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Certification body of BV CPS GmbH
Accredited according to EN 45011 -
ISO / IEC Guide 65

Certificate of compliance

Applicant: **Shenzhen Growatt New Energy Technology Co., Ltd**
1st East & 3rd Floor. Jiayu Industrial Zone. Xibianling.
Shangwu Village. Shiyan. Baoan District. Shenzhen.
P.R.China

Product: **Grid-tied photovoltaic (PV) inverter**

Model: **Growatt 1000. Growatt 1500. Growatt 2000.
Growatt 3000. Growatt 4000**

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: **12TH0218-G83/2**

Certificate number: **U13-0407**

Date of issue: **2013-06-26** **Valid until:** **2016-06-25**

Certification body

Dieter Zitzmann



Deutsche
Akkreditierungsstelle
D-ZE-12024-01-01



QUALITY



HEALTH



SAFETY



ENVIRONMENT



SOCIAL
ACCOUNTABILITY

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

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

Manufacturer / applicant:	Shenzhen Growatt New Energy Technology Co., Ltd 1st East & 3rd Floor. Jiayu Industrial Zone. Xibianling. Shangwu Village. Shiyan. Baoan District. Shenzhen. P.R.China				
SSEG Type	Grid-tied photovoltaic inverter				
Rated values	Growatt 1000	Growatt 1500	Growatt 2000	Growatt 3000	Growatt 4000
Maximum rated capacity	1000W	1600W	2000W	2850W	3680W
Rated voltage	230V	230V	230V	230V	230V
Firmware version	V1.02				
Measurement period:	2013-04-01 to 2013-05-31				

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.

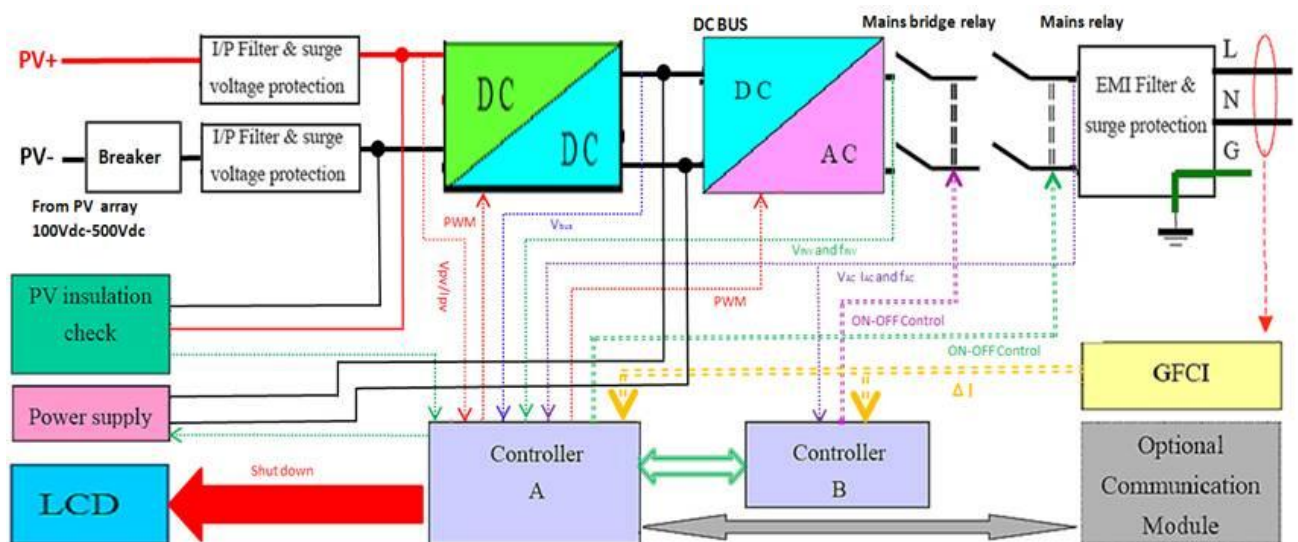


Figure 1 – Schematic structure of the power generation unit

Differences between SSEG units:

The models Growatt 1000, Growatt 1500, Growatt 2000, Growatt 3000 and Growatt 4000 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						
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	201.4V	2.53s	204.1V / 3.5s	No trip
U/V stage 2	184V	0.5s	185.2V	0.532s	188V / 2.48s	No trip
					180V / 0.48s	No trip
O/V stage 1	262.2V	1.0s	260.9V	1.03s	258.2V 2.0s	No trip
O/V stage 2	273.7V	0.5s	271.9V	0.526s	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.						

