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

Report	
Report Reference No. ..... :	64.290.22.31025.01 Part 1 of 2
Date of issue ..... :	2022-08-16
Total number of pages ..... :	90 pages
Testing Laboratory ..... :	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch
Address ..... :	TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou 511447, P.R. China
Applicant's name ..... :	INVT Solar Technology (ShenZhen) Co., Ltd.
Address ..... :	6th Floor, Block A, INVT Guangming Technology Building Kejie Fourth Road, Shutianpu Community, Matian Guangming District, 518000 Shenzhen PEOPLE'S REPUBLIC OF CHINA
Test specification:	
Standard ..... :	EN 62109-1:2010
Test procedure ..... :	LVD
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	IEC62109_1B
TRF 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.

Test item description ..... :	Hybrid Solar Inverter
Trademark ..... :	invt
Manufacturer ..... :	Same as applicant
Model/Type reference ..... :	BD6KTR-RH3, BD8KTR-RH3, BD10KTR-RH3, BD12KTR-RH3, BD15KTR-RH3
Ratings ..... :	See page 7 to 9

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

☒	Testing location / address …….:	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou 511447, China
	Tested by (name + signature) ..... :	Jenn Huang
	Approved by (+ signature)..... :	Symbol Zhao

Telephone : +86 20 38320668
Telefax : +86 20 38320478

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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

This test report contains 2 parts listed in below table:

Item	Description	Pages
Part 1	EN 62109-1:2010 test report	90
Part 2	EN 62109-2:2011 test report	26

This test report shall be also used in conjunction with 12 pages of photo document.

Summary of testing:

All tests were carried out according to IEC 62109-1:2010. The text of EN 62109-1:2010 was approved by CENELEC as a European Standard without any modification.

If no special indicates, all the tests are applied for model: BD15KTR-RH3.

Tests performed (name of test and test clause):

Clause	Requirement
4.3	Thermal testing
4.4	Testing in single fault condition
4.4.4.5	Output short circuit
4.4.4.6	Back feed current tests
4.5	Humidity preconditioning
4.6	Back feed voltage protection
4.7	Electrical ratings tests
5.1.2	Durability of markings
5.2	Warning markings
5.3	Documentation
6.3	Ingress protection
7.3	Protection against electric shock
7.4	Protection against energy hazards
7.5	Electrical tests related to shock hazard
8.5	Wall mounting
13.1	Handles and manual controls
13.7	Mechanical resistance to deflection, impact, or drop
15	Software and firmware performing safety func-tions.

Testing location:

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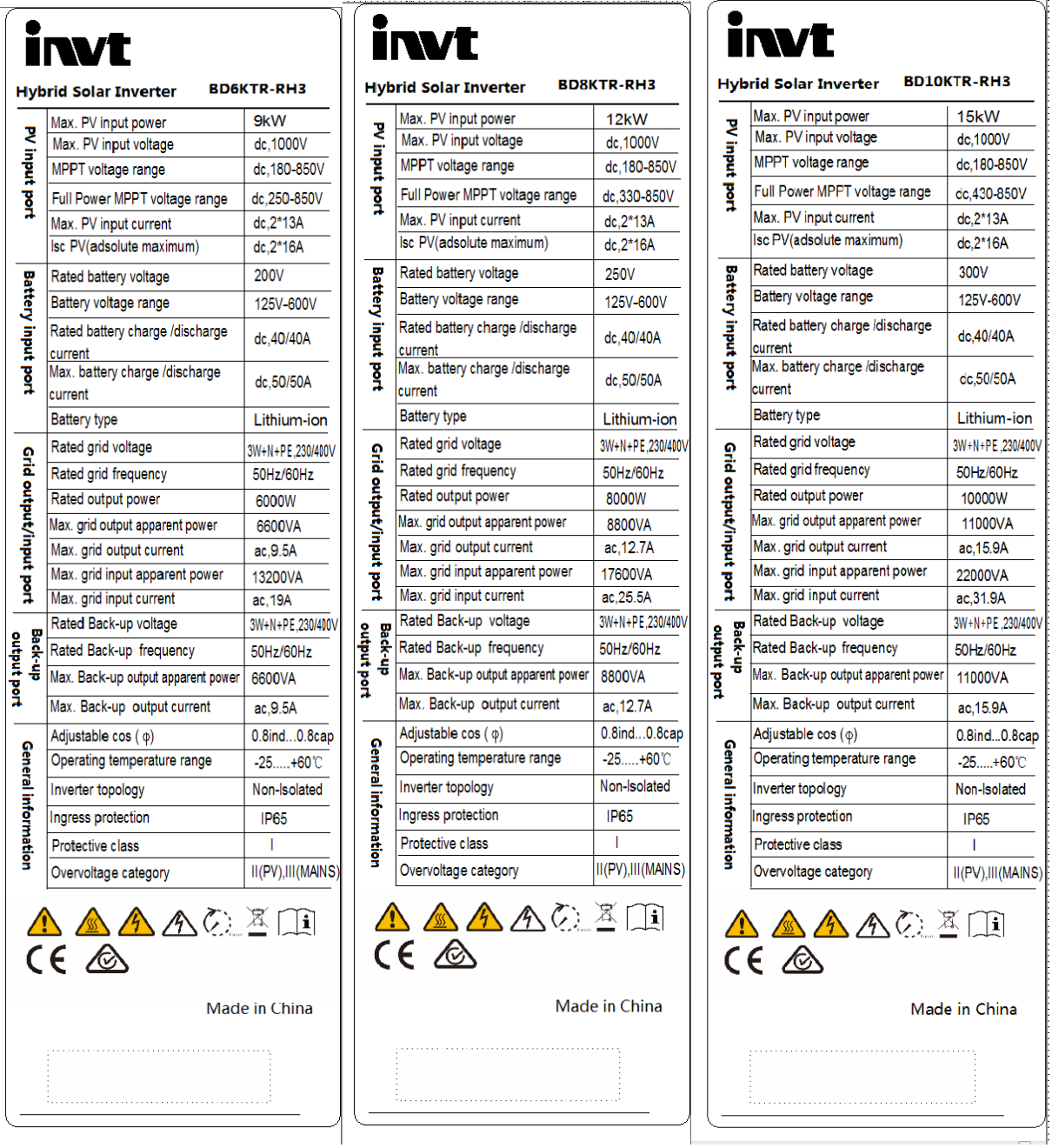
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

Copy of marking plate:



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Hybrid Solar Inverter **BD6KTR-RH3**

PV input port	Max. PV input power	9kW
	Max. PV input voltage	dc,1000V
	MPPT voltage range	dc,180-850V
	Full Power MPPT voltage range	dc,250-850V
	Max. PV input current	dc,2*13A
	Isc PV(adsolute maximum)	dc,2*16A
Battery input port	Rated battery voltage	200V
	Battery voltage range	125V-600V
	Rated battery charge /discharge current	dc,40/40A
	Max. battery charge /discharge current	dc,50/50A
	Battery type	Lithium-ion
Grid output/input port	Rated grid voltage	3W+N+PE,230/400V
	Rated grid frequency	50Hz/60Hz
	Rated output power	6000W
	Max. grid output apparent power	6600VA
	Max. grid output current	ac,9.5A
	Max. grid input apparent power	13200VA
	Max. grid input current	ac,19A
Back-up output port	Rated Back-up voltage	3W+N+PE,230/400V
	Rated Back-up frequency	50Hz/60Hz
	Max. Back-up output apparent power	6600VA
	Max. Back-up output current	ac,9.5A
General information	Adjustable cos (φ)	0.8ind...0.8cap
	Operating temperature range	-25.....+60℃
	Inverter topology	Non-Isolated
	Ingress protection	IP65
	Protective class	I
	Overvoltage category	II(PV),III(MAINS)

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Hybrid Solar Inverter **BD8KTR-RH3**

PV input port	Max. PV input power	12kW
	Max. PV input voltage	dc,1000V
	MPPT voltage range	dc,180-850V
	Full Power MPPT voltage range	dc,330-850V
	Max. PV input current	dc,2*13A
	Isc PV(adsolute maximum)	dc,2*16A
Battery input port	Rated battery voltage	250V
	Battery voltage range	125V-600V
	Rated battery charge /discharge current	dc,40/40A
	Max. battery charge /discharge current	dc,50/50A
	Battery type	Lithium-ion
Grid output/input port	Rated grid voltage	3W+N+PE,230/400V
	Rated grid frequency	50Hz/60Hz
	Rated output power	8000W
	Max. grid output apparent power	8800VA
	Max. grid output current	ac,12.7A
	Max. grid input apparent power	17600VA
	Max. grid input current	ac,25.5A
Back-up output port	Rated Back-up voltage	3W+N+PE,230/400V
	Rated Back-up frequency	50Hz/60Hz
	Max. Back-up output apparent power	8800VA
	Max. Back-up output current	ac,12.7A
General information	Adjustable cos (φ)	0.8ind...0.8cap
	Operating temperature range	-25.....+60℃
	Inverter topology	Non-Isolated
	Ingress protection	IP65
	Protective class	I
	Overvoltage category	II(PV),III(MAINS)

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Hybrid Solar Inverter **BD10KTR-RH3**

PV input port	Max. PV input power	15kW
	Max. PV input voltage	dc,1000V
	MPPT voltage range	dc,180-850V
	Full Power MPPT voltage range	cc,430-850V
	Max. PV input current	dc,2*13A
	Isc PV(adsolute maximum)	dc,2*16A
Battery input port	Rated battery voltage	300V
	Battery voltage range	125V-600V
	Rated battery charge /discharge current	dc,40/40A
	Max. battery charge /discharge current	cc,50/50A
	Battery type	Lithium-ion
Grid output/input port	Rated grid voltage	3W+N+PE,230/400V
	Rated grid frequency	50Hz/60Hz
	Rated output power	10000W
	Max. grid output apparent power	11000VA
	Max. grid output current	ac,15.9A
	Max. grid input apparent power	22000VA
	Max. grid input current	ac,31.9A
Back-up output port	Rated Back-up voltage	3W+N+PE,230/400V
	Rated Back-up frequency	50Hz/60Hz
	Max. Back-up output apparent power	11000VA
	Max. Back-up output current	ac,15.9A
General information	Adjustable cos (φ)	0.8ind...0.8cap
	Operating temperature range	-25.....+60℃
	Inverter topology	Non-Isolated
	Ingress protection	IP65
	Protective class	I
	Overvoltage category	II(PV),III(MAINS)

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Telephone : +86 20 38320668
Telefax : +86 20 38320478

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TÜV SÜD Certification and Testing (China) Co., Ltd.
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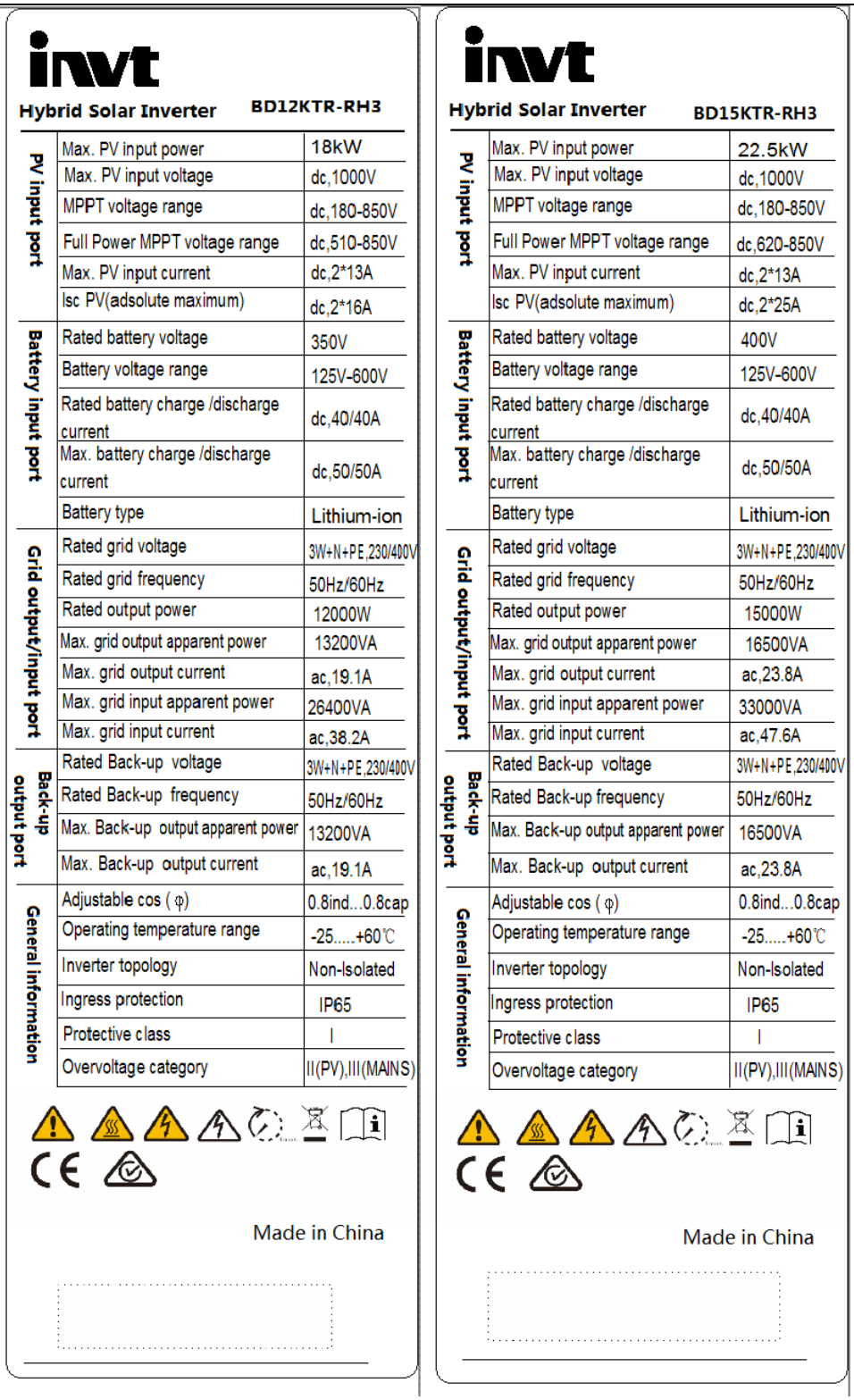
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China



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Hybrid Solar Inverter BD12KTR-RH3

PV input port	Max. PV input power	18kW
	Max. PV input voltage	dc,1000V
	MPPT voltage range	dc,180-850V
	Full Power MPPT voltage range	dc,510-850V
	Max. PV input current	dc,2*13A
	Isc PV(adsolute maximum)	dc,2*16A
Battery input port	Rated battery voltage	350V
	Battery voltage range	125V-600V
	Rated battery charge /discharge current	dc,40/40A
	Max. battery charge /discharge current	dc,50/50A
	Battery type	Lithium-ion
Grid output/input port	Rated grid voltage	3W+N+PE,230/400V
	Rated grid frequency	50Hz/60Hz
	Rated output power	12000W
	Max. grid output apparent power	13200VA
	Max. grid output current	ac,19.1A
	Max. grid input apparent power	26400VA
	Max. grid input current	ac,38.2A
Back-up output port	Rated Back-up voltage	3W+N+PE,230/400V
	Rated Back-up frequency	50Hz/60Hz
	Max. Back-up output apparent power	13200VA
	Max. Back-up output current	ac,19.1A
General information	Adjustable cos (φ)	0.8ind...0.8cap
	Operating temperature range	-25.....+60℃
	Inverter topology	Non-Isolated
	Ingress protection	IP65
	Protective class	I
	Overvoltage category	II(PV),III(MAINS)

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Hybrid Solar Inverter BD15KTR-RH3

PV input port	Max. PV input power	22.5kW
	Max. PV input voltage	dc,1000V
	MPPT voltage range	dc,180-850V
	Full Power MPPT voltage range	dc,620-850V
	Max. PV input current	dc,2*13A
	Isc PV(adsolute maximum)	dc,2*25A
Battery input port	Rated battery voltage	400V
	Battery voltage range	125V-600V
	Rated battery charge /discharge current	dc,40/40A
	Max. battery charge /discharge current	dc,50/50A
	Battery type	Lithium-ion
Grid output/input port	Rated grid voltage	3W+N+PE,230/400V
	Rated grid frequency	50Hz/60Hz
	Rated output power	15000W
	Max. grid output apparent power	16500VA
	Max. grid output current	ac,23.8A
	Max. grid input apparent power	33000VA
	Max. grid input current	ac,47.6A
Back-up output port	Rated Back-up voltage	3W+N+PE,230/400V
	Rated Back-up frequency	50Hz/60Hz
	Max. Back-up output apparent power	16500VA
	Max. Back-up output current	ac,23.8A
General information	Adjustable cos (φ)	0.8ind...0.8cap
	Operating temperature range	-25.....+60℃
	Inverter topology	Non-Isolated
	Ingress protection	IP65
	Protective class	I
	Overvoltage category	II(PV),III(MAINS)

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Telephone : +86 20 38320668
Telefax : +86 20 38320478

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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
Enviromental category..... :	☒ outdoor ☐ indoor unconditional ☐ indoor conditional
Over voltage category Mains ..... :	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV
Over voltage category PV/battery..... :	☐ OVC I ☒ OVC II ☐ OVC III ☐ OVC IV
Mains supply tolerance (%)..... :	+/- 10%
Tested for power systems ..... :	TN system
IT testing, phase-phase voltage (V) ..... :	--
Class of equipment ..... :	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg) ..... :	BD6KTR-RH3:30kg, BD8KTR-RH3:30kg, BD10KTR-RH3:31kg, BD12KTR-RH3:32kg, BD15KTR-RH3:34kg
Pollution degree ..... :	PD2(internal), PD3(external)
IP protection class..... :	IP 65

Testing

Date of receipt of test item(s)..... :	2022-02-09, 2022-08-01
Dates tests performed..... :	2022-05-09 to 2022-06-10, 2022-08-01 to 2022-08-15

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 was not evaluated for the requirement :	N/E
– test object does not meet the requirement ..... :	Fail (F)

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.
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.

Abbreviations used in the report:

Basic insulation (BI); Supplementary insulation (SI); Double insulation (DI); Reinforced insulation (RI); Functional insulation (FI); Single fault condition (SFC); Normal condition (NC); Main's overvoltage category (OVC); Pollution degree (PD), CDF (Construction Data form)

Name and address of factory (ies) ..... :

Factory name: Shenzhen INVT Electric Co., Ltd. Bao'an Branch Factory

Address: F1-F4, No.3 Building, Emerson Industrial Park, Fengtang Road, Tangwei Community, Fuhai, Bao'an District, Shenzhen City, Guangdong Province, 518103, P.R. China

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

General product information:

(1)	All the models are three phase non-isolated type multi-functions Hybrid Solar Inverter which will be installed and connected to the grid network or standalone after installation. It has four operating modes: • PV to Grid mode • PV to battery mode • Grid to Battery charge mode • Battery discharge to grid
(2)	The inverter module shall be used at specified ambient conditions: • Outdoor. • Temperature range: -25 °C ~ +60 °C, auto-derating when ambient temperature is above 45 °C. • Altitude: <＝2000m. • Overvoltage category: III (Mains), II (Battery), II (PV) • Relative humidity range: 0 ~ 95 % (Condensing). • Can used in wet location. • Environment pollution degree: less than or equal to 3.
(3)	If certain functions are not permitted by local regulation, the function shall be disabled by hardware or software setting (if applicable) by the manufacturer before putting into the market. For example, it's not permissible to draw electricity from the grid and then feed it back in order to claim statutory reimbursement in some nations.
(4)	Low voltage electrical installations shall comply with national and local regulation. Only qualified electricians are allowed to install and maintain the converter.
(5)	In order to protect the inverter, user and installer, external DC and AC circuit breaker shall be equipped for all source port (battery, AC grid) at the end-use application.
(6)	The internal insulation structure of the inverter is adopted BI+SI combination mode.

Model differences:

All models have same electrical schematic diagram and same software setting and control program except for different power output, The differences of BD6KTR-RH3, BD8KTR-RH3, BD10KTR-RH3, BD12KTR-RH3, BD15KTR-RH3 as below table, for more detail, refer to photo document and CDF.

No	Component	Usage amount		
		BD6KTR-RH3, BD8KTR-RH3, BD10KTR-RH3	BD12KTR-RH3	BD15KTR-RH3
1	IGBT (ST#STGWA40H120DF)	Quantity 2 (IGBT2-IGBT3)	Quantity 4 (IGBT1-IGBT4)	Quantity 4 (IGBT1-IGBT4)
2	IGBT (IKW40N120CS6)	Quantity 6 (IGBT10, IGBT13, IGBT14, IGBT16, IGBT19, IGBT20)		Quantity 12 (IGBT10-IGBT21)
3	Inductor	PV:1.2mH±10%@0A"0.7mH±10%@15A0.7mH±10%@15A" INV: 1.5mH±10%@0A0.77mH±10%@20.4Apk		PV:1.5mH± 10%@0A0.6mH± 10%@25A INV:1mH±

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		BAT: 0.44mH±10%@0A0.21mH±10%@50A*2PCS	10%@0A0.42mH± 10%@30A BAT:0.44mH±10%@0 A0.21mH±10%@50A

Rating:

Model	BD6KTR-RH3	BD8KTR-RH3	BD10KTR-RH3	BD12KTR-RH3	BD15KTR-RH3
Battery terminal parameters					
Rated battery DC voltage	200 Vd.c.	250 Vd.c.	300 Vd.c.	350 Vd.c.	400 Vd.c.
Battery DC voltage range	125-600 Vd.c.				
Max charging / discharging current	50 Ad.c.				
Battery type	Lithium-ion				
Maximum charge/discharge power	15000 W				
PV terminal parameters					
Max. Input Power	9000 W	12000 W	15000 W	18000 W	22500 W
Maximum DC input voltage	1000 Vd.c.				
MPPT Range	180~850 Vd.c.				
MPPT Range (full load)	250~850 Vd.c.	330~850Vd.c.	430~850Vd.c.	510~850Vd.c.	620~850Vd.c.
Max. Input Current	2*13 Ad.c.				
Isc PV	2*16 Ad.c.				2*25 Ad.c.
Grid terminal parameters					
Rated output Power	6000 W	8000 W	10000 W	12000 W	15000 W
Maximum continuous output apparent power	6600 VA	8800 VA	11000 VA	13200 VA	16500 VA
Max. AC output current	9.5 Aa.c.	12.7 Aa.c.	15.9 Aa.c.	19.1 Aa.c.	23.8 Aa.c.
Maximum continuous input apparent power	13200 VA	17600 VA	22000 VA	26400 VA	33000 VA
Max. AC input current	19 Aa.c.	25.5 Aa.c.	31.9 Aa.c.	38.2 Aa.c.	47.6 Aa.c.
Rated AC voltage	230/400 Va.c., 3W+N+PE				
Rated AC fre-	50/60 Hz				

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5F, Communication Building, 163 Pingyun Rd, Huangpu
Ave. West,Guangzhou, 510656, P.R.China

quency					
Power factor	0.8 lagging to 0.8 leading				
Backup terminal parameters					
Rated apparent power	6000 VA	8000 VA	10000 VA	12000 VA	15000 VA
Maximum continuous output apparent power	6600 VA	8800 VA	11000 VA	13200 VA	16500 VA
Max. AC current	9.5 Aa.c.	12.7 Aa.c.	15.9 Aa.c.	19.1 Aa.c.	23.8 Aa.c.
Rated AC voltage	230/400 Va.c., 3W+N+PE				
Rated AC frequency	50/60 Hz				
General					
Protection class	I				
Ingress protection	IP 65				
Overvoltage Category	II(PV/Battery), III(Mains)				
Temperature	-25 °C ~ +60 °C, derating above 45 °C				
Altitude	≤2000				

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IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

