

**TEST REPORT**  
**IEC 62116 2nd ed.**

**Test procedure of islanding prevention measures for  
Utility-interconnected photovoltaic inverters**

**Report Reference No.** .....: 160429138GZU-003  
**Tested by (name + signature)**.....: Tommy Zhong  
**Approved by (name + signature)** .....: Grady Ye  
**Date of issue**.....: 31 May, 2016  
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**CB Testing Laboratory** .....: Intertek Testing Services Shenzhen Ltd. Guangzhou Branch  
**Address**.....: Block E, No.7-2 Guang Dong Software Science Park, Caipin Road,  
Guangzhou Science City, GETDD, Guangzhou, China  
**Testing location / procedure** .....: CBTL  SMT  TMP  TL   
**Testing location / address**.....: Same as above


**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 62116 2<sup>nd</sup> ed. 2014-02  
**Test procedure**.....: Type test  
**Non-standard test method**.....: N/A


**Test Report Form No.** .....: IEC62116\_2ed\_b  
**TTRF Originator**.....: Intertek  
**Master TRRF** .....: Dated 2014-03

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<b>Test item description</b> .....	Solar Inverter
Trade Mark .....	
Manufacturer.....	Same as applicant
Model/Type reference.....	Sofar 3000TL, Sofar 2700TL, Sofar 2200TL, Sofar 1600TL, Sofar 1100TL
Ratings DC input .....	Input voltage rang: 100-500 V (for Sofar 3000TL, Sofar 2700TL, Sofar 2200TL); 90-450 V (for Sofar 1600TL, Sofar 1100TL) MPPT voltage range with full power output: 230-500 V (for Sofar 3000TL); 200-500 V (for Sofar 2700TL); 170-500 V (for Sofar 2200TL); 165-450 V (for Sofar 1600TL); 110-450 V (for Sofar 1100TL) Max. input current: 13 A (for Sofar 3000TL, Sofar 2700TL, Sofar 2200TL); 10 A (for Sofar 1600TL, Sofar 1100TL)
Ratings AC Output.....	Nominal output voltage: 230 V Max. output current: 13 A (for Sofar 3000TL); 11.5 A (for Sofar 2700TL); 9.5 A (for Sofar 2200TL); 7 A (for Sofar 1600TL); 4.5 A (for Sofar 1100TL) Nominal frequency: 50 Hz Max. output power: 2800 W (for Sofar 3000TL); 2500 W (for Sofar 2700TL); 2000 W (for Sofar 2200TL); 1500 W (for Sofar 1600TL); 1000 W (for Sofar 1100TL) Ingress protection: IP65 Operating temperature range: -25~60°C
Software version.....	V3.10

## Copy of marking plate:

		PV Inverter 光伏逆变器
Model No.(产品型号):	SOFAR 3000TL	
Vmax. DC input voltage(最大直流输入电压):	500V	
DC input voltage range(输入直流电压范围):	100-500V	
Imax. DC input current(最大直流输入电流):	13A	
Isc(max.) DC current(最大直流短路电流):	15A	
Nominal grid voltage(额定电网电压):	230V~	
Nominal AC output current(额定输出电流):	13A	
Nominal grid frequency(额定电网频率):	50Hz	
Nominal output power(额定输出功率):	2920W	
Power factor(功率因数):	1(adjustable+/-0.8)	
Ingress protection(保护等级):	IP65	
Operating temperature range(工作温度):	-25-+60°C	
Protective class(保护类别):	Class I	
Made in China(中国制造)		
Manufacturer: Shenzhen SOFARSOLAR Co., Ltd. 制造商: 深圳市首航新能源有限公司		
VDE0126-1-1,VDE-AR-N 4105,G83/2,EN50438, C10/11,AS4777,RD1699,UTE C15-712-1		
		

## 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.
3. Labels of the other models are same as above except of the model name and parameters of rating.

## Summary of testing:

The sample(s) tested complied with the type test requirement of IEC 62116 2<sup>nd</sup> ed. 2014-02

<b>Test item particulars</b> ..... :	
Classification of installation and use..... :	Fixed and outdoor use
Supply Connection..... :	Permanent connection
..... :	
..... :	
<b>Possible test case verdicts:</b>	
- 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)
<b>Testing</b> ..... :	
Date of receipt of test item..... :	29 Apr., 2016
Date (s) of performance of tests..... :	24 May, 2016 – 25 May, 2016
<b>General remarks:</b>	
<b>This report is not valid as a CB Test Report</b>	
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.	
When determining for test conclusion, measurement uncertainty of tests has been considered. This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program. The test report only allows to be revised only within the report defined retention period unless standard or regulation was withdrawn or invalid.	
"(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 point is used as the decimal separator.	

