

Type Verification Test Report

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

SSEG Type reference number		Growatt 6000UE	
SSEG Type		Photovoltaic inverter	
System Supplier name		Shenzhen Growatt New Energy Technology CO ,Ltd	
Address		1st East & 3rd Floor, Jiayu Industrial Zone, Xibianling, Shangwu Village, Shiyao, Baoan District, Shenzhen, P.R.China	
<b>Tel.</b>	+86 755 2951 5888	<b>Fax</b>	+86 755 2747 2131
<b>E:mail</b>	info@ginverter.com	<b>Web site</b>	<a href="http://www.ginverter.com">www.ginverter.com</a>

Maximum rated capacity, use separate sheet if more than one connection option.	Connection Option	
	N/A	kW single phase, single, split or three phase system
	4	kW three phase
	5	kW three phase
	6	kW three phase
	N/A	kW two phases in three phase system
	N/A	kW two phases split phase system

SSEG manufacturer/supplier declaration.  
 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.

Signed	<i>James Wang</i>	On behalf of	Shenzhen Growatt New Energy Technology CO ,Ltd
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Note that testing can be done by the manufacturer of an individual company, by an external test house, or by the supplier of the complete system, or any combination of them as appropriate.

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.

The family product model is made by the following products:

Growatt 4000UE

Growatt 5000UE

Growatt 6000UE

The model Growatt 6000UE is as the representative test models in this report.

Power Quality. Harmonics. The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1					PASS	
SSEG rating per phase (rpp)		6	kW		NV=MV*3.68/rpp	
Harmonic	At 45-55% of rated output	100% of rated output				
Average harmonic current results – Phase 1						
	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.067	0.067	0.082	0.082	1.080	
3	0.016	0.016	0.023	0.023	2.300	
4	0.026	0.026	0.035	0.035	0.430	
5	0.072	0.072	0.084	0.084	1.140	
6	0.008	0.008	0.012	0.012	0.300	
7	0.033	0.033	0.057	0.057	0.770	
8	0.004	0.004	0.006	0.006	0.230	
9	0.032	0.032	0.037	0.037	0.400	
10	0.009	0.009	0.012	0.012	0.184	
11	0.093	0.093	0.100	0.100	0.330	
12	0.007	0.007	0.008	0.008	0.153	
13	0.016	0.016	0.022	0.022	0.210	
14	0.005	0.005	0.010	0.010	0.131	
15	0.009	0.009	0.012	0.012	0.150	
16	0.009	0.009	0.012	0.012	0.115	
17	0.022	0.022	0.024	0.024	0.132	
18	0.005	0.005	0.008	0.008	0.102	
19	0.015	0.015	0.022	0.022	0.118	
20	0.004	0.004	0.006	0.006	0.092	
21	0.008	0.008	0.011	0.011	0.107	0.160
22	0.019	0.019	0.041	0.041	0.084	
23	0.020	0.020	0.025	0.025	0.098	0.147
24	0.031	0.031	0.066	0.066	0.077	
25	0.010	0.010	0.012	0.012	0.090	0.135
26	0.005	0.005	0.007	0.007	0.071	
27	0.009	0.009	0.017	0.017	0.083	0.124
28	0.030	0.030	0.065	0.065	0.066	
29	0.008	0.008	0.013	0.013	0.078	0.117
30	0.026	0.026	0.054	0.054	0.061	
31	0.004	0.004	0.007	0.007	0.073	0.109
32	0.003	0.003	0.005	0.005	0.058	
33	0.003	0.003	0.004	0.004	0.068	0.102
34	0.004	0.004	0.007	0.007	0.054	
35	0.005	0.005	0.006	0.006	0.064	0.096
36	0.004	0.004	0.008	0.008	0.051	
37	0.002	0.002	0.003	0.003	0.061	0.091
38	0.002	0.002	0.003	0.003	0.048	
39	0.002	0.002	0.003	0.003	0.058	0.087
40	0.003	0.003	0.004	0.004	0.046	