Proteccion. 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	47.52Hz	20.12s	47.7Hz / 25s	No trip
U/F stage 2	47Hz	0.5s	47.02Hz	0.520s	47.2Hz / 19.98s	No trip
					46.8Hz / 0.48s	No trip
O/F stage 1	51.5Hz	90s	51.48Hz	90.30s	51.3Hz / 95s	No trip
O/F stage 2	52Hz	0.5s	51.99Hz	0.523s	51.8Hz / 89.98s	No trip
					52.2Hz / 0.48s	No trip



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Protection. Loss of Mains.

The requirement is specified in section 5.3.2. test procedure in Annex A or B 1.3.4

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.

Balancing load on islanded network	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% Q Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of -5% Q Test 10
Trip time. Ph1 fuse removed	192ms	124ms	160ms	222ms	116ms	152ms

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:
Song Chuan SCL-1-H-DPNO-F 12VDC with 25ms
Type of switching equipment 2:
Song Chuan SCL-1-H-DPNO-F 12VDC with 25ms

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

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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		66s			
Frequency					
Time delay setting		Measured delay			
20s		65s			
		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	

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

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

Power Quality. Harmonics.						
The requirement is specified in section 5.4.1. test procedure in Annex A or B 1.4.1						
Growatt 1000						
SSEG rating per phase (rpp)				NV=MV*3.68/rpp		
	At 45-55% of rated ouput 0.497kW		100% of rated output 0.996kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit inBS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0.046	0.170	0.035	0.129	1.080	
3rd	0.073	0.269	0.083	0.306	2.300	
4th	0.034	0.126	0.015	0.056	0.430	
5th	0.045	0.167	0.048	0.176	1.140	
6th	0.012	0.043	0.010	0.036	0.300	
7th	0.024	0.088	0.026	0.095	0.770	
8th	0.010	0.036	0.007	0.027	0.230	
9th	0.014	0.053	0.019	0.070	0.400	
10th	0.008	0.030	0.006	0.021	0.184	
11th	0.009	0.032	0.015	0.055	0.330	
12th	0.008	0.028	0.005	0.020	0.153	
13th	0.007	0.027	0.013	0.047	0.210	
14th	0.006	0.022	0.005	0.018	0.131	
15th	0.011	0.039	0.010	0.038	0.150	
16th	0.005	0.020	0.005	0.018	0.115	
17th	0.011	0.041	0.013	0.049	0.132	
18th	0.005	0.019	0.006	0.021	0.102	
19th	0.012	0.043	0.015	0.054	0.118	
20th	0.005	0.017	0.006	0.021	0.092	
21th	0.013	0.046	0.018	0.067	0.107	0.160
22th	0.004	0.016	0.006	0.021	0.084	
23th	0.010	0.038	0.016	0.060	0.098	0.147
24th	0.004	0.015	0.006	0.022	0.077	
25th	0.009	0.035	0.017	0.063	0.090	0.135

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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						
SSEG rating per phase (rpp)					NV=MV*3.68/rpp	
	At 45-55% of rated output 0.497kW		100% of rated output 0.996kW			
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
26th	0.004	0.015	0.006	0.021	0.071	
27th	0.008	0.028	0.014	0.052	0.083	0.124
28th	0.004	0.015	0.006	0.021	0.066	
29th	0.009	0.033	0.019	0.070	0.078	0.117
30th	0.004	0.013	0.005	0.019	0.061	
31th	0.008	0.029	0.017	0.062	0.073	0.109
32th	0.003	0.013	0.005	0.019	0.058	
33th	0.009	0.033	0.017	0.063	0.068	0.102
34th	0.003	0.011	0.005	0.018	0.054	
35th	0.008	0.030	0.014	0.053	0.064	0.096
36th	0.003	0.009	0.005	0.017	0.051	
37th	0.007	0.025	0.012	0.045	0.061	0.091
38th	0.002	0.008	0.005	0.018	0.048	
39th	0.006	0.020	0.011	0.040	0.058	0.087
40th	0.003	0.009	0.005	0.018	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.