4	General testing requirements		P
4.1	General		P
4.2	General conditions for testing		P
4.2.1	Sequence of tests		P
4.2.2	Reference test conditions		P
4.2.2.1	Environmental conditions	A complete EUT is tested with subassemblies tested at humidity test.	P
	Unless otherwise specified, the following ambient environmental conditions shall exist in the test location: a) temperature of 15 °C to 40 °C b) a relative humidity of not more than 75 % and not less than 5% c) an air pressure of 75 kPa to 106 kPa. d) no frost, dew, percolating water, rain, solar radiation, etc.	Max. 60°C rated ambient temperature.	P
4.2.2.2	State of equipment		P
4.2.2.3	Position of equipment	The equipment is installed in accordance with the manufacturer's instructions, in the configuration that results in the worst-case test conditions.	P
4.2.2.4	Accessories	No accessories or operator interchangeable parts	N/A
4.2.2.5	Covers and removable parts	Cover or removable parts must be removed using a tool.	P
4.2.2.6	Main supply	230/400 Va.c., 3W+N+PE. (90% to 110% tolerance), 50 Hz, three phases, TN system considered.	P
4.2.2.7	Supply ports other than the mains	DC input	P
4.2.2.7.1	Photovoltaic supply sources	PV input	P
4.2.2.7.2	Battery inputs	External battery pack can connect to the unit	P
4.2.2.8	Conditions of loading for output ports		P
4.2.2.9	Earthing terminals	Protective conductor terminal was connected to earth. No functional earth terminal.	P
4.2.2.10	Controls		P
	Controls which the operator can adjust shall be set to any position except that	Control is set to max. AC output power. But it is not intended for user	P

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IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
	a) mains selection devices shall be set to the correct value unless otherwise noted in this standard;	No mains selection devices	N/A
	b) Combinations of settings shall not be made if they are prohibited by the manufacturer's instructions provided with the equipment.		N/A
4.2.2.11	Available short circuit current		P
4.3	Thermal testing		P
4.3.1	General		P
4.3.2	Maximum temperature		P
4.3.2.1	General		P
	Materials and components shall be selected so that under the most severe rated operating conditions, the temperatures do not exceed the temperature limits.		P
	Conformity is verified by measuring temperatures under the conditions given in 4.2 for each rated operating condition or mode of the PCE that could affect the resulting temperatures.		P
	The temperature limits specified below are total temperature limits (not temperature rise limits).		P
	Tests of equipment rated for use in ambient temperatures up to 50°C may be conducted at any ambient temperature in the range given in 4.2.2.1, in which case the difference between the maximum rated ambient temperature and the test ambient is to be subtracted from or added to (as appropriate) the measured temperatures for comparison to the limits specified below.		N/A
	PCE rated for use in ambient temperatures more than 50°C shall be tested at the maximum rated ambient temperature +/- 5°C. the difference between the maximum rated ambient temperature and the test ambient is to be subtracted from or added to the measured temperatures for comparison to the limits specified.	Maximum rated ambient temperature of the unit: 60°C. (See appended table)	P
	PCE with different output ratings or with automatic derating for different ambient temperatures shall be tested under as many conditions as are necessary to record worst-case temperatures, including at least the maximum ambient before derating, and the maximum ambient with derating.	Derating above 45 °C. (See appended table)	P
	During thermal testing within NORMAL CONDITIONS protective devices shall not operate.		P
	Temperatures are to be measured by thermocouples, except that for coils the change of resistance method may be used.	Method of thermocouples is used, including transformers, inductors, and other coils. Multiple embedded thermocouples, where the thermocouples are attached during winding of	P

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IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
		the part, are more likely to record hot-spot temperatures.	
	Limits: - for coils and their insulation systems, the temperature limits in Table 1 apply.		P
	- for other components the measured temperatures shall not exceed the lower of:	(See appended table)	P
	- the applicable IEC component standards		P
	- the component or material's rated manufacturer's operating temperature		P
	- if neither of the above exists, temperature limits are given in Table 2.		P
4.3.2.2	Touch temperatures		P
	The maximum temperature for accessible parts of the PCE shall be in compliance with table 3	(See appended table)	P
	It is permitted that accessible parts that are required to get hot as part of their intended function (for example heatsinks) may have temperatures up to 100 °C, if the parts are marked with the hot surface marking of symbol 14 of Annex C. For products only for use in a closed electrical operating area the 100 °C limit does not apply.	For metal enclosure, heatsinks, the limit 100 °C apply and hot surface marking is used.	P
4.3.2.3	Temperature limits for mounting surfaces		P
	In order to protect against long-term degradation of building materials, surfaces of the PCE that will be in contact with the mounting surface shall not exceed a maximum total temperature of 90 °C.		P
4.4	Testing in single fault condition		P
4.4.1	General		P
	Testing in single fault conditions is done to determine that no hazards result from reasonably expected fault conditions that may arise in normal service or from reasonably expected misuse.		P
	Fault testing shall be done unless it can be conclusively demonstrated that no hazards could arise from a particular fault condition, or unless alternative methods of checking conformity are specified in this standard in place of fault testing.		P
4.4.2	Test conditions and duration for testing under fault conditions		P
4.4.2.1	General		P
	The equipment shall be operated under the combination of conditions in 4.2, which is least favourable for the particular fault test being performed.		P
	Fault conditions are to be applied only one at a time and shall be applied in turn in any convenient order.		P

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Telefax : +86 20 38320478

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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	any damage to the protective earthing conductor or terminal, or to protective bonding means; and		
	c) by inspection to ensure a fuse connected between the protective earthing terminal and the protective earthing conductor in the test setup has not opened; the fuse shall be rated 3A non-time-delay (for equipment rated for use on circuits protected by overcurrent protection rated 30A or less) or 30A to 35A non-time-delay(for equipment rated for use on circuits protected by overcurrent protection rated more than 30A); the enclosure is not to be contacting earth in any other location during the testing; and		P
	d) by inspection of the enclosure to ensure that no damage has resulted that allows access to parts that are hazardous live.		P
4.4.3.2	Protection against the spread of fire	After all single fault conditions, the below requirements are considered to check if any fire hazard	P
	Compliance with requirements for protection against the spread of fire is checked by placing the equipment on white tissue-paper covering a softwood surface and covering the equipment with cheesecloth or surgical cotton during the fault testing. As an alternative, the cheesecloth or surgical cotton may be placed only over the openings of large equipment.		P
	There shall be no emission of molten metal, burning insulation, or flaming or glowing particles from the fire enclosure, and there shall be no charring, glowing, or flaming of the tissue paper, cheesecloth, or glowing or flaming of surgical cotton.		P
4.4.3.3	Protection against other hazards		P
	Conformity with requirements for protection against other HAZARDS after application of the fault tests is checked as specified elsewhere in this standard.		P
4.4.3.4	Protection against parts expulsion hazards		P
	Failure of any component within the PCE shall not release parts outside the PCE enclosure with sufficient energy to lead to a hazard, for example, expulsion of material into an area occupied by personnel.		P
4.4.4	Single Fault conditions to be applied		P
4.4.4.1	Component fault tests	(See appended table)	P
	The following faults are simulated:		P
	a) Short circuit or open circuit of relevant components		P
	b) Short circuit or open circuit of any components or insulation where failure could adversely affect supplementary insulation or reinforced insulation.		P

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Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
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	c) In addition, where required by Method 2 of 9.1.1, components that could result in a fire hazard are to be overloaded unless they comply with the requirements of 9.1.3		P
4.4.4.2	Equipment or parts for short-term or intermittent operation		N/A
	Components such as motors, relays, other electromagnetic devices and heaters, which are normally operated only intermittently, shall be operated continuously if continuous operation could occur in a single fault conditions.		N/A
4.4.4.3	Motors		P
	Motors shall be stopped while fully energized or prevented from starting, whichever is less favourable.	(see appended table)	P
4.4.4.4	Transformer short circuit tests	(see appended table)	P
	The output windings of transformers shall be short-circuited one at a time. A transformer damaged during one test may be repaired or replaced before the next test.		P
4.4.4.5	Output short circuit		P
	Testing is required to be performed on all combinations of terminals for the port under consideration, two at a time, including neutral and earth terminals and one test with all current-carrying terminals of the port shorted together at once.	(1) Grid output: max. output short-circuit current is 226 A_{peak} impulse (214.60ms, duration) (2) Load output: max. output short-circuit current is 156 A_{peak} impulse (186ms, duration) Above three combinations of output terminals are tested one a time.	P
	the short-circuit currents are to be recorded and if they exceed the maximum rated current of the circuit, the maximum measured current shall be provided in the installation manual for the purpose of coordination of overcurrent protection of the external circuit conductors.		P
4.4.4.6	Backfeed current test		P
	For equipment intended to be connected simultaneously to more than one source of supply, each input of the PCE shall be tested one at a time, to determine if hazardous conditions can result from current	DC and AC consider as source of supply.	P

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TÜV SÜD Certification and Testing (China) Co., Ltd.
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	from one source of supply flowing into the wiring for another source under fault conditions.		
	With the PCE operating under normal conditions, a short circuit shall be applied at the field wiring terminals of the circuit under consideration, with all intended other sources connected to the PCE through the over current protective devices (if any) intended to be present in the installation.		P
	the short-circuit currents are to be recorded and if they exceed the maximum rated current for the port, the maximum measured current shall be provided in the installation manual for the purpose of coordination of overcurrent protection of the external circuit conductors	The PV input max. back-feedcircuit current is 28.8 Apeak impulse (213.6 ms)	P
4.4.4.7	Output overload	(see appended table)	P
	Each output of the PCE, and each section of a tapped output, shall be overloaded in turn, one at a time. The other windings are loaded or not loaded, whichever load condition of normal use is less favorable. Overloading is carried out by connecting a variable resistor across the winding. The resistor is adjusted as quickly as possible and readjusted, if necessary, after 1 min to maintain the applicable overload. No further readjustments are then permitted.		P
	If over-current protection is provided by a current-sensitive device or circuit, the overload test current is the maximum current which the over-current protection device is just capable of passing for 1 h. If this value cannot be derived from the specification, it is to be established by test. Before the test, the device is made inoperative or replaced by a link with negligible impedance.		N/A
	For equipment in which the output voltage is designed to collapse when a specified overload current is reached, the overload is slowly increased to the point of maximum output power before the point which causes the output voltage to collapse.		P
	In all other cases, the loading is the maximum power output obtainable from the output.		P
4.4.4.8	Cooling system failure	(see appended table)	P
4.4.4.9	Heating devices		N/A
	In equipment incorporating heating devices, the following faults shall be applied one at a time: a) timers which limit the heating period shall be overridden to energize the heating circuit continuously; b) temperature control devices or circuits shall have single fault conditions applied such that control over the heater is lost. Over-temperature protection devices meeting the requirements of 14.3 are left op-		N/A

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TÜV SÜD Certification and Testing (China) Co., Ltd.
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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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	erational during the test.		
4.4.4.10	Safety interlock	No safety interlock	N/A
4.4.4.11	Reverse d.c. connections	(see appended table)	P
4.4.4.12	Voltage selector mismatch	No voltage selector	N/A
4.4.4.13	Mis-wiring with incorrect phase sequence or polarity	(see appended table)	P
4.4.4.14	PWB short-circuit test		P
4.5	Humidity preconditioning		P
4.5.1	General		P
4.5.2	Conditions		P
	Relative humidity (%), temperature (°C)	95% RH., 40 °C, 48 h	P
4.6	Voltage Backfeed protection		P
4.6.1	Backfeed tests under normal conditions	The PV input terminal is not accessible to people after installation. The discharge time after disconnection from DC and AC sources is tested in Cl. 7.3.9.2. For service access, the unit was marked with discharge time	P
4.6.2	Backfeed tests under single-fault condtions		P
4.6.3	Compliance with backfeed tests		P
	The PCE is compliant with the requirements if during the tests in 4.6.1 and 4.6.2 no hazardous voltage or energy is present on the PCE terminals for the source under test. Measurements are taken 15 s or 1 s after the source is de-energized or disconnected, as follows:		P
	- 15 s for sources that are connected by fixed wiring		P
	- 1 s for sources that are cord-connected or use connectors that can be opened without the use of a tool		N/A
4.7	Electrical ratings tests		P
4.7.1	Input ratings	(see appended table)	P
4.7.1.1	Measurement requirements for DC input ports		P
4.7.2	Output ratings	(see appended table)	P

5	**MARKING AND DOCUMENTATION**		P
5.1	Marking		P
5.1.1	General		P
	Equipment shall bear markings as specified in 5.1 and 5.2	Label are marked on the PCE and graphic symbol is ex-	P

Telephone : +86 20 38320668
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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
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		plained	
	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		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	Trademark	P
	b) model number, name or other means to identify the equipment	Model number	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.	Serial number	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:	Special requirement as per IEC 62109-2.	P
	– input voltage, type of voltage (a.c. or d.c.), frequency, and max. continuous current for each input	Refer to the marking label	P
	– output voltage, type of voltage (a.c. or d.c.), frequency, max. continuous current, and for a.c. outputs, either the power or power factor for each output	Refer to the marking label	P
	– the ingress protection (IP) rating as in 6.3 below	See marking label	P
5.1.5	Fuse identification		P
	Marking shall be located adjacent to each fuse or fuseholder, or on the fuseholder, or in another location provided that it is obvious to which fuse the marking applies, giving the fuse current rating and where fuses of different voltage rating value could be fitted, the fuse voltage rating.		P
	Where fuses with special fusing characteristics such as time delay or breaking capacity are necessary, the type shall also be indicated		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		N/A

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn
TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
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	servicing instructions which shall contain the relevant information.		
5.1.6	Terminals, Connections, and Controls	PV input, grid, back up, battery connection and communication interface	P
	If necessary for safety, an indication shall be given of the purpose of Terminals, connectors, controls, and indicators, and their various positions, including any connections for coolant fluids such as water and drainage. The symbols in Annex C may be used, and where there is insufficient space, symbol 9 of Annex C may be used.	Symbol 9 are marked on the PCE and user manual indicate the installation and safety of connection of connector, control and indicator.	P
	Push-buttons and actuators of emergency stop devices, and indicator lamps used only to indicate a warning of danger or the need for urgent action shall be coloured red.	No emergency stop	N/A
	A multiple-voltage unit shall be marked to indicate the particular voltage for which it is set when shipped from the factory. The marking is allowed to be in the form of a paper tag or any other nonpermanent material.	No setting is accessible to user	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	The input PV terminals for each module and whole unit are silk-screen with sign “+“ for positive and “-“ for negative	P
	– a pictorial representation illustrating the proper polarity where the correct polarity can be unambiguously determined from the representation	Not provided	N/A
5.1.6.1	Protective Conductor Terminals		P
	The means of connection for the protective earthing conductor shall be marked with:	The PE terminal is connected via AC output cable	P
	– symbol 7 of Annex C; or		P
	– the letters “PE“; or		P
	– the colour coding green-yellow.		P
5.1.7	Switches and circuit-breakers		N/A
	The on and off-positions of switches and circuits breakers shall be clearly marked. If a push-button switch is used as the power switch, symbols 10 and 16 of Annex C may be used to indicate the on-position, or symbols 11 and 17 to indicate the off-position, with the pair of symbols (10 and 16, or 11 and 17) close together.		N/A
5.1.8	Class II Equipment	Class I	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		N/A

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
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	DOUBLE INSULATION or REINFORCED INSULATION shall not bear symbol 12 of Table Annex C.		
	Where such equipment has provision for the connection of an earthing conductor for functional reasons (see 7.3.6.4) it shall be marked with symbol 6 of Annex C		N/A
5.1.9	Terminal boxes for External Connections	No such terminal box	N/A
	Where required by note 1 of Table 2 as a result of high temperatures of terminals or parts in the wiring compartment, there shall be a marking, visible beside the terminal before connection, of either:		N/A
	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		P
	– Printed text characters shall be at least 1.5 mm high and shall contrast in colour with the background		P
	– Symbols or text that are moulded, stamped or engraved in a material shall have a character height of at least 2,0 mm, and if not contrasting in colour from the background, shall have a depht or raised height of at least 0,5 mm.		N/A
	If it is necessary to refer to the instruction manual to preserve the protection afforded by the equipment, the equipment shall be marked with symbol 9 of Annex C	The manual provides necessary information for the warning marking.	P
	Symbol 9 of Annex C is not required to be used adjacent to symbols that are explained in the manual		P
5.2.2	Content for warning markings		P
5.2.2.1	Ungrounded heatsinks and similar parts	Grounded heatsink and metal enclosure.	N/A
	An ungrounded heat sink or other part that may be mistaken for a grounded part and involves a risk of electric shock in accordance with 7.3 shall be marked with symbol 13 of Annex C, or equivalent. The marking may be on or adjacent to the heatsink and shall be clearly visible when the PCE is disassembled to the extent that a risk of contact with the heatsink exists.		N/A

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn
TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
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5.2.2.2	Hot Surfaces	See below	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 marked on PCE	P
5.2.2.3	Coolant	Coolant is not used	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.	Symbol 21 is marked on PCE	P
5.2.2.5	Motor guarding		P
	Where required by 8.2 a marking shall be provided where it is visible to service personnel before removal of a guard, warning of the hazard and giving instructions for safe servicing (for example disconnection of the source before removing the guard).		P
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.	Symbol 13 provided on PCE	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

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn
TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
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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.		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	See ratings table	P
	– WET LOCATIONS classification fort he intended external environment as per 6.1		P
	– POLLUTION DEGREE classification for the intended external environment as per 6.2	See ratings table	P
	– INGRESS PROTECTION rating as per 6.3	See marking label	P
	– Ambient temperature and relative humidity ratings		P
	– MAXIMUM altitude rating	2000m (clearances for use at altitudes up to 3000m are considered)	P
	– OVERVOLTAGE CATEGORY assigned to each input and output port as per 7.3.7.1.2, accompanied by guidance regarding how to ensure that the installation complies with the required overvoltage categories;	OVC II (PV, battery), OVC III (Mains)	P
	d) a warning that when the photovoltaic array is exposed to light, it supplies a d.c. voltage to the PCE		P
5.3.1.1	Language	English provided	P
	Instructions related to safety shall be in a language that is acceptable in the country where the equipment is to be installed.	For other country language, further evaluation is needed.	N/A
5.3.1.2	Format		P

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Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
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	In general, the documentation must be provided in printed form and is to be delivered with the equipment.	Printed form provided and is to be delivered with equipment	P
	For equipment which requires the use of a computer for both installation and operation, documentation may be provided in electronic format without accompanying printed format.		P
5.3.2	Information related to installation		P
	The documentation shall include installation and where applicable, specific commissioning instructions and, if necessary for safety, warnings against hazards which could arise during installation or commissioning of the equipment. The information provided shall include:		P
	a) assembly, location, and mounting requirements:		P
	b) ratings and means of connection to each source of supply and any requirements related to wiring and external controls, colour coding of leads, disconnection means, or overcurrent protection needed, including instructions that the installation position shall not prevent access to the disconnection means;		P
	c) ratings and means of connection of any outputs from the PCE, and any requirements related to wiring and externals controls, colour coding of leads, or overcurrent protection needed;		P
	d) explanation of the pin-out of connectors for external connections, unless the connector is used for a standard purpose (e.g. RS 232)		P
	e) ventilation requirements;		P
	f) requirements for special services, for example cooling liquid;	No cooling liquid or other special service	N/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;	No such battery	P
	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 exceeds the max. rated current of the circuit, as per 4.4.4.6;		P
	k) for each input to the PCE, the max value of short-circuit current available from the source, for which the PCE is designed; and		P

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	l) compatibility with RCD and RCM;	External RCD type B required for backup load	P
	m) instructions for protective earthing, including the information required by 7.3.6.3.7 if a second protective earthing conductor is to be installed:		N/A
	n) where required by 7.3.8, the installation instructions shall include the following or equivalent wording:		P
	"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. "		P
	o) for PCE intended to charge batteries, the battery nominal voltage rating, size, and type		P
	p) PV array configuration information, such as ratings, whether the array is to be grounded or floating, any external protection devices needed, etc.		P
5.3.3	Information related to operation		P
	Instructions for use shall include any operating instructions necessary to ensure safe operation, including the following, as applicable:		P
	– Instructions for adjustment of controls including the effects of adjustment;		P
	– Instructions for interconnection to accessories and other equipment, including indication of suitable accessories, detachable parts and any special materials;		P
	– Warnings regarding the risk of burns from surfaces permitted to exceed the temperature limits of 4.3.2 and required operator actions to reduce the risk; and		P
	– Instructions, that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.		P
5.3.4	Information related to maintenance		P
	Maintenance instructions shall include the following:		P
	– Intervals and instructions for any preventive maintenance that is required to maintain safety (for example air filter replacement or periodic retightening 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

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Telefax : +86 20 38320478
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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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	– Part numbers and instructions for obtaining any required operator replaceable parts;	No replaceable parts	N/A
	– Instructions for safe cleaning (if recommended)		P
	– Where there is more than one source of supply energizing the PCE, information shall be provided in the manual to indicate which disconnect device or devices are required to be operated in order to completely isolate the equipment.		P
5.3.4.1	Battery maintenance	No energy storage battery inside	N/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
	– 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.		N/A
	c) Wear rubber gloves and boots.		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).		N/A

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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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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	See general product information	P
	– Suitability for WET LOCATIONS or not		P
	– POLLUTION DEGREE rating in 6.2 below	See ratings table	P
	– INGRESS PROTECTION (IP) rating, as in 6.3 below	See ratings table	P
	– Ultraviolet (UV) exposure rating, as in 6.4 below	metal enclosure	P
	– Ambient temperature and relative humidity ratings, as in 6.5 below		P
6.1	Environmental categories and minimum environmental conditions		P
6.1.1	Outdoor		P
6.1.2	Indoor, unconditioned		N/A
6.1.3	Indoor, conditioned		N/A
6.2	Pollution degree	See ratings table	P
6.3	Ingress Protection	See ratings table	P
6.4	UV exposure		P
6.5	Temperature and humidity		P

7	**PROTECTION AGAINST ELECTRIC SHOCK AND ENERGY HAZARDS**		P
7.1	General		P
7.2	Fault conditions	Normal and single fault condition are considered	P
7.3	Protection against electric shock		P
7.3.1	General	In the PCE the earthed metal enclosure is evaluated by means of basic insulation from DVC C circuit. DVC A circuit and unearthed accessible parts are evaluated by means of double insulation or reinforce insulation from DVC C/B. DVC C: The PV/DG input and mains output. DVC A: the communication interface and LED board/LED module outside surface	P
7.3.2	Decisive voltage classification		P
7.3.2.1	Use of decisive voltage class (DVC)	Working voltage and protective	P

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Telefax : +86 20 38320478
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		measures are considered.	
7.3.2.2	Limits of DVC (according table 6)		P
7.3.2.3	Short-terms limits of accessible voltages under fault conditions		N/A
7.3.2.4	Requirements for protection (according table 7)	Single fault condition is considered. Accessible earthed conductive parts are separated from DVC-C circuits by basic insulation. Accessible unearthed conductive parts separated from DVC C circuit by BI+SI insulation	P
7.3.2.5	Connection to PELV and SELV circuits	The external communication interface is considered as SELV	P
7.3.2.6	Working voltage and DVC		P
7.3.2.6.1	General	Transients and voltage fluctuations are disregarded. And worst case normal operating condition is considered	P
7.3.2.6.2	AC working voltage (see Figure 2)	230 Vr.m.s, 325 Vpeak considered	P
7.3.2.6.3	DC working voltage (see Figure 3)	Max. DC open voltage: 1000 Vd.c.	P
7.3.2.6.4	Pulsating working voltage (see Figure 4)		N/A
7.3.3	protective separation	See description in Cl. 7.3.1	P
	Protective separation shall be achieved by:		P
	▪ double or reinforced insulation, or		P
	▪ protective screening, i.e. by a conductive screen connected to earth by protective bonding in the PCE, or connected to the protective earth conductor itself, whereby the screen is separated from live parts by at least basic insulation, or		P
	▪ protective impedance comprising limitation of current per 7.3.5.3 and of discharged energy per 7.3.5.4, or		P
	▪ limitation of voltage according to 7.3.5.4.		N/A
	The protective separation shall be fully and effectively maintained under all conditions of intended use of the PCE		P
7.3.4	Protection against direct contact		P
7.3.4.1	General		P
	Protection against direct contact is employed to prevent persons from touching live parts that do not meet the requirements of 7.3.5 and shall be provid-	Enclosure provided	P

