.25	1667	0.998
600	8.48	5090.1	230	7.19	1652	0.999
			230	7.21	1658	0.999
			230	7.22	1660	0.999
850.2	6.02	5115	230	7.18	1649	0.998
			230	7.25	1664	0.998
			230	7.24	1662	0.998
958.4	4.34	4162	230	5.81	1332	0.997
			230	5.89	1351	0.997
			230	5.87	1347	0.997
EVVO 6000TL3P						
289.6	21.57	6244	230	8.74	2010	0.998
			230	8.73	2008	0.998
			230	8.73	2009	0.998
600	10.29	6175.2	230	8.72	2005	0.999
			230	8.75	2011	0.999
			230	8.76	2015	0.999
850.1	7.31	6211.4	230	8.73	2005	0.999
			230	8.8	2021	0.999
			230	8.79	2020	0.999
958.4	4.34	4162.3	230	5.81	1331	0.997
			230	5.89	1350	0.997
			230	5.87	1347	0.997
EVVO 8000TL3P						

380.1	21.61	8216.9	230	11.55	2657	0.998
			230	11.56	2663	0.998
			230	11.57	2669	0.998
599.7	13.62	8172	230	11.53	2654	0.999
			230	11.56	2662	0.999
			230	11.58	2667	0.999
850	9.67	8221	230	11.56	2657	0.999
			230	11.64	2675	0.999
			230	11.64	2676	0.999
958.2	8.57	8208	230	11.5	2643	0.999
			230	11.6	2667	0.999
			230	11.6	2667	0.999
EVVO 10000TL3P						
479.8	21.34	10241.9	230	14.43	3310	0.998
			230	14.44	3330	0.998
			230	14.47	3332	0.998

600.1	17.04	10230	230	14.4	3317	0.999
			230	14.44	3326	0.999
			230	14.47	3333	0.999
849.8	12.07	10258	230	14.41	3312	0.999
			230	14.51	3334	0.999
			230	14.52	3337	0.999
958.4	4.28	4106	230	5.72	1310	0.997
			230	5.82	1332	0.997
			230	5.8	1329	0.997
EVVO 12000TL3P						
574.4	21.46	11995.8	230	17.32	3991	0.998
			230	17.31	3989	0.998
			230	17.32	3991	0.998
600	20.54	12324	230	17.32	3991	0.999
			230	17.37	4004	0.999
			230	17.41	4012	0.999

849.7	14.54	12360	230	17.33	3989	0.999
			230	17.44	4014	0.999
			230	17.46	4018	0.999
958.3	5.49	5258	230	7.34	1684	0.998
			230	7.44	1707	0.998
			230	7.43	1705	0.998
Supplementary information:						

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)
Model EVVO 12000TL3P		
Input: 850Vd.c,14.6Ad.c, Output: 230Va.c., 12Kw		
PV input terminal	60.4	85
DC Switch	55.5	85
Internal wire to the input terminal	60.4	105
Cap C116	59.3	85
Inductor L7	72.2	85
Cap C117	71.8	85
Cap C113	70.1	85
Y-cap CY8	71.0	105
Body of U13	75.0	105
Q16	91.5	130
Internal ambient	74.7	Ref.
Boost inductor 1	77.2	110
Boost inductor 2	83.3	110
Q2	73.8	130
D1	84.7	130
D3	86.3	130
Q6	78.6	130
Q18	98.0	130
Q12	89.2	130
Q15	88.3	130
Q9	100.0	130

Q13	88.5	130
Q10	87.0	130
Q11	86.0	130
Q14	84.5	130
Q8	88.3	130
C4	73.1	85
Main inductor	109.1	110
Q7	76.4	130
Q17	94.3	130
C71	93.2	105
L1	100.3	110
C70	92.8	105
Ambient of Relay RL3	78.5	85
L2	91.4	110
Cap EC4	74.1	85
Cap EC1	72.8	85
Cap C8	63.7	85
Cap C6	73.1	85
Ambient of Relay RL7	72.5	85
MOV4	68.3	85
Internal wire to the output	59.1	105
U1	85.8	105
UT3	66.0	130
Button	61.5	85
Heatsink	67.2	90
CT3	62.0	Ref.
C609	72.0	85
QC5	81.0	Ref.
TC1	67.4	Ref.
UC20	81.3	Ref.
UC73	79.3	Ref.
C313	61.1	85
C57	62.5	95
Middle of the cover	58.7	85
Display	50.9	85
Ambient	46.3	--
Input: 850Vd.c, output derating to 8450W (derating from 45°C)		
PV input terminal	70.8	85
DC Switch	68.3	85

Internal wire to the input terminal	70.9	105
Cap C116	70.3	85
Inductor L7	79.5	85
Cap C117	79.6	85
Cap C113	78.1	85
Y-cap CY8	80.0	105
Body of U13	82.2	105
Q16	91.9	130
Internal ambient	81.9	Ref.
Boost inductor 1	82.4	110
Boost inductor 2	87.8	110
Q2	85.4	130
D1	97.3	130
D3	99.1	130
Q6	91.3	130
Q18	111.6	130
Q12	101.8	130
Q15	100.9	130
Q9	114.1	130
Q13	103.6	130
Q10	102.2	130
Q11	100.6	130
Q14	99.4	130
Q8	102.5	130
C4	81.2	85
Main inductor	109.3	110
Q7	89.6	130
Q17	109.9	130
C71	97.3	105
L1	104.1	110
C70	96.4	105
Ambient of Relay RL3	81.5	85
L2	97.1	110
Cap EC4	80.5	85
Cap EC1	79.7	85
Cap C8	74.9	85
Cap C6	79.5	85
Ambient of Relay RL7	76.1	85
MOV4	77.9	85

Internal wire to the output	70.0	105
U1	92.5	105
UT3	77.2	130
Button	66.5	85
Heatsink	80.8	90
CT3	73.1	Ref.
C609	81.0	85
QC5	91.7	Ref.
TC1	77.6	Ref.
UC20	90.4	Ref.
UC73	88.3	Ref.
C313	72.4	85
C57	72.9	95
Middle of the cover	69.2	85
Display	69.0	85
Ambient	62.0	--
Input: 575Vd.c, 21.46Ad.c, Output: 230Va.c., 12kW		
PV input terminal	61.6	85
DC Switch	56.3	85
Internal wire to the input terminal	63.5	105
Cap C116	59.9	85
Inductor L7	76.9	85
Cap C117	74.5	85
Cap C113	72.9	85
Y-cap CY8	72.6	105
Body of U13	79.0	105
Q16	78.2	130
Internal ambient	78.4	Ref.
Boost inductor 1	91.0	110
Boost inductor 2	96.0	110
Q2	102.2	130
D1	103.3	130
D3	102.0	130
Q6	109.9	130
Q18	103.6	130
Q12	86.6	130
Q15	84.2	130
Q9	99.2	130
Q13	80.3	130

Q10	78.6	130
Q11	78.4	130
Q14	78.3	130
Q8	87.6	130
C4	71.8	85
Main inductor	99.3	110
Q7	74.2	130
Q17	92.3	130
C71	86.4	105
L1	99.3	110
C70	85.9	105
Ambient of Relay RL3	79.6	85
L2	89.7	110
Cap EC4	73.4	85
Cap EC1	71.6	85
Cap C8	63.9	85
Cap C6	72.0	85
Ambient of Relay RL7	76.3	85
MOV4	68.0	85
Internal wire to the output	59.1	105
U1	83.6	105
UT3	66.1	130
Button	62.0	85
Heatsink	67.1	90
CT3	62.1	Ref.
C609	73.3	85
QC5	77.0	Ref.
TC1	66.9	Ref.
UC20	82.2	Ref.
UC73	80.0	Ref.
C313	59.5	85
C57	62.8	95
Middle of the cover	58.7	85
Display	51.4	85
Ambient	47.7	--
Input: 575Vd.c, output derating to 8450W (derating from 45°C)		
PV input terminal	69.8	85
DC Switch	66.8	85
Internal wire to the input terminal	70.7	105

Cap C116	68.7	85
Inductor L7	82.1	85
Cap C117	80.7	85
Cap C113	79.8	85
Y-cap CY8	79.2	105
Body of U13	84.8	105
Q16	85.6	130
Internal ambient	84.2	Ref.
Boost inductor 1	94.8	110
Boost inductor 2	99.7	110
Q2	108.5	130
D1	110.6	130
D3	109.3	130
Q6	117.0	130
Q18	111.4	130
Q12	94.3	130
Q15	92.0	130
Q9	107.8	130
Q13	87.5	130
Q10	85.9	130
Q11	85.7	130
Q14	85.8	130
Q8	95.1	130
C4	79.0	85
Main inductor	103.4	110
Q7	82.3	130
Q17	99.9	130
C71	91.7	105
L1	104.1	110
C70	91.0	105
Ambient of Relay RL3	80.6	85
L2	95.5	110
Cap EC4	79.9	85
Cap EC1	78.3	85
Cap C8	71.4	85
Cap C6	78.6	85
Ambient of Relay RL7	76.7	85
MOV4	75.1	85
Internal wire to the output	67.6	105

U1	89.7	105
UT3	74.4	130
Button	64.5	85
Heatsink	75.5	90
CT3	70.7	Ref.
C609	80.2	85
QC5	85.3	Ref.
TC1	75.5	Ref.
UC20	89.3	Ref.
UC73	87.2	Ref.
C313	69.5	85
C57	71.5	95
Middle of the cover	67.7	85
Display	67.5	85
Ambient	62.3	**--**

Supplementary information:

	TABLE: Heating test, resistance method	N/A
	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: Test at max. ambient 60°C and derating temperature point 45°C with maximum load.

4.4	**TABLE: fault condition tests**	P
	ambient temperature (°C) ..... :	—

No.	component No.	fault	test voltage (V)	test time	fuse No.	fuse current (A)	result
Control board CD-U2							
1.	CY3	s-c	600	1min	--	--	PCE Shutdown, Q9, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18 damaged. No hazard.
2.	EC2	s-c	600	1min	--	--	PCE Shutdown, C43, C44 damaged. No hazard.

