<table>
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TEST REPORT
IEC 62109-2
Safety of Power Converter for use in Photovoltaic Power Systems
Part 2: Particular requirements for inverters
</td></tr>
</table>

Report Number. .... :	130918053GZU-005
Date of issue .... :	10 Jan., 2014
Total number of pages	24 pages

Applicant's name.............................. :	Shenzhen SOFARSOLAR Co., Ltd.
Address .... :	3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China

Test specification:	
Standard.. :	IEC/EN 62109-2:2011 (First Edition)
Test procedure................................. :	SAA
Non-standard test method…………..:	N/A

Test Report Form No. .... :	IEC62109_2A
Test Report Form(s) Originator........ :	LCIE - Laboratoire Central des Industries Electriques
Master TRF .... :	Dated 2012-02

Test item description .... :	Grid-connected PV inverter
Trade Mark .... :	S⊘FAR SOLAR
Manufacturer .... :	Same as applicant
Model/Type reference .... :	Sofar 20000TL-Sx, Sofar 17000TL-Sx, Sofar 15000TL-Sx, Sofar 10000TL-Sx (x=0-6)
Ratings .... :	Maximum d.c. input voltage: 1000 V
	Input voltage rang: 250-960 V
	Max. input current: 2×24 A (for Sofar 20000TL-Sx); 2×21 A (for Sofar 17000TL-Sx, Sofar 15000TL-Sx); 2×15 A (for Sofar 10000TL-Sx)
	Max. PV Isc: 2×30 A (for Sofar 20000TL-Sx); 2×27 A (for Sofar 17000TL-Sx, Sofar 15000TL-Sx); 2×20 A (for Sofar 10000TL-Sx)
	Nominal output voltage: 3/N/PE230V/400V
	Max. output current: 3×29 A (for Sofar 20000TL-Sx); 3×25 A (for Sofar 17000TL-Sx); 3×22 A (for Sofar 15000TL-Sx); 3×15 A (for Sofar 10000TL-Sx)
	Nominal frequency: 50 Hz
	Max. output power: 20000 W (for Sofar 20000TL-Sx); 17000 W (for Sofar 17000TL-Sx); 15000 W (for Sofar 15000TL-Sx); 10000 W (for Sofar 10000TL-Sx)
	Ingress protection: IP65
	Operating temperature range: -25～60℃

Testing procedure and testing location:			
☒	Testing Laboratory:	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch	
Testing location/ address............................:		Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD, Guangzhou, China	
Tested by (name + signature)..............:		Tommy Zhong	
Approved by (name + signature).........:		Grady Ye	

☐	Testing procedure: TMP	N/A	
Testing location/ address............................:		N/A	
Tested by (name + signature)..............:		N/A	
Approved by (name + signature).........:		N/A	

☐	Testing procedure: WMT	N/A	
Testing location/ address............................:		N/A	
Tested by (name + signature)..............:		N/A	
Witnessed by (name + signature).......:		N/A	
Approved by (name + signature).........:		N/A	

☐	Testing procedure: SMT	N/A	
Testing location/ address............................:		N/A	
Tested by (name + signature)..............:		N/A	
Approved by (name + signature).........:		N/A	
Supervised by (name + signature).......:		N/A	

TRF No. IEC62109_2A

Summary of testing:	
Tests performed (name of test and test clause): All applicable tests	Testing location: Intertek Testing Services Shenzhen Ltd. Guangzhou Branch Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD, Guangzhou, China
Summary of compliance with National Differences N/A	

Copy of marking plate:

SOFAR SOLAR
Solar Inverter   Sofar 20000TL-S0

Maximum d.c. input voltage	1000V
DC voltage range	250-960V
Max. input current	2*24A
Maximum PV I_{sc}	2*30A
Nominal output voltage	3/N/PE230V/400V
Max. output current	3*29A
Nominal frequency	50Hz
Max. output power	20000W
Power factor	>0.99(adjustable)
Ingress protection	IP65
Operating temperature range	-25-+60°C
Protective class	Class I

Manufacturer: Shenzhen SOFARSOLAR Co.,Ltd

Made in China

SOFAR SOLAR
Solar Inverter   Sofar 17000TL-S0

Maximum d.c. input voltage	1000V
DC voltage range	250-960V
Max. input current	2*21A
Maximum PV I_{sc}	2*27A
Nominal output voltage	3/N/PE230V/400V
Max. output current	3*25A
Nominal frequency	50Hz
Max. output power	17000W
Power factor	>0.99(adjustable)
Ingress protection	IP65
Operating temperature range	-25-+60°C
Protective class	Class I

