G83/2-1 Engineering Recommendation

Type Approval and manufacturer/supplier declaration of compliance with the requirements of Engineering Recommendation G83/2-1.			
SSEG Type reference number		Growatt 3000TL3-S/ Growatt 4000 TL3-S / Growatt 5000 TL3-S / Growatt 6000TL3-S / Growatt 7000TL3-S /Growatt 8000TL3-S/ Growatt 9000 TL3-S / Growatt 10000 TL3-S	
SSEG Type		Photovoltaic inverter	
System Supplier name		Growatt New Energy Technology Co., Ltd.	
Address		1st East & 3rd Floor of Building A,Building B,Jiayu Industrial Park,#28,GuangHui Road,LongTeng Community,Shiyan Street,Baoan,District,Shenzhen, P.R.China	
Tel	+86 755 2951 5888	Fax	+86 755 2747 2131
E-mail	info@ginverter.com	Web site	www.ginverter.com
Maximum rated capacity	Connection Option		
	N/A	kW single phase, single, split or three phase system	
	3	KW three phase	
	4	KW three phase	
	5	KW three phase	
	6	KW three phase	
	7	KW three phase	
	8	KW three phase	
	9	KW three phase	
	10	KW three phase	
	N/A	kW two phase in three phase system	
	N/A	kW two phase 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 G83/2-1.			
Singed	James Wang	On behalf of	Growatt New Energy Technology Co., Ltd.

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.
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 3000TL3-S
Growatt 4000TL3-S
Growatt 5000TL3-S
Growatt 6000TL3-S
Growatt 7000TL3-S
Growatt 8000TL3-S
Growatt 9000 TL3-S
Growatt 10000 TL3-S

The model Growatt 10000TL3-S is as the representative test models in this report.

G83/2-1 Appendix 4 Type Verification Test Report

Power Quality. Harmonics. The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1						
SSEG rating per phase (rpp)			3.33	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	0.020	0.022	0.024	0.027	1.080	
3	0.040	0.045	0.046	0.051	2.300	
4	0.031	0.035	0.051	0.056	0.430	
5	0.190	0.210	0.248	0.274	1.140	
6	0.018	0.020	0.024	0.027	0.300	
7	0.114	0.126	0.140	0.155	0.770	
8	0.014	0.015	0.021	0.023	0.230	
9	0.021	0.023	0.022	0.024	0.400	

10	0.010	0.011	0.014	0.015	0.184	
11	0.039	0.043	0.054	0.060	0.330	
12	0.006	0.007	0.006	0.007	0.153	
13	0.035	0.038	0.045	0.050	0.210	
14	0.005	0.006	0.007	0.008	0.131	
15	0.010	0.011	0.010	0.011	0.150	
16	0.004	0.004	0.005	0.006	0.115	
17	0.021	0.023	0.033	0.036	0.132	
18	0.009	0.010	0.014	0.015	0.102	
19	0.015	0.017	0.025	0.028	0.118	
20	0.007	0.007	0.012	0.013	0.92	
21	0.004	0.004	0.004	0.004	0.107	0.160
22	0.003	0.003	0.004	0.004	0.084	
23	0.008	0.009	0.016	0.018	0.098	0.147
24	0.002	0.002	0.002	0.002	0.077	
25	0.006	0.006	0.012	0.013	0.090	0.135
26	0.002	0.002	0.002	0.002	0.071	
27	0.003	0.003	0.003	0.003	0.083	0.124
28	0.002	0.002	0.002	0.002	0.066	
29	0.005	0.005	0.008	0.009	0.078	0.117
30	0.001	0.001	0.002	0.002	0.061	
31	0.004	0.004	0.006	0.007	0.073	0.109
32	0.002	0.002	0.002	0.002	0.058	
33	0.001	0.001	0.002	0.002	0.068	0.102
34	0.001	0.001	0.001	0.001	0.054	
35	0.003	0.003	0.004	0.004	0.064	0.096
36	0.001	0.002	0.002	0.002	0.051	
37	0.003	0.004	0.004	0.004	0.061	0.091
38	0.001	0.001	0.001	0.001	0.048	
39	0.002	0.002	0.001	0.001	0.058	0.087
40	0.001	0.001	0.001	0.001	0.046	

Average harmonic current results – Phase 2						
	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	0.178	0.197	0.212	0.234	1.080	
3	0.065	0.072	0.073	0.081	2.300	
4	0.040	0.045	0.063	0.070	0.430	
5	0.174	0.193	0.236	0.261	1.140	