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

Power Quality. Harmonics.						
The requirement is specified in section 5.4.1. test procedure in Annex A or B 1.4.1						
Growatt 1000						
SSEG rating per phase (rpp)				NV=MV*3.68/rpp		
	At 45-55% of rated ouput 0.497kW		100% of rated output 0.996kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit inBS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0.046	0.170	0.035	0.129	1.080	
3rd	0.073	0.269	0.083	0.306	2.300	
4th	0.034	0.126	0.015	0.056	0.430	
5th	0.045	0.167	0.048	0.176	1.140	
6th	0.012	0.043	0.010	0.036	0.300	
7th	0.024	0.088	0.026	0.095	0.770	
8th	0.010	0.036	0.007	0.027	0.230	
9th	0.014	0.053	0.019	0.070	0.400	
10th	0.008	0.030	0.006	0.021	0.184	
11th	0.009	0.032	0.015	0.055	0.330	
12th	0.008	0.028	0.005	0.020	0.153	
13th	0.007	0.027	0.013	0.047	0.210	
14th	0.006	0.022	0.005	0.018	0.131	
15th	0.011	0.039	0.010	0.038	0.150	
16th	0.005	0.020	0.005	0.018	0.115	
17th	0.011	0.041	0.013	0.049	0.132	
18th	0.005	0.019	0.006	0.021	0.102	
19th	0.012	0.043	0.015	0.054	0.118	
20th	0.005	0.017	0.006	0.021	0.092	
21th	0.013	0.046	0.018	0.067	0.107	0.160
22th	0.004	0.016	0.006	0.021	0.084	
23th	0.010	0.038	0.016	0.060	0.098	0.147
24th	0.004	0.015	0.006	0.022	0.077	
25th	0.009	0.035	0.017	0.063	0.090	0.135

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Nr. 12TH0218

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)					NV=MV*3.68/rpp	
	At 45-55% of rated output 0.497kW		100% of rated output 0.996kW			
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
26th	0.004	0.015	0.006	0.021	0.071	
27th	0.008	0.028	0.014	0.052	0.083	0.124
28th	0.004	0.015	0.006	0.021	0.066	
29th	0.009	0.033	0.019	0.070	0.078	0.117
30th	0.004	0.013	0.005	0.019	0.061	
31th	0.008	0.029	0.017	0.062	0.073	0.109
32th	0.003	0.013	0.005	0.019	0.058	
33th	0.009	0.033	0.017	0.063	0.068	0.102
34th	0.003	0.011	0.005	0.018	0.054	
35th	0.008	0.030	0.014	0.053	0.064	0.096
36th	0.003	0.009	0.005	0.017	0.051	
37th	0.007	0.025	0.012	0.045	0.061	0.091
38th	0.002	0.008	0.005	0.018	0.048	
39th	0.006	0.020	0.011	0.040	0.058	0.087
40th	0.003	0.009	0.005	0.018	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.

Appendix 4 Type Verification Test Report

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Nr. 12TH0218

Power Quality. Harmonics.						
The requirement is specified in section 5.4.1. test procedure in Annex A or B 1.4.1						
Growatt 1500						
SSEG rating per phase (rpp)				NV=MV*3.68/rpp		
	At 45-55% of rated ouput 0.795kW		100% of rated output 1.553kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit inBS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0.066	0.151	0.038	0.088	1.080	
3rd	0.094	0.217	0.161	0.370	2.300	
4th	0.049	0.113	0.022	0.050	0.430	
5th	0.062	0.144	0.096	0.221	1.140	
6th	0.015	0.035	0.014	0.033	0.300	
7th	0.030	0.069	0.053	0.122	0.770	
8th	0.011	0.026	0.011	0.026	0.230	
9th	0.019	0.044	0.042	0.096	0.400	
10th	0.009	0.021	0.009	0.022	0.184	
11th	0.013	0.029	0.035	0.079	0.330	
12th	0.010	0.022	0.008	0.019	0.153	
13th	0.010	0.023	0.030	0.069	0.210	
14th	0.008	0.017	0.009	0.021	0.131	
15th	0.009	0.020	0.025	0.058	0.150	
16th	0.007	0.015	0.010	0.023	0.115	
17th	0.010	0.024	0.030	0.069	0.132	
18th	0.006	0.014	0.010	0.024	0.102	
19th	0.013	0.030	0.034	0.077	0.118	
20th	0.006	0.014	0.012	0.027	0.092	
21th	0.015	0.034	0.039	0.089	0.107	0.160
22th	0.005	0.012	0.010	0.023	0.084	
23th	0.015	0.035	0.035	0.081	0.098	0.147
24th	0.005	0.012	0.009	0.021	0.077	
25th	0.014	0.033	0.034	0.078	0.090	0.135

