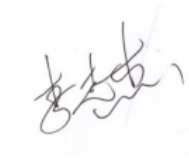
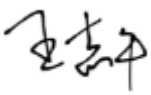
Smarten Your Energy

G99/ 1-3 Type Test Verification Report			
PGM technology		Energy Storage Device	
Manufacturer name		Alpha ESS Co., Ltd.	
Address		Jiu Hua Road 888, Nantong High-Tech Industrial Development Zone, Nantong City, 226300	
Tel	+86 0512 6828 0679	Web site	http://www.alpha-ess.com
E:mail	Jester.li@alpha-ess.com		
Registered Capacity		5kW	

Manufacturer compliance declaration. - I certify that all products supplied by the company with the above Type Tested Manufacturer's 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 EREC G99.

Signed	 Li zhijie	On behalf of	 Wang zhiping

Note that testing can be done by the Manufacturer of an individual component or by an external test house.

Where parts of the testing are carried out by persons or organisations other than the Manufacturer then that person or organisation 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.

A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules – test record

1. Operating Range: Five tests should be carried with the **Power Generating Module** operating at **Registered Capacity** and connected to a suitable test supply or grid simulation set. The power supplied by the primary source shall be kept stable within ± 5 % of the apparent power value set for the entire duration of each test sequence.

Frequency, voltage and **Active Power** measurements at the output terminals of the **Power Generating Module** shall be recorded every second. The tests will verify that the **Power Generating Module** can operate within the required ranges for the specified period of time.

The **Interface Protection** shall be disabled during the tests.

In case of a PV **Power Park Module** the PV primary source may be replaced by a DC source.

In case of a full converter **Power Park Module** (eg wind) the primary source and the prime mover I**nverter**/rectifier may be replaced by a DC source.

Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47 Hz, **Power Factor** = 1, Period of test 20 s	Pass
Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, **Power Factor** = 1, Period of test 90 minutes	Pass
Test 3 Voltage = 110% of nominal (253 V)., Frequency = 51.5 Hz, **Power Factor** = 1, Period of test 90 minutes	Pass
Test 4 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, **Power Factor** = 1, Period of test 15 minutes	Pass
Test 5 RoCoF withstand Confirm that the **Power Generating Module** is capable of staying connected to the **Distribution Network** and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms. Note that this is not expected to be demonstrated on site.	Pass

2. Power Quality – Harmonics:

For **Power Generating Module**s of **Registered Capacity** of less than 75 A per phase (ie 50 kW) the test requirements are specified in Annex A.7.1.5**.** These tests should be carried out as specified in BS EN 61000-3-12 The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 610000-3-12 for three phase equipment.
Power Generating Modules with 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 **Power Generating Module** in order to accept the connection to a **Distribution Network.**
For **Power Generating Module**s of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC G5.

Power Generating Module tested to BS EN 61000-3-12

Power Generating Module rating per phase (rpp)			5.5	kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
Harmonic	At 45-55% of **Registered Capacity**		100% of **Registered Capacity**		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.41	0.435	0.329	0.349	8%	8%
3	0.497	0.527	0.407	0.431	21.6%	Not stated
4	0.083	0.088	0.092	0.098	4%	4%
5	0.42	0.445	0.293	0.311	10.7%	10.7%
6	0.089	0.094	0.058	0.061	2.67%	2.67%
7	0.307	0.325	0.198	0.210	7.2%	7.2%
8	0.06	0.064	0.044	0.047	2%	2%
9	0.225	0.238	0.146	0.155	3.8%	Not stated
10	0.032	0.034	0.029	0.031	1.6%	1.6%
11	0.203	0.215	0.125	0.132	3.1%	3.1%
12	0.031	0.033	0.026	0.028	1.33%	1.33%
13	0.177	0.188	0.102	0.108	2%	2%
THD[1]	---	0.965	---	0.720	23%	13%
PWHD[2]	---	0.714	---	0.439	23%	22%

3. Power Quality – Voltage fluctuations and Flicker:

[1] THD = Total Harmonic Distortion

[2] PWHD = Partial Weighted Harmonic Distortion

For **Power Generating Module**s of **Registered Capacity** of less than 75 A per phase (ie 50 kW) these tests should be undertaken in accordance with Annex A.7.1.4.3. 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.

For **Power Generating Module**s of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC P28.

	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	0.31%	0.24%	0	0.32%	0.24%	0	0.10	0.10
Normalised to standard impedance	0.31%	0.24%	0	0.32%	0.24%	0	0.10	0.10
Normalised to required maximum impedance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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 * 0.4 ^	Ω	Xl	0.15 * 0.25 ^	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	Xl	0.15 * 0.25 ^	Ω
Maximum Impedance	R	N/A	Ω	Xl	N/A	Ω

* Applies to three phase and split single phase **Power Generating Module**s.

