
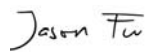



<b>TEST REPORT</b> <b>IEC 62116 2nd ed.</b> <b>Test procedure of islanding prevention measures for</b> <b>Utility-interconnected photovoltaic inverters</b>	
<b>Report Reference No.</b> .....	150715027GZU-002
<b>Tested by (name + signature)</b> .....	Tommy Zhong Assistant Technical Manager 
<b>Approved by (name + signature)</b> .....	Jason Fu Senior Project Engineer 
<b>Date of issue</b> .....	15 Oct.,2015, Revision 1: 22 Mar., 2018
<b>Number of pages</b> .....	13 pages
<b>CB Testing Laboratory</b> .....	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
<b>Address</b> .....	Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD, Guangzhou, China
<b>Testing location / procedure</b> .....	CBTL <input type="checkbox"/> SMT <input type="checkbox"/> TMP <input type="checkbox"/> TL <input checked="" type="checkbox"/>
<b>Testing location / address</b> .....	Same as above
<b>Applicant's name</b> .....	Shenzhen SOFARSOLAR Co., Ltd.
<b>Address</b> .....	5/F, Building 4, Antongda Industrial Park, No.1 Liuxian Avenue, Xin'an Street, Bao'an District, Shenzhen City, Guangdong Province, P.R.China
<b>Test specification:</b>	
<b>Standard</b> .....	IEC 62116 2 <sup>nd</sup> ed. 2014-02
<b>Test procedure</b> .....	Type test
<b>Non-standard test method</b> .....	N/A
<b>Test Report Form No.</b> .....	IEC62116_2ed_b
<b>TTRF Originator</b> .....	Intertek
<b>Master TRRF</b> .....	Dated 2014-03
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<b>Test item description</b> .....	Grid-connected PV inverter
<b>Trade Mark</b> .....	
<b>Manufacturer</b> .....	Same as applicant
<b>Model/Type reference</b> .....	SOFAR 30000TL-Sx, SOFAR 33000TL-Sx, SOFAR 36000TL-Sx, SOFAR 40000TL-Sx (x=0-2)

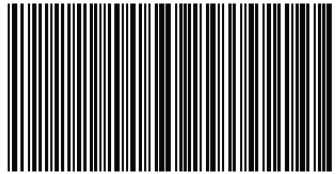
Ratings DC input.....	<p>Maximum d.c. input voltage: 1000 V</p> <p>Input voltage range: 250-960 V</p> <p>MPPT voltage range: 480-800 V (for SOFAR 30000TL-Sx, SOFAR 33000TL-Sx); 580-800 V (for SOFAR 36000TL-Sx); 560-800 V (for SOFAR 40000TL-Sx)</p> <p>Max. input current: 2×32 A (for SOFAR 30000TL-Sx); 2×35 A (for SOFAR 33000TL-Sx); 2×38 A (for SOFAR 36000TL-Sx); 2×35 A (for SOFAR 40000TL-Sx)</p> <p>Max. PV Isc: 2×40 A</p>
Ratings AC Output.....	<p>Nominal output voltage: 3/N/PE230V/400Vac (for SOFAR 30000TL-Sx, SOFAR 33000TL-Sx, SOFAR 36000TL-Sx); 3/PE/480Vac (for SOFAR 40000TL-Sx)</p> <p>Max. output current: 3×43 A (for SOFAR 30000TL-Sx); 3×48A (for SOFAR 33000TL-Sx); 3×54A (for SOFAR 36000TL-Sx); 3×48 A (for SOFAR 40000TL-Sx)</p> <p>Nominal frequency: 50 Hz</p> <p>Max. output power: 30000 VA (for SOFAR 30000TL-Sx); 33000 VA (for SOFAR 33000TL-Sx); 36000 VA (for SOFAR 36000TL-Sx); 40000 VA (for SOFAR 40000TL-Sx)</p> <p>Ingress protection: IP65</p> <p>Operating temperature range: -25~+60°C</p>
Software version .....	V1.00

**Copy of marking plate:**

		Solar Inverter 光伏逆变器	
<b>Model No.(产品型号):</b>	<b>SOFAR 30000TL-S0</b>		
Max. DC input voltage(最大直流输入电压):	1000V		
Operating MPPT voltage range(MPPT电压范围):	250-960V		
Max. Input current(最大输入电流):	2x32A		
Max. PV Isc(最大输入短路电流):	2x40A		
Nominal Grid Voltage(额定电网电压):	3/N/PE, 230/400V~		
Max. Output Current(最大输出电流):	3x43A		
Nominal Grid Frequency(额定电网频率):	50 Hz		
Max. Output power(最大输出功率):	30000VA		
Power factor(功率因数):	>0.99(adjustable+/-0.8)		
Ingress protection(IP等级):	IP65		
Operating Temperature Range(运行环境温度):	-25-+60°C		
Protective Class(保护级别):	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-N4105, G59/3, IEC61727, IEC62116, C10/11, RD1699, UTE C15-712-1, AS4777			
			