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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						
SSEG rating per phase (rpp)				NV=MV*3.68/rpp		
	At 45-55% of rated output 0.795kW		100% of rated output 1.553kW			
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
26th	0.005	0.012	0.008	0.018	0.071	
27th	0.012	0.028	0.024	0.055	0.083	0.124
28th	0.006	0.013	0.008	0.017	0.066	
29th	0.016	0.037	0.028	0.063	0.078	0.117
30th	0.005	0.011	0.006	0.014	0.061	
31th	0.013	0.030	0.020	0.047	0.073	0.109
32th	0.005	0.011	0.005	0.012	0.058	
33th	0.013	0.030	0.018	0.042	0.068	0.102
34th	0.004	0.010	0.005	0.010	0.054	
35th	0.011	0.026	0.014	0.033	0.064	0.096
36th	0.004	0.009	0.004	0.008	0.051	
37th	0.011	0.024	0.011	0.025	0.061	0.091
38th	0.004	0.009	0.003	0.007	0.048	
39th	0.009	0.020	0.009	0.020	0.058	0.087
40th	0.004	0.009	0.003	0.008	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						
Growatt 2000						
SSEG rating per phase (rpp)				NV=MV*3.68/rpp		
	At 45-55% of rated ouput 0.999kW		100% of rated output 2.018kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit inBS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0.076	0.140	0.090	0.166	1.080	
3rd	0.147	0.271	0.153	0.282	2.300	
4th	0.017	0.031	0.028	0.051	0.430	
5th	0.089	0.164	0.088	0.162	1.140	
6th	0.009	0.017	0.015	0.028	0.300	
7th	0.059	0.108	0.052	0.095	0.770	
8th	0.008	0.015	0.012	0.022	0.230	
9th	0.045	0.082	0.041	0.075	0.400	
10th	0.010	0.019	0.012	0.022	0.184	
11th	0.033	0.061	0.031	0.058	0.330	
12th	0.012	0.021	0.014	0.025	0.153	
13th	0.025	0.045	0.029	0.054	0.210	
14th	0.012	0.022	0.016	0.030	0.131	
15th	0.025	0.046	0.025	0.045	0.150	
16th	0.011	0.020	0.018	0.033	0.115	
17th	0.022	0.041	0.030	0.054	0.132	
18th	0.012	0.021	0.018	0.033	0.102	
19th	0.018	0.034	0.032	0.059	0.118	
20th	0.010	0.018	0.018	0.033	0.092	
21th	0.015	0.027	0.039	0.071	0.107	0.160
22th	0.007	0.013	0.018	0.033	0.084	
23th	0.013	0.023	0.031	0.057	0.098	0.147
24th	0.006	0.011	0.016	0.029	0.077	
25th	0.013	0.024	0.029	0.053	0.090	0.135

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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						
SSEG rating per phase (rpp)					NV=MV*3.68/rpp	
	At 45-55% of rated output 0.999kW		100% of rated output 2.018kW			
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
26th	0.006	0.010	0.013	0.025	0.071	
27th	0.011	0.020	0.021	0.039	0.083	0.124
28th	0.005	0.010	0.012	0.022	0.066	
29th	0.011	0.021	0.026	0.047	0.078	0.117
30th	0.006	0.011	0.011	0.019	0.061	
31th	0.010	0.019	0.021	0.038	0.073	0.109
32th	0.006	0.011	0.008	0.015	0.058	
33th	0.011	0.019	0.020	0.036	0.068	0.102
34th	0.006	0.010	0.008	0.014	0.054	
35th	0.010	0.019	0.015	0.027	0.064	0.096
36th	0.006	0.010	0.007	0.012	0.051	
37th	0.010	0.017	0.011	0.021	0.061	0.091
38th	0.005	0.009	0.006	0.010	0.048	
39th	0.009	0.016	0.009	0.017	0.058	0.087
40th	0.005	0.009	0.006	0.010	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.