Manufacturer: Shenzhen SOFARSOLAR Co.,Ltd

Made in China

SOFAR SOLAR
Solar Inverter   Sofar 15000TL-S0

Maximum d.c. input voltage	1000V
DC voltage range	250-960V
Max. input current	2*21A
Maximum PV I_{sc}	2*27A
Nominal output voltage	3/N/PE230V/400V
Max. output current	3*22A
Nominal frequency	50Hz
Max. output power	15000W
Power factor	>0.99(adjustable)
Ingress protection	IP65
Operating temperature range	-25-+60°C
Protective class	Class I

Manufacturer: Shenzhen SOFARSOLAR Co.,Ltd

Made in China

SOFAR SOLAR
Solar Inverter   Sofar 10000TL-S0

Maximum d.c. input voltage	1000V
DC voltage range	250-960V
Max. input current	2*15A
Maximum PV I_{sc}	2*20A
Nominal output voltage	3/N/PE230V/400V
Max. output current	3*15A
Nominal frequency	50Hz
Max. output power	10000W
Power factor	>0.99(adjustable)
Ingress protection	IP65
Operating temperature range	-25-+60°C
Protective class	Class I

Manufacturer: Shenzhen SOFARSOLAR Co.,Ltd

Made in China

S/N
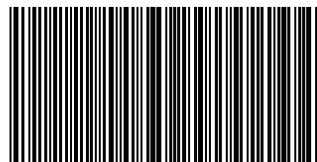
9990123456789

Note:
1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation.

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 ☐ indoor unconditional 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 (%) .... :	-90 / +110 %
Tested for power systems .... :	TN systems
IT testing, phase-phase voltage (V) .... :	N/A
Class of equipment .... :	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mass of equipment (kg) .... :	46
Pollution degree .... :	Outside PD3; Inside PD2
IP protection class.. :	IP 65
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 does not meet the requirement .... :	F (Fail)
Testing... :	
Date of receipt of test item........................... :	18 Sep., 2013
Date (s) of performance of tests................................... :	05 Nov., 2013 – 30 Dec., 2013
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:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(see Enclosure #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

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

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

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The test report only allows to be revised only within the report defined retention period unless standard or regulation was withdrawn or invalid.

This report shall be used together with the report 130918053GZU-004.

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

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided .... :	☐ Yes ☒ Not applicable

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

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

Suga Networks Equipment (Shenzhen) Co., Ltd.
Floor 1 East & Floor 2 of Building B(Manufacturing Site), Floor 3 & 4 of Building A(Office Site), Block 12, Xi Cheng Industrial Park, Xi Xiang Street, BaoAn District, Shenzhen City, China

General product information:

Product covered by this report is grid-connected PV inverter for indoor or outdoor installation. The connection to the DC input and AC output are through connectors. The structure of the unit complied with the IP 65 requirement.

The inverters intended to operate at ambient temperature -25℃ - +60℃ and 250-960 Vdc input, which will be specified in the user manual, The inverters will output full power when operated at 45℃. If operated at higher than 45℃ temperature, the output power derating.

For all models, if the DC input voltage is higher than 850 Vdc the output power will be derating.
For model Sofar 20000TL-Sx, if the DC input voltage is lower than 430 Vdc, the output power will be derating.
For model Sofar 17000TL-Sx, if the DC input voltage is lower than 420 Vdc, the output power will be derating.
For model Sofar 15000TL-Sx, if the DC input voltage is lower than 370 Vdc, the output power will be derating.
For model Sofar 10000TL-Sx, if the DC input voltage is lower than 350 Vdc, the output power will be derating.

For all models, if the AC output voltage is lower than 230 Vac the output current will be limited to not higher than rated output current.

All the models have identical mechanical and electrical construction except some componnents and some parameter of the software architecture in order to control the max output power. And refer to the following table for detail.