3.	R131	s-c	600	1min	--	--	LCD displays ‘ID27’ for three times and than displays ‘ID69’. Recoverable. No hazard, no damaged.
4.	R132	s-c	600	1min	--	--	LCD displays ‘ID27’ for three times and than displays ‘ID69’. Recoverable. No hazard, no damaged.
5.	R150	s-c	600	1min	--	--	LCD displays ‘ID27’ for three times and than displays ‘ID69’. Recoverable. No hazard, no damaged.
6.	R151	s-c	600	1min	--	--	LCD displays ‘ID27’ for three times and than displays ‘ID69’. Recoverable. No hazard, no damaged.
7.	C3	s-c	600	1min	--	--	LCD displays ‘ID02’. Recoverable. No hazard, no damaged.
8.	R21	s-c	600	1min	--	--	Work as normal.
9.	R20	o-c	600	1min	--	--	Work as normal.
10.	R27	s-c	600	1min	--	--	LCD displays ‘ID24’ for three times and than displays ‘ID67’. Recoverable. No hazard, no damaged.
11.	R26	o-c	600	1min	--	--	LCD displays ‘ID02’. Recoverable. No hazard, no damaged.
12.	R33	s-c	600	1min	--	--	LCD displays ‘ID24’ for three times and than displays ‘ID67’. Recoverable. No hazard, no damaged.
13.	R32	o-c	600	1min	--	--	LCD displays ‘ID02’. Recoverable. No hazard, no damaged.
14.	R39	s-c	600	1min	--	--	LCD displays ‘ID24’ for three times and than displays ‘ID67’. Recoverable. No hazard, no damaged.
15.	R38	o-c	600	1min	--	--	LCD displays ‘ID02’. Recoverable. No hazard, no damaged.
16.	R45	s-c	600	1min	--	--	LCD displays ‘ID27’. Recoverable. No hazard, no damaged.
17.	R44	o-c	600	1min	--	--	LCD displays ‘ID27’. Recoverable. No hazard, no damaged.

18.	C112	s-c	600	1min	--	--	The monitor shutdown. Recoverable. No hazard, no damaged.
19.	CY5	s-c	600	1min	--	--	Work as normal.
20.	R246	s-c	600	1min	--	--	LCD displays 'ID27'. Recoverable. No hazard, no damaged.
21.	R271	s-c	180	1min	--	--	The EUT cannot start, LCD displays "ID56'. Recoverable. No hazard, no damaged.
22.	R269	s-c	180	1min	--	--	The EUT cannot start, LCD displays "ID56'. Recoverable. No hazard, no damaged.
23.	R268	o-c	180	1min	--	--	The EUT cannot start, LCD displays "ID56'. Recoverable. No hazard, no damaged.
24.	R283	s-c	180	1min	--	--	The EUT cannot start, LCD displays "ID56'. Recoverable. No hazard, no damaged.
25.	R282	o-c	180	1min	--	--	The EUT cannot start, LCD displays "ID56'. Recoverable. No hazard, no damaged.
26.	R88	s-c	600	10min	--	--	PCE makes noisy. No hazard, no damaged.
27.	R90	s-c	600	10min	--	--	PCE makes noisy. No hazard, no damaged.
28.	R201	s-c	600	1min	--	--	LCD displays 'ID52'. Recoverable. No hazard, no damaged.
29.	R214	s-c	600	1min	--	--	LCD displays 'ID52'. Recoverable. No hazard, no damaged.
30.	Q25 pin1-2	s-c	600	1min	--	--	LCD displays 'ID52'. Recoverable. No hazard, no damaged.
31.	R50	s-c	500	1min	--	--	PCE Shutdown, U1 damaged. No hazard.
32.	R47	s-c	500	1min	--	--	PCE Shutdown, no damaged. No hazard.
33.	C20	s-c	600	1min	--	--	PCE Shutdown, D1, D3 damaged. No hazard.
34.	R167	s-c	600	1min	--	--	LCD displays 'ID24'. Recoverable. No hazard, no damaged.

35.	RL1 Pin3-4	s-c	600	1min	--	--	The EUT cannot start, LCD displays “ID55’. Recoverable. No hazard, no damaged.
36.	RL3 Pin3-4	s-c	600	1min	--	--	The EUT cannot start, LCD displays “ID55’. Recoverable. No hazard, no damaged.
37.	RL5 Pin3-4	s-c	600	1min	--	--	The EUT cannot start, LCD displays “ID55’. Recoverable. No hazard, no damaged.
38.	C394	s-c	600	1min	--	--	PCE Shutdown, LCD displays ‘ID53’. Recoverable. No hazard, no damaged.
39.	RC609	s-c	600	1min	--	--	PCE Shutdown, LCD displays ‘ID53’. Recoverable. No hazard, no damaged.
40.	RC649	o-c	600	1min	--	--	PCE Shutdown, LCD displays ‘ID53’. Recoverable. No hazard, no damaged.
41.	CC209	s-c	600	1min	--	--	PCE Shutdown, Q9 damaged. No hazard.
42.	CC224	s-c	600	1min	--	--	PCE Shutdown, Q12 damaged. No hazard.
43.	CC234	s-c	600	1min	--	--	PCE Shutdown, Q15 damaged. No hazard.
44.	CC243	s-c	600	1min	--	--	PCE Shutdown, LCD displays ‘ID53’. Recoverable. No hazard, no damaged.
45.	CC207	s-c	600	1min	--	--	PCE Shutdown, Q7 damaged. No hazard.
46.	C208	s-c	600	1min	--	--	PCE Shutdown, Q8 damaged. No hazard.
47.	CC222	s-c	600	1min	--	--	LCD displays ‘ID55’. Recoverable. No hazard, no damaged.
48.	UC609A Pin4-5	s-c	600	1min	--	--	Work as normal.
49.	UC637 Pin12-13	s-c	600	1min	--	--	Work as normal.
50.	UC634 pin5-6	s-c	600	1min	--	--	Work as normal.
51.	CC132	s-c	600	1min	--	--	PCE Shutdown, LCD displays ‘ID49’. Recoverable. No hazard, no damaged.

52.	Qc40 D-S	s-c	600	1min	--	--	PCE Shutdown, LCD displays 'ID14'. Recoverable. No hazard, no damaged.
53.	RC459	s-c	600	1min	--	--	PCE Shutdown, LCD displays 'ID59'. Recoverable. No hazard, no damaged.
54.	RL6	s-c	600	1min	--	--	PCE Shutdown, LCD displays 'ID55'. Recoverable. No hazard, no damaged.
55.	RL4	s-c	600	1min	--	--	PCE Shutdown, LCD displays 'ID55'. Recoverable. No hazard, no damaged.
56.	RL2	s-c	600	1min	--	--	PCE Shutdown, LCD displays 'ID55'. Recoverable. No hazard, no damaged.
57.	R162	s-c	600	1min	--	--	PCE Shutdown, LCD displays 'ID24'. Recoverable. No hazard, no damaged.
58.	R177	o-c	600	1min	--	--	PCE Shutdown, LCD displays 'ID24'. Recoverable. No hazard, no damaged.
59.	R187	o-c	600	1min	--	--	PCE Shutdown, LCD displays 'ID24'. Recoverable. No hazard, no damaged.
supplementary information: s-c: short-circuited, o-c: open-circuited, o-l: overload.							
Note(s): The tests are conducted on the model EVVO 12000TL3P to represent all the other models. The unit passed 2120Vdc electric strength test between primary and accessible output connector, 2120Vdc between input & output to earth after single fault test above.							

7.3.6.3.3	**TABLE: protective equipotential bonding ;**	P

Measured between:	Test current (A)	Voltage drop (V)	Resistance (mΩ)	result
supplementary information:				

7.3.6.3.7	TABLE: touch current measurement		P
Measured between:	Measured (mA)	Limit (mA)	Comments/conditions
PV+ to Metal Enclosure	1.71	AC 3.5 / DC 10	--
PV- to Metal Enclosure	1.71		--
PV+ to communication terminal	1.62		--
PV- to communication terminal	1.61		--
PV+ to plastic Enclosure	1.60		--
PV- to plastic Enclosure	1.61		--
L to Metal Enclosure	1.70		--
N to Metal Enclosure	1.71		--
L to communication terminal	1.65		--
N to communication terminal	1.65		--
L to plastic Enclosure	1.70		--
N to plastic Enclosure	1.70		--
supplementary information			

7.3.7	TABLE: clearance and creepage distance measurements					P
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)
On control board 150-303000-2						
Pri. trace to Sec. of isolated opto-coupler UC70(R)	1000	1000	6.1	8.9	10.0	10.1
Pri. trace to Sec. of isolated Isolated transformer TC1 on PCB(R)	1000	1000	6.1	26.0	10.0	26.0
From Pri. Trace to the meatal enclosure(B)	1000	1000	3.6	8.3	10.0	>10.0
From pri. Trace to erthing screw M4	1000	1000	3.6	6.1	5.0	6.1
On main power board						
From body of cap C19 to erthing terminal SC4 on the PCB(B)	1000	1000	3.6	4.1	5.0	4.1
Trace between Y-cap CY1 (B)	1000	1000	3.6	5.8	5.0	5.8
Trace between Y-cap CY11 (B)	1000	1000	3.6	5.9	5.0	5.9
Trace between Y-cap CY4 (B)	1000	1000	3.6	5.4	5.0	5.4
Trace between Y-cap CY4 (B)	1000	1000	3.6	5.6	5.0	5.6
From Pri. trace to erthing terminal SC5 on the PCB(B)	1000	1000	3.6	5.6	5.0	5.6
From trace of earthing below C3	1000	1000	3.6	5.1	5.0	5.1
From IGBT body to earthed heatsink (B)	1000	1000	3.6	12	10.0	12
Body of transistor to the metal enclosure (B)	1000	1000	3.6	5.9	3.2	5.9
From the trace of the main board to the below earthed hetsink(B)	1000	1000	3.6	8.6	10	>10.0
Whole unit						
From transformer of Device board to trace of COM board(R)	1000	1000	6.1	7.2	20.0	>20.0
From the winding of the main inductor to the eathed enclosure (B)	1000	1000	3.6	11.0	10.0	>10.0

Note(s): * F=functional insulation, B=basic insulation, S=supplementary insulation, R=reinforced insulation.