<b>Average harmonic current results – Phase 2</b>						
	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.020	0.020	0.032	0.032	1.080	
3	0.035	0.035	0.041	0.041	2.300	
4	0.038	0.038	0.042	0.042	0.430	
5	0.079	0.079	0.084	0.084	1.140	
6	0.016	0.016	0.020	0.020	0.300	
7	0.035	0.035	0.057	0.057	0.770	
8	0.011	0.011	0.012	0.012	0.230	
9	0.009	0.009	0.013	0.013	0.400	
10	0.015	0.015	0.017	0.017	0.184	
11	0.093	0.093	0.098	0.098	0.330	
12	0.007	0.007	0.009	0.009	0.153	
13	0.025	0.025	0.030	0.030	0.210	
14	0.008	0.008	0.010	0.010	0.131	
15	0.009	0.009	0.015	0.015	0.150	
16	0.006	0.006	0.010	0.010	0.115	
17	0.027	0.027	0.029	0.029	0.132	
18	0.004	0.004	0.006	0.006	0.102	
19	0.016	0.016	0.021	0.021	0.118	
20	0.003	0.003	0.005	0.005	0.092	
21	0.006	0.006	0.011	0.011	0.107	0.160
22	0.022	0.022	0.046	0.046	0.084	
23	0.013	0.013	0.019	0.019	0.098	0.147
24	0.028	0.028	0.060	0.060	0.077	
25	0.016	0.016	0.018	0.018	0.090	0.135
26	0.006	0.006	0.009	0.009	0.071	
27	0.010	0.010	0.019	0.019	0.083	0.124
28	0.035	0.035	0.076	0.076	0.066	
29	0.009	0.009	0.013	0.013	0.078	0.117
30	0.022	0.022	0.047	0.047	0.061	
31	0.009	0.009	0.011	0.011	0.073	0.109
32	0.003	0.003	0.006	0.006	0.058	
33	0.003	0.003	0.005	0.005	0.068	0.102
34	0.005	0.005	0.009	0.009	0.054	
35	0.006	0.006	0.009	0.009	0.064	0.096
36	0.004	0.004	0.008	0.008	0.051	
37	0.006	0.006	0.008	0.008	0.061	0.091
38	0.003	0.003	0.005	0.005	0.048	
39	0.004	0.004	0.006	0.006	0.058	0.087
40	0.003	0.003	0.005	0.005	0.046	

**Average harmonic current results – Phase 3**

	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.051	0.051	0.060	0.060	1.080	
3	0.031	0.031	0.036	0.036	2.300	
4	0.036	0.036	0.039	0.039	0.430	
5	0.073	0.073	0.079	0.079	1.140	
6	0.009	0.009	0.012	0.012	0.300	
7	0.025	0.025	0.053	0.053	0.770	
8	0.008	0.008	0.010	0.010	0.230	
9	0.018	0.018	0.024	0.024	0.400	
10	0.008	0.008	0.011	0.011	0.184	
11	0.089	0.089	0.097	0.097	0.330	
12	0.008	0.008	0.011	0.011	0.153	
13	0.011	0.011	0.014	0.014	0.210	
14	0.007	0.007	0.009	0.009	0.131	
15	0.015	0.015	0.018	0.018	0.150	
16	0.007	0.007	0.009	0.009	0.115	
17	0.021	0.021	0.024	0.024	0.132	
18	0.005	0.005	0.008	0.008	0.102	
19	0.009	0.009	0.013	0.013	0.118	
20	0.004	0.004	0.006	0.006	0.092	
21	0.006	0.006	0.008	0.008	0.107	0.160
22	0.018	0.018	0.036	0.036	0.084	
23	0.011	0.011	0.015	0.015	0.098	0.147
24	0.024	0.024	0.050	0.050	0.077	
25	0.010	0.010	0.012	0.012	0.090	0.135
26	0.003	0.003	0.006	0.006	0.071	
27	0.007	0.007	0.011	0.011	0.083	0.124
28	0.026	0.026	0.056	0.056	0.066	
29	0.007	0.007	0.012	0.012	0.078	0.117
30	0.019	0.019	0.042	0.042	0.061	
31	0.007	0.007	0.009	0.009	0.073	0.109
32	0.002	0.002	0.004	0.004	0.058	
33	0.004	0.004	0.006	0.006	0.068	0.102
34	0.003	0.003	0.007	0.007	0.054	
35	0.005	0.005	0.006	0.006	0.064	0.096
36	0.004	0.004	0.007	0.007	0.051	
37	0.004	0.004	0.005	0.005	0.061	0.091
38	0.004	0.004	0.005	0.005	0.048	
39	0.004	0.004	0.005	0.005	0.058	0.087
40	0.003	0.003	0.005	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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<b>Power Quality. Voltage fluctuations and Flicker.</b> The requirement is specified in section 5.4.2, test procedure in Annex A or B 1.4.3								<b>PASS</b>	
Growatt 6000UE									
	Starting			Stopping			Running		
	d <sub>max</sub>	d <sub>c</sub>	d <sub>(t)</sub>	d <sub>max</sub>	d <sub>c</sub>	d <sub>(t)</sub>	P <sub>st</sub>	P <sub>lt</sub> 2 hours	
Measured Values	-0.55	1.46	0	-0.50	1.41	0	0.636	0.278	
Normalised to standard impedance and 6kW for multiple units	-0.55	1.46	0	-0.50	1.41	0	0.636	0.278	
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3% 500ms	3.3% 500ms	1.0	0.65	
Test start date	2013.7.13 3:41:27 PM			Test end date	2013.7.13 4:51:50 PM				
Test location	Shenzhen Growatt New Energy Technology CO ,Ltd Research & Development Laboratory								