**General product information:**

1. Product covered by this report is non-isolated grid-connected PV inverter for connection with low voltage grid.
2. The inverters intended to operate at ambient temperature  $-25^{\circ}\text{C}$  -  $+60^{\circ}\text{C}$ , which will be specified in the user manual. The inverters will output full power when operated at  $45^{\circ}\text{C}$ . If operated at higher than  $45^{\circ}\text{C}$  temperature, the output power derating.

For model Sofar 3000TL, if the DC input voltage out of 230-500 Vdc, the output power will be derating.  
For model Sofar 2700TL, if the DC input voltage out of 200-500 Vdc, the output power will be derating.  
For model Sofar 2200TL, if the DC input voltage out of 170-500 Vdc, the output power will be derating.  
For model Sofar 1600TL, if the DC input voltage out of 165-450 Vdc, the output power will be derating.  
For model Sofar 1100TL, if the DC input voltage out of 110-450 Vdc, the output power will be derating.

**Model difference:**

All the models have identical mechanical and electrical construction except some components and some parameter of the software architecture in order to control the max output power.

Unless other special note, the model Sofar 3000TL was selected as representative sample for testing.

**Factory information:**

Factory: Dongguan dingqiang Machinery & Electric Co., Ltd.  
Address: No. 8, Fulong road, Qingxi town, Dongguan city, Guangdong, China

IEC62116			
Cl.	Requirement - Test	Result	Verdict
<b>5</b>	<b>Testing equipment</b>		<b>P</b>
5.1	<b>Measuring instruments</b>		P
	Waveform observation shall be measured by a device with memory function	Agilent oscillograph equipped with memory function	P
	The waveform measurement/capture device shall be able to record the waveform from the beginning of the islanding test until the EUT ceases to energize the island.	Waveform caught from the switch open and the EUT cease to energize	P
	For multi-phase EUT, all phases shall be monitored.		P
	The minimum measurement accuracy shall be 1 % or less of rated EUT nominal output voltage		P
	1 % or less of rated EUT output current, real power and reactive power measurements through switch S1 used to determined the circuit balance condition	Less than 1% of the rated EUT output current	P
5.2	<b>DC power source</b>		P
5.2.1	DC power source shall provide voltage and current necessary to meet the testing requirement described in Clause 6	Topcon PV simulator used	P
5.2.2	PV array simulator		P
	The test shall be conducted at the input voltage defined in Table 2		P
	And the current shall be limited to 1.5 times the rated photovoltaic input current		P
	Except when specified otherwise by the test requirements		P
5.2.3	Current and voltage limited DC power supply with series resistance		N/A
	DC power source used as the EUT input source shall be capable of EUT maximum input power at minimum and maximum EUT input operating voltage		N/A
	Power source should provide adjustable current and voltage limit, set to provide the desired short circuit current and open circuit voltage when combined with the series and shunt resistance.		N/A
5.2.4	PV array		N/A
	EUT input source shall be capable of EUT maximum input power at minimum and maximum EUT operating voltage		N/A

IEC62116			
Cl.	Requirement - Test	Result	Verdict
	Testing is limited to times when the irradiance varies by no more than 2 % over the duration of the test as measured by a silicon type pyranometer or reference device		N/A
5.3	<b>AC power source</b>		P
	The utility grid or other AC power source may be used as long as it meets the condition specified in table 4.		P
5.4	<b>AC loads</b>		P
	Non-inductive resistors, low loss inductors, and capacitors with low effective series resistance and effective series inductance shall be utilized in the test circuit		P
	Iron core inductors if used, shall not exceed a current THD of 2% when operated at nominal voltage.		P
	Resistor power ratings should be chosen so as to minimize thermally-induced drift in resistance values during the course of the test		P
6	<b>Test for single or multi-phase inverter</b>		P
6.1	Test procedure		P
	This test shall be performed with the EUT conditions as in Table 5		P
6.1a	Determine EUT test output power $P_{EUT}$ , to be used from table 5. Test conditions A, B, and C may be performed in any order convenient to testing		P
6.1b	By adjusting the DC input source, operate the EUT at the selected $P_{EUT}$ and measure EUT reactive power, $Q_{EUT}$		P
	The utility disconnect switch S1 should be closed.		P
	With no local load connected (that is S2 open so that the RLC load is not connected at this time), and the EUT connected to the utility (S1 is closed),		P
	Turn the EUT on and operate it at the output determined in step a.		P
	Measure the fundamental frequency (50 or 60Hz) real and reactive power flow, $P_{AC}$ and $Q_{AC}$ .		P
	The real power should equal $P_{AC}$ . The reactive power $Q_{AC}$ measured in this step is designated $Q_{EUT}$		P
6.1c	Turn off the EUT and open S1		P