When determine the clearance:

For DC input circuits: Overvoltage Category II applied(impulse withstand voltage 4000V)

For AC output circuits (connected to AC mains): Overvoltage Category III applied (impulse withstand voltage 4000V, temporary overvoltage 2120Vpeak considered.)

Interpolation is used.

For reinforced insulation: 4000V applied.

Requirement about creepage distances for main battery discharging transformer and for the distance to the metal enclosure come from columns 7 and 8 of Table 14. Requirement about creepage distances for other parts come from column 3 of table 14.

PCB with min. CTI 175 used.

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7.3.7	TABLE: distance through insulation measurement				N/A
distance through insulation di at/of:		U r.m.s. (V)	test voltage (V)	required di (mm)	di (mm)
supplementary information:					

7.5	TABLE: electric strength measurements, impulse voltage test and partial discharge test				P
test voltage applied between:		test voltage (V)	impulse withstand voltage (V)	partial discharge extinction voltage (V)	result
PV input terminals to metal enclosure		2120Vdc	--	--	P
AC output terminals to metal enclosure		2120Vdc	--	--	P
PV input terminals to communication ports		4240Vdc	--	--	P
AC output terminals to communication ports		4240Vdc	--	--	P
PV input terminals to LCD screen		4240Vdc	--	--	P
AC output terminals to LCD screen		4240Vdc	--	--	P
Note(s): Based on the system voltage 1000V for DC input and 230V L to N for AC mains.					

9.2	TABLE: Limited power sources	N/A

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						

14	TABLE: list of critical components				P
object/part No.	manufacturer/ trademark	type/model	technical data	standard	mark(s) of conformity[1])
Whole product					
Metal Enclosure	Xingchengyuan	SPCC	material：SPCC size: 446X 413X136 mm, thickness: 1.5mm	--	--
Heat sink	Hongxingfu	6063	material：6063 aluminium size:403 X444 X 60 mm, thickness: 10 mm	--	--
LCD screen cover	Jingning	Makrolon:6557	115x93.5x4.4	UL 746D	UL E41613
PV Input terminal	MC	MC4 Series	1000Vdc, 39A, Max. 90°C, IP68	EN 50521 UL 6703	TUV R60028286 UL E343181
	Amphenol Industrial Operations	Helios H4	1000Vdc, 40A, Max. 90°C, IP68	EN 50521 UL 6703	TUV R50157783 UL E339277
Output terminal	Shanghai Vaconn electronic	VPAC07EW-5S2	400/690Vac, 25A, 90°C	EN 61984	TUV R50243672
PV input switch	Santon	XB3410/2	1000Vdc,16A	EN60947-3	KEMA 2152871.01
PV input internal wire	Shenzhen WeiHuaXing electronic	12AWG 10AWG	12AWG 105°C, 600V 10AWG 105°C, 600V	UL 758	UL E341104
AC output internal wire	Shenzhen WeiHuaXing electronic	12AWG	12AWG 105°C, 600V	UL 758	UL E341104
Internal wire to input Boost inductor	LTK wire co.,LTD	10AWG	UL1015 600V 105°C	UL 758	UL E148000
Internal wire to input Boost inductor	Guangdong Haerkn New energy co.,LTD	10AWG	UL1015 600V 105°C	UL 758	UL E300956
	3Q Wire &Cable co.,LTD	10AWG	UL1015 600V 105°C	UL 758	UL E341104
Internal wire to output inductor	LTK wire co.,LTD	10AWG	UL1015 600V 105°C	UL 758	UL E148000
	Guangdong Haerkn New energy co.,LTD	10AWG	UL1015 600V 105°C	UL 758	UL E300956
	3Q Wire &Cable	10AWG	UL1015 600V	UL 758	UL E341104

	co.,LTD		105°C		
Main output inductor	Huizhou baohui co.,LTD	115-17-016	Class B,0.73mH	--	Test with the appliance
Main power board					
Y-cap	SHANTOU HIGH-NEW TECHNOLOGY DEVELOPMNT ZONE SONGTIAN ENTERPRISE CO LTD	CDY112Y5V1D 472MB	4700pF, 400Vac, 125°C	UL 60384-14, IEC 60384-14	UL E208107 VDE 40025754
	VISHAY	VY1	4700PF, 500Vac, 125°C	UL 60384-14, IEC 60384-14	UL E183844, VDE 40012673
Boost inductor	Huizhou baohui co.,LTD	115-17-017	Class B,2000uH	--	Test with the appliance
Wire	Shanghai Asia Pacific electric co.,LTD	EIW WIRE	180°C	UL 1446	UL E214423
	Tai-I electric wire&cable co.,LTD	EIW WIRE	180°C	UL 1446	UL E85640
Input Resonance inductor	Huizhou baohui co.,LTD	SH-L026	Class B ,1.05mH	--	Test with the appliance
Insulation sheet under the inverter transistor	YOUBOER co.,LTD	K10	35*47*0.152mm ,V-0,130°C	UL 746C	UL E59150
Output relay Rly1,2	Hong Fa	HF161F-W/12-HT	Air gap 31A/250VAC/12 VDC /85 °C	VDE 0435	VDE 40023067
	PANASONIC	ALFG2PF12	31A/250VAC/12 VDC/85 °C	VDE 0435	VDE 40031410
Output current transducer	LEM	CASR 15-NP	15A/CASR 15-NP	UL508	UL E189713
RCD detective inductor	Huizhou baohui co.,LTD	GFCI Module/W539/VAC	GFCI Module/W539/VAC	--	--
output Varistor RV1, RV2	LITTELFUSE	V1000LA160BP	1000Vac,1200Vdc, 85 °C	UL 1414 IEC/EN 61051-1, IEC/EN 61051-2.	UL E320116 VDE 116895
	THINKING ELECTRONIC INDUSTRIAL CO., LTD.	TVR20561KSY	1000Vac, 85°C	UL 1414	UL E314979

Output voltage detective resistor	YAGEO	RC1206FR-071M5L	1.5M/1/4W/F/1206	--	--
Output X cap.	SHANTOU HIGH-NEW TECHNOLOGY DEVELOPMNT ZONE SONGTIAN ENTERPRISE CO LTD	MPX	X2, 2.2uF, 305Vac	UL 60384-14 IEC 60384-14	UL E208107 VDE 40034679
PCB	SHANTOU LUCKY STAR PCB CO LTD	WS666	130°C, V-0, CTI: min.175	UL796	UL E301869
output inductor L1	Huizhou baohui co.,LTD	SH-L004	Class B,2.3mH	--	Test with the appliance
Wire	Shanghai Asia Pacific electric co.,LTD	EIW WIRE	180°C	UL 1446	UL E214423
	Tai-I electric wire&cable co.,LTD	EIW WIRE	180°C	UL 1446	UL E85640
	Dongguan Yida industrial co.,LTD	EIW WIRE	180°C	UL 1446	UL E344055
Tape	Jingjiang yahua pressure sensitive glue	Tape	180°C	UL 1446	UL E165111
Output gastube	SHENZHEN BENCENT ELECTRONIC CO LTD	B8G1500M	1200-1800Vdc, -40-90°C	UL 1449	UL E337906
Output Y-cap	SHANTOU HIGH-NEW TECHNOLOGY DEVELOPMNT ZONE SONGTIAN ENTERPRISE CO LTD	CY1101KE1IEB45WSTO	100pF/400Vac, -25-125°C	IEC 60384-14 EN 60384-14	VDE 40025748
Control board					
Isolated transformer TC1	Huizhou baohui co.,LTD	ETD39H/PC40	Class B ,3.3mH	--	Test with the appliance
Wire	Shanghai Asia Pacific electric co.,LTD	EIW WIRE	180°C	UL 1446	UL E214423
	Tai-I electric wire&cable co.,LTD	EIW WIRE	180°C	UL 1446	UL E85640
Tape	Jingjiang yahua pressure sensitive glue	Tape	180°C	UL 1446	UL E165111
Opto coupler UC11, UC12,	TOSHIBA	TLP785F	Isolation voltage: 5000Vrms 85 °C	UL 1577	UL E67349

UC63, UC64, UC67, UC68, UC70, UC71			External creepage 8mm External clearance 8mm		
[1]) an asterisk indicates a mark which assures the agreed level of surveillance					

End of the report

Test Report issued under the responsibility of:

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

Report Reference No.	50261005 001 attachment 1.	
Tested by (name + signature)	See cover page	.....
Witnessed by (name + signature) ...	N/A	.....
Supervised by (name + signature) ..	N/A	.....
Approved by (name + signature)	See cover page	.....
Date of issue.....	See cover page	
Testing Laboratory.....	See cover page	
Address	See cover page	
Testing location/ procedure	CBTL☐ TMP☐ WMT☐ SMT☐ RMT☐ CCATL☐	
Testing location/ address	See cover page	
Applicant's name	See cover page	
Address	See cover page	
Test specification:		
Standard	IEC 62109-2: 2011	
Test procedure	TÜV Bauart	
Non-standard test method……..:	N/A	
Test Report Form No.....	IEC 62109-2: 2011	
Test Report Form(s) Originator	TÜV Rheinland Group	
Master TRF	2011-08	

Test item description	See report 50261005 001
Trade Mark	See report 50261005 001.
Manufacturer	See report 50261005 001.
Model/Type reference.....	See report 50261005 001.
Ratings	See report 50261005 001.