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	ed by one or more of the measure given in 7.3.4.2 (enclosures and barriers) and 7.3.4.3 (insulation).		
	Open type sub-assemblies and devices do not require protective measures against direct contact but the instruction provided with the equipment must indicate that such measures must be provided in the end equipment or in the installation.	End use product	N/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.	No use under this condition	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.	Enclosure provided to prevent access to inside live parts	P
7.3.4.2.1	General		P
	Parts of enclosures and barriers that provide protection in accordance with these requirements shall not be removable without the use of a tool (see 7.3.4.2.3).	Secured by screws	P
	Polymeric materials used to meet these requirements shall also meet the requirements of 13.6		N/A
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	The communication interface is considered as DVC A	P
	b) decisive voltage classification B, (DVC B) - the probe must not touch bare live parts	The DVC B circuit is not accessible by probe	P
	c) decisive voltage classification C, (DVC C) – the probe must have adequate clearance to live parts, based on the clearance for Basic insulation using the recurring peak working voltage involved,	The DVC C circuit is not accessible by probe	P
7.3.4.2.3	Access probe tests		P
	Compliance with 7.3.4.2.1 is checked by all of the following:		P
	a) Inspection; and		P
	b) Tests with the test finger (Figure D.1) and test pin (Figure D.2) of 0E, the results of which shall comply with the requirements of 7.3.4.2.1 a), b), and c) as applicable. Probe tests are performed on openings in the enclosures after removal of parts that can be detached or opened by an operator without the use of a tool, including fuseholders, and with operator access doors and		P

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Telefax : +86 20 38320478
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	covers open. It is permitted to leave lamps in place for this test. Connectors that can be separated by an operator without use of a tool, shall also be tested during and after disconnection. Any movable parts are to be put in the most unfavorable position.		
	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.	air-intakes for cooling fans.	P
	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.	No openings on top surface.	N/A
7.3.4.2.4	Service access areas	2.573s@60 Vpeak bus after disconnecting DC side. Inside PCE are not intentionally touched with energized parts when installation and maintenance. Symbol 21 of Annex C (5 min) are marked on PCE and explained in user manual.	P
7.3.4.3	Protection by means of insulation of live parts	The earthed enclosure is with basic insulation from the live parts inside	P
	Where the requirements of 7.3.4.2 are not met, live parts shall be provided with insulation if:		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	The communication interface is direct contact and evaluated with reinforce insulation from DVC C/B parts	P

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7.3.5.1	General		P
	Protection in case of direct contact is required to ensure that contact with live parts does not produce a shock hazard.		P
	The protection against direct contact according to 7.3.4 is not required if the circuit contacted is separated from other circuits according to 7.3.2.3, and:	Considered	P
	– is of decisive voltage class A and complies with 7.3.5.2, or		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.	Considered	P
	Conformity is checked by visual inspection and trial insertion.		P
7.3.5.2	Protection using decisive voltage class A	The communication interface is DVC A and reinforce insulated from the live parts by means of isolation transformer and opto-coupler	P
7.3.5.3	Protection by means of protective impedance		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		N/A
	The current available through protective impedance to earth and between simultaneously accessible parts, measured at the accessible live parts, shall not exceed a value of 3,5 mA a.c. or 10 mA d.c. under normal and single-fault conditions.		N/A
7.3.5.3.2	Limitation of discharging energy through protective impedance		N/A
	The discharging energy available between simultaneously accessible parts protected by protective impedance shall not exceed the charging voltage and capacitance limits given in Table 9, which applies to both wet and dry locations, under normal and single fault conditions. Refer to figure 8.		N/A

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7.3.5.4	Protection by means of limited voltages	No such design	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)	Class I also with reinforce insulation design inside PCE	P
	That part of a PCE meets the requirements of 7.3.6.2 and 7.3.6.3 is defined as protective class I	The earthed metal enclosure meets this requirement	P
	That part of a PCE meets the requirements of 7.3.6.4 is defined as protective class II.	The communication interface is reinforce insulated from live parts inside	P
	That part of PCE which meets the requirements of decisive voltage class A and in which no hazardous voltages are derived, is defined as protective class III. No shock hazard is present in such circuits.		N/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 associated hazards.	The manual requires the PCE must be securely earthed	P
7.3.6.2	Insulation between live parts and accessible conductive parts	See Cl. 7.3.7.4 and Cl. 7.3.7.5	P
	Accessible conductive parts of equipment shall be separated from live parts by insulation meeting the requirements of Table 7 or by clearances as specified in 7.3.7.4 and creepages as specified in 7.3.7.5		P
7.3.6.3	Protective class I – Protective bonding and earthing		P
7.3.6.3.1	General		P
	Equipment of protective class I shall be provided with protective earthing, and with protective bonding		P

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	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:		
	a) accessible conductive parts that are protected by one of the measures in 7.3.5.2 to 7.3.5.4, or		N/A
	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:	The PCE provide earthing bar for main protective earthing.	P
	a) through direct metallic contact;		P
	b) through other conductive parts which are not removed when the PCE or sub-units are used as intended ;		P
	c) through a dedicated protective bonding conductor;		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.	No such design	N/A
	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 design	N/A
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		N/A

Telephone : +86 20 38320668
Telefax : +86 20 38320478
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TÜV SÜD Certification and Testing (China) Co., Ltd.
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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

	protective bonding means shall not exceed 0,1 Ω during or at the end of the test below.		
	b) For PCE with an overcurrent protective device rating of more than 16 A, the voltage drop in the protective bonding test shall not exceed 2,5 V during or at the end of the test below.		P
	As alternative to a) and b) the protective bonding may designed according to the requirements for the external protective earthing conductor in 7.3.6.3.5, in which case no testing is required.		N/A
	The impedance of protective bonding means shall be checked by passing a test current through the bond for a period of time as specified below. The test current is based on the rating of the overcurrent protection for the equipment or part of the equipment under consideration, as follows:		P
	a) For pluggable equipment type A, the overcurrent protective device is that provided external to the equipment (for example, in the building wiring, in the mains plug or in an equipment rack);		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;		P
	c) For a circuit or part of the equipment for which an overcurrent protective device is provided as part of the equipment, the rating of the provided overcurrent device.		N/A
	Voltages are measured from the protective earthing terminal to all parts whose protective bonding means are being considered. The impedance of the protective earthing conductor is not included in the measurement. However, if the protective earthing conductor is supplied with the equipment, it is 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.	Measured from the farthest part of earthed metal enclosure to the output earth terminal	P
	On equipment where the protective earth conncection to a subassembly or to a separate unit is part of a cable that also supplies power to that subassembly or unit, the resistance of the 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	Figure 11 used	P

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Telefax : +86 20 38320478
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TÜV SÜD Certification and Testing (China) Co., Ltd.
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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

	terminal where the power source enters the first unit in the system, as shown in Figure 12.		
7.3.6.3.3.1	Test current, duration, and acceptance criteria		P
	The test current, duration of the test and acceptance criteria are as follows:		P
	a) For PCE with an overcurrent protective device rating of 16 A or less, the test current is 200% of the overcurrent protective device rating, but not less than 32 A, applied for 120s. The 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 drops in the protective bonding means, during and at the end of the test, shall not exceed 2,5 V.	Test current: 160A@8min, test result: 0.63V	P
	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.		P
	The test current is derived from an a.c or d.c supply source, the output of which is not earthed.	DC supply	P
	As an alternative to Table 10, where the time-current characteristic of the overcurrent protective device that limits the fault current in the protective bonding means is known because the device is either provided in the equipment or fully specified in the installation instructions, the test duration may be based on that specific device's time-current characteristic,. The tests are conducted for a duration corresponding to the 200% current value on the time-current characteristic.		P
7.3.6.3.4	Protective bonding impedance (routine test)		N/A
	If the continuity of the protective bonding is achieved at any point by a single means only (for example a single conductor or single fastener), or if the PCE is assembled at the installation location, then the impedance of the protective bonding shall also be tested as a routine test. The test shall be as in 7.3.6.3.3, except for the following:		N/A
	▪ the test current may be reduced to any convenient value greater than 10 A sufficient to allow measurement or calculation of the impedance of the protective bonding means:		N/A
	▪ the test duration may be reduced to no less than 2 s		N/A

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Telefax : +86 20 38320478
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Guangzhou Branch, TÜV SÜD Group
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	For equipment subject to the type test in 7.3.6.3.3.1a), the impedance during the routine test shall not exceed 0,1Ω.		N/A
	For equipment subject to the type test in 7.3.6.3.3.1b) the impedance during the routine test shall not exceed 2,5 V divided by the test current required by 7.3.6.3.3.1b).		N/A
7.3.6.3.5	External protective earthing conductor		N/A
	A protective earthing conductor shall be connected at all times when power is supplied to PCE of protective class I. Unless local wiring regulations state otherwise, the protective earthing conductor cross-sectional area shall be determined from Table 11 or by calculation according to IEC 60364-5-54.		N/A
	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:	External protective earthing conductor is integrated with output cable	N/A
	▪ 2,5 mm² if mechanical protection is provided;		N/A
	▪ 4 mm² if mechanical protection is not provided.		N/A
	For cord-connected equipment, provisions shall be made so that the external protective earthing conductor in the cord shall, in the case of failure of the strain-relief mechanism, be the last conductor to be interrupted.		N/A
7.3.6.3.6	Means of connection for the external protective earthing conductor		P
7.3.6.3.6.1	General		P
	The means of connection for the external protective earthing conductor shall be located near the 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 electrolyt-		P

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TÜV SÜD Certification and Testing (China) Co., Ltd.
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	ic corrosion.		
	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		N/A
	Marking shall not be done on easily changeable parts such as screws.		P
7.3.6.3.7	Touch current in case of failure of the protective earthing conductor		P
	The requirements of this sub-clause shall be satisfied to maintain safety in case of damage to or disconnection of the protective earthing conductor.		P
	For pluggable equipment type A, the touch current measured in accordance with 7.5.4 shall not exceed 3,5 mA a.c. or mA d.c.		N/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.		P
	a) Permanently connected wiring, and:		N/A
	• a cross-section of the protective earthing conductor of at least 10 mm² Cu or 16 mm² Al; or		N/A
	• automatic disconnection of the supply in case of discontinuity of the protective 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		N/A

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Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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	the measures in a)		
	or b) above is used. The maximum number of parallel PCEs is used in the testing and has to be stated in the installation manual.		N/A
7.3.6.4	Protective Class II – Double or Reinforced Insulation	Communication interface is evaluated with Reinforced insulation from live part inside. Comply with clause 7.3.4.3	P
	Equipment or parts of equipment designed for protective class II shall have insulation between live parts and accessible surfaces in accordance with 7.3.4.3. The following requirements also apply:		N/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 shall correspond to the rated voltage of the series-connected equipment;		N/A
	• metal-encased equipment of protective class II may have provision on its enclosure for the connection of an equipotential bonding 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	See ratings table	P
	• overvoltage category	PV and Battery side (OVC II),	P

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TÜV SÜD Certification and Testing (China) Co., Ltd.
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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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		Mains (OVC III)	
	• supply earthing system	TN system considered.	P
	• insulation voltage	PV input: max. 1000 Vd.c. and Mains: 230 Va.c.	P
	• location of insulation	See table 7.3.7.4 and 7.3.7.5 for detail	P
	• type of insulation	See table 7.3.7.4 and 7.3.7.5 for detail	P
	Compliance of insulation, creepage distances, and clearance distances, shall be verified by measurement or visual inspection, and the tests of 7.5.		P
7.3.7.1.3	Supply earthing systems		P
	Three basic types of earthing system are described in IEC 60364-1. They are:	Inverter is intended to install in TN system.	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 conductor.		P
	• TT system: has one point directly earthed, the accessible conductive parts of the installation being connected to earth electrodes electrically independent of the earth electrodes of the power system;		N/A
	• IT sytem: 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	See table 7.3.7.4 and 7.3.7.5 for detail	P
	Table 12 makes use of the circuit system voltage and overvoltage category to define the impulse withstand voltage and the temporary overvoltage.		P
7.3.7.2	Insulation between a circuit and its surroundings		P
7.3.7.2.1	General Basic, supplementary and reinforced insulation between a circuit and its surroundings shall be designed according to: Impulse voltage; temporary overvoltage; working voltage of the circuit;	Basic isolation between PV/ battery and AC mains output. 230 Va.c., TN system consider, OVC III (4900 V impulse voltage, 2120 Vd.c. temporary overvoltage) for the mains circuits; 1000 Vd.c. system voltage, OVC II (4900 V impulse voltage, no temporary overvoltage) for the PV circuits.	P

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
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		580 Vd.c. system voltage, OVC II (4900 V impulse voltage, no temporary overvolt-age) for the battery circuits. Reinforced insulation between PV/ AC mains, battery circuits and communication circuits.	
7.3.7.2.2	Circuit connected directly to the mains Clearance and solid insulation between circuit connected directly to the mains and their surroundings shall be designed according to the impulse voltage, temporary overvoltage, or working voltage, whichever gives the most severe requirement		P
7.3.7.2.3	Circuit other than mains circuit Clearance and solid insulation between circuit other than the mains and their surroundings shall be designed according to impulse voltage and recurring peak voltage	PV inverter.	P
7.3.7.2.4	Insulation between circuits a) For clearances and insulation, the requirements are determined by the circuit having the higher impulse voltage; b) For creepages, r.m.s. working voltage across the insulation determines the requirements.	Basic insulation between the PV/battery circuit and PE; Basic insulation between the AC circuit and PE; Impulse voltage (4900 V) is calculated from table 9 for clearance at PV, AC mains, battery side circuit to PE for basic insulation. Reinforced insulation between the power circuit and communication port/ LED; Working voltage (580 Vd.c.) across insulation is used for creepage.	P
7.3.7.3	Functional insulation For parts or circuit in OVC I, functional insulation shall be designed according to the working voltage across the insulation For parts or circuit in OVC II, functional insulation shall be designed according to the applicable impulse voltage as determined by 7.3.7.1.4		P
7.3.7.4	Clearance distances		P
7.3.7.4.1	Determination Table 13 defines the minimum clearance distances required to provide functional, basic , or supplementary insulation		P
	Clearance for use in altitudes above 2000 m shall be	The requirements for the	P

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Telefax : +86 20 38320478
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	calculated with correction factor according to Table A.2 of IEC 60664-1	equipment used at altitude above 2000 m are not considered in this report except those clearances for use at altitudes up to 3000m are considered.	
	For reinforced insulation, the value corresponding to the next higher impulse voltage, or 1.6 times the temporary overvoltage, or 1.6 times the working voltage shall be used, whichever results in the most severe requirement		P
7.3.7.4.2	Electric field homogeneity For homogeneous electric field and impulse voltage is equal to or greater than 6000V for a circuit connected directly to the mains or 4000V within a circuit, the clearance may be reduced to the requirement by Table F.2 Case B of IEC 60664-1. In this case, impulse voltage test shall be performed on the clearance	Inhomogeneous electric field is considered for PCE	N/A
7.3.7.4.3	Clearance to conductive enclosures Clearance shall be measured following the deformation test of 13.7 for conductive enclosures		P
7.3.7.5	Creepage distances		P
7.3.7.5.1	General Creepage distances shall be large enough to prevent long-term degradation of the surface of solid insulators. For reinforced insulation, the value is doubled. If less than clearance, it shall be increased to that clearance		P
7.3.7.5.2	Voltage r.m.s. value of working voltage is used. Interpolation is permitted		P
7.3.7.5.3	Materials		P
7.3.7.6	Coating	No coating provided insulation	N/A
7.3.7.7	PWB spacings for functional insulation		P
7.3.7.8	Solid insulation		P
7.3.7.8.1	General Material for solid insulation shall be able to withstand mechanical, electrical, thermal and climatic stresses in normal use and ageing during the expected lifetime. Compliance is evaluated by test and inspection.	Insulation taps, sheet, Optical Isolator and transformer.	P
7.3.7.8.2	Requirements for electrical withstand capability of solid insulation		P
7.3.7.8.2.1	Basic and supplementary, reinforced, and double insulation. Solid insulation shall withstand the impulse voltage test 7.5.1 and voltage test 7.5.2.		P
	In addition, if recurring peak working voltage across		N/A

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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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Clause	Requirement – Test	Result – Remark	Verdict
	the insulation is greater than 700 V and voltage stress on insulation is greater than 1kV/mm, double and reinforced insulation shall withstand the partial discharge test according to 7.5.3		
7.3.7.8.2.2	Functional insulation		N/A
7.3.7.8.3	Thin sheet or tape material		P
7.3.7.8.3.1	General Insulation of thin sheet or tape less than 0,7 mm is subject to this requirement		P
7.3.7.8.3.2	Material thickness not less than 0,2 mm		P
	Basic or supplementary insulation shall consist of at least one layer of material, and shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic or supplementary insulation.	Communication transformer and opto-coupler consider as reinforced insulation.	P
	Double insulation shall consist of at least two layers of material. Each layer shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic insulation, and the partial discharge requirements of 7.3.7.8.2.1. The two or more layers together shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for double insulation.		N/A
	Reinforced insulation shall consist of a single layer of material, which will meet the impulse, a.c. or d.c. voltage, and partial discharge test requirements 7.3.7.8.2.1 for reinforced insulation.		N/A
7.3.7.8.3.3	Material thickness less than 0,2 mm		P
	Basic or supplementary insulation shall consist of at least one layer of material, and shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic or supplementary insulation.		P
	Double insulation shall consist of at least three layers of material. Each layer shall meet the impulse and a.c. or d.c. voltage test requirements of 7.3.7.8.2.1 for basic insulation any two layers together shall meet the impulse, a.c. or d.c. voltage, and partial discharge test requirements of 7.3.7.8.2.1 for double insulation.		P
	Reinforced insulation consisting of a single layer of material less than 0,2 mm thick is not permitted.		P
7.3.7.8.3.4	Compliance Component, sub-assembly, or material is checked by applicable tests 7.5.1 to 7.5.3 according to 7.3.7.8.		P
7.3.7.8.4	Printed wiring boards (PWBs)		P
7.3.7.8.4.1	General Insulation between conductor layers in double-sided single-layer PWBs, multi-layer PWBs and metal		P

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Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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

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Telefax : +86 20 38320478
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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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Clause	Requirement – Test	Result – Remark	Verdict
7.3.9	Protection against shock hazard due to stored energy		P
7.3.9.1	Operator access area	Accessible communication interface is DVC A	P
	In the case of plugs, connectors, or similar devices that can be disconnected without the use of a tool, the withdrawal of which results in the exposure of conductors (e.g. pins), the discharge time to reduce the voltage to DVC A (see 7.3.2.2) or, for capacitors, to a stored charge level below the limits specified in 7.3.5.3.2, shall not exceed 1 s.		P
7.3.9.2	Service access areas		P
	Capacitors and other energy storage devices located behind panels that are removable for servicing, installation, or disconnection shall present no risk of electric shock or energy hazard from stored charge after disconnection of the PCE.		P
	Capacitors within a PCE shall be discharged to a voltage less than DVC A (see 7.3.2.2), or an energy level below the limits specified in 7.3.5.3.2, within 10 s after the removal of power from the PCE. If this requirement is not achievable for functional or other reasons, the warning symbol 21 of Annex C and an indication of the discharge time shall be placed in a clearly visible position on the enclosure, the capacitor protective barrier, or at a point close to the capacitor(s) concerned (depending on the construction) (see 5.2.2.4).	31.08s@60 Vpeak bus after disconnecting DC side. Inside capacitor discharge to DVC A and no energy hazard level within 5 minutes.	P
	For energy storage devices (such as batteries or ultra capacitors) the intended function of which is to maintain charge even with the PCE off and disconnected from external sources, a barrier or insulation shall be provided so that unintentional contact with hazardous live parts is prevented. The warning symbol 21 of Annex C shall be placed in a clearly visible position on or adjacent to the barrier or insulation, where it will be seen before removal of the barrier or insulation.	Warning symbol 21 of Annex C (5min) is marked on PCE	P
7.4	Protection against energy hazards		P
7.4.1	Determination of hazardous energy level		P
	A hazardous energy level is considered to exist if	Condition b is considered	P
	a) The voltage is 2 V or more, and power available after 60 s exceeds 240 VA.		N/A
	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: $E = 0,5\ CU^2$	U=134.8 Vpeak@20 J	P
7.4.2	Operator Access Areas	No energized parts accessible by user	P

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Telefax : +86 20 38320478
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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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Clause	Requirement – Test	Result – Remark	Verdict
	Equipment shall be so designed that there is no risk of energy hazard in operator access areas from accessible circuits.		P
7.4.3	Services Access Areas		P
	Energy storage devices located behind panels that are removable for servicing, installation or disconnection shall present no risk of electric energy hazard from charge stored after disconnection of the PCE.	31.4s@20J after disconnecting DC side	P
	Energy storage devices within a PCE shall be discharged to an energy level less than 20 J, as in 7.4.1, within 10 s after the removal	Warning symbol 21 of Annex C (5min) is marked on PCE	P
7.5.4	Touch current measurement (type test)		P
	The touch current shall be measured if required by 7.3.6.3.7 and shall not be greater than 3.5 mA a.c. or 10 mA d.c. or special measures of protection as given in 7.3.6.3.7 are required.	The current is beyond the limit and the protection is provided as Cl. 7.3.6.3.7. Test result: 3.1 mA	P
	For type tests on PCE for which wet locations requirements apply according to 6.1, the humidity preconditioning of 4.5 shall be performed immediately prior to the touch current test.		P
7.5.5	Equipment with multiple sources of supply		N/A

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.	Fan's blades are protected by barriers.	P
8.2.1	Protection of service persons		P

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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Clause	Requirement – Test	Result – Remark	Verdict
	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.	The fans stopped operating during servicing.	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.	Wall mounted	N/A
8.4	Provisions for lifting and carrying		P
	If carrying handles or grips are fitted to, or supplied with, the equipment, they shall be capable of withstanding a force of four times the weight of the equipment.	Carried by forklift or crane	P
	Equipment or parts having a mass of 18 kg or more shall be provided with a means for lifting and carrying or directions shall be given in the manufacturer's documentation.	Stated in manual	P
8.5	Wall mounting		P
	Mounting brackets on equipment intended to be mounted on a wall or ceiling shall withstand a force of four times the weight of the equipment.		P
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.	Components are witnessed at normal condition and abnormal tests are verified.	P
9.1.1	Reducing the risk of ignition and spread of flame		P
	For equipment or a portion of equipment, there are two alternative methods of providing protection against ignition and spread of flame that could affect materials, wiring, wound components and electronic components such as integrated circuits, transistors, thyristors, diodes, resistors and capacitors.	Method 1 used	P
9.1.2	Conditions for a fire enclosure		P
	A FIRE ENCLOSURE is required for equipment or parts of equipment for which Method 2 is not fully applied and complied with.		P
9.1.2.1	Parts requiring a fire enclosure		P