6	0.028	0.030	0.033	0.036	0.300	
7	0.123	0.136	0.158	0.175	0.770	
8	0.016	0.018	0.020	0.022	0.230	
9	0.035	0.039	0.031	0.034	0.400	
10	0.017	0.019	0.021	0.023	0.184	
11	0.042	0.047	0.058	0.064	0.330	
12	0.012	0.014	0.014	0.015	0.153	
13	0.034	0.038	0.044	0.049	0.210	
14	0.014	0.015	0.018	0.020	0.131	
15	0.016	0.018	0.017	0.019	0.150	
16	0.006	0.007	0.006	0.007	0.115	
17	0.019	0.021	0.033	0.036	0.132	
18	0.007	0.007	0.012	0.013	0.102	
19	0.015	0.017	0.026	0.029	0.118	
20	0.008	0.008	0.012	0.013	0.92	
21	0.004	0.005	0.004	0.004	0.107	0.160
22	0.004	0.004	0.004	0.004	0.084	
23	0.008	0.008	0.016	0.018	0.098	0.147
24	0.004	0.004	0.004	0.004	0.077	
25	0.006	0.006	0.012	0.013	0.090	0.135
26	0.004	0.005	0.007	0.008	0.071	
27	0.004	0.004	0.005	0.006	0.083	0.124
28	0.003	0.004	0.003	0.003	0.066	
29	0.004	0.005	0.008	0.009	0.078	0.117
30	0.003	0.003	0.003	0.003	0.061	
31	0.004	0.004	0.006	0.007	0.073	0.109
32	0.002	0.003	0.003	0.003	0.058	
33	0.002	0.002	0.002	0.002	0.068	0.102
34	0.002	0.003	0.002	0.002	0.054	
35	0.003	0.003	0.004	0.004	0.064	0.096
36	0.002	0.003	0.003	0.003	0.051	
37	0.003	0.003	0.004	0.004	0.061	0.091
38	0.002	0.002	0.001	0.001	0.048	
39	0.002	0.002	0.002	0.002	0.058	0.087
40	0.002	0.003	0.003	0.003	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	0.179	0.198	0.216	0.239	1.080	
3	0.033	0.036	0.035	0.039	2.300	
4	0.030	0.033	0.053	0.059	0.430	
5	0.203	0.224	0.264	0.292	1.140	
6	0.021	0.024	0.018	0.020	0.300	
7	0.104	0.115	0.138	0.153	0.770	
8	0.015	0.017	0.021	0.023	0.230	
9	0.018	0.020	0.019	0.021	0.400	
10	0.013	0.015	0.013	0.014	0.184	
11	0.049	0.055	0.064	0.071	0.330	
12	0.014	0.016	0.015	0.017	0.153	
13	0.031	0.035	0.043	0.048	0.210	
14	0.013	0.014	0.016	0.018	0.131	
15	0.007	0.008	0.008	0.009	0.150	
16	0.006	0.007	0.005	0.006	0.115	
17	0.022	0.024	0.035	0.039	0.132	
18	0.011	0.012	0.013	0.014	0.102	
19	0.014	0.015	0.024	0.027	0.118	
20	0.008	0.009	0.013	0.014	0.92	
21	0.003	0.003	0.003	0.003	0.107	0.160
22	0.005	0.005	0.004	0.004	0.084	
23	0.008	0.009	0.016	0.018	0.098	0.147
24	0.004	0.005	0.004	0.004	0.077	
25	0.005	0.006	0.010	0.011	0.090	0.135
26	0.005	0.005	0.008	0.009	0.071	
27	0.002	0.002	0.002	0.002	0.083	0.124
28	0.004	0.004	0.004	0.004	0.066	
29	0.005	0.005	0.008	0.009	0.078	0.117
30	0.003	0.003	0.002	0.002	0.061	
31	0.003	0.004	0.005	0.006	0.073	0.109
32	0.003	0.003	0.004	0.004	0.058	
33	0.001	0.001	0.001	0.001	0.068	0.102
34	0.002	0.003	0.003	0.003	0.054	
35	0.003	0.004	0.004	0.004	0.064	0.096
36	0.002	0.002	0.001	0.001	0.051	
37	0.003	0.003	0.003	0.003	0.061	0.091
38	0.002	0.002	0.002	0.002	0.048	
39	0.001	0.001	0.001	0.001	0.058	0.087
40	0.002	0.003	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								
	Starting			Stopping			Running	
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_{st}	P_{lt} 2 hours
Measured Values	0.169	0.24	0	0.169	0.24	0	0.042	0.040
Normalised to standard impedance and 3.68kW for multiple units	0.169	0.24	0	0.169	0.24	0	0.042	0.040
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65
Test start date	2017.6.12			Test end date			2017.6.12	
Test location	Growatt R&D Test Lab							

Power Quality. DC injection. The requirement is specified in section 5.5, test procedure in Annex A or B 1.4.4			
Test power level	10%	55%	100%
Recorded value	18.6mA	15.5mA	12.1mA
as % of rated AC current	0.128%	0.107%	0.084%
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				
	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	

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 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

Protection. Voltage tests. The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2						
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 ±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 ±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. The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4						
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	0.301	0.372	0.324	0.269	0.326	0.389
For Multi phase **SSEG**s 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	0.291	0.324	0.356	0.302	0.317	0.358
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	0.301	0.378	0.354	0.321	0.358	0.347
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on	95% of	95% of	95% of	105% of	105% of	105% of

islanded network	SSEG output	SSEG output	SSEG output	SSEG output	SSEG output	SSEG output
Trip time. Ph3 fuse removed	0.345	0.374	0.358	0.367	0.315	0.306
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.					0.3 ms	
Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.						
Test power and iimbalance	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	0.294	0.367	0.342	0.298	0.347	0.389

Protection. Frequency change, Vector Shift 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	+50 degrees		No Trip
Negative Vector Shift	50.5Hz	-50 degrees		No Trip

Protection. Frequency change, RoCoF Stability test. The requirement is specified in section 5.3.3, test procedure in Annex A or B 1.3.6			
Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0Hz to 51.0Hz	+0.95Hzs^{-1}	2.1s	No Trip
51.0Hz to 49.0Hz	-0.95Hzs^{-1}	2.1s	No Trip

Protection. Re-connection timer. The requirement is specified in section 5.3.4, 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.					
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	36.5	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

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	--	20ms	10V	0.4A
Initial Value of aperiodic current	A	--	100ms	10V	0.38
Initial symmetrical short-circuit current*	I_k	--	250ms	9.6V	0.29
Decaying (aperiodic) component of short circuit current*	i_{DC}	--	500ms	9.2V	0.26
Reactance/Resistance Ratio of source*	*X/R*	--	Time to trip	0.11	In seconds
Self-Monitoring solid state switching The requirement is specified in section 5.3.1, No specified test requirements					YES/ or NA
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.					NA

Additional comments