Form A2-3: Compliance Verification Report for Inverter Connected Power Generating Modules

This form should be used by the **Manufacturer** to demonstrate and declare compliance with the requirements of EREC G99.The form can be used in a variety of ways as detailed below:

1.To obtain **Fully Type Tested** status

The **Manufacturer** can use this form to obtain **Fully Type Tested** status for a **Power Generating Module** by registering this completed form with the Energy Networks Association (ENA) Type Test Verification Report Register.

2.To obtain **Type Tested** status for a product

This form can be used by the **Manufacturer** to obtain **Type Tested** status for a product which is used in a **Power Generating Module** by registering this form with the relevant parts completed with the Energy Networks Association (ENA) Type Test Verification Report Register.

3. One-off Installation

This form can be used by the **Manufacturer** or **Installer** to confirm that the **Power Generating Module** has been tested to satisfy all or part of the requirements of this EREC G99.This form must be submitted to the **DNO** as part of the application.

A combination of (2) and (3) can be used as required, together with Form A2-4 where compliance of the **Interface Protection** is to be demonstrated on site.

Note:

Within this Form A2-3 the term **Power Park Module** will be used but its meaning can be interpreted within Form A2-3 to mean **Power Park Module**, **Generating Unit or Inverter** as appropriate for the context. However, note that compliance must be demonstrated at the **Power Park Module** level.

If the **Power Generating Module** is **Fully Type Tested** and registered with the Energy Networks Association (ENA) Type Test Verification Report Register, the Installation Document (Form A3-1 or A3-2) should include the **Manufacturer's** reference number (the Product ID), and this form does not need to be submitted.

Where the **Power Generating Module** is not registered with the ENA Type Test Verification Report Register or is not **Fully Type Tested** this form (all or in parts as applicable) needs to be completed and provided to the **DNO**, to confirm that the **Power Generating Module** has been tested to satisfy all or part of the requirements of this EREC G99.

PGM technology		Photovoltaic Grid-tied inverter	
Manufacturer name		Solax power Co., Ltd	
Address		Room 220, West Building A, National University Science and Technology Park of Zhejiang University 525, Xixi Rd, Hangzhou, Zhejiang Province, China,310007	
Tel	+86(0571)-56260011	Web site	www.solaxpower.com
E:mail	info@solaxpower.com		
Registered Capacity		4.6kW	
		5.0kW	

There are four options for Testing: (1) **Fully Type Tested**, (2) Partially **Type Tested**, (3) one-off installation, (4) tested on site at time of commissioning. The check box below indicates which tests in this Form have been completed for each of the options. With the exception of **Fully Type Tested PGMs** tests marked with * may be carried out at the time of commissioning (Form A4).

