



**BUREAU
VERITAS**

Certificate of compliance

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

Product: Grid-tied photovoltaic (PV) inverter

Model: SOFAR 3000TLM
SOFAR 3680TLM

Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G83/2 for photovoltaic systems with a single-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter. This serves as a replacement for the disconnection device with isolating function that can access the distribution network provider at any time.

Applied rules and standards:

Engineering Recommendation G83/2:2012

Recommendations for the Connection of Type Tested Small-scale Embedded Generators (Up to 16A per Phase) in Parallel with Low-Voltage Distribution Systems

DIN V VDE V 0126-1-1:2006-02 (Functional safety)

Automatic disconnection device between a generator and the public low-voltage grid

At the time of issue of this certificate the safety concept of an aforementioned representative product corresponds to the valid safety specifications for the specified use in accordance with regulations.

Report number: PVUK140609N058-G83/2

Certificate number: U14-0503

Date of issue: 2014-09-26

Certification body

Dieter Zitzmann



Deutsche
Akkreditierungsstelle
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Certification body of Bureau Veritas Consumer Products Services Germany GmbH
Accredited according to EN 45011 - ISO / IEC Guide 65

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

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Type Approval and declaration of compliance with the requirements of Engineering Recommendation G83/2.

Manufacturer / applicant:	Shenzhen SOFARSOLAR Co., Ltd. 3A-1, Huake Building, East Technology Park Qiaoxiang Road, Nanshan District, Shenzhen China	
SSEG Type	Grid-tied photovoltaic inverter	
Rated values	SOFAR 3000TLM	SOFAR 3680TLM
Maximum rated capacity	3,0 kVA	3,68 kVA
Rated voltage	230V	230V
Firmware version	V1.00	
Measurement period:	2014-06-09 to 2014-09-19	

Description of the structure of the power generation unit (Figure 1):

The power generation unit is equipped with a PV and line-side EMC filter. The power generation unit has no galvanic isolation between DC input and AC output. Output switch-off is performed with single-fault tolerance based on two series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.

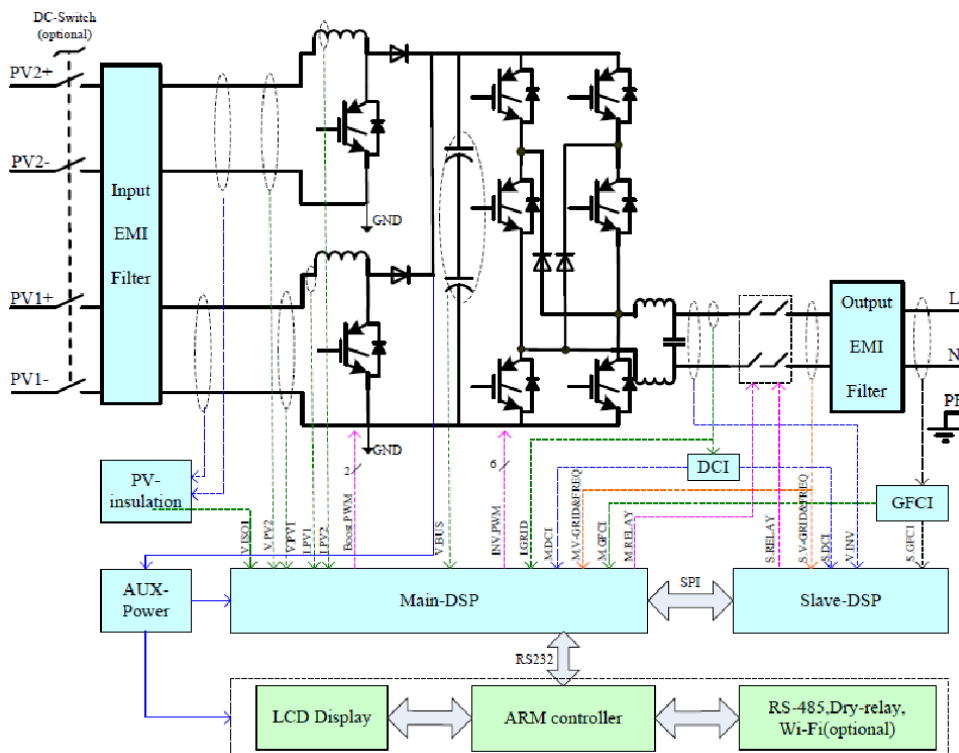


Figure 1 – Schematic structure of the power generation unit

Differences between SSEG units:

