

G83/2 Appendix 4 Type Verification Test Report

Type Approval and manufacturer/supplier declaration of compliance with the requirements of Engineering Recommendation G83/2.			
SSEG Type reference number		Grid-tied photovoltaic (PV) inverter	
SSEG Type		SOFAR 3000TLM; SOFAR 3680TLM.	
System Supplier name		Shenzhen SOFARSOLAR Co., Ltd.	
Address		3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China.	
Tel	+86-755-26969476	Fax	+86-755-26969476-666
E:mail	info@sofarsolar.com	Web site	www.sofarsolar.com
Maximum rated capacity, use separate sheet if more than one connection option.	Connection Option		
	3.0	kW single phase	
	3.68	kW single phase	
	NA	kW two phases in three phase system	
NA	kW two phases split phase system		
<p>System supplier declaration.</p> <p>I certify on behalf of the company named above as a manufacturer/supplier of Small Scale Embedded Generators, that all products manufactured/supplied by the company with the above SSEG Type reference number will be manufactured and tested to ensure that they perform as stated in this Type Verification Test Report, prior to shipment to site and that no site modifications are required to ensure that the product meets all the requirements of G83/2.</p>			
Signed	On behalf of		Shenzhen SOFARSOLAR Co., Ltd.
			
<p>Note that testing can be done by the manufacturer of an individual component, by an external test house, or by the supplier of the complete system, or any combination of them as appropriate.</p> <p>* Where parts of the testing are carried out by persons or organisations other than the supplier then the supplier shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.</p>			

Power Quality. Harmonics. The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1 (SOFAR 3000TLM)						P
SSEG rating per phase (rpp)			3.0	kVA	NV=MV*3,68/rpp	
	At 45-55% of rated output		100% of rated output			
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	0,225	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	0,062	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.

Power Quality. Harmonics. The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1 (SOFAR 3680TLM)						P
SSEG rating per phase (rpp)			3.68	kVA	NV=MV*3,68/rpp	
	At 45-55% of rated output		100% of rated output			
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
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	0,013	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.

Power Quality. Voltage fluctuations and Flicker. The requirement is specified in section 5.4.2, test procedure in Annex A or B 1.4.3								P	
SOFAR 3000TLM									
	Starting			Stopping			Running		
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_s	P_{It} 2 hours	
Measured values	0,01	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	0,219	
Limits set under BS EN 61000-3-2	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65	
SOFAR 3680TLM									
	Starting			Stopping			Running		
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_s	P_{It} 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 61000-3-2	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65	

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

Power Quality. Power factor. The requirement is specified in section 5.6, test procedure in Annex A or B 1.4.2					P
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		
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		

Protection. Frequency tests The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.3						P
Function	Setting		Trip		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

Protection. Voltage tests The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2						P
Function	Setting		Trip		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. Loss of Mains test.							P
The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4							
BS EN 62116.							
SOFAR 3000TLM							
Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10	
Trip time. Limit is 0.5s	211ms	208ms	287ms	201ms	247ms	229ms	
SOFAR 3680TLM							
Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10	
Trip time. Limit is 0.5s	237ms	380ms	348ms	207ms	231ms	295ms	

Protection. Frequency change, Stability test					P
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	

Protection. Re-connection timer.					P
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		Measured			
60s		79s			
Frequency					
Time delay setting		Measured delay			
60s		78s			
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
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Note:

Reference in accordance with BS EN 50438 (2007)

The tests had been performed on the SOFAR 3000TLM is valid for the SOFAR3680TLM, since it is same as in hardware and just power derated by software.

Fault level contribution.

The requirement is specified in section 5.7, test procedure in Annex A or B 1.4.6

P

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

Self-Monitoring solid state switching

The requirement is specified in section 5.3.1, No specified test requirements.

N/A

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.

Additional comments

SOFAR 3000TLM is similar to SOFAR 3680TLM in circuit and construction except for output rating of current and power. The test result can refer to SOFAR 3680TLM