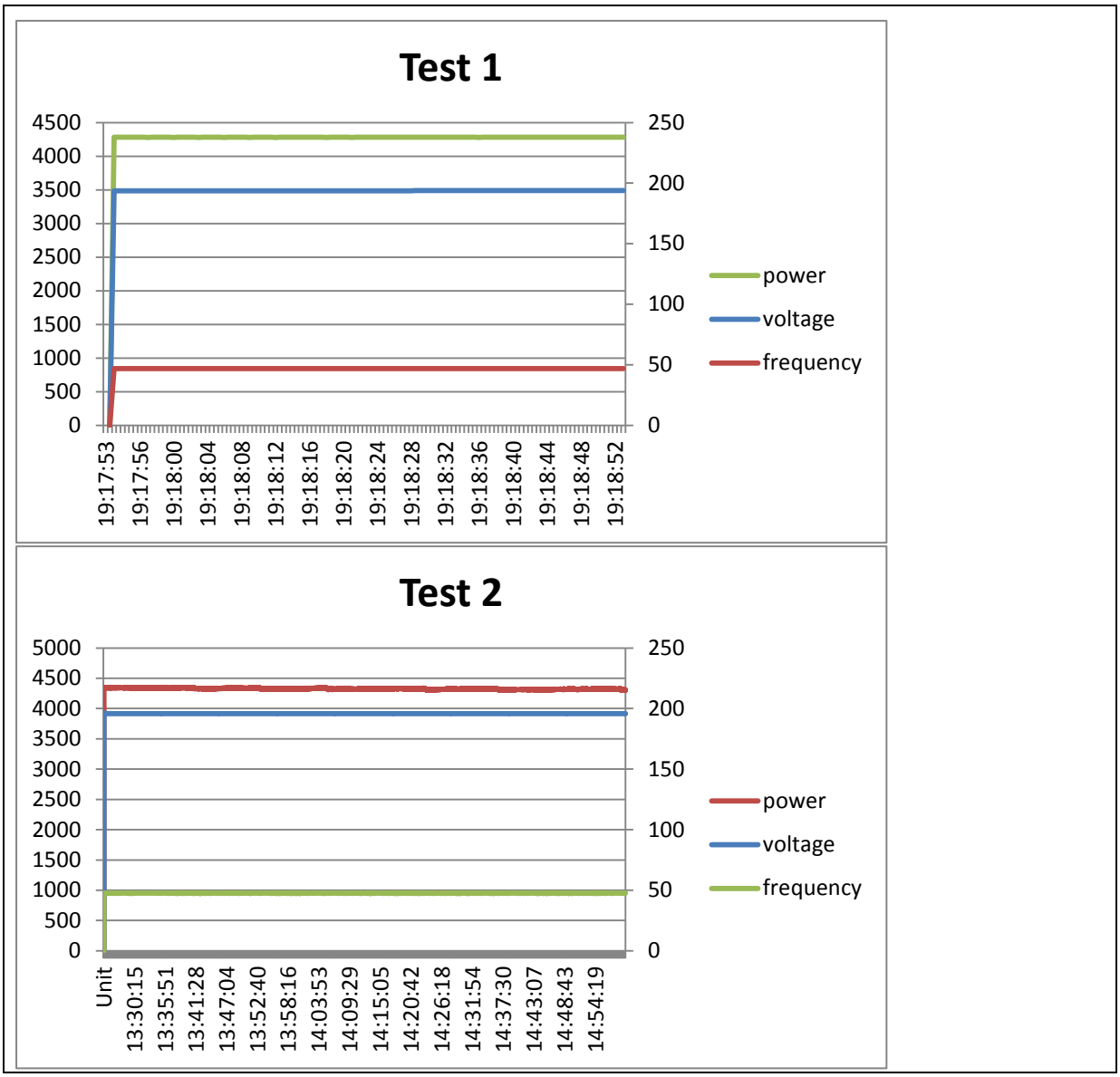
Tested option:	**1. Fully Type Tested**	**2. Partially Type Tested**	**3. One-off Man. Info.**	**4. Tested on Site at time of Commission-ing**
0. **Fully Type Tested**- all tests detailed below completed and evidence attached to this submission		**N/A**	**N/A**	**N/A**
1. Operating Range	**N/A**	✓		
2. PQ – Harmonics		✓		
3. PQ – Voltage Fluctuation and Flicker		✓		
4. PQ – DC Injection (**Power Park Modules** only)		✓		
5. **Power Factor** (PF)*		✓		
6. Frequency protection trip and ride through tests*		✓		
7. Voltage protection trip and ride through tests*		✓		
8. Protection – Loss of Mains Test*, Vector Shift and RoCoF Stability Test*		✓		
9.**LFSM-O** Test*		✓		
10. Protection – Reconnection Timer*		✓		
11. Fault Level Contribution		✓		
12. Self-monitoring Solid State Switch		**N/A**		
13. Wiring functional tests if required by para 15.2.1 (attach relevant schedule of tests)*		**N/A**		
14. Logic Interface (input port)*		✓		

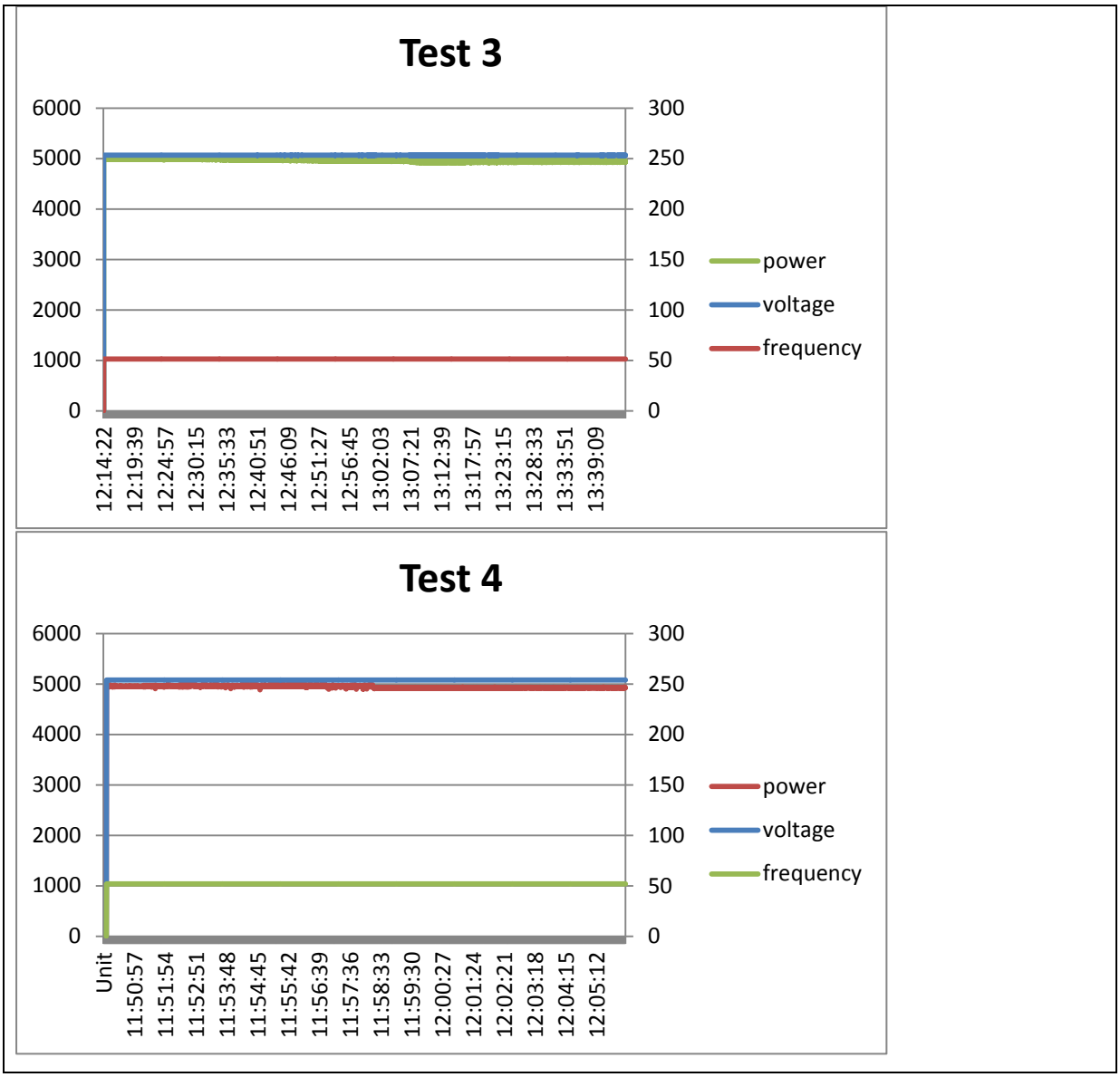
* may be carried out at the time of commissioning (Form A.2-4).