The models SOFAR 3000TLM, SOFAR 3680TLM differ in size of the performance-related components (Sine filter, EMC filter, power semiconductor, machine transformer).

The above stated Small Scale Embedded Generators (SSEGs) are tested according the requirements in the Engineering Recommendation G83/2. Any modification that affects the stated tests must be named by the manufacturer/supplier of the product to ensure that the product meets all requirements of the Engineering Recommendation G83/2.

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

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Protection. Voltage tests.						
The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2						
230V grid						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	201,0V	2,520s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	185,3V	0,529s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	261,2V	1,028s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	272,5V	0,538s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip
Note for Voltage tests the Voltage required to trip is the setting $\pm 3,45V$. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting $\pm 4V$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

Protection. Voltage tests.						
The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2						
240V grid						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	208,8V	2,5s	209,5V	2,525s	212,8V / 3,5s	No trip
U/V stage 2	192V	0,5s	193,1V	0,520s	196V / 2,48s	No trip
					188V / 0,48s	No trip
O/V stage 1	273,6V	1,0s	272,4V	1,030s	269,6V 2,0s	No trip
O/V stage 2	285,6V	0,5s	284,0V	0,525s	281,6V 0,98s	No trip
					289,6V 0,48s	No trip
Note for Voltage tests the Voltage required to trip is the setting $\pm 3,45V$. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting $\pm 4V$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

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Protection. Frequency tests.						
The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.3						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,50Hz	20,024s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	47,00Hz	0,533s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,50Hz	90,036s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,00Hz	0,528s	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip

Note for Frequency Trip tests the Frequency required to trip is the setting $\pm 0,1$ Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No-trip tests" need to be carried out at the setting $\pm 0,2$ Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Loss of Mains.						
The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4						
BS EN 62116						
SOFAR 3000TLM						
Balancing load on islanded network	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
Trip time. Ph1 fuse removed	211ms	208ms	287ms	201ms	247ms	229ms
SOFAR 3680TLM						
Balancing load on islanded network	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
Trip time. Ph1 fuse removed	237ms	380ms	348ms	207ms	231ms	295ms
Note for technologies which have a substantial shut down time this can be added to the 0,5 seconds in establishing that the trip occurred in less than 0,5s. Maximum shut down time could therefore be up to 1,0 seconds for these technologies.						
Indicate additional shut down time included in above results. (Integrated interface switch)				Type of switching equipment 1: Relay with 20ms Type of switching equipment 2: Relay with 20ms		

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Protection. Re-connection timer.				
The requirement is specified in section 5.3.4 Automatic Reconnection, test procedure in Annex A or B 1.3.5				
Test should prove that the reconnection sequence starts after a minimum delay of 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 1.				
Voltage				
Time delay setting		Measured delay		
20s		79s		
Frequency				
Time delay setting		Measured delay		
20s		78s		
230V grid				
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
Confirmation that the SSEG does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection
240V grid				
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 277,6V	At 204,8V	At 47,4Hz	At 51,6Hz
Confirmation that the SSEG does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Protection. Frequency change, Stability test.				
The requirement is specified in section 5.3.3, test procedure in Annex A or B 1.3.6				
	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49,5Hz	+9 degrees		No trip
Negative Vector Shift	50,5Hz	- 9 degrees		No trip
Positive Frequency drift	49,5Hz	+0,19Hz/sec	51,5Hz	No trip
Negative Frequency drift	50,5Hz	-0,19Hz/sec	47,5Hz	No trip