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

List of Attachments (including a total number of pages in each attachment):

See report 50261005 001.

Summary of testing

Tests performed (name of test and test clause):	**Testing location:**
See report 50261005 001.	The laboratory described on the cover page.

Summary of compliance with National Differences

List of countries addressed: See report 50261005 001.

Copy of marking plate:

See report 50261005 001.

Equipment mobility	:	☐ movable	☐ hand-held	
		☐ stationary	☒ fixed (Wall mounted)	
Connection to the mains	:	☐ pluggable equipment	☐ direct plug-in	
		☒ permanent connection	☐ for building-in	
Enviromental category	:	☒ outdoor	☐ indoor conditional	☐ indoor unconditional
Operating condition	:	☒ continuous	☐ short-time	☐ intermittent
Over voltage category mains	:	☐ OVC I	☐ OVC II	☒ OVC III ☐ OVC IV
Over voltage category PV	:	☐ OVC I	☒ OVC II	☐ OVC III ☐ OVC IV
Mains supply tolerance (%)	:	According to specified supply range		
Tested for IT power systems	:	☐ Yes	☒ No	
IT testing, phase-phase voltage (V)	:	N/A		
Class of equipment	:	☒ Class I	☐ Class II	
		☐ Class III	☐ Not classified	
Mass of equipment (kg)	:	65		
Pollution degree	:	☐ PD 1	☐ PD 2	☒ PD 3
IP protection class	:	IP65		

Possible test case verdicts:

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

Testing:

Date of receipt of test items : See report 50261005 001.

Date(s) of performance of tests : See report 50261005 001.

General remarks:

"(see Attachment #)" refers to additional information appended to the report.

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

The tests results presented in this report relate only to the object tested.

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

List of test equipment must be kept on file and available for review.

Additional test data and/or information provided in the attachments to this report.

Throughout this report a ☐ comma / ☒ **point** is used as the decimal separator.

Manufacturer's Declaration per sub-clause 6.2.5 of IECEE 02:

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

☐ Yes

☒ Not applicable

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

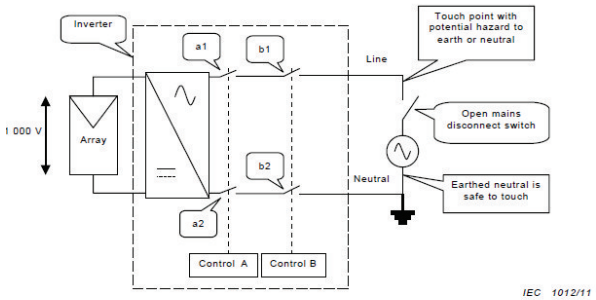
Name and address of factory (ies) : See report 50261005 001.

General product information:

See report 50261005 001.

Throughout the test report following abbreviations may be used:

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

IEC 62109-2: 2011			
Clause	Requirement – Test	Result - Remark	Verdict
4	General testing requirements *This clause of Part 1 is applicable with the following exceptions:*		P
4.4	Testing in SINGLE FAULT CONDITIONS		P
4.4.4	SINGLE FAULT CONDITIONS to be applied: *Additional subclauses:*	The PCE could detect and indicate the fault condition and disconnect from or not connect to the grid in case of single fault condition. Refer to the appended table 4.4 of IEC/EN 62109-1 test report 50261005 001.	P
4.4.4.15	Fault-tolerance of protection for GRID-INTERACTIVE INVERTERS		P
4.4.4.15.1	Fault-tolerance of residual current monitoring		P
4.4.4.15.2	Fault-tolerance of automatic disconnecting means		P
4.4.4.15.2.1	General		P
4.4.4.15.2.2	Design of insulation or separation  **Figure 20 – Example system discussed in Note 2 above**		P
4.4.4.15.2.3	Automatic checking of the disconnect means		P
4.4.4.16	Stand-alone inverters-load transfer test	Grid-interactive inverter.	P
4.4.4.17	Cooling system failure – Blanketing test	See following table 4.4.4.17.	P
4.7	Electrical Ratings Tests *Additional subclauses:*	Refer to the appended table 4.7 of IEC/EN 62109-1 test report 50261005 001.	P
4.7.3	Measurement requirements for AC output ports for stand-alone inverters	Grid-interactive inverter.	N/A
4.7.4	Stand-alone Inverter AC output voltage and frequency		N/A
4.7.4.1	General		N/A
4.7.4.2	Steady state output voltage at nominal DC input		N/A

IEC 62109-2: 2011			
Clause	Requirement – Test	Result - Remark	Verdict
4.7.4.3	Steady state output voltage across the DC input range		N/A
4.7.4.4	Load step response of the output voltage at nominal DC input		N/A
4.7.4.5	Steady state output frequency		N/A
4.7.5	Stand-alone inverter output voltage waveform		N/A
4.7.5.1	General		N/A
4.7.5.2	Sinusoidal output voltage waveform requirements	See following table 4.7.5.2.	N/A
4.7.5.3	Non-sinusoidal output waveform requirements	Sinusoidal output.	N/A
4.7.5.3.1	General		N/A
4.7.5.3.2	Total harmonic distortion		N/A
4.7.5.3.3	Waveform slope		N/A
4.7.5.3.4	Peak voltage		N/A
4.7.5.4	Information requirements for non-sinusoidal waveforms		N/A
4.7.5.5	Output voltage waveform requirements for inverters for dedicated loads	Not for dedicated loads.	N/A
4.8	Additional tests for grid-interactive inverters	See below.	P
4.8.1	General requirements regarding inverter isolation and array grounding		N/A
4.8.2	Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays	Only for ungrounded arrays.	N/A
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays	Complied.	P
4.8.2.2	Array insulation resistance detection for inverters for functionally grounded arrays		N/A
4.8.3	Array residual current detection	Complied.	P
4.8.3.1	General		P
4.8.3.2	30mA touch current type test for isolated inverters	Non-isolated inverters.	N/A
4.8.3.3	Fire hazard residual current type test for isolated inverters		N/A
4.8.3.4	Protection by application of RCD's	Complied.	P
4.8.3.5	Protection by residual current monitoring	See following table 4.8.3.5.	P
4.8.3.5.1	General		P

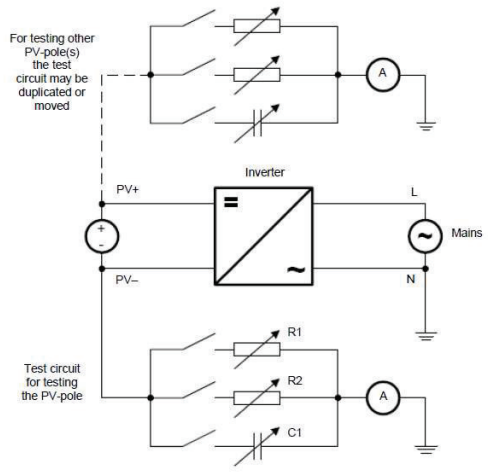
<table>
<tr><td colspan="4">IEC 62109-2: 2011</td></tr>
<tr><td>Clause</td><td>Requirement – Test</td><td>Result - Remark</td><td>Verdict</td></tr>
<tr><td></td><td>Table 31 – Response time limits for sudden changes in residual current
<table>
<tr><th>Residual current sudden change</th><th>Max time to inverter disconnection from the mains</th></tr>
<tr><td>30 mA</td><td>0,3 s</td></tr>
<tr><td>60 mA</td><td>0,15 s</td></tr>
<tr><td>150 mA</td><td>0,04 s</td></tr>
</table>
NOTE These values of residual current and time are based on the RCD standard IEC61008-1.


Figure 21 – Example test circuit for residual current detection testing</td><td>See following table 4.8.3.5.</td><td>P</td></tr>
<tr><td>4.8.3.5.2</td><td>Test for detection of excessive continuous residual current</td><td>See appended table.</td><td>P</td></tr>
<tr><td>4.8.3.5.3</td><td>Test for detection of sudden changes in residual current</td><td>See appended table.</td><td>P</td></tr>
<tr><td>4.8.3.6</td><td>Systems located in closed electrical operating areas</td><td></td><td>N/A</td></tr>
<tr><td>5</td><td>Marking and documentation
This clause of Part 1 is applicable with the following exceptions:</td><td>See report 50261005 001.</td><td>P</td></tr>
<tr><td>5.1</td><td>Marking</td><td></td><td>P</td></tr>
<tr><td>5.1.4</td><td>Equipment ratings
Replacement:</td><td>See report 50261005 001.</td><td>P</td></tr>
<tr><td>5.2</td><td>Warning markings</td><td>See report 50261005 001.</td><td>P</td></tr>
</table>

IEC 62109-2: 2011			
Clause	Requirement – Test	Result - Remark	Verdict
5.2.2	Content for warning markings		P
5.2.2.6	Inverters for closed electrical operating areas		N/A
5.3	Documentation		P
5.3.2	Information related to installation Additional subclauses:		P
5.3.2.1	Ratings		P
5.3.2.2	Grid-interactive inverter setpoints		P
5.3.2.3	Transformers and isolation		P
5.3.2.4	Transformers required but not provided	See above.	N/A
5.3.2.5	PV modules for non-isolated inverters		P
5.3.2.6	Non-sinusoidal output waveform information		N/A
5.3.2.7	Systems located in closed electrical operating areas		N/A
5.3.2.8	Stand- alone inverter output circuit bonding		N/A
5.3.2.9	Protection by application of RCD's	Not used.	N/A
5.3.2.10	Remote indication of faults		P
5.3.2.11	External array insulation resistance measurement and response		P
5.3.2.12	Array functional grounding information		N/A
5.3.2.13	Stand-alone inverters for dedicated loads		N/A
5.3.2.14	Identification of firmware version(s)		P
6	Environmental requirements and conditions *This clause of Part 1 is applicable.*		P
7	Protection against electric shock and energy hazards *This clause of Part 1 is applicable except for the following additions:*	See report 50261005 001.	P
7.3	Protection against electric shock *Additional subclauses:*		P
7.3.10	Additional requirements for stand-alone inverters		N/A
	Stand-alone inverter output circuit bonding		N/A
	Stand-alone inverter isolation and protection of DVC-A circuits		N/A
7.3.11	Functionally grounded arrays		N/A
8	Protection against mechanical hazards *This clause of Part 1 is applicable.*	See report 50261005 001.	P