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Clause	Requirement – Test	Result – Remark	Verdict
	Except where Method 2 is used, or as permitted in 9.1.2.2, the following are considered to have a risk of ignition and, therefore, require a FIRE ENCLOSURE:		P
	– components in PRIMARY CIRCUITS		P
	– components in SECONDARY CIRCUITS supplied by power sources which exceed the limits for a LIMITED POWER SOURCE as specified in 9.2;		P
	– components in SECONDARY CIRCUITS supplied by a LIMITED POWER SOURCE as specified in 9.2, but not mounted on a material of FLAMMABILITY CLASS V-1;		N/A
	– components within a power supply unit or assembly having a limited power output complying with the criteria for a LIMITED POWER SOURCE as specified in 9.2, including overcurrent protective devices, limiting impedances, regulating networks and wiring, up to the point where the LIMITED POWER SOURCE output criteria are met;		P
	– components having unenclosed arcing parts, such as open switch and relay contacts and commutators, in a circuit at HAZARDOUS VOLTAGE or at a HAZARDOUS ENERGY LEVEL; and		N/A
	– insulated wiring, except as permitte in 9.1.2.2.		N/A
9.1.2.2	Parts not requiring a fire enclosure	Fire enclosure used	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		P
	If an enclosure material is not classified as specified below, a test may be performed on the final enclosure or part of the enclosure, in which case the material shall additionally be subjected to periodic SAMPLE testing.		P
9.1.3.3	Materials for components and other parts inside fire enclosures	At least V-1 material used inside fire enclosure, PCB rated V-0 and internal wire rated VW-1	P
9.1.3.4	Materials for air filter assemblies	Metal material for air filter assemblies	N/A
9.1.4	Openings in fire enclosures		P
9.1.4.1	General		P

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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Clause	Requirement – Test	Result – Remark	Verdict
	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.	The equipment is intended to be used one orientation.	P
	These requirements are in addition to those in the following sections:		P
	– 7.3.4, Protection against direct contact;		P
	– 7.4, Protection against energy hazards;		P
	– 13.5, Openings in enclosures		P
9.1.4.2	Side openings treated as bottom openings	The equipment is intended to be used one orientation.	P
9.1.4.3	Openings in the bottom of a fire enclosure		P
	The bottom of a FIRE ENCLOSURE or individual barriers, shall provide protection against emission of flaming or molten material under all internal parts, including partially enclosed components or assemblies, for which Method 2 of 9.1.1 has not been fully applied and complied with.		P
9.1.4.4	Equipment for use in a CLOSED ELECTRICAL OPERATING AREA	Not intend use at this 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	The covers can only be opened with tool and is not intended to be routinely opened by the user.	P
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		N/A
9.3	Short-circuit and overcurrent protection		P
9.3.1	General		P
	The PCE shall not present a hazard, under short-circuit or overcurrent conditions at any port, including phase-to-phase, phase-to-earth and phase-to-neutral, and adequate information shall be provided to allow proper selection of external wiring and external protective devices.		P

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Telefax : +86 20 38320478

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
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.	Circuit breaker in PV and AC side are external installed required in user manual.	P
9.3.3	Protective devices provided or specified shall have adequate breaking capacity to interrupt the maximum short circuit current specified for the port to which they are connected. If protection that is provided integral to the PCE for an input port is not rated for the short-circuit current of the circuit in which it is used, the installation instructions shall specify that an upstream protective device, rated for the prospective short-circuit current of that port, shall be used to provide backup protection.		P
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.		P
10.2	Sonic pressure and Sound level		P
10.2.1	Hazardous Noise Levels		P
11	**PROTECTION AGAINST LIQUID HAZARDS**		N/A
11.1	Liquid Containment, Pressure and Leakage	No liquid containment system	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

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Telefax : +86 20 38320478
http://www.tuv-sud.cn
TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict

13	**PHYSICAL REQUIREMENTS**		P
13.1	Handles and manual controls		P
	Handles, knobs, grips, levers and the like shall be reliably fixed so that they will not work loose in normal use, if this might result in a hazard. Sealing compounds and the like, other than selfhardening resins, shall not be used to prevent loosening. If handles, knobs and the like are used to indicate the position of switches or similar components, it shall not be possible to fix them in a wrong position if this might result in hazard.		P
13.1.1	Adjustable controls		P
13.2	Securing of parts		P
13.3	Provisions for external connections		P
13.3.1	General	Installation manuals provide information for the disconnection means	P
13.3.2	Connection to an a.c. Mains supply	Permanent connected	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:	See above	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		P
	– 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		P
13.3.2.5	Cord anchorages and strain relief		P
	For equipment with a non-detachable power supply cord, a cord anchorage shall be supplied such that:		P
	– the connecting points of the cord conductors are relieved from strain; and		P
	– the outer covering of the cord is protected from abrasion.		P
13.3.2.6	Protection against mechanical damage		P

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
13.3.3	Wiring terminals for connection of external conductors		P
13.3.3.1	Wiring terminals		P
13.3.3.2	Screw terminals		P
13.3.3.3	Wiring terminal sizes		P
13.3.3.4	Wiring terminal design		P
13.3.3.5	Grouping of wiring terminals		P
13.3.3.6	Stranded wire	Installation manual instruct the disconnect device when connecting AC mains	P
13.3.4	Supply wiring space		P
13.3.5	Wire bending space for wires 10 mm² and greater		P
13.3.6	Disconnection from supply sources	External circuit breaker required	P
13.3.7	Connectors, plugs and sockets		N/A
13.3.8	Direct plug-in equipment		N/A
13.4	Internal wiring and connections		P
13.4.1	General		P
13.4.2	Routing	Internal wire is routed to avoid sharp edge and overheat	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		P
13.5.1	Top and side openings	Side openings	P
	Openings in the top and sides of ENCLOSURES shall be so located or constructed that it is unlikely that objects will enter the openings and create hazards by contacting bare conductive parts.		P
13.6	Polymeric Materials		N/A
13.6.1	General		N/A
13.6.1.1	Thermal index or capability		N/A
13.6.2	Polymers serving as enclosures or barriers preventing access to hazards		N/A
13.6.2.1	Stress relief test	UL certified plastic material with a higher temperature rating used for required part.	N/A
13.6.3	Polymers serving as solid insulation		P
13.6.3.1	Resistance to arcing	Arcing parts are enclosed inside certified breaker, switch within rating	N/A

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
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	Metal enclosure	P
13.7	Mechanical resistance to deflection, impact, or drop		P
13.7.1	General		P
13.7.2	250-N deflection test for metal enclosures	Test on outer enclosure of main cabinet and each module	P
13.7.3	7-J impact test for polymeric enclosures	Tested on display	P
13.7.4	Drop test		N/A
13.8	Thickness requirements for metal enclosures		P
13.8.1	General	Tested with Cl. 13.7	P
13.8.2	Cast metal		N/A
13.8.3	Sheet metal		N/A

14	**COMPONENTS**		P
14.1	General		P
	Where safety is involved, components shall be used in accordance with their specified RATINGS unless a specific exception is made. They shall conform to one of the following:		P
	a) applicable safety requirements of a relevant IEC standard. Conformity with other requirements of the component standard is not required. If necessary for the application, components shall be subjected to the test of this standard, except that it is not necessary to carry out identical or equivalent tests already performed to check conformity with the component standard;		P
	b) the requirements of this standard and, where necessary for the application, any additional applicable safety requirements of the relevant IEC component standard;		P
	c) if there is no relevant IEC standard, the requirements of this standard;		P
	d) applicable safety requirements of a non-IEC standard which are at least as high as those of the applicable IEC standard, provided that the component has been approved to the non-IEC standard by a recognized testing authority.		P

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Telefax : +86 20 38320478
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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
	Components such as optocouplers, capacitors, transformers, and relays connected across basic, supplemental, reinforced, or double insulation shall comply with the requirements applicable for the grade of insulation being bridged, and if not 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		P
	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.		P
14.3	Overtemperature protection devices		P
14.4	Fuse holders		P
14.5	MAINS voltage selecting devices		N/A
14.6	Printed circuit boards		P
	Printed circuit boards shall be made of material with a flammability classification of V-1 of IEC 60707 or better.	V-0	P
	This requirement does not apply to thin-film flexible printed circuit boards that contain only circuits powered from limited power sources meeting the requirements of 9.2.		N/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.	Inspection of data on the materials	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.		P
14.8	Batteries		N/A
	Equipment containing batteries shall be designed to reduce the risk of fire, explosion and chemical leaks under normal conditions and after a single fault in the equipment including a fault in circuitry within the equipment battery pack.	No battery used.	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

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Telefax : +86 20 38320478
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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
14.8.1.3	Ventilation instructions		N/A
14.8.2	Battery Mounting		N/A
	Compliance is verified by the application of the force to the battery's mounting surface. The test force is to be increased gradually so as to reach the required value in 5 to 10 s, and is to be maintained at that value for 1 min. A nonmetallic rack or tray shall be tested at the highest normal condition 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
	b) contaminating adjacent electrical components or materials; and		N/A
	c) bridging required electrical distances		N/A
14.8.4	Battery Connections		N/A
	Reverse battery connection of the terminals shall be prevented if reverse connection could result in a hazard within the meaning of this Standard		N/A
14.8.5	Battery maintenance instructions		N/A
	The information and instructions listed in 5.3.4.1 shall be included in the operator manual for 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		P
Annex A	Measurement of clearances and creepage distances (see 7.3.7.4 and 7.3.7.5)		P
Annex B	Programmable Equipment		P

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

IEC 62109-1			
Clause	Requirement – Test	Result – Remark	Verdict
B.1	Software or firmware that perform safety critical functions		P
B.1.1	Firmware or software that performs a critical safety function/s, the failure of which can result in a risk of fire, electric shock or other hazard as specified by this standard, shall be evaluated by one of the following means.		P
	a) All software or firmware limits or controls shall be disabled before the test to evaluate the hardware circuitry during the abnormal test condition related to the safety function.		P
	b) Protective controls employing software or firmware to perform their function(s), shall be so constructed that they comply with IEC 60730-1 Annex H to address the risks identified in B.2.1.		N/A
B.2	Evaluation of controls employing software		P
Annex C	Symbols to be used in equipment markings		P
Annex D	Test Probes for Determining Access		P
Annex E	RCDs	External RCD or RCM of Type B is required if needed.	P
Annex F	Altitude correction for clearances	Considered for clearance for altitude <2000m	P
Annex G	Clearance and creepage distance determination for frequencies greater than 30 kHz		P
Annex H	Measuring Instrument for Touch Current Measurements		P
H.1	Measuring instrument		P
H.2	Alternative measuring instrument		N/A
Annex I	Examples of Protection, Insulation, and Overvoltage Category Requirements for PCE		P
Annex J	Ultraviolet light conditioning test		P

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Telefax : +86 20 38320478

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

4.7	TABLE: mains supply electrical data in normal condition, test at 50Hz	P

Model: BD6KTR-RH3, 50Hz

PV to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	181.4	12.7	2296.9	230	3.4	2158.5
--	--	--	249.2	24.4	6077.7	207.0	9.4	5817.8
--	--	--	251.5	24.4	6120.2	230.2	8.8	6000.2
--	--	--	252.5	24.2	6096.8	253.1V	8.0	5979.1
--	--	--	849.7	7.0	5955.5	207.0	9.3	5775.8
--	--	--	852.5	7.1	6082.5	230.1V	8.8	5963.0
--	--	--	850.2	7.2	6103.4	253.2V	8.0	5996.5
--	--	--	1001.1	3.5	3486.1	230.4V	5.2	3429.2

PV to battery

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.6	40.6	-6066.5	700.0	9.2	6440.6	--	--	--
250.3	24.8	-6054.6	699.7	9.1	6344.1	--	--	--
600.0	11.4	-6024.3	700.1	8.9	6261.9	--	--	--

Grid to Battery (charge priority)

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.6	37.4	-5612.2	--	--	--	230.2	8.7	-5987.8
600.0	9.8	-5766.6	--	--	--	230.4	8.7	-5989.9

Battery discharge to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.4	42.5	6347.8	--	--	--	230.6	8.6	5939.1
599.8	10.5	6191.9	--	--	--	230.1	8.6	5962.0

supplementary information:

sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.

4.7	TABLE: mains supply electrical data in normal condition, test at 50Hz	P

Model: BD8KTR-RH3, 50Hz

PV to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	184.1	12.4	2284.2	230.2	3.4	2152.7

Telephone : +86 20 38320668
Telefax : +86 20 38320478
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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

--	--	--	329.2	24.7	8129.3	207.1	12.6	7825.2
--	--	--	331.4	24.5	8128.6	230.4	11.7	7999.7
--	--	--	334.3	24.3	8113.6	253.1	10.6	7995.7
--	--	--	849.7	9.4	8014.6	207.1	12.5	7785.1
--	--	--	855.4	9.5	8087.1	230.2	11.6	7978.0
--	--	--	852.2	9.5	8096.6	253.1	10.6	7989.7
--	--	--	1000.2	4.7	4655.7	230.0	6.8	4568.2

PV to battery

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	51.1	-7608.8	699.5	12.0	8426.0	--	--	--
330.4	25.0	-8064.8	699.5	12.0	8389.1	--	--	--
600.1	14.5	-8041.3	700.0	11.9	8305.6	--	--	--

Grid to Battery (charge priority)

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.7	49.7	-7479.9	--	--	--	230.0	11.6	-8001.3
600.1	12.9	-7725.4	--	--	--	230.2	11.6	-7986.8

Battery discharge to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.3	49.8	7424.6	--	--	--	230.2	10.1	6931.7
599.7	13.9	8279.8	--	--	--	230.3	11.6	7999.1

supplementary information:

sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.

4.7	**TABLE: mains supply electrical data in normal condition, test at 50Hz**	P

Model: BD10KTR-RH3, 50Hz

PV to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	181.7	12.9	2340.2	230.1	3.5	2206.7
--	--	--	429.0	23.6	10105.2	207.2	16.0	9940.6
--	--	--	432.6	23.5	10169.7	230.4	14.5	9997.0
--	--	--	429.1	23.7	10152.7	253.2	13.2	9993.0
--	--	--	851.3	11.8	10079.3	207.2	16.1	9951.9
--	--	--	850.4	11.9	10098.4	230.1	14.6	10008.9
--	--	--	849.2	11.9	10099.5	253.2	13.2	9997.3

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

--	--	--	999.9	5.9	5897.4	230.1	8.5	5776.6

PV to battery

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	51.2	-7617.5	699.4	15.1	10540.1	--	--	--
430.3	23.8	-10062.8	699.5	14.8	10383.0	--	--	--
600.1	17.5	-10043.3	699.6	14.8	10327.7	--	--	--

Grid to Battery (charge priority)

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	49.5	-7458.4	--	--	--	230.2	11.6	-7977.7
600.1	16.2	-9674.3	--	--	--	230.5	14.5	-9996.9

Battery discharge to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.3	49.8	7428.4	--	--	--	230.1	10.1	6937.7
599.7	17.3	10325.1	--	--	--	230.2	14.5	9991.8

supplementary information:

sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.

4.7	**TABLE: mains supply electrical data in normal condition, test at 50Hz**	P

Model: BD12KTR-RH3, 50Hz

PV to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	182.3	12.8	2331.2	230.2	3.5	2198.0
--	--	--	509.2	24.0	12230.1	207.0	19.1	11836.7
--	--	--	510.9	23.7	12120.5	230.5	17.4	11995.2
--	--	--	516.1	23.5	12099.5	253.3	15.9	11988.7
--	--	--	849.7	14.3	12143.0	207.0	19.0	11799.1
--	--	--	844.4	14.3	12100.2	230.3	17.4	12000.8
--	--	--	851.5	14.3	12153.3	253.2	15.9	11996.2
--	--	--	1000.28	7.14	7137.58	230.32	10.19	6975.01

PV to battery

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.7	50.4	-7455.7	699.3	18.0	12580.5	--	--	--
510.3	24.2	-12077.1	699.7	17.8	12422.6	--	--	--

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

600.2	20.7	-12058.1	699.3	17.7	12374.7	--	--	--
Grid to Battery (charge priority)								
Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	49.5	-7460.5	--	--	--	230.2	11.6	-7979.5
600.2	19.5	-11606.6	--	--	--	229.8	17.4	-12004.4
Battery discharge to grid								
Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.3	49.6	7407.1	--	--	--	230.7	10.0	6917.3
599.6	20.8	12413.9	--	--	--	230.2	17.4	12014.3
supplementary information:								
sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.								

4.7	**TABLE: mains supply electrical data in normal condition, test at 50Hz**							P
Model: BD15KTR-RH3, 50Hz								
PV to grid								
Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	184.1	16.2	2989.5	230.3	4.2	2836.6
--	--	--	619.2	24.6	15213.9	207.1	23.7	14745.8
--	--	--	619.2	24.9	15436.8	230.5	21.7	15013.2
--	--	--	619.2	24.9	15395.2	253.4	19.7	14989.7
--	--	--	849.7	18.0	15267.8	207.1	23.9	14826.8
--	--	--	847.8	17.9	15147.5	230.4	21.7	15010.3
--	--	--	847.3	17.9	15134.2	253.1	19.8	15001.4
--	--	--	996.4	9.0	8982.1	230.4	12.9	8865.9
PV to battery								
Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.7	50.3	-7434.5	699.2	22.1	15478.6	--	--	--
430.4	35.1	-14917.5	697.9	22.0	15367.0	--	--	--
600.2	25.5	-15014.6	698.5	22.0	15372.8	--	--	--
Grid to Battery (charge priority)								
Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	49.5	-7456.2	--	--	--	230.2	11.6	-7977.4
600.2	24.3	-14513.3	--	--	--	230.0	21.8	-15023.9
Battery discharge to grid								

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Telefax : +86 20 38320478

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.3	49.7	7411.2	--	--	--	230.7	10.0	6917.6
599.5	25.9	15529.9	--	--	--	230.5	21.8	15034.3
supplementary information: sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.								

4.7	**TABLE: mains supply electrical data in normal condition, test at 50Hz**	P

Model: BD6KTR-RH3, 60Hz

PV to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	183.5	12.5	2286.5	229.8	3.6	2155.5
--	--	--	249.2	24.5	6104.4	207.0	9.4	5843.5
--	--	--	252.8	24.2	6122.9	230.2	8.9	5992.8
--	--	--	250.5	24.5	6129.7	253.2	8.1	5999.1
--	--	--	849.8	7.0	5978.4	207.0	9.4	5797.9
--	--	--	851.0	7.1	6018.3	230.0	8.9	5998.0
--	--	--	851.7	7.2	6108.5	253.1	8.1	5999.3
--	--	--	1000.6	3.5	3527.6	229.8	5.3	3467.4

PV to battery

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.6	40.7	-6069.9	699.9	9.2	6445.2	--	--	--
250.3	24.8	-6051.2	699.8	9.1	6343.4	--	--	--
600.1	11.3	-5970.8	700.2	8.9	6206.8	--	--	--

Grid to Battery (charge priority)

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.6	37.4	-5613.7	--	--	--	230.2	8.7	-5990.1
600.0	9.7	-5785.1	--	--	--	230.4	8.7	-5995.8

Battery discharge to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.4	43.1	6423.8	--	--	--	230.1	8.7	6004.8
600.0	9.9	-5787.6	--	--	--	230.4	8.7	-6008.6

supplementary information:

sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

4.7	TABLE: mains supply electrical data in normal condition, test at 50Hz	P

Model: BD8KTR-RH3, 60Hz

PV to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	182.9	12.8	2334.4	230.0	3.6	2201.8
--	--	--	329.2	24.8	8147.8	207.1	12.6	7842.8
--	--	--	332.2	24.5	8127.4	230.3	11.7	7991.4
--	--	--	322.0	25.2	8124.2	253.1	10.7	7985.7
--	--	--	849.7	9.5	8111.2	207.1	12.9	7948.0
--	--	--	852.3	9.5	8089.7	230.1	11.7	7977.8
--	--	--	850.2	9.5	8117.6	253.1	10.7	7997.7
--	--	--	999.7	4.7	4697.5	229.7	6.9	4608.7

PV to battery

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	50.7	-7617.5	699.7	12.1	8486.4	--	--	--
330.4	24.9	-8028.3	699.8	11.9	8351.1	--	--	--
600.1	14.4	-7977.8	699.9	11.8	8241.1	--	--	--

Grid to Battery (charge priority)

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.7	49.7	-7479.9	--	--	--	230.0	11.6	-8001.3
600.1	12.9	-7725.4	--	--	--	230.2	11.6	-7986.8

Battery discharge to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.3	49.8	7424.6	--	--	--	230.2	10.1	6931.7
599.7	13.9	8279.8	--	--	--	230.3	11.6	7999.1

supplementary information:

sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.

4.7	TABLE: mains supply electrical data in normal condition, test at 50Hz	P

Model: BD10KTR-RH3, 60Hz

PV to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	181.4	12.8	2313.3	229.6	3.6	2179.9

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Telefax : +86 20 38320478

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

--	--	--	431.0	23.5	10119.9	207.1	16.1	9963.0
--	--	--	432.3	23.4	10116.2	230.1	14.6	9990.8
--	--	--	429.7	23.6	10123.0	253.2	13.3	10004.0
--	--	--	848.4	11.9	10089.7	207.1	16.1	9941.9
--	--	--	852.2	11.8	10095.8	230.1	14.6	9975.2
--	--	--	848.7	11.9	10096.4	253.1	13.3	9983.6
--	--	--	999.7	5.9	5934.9	229.8	8.6	5812.2

PV to battery

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	50.9	-7632.8	699.6	15.1	10539.5	--	--	--
430.3	23.9	-10063.3	699.5	14.9	10393.5	--	--	--
600.1	17.5	-10011.8	699.5	14.7	10296.6	--	--	--

Grid to Battery (charge priority)

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	49.5	-7458.4	--	--	--	230.2	11.6	-7977.7
600.1	16.2	-9674.3	--	--	--	230.5	14.5	-9996.9

Battery discharge to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.3	49.8	7428.4	--	--	--	230.1	10.1	6937.7
599.7	17.3	10325.1	--	--	--	230.2	14.5	9991.8

supplementary information:

sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.

4.7	**TABLE: mains supply electrical data in normal condition, test at 50Hz**	P

Model: BD12KTR-RH3, 60Hz

PV to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	181.9	12.8	2333.5	229.7	3.6	2199.3
--	--	--	509.2	24.0	12210.8	207.1	19.0	11819.2
--	--	--	508.7	23.9	12172.6	230.1	17.5	11993.7
--	--	--	507.2	24.0	12171.8	253.2	15.9	11992.3
--	--	--	849.5	14.3	12148.1	207.1	19.3	11934.8
--	--	--	850.8	14.2	12102.6	230.2	17.5	12002.7
--	--	--	848.4	14.3	12124.3	253.2	15.9	12005.9

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

--	--	--	999.6	7.1	7099.5	230.1	10.2	6954.9

PV to battery

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	51.1	-7603.9	699.3	17.9	12549.4	--	--	--
510.3	24.2	-12039.8	699.4	17.7	12387.5	--	--	--
600.2	20.7	-12018.7	699.4	17.6	12339.9	--	--	--

Grid to Battery (charge priority)

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	49.5	-7458.5	--	--	--	230.2	11.6	-7980.8
600.2	19.4	-11610.4	--	--	--	230.3	17.4	-11999.7

Battery discharge to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.3	49.8	7427.2	--	--	--	230.2	10.1	6931.6
599.6	20.7	12399.5	--	--	--	230.2	17.4	12005.8

supplementary information:

sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.

4.7	**TABLE: mains supply electrical data in normal condition, test at 50Hz**	P

Model: BD15KTR-RH3, 60Hz

PV to grid

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
--	--	--	184.7	16.2	2982.0	229.8	4.3	2831.9
--	--	--	619.2	24.5	15176.5	207.1	23.7	14713.1
--	--	--	619.2	24.9	15422.4	230.5	21.7	14996.1
--	--	--	619.2	24.8	15372.6	253.4	19.7	14966.9
--	--	--	849.6	18.0	15260.9	207.1	23.9	14816.7
--	--	--	847.8	17.9	15148.0	230.3	21.8	15004.3
--	--	--	849.8	17.8	15149.4	253.1	19.8	14994.6
--	--	--	996.3	9.0	8952.6	230.1	12.8	8797.9

PV to battery

Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)(string1/2)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	50.7	-7632.4	699.2	22.4	15631.8	--	--	--
430.4	35.3	-15160.9	699.2	22.3	15592.3	--	--	--

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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

600.2	25.3	-15114.6	699.2	22.1	15441.0	--	--	--
Grid to Battery (charge priority)								
Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
150.8	49.5	-7457.5	--	--	--	230.2	11.6	-7977.2
600.2	24.2	-14532.7	--	--	--	230.0	21.8	-15018.8
Battery discharge to grid								
Battery terminal			PV terminal			Grid terminal		
U(V)	I(A)	P(W)	U(V)	I(A)	P(W)	U(V)	I(A)	P(W)
149.3	49.7	7420.5	--	--	--	230.2	10.0	6925.4
599.5	26.0	15546.7	--	--	--	230.5	21.8	15044.8
supplementary information: sign “-” means battery charging, or absorbs power from grid, sign “+” means battery discharging or supply power to grid.								