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

Power Quality. Harmonics.						
The requirement is specified in section 5.4.1. test procedure in Annex A or B 1.4.1						
Growatt 3000						
SSEG rating per phase (rpp)				NV=MV*3.68/rpp		
	At 45-55% of rated ouput 1.440kW		100% of rated output 2.868kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit inBS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0.078	0.101	0.100	0.129	1.080	
3rd	0.149	0.192	0.154	0.199	2.300	
4th	0.022	0.028	0.033	0.043	0.430	
5th	0.086	0.112	0.100	0.129	1.140	
6th	0.012	0.015	0.019	0.025	0.300	
7th	0.052	0.067	0.049	0.063	0.770	
8th	0.009	0.011	0.015	0.019	0.230	
9th	0.040	0.052	0.048	0.061	0.400	
10th	0.009	0.012	0.013	0.017	0.184	
11th	0.029	0.037	0.051	0.065	0.330	
12th	0.013	0.016	0.017	0.021	0.153	
13th	0.020	0.025	0.053	0.068	0.210	
14th	0.013	0.016	0.021	0.026	0.131	
15th	0.016	0.021	0.046	0.059	0.150	
16th	0.014	0.018	0.022	0.029	0.115	
17th	0.016	0.021	0.060	0.077	0.132	
18th	0.015	0.020	0.025	0.033	0.102	
19th	0.018	0.024	0.061	0.079	0.118	
20th	0.015	0.019	0.025	0.032	0.092	
21th	0.020	0.026	0.069	0.089	0.107	0.160
22th	0.014	0.018	0.024	0.031	0.084	
23th	0.018	0.023	0.056	0.072	0.098	0.147
24th	0.012	0.015	0.021	0.027	0.077	
25th	0.018	0.023	0.053	0.068	0.090	0.135

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

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)					NV=MV*3.68/rpp	
	At 45-55% of rated output 1.440kW		100% of rated output 2.868kW			
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
26th	0.010	0.013	0.017	0.022	0.071	
27th	0.016	0.020	0.037	0.047	0.083	0.124
28th	0.010	0.013	0.016	0.021	0.066	
29th	0.016	0.021	0.044	0.057	0.078	0.117
30th	0.009	0.011	0.014	0.019	0.061	
31th	0.014	0.018	0.035	0.045	0.073	0.109
32th	0.007	0.009	0.012	0.016	0.058	
33th	0.014	0.018	0.031	0.041	0.068	0.102
34th	0.006	0.007	0.010	0.013	0.054	
35th	0.012	0.015	0.025	0.032	0.064	0.096
36th	0.005	0.006	0.008	0.011	0.051	
37th	0.009	0.012	0.019	0.025	0.061	0.091
38th	0.004	0.006	0.007	0.009	0.048	
39th	0.007	0.009	0.015	0.019	0.058	0.087
40th	0.004	0.006	0.007	0.009	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.

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

Power Quality. Harmonics.						
The requirement is specified in section 5.4.1. test procedure in Annex A or B 1.4.1						
Growatt 4000						
SSEG rating per phase (rpp)				NV=MV*3.68/rpp		
	At 45-55% of rated ouput 2.031kW		100% of rated output 3.648kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit inBS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0.065	0.065	0.103	0.103	1.080	
3rd	0.173	0.173	0.179	0.179	2.300	
4th	0.033	0.033	0.051	0.051	0.430	
5th	0.132	0.132	0.139	0.139	1.140	
6th	0.021	0.021	0.029	0.029	0.300	
7th	0.088	0.088	0.074	0.074	0.770	
8th	0.014	0.014	0.020	0.020	0.230	
9th	0.065	0.065	0.071	0.071	0.400	
10th	0.010	0.010	0.016	0.016	0.184	
11th	0.046	0.046	0.056	0.056	0.330	
12th	0.009	0.009	0.017	0.017	0.153	
13th	0.031	0.031	0.050	0.050	0.210	
14th	0.009	0.009	0.018	0.018	0.131	
15th	0.020	0.020	0.042	0.042	0.150	
16th	0.010	0.010	0.019	0.019	0.115	
17th	0.019	0.019	0.043	0.043	0.132	
18th	0.009	0.009	0.019	0.019	0.102	
19th	0.017	0.017	0.048	0.048	0.118	
20th	0.010	0.010	0.020	0.020	0.092	
21th	0.017	0.017	0.063	0.063	0.107	0.160
22th	0.011	0.011	0.020	0.020	0.084	
23th	0.018	0.018	0.047	0.047	0.098	0.147
24th	0.010	0.010	0.018	0.018	0.077	
25th	0.020	0.020	0.051	0.051	0.090	0.135