^ Applies to single phase **Power Generating Module** and **Power Generating Module**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 x 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 Xl 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

Test start date	29 Jul, 2019	Test end date	13 Aug, 2019
Test location	Jiu Hua Road 888, Nantong High-Tech Industrial Development Zone, Nantong City, 226300		

4. Power quality – DC injection: The tests should be carried out on a single **Generating Unit**. Tests are to be carried out at three defined power levels ±5%. At 230 V a 5 kW single phase **Inverter** has a current output of 21.7 A so DC limit is 54.3 mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.

Test power level	10%	55%	100%
Recorded value in Amps	23.8mA	31.2mA	34.8mA
as % of rated AC current	0.11	0.14	0.16
Limit	0.25%	0.25%	0.25%

5. Power Factor: The tests should be carried out on a single **Power Generating Module**. Tests are to be carried out at three voltage levels and at **Registered Capacity**. Voltage to be maintained within ±1.5% of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.1.4.2.

Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9988	0.9989	0.9991
Power Factor Limit	>0.95	>0.95	>0.95

6. Protection – Frequency tests: These tests should be carried out in accordance with the Annex A.7.1.2.3.

Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.52Hz	20.037s	47.7 Hz 30 s	No trip
U/F stage 2	47 Hz	0.5 s	46.96Hz	0.532s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F	52 Hz	0.5 s	52.03Hz	0.533s	51.8 Hz 120.0 s	No trip
					52.2 Hz 0.45 s	No trip

Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. 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 ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

7. Protection – Voltage tests: These tests should be carried out in accordance with Annex A.7.1.2.2.

Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	0.8 pu (184 V)	2.5 s	183.8V	2.535s	188 V 5.0 s	No trip
					180 V 2.45 s	No trip
O/V stage 1	1.14 pu (262.2 V)	1.0 s	262.5V	1.045s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	274.2V	0.543s	269.7 V 0.95 s	No trip
					277.7 V 0.45 s	No trip

Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. 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 ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

8. Protection – Loss of Mains test: These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.

The following sub set of tests should be recorded in the following table.

Test Power and imbalance	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	0.31s	0.28s	0.23s	0.32s	0.30s	0.24s

Loss of Mains Protection, Vector Shift Stability test. This test should be carried out in accordance with Annex A.7.1.2.6.

	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.5 Hz	+50 degrees	No trip
Negative Vector Shift	50.5 Hz	- 50 degrees	No trip

Loss of Mains Protection, RoCoF Stability test: This test should be carried out in accordance with Annex A.7.1.2.6.

Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hzs^{-1}	2.1 s	No trip

51.0 Hz to 49.0 Hz	-0.95 Hzs^{-1}	2.1 s	No trip

9. Limited Frequency Sensitive Mode – Over frequency test: The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%.

This test should be carried out in accordance with Annex A.7.1.3.

Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.	**Y**

Alternatively, simulation results should be noted below:

Test sequence at **Registered Capacity** >80%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00Hz ±0.01Hz	5157W	50.00Hz	5267W	-
Step b) 50.45Hz ±0.05Hz	5045W	50.45Hz	4760W	27.14%
Step c) 50.70Hz ±0.10Hz	4568W	50.70Hz	3680W	19.64%
Step d) 51.15Hz ±0.05Hz	3536W	51.15Hz	4654W	20.43%
Step e) 50.70Hz ±0.10Hz	4467W	50.70Hz	5210W	19.61%
Step f) 50.45Hz ±0.05Hz	4994W	50.45Hz	5333W	20.39%
Step g) 50.00Hz ±0.01Hz	5109W	50.00Hz	5267W	-
Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00Hz ±0.01Hz	2626W	50.00Hz	2739W	-
Step b) 50.45Hz ±0.05Hz	2531W	50.45Hz	2642W	25.19%
Step c) 50.70Hz ±0.10Hz	2055W	50.70Hz	2141W	20.01%
Step d) 51.15Hz ±0.05Hz	1076W	51.15Hz	1123W	20.57%
Step e) 50.70Hz ±0.10Hz	2081W	50.70Hz	2168W	20.20%

Step f) 50.45Hz ±0.05Hz	2580W	50.45Hz	2694W	20.40%
Step g) 50.00Hz ±0.01Hz	2633W	50.00Hz	2746W	-

10. Protection – Re-connection timer.					
Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 10.1.					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
30s	31s	At 1.16 pu (266.2 V)	At 0.78 pu (180.0 V)	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Power Generating Module** does not re-connect.		Yes	Yes	Yes	Yes

11. Fault level contribution: These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5.		
For **Inverter** output		
Time after fault	Volts	Amps
20ms	52.2V	29.9A
100ms	51.7V	0A
250ms	51.3V	0A
500ms	51.3V	0A
Time to trip	0.062s	In seconds

12. Self-Monitoring solid state switching: No specified test requirements. Refer to Annex A.7.1.7.	
It has been verified that in the event of the solid state switching device failing to disconnect the **Power Park Module**, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.	NA

13. Wiring functional tests: If required by para 15.2.1.	
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	NA

14. Logic interface (input port).	
Confirm that an input port is provided and can be used to shut down the module.	NA

Additional comments.