IEC 62109-2: 2011			
Clause	Requirement – Test	Result - Remark	Verdict
9	Protection against fire hazards *This clause of Part 1 is applicable with the following exceptions:*		P
9.3	Short-circuit and overcurrent protection *Additional subclause:*		P
9.3.4	Inverter backfeed current onto the array		P
10	Protection against sonic pressure hazards *This clause of Part 1 is applicable*	See report 50261005 001	P
11	Protection against liquid hazards *This clause of Part 1 is applicable*	See report 50261005 001	P
12	Protection against chemical hazards *This clause of Part 1 is applicable*	See report 50261005 001	P
13	Physical requirements *This clause of Part 1 is applicable with the following exception:* *Additional subclause:*	See report 50261005 001	P
13.9	Fault indication		P
	a) a visible or audible indication, integral to the inverter, and detectable from outside the inverter, and	LCD panel is available for fault indication.	P
	b) an electrical or electronic indication that can be remotely accessed and used.	RS485/232 port as communication connection.	P
14	Components *This clause of Part 1 is applicable*	See report 50261005 001	P

4.4.4.17	Cooling system fainlure – Blanketing test		P
	Test voltage(V)	See below	--
	t1(°C)	See below	--
	t2(°C)	See below	--
Maximum temperature T of part/at:		Measured T (°C)	allowed T_{max} (°C)
Test Voltage		600Vdc	--
Heatsink beside the main inductor		78.8	90
Heatsink left		73.6	90
Ambient		62	--
Note(s):			

4.7.5.2	Stand-alone inverter output voltage waveform	N/A
Harmonics at continuous operation		

P/Pn[%]	5%	50%	100%	Limites Limit
Ordinal number	Measurement [Harmonic/Fundamental]			
	[%]	[%]	[%]	[%]
2				6.0
3				6.0
4				6.0
5				6.0
6				6.0
7				6.0
8				6.0
9				6.0
10				6.0
11				6.0
12				6.0
13				6.0
14				6.0
15				6.0
16				6.0
17				6.0
18				6.0
19				6.0

20				6.0
21				6.0
22				6.0
23				6.0
24				6.0
25				6.0
26				6.0
27				6.0
28				6.0
29				6.0
30				6.0
31				6.0
32				6.0
33				6.0
34				6.0
35				6.0
36				6.0
37				6.0
38				6.0
39				6.0
40				6.0
THD				10.0
Note:				

4.8.2	TABLE: Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays	P
4.8.2.1	TABLE: Insulation resistance measurement	

Conditions	Measurement [I.F. / N.O.]				Identification
	PV / DC Supply Voltage [Vdc]				
	160	600	850	960	
PV1+ to PE: 0.9 times [kΩ]	I.F.	I.F.	I.F.	I.F.	I.F.: Isolation Fault N.O.: Normal Operation
PV1- to PE: 0.9 times [kΩ]	I.F.	I.F.	I.F.	I.F.	
PV1+ to PE: 1.0 times [kΩ]	N.O.	N.O.	N.O.	N.O.	

PV1- to PE: 1.0 times [kΩ]	N.O.	N.O.	N.O.	N.O.	
PV1+ to PE: 1.1 times [kΩ]	N.O.	N.O.	N.O.	N.O.	
PV1- to PE: 1.1 times [kΩ]	N.O.	N.O.	N.O.	N.O.	

Note:

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

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

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

Supplementary information:

Array Insulation Resistance Threshold Value should be larger than R = $V_{MAX\,PV}$ / 30mA

4.8.3.2, 4.8.3.3	TABLE: Touch current and fire hazard residual current measurement			N/A
Condition	PV power supply " + " → earthing [mA]	PV power supply " - " → earthing [mA]	Limit [mA]	Comments
30mA touch current	--	--	--	--
Condition	PV power supply " + " → earthing [mA]	PV power supply " - " → earthing [mA]	Limit [mA]	Comments
fire hazard residual current	--	--	--	Inverter ≤ 30kVA
fire hazard residual current	--	--	10mA / kW	Inverter > 30kVA
--	--	--	--	--

Note:

Using measurement circuit of IEC 60990 figure 4 for testing touch current.

Using ammeter for testing fire hazard residual current.

4.8.3.5	TABLE: Protection by residual current monitoring	P
Test conditions:	Output power (kVA) : 12 Input voltage (V_{DC}): 850 Frequency (Hz): 50 Output AC Voltage (V_{AC}): 230	
4.8.3.5.2	Test for detection of excessive continuous residual current	P

Fault Current (mA)		Disconnection time (ms)	
Measured Fault Current	Limit 300mA for output power ≤ 30 kVA 10mA per kVA for output power > 30 kVA	Measured Disconnection time	Limit
+ PV to N:			
221 mA	300	--	--
220 mA	300	--	--
219 mA	300	--	--
221 mA	300	--	--
220 mA	300	--	--
- PV to N:			
228 mA	300	--	--
230 mA	300	--	--
229 mA	300	--	--
231 mA	300	--	--
228 mA	300	--	--

Note:
– maximum 300mA for inverters with continuous output power rating ≤30 kVA;
– maximum 10mA per kVA of rated continuous output power for inverters with continuous output power rating > 30 kVA.
This test shall be repeated 5 times, and for all 5 tests the time to disconnect shall not exceed 0,3s.
The test is repeated for each PV input terminal. It is not required to test all PV input terminals if analysis of the design indicates that one or more terminals can be expected to have the same result, for example where multiple PV string inputs are in parallel.

Supplementary information: Tested on model EVVO 12000TL3P to present all the models.

4.8.3.5.3	TABLE: Test for detection of sudden changes in residual current	P
+PV to N		
Limit (mA)	U_N Disconnection time (ms)	Limit (ms)
30	221.0	300
30	228.0	300
30	222.5	300
30	231.0	300
30	227.1	300
60	132.0	150
60	132.0	150
60	130.4	150
60	133.4	150

60	133.2	150
150	35.2	40
150	34.6	40
150	36.2	40
150	35.6	40
150	34.2	40
-PV to N		
Limit (mA)	U_N Disconnection time (ms)	Limit (ms)
30	220.8	300
30	216.2	300
30	224.8	300
30	226.4	300
30	221.4	300
60	132.6	150
60	131.2	150
60	131.4	150
60	134.0	150
60	132.6	150
150	34.4	40
150	33.4	40
150	34.2	40
150	35.4	40
150	34.8	40
Note: The capacitive current is risen until disconnection. Test condition: I_c + 30/60/150mA <= I_{cmax}. R_1 is set that 30/60/150mA Flow and switch S is closed.		
Supplementary information: Tested on model EVVO 12000TL3P to present all the models.		