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Power Quality. Harmonics.						
The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1						
SOFAR 3000TLM						
SSEG rating per phase (rpp)				NV=MV*3,68/rpp		
	At 45-55% of rated ouput 1,5kW		100% of rated output 3,0kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,014	0,018	0,023	0,028	1,080	
3rd	0,132	0,161	0,191	0,235	2,300	
4th	0,012	0,014	0,020	0,025	0,430	
5th	0,045	0,055	0,051	0,062	1,140	
6th	0,008	0,010	0,014	0,017	0,300	
7th	0,039	0,047	0,048	0,059	0,770	
8th	0,007	0,009	0,010	0,013	0,230	
9th	0,034	0,041	0,053	0,064	0,400	
10th	0,006	0,008	0,009	0,011	0,184	
11th	0,037	0,045	0,054	0,066	0,330	
12th	0,006	0,007	0,008	0,010	0,153	
13th	0,040	0,049	0,054	0,067	0,210	
14th	0,005	0,007	0,007	0,009	0,131	
15th	0,036	0,044	0,055	0,067	0,150	
16th	0,005	0,006	0,007	0,009	0,115	
17th	0,036	0,045	0,050	0,062	0,132	
18th	0,004	0,005	0,007	0,009	0,102	
19th	0,032	0,039	0,044	0,054	0,118	
20th	0,004	0,005	0,006	0,008	0,092	
21th	0,031	0,038	0,040	0,049	0,107	0,160
22th	0,004	0,005	0,005	0,007	0,084	
23th	0,027	0,033	0,036	0,044	0,098	0,147
24th	0,003	0,004	0,006	0,007	0,077	
25th	0,024	0,030	0,031	0,038	0,090	0,135
26th	0,004	0,004	0,005	0,006	0,071	
27th	0,019	0,023	0,026	0,032	0,083	0,124
28th	0,006	0,008	0,005	0,006	0,066	
29th	0,017	0,021	0,022	0,027	0,078	0,117
30th	0,003	0,004	0,005	0,006	0,061	
31th	0,015	0,019	0,020	0,024	0,073	0,109
32th	0,004	0,005	0,004	0,005	0,058	
33th	0,014	0,017	0,018	0,022	0,068	0,102
34th	0,003	0,003	0,004	0,004	0,054	
35th	0,012	0,015	0,014	0,017	0,064	0,096
36th	0,002	0,003	0,007	0,009	0,051	
37th	0,010	0,012	0,012	0,015	0,061	0,091
38th	0,003	0,004	0,003	0,004	0,048	
39th	0,008	0,010	0,011	0,013	0,058	0,087
40th	0,003	0,003	0,004	0,005	0,046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