Model	DC Cable Gland	PV connector	DC inside connector	Fuse PCB+ String detection board	DC surge arrester	DC switch	AC switch	AC surge arrester
Sofar 20000TL-S0 Sofar 17000TL-S0 Sofar 15000TL-S0 Sofar 10000TL-S0	√		√					
Sofar 20000TL-S1 Sofar 17000TL-S1 Sofar 15000TL-S1 Sofar 10000TL-S1	√		√			√		
Sofar 20000TL-S2 Sofar 17000TL-S2 Sofar 15000TL-S2 Sofar 10000TL-S2		√	√			√		
Sofar 20000TL-S3 Sofar 17000TL-S3 Sofar 15000TL-S3 Sofar 10000TL-S3		√		√		√		
Sofar 20000TL-S4 Sofar 17000TL-S4 Sofar 15000TL-S4 Sofar 10000TL-S4		√		√	√	√		
Sofar 20000TL-S5 Sofar 17000TL-S5 Sofar 15000TL-S5		√		√	√	√		√

Sofar 10000TL-S5							
Sofar 20000TL-S6 Sofar 17000TL-S6 Sofar 15000TL-S6 Sofar 10000TL-S6	√		√	√	√	√	√

√ denote incorporating this component

	Sofar 20000TL-Sx	Sofar 17000TL-Sx	Sofar 15000TL-Sx	Sofar 10000TL-Sx
PV connector (pair)	3×2	3×2	2×2	2×2
Boost chock	1800 µH	2100 µH	2100 µH	3000 µH
Boost IGBT (Q19, Q20, Q28, Q29)	2×2 parallel	2×2 parallel	2×2 parallel	2×1
Boost diode (D19, D20, D24, D25)	2×2 parallel	2×2 parallel	2×2 parallel	2×1
Input current sampling resistor (REA79, REA71, REA81, REA73)	15 kΩ	15 kΩ	15 kΩ	10 kΩ
Bus capacitor (CD1, CD2, CD3, CD4, CD5, CD6, CD7, CD8, CD39, CD40)	10 units	8 units	6 units	4 units
Boost capacitor (CA129, CA131, CA145, CA148)	4 units	4 units	3 units	2 units
Inverter chock	730 µH	850 µH	960 µH	1460 µH
IGBT module (QD1, QD2, QD3)	10-FZ12NMA080SH01-M260F DS_F3L80R12W1H3_B11	10-FZ12NMA080SH01-M260F DS_F3L80R12W1H3_B11	10-FZ12NMA080SH01-M260F DS_F3L80R12W1H3_B11 10-FZ12NMA040SH-M267F	10-FZ12NMA080SH01-M260F DS_F3L80R12W1H3_B11 10-FZ12NMA040SH-M267F
Input current sampling resistor (RB46, RB52, RB79, RB81, RB95, RB58)	2,7 kΩ	2,7 kΩ	2,7 kΩ	1,5 kΩ

Other than special notice, the model Sofar 20000TL-S6 is as the representative test model in this report.

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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	(See attached table)	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		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		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 separation is maintained between the PV array and the mains when the disconnecting means is intended to be in the open state.	There are two relays in serial used as automatic disconnection means. Contact gap is >1,5 mm for each relay.	P
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.	The automatic disconnection means is automatically checked before the inverter start operation	P
4.4.4.15.2.3	For non-isolated inverter, automatic checking of the isolation provided by a disconnect means after single fault.		P
	If the check fail: - any still-functional disconnection means shall be left in the open position		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- 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	Indicate "ID55" on display board	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:	Not stand alone inverter	N/A
	- shall continue to operate normally		N/A
	- shall not present a risk of fire as the result of an out-of-phase transfer		N/A
	- shall not present a risk of shock as the result of an out-of-phase transfer		N/A
	- And having control preventing switching: components for malfunctioning ……….…..:		N/A
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		N/A
4.7.4	Stand-alone Inverter AC output voltage and frequency		N/A
4.7.4.1	General		N/A
4.7.4.2	Steady state output voltage at nominal DC input 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.	Not stand-alone inverter	N/A
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.		N/A
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.		N/A
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 %.		N/A
4.7.5	Stand-alone inverter output voltage waveform		N/A
4.7.5.1	General		N/A
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 %.	Not stand-alone inverter	N/A
4.7.5.3	Non-sinusoidal output waveform requirements	Sinusoidal output wave form	N/A
4.7.5.3.1	General		N/A
4.7.5.3.2	The total harmonic distortion (THD) of the voltage		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	waveform shall not exceed 40 %.		
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
	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		P
	- Type of Array grounding supported ………:	Ungrounded	P
	- Inverter isolation …………………………:	Non- isolated	P
4.8.2	Array insulation resistance detection for inverters for ungrounded and functionally grounded arrays	(See attached table)	P
4.8.2.1	Array insulation resistance detection for inverters for ungrounded arrays		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.	The inverter can measure DC insulation resistance from PV input array to ground before starting operation	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		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		P
	Isolated inverters shall indicate a fault if the insulation resistance is less than the limit value		P