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Cl.	Requirement - Test	Result	Verdict
6.1d	Adjust the RLC circuit to have $Q_f = 1,0 \pm 0,05$		P
6.1e	Connect the RLC load configured in step d to the EUT by closing S2		P
	Close S1 and turn the EUT on, making certain that the power output is as determined in step a		P
	Adjust R, L and C as necessary to ensure that the fundamental (50 Hz or 60 Hz) component of current $I_{AC}$ through S1 is 0,0A with tolerance of $\pm 1\%$ of the rated current of the EUT on a steady state basis in each phase		P
6.1f	Open the utility-disconnect switch S1 to initiate the test. Run-on time, $t_R$ shall be recorded as the time between the opening of switch s1 and the point at which the EUT output current drops and remains below 1% of its rated output levels.		P
6.1g	For test condition A in Table 5 (100%), adjust the real load and only one of the reactive load components (either capacitance C, or inductance L) to each of the load imbalance conditions shown in the shaded portion of table 6.		P
	After each adjustment, an island test is run and run-on time is recorded		P
	If any of the recorded run-on times are longer than the one recorded for the rated balance condition (i.e. test f)		P
	Then, the non-shaded parameter combinations also require testing.		P
	If no run-on time exceeds the one of balance condition, then this part of test sequence is deemed be completed.		P
6.1h	For test conditions B and C, adjust the only one reactive load components (either capacitance C or inductance L may be chosen) by approximately 1% per test, with a total range of 95% to 105% of the operating point as shown in table 7.		P
	After each adjustment, an island test is run and run-on time is recorded.		P
	If run-on times are still increasing at the 95% or 105% points, additional 1% increments shall be taken until run-on times begin decreasing.		P



IEC62116			
Cl.	Requirement - Test	Result	Verdict
6.2	<b>Pass/fail criteria</b>		P
	An EUT is considered to comply with the requirements for islanding protection when each case of record run-on time is less than 2s or	See appendix table below	P
	Meets the requirements of local codes		P

Appendix 1: The test table

**Specification of the EUT provided by manufacturer**

1) Rating			
a) Maximum output power	2800W		
b) DC. voltage range	100-500V, (230-500V with full power output)		
c) DC. current limits	13A		
d) AC voltage range	230V		
e) Frequency range	50Hz		
f) AC current limits	13A		
g) Efficiency	98%		
h) Voltage and frequency trip settings (magnitude and timing)(the most severe condition)	Parameter	Magnitude	Timing
	Over voltage	253V	2s
	Under voltage	195.5V	2s
	Over frequency	51Hz	0.2s
	Under frequency	49Hz	0.2s
i) Other software settings	Island trip settings: <2s;		
j) Firmware version	V3.10		
2) Others			
a) Displays	LCD/LED		
b) Temperature range	-25°C to +60°C		
c) Humidity	0~95%		
d) Size	405*314*135mm		
e) Weight	12kg		

**Table 9 – List of tested condition and run on time**

No.	PEUT <sup>1)</sup> (% of EUT rating)	Reactive load (% of QL in 6.1.d)1)	PAC <sup>2)</sup> (% of nominal)	QAC <sup>3)</sup> (% of nominal)	Run on time (ms)	PEUT (W)	Actual Qf	VDC	Remarks <sup>4)</sup>
1	100	100	0	0	892	2800	1.00	480	Test A at BL
2	66	66	0	0	840	1848	1.00	365	Test B at BL
3	33	33	0	0	372	924	1.00	250	Test C at BL
4	100	100	-5	-5	202	2800	1.07	480	Test A at IB
5	100	100	-5	0	808	2800	1.05	480	Test A at IB
6	100	100	-5	5	432	2800	1.03	480	Test A at IB
7	100	100	0	-5	188	2800	1.02	480	Test A at IB
8	100	100	0	5	406	2800	0.98	480	Test A at IB
9	100	100	5	-5	190	2800	0.97	480	Test A at IB
10	100	100	5	0	824	2800	0.95	480	Test A at IB
11	100	100	5	5	490	2800	0.93	480	Test A at IB
12	66	66	0	-5	194	1848	1.03	365	Test B at IB
13	66	66	0	-4	212	1848	1.02	365	Test B at IB
14	66	66	0	-3	207	1848	1.02	365	Test B at IB

Appendix 1: The test table

15	66	66	0	-2	812	1848	1.01	365	Test B at IB
16	66	66	0	-1	868	1848	1.01	365	Test B at IB
17	66	66	0	1	315	1848	1.00	365	Test B at IB
18	66	66	0	2	440	1848	1.00	365	Test B at IB
19	66	66	0	3	406	1848	0.99	365	Test B at IB
20	66	66	0	4	358	1848	0.99	365	Test B at IB
21	66	66	0	5	314	1848	0.98	365	Test B at IB
22	33	33	0	-5	186	924	1.03	250	Test C at IB
23	33	33	0	-4	410	924	1.02	250	Test C at IB
24	33	33	0	-3	508	924	1.02	250	Test C at IB
25	33	33	0	-2	386	924	1.01	250	Test C at IB
26	33	33	0	-1	354	924	1.01	250	Test C at IB
27	33	33	0	1	422	924	1.00	250	Test C at IB
28	33	33	0	2	404	924	0.99	250	Test C at IB
29	33	33	0	3	340	924	0.98	250	Test C at IB
30	33	33	0	4	398	924	0.98	250	Test C at IB
31	33	33	0	5	302	924	0.97	250	Test C at IB