- End of test report -

Attachment 2 Photo documentation

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

Figure 1. Oversize view

Figure 2. View of terminals

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

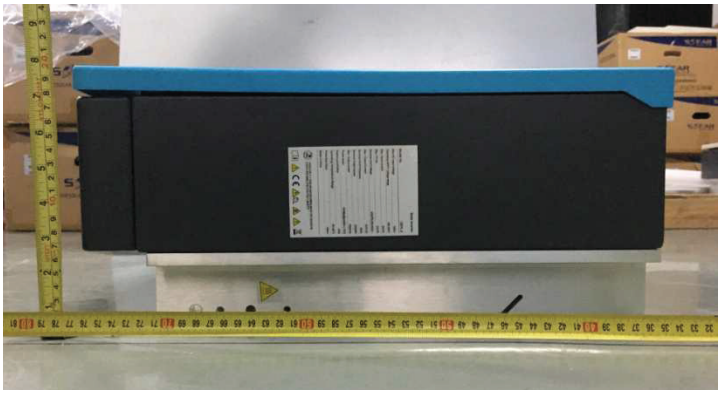


Figure 3. Side view

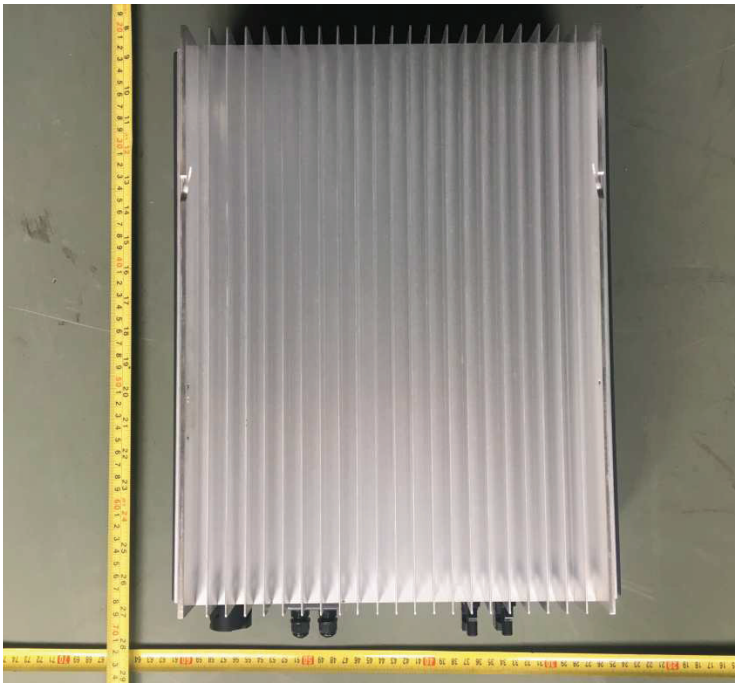


Figure 4. Rear view

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

Figure 5. Internal view 1

Figure 6. Internal view 2

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

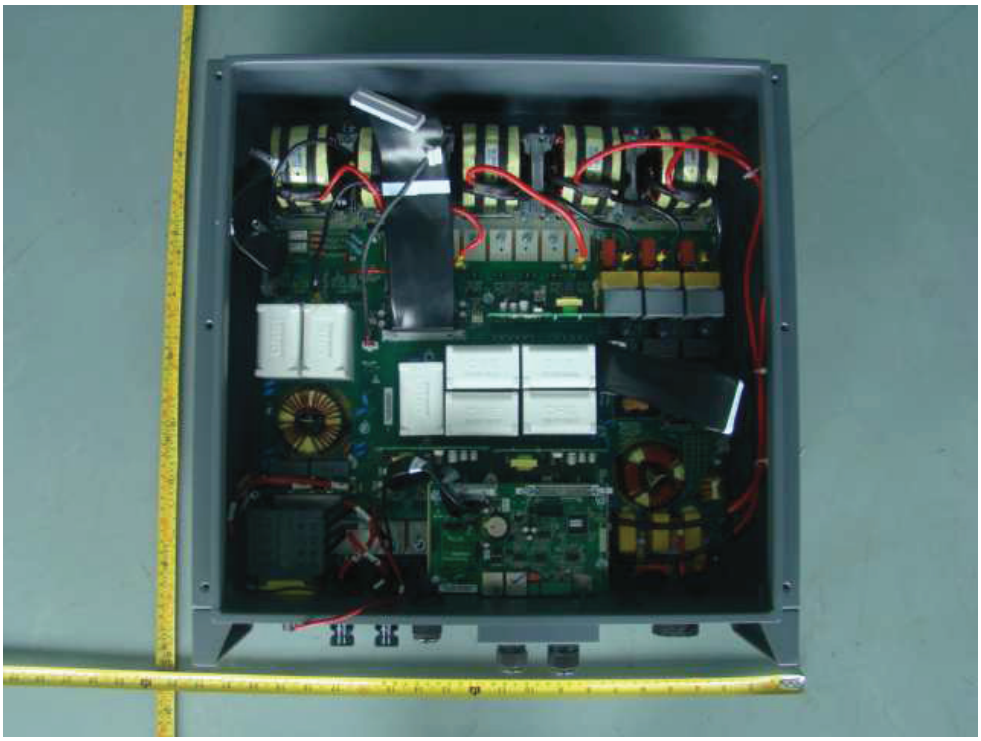


Figure 7. Internal view 3

Figure 8. Internal view 4

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

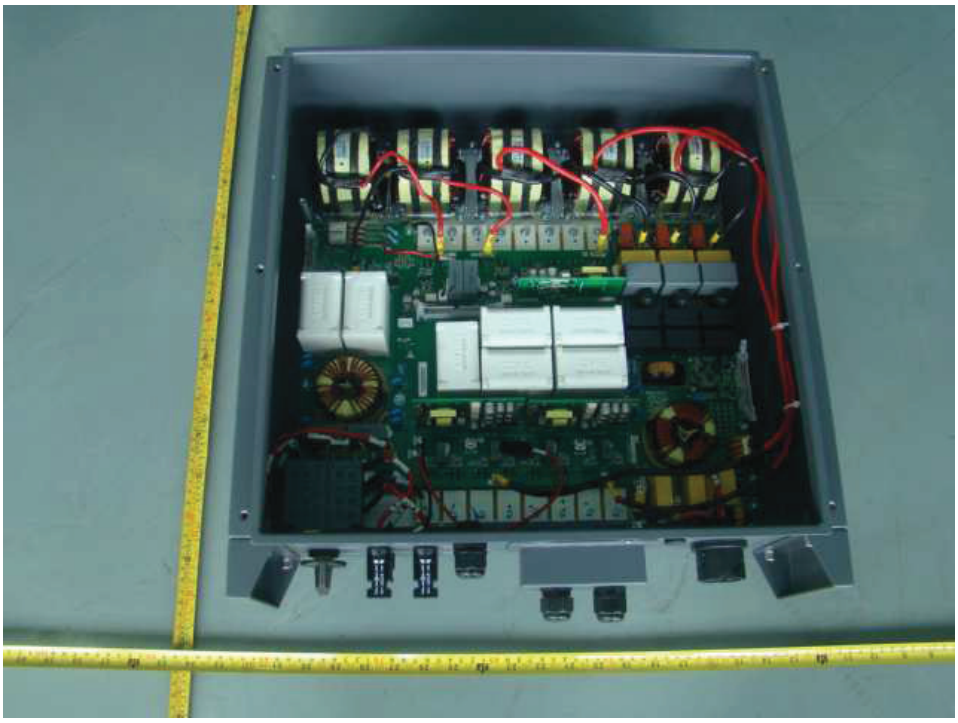