4.3	**Thermal testing (by thermocouples)**							P
Model	BD15KTR-RH3							
No.	Ambient (°C)	Humidity (RH)	Test time	Input (Vdc, A, W)		Output (Vac, A, W)		
(1)	45	47	4h01min	PV	PV1: 623.9/12.0/7487 PV2: 612.9/12.2/7478	Grid	L1	229.9/2.1/317
							L2	227.7/1.8/267
							L3	229.3/1.8/268
				BAT	-	Load	L1	232.9/20.5/4781
							L2	232.4/20.5/4781
							L3	232.2/20.4/4781
(2)	45	47	4h10min	PV	PV1: 810.3/9.2/7489 PV2: 804.2/9.3/7482	Grid	L1	233.8/2.0/264
							L2	233.1/1.7/184
							L3	233.3/1.7/207
				BAT	-	Load	L1	233.9/20.4/4779
							L2	233.9/20.4/4779
							L3	235.0/20.5/4779
(3)	60	47	4h05min	PV	PV1:604.6/12.4/7498 PV2:627.5/11.9/7468	Grid	L1	232.8/1.9/233
							L2	232.0/1.7/170
							L3	232.2/1.7/181
				BAT	-	Load	L1	232.9/20.4/4765
							L2	232.4/20.4/4765
							L3	232.2/20.4/4765
(4)	60	47	4h02min	PV	PV1:812.2/9.2/7468 PV2:806.4/9.2/7465	Grid	L1	232.4/1.8/245
							L2	232.1/1.6/184
							L3	233.1/1.6/206

Telephone : +86 20 38320668
Telefax : +86 20 38320478
http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

				BAT	-	Load	L1	233.6/20.4/4768
							L2	233.7/20.4/4768
							L3	234.1/20.4/4768
(5)	45	47	4h05min	PV	-	Grid	L1	230.1/21.7/5004
							L2	228.9/21.6/4945
							L3	228.5/21.6/4940
				BAT	456.7/-33.0/	Load	L1	-
							L2	-
							L3	-
(6)	60	47	4h07min	PV	-	Grid	L1	231.6/17.7/4091
							L2	230.0/17.3/2964
							L3	229.8/17.3/3974
				BAT	452.1/27.0	Load	L1	-
							L2	-
							L3	-

No.	Temperature (°C) of part at:	Measured temperature (°C)			Corrected temperature (°C)			Limits (°C)
		(1)^	(2)^	(3)	(1)	(2)	(3)	-
EM1								
1.	SN2	55.2	54.0	75.4	59.4	58.2	75.4	105
2.	SN1	55.3	53.8	75.6	59.5	58.0	75.6	105
3.	X Cap C11	48.8	46.7	68.4	53.0	50.9	68.4	110
4.	X Cap C42	54.3	52.5	74.1	58.5	56.7	74.1	110
5.	Winding of filter TR1	56.0	54.8	76.3	60.2	59.0	76.3	180
6.	Core of filter TR1	52.8	51.1	72.8	57.0	55.3	72.8	180
7.	PCB near TR1	57.9	56.8	78.1	62.1	61.0	78.1	130
8.	Y cap C70	53.5	51.6	72.9	57.7	55.8	72.9	110
9.	Y cap C57	52.8	50.8	72.6	57.0	55.0	72.6	110
10.	Relay K4 ambi-ent	54.7	53.1	75.0	58.9	57.3	75.0	85
11.	Winding of filter L2	50.2	48.3	69.8	54.4	52.5	69.8	180
12.	Core of filter L2	49.6	47.7	69.1	53.8	51.9	69.1	180
13.	Relay K6 ambi-ent	51.1	49.0	70.6	55.3	53.2	70.6	85
14.	X cap C64	52.7	51.9	72.1	56.9	56.1	72.1	110
15.	C162	50.1	49.2	69.4	54.3	53.4	69.4	110
EM2								
16.	Winding of transformer TR2	71.1	71.0	89.0	75.3	75.2	89.0	150

Telephone : +86 20 38320668
Telefax : +86 20 38320478

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TÜV SÜD Certification and Testing (China) Co., Ltd.
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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

17.	Bobbin of transformer TR2	61.5	60.1	75.6	65.7	64.3	75.6	150
18.	C51	50.4	49.5	69.8	54.6	53.7	69.8	110
19.	HS1	62.0	62.3	81.0	66.2	66.5	81.0	Ref.
20.	Relay RLY1 ambient	58.7	58.0	77.8	62.9	62.2	77.8	85
21.	LR1	54.6	51.9	74.4	58.8	56.1	74.4	Ref.
22.	LR2	51.3	49.9	70.7	55.5	54.1	70.7	Ref.
23.	K2	50.0	49.2	69.3	54.2	53.4	69.3	85
24.	Y cap C35	55.1	53.2	75.2	59.3	57.4	75.2	125
25.	X cap C69	50.6	48.4	70.2	54.8	52.6	70.2	110
26.	X cap C74	54.6	53.0	75.0	58.8	57.2	75.0	110
27.	Winding of filter TR1	49.7	48.9	69.0	53.9	53.1	69.0	150
28.	Core of filter TR1	49.8	48.8	68.8	54.0	53.0	68.8	150
29.	Thermistor RV3	48.8	48.2	68.6	53.0	52.4	68.6	85
30.	X cap C79	49.6	48.9	69.2	53.8	53.1	69.2	125
31.	GOT1	48.2	47.4	68.0	52.4	51.6	68.0	100
DR1 board								
32.	Winding of transformer TR2	54.7	52.9	74.0	58.9	57.1	74.0	150
33.	Bobbin of transformer TR2	54.8	53.1	74.2	59.0	57.3	74.2	150
34.	Optocoupler PC4	53.9	51.6	73.7	58.1	55.8	73.7	100
35.	C62	48.8	47.4	68.3	53.0	51.6	68.3	105
36.	SN3	54.0	51.8	73.9	58.2	56.0	73.9	105
37.	IGBT 3	66.6	57.4	89.1	70.8	61.6	89.1	175
38.	Diode D36	60.3	54.7	81.8	64.5	58.9	81.8	Ref.
39.	IGBT2	60.6	52.3	81.4	64.8	56.5	81.4	175
40.	Mos Q17	52.3	49.5	73.0	56.5	53.7	73.0	175
41.	Mos Q16	52.9	49.3	73.2	57.1	53.5	73.2	175
42.	Optocoupler PC1	55.3	53.8	75.1	59.5	58.0	75.1	110
43.	Cap C59	53.7	51.7	72.8	57.9	55.9	72.8	105
44.	Cap C30	54.0	51.4	73.3	58.2	55.6	73.3	105
45.	Cap C52	53.6	51.8	72.8	57.8	56.0	72.8	105
46.	Relay K1 ambient	51.7	50.7	71.3	55.9	54.9	71.3	75
47.	IGBT7	55.7	57.4	76.1	59.9	61.6	76.1	175
48.	IGBT6	55.3	57.0	75.5	59.5	61.2	75.5	175

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Telefax : +86 20 38320478

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

49.	C140	49.8	48.5	68.9	54.0	52.7	68.9	105
50.	IGBT15	57.4	58.3	78.2	61.6	62.5	78.2	175
51.	IGBT12	58.5	59.7	79.3	62.7	63.9	79.3	175
52.	IGBT10	56.8	57.7	77.3	61.0	61.9	77.3	175
53.	IGBT11	58.4	59.6	79.1	62.6	63.8	79.1	175
54.	IGBT13	57.6	58.7	78.3	61.8	62.9	78.3	175
55.	IGBT14	56.8	57.9	77.7	61.0	62.1	77.7	175
56.	IGBT8	54.5	55.7	75.0	58.7	59.9	75.0	175
DR2 board								
57.	Optocoupler PC10	57.6	56.3	77.4	61.8	60.5	77.4	110
58.	Winding of transformer TR6	56.0	54.3	75.3	60.2	58.5	75.3	150
59.	Bobbin of transformer TR6	56.0	54.4	75.4	60.2	58.6	75.4	150
60.	Optocoupler PC3	55.1	54.1	75.0	59.3	58.3	75.0	110
61.	Cap C2	54.6	53.0	74.3	58.8	57.2	74.3	105
62.	Winding of transformer TR2	55.5	53.5	75.0	59.7	57.7	75.0	150
63.	Bobbin of transformer TR2	54.5	52.5	74.4	58.7	56.7	74.4	150
64.	Optocoupler PC8	54.4	52.4	74.1	58.6	56.6	74.1	110
65.	Y Cap C63	53.6	50.6	73.1	57.8	54.8	73.1	105
66.	Y cap C72	53.5	50.6	73.1	57.7	54.8	73.1	105
67.	Core of filter L1	57.4	55.7	77.2	61.6	59.9	77.2	150
68.	Winding of filter L1	58.9	57.3	78.6	63.1	61.5	78.6	150
69.	U4	55.2	52.9	74.6	59.4	57.1	74.6	Ref.
70.	U12	53.5	51.4	72.5	57.7	55.6	72.5	Ref.
Communication bord								
71.	Winding of transformer TR1	48.7	47.9	67.2	52.9	52.1	67.2	150
72.	Bobbin of transformer TR1	48.7	47.8	67.2	52.9	52.0	67.2	150
73.	Screen	44.6	44.3	63.9	48.8	48.5	63.9	65
74.	Button	43.3	42.5	63.2	47.5	46.7	63.2	85
75.	PV connector inside	47.0	44.6	66.6	51.2	48.8	66.6	120
76.	PV connector outside	42.4	41.4	62.0	46.6	45.6	62.0	120
77.	AC lead wire	48.5	46.4	68.0	52.7	50.6	68.0	105

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Telefax : +86 20 38320478

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

78.	AC terminal block	44.0	43.0	63.8	48.2	47.2	63.8	120
79.	Battery connect-or inside	44.7	43.4	64.2	48.9	47.6	64.2	120
80.	Battery connect-or outside	40.7	40.4	60.2	44.9	44.6	60.2	120
81.	PV cable inside	47.2	45.8	66.7	51.4	50.0	66.7	105
82.	AC cable inside	48.1	44.9	67.7	52.3	49.1	67.7	105
83.	Fan 1	50.2	48.0	69.5	54.4	52.2	69.5	85
84.	Fan 2	53.5	51.9	73.2	57.7	56.1	73.2	85
85.	Core of boost inductor	86.8	54.2	109.4	91.0	58.4	109.4	150
86.	Battery Fuse	48.0	46.8	67.4	52.2	51.0	67.4	90
87.	Front enclosure	44.5	43.3	64.2	48.7	47.5	64.2	70
88.	Left enclosure	46.5	45.4	66.2	50.7	49.6	66.2	70
89.	Right enclosure	45.4	44.3	65.3	49.6	48.5	65.3	70
90.	Top enclosure	48.4	48.1	68.6	52.6	52.3	68.6	70
91.	Heatsinking	47.8	44.8	67.8	52.0	49.0	67.8	70
92.	Switch outside	43.0	42.2	62.6	47.2	46.4	62.6	85
93.	Ambient	40.8	40.8	60.0	45.0	45.0	60.0	Ref.
94.	Internal ambient	52.0	49.9	71.6	56.2	54.1	71.6	Ref.
No.	Temperature (°C) of part at:	Measured temperature (°C)			Corrected temperature (°C)			Limits (°C)
		(4)	(5)^	(6)	(4)	(5)	(6)	-
EM1								
1.	SN2	66.9	72.8	90.1	67.1	77.0	90.3	105
2.	SN1	69.2	83.7	99.9	69.4	87.9	100.1	105
3.	X Cap C11	74.3	56.1	74.7	74.5	60.3	74.9	110
4.	X Cap C42	68.0	92.6	103.8	68.2	96.8	104.0	110
5.	Winding of filter TR1	71.6	101.9	116.2	71.8	106.1	116.4	180
6.	Core of filter TR1	78.4	93.6	109.1	78.6	97.8	109.3	180
7.	PCB near TR1	78.1	93.2	107.8	78.3	97.4	108.0	130
8.	Y cap C70	70.9	68.4	82.5	71.1	72.6	82.7	110
9.	Y cap C57	75.4	65.0	83.3	75.6	69.2	83.5	110
10.	Relay K4 ambi-ent	72.1	68.4	78.4	72.3	72.6	78.5	85
11.	Winding of filter L2	73.6	67.5	85.0	73.8	71.7	85.2	180
12.	Core of filter L2	69.1	62.1	80.1	69.3	66.3	80.3	180
13.	Relay K6 ambi-ent	68.7	59.7	78.3	68.9	63.9	78.5	85

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Telefax : +86 20 38320478

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

14.	X cap C64	71.1	64.0	78.8	71.3	68.2	79.0	110
15.	C162	68.4	65.2	80.3	68.6	69.4	80.5	110
EM2								
16.	Winding of transformer TR2	89.3	83.5	98.2	89.5	87.7	98.4	150
17.	Bobbin of transformer TR2	75.0	59.2	77.6	75.2	63.4	77.8	150
18.	C51	69.1	60.7	76.8	69.3	64.9	77.0	110
19.	HS1	81.2	74.5	90.1	81.4	78.7	90.3	Ref.
20.	Relay RLY1 ambient	77.0	68.9	84.6	77.2	73.1	84.8	85
21.	LR1	71.2	80.6	92.7	71.4	84.8	92.9	Ref.
22.	LR2	69.0	113.6	122.9	69.2	117.8	123.1	Ref.
23.	K2	68.4	58.7	74.5	68.6	62.9	74.7	85
24.	Y cap C35	74.7	93.6	104.3	74.9	97.8	104.5	125
25.	X cap C69	68.9	62.4	79.9	69.1	66.6	80.1	110
26.	X cap C74	74.0	69.5	88.2	74.2	73.7	88.4	110
27.	Winding of filter TR1	68.2	98.2	109.2	68.4	102.4	109.4	150
28.	Core of filter TR1	68.0	109.6	120.4	68.2	113.8	120.6	150
29.	Thermistor RV3	67.6	64.4	79.8	67.8	68.6	80.0	85
30.	X cap C79	68.5	64.8	79.0	68.7	69.0	79.2	125
31.	GOT1	66.9	59.9	75.7	67.1	64.1	75.9	100
DR1 board								
32.	Winding of transformer TR2	73.8	61.9	80.1	74.0	66.1	80.3	150
33.	Bobbin of transformer TR2	73.8	62.2	80.7	74.0	66.4	80.9	150
34.	Optocoupler PC4	71.1	69.8	84.3	71.3	74.0	84.5	100
35.	C62	66.6	61.9	77.3	66.8	66.1	77.5	105
36.	SN3	71.5	70.1	84.0	71.7	74.3	84.2	105
37.	IGBT 3	77.8	59.4	76.1	78.0	63.6	76.3	175
38.	Diode D36	75.0	61.1	77.5	75.2	65.3	77.7	Ref.
39.	IGBT2	70.0	60.0	76.7	70.2	64.2	76.9	175
40.	Mos Q17	69.7	69.1	84.5	69.9	73.3	84.7	175
41.	Mos Q16	69.3	70.0	85.4	69.5	74.2	85.6	175
42.	Optocoupler PC1	74.7	63.1	81.1	74.9	67.3	81.3	110
43.	Cap C59	70.8	66.1	80.5	71.0	70.3	80.7	105
44.	Cap C30	70.6	66.3	80.9	70.8	70.5	81.1	105

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Telefax : +86 20 38320478

http://www.tuv-sud.cn

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

45.	Cap C52	71.2	63.7	78.7	71.4	67.9	78.9	105
46.	Relay K1 ambi-ent	70.2	61.9	77.3	70.4	66.1	77.5	85
47.	IGBT7	77.7	65.3	81.4	77.9	69.5	81.6	175
48.	IGBT6	77.2	64.4	80.7	77.4	68.6	80.9	175
49.	C140	67.7	66.7	81.2	67.9	70.9	81.4	105
50.	IGBT15	78.9	68.7	84.0	79.1	72.9	84.2	175
51.	IGBT12	80.5	69.6	85.5	80.7	73.8	85.7	175
52.	IGBT10	78.3	66.8	83.0	78.5	71.0	83.2	175
53.	IGBT11	80.3	69.3	85.4	80.5	73.5	85.6	175
54.	IGBT13	79.4	68.2	84.4	79.6	72.4	84.6	175
55.	IGBT14	78.6	67.3	83.2	78.8	71.5	83.4	175
56.	IGBT8	76.1	64.4	79.9	76.3	68.6	80.1	175
DR2 board								
57.	Optocoupler PC10	64.8	67.5	84.6	65.0	71.7	84.8	110
58.	Winding of transformer TR6	75.2	65.2	82.7	75.4	69.4	82.9	150
59.	Bobbin of trans-former TR6	75.5	65.5	82.8	75.7	69.7	83.0	150
60.	Optocoupler PC3	75.0	62.1	80.2	75.2	66.3	80.4	110
61.	Cap C2	74.1	63.2	81.1	74.3	67.4	81.3	105
62.	Winding of transformer TR2	72.7	68.0	83.0	72.9	72.2	83.2	150
63.	Bobbin of trans-former TR2	71.9	67.4	82.1	72.1	71.6	82.3	150
64.	Optocoupler PC8	73.8	63.0	80.9	74.0	67.2	81.1	110
65.	Y Cap C63	77.7	67.9	82.5	77.9	72.1	82.7	105
66.	Y cap C72	71.8	68.2	82.9	72.0	72.4	83.1	105
67.	Core of filter L1	76.2	68.7	87.2	76.4	72.9	87.4	150
68.	Winding of filter L1	77.8	70.8	89.4	78.0	75.0	89.6	150
69.	U4	73.4	64.7	82.9	73.6	68.9	83.1	Ref.
70.	U12	71.3	64.8	82.6	71.5	69.0	82.8	Ref.
Communication bord								
71.	Winding of transformer TR1	66.3	51.5	69.6	66.5	55.7	69.8	150
72.	Bobbin of trans-former TR1	66.3	51.5	69.5	66.5	55.7	69.7	150
73.	Screen	63.7	46.8	65.2	63.9	51.0	65.4	70
74.	Button	77.0	45.2	64.7	77.2	49.4	64.9	85

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Telefax : +86 20 38320478

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

75.	PV connector inside	65.1	48.7	68.7	65.3	52.9	68.9	120
76.	PV connector outside	61.5	42.2	62.2	61.7	46.4	62.4	120
77.	AC lead wire	66.9	56.6	75.1	67.1	60.8	75.3	105
78.	AC terminal block	63.1	46.4	66.1	63.3	50.6	66.3	120
79.	Battery connect-or inside	63.3	47.5	67.2	63.5	51.7	67.4	120
80.	Battery connect-or outside	60.2	40.5	60.6	60.4	44.7	60.8	120
81.	PV cable inside	65.8	55.3	73.6	66.0	59.5	73.8	105
82.	AC cable inside	65.1	47.1	67.3	65.3	51.3	67.5	105
83.	Fan 1	68.3	56.4	75.4	68.5	60.6	75.6	85
84.	Fan 2	75.2	61.6	79.9	75.4	65.8	80.1	85
85.	Core of boost inductor	72.5	57.7	77.4	72.7	61.9	77.6	150
86.	Battery Fuse	66.0	58.3	74.2	66.2	62.5	74.4	90
87.	Front enclosure	76.2*	47.7	67.0	76.4*	51.9	67.2	70
88.	Left enclosure	65.6	49.9	69.3	65.8	54.1	69.5	70
89.	Right enclosure	64.6	47.6	67.2	64.8	51.8	67.4	70
90.	Top enclosure	68.8	52.9	71.8*	69.0	57.1	72.0*	70
91.	Heatsinking	65.1	51.1	70.5*	65.3	55.3	70.7*	70
92.	Switch outside	62.1	43.7	63.8	62.3	47.9	64.0	85
93.	Ambient	59.8	40.8	59.9	60.0	45.0	60.1	Ref.
94.	Internal ambient	62.9	60.4	78.4	63.1	64.6	78.6	Ref.
Remark: '*': There is an external anti-hot label. "^": Because of the deviation, the measured ambient temperature is 40.8°C, and the Corrected temperature is 45°C.								

