G59/3 Generating Unit Type Test Sheet

Type Tested Generating Unit

This Type Test sheet shall be used to record the results of the type testing of Generating Unit between16A per phase and 17kW per phase maximum output at 230V (17kW limit single phase, 34kW limit split phase, 50kW limit 3 phase) It includes the **Generating Unit**s supplier declaration of compliance with the requirements of Engineering Recommendation G59/3			
Type Tested reference number		DQ141002	
Generating Unit technology		Transformer less PV inverter	
Model Name		Solis-mini-700, Solis-mini-1000, Solis-mini-1500, Solis-mini-2000,	
System supplier name		Ningbo Ginlong Technologies Co.,Ltd.	
Address		No. 57 Jintong Road,Seafront(Binhai) Industrial Park,Xiangshan,Ningbo, Zhejiang, 315712,P.R.China	
Tel	(+86) 574 6580 3377	Fax	(+86) 574 6578 1606
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Maximum export capacity, use separate sheet if more than one connection option.	0.7~2	kW single phase, single, split or three phase system
	--	kW three phase
	--	kW two phases in three phase system
	--	kW two phases split phase system

System supplier declaration. - I certify on behalf of the company named above as a supplier of a **Generating Unit**, that all products supplied by the company with the above Type Test reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site modifications are required to ensure that the product meets all the requirements of G59/3.

Signed	Zhang Kun 15.Oct.2014	On behalf of	GinlongTechnologies 宁波锦浪新能源科技有限公司 NINGBO GINLONG TECHNOLOGIES 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.

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G59/3 TYPE TEST VERIFICATION REPORT

Power Quality. Harmonics. These tests should be carried out as specified in 61000-3-12 or 61000-3-2. Only one set of tests is required and the **Manufacturer** should decide which one to use and complete the relevant table. The chosen test should be undertaken with a fixed source of energy at two power levels a) between 45 and 55% and b) at 100% of maximum export capacity.

The test should be carried out on a single **Generating Unit.** The results need to comply with the limits of table 2 of BS EN 61000-3-12 for single phase equipment, to table 3 of BS EN 61000-3-12 for three phase equipment or to table 1 of BS EN 61000-3-2 if that standard is used.

Note that Generating Units meeting the requirements of BS EN 61000-3-2 will need no further assesment with regards to harmonics. Generating Unitswith emissions close to the limits laid down in BS EN 61000-3-12 may require the installation of a transformer between 2 and 4 times the rating of the **Generating Unit** in order to accept the connection to a **DNO**'s network.

Generating Unit tested to BS EN 61000-3-12

SSEG rating per phase (rpp)			2	kW		
Harmonic	At 45-55% of rated output		100% of rated output			
No.of Harmonic	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	0.064	0.071	0.045	0.053	1.080	
3	0.352	0.367	0.287	0.296	2.300	
4	0.046	0.053	0.031	0.038	0.430	
5	0.187	0.195	0.176	0.192	1.140	
6	0.037	0.045	0.025	0.033	0.300	
7	0.112	0.121	0.108	0.119	0.770	
8	0.029	0.034	0.023	0.032	0.230	
9	0.075	0.083	0.084	0.095	0.400	
10	0.023	0.031	0.025	0.037	0.184	
11	0.047	0.054	0.073	0.081	0.330	
12	0.017	0.026	0.021	0.017	0.153	
13	0.045	0.057	0.043	0.049	0.210	