		Solar Inverter 光伏逆变器	
<b>Model No.(产品型号):</b>	<b>SOFAR 40000TL-S0</b>		
Max. DC input voltage(最大直流输入电压):	1000V		
Operating MPPT voltage range(MPPT电压范围):	250-960V		
Max. Input current(最大输入电流):	2x35A		
Max. PV Isc(最大输入短路电流):	2x40A		
Nominal Grid Voltage(额定电网电压):	3/PE, 480V~		
Max. Output Current(最大输出电流):	3x48A		
Nominal Grid Frequency(额定电网频率):	50 Hz		
Max. Output power(最大输出功率):	40000VA		
Power factor(功率因数):	>0.99(adjustable+/-0.8)		
Ingress protection(IP等级):	IP65		
Operating Temperature Range(运行环境温度):	-25-+60°C		
Protective Class(保护级别):	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-N4105, G59/3, IEC61727, IEC62116, C10/11, RD1699, UTE C15-712-1, AS4777			
			

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
3. The labels of the other models are same as above except the model name and the 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, IP 65 and indoor/ outdoor used
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 .....	15 Jul.,2015
Date (s) of performance of tests .....	15 Jul.,2015 – 30 Sep., 2015
<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.	
<b>Revision 1: This report is based on and superseded original report 150715027GZU-002, dated 15 Oct., 2015, with below modified information:</b>	
1. Change the Applicant's address from "3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China" to "5/F, Building 4, Antongda Industrial Park, No.1 Liuxian Avenue, Xin' an Street, Bao'an District, Shenzhen City, Guangdong Province, P.R.China"	
2. Add a new model SOFAR 36000TL-Sx	
<b>After evaluation, no additional test should be reevaluated.</b>	

**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.

Model SOFAR 30000TL-Sx, SOFAR 33000TL-Sx and SOFAR 36000TL-Sx are non-isolated inverter; Model SOFAR 40000TL-Sx is a isolated inverter, which output should be connected with isolated transformer.

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

For all models, if the DC input voltage is higher than 800 Vdc the output power will be derating.

For model SOFAR 40000TL-Sx, if the DC input voltage is lower than 560 Vdc, the output power will be derating.

For model SOFAR 36000TL-Sx, if the DC input voltage is lower than 580 Vdc, the output power will be derating.

For model SOFAR 30000TL-Sx and SOFAR 33000TL-Sx, if the DC input voltage is lower than 480 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. If the DC output voltage is lower than 480 Vdc / 580Vdc / 560 Vdc, the input current lower than current of input 480 Vdc / 580Vdc /560 Vdc.

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

Model	DC surge arrester	AC surge arrester
SOFAR 30000TL-S0 SOFAR 33000TL-S0 SOFAR 36000TL-S0 SOFAR 40000TL-S0		
SOFAR 30000TL-S1 SOFAR 33000TL-S1 SOFAR 36000TL-S1 SOFAR 40000TL-S1	✓	
SOFAR 30000TL-S2 SOFAR 33000TL-S2 SOFAR 36000TL-S2 SOFAR 40000TL-S2	✓	✓

✓ denote incorporating this component

Model	SOFAR 40000TL-Sx, SOFAR 36000TL-Sx, SOFAR 33000TL-Sx	SOFAR 30000TL-Sx
Heat-dissipating methods	With two Fans	Natural cooling

**Factory information:**

Suga Networks Equipment (Shenzhen) Co., Ltd.

Suga High-tech Industrial Park, No 8, Fulong Road, Sanzhong, Qingxi Town, Dongguan, Guangdong, China

Other than special notice, the model SOFAR 33000TL-S2 is as the representative test model in this report.

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

IEC62116			
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	33000W		
b) DC. voltage range	250-960V		
c) DC. current limits	2x35A		
d) AC voltage range	207V-253V		
e) Frequency range	50Hz		
f) AC current limits	3x48A		
g) Efficiency	98.2%		
h) Voltage and frequency trip settings (magnitude and timing)(the most severe condition)	Parameter	Magnitude	Timing
	Over voltage	253V	2s
	Under voltage	184V	2s
	Over frequency	51Hz	2s
	Under frequency	48Hz	2s
i) Other software settings	Island trip settings: <2s;		
j) Firmware version	V1.00		
2) Others			
a) Displays	LCD		
b) Temperature range	-25°C to +60°C		
c) Humidity	0~95%		
d) Size	773*564*258mm		
e) Weight	50kg		