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Telefax : +86 20 38320478

http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

	TABLE: fault condition tests					P
	Ambient temperature (°C) ……....:			25.4		—
	Relative humidity……:			54.5		—
No.	component	Fault	Input (Vdc)	Output (Vac, kW)	Test duration	Observation
Clause 4.4.4.1 Component fault tests						
1.	C51	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. The F2 was damaged. No hazard. After remove the fault condition, cannot restart normal operation.
2.	D7	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down and LCD show alarmed “Inverter current abnormal”. No hazard. After remove the fault condition, restart normal operation.
3.	C21	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down and LCD show alarmed “RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
4.	U1 1-5	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. No hazard. After remove the fault condition, restart normal operation.
5.	PC1 1-4	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. No hazard. After remove the fault condition, restart normal operation.
6.	RV2	O-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit normal operation
7.	K10	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down and LCD show alarmed “RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
8.	K11	S-C	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot normal operation and LCD show alarmed “RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
9.	K14	S-C	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot normal operation and LCD show alarmed “RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
10.	K15	S-C	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot normal operation and LCD show alarmed “RELAY abnormal”. No hazard. After remove the fault

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Telefax : +86 20 38320478
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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

						condition, restart normal operation.
11.	K7	S-C	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot normal operation and LCD show alarmed “RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
12.	K12	S-C	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot normal operation and LCD show alarmed “RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
13.	K13	S-C	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot normal operation and LCD show alarmed “RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
14.	K16	S-C	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot normal operation and LCD show alarmed “RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
15.	RLY 1	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit normal operation
16.	K9	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit operation abnormally and LCD show alarmed “GEN RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
17.	K10	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit operation abnormally and LCD show alarmed “GEN RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
18.	K11	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit operation abnormally and LCD show alarmed “GEN RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
19.	K13	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit operation abnormally and LCD show alarmed “GEN RELAY abnormal”. No hazard. After remove the fault condition, restart normal operation.
20.	C50	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down and LCD show “Bus over-voltage”. No hazard. After remove the fault condition, restart normal operation.
21.	R93	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit normal operation
22.	RV7	O-C	700	230V/10k	10min	The fault applied during the unit operating. After applied the fault, the unit normal opera-

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Telefax : +86 20 38320478
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				W		tion
23.	R172	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit normal operation
24.	RV2	O-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit normal operation
25.	K2	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down and LCD show “Bus low-voltage”. No hazard. After remove the fault condition, restart normal operation.
26.	IGBT6 (pin C to pin E) of Boost IGBT	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. The IGBT-CN20 was damaged. No hazard. After remove the fault condition, cannot restart normal operation.
27.	IGBT15 (pin C to pin E) of Boost IGBT	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. The IGBT21 was damaged. No hazard. After remove the fault condition, cannot restart normal operation.
28.	C52	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. The Q14 was damaged. No hazard. After remove the fault condition, cannot restart normal operation.
29.	C57(Bus Capacitor)	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. The Q10 was damaged. No hazard. After remove the fault condition, cannot restart normal operation.
30.	PC1 2-8	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. The Q16 was damaged. No hazard. After remove the fault condition, cannot restart normal operation.
Clause 4.4.4.4 Transformer short circuit tests						
31.	TR2 pin8 to pin9 (EM2 board)	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down and LCD show alarmed “1: Bus over-voltage, 2: INV over current”. No hazard. After remove the fault condition, restart normal operation.
32.	TR2 pin10 to pin9 (EM2 board)	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. No hazard. After remove the fault condition, restart normal operation.
33.	TR2 pin11 to pin12 (EM2 board)	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit shut down. No hazard. After remove the fault condition, restart normal operation.
Clause 4.4.4.8 Cooling system failure						

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34.	Fan (internal)	Dis-con-nected	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit normal operation
35.	Fan(external)	Block	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit derating output and LCD show “Fan fault”. No hazard. After remove the fault condition, restart normal operation.
Clause 4.4.4.11 Reverse d.c. connections						
36.	PV1+ and PV1-	Re-versed	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot operation normally and LCD show “PV reverse”. No hazard. After remove the fault condition, restart normal operation.
Clause 4.4.4.13 Mis-wiring with incorrect phase sequence or polarity						
37.	L1&L2	Mis-wiring	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot operation normally and LCD show “GRID reverse”. No hazard. After remove the fault condition, restart normal operation.
38.	L1&L2	S-C	700	230V/10kW	10min	The fault applied during the unit operating. After applied the fault, the unit cannot operation normally and LCD show “BUS over-voltage”. No hazard. After remove the fault condition, restart normal operation.
39.	L2	dis-con-nected	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot operation normally and LCD show “GRID lacks”, then the unit enters the off-grid mode. No hazard. After remove the fault condition, restart normal operation.
40.	PE conductor	Not con-nected before ener-gized	700	230V/10kW	10min	The fault applied before the unit operating. After applied the fault, the unit cannot operation normally and LCD show “BUS over-voltage”. No hazard. After remove the fault condition, restart normal operation.
supplementary information: S-C: short circuit, O-C: open circuit, O-L: overload, R: reversed						

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7.3.7.4 & 7.3.7.5	Clearance and creepage distance measurements					P	
clearnace cl and creepage distance dcr at / of:	Up (V)	U r.m.s. (V)	U impulse (V)	required cl (mm)	cl (mm)	required dcr (mm)	dcr (mm)
Below creepage distances and clearances for basic insulation or other insulation measured on Communi-cation board							
Insulation band width of transformer TR1(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	13.4	5.0	13.4
Insulation band width of PC 10(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 24(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 8(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 9(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 21(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 2(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 3(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 4(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 1(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.5	5.0	7.5
Insulation band width of U11(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.5	5.0	7.5
Insulation band width of PC 13(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.5	5.0	7.5
Insulation band width of K1(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	8.0	5.0	8.0
Insulation band width of K2 (SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	8.0	5.0	8.0
Insulation band width of PC 18(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 6(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 7(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 15(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of PC 17(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of U5(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.5	5.0	6.5
Insulation band width of	1000	1000Vd.c,	4900	3.6	6.5	5.0	6.5

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U4(SI)		230Va.c.					
Insulation band width of PC 11(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.5	5.0	7.5
Insulation band width of PC 17(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.5	5.0	7.5
Insulation band width of PC 12(SI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.5	5.0	7.5
Below creepage distances and clearances for basic insulation or other insulation measured on EM2 board							
Insulation band width of screw H9 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	3.6	5.0	3.6
Insulation band width of screw 12 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	3.6	5.0	3.6
Insulation band width of screw H10 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	4.7	5.0	4.7
Insulation band width of screw H13 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.1	5.0	7.1
Insulation band width of screw H11 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	5.3	5.0	5.3
Insulation band width of screw H5 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.3	5.0	7.3
Insulation band width of screw H6 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.3	5.0	7.3
Insulation band width of screw H7 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.3	5.0	7.3
Insulation band width of screw H8 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.3	5.0	7.3
Insulation band width of TR2 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	15.2	5.0	15.2
Insulation band width of RY1(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	10.2	5.0	10.2
Insulation band width of RY2(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	10.2	5.0	10.2
Insulation band width of K17(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	16.4	5.0	16.4
Insulation band width of K10(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	11.3	5.0	11.3
Insulation band width of K7(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	11.3	5.0	11.3
Insulation band width of PC1(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.4	5.0	6.4
Insulation band width of C53(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	9.0	5.0	9.0
Below creepage distances and clearances for basic insulation or other insulation measured DR3 board							
Insulation band width of screw H6 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.2	5.0	7.2

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Insulation band width of screw H1(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.2	5.0	6.2
Insulation band width of screw H6(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.1	5.0	7.1
Insulation band width of K2 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	16.2	5.0	16.2
Insulation band width of CN25 BOTTOM(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	5.7	5.0	5.7
Insulation band width of CN 25 TOP(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	24	5.0	24
Below creepage distances and clearances for basic insulation or other insulation measured EM1 board							
Insulation band width of screw H10(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.9	5.0	7.9
Insulation band width of screw H11(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	8.6	5.0	8.6
Insulation band width of screw H1(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	10.6	5.0	10.6
Insulation band width of screw H2(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.6	5.0	7.6
Insulation band width of screw H3(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	7.3	5.0	7.3
Insulation band width of R108*10(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	20	5.0	20
Insulation band width of K14(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	12	5.0	12
Insulation band width of K19(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	12	5.0	12
Insulation band width of K20(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	12	5.0	12
Insulation band width of R57*4(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	10	5.0	10
Below creepage distances and clearances for basic insulation or other insulation measured on DR1 board							
Insulation band width of screw H1(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	8.8	5.0	8.8
Insulation band width PC11(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.3	5.0	6.3
Insulation band width TR3(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	10	5.0	10
Insulation band width IGBT(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	8.1	5.0	8.1
Below creepage distances and clearances for basic insulation or other insulation measured on DR2 board							
Insulation band width TR1(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	10	5.0	10
Insulation band width IGBT(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	8.1	5.0	8.1

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Telefax : +86 20 38320478

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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

Insulation band width PC(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	6.3	5.0	6.3
Insulation band width SN(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	3.7	5.0	3.7
Insulation band width R40*12(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	30	5.0	30
Insulation band width R83(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	12.5	5.0	12.5
Insulation band width R211(BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	20	5.0	20
Insulation band width of screw H8 (BI)	1000	1000Vd.c, 230Va.c.	4900	3.6	5.6	5.0	5.6
supplementary information: N/A							

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
Battery/PV /AC port to PE	2120Vd.c.	4900 V_{peak}	N/A	No breakdown
Battery/PV/AC port to Communication port	4240Vd.c.	6000 V_{peak}	N/A	No breakdown
Battery/PV/AC port to LED outside surface	4240Vd.c.	6000 V_{peak}	N/A	No breakdown
Battery/PV to AC load/grid terminal (Grid relays opened)	2120Vd.c.	4900V_{peak}	N/A	No breakdown
Supplementary information: Circuit breakers, contactors are closed before applied these tests.				

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Object/part No.	Manufacturer/ Trademark	Type / Model	Technical data	Standard	Mark(s) of Conformity
Metal enclosure	Shenzhen INVT Electric Co., Ltd.	Aluminum alloy 5052,	Thickness: 2mm	-	Tested with Appliance
Heat-sink	Shenzhen INVT Electric Co., Ltd.	Aluminum AL6063,	LxWxH: 434*355*79.5 mm	-	Tested with Appliance
LCD cover	Shenzhen HE CHUAN TECHNOLOGY Co., Ltd.	PC	164*144.5*1.0mm	-	Tested with Appliance
--(alternative PV connector)	Wuxi Betteri Electronic Technology Co., Ltd.	BC03A, BC03B	1000 Vdc, 30 A, -40 °C - +85 °C, IP67	EN 50521：2012 UL6703	E258184
DC Switch	Santon International B.V.	XBE+3310-2	500V;32A	UL508I	E362334
--(alternative)	PROJO Electric CO.,Ltd	PEDS150(R)-HM32-3	500V;32A	IEC/EN60947-3:2009+A1+A2, AS60947.3、UL508I、GB/T14048.3	E489584
--(alternative)	BENY	BYSS.1-32 /T-3P	500V;32A	UL508i, IEC60947-3, AS60947-3	TUV-R50425301
Internal wiring (PV-in)	Various	1015	12AWG, 105°C, 600V	UL 758	E314168
Internal wiring (AC-out)	Various	1015	10AWG, 105°C, 600V	UL 758	E314168
Battery connector	SHEN ZHEN CONNECTION Electronic Co.,Ltd	QCTB25	600V;115A; -40℃～+120℃	IEC 947-7-7	E304128
--(alternative)	NINGBO DEGSON ELECTRICAL CO., LTD	DGH25	600V;115A; -40℃～+120℃	IEC60947/UL1059	E228872
AC output connector (for inverter panel)	SHEN ZHEN CONNECTION Electronic Co.,Ltd	QCTB10	1PIN;300V;65A; -40℃~+120℃	EN 60999	E304128
--(alternative)	NINGBO DEGSON ELECTRICAL CO., LTD	DGH10-01P-11-00A(H)	1PIN;300V;65A	IEC60947/UL1059	E228872
(Alternative)	CHINA PCBONE	RB02	130°C, V-0	UL796	E347858

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	TECHNOLOGY LTD				
Heat shrinkable casing	CHANGYUAN ELECTRONICS GROUP CO LTD	CB-600	600V,105°C	UL224	E180908
DC fan internal	MINEBEAMITSUMI INC.	06025SA12NAL01	12V,0.15A	UL 94-V0	E89936
Inductor (PV, INV, BAT)	Shenzhen INVT Electric Co., Ltd.	PE2023L1	PV1, PV2 1.2mH±10%@0A 0.7mH±10%@15A*3PCS INV1, INV2, INV3 1.5mH±10%@0A (1mH±10%@16A)*2PCS BAT 0.67mH±10%@0A 0.24mH±10%@50A*1PCS class H	-	Tested with Appliance
--Tape	JINGJIANG PRESSURE SENSITIVE GLUE FTY	WF	WF, 130℃	UL 510	E165111
--(alternative)	P LEO & CO (BC) LTD	1K7170 0.06	1K7170, 220℃	UL 510	E126174
--(alternative)	JINGJIANG PRESSURE SENSITIVE GLUE FTY	PF 0.06	PF 180℃	UL 510	E165111
--Tube	CHANGYUAN ELECTRONICS (SHENZHEN) CO LTD	CB-TT-S	200℃/600V	UL 1441	E180908
--Varnish	SHAANXI HONGYE ELECTRICAL AND ELECTRONIC NEW MATERIAL CO LTD	HY142X	155℃	UL 1446	E337004
--LEAD WIRE	GUANGDONG HAERKN NEW ENERGY CO LTD	UL1015,600V	105℃	UL 1446	E300956
--(alternative)	3Q WIRE & CABLE CO LTD	UL1015,600V	105℃	UL 1446	E341104

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--(alternative)	SHEN ZHEN ANPIN SILICONE MATERIAL CO LTD	AP905	150℃	UL 1446	E257078
--(alternative)	CHINA BLUESTAR CHENGRAND CO LTD	GMX-8152	105℃	UL 1446	E231281
DR1					
Capacitor (C130, C132)	Xiamen Faratronic Co., Ltd.	C323C223K60C450	1600VDC;0.022 uF;±10%; -40°C~105°C	IEC 60384-16	Tested with Appliance
Capacitor (C29-C30, C77-C78)	Xiamen Faratronic Co., Ltd.	C3D3L105KB00C00	1200VDC;1.0uF; 10%	EN 61071：2007，EN 61881-1：2011	R 50266108
Optocoupler (PC1-PC6)	AVAGO	ACPL-T350-500E(AVAGO)	0.5;15ns; -40°C~100°C	EN60747-5-5	E55361
-alternative	SHARP	PC925LENIP0F-UL	0.5;15ns; -40°C~100°C	EN60747-5-5	VDE40008898
Capacitor (C52-C59, C149-C152)	Nichicon	EKMS551VSN471MA60S	470uF, 550 V, -25°C~105°C	-	Tested with Appliance
-alternative	RUBYCON	550 MXG 470 M SGP SN 35X60	470uF, 500 V, -25°C~105°C	-	Tested with Appliance
-alternative	CHMI-CON	EKMS551VSN471MA60S	470uF, 500 V, -25°C~105°C	-	Tested with Appliance
-alternative	JIANGHAI	ECS2YBB471MLA350070E	470uF, 500 V, -25°C~105°C	-	Tested with Appliance
Transformer (TR1-3)	Shenzhen INVT Electric Co., Ltd.	KB1726-27175	1.3mH;±10%;	-	Tested with Appliance
-Bobbin	CHANG CHUN PLASTICS CO.,LTD	PHENOLIC T375HF	150℃	UL 74	E59481
-Insulation tape	JINGJIANG YA HUA STICKING TAPE CO.,LTD	CT	130°C	UL 510	E165111
- COPPER WIRE	HUIZHOU GOLDEN OCEAN MAGNET WIRE FACTORY	Xuew-f MW79C	155°C	UL 1446	E225143
-COPPER WIRE	HOI LUEN ELECTRICAL MFR CO.,LTD	XUEW-F MW79C	155°C	UL 1446	E164409
-BUSHING	SHEN ZHEN WOER HEAT SHRINKABLE	WF	200℃	UL 224	E203950

Telephone : +86 20 38320668
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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

	MATERIAL CO.,LTD				
HALL(PV)(SN1~SN2)	LEM	HLSR 20-P(LEM)	20 A;5V;-40℃～105℃;	EN 50178:1997 IEC 61010-1:2010 IEC61326-1:2012 UL508:2010	E189713
HALL(BAT)(SN3)	LEM	HLSR 50-P(LEM)	50 A;2.5V;+5V;2.5us	EN 50178:1997 IEC 61010-1:2010 IEC61326-1:2012 UL508:2010	E189713
--(alternative)	XIAMEN HONGFA ELECTROACOUSTIC CO LTD	HF36F	12VDC/10A/-40~70℃	ANSI/UL 508;CAN/CSA C22.2. No14-10	E134517
IGBT(Q10-Q17)	INFINEON	IKW75N65EH5	650V;75A;1.65V;175℃;PG-TO247-3	-	Tested with Appliance
--(alternative)	INFINEON	STGWA80H65DFB	650V;80A;1.6V;175°C;TO247	-	Tested with Appliance
IGBT(CN19-CN24)	INFINEON	IKW50N65ES5	650V;50A;1.6V;175°C;TO247	-	Tested with Appliance
IGBT(IGBT1-IGBT4)	ST	STGWA40H120DF2	1200V;40A;2.5V;175℃;TO247	-	Tested with Appliance
--(alternative)	INFINEON	IKW40N120H3	1200V;40A;2.7V;175℃;TO-247	-	Tested with Appliance
IGBT(IGBT10-IGBT21)	INFINEON	IKW40N120CS6	1200V;40A;1.7V;175℃;TO-247	-	Tested with Appliance
DR2					
Capacitor(C1-C6)	Xiamen Faratronic Co., Ltd	C823A333J60C000	1000V;0.033uF;±5%；-40~+105°C	IEC 60384-16	Tested with Appliance
Capacitor(C61-C63)	MURATA	DE1E3KX472MA4BN01F-UL	4700pF±20%-400VAC	EN60384-14	VDE 40002831
-alternative	Shanxi Huaxing Electronics Development Co., Ltd.	CT7Y1	4700 pF, 400 Vac, Y1, 25/125/21	EN60384-14	VDE 40015542
Optocoupler	AVAGO	ACPL-T350-500E(AVAGO)	0.5;15ns; -40°C ~ +100°C	IEC/EN/DIN EN 60747-5-2	E55361
-alternative	SHARP	PC925LENIP0F-UL	0.5;15ns	IEC/EN/DIN EN 60747-5-2	VDE40008898

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Transformer (TR1-6)	Shenzhen INVT Electric Co., Ltd.	KB1726-27175	1.3mH; ±10%; Class F	-	Tested with Appliance
-Bobbin	CHANG CHUN PLASTICS CO.,LTD	PHENOLIC T375HF	150℃	UL 94	E59481
-Insulation tape	JINGJIANG YA HUA STICKING TAPE CO.,LTD	CT	130°C	UL 510	E165111
- COPPER WIRE	HUIZHOU GOLDEN OCEAN MAGNET WIRE FACTORY	XUEW-F MW79C	155°C	UL 1446	E225143
- COPPER WIRE	HOI LUEN ELECTRICAL MFR CO.,LTD	XUEW-F MW79C	155°C	UL 1446	E164409
-BUSHING	SHEN ZHEN WOER HEAT SHRINKABLE MATERIAL CO.,LTD	TEFLON/WF	200℃	UL 224	E203950
BUS Cap （C151-C157）	Nichicon	EKMS551VSN471MA60S	470uF, 550 V, -25°C~105°C	-	Tested with Appliance
-(alternative)	RUBYCON	550 MXG 470 M SGP SN 35X60	470uF, 500 V, -25°C~105°C	-	Tested with Appliance
-(alternative)	CHMI-CON	EKMS551VSN471MA60S	470uF, 500 V, -25°C~105°C	-	Tested with Appliance
-(alternative)	JIANGHAI	ECS2YBB471MLA350070E	470uF, 500 V, -25°C~105°C	-	Tested with Appliance
DR3					
Varistor, RV1, RV2, RV3	brightking	821KD20	820Vdc±10%-D20mm-6500A;-40°C~ +85°	UL1414, UL1449(3rd Edition)	VDE 40027827
-alternative	Centra Science Corp.	20D821K	820 Vd.c., 6,5 kA, -40°C~ +85°	UL1414, UL1449(3rd Edition)	VDE 40008220
-alternative	Shanxi Huaxing Electronics Development Co., Ltd.	MYG20G20K102-UL	1000Vdc±10%-D20mm-6500A	UL1414, UL1449(3rd Edition)	VDE40018747
-alternative	Centra Science Corp.	CNR 14D102K	1000 Vac, 4500A 40/85/56	UL1414, UL1449(3rd Edition)	VDE 40008220
Y Capacitor (C3-C8, C63-C74, C145, C147-C153)	MURATA	DE1E3KX472MA4BN01F-UL	4700pF±20%-400VAC(UL250 VAC)	IEC 60384-14,EN 60384-1	EN60384-14

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-alternative	Shanxi Huaxing Electronics Development Co., Ltd.	CT7Y1	4700 pF, 400 Vac, Y1, 25/125/21	IEC 60384-14,EN 60384-1	VDE 40015542
Inductor (BAT) L1	Shenzhen INVT Electric Co., Ltd.	PE1921_DR3_L2	1.8mH;80A	-	Tested with Appliance
-- Wire	TAI-I ELECTRIC WIRE & CABLE CO.,LTD	MW30C	EIW 2.3, 180℃	UL 1446	E85640
--(alternative)	TAI-I ELECTRIC WIRE & CABLE CO.,LTD	MW30C	EIW 2.3, 180℃	UL 1446	E197768
-- TAPE	JINGJIANG YAHUA PRESSURE SENSITIVE GLUE CO LTD	CT-280B	130℃	UL 510	E165111
-- BOARD	KINGBOARD LAMINATES	FR-4	130℃	UL 746	E123995
Inductor (PV) L1	Shenzhen INVT Electric Co., Ltd.	PE2024-DR3-L1	2mH±10%;12.5 A;	-	Tested with Appliance
-- Wire	TAI-I ELECTRIC WIRE & CABLE CO.,LTD	MW30C	EIW 2.3, 180℃	UL 1446	E85640
--(alternative)	TAI-I ELECTRIC WIRE & CABLE CO.,LTD	MW30C	EIW 2.3, 180℃	UL 1446	E197768
-- TAPE	JINGJIANG YAHUA STICKING TAPE CO.,LTD	CT-280B	180℃	UL 510	E165111
-- BOARD	KINGBOARD LAMINATES	FR-4	130℃	UL 746	E123995
Capacitor(C125-C126)	Xiamen Faratronic Co., Ltd.	C3D1M406JM1A452	1100VDC;40uF; ±5%	-	Tested with Appliance
--(alternative)	PANASONIC	EZPE1B406MTA	1100VDC;40uF; ±5%	-	Tested with Appliance
--(alternative)	VISHAY	MKP1848640094Y5	1100VDC;40uF; ±5%	-	Tested with Appliance
Capacitor(C60-C61)	Xiamen Faratronic Co., Ltd.	C3D3L105KB00C00	1200VDC;1.0uF; 10%	GB/T17702, IEC 61071	Tested with Appliance
Capacitor(C49,C62)	Xiamen Faratronic Co., Ltd.	C822J105KB0C550	630VDC;1uF;5% -40℃~105℃	IEC 60384-16	Tested with Appliance

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--(alternative)	Hongfarad	HMPS105J630RHXJ	630VDC;1uF;5%; -40℃~105℃	IEC 60384-16	Tested with Appliance
--(alternative)	KEMET	R76PR41004030J(KEMET)	630VDC;1uF;5%; -55℃~110℃	IEC 60384-16	Tested with Appliance
Capacitor(C139-C142)	Xiamen Faratronic Co., Ltd.	C3D1U106KB00C00	600V;10uF	IEC 61071	Tested with Appliance
RELAY(RLY)	XIAMEN HONGFA ELECTROACOUSTIC CO LTD	HF167F12-HF	90A;400Vac	IEC62109	R50360703
--(alternative)	Panasonic Corporation	HE1AN-W-DC12V-Y6	90A;400Vac	IEC62109	E43028
FUSE(F9)	COOPER Bussmann (UK) Ltd	RS308-HB-4G	690VAC/500VDC;100A	IEC 60269	E91958
FUSE(F10)	Hollyland (China) Electronics Technology Corporation Ltd.	6FF(P)-015H4	1000Vdc;1.5A	IEC60127	E156471
EM1					
INV current sensor (SN2-4)	LEM Electronics (China) Co., Ltd.	CKSR 50-NP	50 A;5V	EN 50178:1997 IEC60950-1:2006 IEC 61010-1:2010 IEC61326-1:2012 UL508:2010	E67380
--(alternative)	Sinomags Technology Co., Ltd	STB-50CAS	50 A;5V	EN 50178:1997 IEC60950-1:2006 IEC 61010-1:2010 IEC61326-1:2012 UL508:2010	E189713
Capacitor(C30-C32)	Xiamen Faratronic Co., Ltd.	C6AQ1106JF20550	300VAC;10uF;±10%	EN 61071:2007	R 50266136
Capacitor(C69-C71)	Xiamen Faratronic Co., Ltd.	C4BR2475MBWC000	350VAC;4.7uF;±20%; -40℃ ~ +110℃	UL60384-14:2014, CSA E60384-14:09	E186600
--(alternative)	Hongfarad	HMKP475M310REAL	310VAC;4.7uF;±20%; 40℃ ~ +110℃	UL60384-14:2014	E484578
Y Capacitor (C33, C35, C37, C39, C41-C42,	MURATA	DE1E3KX472MA4BN01F-UL	4700pF±20%-400VAC(UL250VAC)	IEC 60384-14, EN 60384-1	E37921

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C50, C53, C56)					
-alternative	Shanxi Huaxing Electronics Development Co., Ltd.	CT7Y1	4700 pF, 400 Vac, Y1, 25/125/21	IEC 60384-14, EN 60384-1	E217400
RCD current sensor (SN1)	Shenzhen INVT Electric Co., Ltd.	MP2510-4AS	73:10:1:1:1:1, 800mΩ,144mΩ	-	Tested with Appliance
--Tube	GREAT HOLDING INDUSTRIAL	TFT	VW-1/300V/200℃	UL 224	E156256
-alternative	GREAT HOLDING INDUSTRIAL	TFL	VW-1/300V/200℃	UL 224	E156256
Wire	DONGGUAN HUAYU ELECTRONICS TECHNOLOGY CO LTD	DTM-B 0.30	130℃/1.41kVpeak	UL 1446	E323485
-alternative	FURUKAWA ELECTRIC	TEX-E 0.30	130℃/1.41kVpeak	UL 1446	E206440
Varnish	WU JIANG TAIHU INSULATING MATERIAL CO LTD	ET-90(a)	180℃	UL 1446	E228349
-alternative	ELANTAS ELECTRICAL INSULATION ELANTAS PDG INC	468-2(x)	180℃	UL 1446	E75225
Inductor TR1	Shenzhen INVT Electric Co., Ltd.	PE1827L2	1mH;30A	-	Tested with Appliance
-- Wire	TAI-I ELECTRIC WIRE & CABLE CO.,LTD	MW30C	EIW 2.3, 180℃	UL1446	E85640
--(alternative)	TAI-I ELECTRIC WIRE & CABLE CO.,LTD	MW30C	EIW 2.3, 180℃	UL1446	E197768
-- TAPE	JINGJIANG YAHUA STICKING TAPE CO.,LTD	CT-280B	130℃	UL 510	E165111
-- BOARD	KINGBOARD LAMINATES	FR-4	130℃	UL 746	E123995
Relay (K1-K13)	Panasonic Electronics Corporation	ALFG2PF12	33A;250VAC	IEC62109	VDE 40023067