<b>Power quality. DC injection.</b> The requirement is specified in section 5.5, test procedure in Annex A or B 1.4.4					<b>PASS</b>
Growatt 6000UE					
Test power level	10%	55%	100%		
Recorded value	21.3mA	-15.3mA	10.1mA		
as % of rated AC current	0.237%	0.170%	0.112%		
Limit	0.25%	0.25%	0.25%		

<b>Power Quality. Power factor.</b> The requirement is specified in section 5.6, test procedure in Annex A or B 1.4.2					<b>PASS</b>
Growatt 6000UE					
	216.2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within ±1.5% of the stated level during the test.	
Measured value	0.998	0.999	0.998		
Limit	>0.95	>0.95	>0.95		

<b>Protection. Frequency tests</b> The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.3						<b>PASS</b>
Growatt 6000 3ph UE						
Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5Hz	20s	47.51Hz	20.05s	47.7Hz 25s	No Trip
U/F stage 2	47Hz	0.5s	47.01Hz	0.548s	47.2Hz 19.98s	No Trip
					46.8Hz 0.48s	No Trip
O/F stage 1	51.5Hz	90s	51.50Hz	90.04s	51.3Hz 95s	No Trip
O/F stage 2	52Hz	0.5s	52.00Hz	0.548s	51.8Hz 89.98s	No Trip
					52.2Hz 0.48s	No Trip

<b>Protection. Voltage tests</b> The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2						<b>PASS</b>
Growatt 6000UE						
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V stage 1	200.1V	2.5s	200.45V	2.582s	204.1V 3.5s	No Trip
U/V stage 2	184V	0.5s	184.5V	0.584s	188V 2.48s	No Trip
					180V 0.48s	No Trip
O/V stage 1	262.2V	1.0s	262.38V	1.062s	258.2V 2.0s	No Trip
O/V stage 2	273.7V	0.5s	273.9V	0.574s	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.

<b>Protection. Loss of Mains test.</b> The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4						<b>PASS</b>
Growatt 6000 UE						
To be carried out at three output power levels with a tolerance of plus or minus 5% in Test Power levels.						
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of SSEG output	95% of SSEG output	95% of SSEG output	105% of SSEG output	105% of SSEG output	105% of SSEG output
Trip time. Limit is 0.5 seconds	0.32	0.21	0.16	0.17	0.31	0.25
For Multi phase <b>SSEGs</b> confirm that the device shuts down correctly after the removal of a single fuse as well as operation of all phases.						
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of SSEG output	95% of SSEG output	95% of SSEG output	105% of SSEG output	105% of SSEG output	105% of SSEG output
Trip time. Ph1 fuse removed	0.21	0.36	0.31	0.25	0.16	0.20
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of SSEG output	95% of SSEG output	95% of SSEG output	105% of SSEG output	105% of SSEG output	105% of SSEG output
Trip time. Ph2 fuse removed	0.22	0.36	0.30	0.26	0.19	0.22
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of SSEG output	95% of SSEG output	95% of SSEG output	105% of SSEG output	105% of SSEG output	105% of SSEG output
Trip time. Ph3 fuse removed	0.20	0.37	0.33	0.25	0.16	0.18
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.						

<b>Protection. Frequency change, Stability test</b> The requirement is specified in section 5.3.3, test procedure in Annex A or B 1.3.6					<b>PASS</b>
Growatt 6000 3ph UE					
	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	

<b>Protection. Re-connection timer.</b> The requirement is specified in section 5.3.4, test procedure in Annex A or B 1.3.5					<b>PASS</b>
Growatt 6000UE					
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.					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
20S	36.21/36.22 36.11/36.21	At 266.2V	At 196.1V	At 47.4Hz	At 51.6Hz
Confirmation that the SSEG does not re-connect.		No Connect	No Connect	No Connect	No Connect

<b>Fault level contribution.</b> The requirement is specified in section 5.7, test procedure in Annex A or B 1.4.6					<b>PASS</b>
Growatt 6000UE					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$i_p$	--	20ms	30V <sub>r.m.s</sub>	0.4A
Initial Value of aperiodic current	$A$	--	100ms	30V <sub>r.m.s</sub>	0
Initial symmetrical short-circuit current*	$I_k$	--	250ms	30V <sub>r.m.s</sub>	0
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	--	500ms	30V <sub>r.m.s</sub>	0
Reactance/Resistance Ratio of source*	$X/R$	--	Time to trip	0.11	In seconds

<b>Self-Monitoring solid state switching</b> The requirement is specified in section 5.3.1, No specified test requirements.		Yes/or NA
Growatt 6000UE		
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.		Yes