**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 (KW)	Actual Qf	VDC	Remarks <sup>4)</sup>
1	100	100	0	0	1160	33.2	0.988	802.1	Test A at BL
2	66	66	0	0	1050	19.8	0.955	620.5	Test B at BL
3	33	33	0	0	1060	10.8	0.965	487.6	Test C at BL
4	100	100	-5	-5	992	33.2	1.001	802.1	Test A at IB
5	100	100	-5	0	1140	33.2	1.031	802.1	Test A at IB
6	100	100	-5	5	224	33.2	1.032	802.1	Test A at IB
7	100	100	0	-5	1040	33.2	0.957	802.1	Test A at IB
8	100	100	0	5	208	33.2	0.993	802.1	Test A at IB
9	100	100	5	-5	192	33.2	0.946	802.1	Test A at IB
10	100	100	5	0	922	33.2	0.918	802.1	Test A at IB
11	100	100	5	5	944	33.2	0.942	802.1	Test A at IB
12	66	66	0	-6	608	19.8	0.938	620.5	Test A at IB
13	66	66	0	-5	976	19.8	0.948	620.5	Test B at IB

Appendix 1: The test table

14	66	66	0	-4	944	19.8	0.946	620.5	Test B at IB
15	66	66	0	-3	984	19.8	0.951	620.5	Test B at IB
16	66	66	0	-2	984	19.8	0.953	620.5	Test B at IB
17	66	66	0	-1	1050	19.8	0.951	620.5	Test B at IB
18	66	66	0	1	952	19.8	0.953	620.5	Test B at IB
19	66	66	0	2	1020	19.8	0.965	620.5	Test B at IB
20	66	66	0	3	224	19.8	0.964	620.5	Test B at IB
21	66	66	0	4	224	19.8	0.974	620.5	Test B at IB
22	66	66	0	5	212	19.8	0.981	620.5	Test B at IB
23	33	33	0	-7	640	10.8	0.951	487.6	Test C at IB
24	33	33	0	-6	992	10.8	0.949	487.6	Test C at IB
25	33	33	0	-5	992	10.8	0.954	487.6	Test C at IB
26	33	33	0	-4	584	10.8	0.956	487.6	Test C at IB
27	33	33	0	-3	1060	10.8	0.961	487.6	Test C at IB
28	33	33	0	-2	1000	10.8	0.966	487.6	Test C at IB
29	33	33	0	-1	936	10.8	0.968	487.6	Test C at IB
30	33	33	0	1	952	10.8	0.961	487.6	Test C at IB
31	33	33	0	2	944	10.8	0.959	487.6	Test C at IB
32	33	33	0	3	216	10.8	0.968	487.6	Test C at IB
33	33	33	0	4	232	10.8	0.975	487.6	Test C at IB
34	33	33	0	5	200	10.8	0.968	487.6	Test C at IB

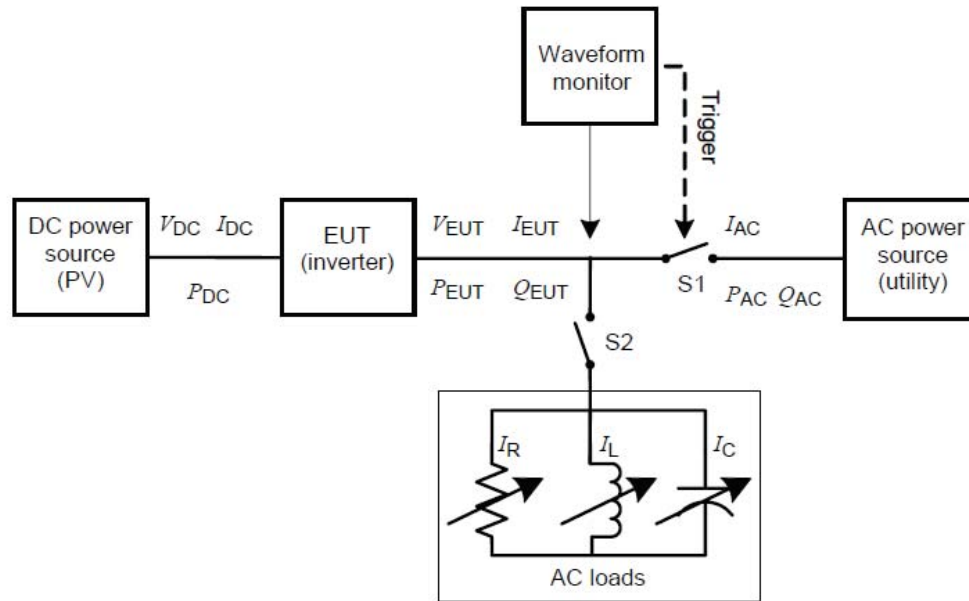
Remark:

- 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.

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 – 60A ( 0.01A step)
2) AC power source	
a) Output wiring	Three 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 – 100A
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

Appendix 3: Block diagram of test circuit



IEC 1567/08

Figure: Test circuit for islanding detection function of inverter

(End of the report)