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-alternative	Zettler relay(xiamen) Co., Ltd.	AZ7695-1A-12DK（201）	Contact: 250 Va.c., 33 A(cos phi=0,95), gap: 1,8 mm, 10E; Coil ratings: 12 Vd.c., 0,9 W, Class F	UL 508, IEC 61810-1	TUV R 50251020
-alternative	XIAMEN HONGFA ELECTROACOUSTIC CO LTD	HF161F-W	33A;250VAC	IEC62109-2-2011	VDE 40031410
Capacitor(C10-C12)	Xiamen Faratronic Co., Ltd	D43Q1223M6QC450	300VAC 0.022uF± 20%	UL60384-14:2014, CSA E60384-14:09	E186600
CT1					
Microprocessor (U12)	Texas Instruments	TMS320F280049CPZS	-	-	Tested with Appliance
Microprocessor (U4)	ST Microelectronics	STM32F103VCT6	-	-	Tested with Appliance
-alternative	Geehy Semiconductor Co.Ltd	APM32F103VCT6	-	-	Tested with Appliance
EM2					
Y Capacitor (C52-C53, C75, C77, C79, C81, C83, C85-C86)	MURATA	DE1E3KX472MA4BN01F-UL	4700pF±20%-400VAC(UL250VAC)	IEC 60384-14, EN 60384-14	E37921
-alternative	Shanxi Huaxing Electronics Development Co., Ltd.	CT7Y1	4700 pF, 400 Vac, Y1, 25/125/21	IEC 60384-14, EN 60384-1	E217400
Relay (K7, K10-K16)	Zettler relay(xiamen) Co., Ltd.	azsr143	Contact: 250 Va.c.,50A 12 V d.c. Class F	UL 508, IEC 61810-1	E365652
-alternative	XIAMEN HONGFA ELECTROACOUSTIC CO LTD	HF161F-40W	43A;250VAC	IEC62109-2-2011	R50475730
Inductor TR1	Shenzhen INVT Electric Co., Ltd.	PE1827L2	1mH;30A	-	Tested with Appliance
-- Wire	TAI-I ELECTRIC WIRE & CABLE CO.,LTD	MW30C	EIW 2.3, 180℃	UL 1446	E85640
-- TAPE	JINGJIANG YAHUA STICKING TAPE CO.,LTD	CT-280B	130℃	UL 510	E165111
-- BOARD	KINGBOARD LAMINATES	FR-4	130℃	UL 746	E123995

Telephone : +86 20 38320668
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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

Capacitor(C58-C60)	Xiamen Faratronic Co., Ltd.	C4BR2105K9WC000	350VAC;1.0uF;±10%; -40℃ ~ +110℃	UL60384-14:2014, CSA E60384-14:09	E186600
--(alternative)	Hongfarad	HMKP105K310NHXH	310VAC;1.0uF;±10%;X2; -40℃ ~ +110℃	UL60384-14:2014,	E484578
Capacitor (C67, C69, C71)	Xiamen Faratronic Co., Ltd.	C4BR2225MBWC000	350VAC;2.2uF;±20%； -40℃ ~ +110℃	UL60384-14:2014, CSA E60384-14:09	E186600
--(alternative)	Hongfarad	HMKP225K310RHXL	310VAC;2.2uF;±20%； -40℃ ~ +110℃	UL60384-14:2014,	E484578
RELAY(RLY1-2)	SONG CHUAN PRECISION CO.,LTD	507N-2CH-F-C12VDC	8A/240VAC;12VDC/0.4W	ANSI/UL 508; CAN/CSA C22.2. No14-10	E88991
RELAY(K17)	TYCO ELECTRONICS(SHENZHEN)CO.,LTD	SDT-SH-112DM	12VDC/10A/-30~70℃	ANSI/UL 508; CAN/CSA C22.2. No14-10	E58304
--(alternative)	XIAMEN HONGFA ELECTROACOUSTIC CO LTD	HF36F	12VDC/10A/-40~70℃	ANSI/UL 508; CAN/CSA C22.2. No14-10	E134517
FUSE(F1)	Hollyland (China) Electronics Technology Corporation Ltd	6FF(P)020H4	1000Vdc;2A;	IEC60127	E156471
FUSE(F2)	Hollyland (China) Electronics Technology Corporation Ltd	6FF(P)-015H4	1000Vdc;1.5A	IEC60127	E156471
Inductor TR2	Shenzhen INVT Electric Co., Ltd.	PE2023-EM2-TR1	1.5mH	-	Tested with Appliance
BOBBIN	CHANG CHUN PLASTICS CO.,LTD SUMITOMO BAKELITE CO LTD	T375HF	150℃	UL RATING 94V-0	E59481
WIRE	HUIZHOU GOLDEN OCEAN MAGNET WIRE FACTORY	UEW-X MW75C	130℃	UL 1446	E225143
--(alternative)	HOI LUEN ELECTRICAL MFR CO.,LTD	XUEW MW75C	130℃	UL 1446	E164409
TAPE	HUIZHOU YA HUA STICKING TAPE CO.,LTD	CT	130℃	UL 510	E165111

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TUBE	CHANGYUAN ELECTRONICS (SHENZHEN) CO LTD	CB-TT-L	200℃	UL 224	E180908
MARGIN TAPE	HUIZHOU YA HUA STICKING TAPE CO.,LTD	WF	130℃	UL 224	E165111
VARNISH	SUZHOU TAIHU INSULATING MATERIAL CO LTD	T-4260(a)	130℃	UL 1446	E228349
Feedback Opto-coupler (PC1)	Sharp Corpora-tion	PC123X5YIP0F	CTR200%～400%;4;3;5000.0;-30~+110℃	EN60747	E64380
--(alternative)	Lite ON	LTV-816S-TP	CTR200%～400%;4;3;5000.0;-30~+110℃	EN60747	E113898
TF1					
Y Capacitor (C104)	MURATA	DE1E3KX472MA4BN01F-UL	4700pF±20%-400VAC(UL250 VAC)	IEC 60384-14, EN 60384-14	E37921
-alternative	Shanxi Huaxing Electronics De-velopment Co., Ltd.	CT7Y1	4700 pF, 400 Vac, Y1, 25/125/21	IEC 60384-14, EN 60384-1	E217400
Inductor TR1	Shenzhen INVT Electric Co., Ltd.	PE2023-EM2-TR1	1.5mH	-	
BOBBIN	CHANG CHUN PLASTICS CO.,LTD SUMITOMO BAKELITE CO LTD	T375HF	150℃	UL RATING 94V-0	E59481
WIRE	HUIZHOU GOLDEN OCEAN MAGNET WIRE FACTORY	UEW-X MW75C	130℃	UL 1446	E225143
--(alternative)	HOI LUEN ELECTRICAL MFR CO.,LTD	XUEW MW75C	130℃	UL 1446	E164409
TAPE	HUIZHOU YA HUA STICKING TAPE CO.,LTD	CT	130℃	UL 510	E165111
TUBE	CHANGYUAN ELECTRONICS (SHENZHEN) CO LTD	CB-TT-L	200℃	UL 224	E180908

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MARGIN TAPE	JINGJIANG YA HUA STICKING TAPE CO.,LTD	WF	130℃	UL 510	E165111
VARNISH	SUZHOU TAIHU INSULATING MATERIAL CO LTD	T-4260(a)	130℃	UL 1446	E228349
Optocoupler (PC2-PC4, PC6-PC10, PC13, PC15, PC17-PC18, PC21, PC24)	Sharp Corpora-tion	PC123X5YIP0F	CTR200%～400%;4;3;5000.0;-30~+110℃	EN60747	E64380
--(alternative)	Lite ON	LTV-816S-TP	CTR200%～400%;4;3;5000.0;-30~+110℃	EN60747	E113898
USB Optocou-pler(U11)	ADI	ADuM3160(ADI)	4ns;20ns;560V;-40~+105℃	UL1577	E214100
RELAY(K1~K2)	XIAMEN HONGFA ELECTROACOUSTIC CO LTD	HF33F-005-ZS3	5A;250VAC/30VDC; -40~+85℃	IEC60335-1	VDE 125661
--(alternative)	SONG CHUAN	892-1CC-F-V-5DC	5A;250VAC/30VDC; -40~+85℃	IEC60335-1	VDE 40006318

…….. End of test report ……

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Telefax : +86 20 38320478

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

TEST REPORT
IEC 62109-2:2011
Safety of power converters for use in photovoltaic power systems – Part 2: Particular requirements for inverters

Report Number. .....:	64.290.22.31025.01 Part 2 of 2
Date of issue .....:	2022-08-16
Total number of pages.....	26 pages
Applicant's name.....:	INVT Solar Technology (ShenZhen) Co., Ltd.
Address .....:	6th Floor, Block A, INVT Guangming Technology Building Kejie Fourth Road, Shutianpu Community, Matian Guangming District, 518000 Shenzhen PEOPLE'S REPUBLIC OF CHINA
Test specification:	
Standard.....:	EN 62109-2:2011
Test procedure .....:	LVD
Non-standard test method……..:	N/A
Test Report Form No. .....:	IEC62109_2B
Test Report Form(s) Originator ....:	LCIE - Laboratoire Central des Industries Electriques
Master TRF.....:	Dated 2016-08

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.

Test item description .....:	Hybrid Solar Inverter
Trade Mark .....:	invt
Manufacturer.....:	Same as applicant
Model/Type reference .....:	BD6KTR-RH3, BD8KTR-RH3, BD10KTR-RH3, BD12KTR-RH3, BD15KTR-RH3
Ratings .....:	See report No.: 64.290.22.31025.01 Part 1 of 2

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

☒	Testing location / address …….:	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou 511447, China
	Tested by (name + signature) .....:	Jenn Huang
	Approved by (+ signature) .....:	Symbol Zhao

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Telefax : +86 20 38320478

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TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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

See report No.: 64.290.22.31025.01 Part 1 of 2

Revision history:

See report No.: 64.290.22.31025.01 Part 1 of 2

Summary of testing:

All tests were carried out according to IEC 62109-2:2011. The text of EN 62109-2:2011 was approved by CENELEC as a European Standard without any modification.

If no special indicates, all the tests are applied for model: BD15KTR-RH3.

Tests performed (name of test and test clause):

Clause	Requirement
4.4.4.15.1	Fault-tolerance of residual current monitoring
4.4.4.15.2	Fault-tolerance of automatic disconnecting means
4.4.4.16	Stand-alone inverters – Load transfer test
4.4.4.17	Cooling system failure – Blanketing test
4.7.4.2	Steady state output voltage at nominal DC input
4.7.4.3	Steady state output voltage across the DC input range
4.7.4.4	Load step response of the output voltage at nominal DC input
4.7.4.5	Steady state output frequency
4.7.5.2	Sinusoidal output voltage waveform requirements
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays
4.8.3.5.2	Test for detection of excessive continuous residual current
4.8.3.5.3	Test for detection of sudden changes in residual current

Testing location:

TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch

TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou 511447, China

Copy of marking plate

See report No.: 64.290.22.31025.01 Part 1 of 2

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Telefax : +86 20 38320478

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Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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 (%) ..... :	+/- 10%
Tested for power systems..... :	TN system
IT testing, phase-phase voltage (V)..... :	--
Class of equipment ..... :	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg) ..... :	BD6KTR-RH3:30kg, BD8KTR-RH3:30kg, BD10KTR-RH3:31kg, BD12KTR-RH3:32kg, BD15KTR-RH3:34kg
Dimensions (Width x High x Depth mm) ……..:	See ratings
Pollution degree..... :	See ratings
IP protection class ..... :	See ratings
Testing ..... :	
Date of receipt of test item..... :	2021-08-02, 2022-08-01
Date (s) of performance of tests ..... :	2022-02-09 to 2022-06-10, 2022-08-01 to 2022-08-15
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)

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General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.
The tests result presented in this report relate only to the object tested.

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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.

Abbreviations used in the report:
Basic insulation (BI); Supplementary insulation (SI); Double insulation (DI); Reinforced insulation (RI); Functional insulation (FI); Single fault condition (SFC); Normal condition (NC); Supply overvoltage category (OVC); Pollution degree (PD), CDF (Data form for electrical equipment and machinery)

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) ..... :

Factory name: Shenzhen INVT Electric Co., Ltd. Bao'an Branch Factory

Address: F1-F4, No.3 Building, Emerson Industrial Park, Fengtang Road, Tangwei Community, Fuhai, Bao'an District, Shenzhen City, Guangdong Province, 518103, P.R. China

General product information:
See Report No.: 64.290.22.31025.01 Part 1 of 2.

Model differences:

See Report No.: 64.290.22.31025.01 Part 1 of 2.

Electrical Ratings:
See Report No.: 64.290.22.31025.01 Part 1 of 2.

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
4	General testing requirements		P
4.4.4	Single fault conditions to be applied		P
4.4.4.15	Fault-tolerance of protection for grid-interactive inverters		P
4.4.4.15.1	Fault-tolerance of residual current monitoring according to 4.8.3.5: the residual current monitoring system operates properly	See appended table 4.4.4.15.1	P
	a) .- The inverter ceases to operate		P
	- Indicates a fault in accordance with §13.9		P
	- Disconnect from the mains		P
	- not re-connect after any sequence of removing and reconnecting PV power		P
	- not re-connect after any sequence of removing and reconnecting AC power		P
	- not re-connect after any sequence of removing and reconnecting both PV and AC power		P
	b) .- The inverter continues to operate		N/A
	- the residual current monitoring system operates properly under single fault condition		N/A
	- Indicates a fault in accordance with §13.9		N/A
	c) .- The inverter continues to operate regardless of loss of residual current monitoring functionality		N/A
	- not re-connect after any sequence of removing and reconnecting PV power		N/A
	- not re-connect after any sequence of removing and reconnecting AC power		N/A
	- not re-connect after any sequence of removing and reconnecting both PV and AC power		N/A
	- Indicates a fault in accordance with §13.9		N/A
4.4.4.15.2	Fault-tolerance of automatic disconnecting means		P
4.4.4.15.2 .1	The means provided for automatic disconnection of a grid-interactive inverter from the mains shall:		P
	- disconnect all grounded current-carrying conductors from the mains	Neutral conductors consider as grounded according to EU electrical regulation.	P
	- disconnect all ungrounded current-carrying conductors from the mains		P
	- be such that with a single fault applied to the disconnection means or to any other location in the inverter, at least basic insulation or simple	See appended table 4.4.4.15.2 Fault-tolerance of automatic disconnecting	P

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
	separation is maintained between the PV array and the mains when the disconnecting means is intended to be in the open state.		
4.4.4.15.2.2	Design of insulation or separation complies with requirements of 7.3.7 of Part 1: report here Part 1 comment and verdict.		P
4.4.4.15.2.3	For non-isolated inverter, automatic checking of the isolation provided by a disconnect means after single fault.	See appended test table 4.4.4.15.2 Fault-tolerance of automatic disconnecting.	P
	If the check fail: - any still-functional disconnection means shall be left in the open position		P
	- at least basic or simple separation shall be maintained between the PV input and the mains		P
	- the inverter shall not start operation		P
	- the inverter shall indicate a fault in accordance with 13.9		P
4.4.4.16	A stand-alone inverter with a transfer switch to transfer AC loads from the mains or other AC bypass source to the inverter output:	Stand-alone mode was checked by the tests accordingly.	P
	- shall continue to operate normally		P
	- shall not present a risk of fire as the result of an out-of-phase transfer		P
	- shall not present a risk of shock as the result of an out-of-phase transfer		P
	- And having control preventing switching: components for malfunctioning ……..…:		P
4.4.4.17	Cooling system failure – Blanketing test No hazards according to the criteria of sub-clause 4.4.3 of Part 1 shall result from blanketing the inverter. This test is not required for inverters restricted to use only in closed electrical operating areas.	See appended test table Cooling system failure – Blanketing test.	P
	Test stop condition: time duration value or stabilized temperature ……..:		P
4.7	Electrical ratings tests		P
4.7.4	Stand-alone Inverter AC output voltage and frequency		P
4.7.4.1	General		P
4.7.4.2	Steady state output voltage at nominal DC input The steady-state AC output voltage shall not be less than 90 % or more than 110 % of the rated nominal voltage with the inverter supplied with its nominal value of DC input voltage.	(See attached table)	P

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
4.7.4.3	Steady state output voltage across the DC input range The steady-state AC output voltage shall not be less than 85 % or more than 110 % of the rated nominal voltage with the inverter supplied with any value within the rated range of DC input voltage.	(See attached table)	P
4.7.4.4	Load step response of the output voltage at nominal DC input The AC output voltage shall not be less than 85 % or more than 110 % of the rated nominal voltage for more than 1,5 s after application or removal of a resistive load.	(See attached table)	P
4.7.4.5	Steady state output frequency The steady-state AC output frequency shall not vary from the nominal value by more than +4 % or –6 %.	(See attached table)	P
4.7.5	Stand-alone inverter output voltage waveform		P
4.7.5.1	General		P
4.7.5.2	The AC output voltage waveform of a sinusoidal output stand-alone inverter shall have a total harmonic distortion (THD) not exceeding of 10 % and no individual harmonic at a level exceeding 6 %.	(See attached table)	P
4.7.5.3	Non-sinusoidal output waveform requirements		N/A
4.7.5.3.1	General		N/A
4.7.5.3.2	The total harmonic distortion (THD) of the voltage waveform shall not exceed 40 %.		N/A
4.7.5.3.3	The slope of the rising and falling edges of the positive and negative half-cycles of the voltage waveform shall not exceed 10 V/µs measured between the points at which the waveform has a voltage of 10 % and 90 % of the peak voltage for that half-cycle.		N/A
4.7.5.3.4	The absolute value of the peak voltage of the positive and negative half-cycles of the waveform shall not exceed 1,414 times 110 % of the RMS value of the rated nominal AC output voltage.		N/A
4.7.5.4	Information requirements for non-sinusoidal waveforms The instructions provided with a stand-alone inverter not complying with 4.7.5.2 shall include the information in 5.3.2.6.		N/A
4.7.5.5	Output voltage waveform requirements for inverters for dedicated loads. For an inverter that is intended only for use with a known dedicated load, the following requirements may be used as an alternative to the waveform requirements in 4.7.5.2 to 4.7.5.3.		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	The combination of the inverter and dedicated load shall be evaluated to ensure that the output waveform does not cause any hazards in the load equipment and inverter, or cause the load equipment to fail to comply with the applicable product safety standards.		N/A
	The inverter shall be marked with symbols 9 and 15 of Table C.1 of Part 1.		N/A
	The installation instructions provided with the inverter shall include the information in 5.3.2.13.		N/A
4.8	Additional tests for grid-interactive inverters		P
4.8.1	General requirements regarding inverter isolation and array grounding		N/A
	- Type of Array grounding supported ……:	Ungrounded	N/A
	- Inverter isolation ……..:		N/A
4.8.2	Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays	See below	P
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays	For this type of PV array, the resistance at each PV terminal is measured with the insulation resistance before starting up.	P
	Inverter shall have means to measure DC insulation resistance from PV input (array) to ground before starting operation		P
	Or Inverter shall be provided with instruction in accordance with 5.3.2.11.		N/A
	Measured DC insulation resistance: ……:		P
	Inverter measurement circuit shall be capable of detecting insulation resistance below the limit value R= Vmax/30mA under normal conditions	The limit of the PV array insulation resistance: Vmax PV =1000 Vd.c.	P
	Inverter measurement circuit shall be capable of detecting insulation resistance below the limit value R= Vmax/30mA with ground fault in the PV array	R=1000 / 30=33.33 kΩ, the manufacturer's default setting is 34 kΩ	P
	Isolated inverters shall indicate a fault if the insulation resistance is less than the limit value	Indicate fault	P
	Isolated inverter fault indication maintained until insulation resistance has recovered to a value higher than the limit value		P
	Non-isolated inverters, or inverters with isolation not complying with the leakage current limits in the minimum inverter isolation requirements in Table 30:		P
	- shall indicate a fault in accordance with 13.9		P
	- shall not connect to the mains		P
4.8.2.2	Array insulation resistance detection for inverters for functionally grounded arrays		N/A

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
	a-1)The value of the total resistance, including the intentional resistance for array functional grounding, the expected insulation resistance of the array to ground, and the resistance of any other networks connected to ground (for example measurement networks) must not be lower than R = (VMAX PV/30 mA) ohms.		N/A
	a-2) The installation instructions shall include the information required in 5.3.2.12.		N/A
	b-1) As an alternative to a), or if a resistor value lower than in a) is used, the inverter shall incorporate means to detect, during operation, if the total current through the resistor and any networks (for example measurement networks) in parallel with it, exceeds the residual current values and times in Table 31		N/A
	b-2) Inverter shall either disconnect the resistor or limit the current by other means …….:		N/A
	b-3) If the inverter is a non-isolated inverter, or has isolation not complying with the leakage current limits in the minimum inverter isolation requirements in Table 30, it shall also disconnect from the mains.		N/A
	c) The inverter shall have means to measure the DC insulation resistance from the PV input to ground before starting operation, in accordance with 4.8.2.1.		N/A
4.8.3	Array residual current detection		P
4.8.3.1	General		P
4.8.3.2	30 mA touch current type test for isolated inverters	Transformer less type	N/A
4.8.3.3	Fire hazard residual current type test for isolated inverters	Transformer less type	N/A
4.8.3.4	Protection by application of RCD's		N/A
	- The requirement for additional protection in 4.8.3.1 can be met by provision of an RCD with a residual current setting of 30 mA, located between the inverter and the mains..		N/A
	- The selection of the RCD type to ensure compatibility with the inverter must be made according to rules for RCD selection in Part 1.		N/A
	- The RCD provided integral to the inverter, or		N/A
	- The RDC provided by the installer if details of the rating, type, and location for the RCD are given in the installation instructions per 5.3.2.9.		N/A

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
4.8.3.5	Protection by residual current monitoring		P
4.8.3.5.1	General		P
	Where required by Table 30, the inverter shall provide residual current monitoring that functions whenever the inverter is connected to the mains with the automatic disconnection means closed.		P
	The residual current monitoring means shall measure the total (both a.c. and d.c. components) RMS current.		P
	As indicated in Table 30 for different inverter types, array types, and inverter isolation levels, detection may be required for excessive continuous residual current, excessive sudden changes in residual current, or both, according to the following limits:		P
	a) Continuous residual current: The inverter shall disconnect within 0,3 s and indicate a fault in accordance with 13.9 if the continuous residual current exceeds:		P
	- maximum 300 mA for inverters with continuous ouput power rating ≤30kV;		P
	- maximum 10 mA per kVA of rated continuous output power for inverters with continuous output power rating > 30 kVA.		N/A
	The inverter may attempt to re-connect if the array insulation resistance meets the limit in 4.8.2.		N/A
	b) Sudden changes in residual current: The inverter shall disconnect from the mains within the time specified in Table 31		P
	The inverter indicates a fault in accordance with 13.9, if a sudden increase in the RMS residual current is detected exceeding the value in the table.		P
	The inverter may attempt to re-connect if the array insulation resistance meets the limit in 4.8.2.		N/A
4.8.3.5.2	Test for detection of excessive continuous residual current: test repeated 5 times and time to disconnect shall not exceed 0,3 s.	See appended test table 4.8.3.5.2 Test for detection of excessive continuous residual current	P
4.8.3.5.3	Test for detection of sudden changes in residual current repeated 5 times and each of the 5 results shall not exceed the time limit indicated in for each row (30mA, 60mA and150mA) of Table 31.		P
4.8.3.6	Systems located in closed electrical operating areas		N/A
	The protection against shock hazard is not required if the installation information provided with the inverter indicates the restriction for use in a closed electrical operating area, and		N/A
	Installation information indicates what forms of shock hazard protection are and are not provided		N/A