14	0.011	0.018	0.017	0.025	0.131	
15	0.025	0.033	0.037	0.043	0.150	
16	0.016	0.023	0.012	0.015	0.115	
17	0.013	0.019	0.021	0.026	0.132	
18	0.012	0.017	0.015	0.02	0.102	
19	0.014	0.022	0.017	0.023	0.118	
20	0.21	0.028	0.013	0.019	0.092	
21	0.017	0.025	0.014	0.019	0.107	0.160
22	0.012	0.017	0.012	0.018	0.084	
23	0.009	0.015	0.0011	0.017	0.098	0.147
24	0.007	0.016	0.012	0.019	0.077	
25	0.013	0.021	0.017	0.025	0.090	0.135
26	0.011	0.019	0.014	0.022	0.071	
27	0.009	0.015	0.009	0.017	0.083	0.124
28	0.011	0.017	0.012	0.019	0.066	
29	0.015	0.023	0.008	0.015	0.078	0.117
30	0.016	0.021	0.007	0.015	0.061	
31	0.013	0.018	0.006	0.013	0.073	0.109
32	0.009	0.015	0.007	0.013	0.058	
33	0.008	0.015	0.005	0.011	0.068	0.102
34	0.01	0.017	0.006	0.011	0.054	
35	0.007	0.013	0.004	0.009	0.064	0.096
36	0.008	0.015	0.006	0.012	0.051	
37	0.009	0.009	0.005	0.011	0.061	0.091
38	0.005	0.009	0.004	0.008	0.048	
39	0.006	0.011	0.004	0.007	0.058	0.087
40	0.005	0.013	0.005	0.007	0.046	

41	0.008	0.012	0.006	0.011	0.057	0.085
42	0.011	0.013	0.007	0.012	0.044	
43	0.009	0.012	0.009	0.014	0.055	0.081
44	0.006	0.009	0.009	0.013	0.042	
45	0.008	0.011	0.006	0.009	0.043	0.078
46	0.007	0.010	0.007	0.009	0.051	
47	0.007	0.013	0.007	0.011	0.041	0.075
48	0.006	0.010	0.006	0.008	0.049	
49	0.004	0.009	0.005	0.009	0.058	0.071
50	0.005	0.009	0.003	0.006	0.046	

Power Quality. Voltage fluctuations and Flicker. The tests should be carried out on a single **Generating Unit.** Results should be normalised to a standard source impedance or if this results in figures above the limits set in BS EN 61000-3-11 to a suitable Maximum Impedance.

	Starting			Stopping			Running	
	d max	d c	d(t)	d max	d c	d(t)	P st	P lt 2 hours
Measured Values at test impedance	0.43	0.35	0	0.37	0.24	0	0.06	0.07
Normalised to standard impedance	0.43	0.35	0	0.37	0.24	0	0.06	0.07
Normalised to required maximum impedance	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65

Test Impedance	R	0.24	Ω	XI	0.15	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	XI	0.15 * 0.25 ^	Ω
Maximum	R		Ω	XI		Ω

Impedance						

* Applies to three phase and split single phase **Generating Unit**s

^ Applies to single phase **Generating Unit**s and **Generating Unit**s using two phases on a three phase system

For voltage change and flicker measurements the following formula is to be used to convert the measured values to the normalised values where the power factor of the generation output is 0.98 or above.

Normalised value = Measured value*reference source resistance/measured source resistance at test point

Single phase units reference source resistance is 0.4 Ω

Two phase units in a three phase system reference source resistance is 0.4 Ω

Two phase units in a split phase system reference source resistance is 0.24 Ω

Three phase units reference source resistance is 0.24 Ω

Where the power factor of the output is under 0.98 then the XI to R ratio of the test impedance should be close to that of the Standard Impedance.

The stopping test should be a trip from full load operation.

The duration of these tests need to comply with the particular requirements set out in the testing notes for the technology under test. Dates and location of the test need to be noted below

Power quality. DC injection. The tests should be carried out on a single **Generating Unit** Tests are to be carried out three power defined levels ±5%. At 230V a 4 kW single phase inverter has a current output of 17.4A so DC limit is 43.75mA.

Test power level	10%	55%	100%	--
Recorded value in mA	15.2mA	13.3mA	16.4mA	
as % of rated AC current	0.09%	0.08%	0.09%	--
Limit	0.25%	0.25%	0.25%	--

Power Quality. Power factor. The tests should be carried out on a single Generating Unit. Testa are to be carried out at three voltage levels and at full output. Voltage to be maintained within ±1.5% of the stated level during the test.