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Power Quality. Harmonics.						
The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1						
SOFAR 3680TLM						
SSEG rating per phase (rpp)				NV=MV*3,68/rpp		
	At 45-55% of rated ouput 1,84kW		100% of rated output 3,68kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,016	0,016	0,036	0,036	1,080	
3rd	0,143	0,143	0,230	0,230	2,300	
4th	0,013	0,013	0,027	0,027	0,430	
5th	0,039	0,039	0,051	0,051	1,140	
6th	0,007	0,007	0,021	0,021	0,300	
7th	0,037	0,037	0,040	0,040	0,770	
8th	0,006	0,006	0,024	0,024	0,230	
9th	0,037	0,037	0,070	0,070	0,400	
10th	0,007	0,007	0,018	0,018	0,184	
11th	0,041	0,041	0,047	0,047	0,330	
12th	0,006	0,006	0,010	0,010	0,153	
13th	0,040	0,040	0,048	0,048	0,210	
14th	0,005	0,005	0,014	0,014	0,131	
15th	0,038	0,038	0,062	0,062	0,150	
16th	0,005	0,005	0,016	0,016	0,115	
17th	0,034	0,034	0,038	0,038	0,132	
18th	0,004	0,004	0,011	0,011	0,102	
19th	0,031	0,031	0,041	0,041	0,118	
20th	0,004	0,004	0,007	0,007	0,092	
21th	0,028	0,028	0,036	0,036	0,107	0,160
22th	0,003	0,003	0,008	0,008	0,084	
23th	0,024	0,024	0,028	0,028	0,098	0,147
24th	0,004	0,004	0,009	0,009	0,077	
25th	0,021	0,021	0,024	0,024	0,090	0,135
26th	0,004	0,004	0,006	0,006	0,071	
27th	0,018	0,018	0,022	0,022	0,083	0,124
28th	0,004	0,004	0,006	0,006	0,066	
29th	0,016	0,016	0,016	0,016	0,078	0,117
30th	0,002	0,002	0,006	0,006	0,061	
31th	0,013	0,013	0,014	0,014	0,073	0,109
32th	0,004	0,004	0,004	0,004	0,058	
33th	0,012	0,012	0,010	0,010	0,068	0,102
34th	0,003	0,003	0,006	0,006	0,054	
35th	0,010	0,010	0,008	0,008	0,064	0,096
36th	0,002	0,002	0,004	0,004	0,051	
37th	0,008	0,008	0,006	0,006	0,061	0,091
38th	0,002	0,002	0,004	0,004	0,048	
39th	0,007	0,007	0,006	0,006	0,058	0,087
40th	0,002	0,002	0,003	0,003	0,046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

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Power Quality. Power factor.				
The requirement is specified in section 5.6, test procedure in Annex A or B 1.4.2				
230V grid				
SOFAR 3680TLM				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0,999	0,999	0,999	
Limit	>0,95	>0,95	>0,95	
SOFAR 3000TLM				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0,999	0,999	0,999	
Limit	>0,95	>0,95	>0,95	
240V grid				
SOFAR 3680TLM				
	225,6V	240V	264V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0,998	0,998	0,998	
Limit	>0,95	>0,95	>0,95	
SOFAR 3000TLM				
	225,6V	240V	264V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0,998	0,998	0,998	
Limit	>0,95	>0,95	>0,95	

Power Quality. Voltage fluctuation and Flicker.								
The requirement is specified in section 5.4.2, test procedure in Annex A or B 1.4.3								
SOFAR 3000TLM								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	0,10	0,06	0,01	0,13	0,04	0,01	0,17	0,17
Normalised to standard impedance and 3.68kW for multiple units	0,12	0,07	0,01	0,16	0,05	0,01	0,21	0,21
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
SOFAR 3680TLM								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	0,01	0,01	0,01	0,01	0,01	0,01	0,12	0,12
Normalised to standard impedance and 3.68kW for multiple units	0,01	0,01	0,01	0,01	0,01	0,01	0,12	0,12
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

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Power Quality. DC injection.			
The requirement is specified in section 5.5, test procedure in Annex A or B 1.4.4			
Test level power	10%	55%	100%
SOFAR 3000TLM			
Recorded value of phase 1	13,6mA	14,5mA	13,9mA
As % of rated AC current phase 1	0,10%	0,11%	0,11%
Limit	0,25%	0,25%	0,25%
SOFAR 3680TLM			
Recorded value of phase 1	15,9mA	14,7mA	17,3mA
As % of rated AC current phase 1	0,10%	0,10%	0,11%
Limit	0,25%	0,25%	0,25%

Fault level Contribution.					
The requirement is specified in section 5.7, test procedure in Annex A or B 1.4.6					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	I_p	N/A	20ms	44,1	17,1
Initial Value of aperiodic current	A	N/A	100ms	31,7	15,6
Initial symmetrical short-circuit current*	I_k	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,078	In seconds

For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.

* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.

Self Monitoring – Solid state switching.	N/A
The requirement is specified in section 5.3.1, No specified test requirements.	
It has been verified that in the event of the solid state switching device failing to disconnect the SSEG, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.	
Note. Unit do not provide solid state switching relays. In case the semiconductor bridge is switched off, then the voltage on the output drops to 0. In this case the relays on the output will also open.	