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Clause	Requirement + Test	Result - Remark	Verdict
	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:		N/A
	- shall indicate a fault in accordance with 13.9		N/A
	- shall not connect to the mains		N/A
4.8.2.2	Array insulation resistance detection for inverters for functionally grounded arrays	Not for functionally grounded arrays	N/A
	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	Integrated RCM inside PCE	P
4.8.3.2	30 mA touch current type test for isolated inverters		N/A
4.8.3.3	Fire hazard residual current type test for isolated inverters		N/A
4.8.3.4	Protection by application of RCD's	Integrated RCM inside PCE	P
	- 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..		P
	- The selection of the RCD type to ensure compatibility with the inverter must be made according to rules for RCD selection in Part 1.		P
	- The RCD provided integral to the inverter, or		P
	- 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
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		P

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Clause	Requirement + Test	Result - Remark	Verdict
	inverter is connected to the mains with the automatic disconnection means closed.		
	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.	Can not re-connected	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.	Can not re-connected	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 attached 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	Not located in such 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 integral to the inverter, in accordance with 5.3.2.7.		N/A
	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:	Refer to page 5	P
	- Vmax PV (absolute maximum) (d.c. V)	Refer to page 5	P
	- Isc PV (absolute maximum) (d.c. A)	Refer to page 5	P
	a.c. output ratings:	Refer to page 5	P

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Clause	Requirement + Test	Result - Remark	Verdict
	- Voltage (nominal or range) (a.c. V)	Refer to page 5	P
	- Current (maximum continuous) (a.c. A)	Refer to page 5	P
	- Frequency (nominal or range) (Hz)	Refer to page 5	P
	- Power (maximum continuous) (W or VA)	Refer to page 5	P
	- Power factor range	Refer to page 5	P
	a.c input ratings:		N/A
	- Voltage (nominal or range) (a.c. V)		N/A
	- Current (maximum continuous) (a.c. A)		N/A
	- Frequency (nominal or range) (Hz)		N/A
	d.c. output ratings:		N/A
	- Voltage (nominal or range) (d.c. V)		N/A
	- Current (maximum continuous) (d.c. A)		N/A
	Protective class (I or II or III)	Refer to page 5	P
	Ingress protection (IP) rating per part 1	Refer to page 5	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.		P
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.	Not for such areas	N/A
5.3	Documentation		P
5.3.2	Information related to installation		P
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 :		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
	- 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:		N/A
	- Voltage (nominal or range) (a.c. V)		N/A
	- Current (maximum continuous) (a.c. A)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	- Current (inrush) (a.c. A, peak and duration)		N/A
	- Frequency (nominal or range) (Hz)		N/A
	d.c input (other than PV) quantities:		N/A
	- Voltage (nominal or range) (d.c. V)		N/A
	- Nominal battery voltage (d.c. V)		N/A
	- Current (maximum continuous) (d.c. A)		N/A
	d.c. output quantities:		N/A
	- Voltage (nominal or range) (d.c. V)		N/A
	- Nominal battery voltage (d.c. V)		N/A
	- Current (maximum continuous) (d.c. A)		N/A
	Protective class (I or II or III)		P
	Ingress protection (IP) rating per part 1		P
5.3.2.2	Grid-interactive inverter setpoints		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: ……………………………………	Not with field adjustable trip points	N/A
	The setting of field adjustable setpoints shall be accessible rom the PCE		N/A
5.3.2.3	Transformers and isolation		N/A
	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.		N/A
	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		N/A
	- 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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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.		P
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		N/A
	Where required by 7.3.10, the documentation for an inverter shall include the following:		N/A
	-　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;		N/A
	-　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	Integrated RCM used inside	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		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	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.		N/A
5.3.2.11	External array insulation resistance measurement and response	Integrated resistance measurement inside	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
	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)		N/A
	An inverter utilizing firmware for any protective functions shall provide means to identify the firmware version.		N/A
	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……………………		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
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		N/A
	One circuit conductor bonded to earth to create a grounded conductor and an earthed system.	Grid-interactive	N/A
	The means used to bond the grounded conductor to protective earth provided within the inverter or		N/A
	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,		N/A
	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.		N/A
	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..		N/A
	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.		N/A
	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…………………………………….……	0 mA	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.		P
13	Physical requirements		P
13.9	Fault indication		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Where this Part 2 requires the inverter to indicate a fault, both of the following shall be provided:		P
	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.	Refer to installation instructions	P