	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	>0.99	>0.99	>0.99	
Limit	>0.95	>0.95	>0.95	

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	20.2s	47.53Hz	20.3s	47.7Hz / 25s	Yes
U/F stage 2	47Hz	0.63s	47.03Hz	0.63s	47.2Hz / 19.98s	Yes
--	--	--	--	--	46.8Hz / 0.48s	Yes
O/F stage 1	51.5Hz	90.3s	51.47	90.2s	51.3Hz / 95s	Yes
O/F stage 2	52Hz	0.54s	51.97	0.55s	51.8Hz / 89.98s	Yes
--	--	--	--	--	52.2Hz / 0.48s	Yes
Note. For frequency Trip tests the Frequency required to trip is the setting ± 0.1Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used.. The "No-trip tests" need to be carried out at the setting ± 0.2Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

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	2.7s	202.5	2.7s	204.1V / 3.5s	Yes
U/V stage 2	184V	0.6s	185.3	0.62s	188V / 2.48s	Yes
--	--	--	--	--	180V / 0.48s	Yes
O/V stage 1	262.2V	1.2s	261.3	1.2s	258.2V / 2.0s	Yes
O/V stage 2	273.7V	0.6s	272.2	0.63s	269.7V / 0.98s	Yes
--	--	--	--	--	277.7V / 0.48s	Yes
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.

a) **Protection. Loss of Mains test and single phase test.** The tests are to be To be carried out at three output power levels plus or minus 5%, an alternative for inverter connected Generating Units can be used instead.						
To be carried out at three output power levels plus or minus 5%, an alternative for inverter connected Generating Units can be used instead.						
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Generating Unit** output	95% of **Generating Unit** output	95% of **Generating Unit** output	105% of **Generating Unit** output	105% of **Generating Unit** output	105% of **Generating Unit** output
Trip time. Limit is 0.5s	0.29s	0.37s	0.15s	0.42s	0.27s	0.35s
Note. For technologies which have a substantial shut down time this can be added to the 0.5s in establishing that the trip occurred in less than 0.5s maximum. Shut down time could therefore be up to 1.0s for these technologies.						
Indicate additional shut down time included in above results						--

b) **Protection. Frequency change, Stability test**				
	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49.5Hz	+9 degrees	--	Yes
Negative Vector Shift	50.5Hz	- 9 degrees	--	Yes
Positive Frequency drift	49.5Hz	$+0.19Hzs^{-1}$	51.5Hz	Yes
Negative Frequency drift	50.5Hz	$-0.19Hzs^{-1}$	47.5Hz	Yes

c) **Protection. Re-connection timer**. The tests should prove that the reconnection sequence starts in no less than 20s for restoration of voltage and frequency to within the stage 1 settings of table 10.5.7.1		
Test should prove that the reconnection sequence starts in no less than 20s for restoration of voltage and frequency to within the stage 1 settings of table 10.5.7.1		
Time delay setting (s)	Measured delay (s)	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 10.5.7.1.

30	33	At 266.2V	At 196.1V	At 47.4Hz	At 51.6Hz
Confirmation that the **Generating Unit** does not re-connect		Yes	Yes	Yes	Yes

d) Fault level contribution.					
For machines with electro-magnetic output			For Inverter output		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	--	20ms	2.78V	21.3A
Initial Value of aperiodic current	*A*	--	100ms	0	0
0Initial symmetrical short-circuit current*	I_k	--	250ms	0	0
Decaying (aperiodic) component of short circuit current*	i_{DC}	--	500ms	0	0
Reactance/Resistance Ratio of source*	X/R	--	Time to trip	<20ms	In seconds
For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the **Generating Unit** terminals. * Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot					

e) Self Monitoring solid state switching	Yes/NA
It has been verified that in the event of the solid state switching device failing to disconnect the **Generating Unit**, 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
Solis mini single phase inverter all 4 models are the same with typology and firmware, so the test result are based on Solis-mini-2000.