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
	integral to the inverter, in accordance with 5.3.2.7.		
	The inverter shall be marked as in 5.2.2.6.		N/A
5	MARKING AND DOCUMENTATION		P
5.1	Marking		P
5.1.4	Equipment ratings		P
	PV input ratings:	See marking label.	P
	- Vmax PV (absolute maximum) (d.c. V)	See marking label.	P
	- Isc PV (absolute maximum) (d.c. A)	See marking label.	P
	a.c. output ratings:	See marking label.	P
	- Voltage (nominal or range) (a.c. V)	See marking label.	P
	- Current (maximum continuous) (a.c. A)	See marking label.	P
	- Frequency (nominal or range) (Hz)	See marking label.	P
	- Power (maximum continuous) (W or VA)	See marking label.	P
	- Power factor range	See marking label.	P
	a.c input ratings:	See marking label.	P
	- Voltage (nominal or range) (a.c. V)	See marking label.	P
	- Current (maximum continuous) (a.c. A)	See marking label.	P
	- Frequency (nominal or range) (Hz)	See marking label.	P
	d.c. output ratings:	See marking label.	P
	- Voltage (nominal or range) (d.c. V)	See marking label.	P
	- Current (maximum continuous) (d.c. A)	See marking label.	P
	Protective class (I or II or III)	I	P
	Ingress protection (IP) rating per part 1	See marking label.	P
	An inverter that is adjustable for more than one nominal output voltage shall be marked to indicate the particular voltage for which it is set when shipped from the factory.		N/A
5.2	Warning markings		P
5.2.2	Content for warning markings		P
5.2.2.6	Inverters for closed electrical operating areas		N/A
	Where required by 4.8.3.6, an inverter not provided with full protection against shock hazard on the PV array shall be marked with a warning that the inverter is only for use in a closed electrical operating area and referring to the installation instructions.		N/A
5.3	Documentation		P
5.3.2	Information related to installation		P

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
5.3.2.1	Ratings. Subclause 5.3.2 of Part 1 requires the documentation to include ratings information for each input and output. For inverters this information shall be as in Table 33 below. Only those ratings that are applicable based on the type of inverter are required.		P
	PV input quantities:	See user manual	P
	- Vmax PV (absolute maximum) (d.c. V)		P
	- PV input operating voltage range (d.c. V)		P
	- Maximum operating PV input current (d.c. A)		P
	- Isc PV (absolute maximum) (d.c. A)		P
	- Max. inverter backfeed current to the array (a.c. or d.c. A)		P
	a.c. output quantities:		P
	- Voltage (nominal or range) (a.c. V)		P
	- Current (maximum continuous) (a.c. A)		P
	- Current (inrush) (a.c. A, peak and duration)		P
	- Frequency (nominal or range) (Hz)		P
	- Power (maximum continuous) (W or VA)		P
	- Power factor range		P
	- Maximum output fault current (a.c. A, peak and duration or RMS)		P
	- Maximum output overcurrent protection (a.c. A)		P
	a.c. input quantities:		P
	- Voltage (nominal or range) (a.c. V)		P
	- Current (maximum continuous) (a.c. A)		P
	- Current (inrush) (a.c. A, peak and duration)		P
	- Frequency (nominal or range) (Hz)		P
	d.c input (other than PV) quantities:		P
	- Voltage (nominal or range) (d.c. V)		P
	- Nominal battery voltage (d.c. V)		P
	- Current (maximum continuous) (d.c. A)		P
	d.c. output quantities:		P
	- Voltage (nominal or range) (d.c. V)		P
	- Nominal battery voltage (d.c. V)		P
	- Current (maximum continuous) (d.c. A)		P
	Protective class (I or II or III)		P
	Ingress protection (IP) rating per part 1		P

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
5.3.2.2	Grid-interactive inverter setpoints	Non-adjustable to operator, pre-set by manufacture before shipment	N/A
	For a grid-interactive unit with field adjustable trip points, trip times, or reconnect times, the presence of such controls, the means for adjustment, the factory default values, and the limits of the ranges of adjustability shall be provided in the documentation for the PCE or in other format such as on a website. Provided solution: ……		N/A
	The setting of field adjustable setpoints shall be accessible rom the PCE		N/A
5.3.2.3	Transformers and isolation		P
	whether an internal isolation transformer is provided, and if so, what level of insulation (functional, basic, reinforced, or double) is provided by that transformer. The instructions shall also indicate what the resulting installation requirements are regarding such things as earthing or not earthing the array, providing external residual current detection devices, etc.	Non-isolation	P
	An inverter shall be provided with information to the installer regarding:		N/A
	- providing of internal isolation transformer		N/A
	- the level of insulation (functional, basic, reinforced, or double)		N/A
	The instructions shall also indicate what the resulting installation requirements are regarding:		N/A
	- earthing or not earthing the array	Not earthing	P
	- providing external residual current detection devices		N/A
	- requiring an external isolation transformer,		N/A
5.3.2.4	Transformers required but not provided		N/A
	An inverter that requires an external isolation transformer not provided with the unit, shall be provided with instructions that specify, and for the external isolation transformer with which it is intended to be used:		N/A
	- the configuration type		N/A
	- electrical ratings		N/A
	- environmental ratings		N/A
5.3.2.5	PV modules for non-isolated inverters		P
	Non-isolated inverters shall be provided with installation instructions that require PV modules that have an IEC 61730 Class A rating		P

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

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
	- if output circuit bonding is required but is not provided integral to the inverter, the required means shall be described in the installation instructions, including which conductor is to be bonded and the required current carrying capability or cross-section of the bonding means;		P
	- if the output circuit is intended to be floating, the documentation for the inverter shall indicate that the output is floating.		N/A
5.3.2.9	Protection by application of RCD's		N/A
	Where the requirement for additional protection in 4.8.3.1 is met by requiring an RCD that is not provided integral to the inverter, as allowed by 4.8.3.4, the installation instructions shall state the need for the RCD,.		N/A
	and shall specify its rating, type, and required circuit location		N/A
5.3.2.10	Remote indication of faults		P
	The installation instructions shall include an explanation of how to properly make connections to (where applicable), and use, the electrical or electronic fault indication required by 13.9.		P
5.3.2.11	External array insulation resistance measurement and response		N/A
	The installation instructions for an inverter for use with ungrounded arrays that does not incorporate all the aspects of the insulation resistance measurement and response requirements in 4.8.2.1, must include:		N/A
	- for isolated inverters: an explanation of what aspects of array insulation resistance measurement and response are not provided, and		N/A
	- an instruction to consult local regulations to determine if any additional functions are required or not;		N/A
	- for non-isolated inverters: an explanation of what external equipment must be provided in the system, and		N/A
	- what the setpoints and response implemented by that equipment must be, and:		N/A
	- how that equipment is to be interfaced with the rest of the system.		N/A
5.3.2.12	Array functional grounding information		N/A
	Where approach a) of 4.8.2.2 is used, the installation instructions for the inverter shall include all of the following:		N/A
	a) the value of the total resistance between the PV circuit and ground integral to the inverter ……		N/A

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
	b) the minimum array insulation resistance to ground that system designer or installer must meet when selecting the PV panel and system design, based on the minimum value that the design of the PV functional grounding in the inverter was based on ……;		N/A
	c) the minimum value of the total resistance R = VMAX PV/30 mA that the system must meet, with an explanation of how to calculate the total ……;		N/A
	d) a warning that there is a risk of shock hazard if the total minimum resistance requirement is not met.		N/A
5.3.2.13	Stand-alone inverters for dedicated loads		N/A
	Where the approach of 4.7.5.5 is used, the installation instructions for the inverter shall include a warning that the inverter is only to be used with the dedicated load for which it was evaluated, and		N/A
	shall specify the dedicated load.		N/A
5.3.2.14	Identification of firmware version(s)		P
	An inverter utilizing firmware for any protective functions shall provide means to identify the firmware version.		P
	This can be a marking, but the information can also be provided by a display panel, communications port or any other type of user interface…….	The firmware version can be identified.	P
7	Protection against electric shock and energy hazards		P
7.3	Protection against electric shock		P
7.3.10	Additional requirements for stand-alone inverters		P
	One circuit conductor bonded to earth to create a grounded conductor and an earthed system.		P
	The means used to bond the grounded conductor to protective earth provided within the inverter or		P
	as part of the installation		N/A
	If not provided integral to the inverter, the required means shall be described in the installation instructions as per 5.3.2.8.		N/A
	The means used to bond the grounded conductor to protective earth shall comply with the requirements for protective bonding in Part 1,		P

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IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
	If the bond can only ever carry fault currents in stand-alone mode, the maximum current for the bond is determined by the inverter maximum output fault current.		P
	Output circuit bonding arrangements shall ensure that in any mode of operation, the system only has the grounded circuit conductor bonded to earth in one place at a time..		P
	Switching arrangements may be used, in which case the switching device used is to be subjected to the bond impedance test along with the rest of the bonding path		N/A
	Inverters intended to have a circuit conductor bonded to earth shall not impose any normal current on the bond except for leakage current.		P
	Outputs that are intentionally floating with no circuit conductor bonded to ground, must not have any voltages with respect to ground that are a shock hazard in accordance with Clause 7 of Parts 1 and 2.		N/A
	The documentation for the inverter shall indicate that the output is floating as per 5.3.2.8.		N/A
7.3.11	Functionally grounded arrays		N/A
	All PV conductors in a functionally grounded array shall be treated as being live parts with respect to protection against electric shock.		N/A
9	Protection against fire hazards		P
9.3	Short-circuit and overcurrent protection		P
9.3.4	Inverter backfeed current onto the array		P
	The backfeed current testing and documentation requirements in Part 1 apply, including but not limited to the following.		P
	Inverter backfeed current onto the PV array maximum value……..		P
	This inverter backfeed current value shall be provided in the installation instructions regardless of the value of the current, in accordance with Table 33.		N/A
13	Physical requirements		P
13.9	Fault indication		P
	Where this Part 2 requires the inverter to indicate a fault, both of the following shall be provided:		P

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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

IEC 62109-2			
Clause	Requirement – Test	Result – Remark	Verdict
	a) a visible or audible indication, integral to the inverter, and detectable from outside the inverter, and		P
	b) an electrical or electronic indication that can be remotely accessed and used.		P
	The installation instructions shall include information regarding how to properly make connections (where applicable) and use the electrical or electronic means in b) above, in accordance with 5.3.2.10.		P

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4.4.4.15.2	Fault-tolerance of automatic disconnecting means	P	
	Ambient temperature (°C) ..... :	25.3	—
	Power source for EUT: Manufacturer, model/type, output rating ..... :	--	—

No.	Component	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
1.	Relay, K7 for grid relay-L1	S-C	0V	30s	\	\	The fault applied before the unit operation. After applied the fault, the unit cannot operation and the software alarmed “The relay on the network side is faulty”. No output. No hazard. No damage. Can resettable.
2.	Relay, K10 for grid relay-L1	S-C	0V	30s	\	\	Same as above
3.	Relay, K11 for grid relay-L2	S-C	230 Va.c.	30s	\	\	Same as above
4.	Relay, K12 for grid relay-L2	S-C	230 Va.c.	30s	\	\	Same as above
5.	Relay, K13 for grid relay-L3	S-C	230 Va.c.	30s	\	\	Same as above
6.	Relay, K14 for grid relay-L3	S-C	230 Va.c.	30s	\	\	Same as above
7.	Relay, K15 for grid relay-N	S-C	230 Va.c.	30s	\	\	Same as above
8.	Relay, K16 for grid relay-N	S-C	230 Va.c.	30s	\	\	Same as above
Check that the relays fulfil the basic insulation or simple separation based on the PV circuit working voltage.							L distance: Yes N distance: Yes
Each active phase can be switched. (L and N)							Yes
Supplementary information: S-C: short circuit, O-C: open circuit							

4.4.4.16	Stand-alone inverters – Load transfer test						P
Battery / PV			**Back up load**			**Grid**	
P (W)	I(A)	U (V)	P (W)	I(A)	U (V)	P (W)	I(A)	U (V)
15503.9	38.8	399.4	14924.5	21.6 21.4 21.9	230.4	-345	0.5 0.4 0.5	230.2
14	0	399.4	14912.9	21.6 21.4 21.9	230.4	-14914.8	21.6 21.3 21.5	230.3
5192	13.87	399.4	14912.9	21.6 21.5 21.9	230.4	-344	0.5 0.4 0.5	230.2
13	0	399.4	14915.9	21.3 21.4 21.9	230.4	-14913.8	21.5 21.4 21.5	230.3
5187	13.85	399.4	14914.9	21.4 21.5 21.9	230.2	-345	0.5 0.4 0.5	230
11	0	399.4	14912.9	21.6 21.4 21.9	230.3	-14912.8	21.6 21.3 21.5	230.3
Supplementary information: N/A								

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4.4.4.17	Cooling system failure – Blanketing test		P
Model			
	Test condition	PV1: 623.9 Vd.c., 12.0 Ad.c., 7487W PV2: 612.9 Vd.c., 12.2Ad.c., 7478W Battery: 81.5 Vd.c., 0.1 Ad.c, 0 W Load: 230 Va.c., 0Aa.c., 0W Grid: 230 Va.c., 21.6 Aa.c., 14490 w	— — — —
	t_{amb1} (°C)	25.6 °C	—
	t_{amb2} (°C)	25.6 °C	—
	Test duration……..	3 h	

maximum temperature T of part/at:	T (°C)	T_{max} (°C)
Top of enclosure	65.8	90.0
Right of enclosure	54.8	90.0
External heat sink	85.0	90.0
Left of enclosure	63.6	90.0
Front of enclosure	55.6	90.0
Supplementary information: N/A		

4.7.4.2 & 4.7.4.3 & 4.7.4.4&4.7.4.5	Steady state output frequency							P
Model	**BD15KTR-RH3 @ 50Hz**							
PV			Battery port			Back up load		
U (V) d.c.	I (A) d.c.	P (W)	U (V) d.c.	I (A) d.c.	P (W)	P (W) AC	F(Hz)	U (V) AC
619.1	0	0	0	0	0	0	50.000	231.71
619.2	14.13	6283	0	0	0	14875	50.000	230.91
619.1	0	0	0	0	0	0	50.000	231.62
619.2	14.12	6277	0	0	0	14873	50.000	230.91
849.5	0	0	0	0	0	0	50.000	230.65
849.5	18.30	15520	0	0	0	14874	50.000	230.88
849.6	0	0	0	0	0	0	50.000	230.64
849.6	18.27	15519	0	0	0	14874	50.000	230.89
Model	**BD15KTR-RH3 @ 60Hz**							
PV			Battery port			Back up load		
U (V) d.c.	I (A) d.c.	P (W)	U (V) d.c.	I (A) d.c.	P (W)	P (W) AC	F(Hz)	U (V) AC
619.1	0	0	0	0	0	0	60.000	231.72
619.1	14.12	6282	0	0	0	14876	60.000	230.91
619.1	0	0	0	0	0	0	60.000	231.63
619.2	14.12	6277	0	0	0	14874	60.000	230.91
849.4	0	0	0	0	0	0	60.000	230.65
849.5	18.31	15521	0	0	0	14874	60.000	230.88
849.4	0	0	0	0	0	0	60.000	230.64
849.6	18.26	15520	0	0	0	14874	60.000	230.89
supplementary information: sign “+”, means battery charge, “-” means discharge.								

4.7.5.2	Sinusoidal output voltage waveform requirements			P
Model	50Hz, BD15KTR-RH3			
Harmonic. Nr.(U)	P/ P_{rated} : % of rated output power			Limits (% of Fundamental)
	5%	50%	100%	
2	0.050%	0.040%	0.050%	6%
3	0.300%	0.920%	1.100%	6%

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4	0.040%	0.020%	0.030%	6%
5	0.480%	0.640%	0.640%	6%
6	0.030%	0.020%	0.020%	6%
7	0.660%	0.540%	0.490%	6%
8	0.030%	0.010%	0.010%	6%
9	0.160%	0.510%	0.400%	6%
10	0.010%	0.010%	0.010%	6%
11	0.170%	0.480%	0.360%	6%
12	0.020%	0.010%	0.010%	6%
13	0.190%	0.440%	0.340%	6%
14	0.010%	0.010%	0.020%	6%
15	0.150%	0.390%	0.300%	6%
16	0.010%	0.020%	0.010%	6%
17	0.120%	0.350%	0.270%	6%
18	0.010%	0.020%	0.010%	6%
19	0.090%	0.310%	0.260%	6%
20	0.020%	0.010%	0.010%	6%
21	0.080%	0.260%	0.250%	6%
22	0.010%	0.010%	0.010%	6%
23	0.090%	0.220%	0.220%	6%
24	0.010%	0.010%	0.010%	6%
25	0.080%	0.180%	0.200%	6%
26	0.030%	0.010%	0.010%	6%
27	0.190%	0.150%	0.180%	6%
28	0.020%	0.010%	0.010%	6%
29	0.200%	0.140%	0.160%	6%
30	0.020%	0.010%	0.010%	6%
31	0.230%	0.120%	0.130%	6%
32	0.030%	0.010%	0.010%	6%
33	0.190%	0.100%	0.110%	6%
34	0.050%	0.010%	0.010%	6%
35	0.280%	0.090%	0.100%	6%
36	0.020%	0.010%	0.010%	6%
37	0.190%	0.060%	0.070%	6%
38	0.030%	0.010%	0.010%	6%
39	0.180%	0.040%	0.070%	6%
40	0.020%	0.010%	0.010%	6%
THD (2-	1.140%	1.680%	1.670%	10%

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40)				
Supplementary information: N/A				

4.7.5.2	**Sinusoidal output voltage waveform requirements**			P
Model	60Hz, BD15KTR-RH3			
Harmonic. Nr.(U)	P/ P_{rated} : % of rated output power			Limits (% of Fundamental)
	5%	50%	100%	
2	0.040%	0.020%	0.020%	6%
3	0.370%	0.950%	1.200%	6%
4	0.020%	0.010%	0.010%	6%
5	0.530%	0.660%	0.680%	6%
6	0.020%	0.010%	0.020%	6%
7	0.550%	0.560%	0.520%	6%
8	0.010%	0.020%	0.010%	6%
9	0.190%	0.540%	0.420%	6%
10	0.010%	0.010%	0.020%	6%
11	0.180%	0.500%	0.380%	6%
12	0.010%	0.010%	0.010%	6%
13	0.240%	0.470%	0.350%	6%
14	0.020%	0.010%	0.010%	6%
15	0.070%	0.430%	0.310%	6%
16	0.020%	0.010%	0.010%	6%
17	0.080%	0.390%	0.280%	6%
18	0.030%	0.010%	0.010%	6%
19	0.040%	0.350%	0.270%	6%
20	0.030%	0.010%	0.010%	6%
21	0.210%	0.290%	0.250%	6%
22	0.040%	0.010%	0.010%	6%
23	0.200%	0.240%	0.220%	6%
24	0.040%	0.010%	0.010%	6%
25	0.250%	0.190%	0.190%	6%
26	0.050%	0.010%	0.010%	6%
27	0.400%	0.140%	0.160%	6%
28	0.050%	0.010%	0.010%	6%
29	0.280%	0.110%	0.140%	6%
30	0.040%	0.010%	0.010%	6%
31	0.230%	0.060%	0.110%	6%
32	0.050%	0.010%	0.010%	6%

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33	0.230%	0.040%	0.090%	6%
34	0.040%	0.010%	0.010%	6%
35	0.170%	0.030%	0.070%	6%
36	0.030%	0.010%	0.010%	6%
37	0.130%	0.020%	0.050%	6%
38	0.020%	0.010%	0.010%	6%
39	0.100%	0.010%	0.050%	6%
40	0.020%	0.010%	0.010%	6%
THD (2-40)	1.190%	1.760%	1.770%	10%
Supplementary information: N/A				

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

DC Voltage below minimum operating voltage (V)	DC Voltage for inverter begin operation (V)	Resistance between ground and PV input terminal (Ω)	Required Insulation resistance R = (V_{MAX} PV / 30mA) (Ω)	Result
PV+, (tracker 1)				
180	825	19.8 KΩ	19.74 KΩ (Default setting:34 KΩ)	The fault applied before the unit operation. After applied the fault, the unit cannot operation and the software alarmed “27 & 37 ”. No output and the panel red light flashing. No hazard. No damage. Can resettable.
PV-, (tracker 1)				
180	825	19.8 KΩ	19.73 KΩ (Default setting:34 KΩ)	The fault applied before the unit operation. After applied the fault, the unit cannot operation and the software alarmed “27 & 37 ”. No output and the panel red light flashing. No hazard. No damage. Can resettable.

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Telefax : +86 20 38320478

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5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China

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:

The manufacturer's default setting is 34 kΩ.
As the tracker of PV1 negative and PV2 negative are in parallel internal, only test the PV1 negative.

4.8.3.5	**TABLE: Protection by residual current monitoring**								P
Test conditions:	See below								
4.8.3.5.2	Test for detection of excessive continuous residual current								P
Tracker No.	PV (+ or -)	Input (Vd.c.)	Output (Va.c., kW)	Baseline trigger current (mA)	Measured trigger time (ms), shall < 300 ms (Repeat 5 times)				
PV1	+	630	230,10	250	58.0	54.0	50.0	52.0	60.0
PV1	-	630	230,10	250	53.0	60.0	58.0	57.0	69.0

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 300 ms. 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:

1. All above test doesn't connect to grid until the fault are excluded.
2. Trip settings by designer
3. All above tests indicate a fault in accordance with clause 13.9.
4. Trip current settings is 250 mA for both PV+ and PV- with respect to PE.
5. As the tracker of PV1 negative and PV2 negative are short circuit internal, only test the PV1 negative.

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4.8.3.5	TABLE: Protection by residual current monitoring	P
Test conditions:	See below	
4.8.3.5.3	TABLE: Test for detection of sudden changes in residual current	P

Tracker No.	PV (+ or -)	Input (Vd.c.)	Output (Va.c., kW)	Baseline trigger current (mA)	Measured trigger time (ms), shall < 300 ms for (30 mA); <150 ms for (60 mA); <40 ms for (150 mA) (repeat 5 times)				
30 mA sudden changes in residual current									
PV1	+	621.7	230.5/10.5	250	214.0	230.0	228.0	218.0	216.0
PV1	-	623.5	238.6/10.5	250	218.0	216.0	215.0	224.0	222.0
60 mA sudden changes in residual current									
PV1	+	626.6	230.6/10.6	250	96.0	97.0	93.0	93.0	90.0
PV1	-	627.9	237.9/10.6	250	109.0	95.0	93.0	96.0	103.0
150 mA sudden changes in residual current									
PV1	+	624.4	229.9/10.5	150	32.8	33.0	32.4	31.4	30.4
PV1	-	627.6	232.4/10.6	150	35.0	31.8	32.6	30.2	35.2

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:

1. All above tests indicate a fault in accordance with clause 13.9.
2. As the tracker of PV1 negative and PV2 negative are short circuit internal, only test the PV1 negative.
3. Trip settings by designer

…….…….. End of test report……..

Telephone : +86 20 38320668
Telefax : +86 20 38320478

http://www.tuv-sud.cn

TÜV SÜD Certification and Testing (China) Co., Ltd.
Guangzhou Branch, TÜV SÜD Group
5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West,Guangzhou, 510656, P.R.China