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Clause	Requirement + Test	Result - Remark	Verdict

4.4.4	TABLE: Single fault condition to be applied					P
	Ambient temperature (°C) ....:		25			—
	Power source for EUT: Manufacturer, model/type, output rating ....:		--			—
4.4.4.15.1	Fault-tolerance of residual current monitoring					

Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
CB18	S/C	Input: 850 Vdc Output: 230 Vac	1 s	--	--	Display "ID20" and can not start up.

4.4.4	TABLE: Single fault condition to be applied					P
	Ambient temperature (°C) ....:		25			—
4.4.4.15.2	Fault-tolerance of automatic disconnecting means					

Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
One output relay	S/C	Input: 850 Vdc; Output: 230 Vac	1 s	--	--	Display "ID55" and can not connect to the grid.

Supplementary information: --

4.4.4.17	Cooling system fainlure – Blanketing test		P
	Test voltage (Vdc) .... :	430 Vdc	—
	Test voltage (Vac) .... :	230 Vac	—

maximum temperature T of part/at::	T (°C)	T_{max} (°C)
Ambient temp.	26,8	--
Front of the enclosure	83,2	--
Side of the enclosure	74,8	--
Back of the enclosure	89,5	--

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Clause	Requirement + Test	Result - Remark	Verdict

4.7.4	TABLE: Steady state Inverter AC output voltage and frequency		N/A
	Nominal DC input (V) Nominal output AC voltage (V) :	--	
AC output U (V)	Frequency (Hz)	Condition/status	Comments
--	--	--	--
Supplementary information:			

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		

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
DC+				
332	350	30 k	33,3 k	Indicated "ID56" and can not start up"
DC-				
332	350	30 k	33,3 k	Indicated "ID56" and can not start up"

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:

4.8.3.4	TABLE: 30mA touch current type test for isolated inverters		N/A
Condition		Current (mA)	Limit (30mA)
--		--	--
Supplementary information:N/A			

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Clause	Requirement + Test	Result - Remark	Verdict

4.8.3.3	TABLE: Fire hazard residual current type test for isolated inverters		N/A
Condition		Current (mA)	Limit (300mA or 10mA per kVA)
--		--	--
Supplementary information: N/A			

4.8.3.5	TABLE: Protection by residual current monitoring		P
Test conditions:	Output power (W) : 20000 W Input voltage (V_{DC}): 850 Vdc Frequency (Hz): 50 Hz Output AC Voltage (V_{AC}): 230 Vac		
4.8.3.5.2	Test for detection of excessive continuous residual current		

Fault Current (mA)		Disconnection time (ms)	
Measured Fault Current	Limit 300mA for output power ≤ 30 kVA 10mA per kVA for output power > 30 kVA	Measured Disconnection time	Limit
+ PV to N:			
247	300	251,5	300
245	300	252,0	300
253	300	261,5	300
248	300	248,5	300
256	300	265,0	300
- PV to N:			
252	300	255,2	300
255	300	270,0	300
257	300	267,0	300
247	300	259,0	300
242	300	250,5	300

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

Supplementary information: --

4.8.3.5.3	TABLE: Test for detection of sudden changes in residual current		P
+PV to N			
Limit (mA)	U_N		Limit

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Clause	Requirement + Test	Result - Remark	Verdict

Disconnection time (ms)		(ms)
30	207,0	300
30	248,0	300
30	223,5	300
30	200,5	300
30	227,5	300
60	130,0	150
60	121,0	150
60	137,0	150
60	109,5	150
60	126,5	150
150	30,6	40
150	32,4	40
150	30,0	40
150	23,4	40
150	34,2	40

-PV to N		
Limit (mA)	U_N	Limit (ms)
	Disconnection time (ms)	
30	238,0	300
30	246,0	300
30	254,0	300
30	248,0	300
30	212,0	300
60	141,5	150
60	130,0	150
60	124,0	150
60	136,0	150
60	125,0	150
150	32,8	40
150	33,0	40
150	27,7	40
150	35,4	40
150	36,0	40

Note:
The capacitive current is risen until disconnection.
Test condition: I_c + 30/60/150mA <= I_{cmax}. R_1 is set that 30/60/150mA Flow and switch S is closed.

(End of the report)