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

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)				NV=MV*3.68/rpp		
	At 45-55% of rated output 2.031kW		100% of rated output 3.648kW			
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
26th	0.009	0.009	0.015	0.015	0.071	
27th	0.016	0.016	0.041	0.041	0.083	0.124
28th	0.012	0.012	0.020	0.020	0.066	
29th	0.022	0.022	0.049	0.049	0.078	0.117
30th	0.009	0.009	0.014	0.014	0.061	
31th	0.021	0.021	0.042	0.042	0.073	0.109
32th	0.007	0.007	0.012	0.012	0.058	
33th	0.019	0.019	0.041	0.041	0.068	0.102
34th	0.006	0.006	0.011	0.011	0.054	
35th	0.016	0.016	0.038	0.038	0.064	0.096
36th	0.006	0.006	0.008	0.008	0.051	
37th	0.012	0.012	0.028	0.028	0.061	0.091
38th	0.005	0.005	0.007	0.007	0.048	
39th	0.009	0.009	0.024	0.024	0.058	0.087
40th	0.004	0.004	0.006	0.006	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.

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

Power Quality. Power factor.				
The requirement is specified in section 5.6. test procedure in Annex A or B 1.4.2				
Growatt 1000				
	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	0.9983	0.9964	0.9854	
Limit	>0.95	>0.95	>0.95	
Growatt 1500				
	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	0.9982	0.9975	0.9958	
Limit	>0.95	>0.95	>0.95	
Growatt 2000				
	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	0.9992	0.9985	0.9976	
Limit	>0.95	>0.95	>0.95	
Growatt 3000				
	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	0.9995	0.9995	0.9976	
Limit	>0.95	>0.95	>0.95	
Growatt 4000				
	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	0.9978	0.9981	0.9982	
Limit	>0.95	>0.95	>0.95	

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

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

Growatt 1000

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	1.08%	0.89%	0.89% 500ms	1.08%	0.89%	0.89% 500ms	0.27	0.17
Normalised to standard impedance and 3.68kW for multiple units	3.98%	3.28%	3.28%	3.98%	3.28%	3.28%	1.0	0.63
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65

Growatt 1500

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	1.73%	1.43%	1.43% 500ms	1.73%	1.43%	1.43% 500ms	0.43	0.28
Normalised to standard impedance and 3.68kW for multiple units	3.98%	3.29%	3.29%	3.98%	3.29%	3.29%	0.99	0.64
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65

Growatt 2000

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	2.17%	1.79%	1.79% 500ms	2.17%	1.79%	1.79% 500ms	0.54	0.35
Normalised to standard impedance and 3.68kW for multiple units	3.29%	3.29%	3.30%	3.99%	3.29%	3.29%	1.0	0.64
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

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

Growatt 3000

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	3.09%	2.55%	2.55% 500ms	3.09%	2.55%	2.55% 500ms	0.77	0.50
Normalised to standard impedance and 3.68kW for multiple units	3.99%	3.29%	3.29%	3.99%	3.29%	3.29%	1.0	0.65
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65

Growatt 4000

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65
Normalised to standard impedance and 3.68kW for multiple units	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65



Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

Power Quality. DC injection.			
The requirement is specified in section 5.5. test procedure in Annex A or B 1.4.4			
Growatt 1000			
Test level power	10%	55%	100%
Recorded value	7.0 mA	10.9 mA	-15.7 mA
Limit	20mA	20mA	20mA
Growatt 3000			
Test level power	10%	55%	100%
Recorded value	-12.2 mA	-14.2 mA	14.5 mA
As % of rated AC current	0.10%	0.11%	0.12%
Limit	0.25%	0.25%	0.25%
Growatt 4000			
Test level power	10%	55%	100%
Recorded value	-16.6 mA	-31.3 mA	-21.9 mA
As % of rated AC current	0.08%	0.16%	0.11%
Limit	0.25%	0.25%	0.25%

Appendix 4 Type Verification Test Report

Extract from test report according the Engineering Recommendation G83/2

Nr. 12TH0218

Fault level Contribution.					
The requirement is specified in section 5.7. test procedure in Annex A or B 1.4.6					
Growatt 3000					
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	55.1	16.8
Initial Value of aperiodic current	A	N/A	100ms	32.9	8.52
Initial symmetrical short-circuit current*	I_k	N/A	250ms	28.0	5.46
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	0.05	In seconds
Growatt 4000					
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	35.7	14.1
Initial Value of aperiodic current	A	N/A	100ms	27.9	6.78
Initial symmetrical short-circuit current*	I_k	N/A	250ms	26.5	4.32
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	0.07	In seconds

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.	