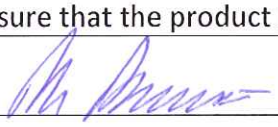
Engineering Recommendation G83/2
Type Verification Test Report

Type approval and manufacturer/supplier declaration of compliance with the requirements of Engineering Recommendation G83/2

SSEG DETAILS	
SSEG Type Reference:	**EnaSolar 3.8kWGT-UK (Photovoltaic)**
SSEG Type:	Photovoltaic
Manufacturer:	**EnaSolar Ltd** 66 Treffers Road, Christchurch 8042, New Zealand Telephone: +64 3 366 4550, Fax:+64 3 366 0884 www.enasolar.net support@enasolar.net
Maximum Rated Capacity: (SSEG Rating Less Parasitic Load)	3680W

SSEG MANUFACTURER DECLARATION			
I certify on behalf of EnaSolar as the manufacturer of Small Scale Embedded Generators, that all products manufactured 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.			
Signed		On behalf of	**EnaSolar Ltd**

Power Quality. Harmonics						
SSEG rating per phase (rpp)			3.68	kW	NV=MV*3.68/rpp	
Harmonic	At 50% of rated output		At 100% of rated output			
	Measured value (MV) in Amps	Normalised Value (NV) in Amps	Measured value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN3100 -3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.016	0.016	0.016	0.016	**1.08**	
3	0.733	0.733	0.580	0.580	**2.3**	
4	0.017	0.017	0.019	0.019	**0.43**	
5	0.071	0.071	0.083	0.083	**1.14**	
6	0.019	0.019	0.012	0.012	**0.3**	
7	0.061	0.061	0.059	0.059	**0.77**	
8	0.020	0.020	0.014	0.014	**0.23**	
9	0.074	0.074	0.097	0.097	**0.4**	
10	0.018	0.018	0.010	0.010	**0.184**	
11	0.046	0.046	0.095	0.095	**0.33**	
12	0.012	0.012	0.006	0.006	**0.153**	
13	0.039	0.039	0.066	0.066	**0.21**	
14	0.012	0.012	0.008	0.008	**0.131**	
15	0.017	0.017	0.043	0.043	**0.15**	
16	0.002	0.002	0.008	0.008	**0.115**	
17	0.022	0.022	0.038	0.038	**0.132**	
18	0.010	0.010	0.005	0.005	**0.102**	
19	0.002	0.002	0.029	0.029	**0.118**	
20	0.008	0.008	0.015	0.015	**0.092**	
21	0.014	0.014	0.024	0.024	**0.107**	
22	0.004	0.004	0.005	0.005	**0.084**	
23	0.006	0.006	0.012	0.012	**0.098**	
24	0.005	0.005	0.007	0.007	**0.077**	
25	0.006	0.006	0.006	0.006	**0.09**	
26	0.003	0.003	0.004	0.004	**0.071**	
27	0.005	0.005	0.006	0.006	**0.083**	
28	0.001	0.001	0.001	0.001	**0.066**	
29	0.004	0.004	0.010	0.010	**0.078**	
30	0.003	0.003	0.003	0.003	**0.061**	
31	0.004	0.004	0.008	0.008	**0.073**	
32	0.002	0.002	0.002	0.002	**0.058**	
33	0.001	0.001	0.005	0.005	**0.068**	
34	0.001	0.001	0.001	0.001	**0.054**	
35	0.004	0.004	0.005	0.005	**0.064**	
36	0.001	0.001	0.002	0.002	**0.051**	
37	0.005	0.005	0.004	0.004	**0.061**	
38	0.001	0.001	0.002	0.002	**0.048**	
39	0.004	0.004	0.005	0.005	**0.058**	
40	0.004	0.004	0.009	0.009	**0.046**	
Power Quality. Voltage fluctuations and flicker						

	Starting			Stopping			Running	
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_{st}	P_{lt} 2 hours
Measured Values	2.04%	2%	0%	3%	3.05%	0.17%	0.234	0.201
Normalised to standard impedance and 3.68kW for multiple units	1.94%	1.9%	0%	2.86%	2.9%	0.16%	0.142	0.122
Limits in BS EN61000-3-3	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65

Test start date	15/01/2014	Test end date	17/01/2014
Test location	EnaSolar, 66 Treffers Road, Christchurch, New Zealand		

Power Quality. DC injection			
Test Power Level	10%	55%	100%
Recorded value	10mA	9mA	7mA
% of rated AC current	0.063%	0.056%	0.044%
Limit	0.25%	0.25%	0.25%

Power Quality. Power Factor			
	216.2V	230V	253V
Recorded value	0.9992	0.999	0.9978
Limit	>0.95	>0.95	>0.95

Protection. Frequency tests.						
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	47.45Hz	20.12s	47.7Hz 25s	No trip
U/F stage 2	47Hz	0.5s	46.95Hz	0.59s	47.2Hz 19.98s	No trip
					46.8Hz 0.48s	No trip
O/F stage 1	51.5Hz	90s	51.55Hz	90.12s	51.3Hz 95s	No trip
O/F stage 2	52Hz	0.5s	52.05Hz	0.71s	51.8Hz 89.98s	No trip
					52.2Hz 0.48s	No trip

Protection. Voltage tests.						
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	199.3V	2.59s	204.1V 3.5s	No trip
U/V stage 2	184V	0.5s	182.5V	0.51s	188V 2.48s	No trip
					180V 0.48s	No trip
O/V stage 1	262.2V	1.0s	262.2V	1s	258.2V 2s	No trip
O/V stage 2	273.7V	0.5s	275.7V	0.51s	269.7V 0.98s	No trip
					277.7V 0.48s	No trip

Protection. Loss of mains test.						
Test Power	33%	66%	100%	33%	66%	100%
Balancing load on islanded network	-5% Q	-5% Q	-5% P	-5% Q	-5% Q	-5% P
Trip Time	0.2s	0.17s	0.41s	0.16s	0.11s	0.27s
Limit	0.5s	0.5s	0.5s	0.5s	0.5s	0.5s

Protection. Frequency change, Stability test.				
	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
Positive Frequency drift	50.5Hz	-0.19Hz/Sec	47.5Hz	No trip

Protection. Re-connection timer.					
Time delay setting	Measured Delay				
20 Seconds	>20 Sec	At 266.2V	At 196.1V	At 47.4Hz	At 51.6Hz
Confirmation that the SSEG does not re-connect		AC over voltage	AC under voltage	AC under Frequency	AC over Frequency

Fault level contribution – Inverter SSEG.		
Time after fault	Volts	Amps
20ms	122.69	14.1
100ms	89.2	9.82
250ms	93.82	12.9
500ms	104.65	12.9
Time to trip	0.522	In seconds

Self Monitoring – Solid state switching.
Not applicable as electro-mechanical relays are used.