Figure 9. Internal view with only main board

Figure 10. Internal bottom

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

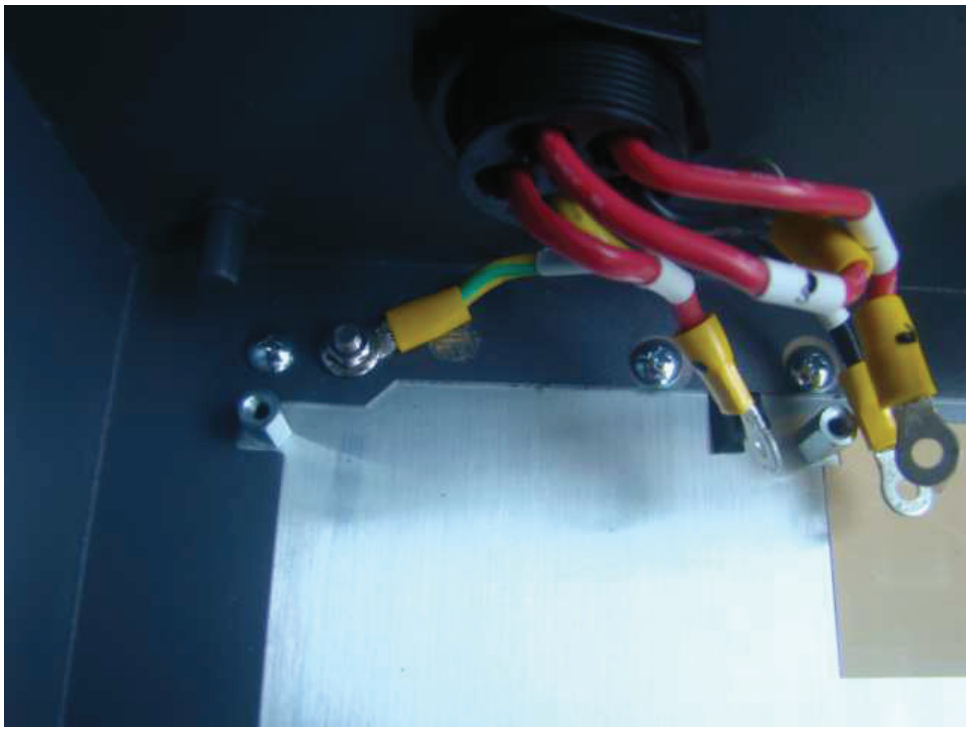


Figure 11. Earthing terminal

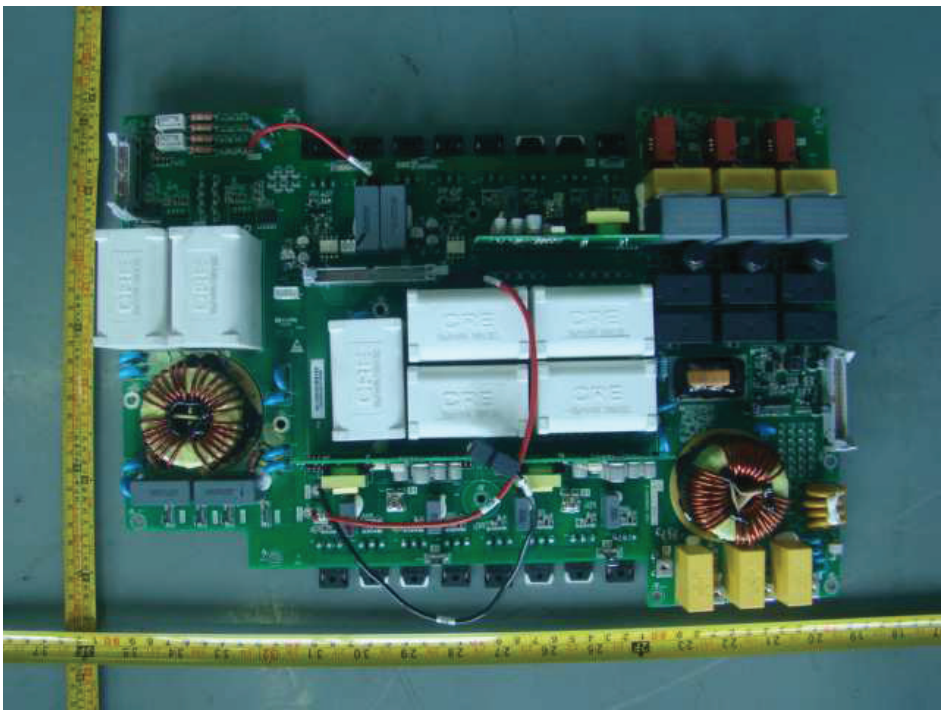


Figure 12. Component side of main board

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

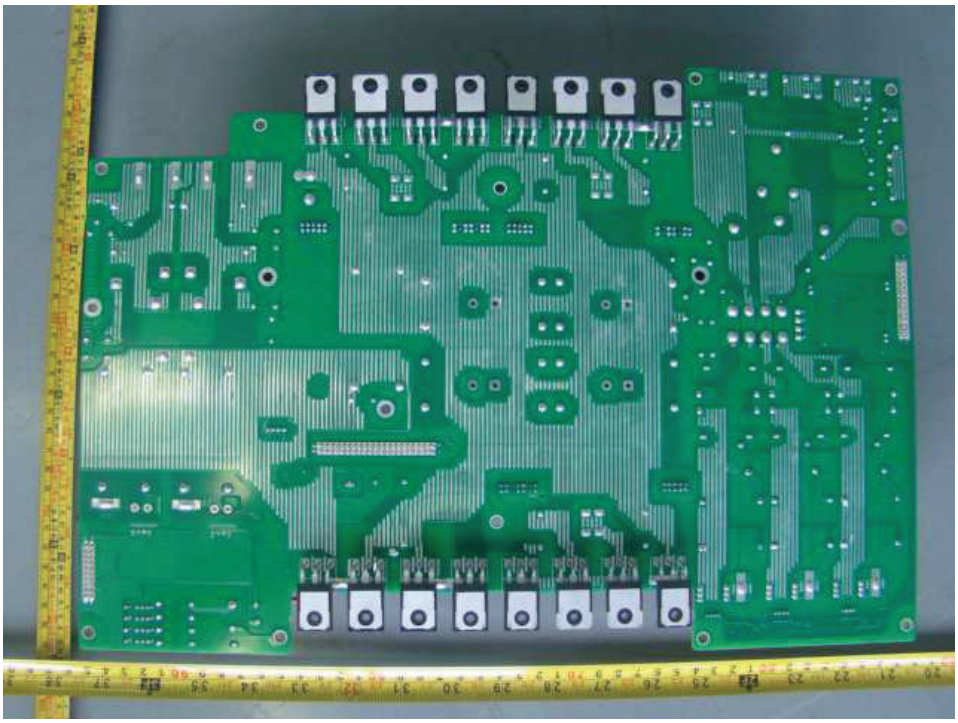


Figure 13. Trace side of main board

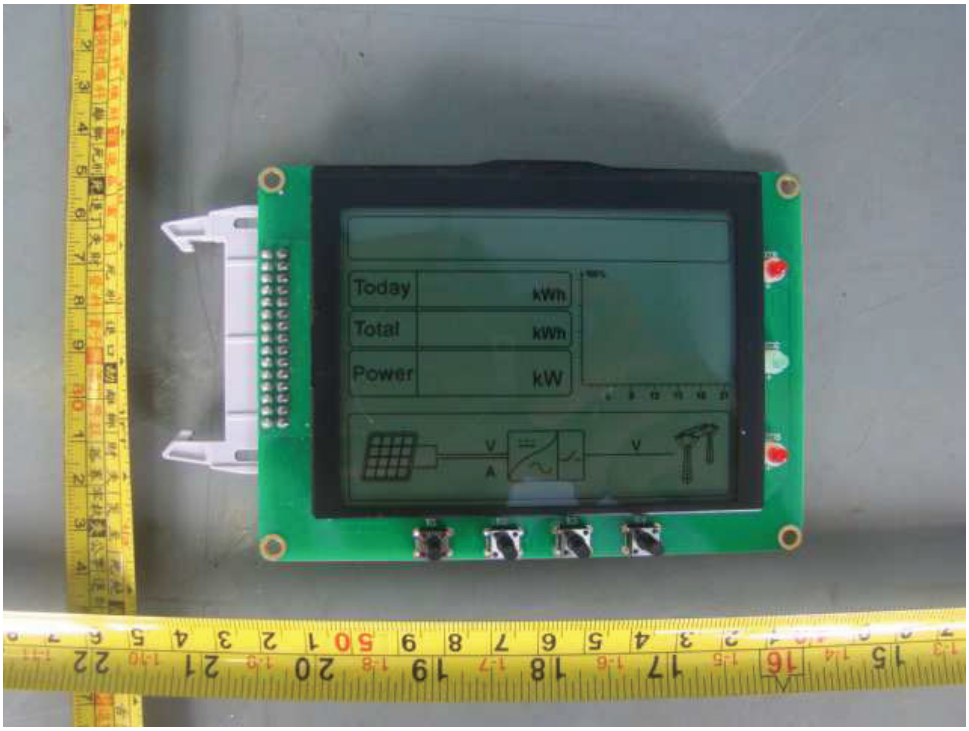


Figure 14. Component side of LCD board

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

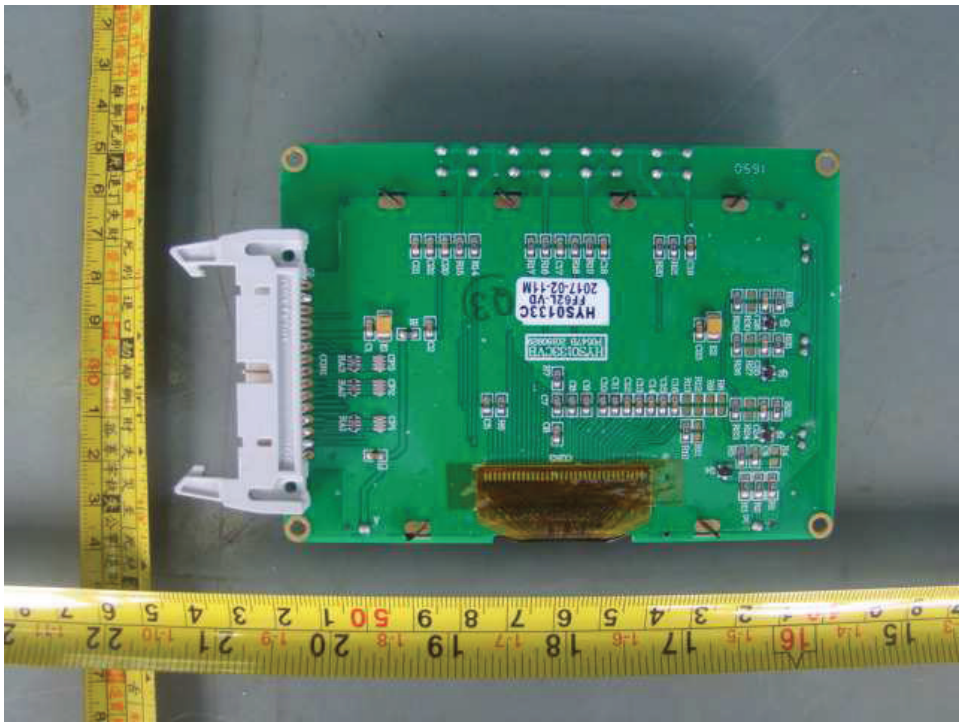


Figure 15. Trace side of LCD board

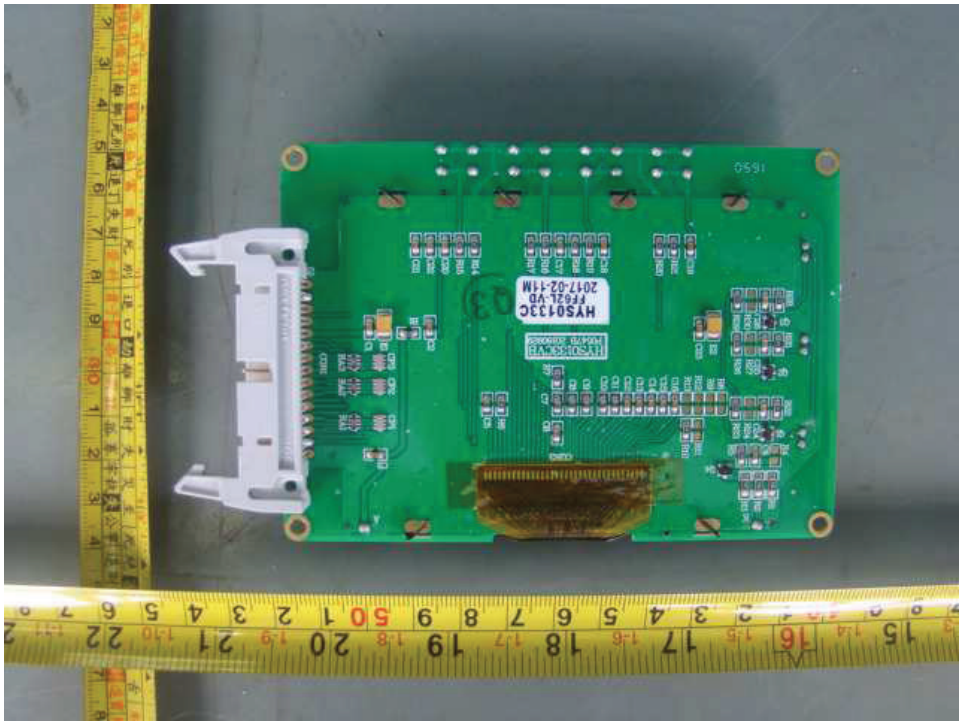