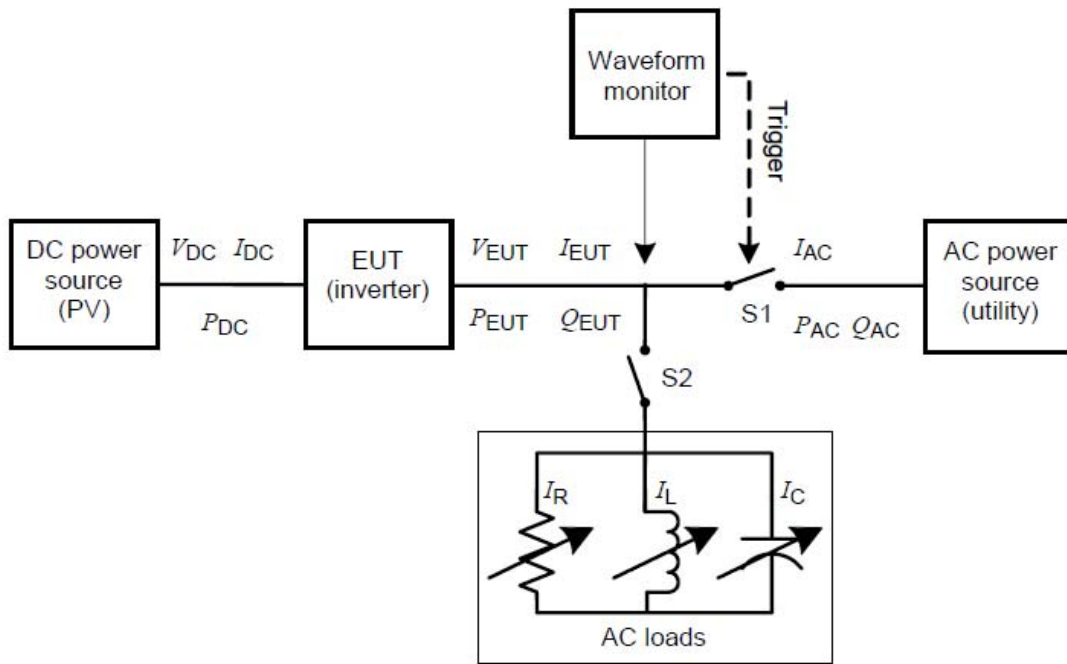
Remark:

- 1) PEUT: EUT output power
- 2) PAC: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0% test condition value.
- 3) QAC: Reactive power flow at S1 in Figure 1. Positive means power form EUT to utility. Nominal is the 0% test condition value.
- 4) BL: Balance condition, IB: Imbalance condition.

Note: test condition A (100%): If any of the recorded run-on times are longer than the one recorded for the rated balance condition, i.e. test procedure 6.1 f), then the non-shaded parameter combinations (no.32~47) also require testing.

Appendix 2: Specification of testing equipment

Items	Specifications
1) DC power source ( or PV array simulator)	
a) Voltage range	0 – 1000Vdc ( 0.01V step)
b) Current range	0 – 40A ( 0.01A step)
2) AC power source	
a) Output wiring	Single phase
b) Output capacity	48KVA
c) Output voltage	10-300Vrms
d) Output frequency	45-65Hz
e) Voltage stability	± 100ppm/°C
f) Output voltage distortion	0.05% max.
3) Digital meter	
a) Voltage range	0 – 1000Vdc, 0 – 600Vrms
b) Current range	0 – 30A
c) Frequency range ( accuracy)	0.2%
d) Measurement items	Voltage (V)    Current (A)    Active power (W) Reactive power (Var) Volt-ampere (VA) Power factor (PF) Frequency (Hz) Electric energy (Wh)
4) Waveform recorder	
a) Sampling speed	1000K/s
b) Recording device	Memory record and USB reading
c) Time accuracy	± 500ppm
5) AC load	
a) Resistive load	Maximum voltage: 300Vrms Current range: 0 – 100A ( 0.001Ω step) Capacity: 100KVA
b) Inductive load	Maximum voltage: 300Vrms Current range: 0 – 100A ( 0.001Ω step) Capacity: 100KVA
c) Capacitive load	Maximum voltage: 300Vrms Current range: 0 – 100A



IEC 1567/08

Figure: Test circuit for islanding detection function of inverter

(End of the report)