Figure 16. Component side of control board

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

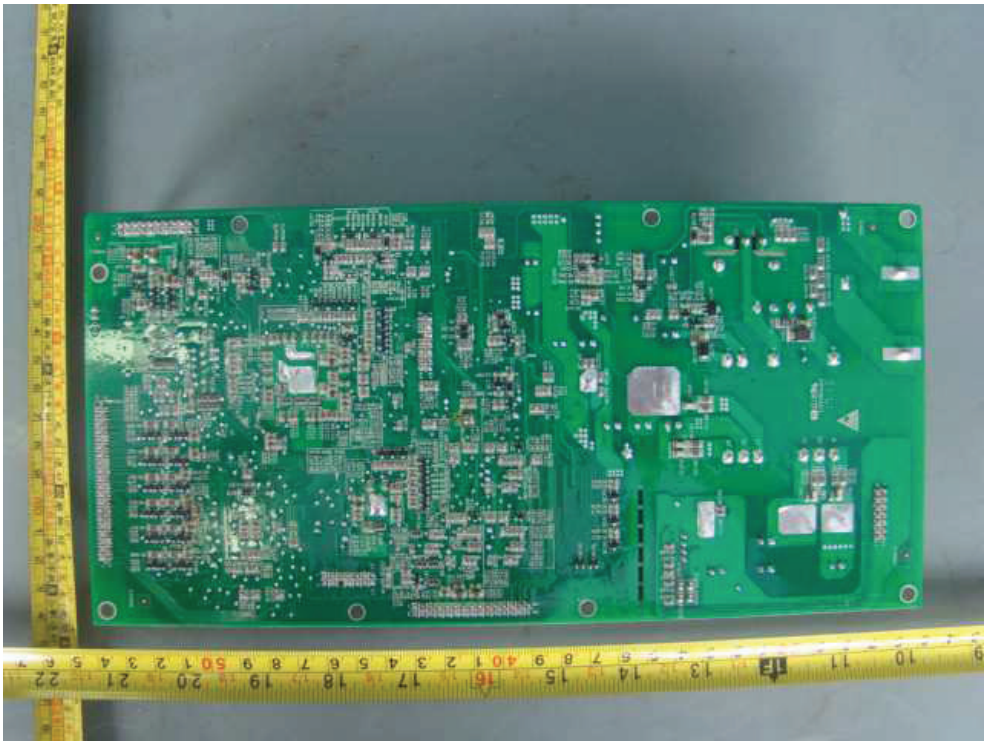


Figure 17. Trace side of control board

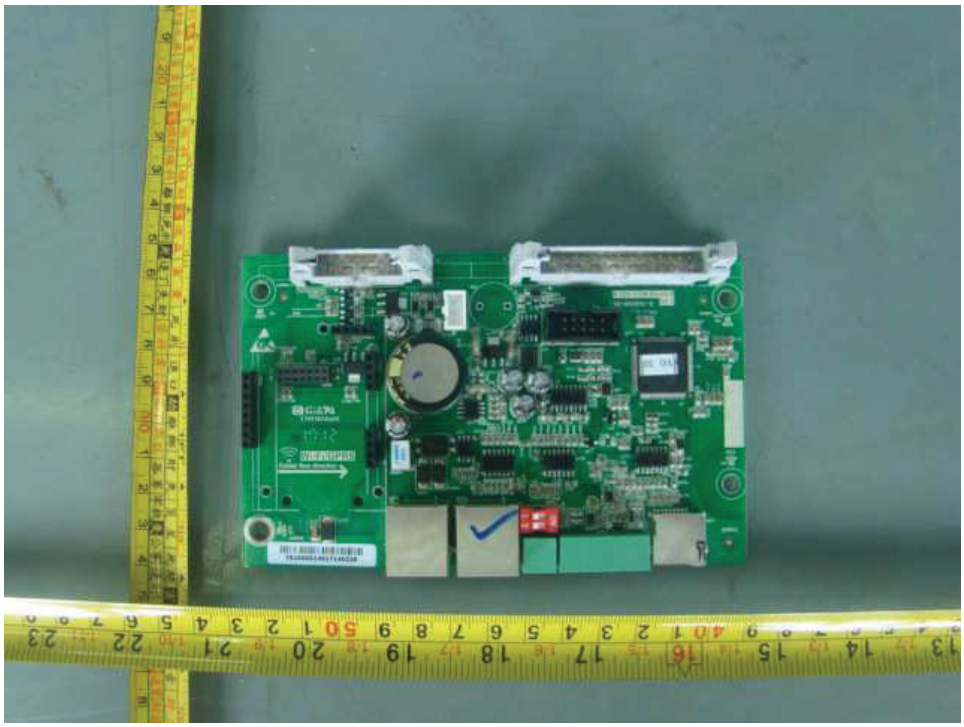


Figure 18. Component side of COM board

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

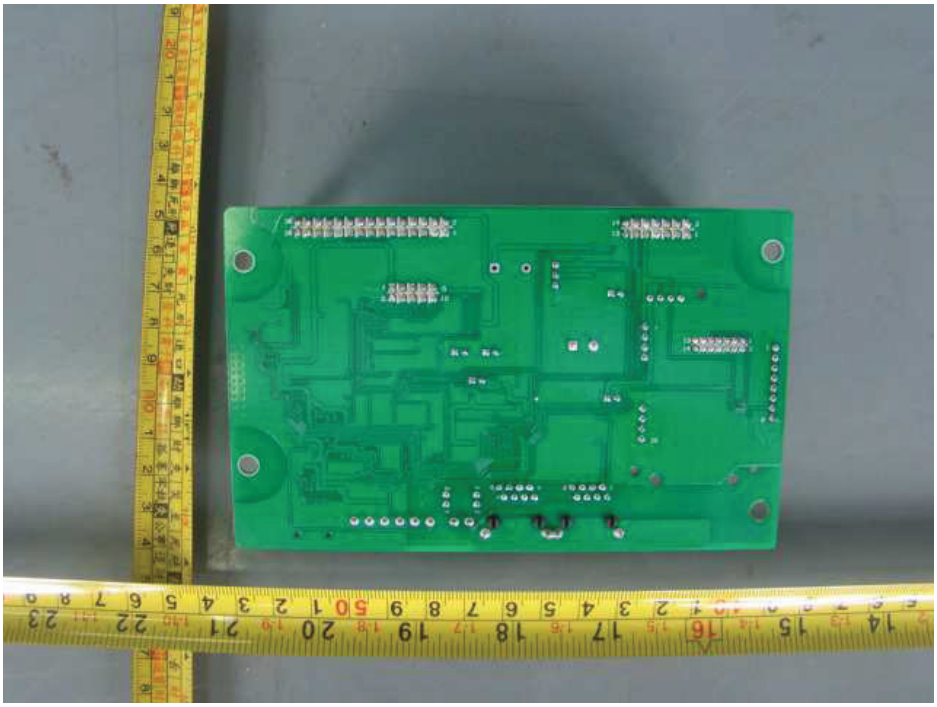


Figure 19. Trace side of COM board

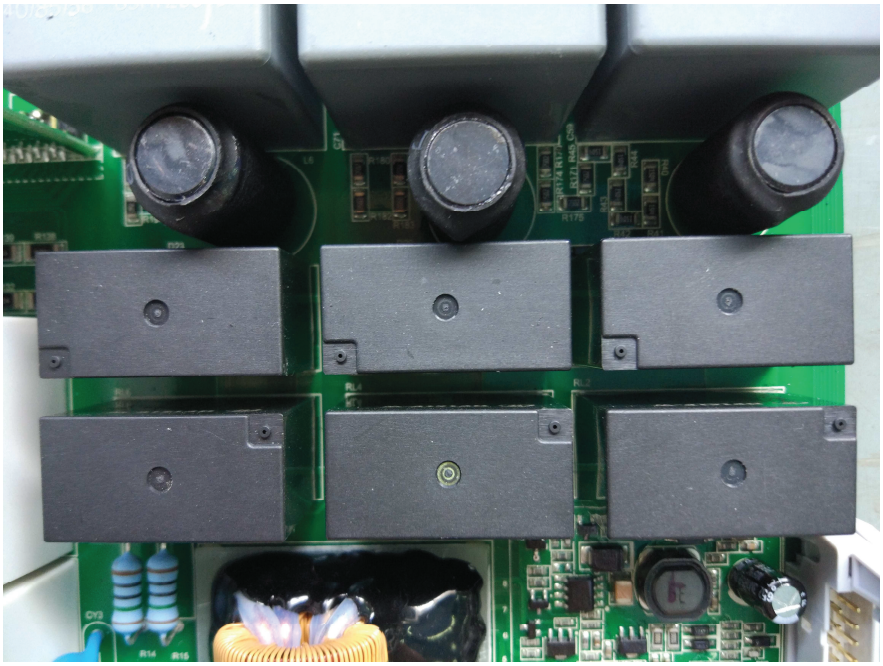


Figure 20. AC output relay

Product: Grid-tied PV Inverter

Type: EVVO 3000TL3P, EVVO 4000TL3P, EVVO 4800TL3P, EVVO 5000TL3P, EVVO 6000TL3P, EVVO 8000TL3P, EVVO 10000TL3P, EVVO 12000TL3P

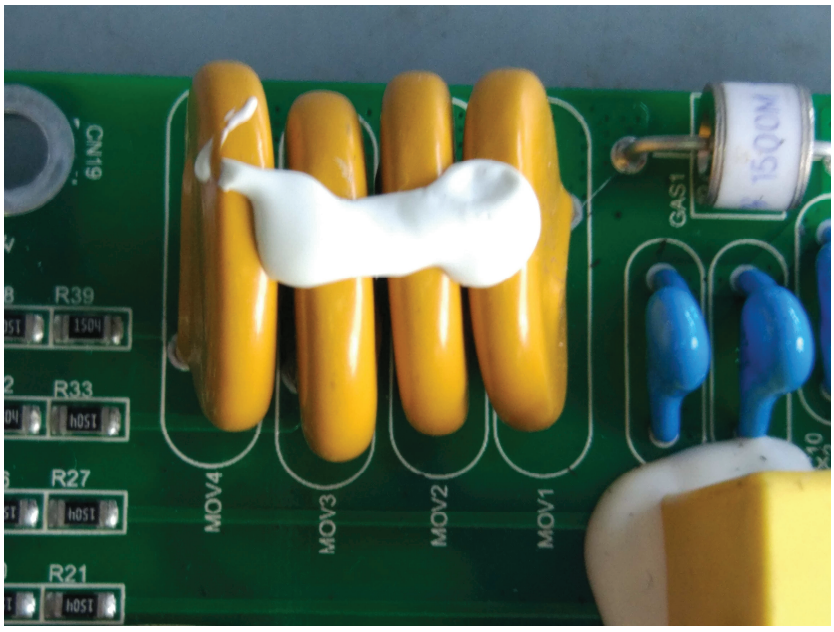


Figure 21. MOV

Figure 22. BUS cap