Document reference(s) for **Manufacturers' Information:**

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		On behalf of	Solax power Co., Ltd
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: Two 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 20s	
Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, **Power Factor** = 1, Period of test 90 minutes	
Test 3 Voltage = 110% of nominal (253 V)., Frequency = 51.5 Hz, **Power Factor** = 1, Period of test 90 minutes	
Test 4 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, **Power Factor** = 1, Period of test 15 minutes	


Test 1
4500
4000
3500
3000
2500
2000
1500
1000
500
0
250
200
150
100
50
0
19:17:53
19:17:56
19:18:00
19:18:04
19:18:08
19:18:12
19:18:16
19:18:20
19:18:24
19:18:28
19:18:32
19:18:36
19:18:40
19:18:44
19:18:48
19:18:52
power
voltage
frequency
Test 2
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
250
200
150
100
50
0
Unit
13:30:15
13:35:51
13:41:28
13:47:04
13:52:40
13:58:16
14:03:53
14:09:29
14:15:05
14:20:42
14:26:18
14:31:54
14:37:30
14:43:07
14:48:43
14:54:19
power
voltage
frequency


Test 3
6000
5000
4000
3000
2000
1000
0
300
250
200
150
100
50
0
power
voltage
frequency
12:14:22
12:19:39
12:24:57
12:30:15
12:35:33
12:40:51
12:46:09
12:51:27
12:56:45
13:02:03
13:07:21
13:12:39
13:17:57
13:23:15
13:28:33
13:33:51
13:39:09
Test 4
6000
5000
4000
3000
2000
1000
0
300
250
200
150
100
50
0
power
voltage
frequency
Unit
11:50:57
11:51:54
11:52:51
11:53:48
11:54:45
11:55:42
11:56:39
11:57:36
11:58:33
11:59:30
12:00:27
12:01:24
12:02:21
12:03:18
12:04:15
12:05:12

2. Power Quality – Harmonics:

For **Power Generating Modules** 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 61000-3-12The results need to comply with the limits of Table2 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 Modules** of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation must be designed in accordance with EREC G5.

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

Power Generating Module rating per phase (rpp)			4.6	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	0.0324	0.1620%	0.1079	0.5395%	8%	8%
3	0.1910	0.9550%	0.2048	1.0240%	21.6%	Not stated
4	0.0282	0.1410%	0.0375	0.1875%	4%	4%
5	0.0927	0.4635%	0.0666	0.3330%	10.7%	10.7%
6	0.0069	0.0345%	0.0133	0.0665%	2.67%	2.67%
7	0.0506	0.2530%	0.0279	0.1395%	7.2%	7.2%
8	0.0068	0.0340%	0.0118	0.0590%	2%	2%
9	0.0447	0.2235%	0.0266	0.1330%	3.8%	Not stated
10	0.0049	0.0245%	0.0074	0.0370%	1.6%	1.6%
11	0.0235	0.1175%	0.0259	0.1295%	3.1%	3.1%
12	0.0077	0.0385%	0.0072	0.0360%	1.33%	1.33%
13	0.0306	0.1530%	0.0210	0.1050%	2%	2%
THD[1]		2.0%		1.03%	23%	13%
PWHD[2]					23%	22%

[1] THD = Total Harmonic Distortion

2. Power Quality – Harmonics:

For **Power Generating Modules** 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 61000-3-12The results need to comply with the limits of Table2 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 Modules** of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation must be designed in accordance with EREC G5.

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

Power Generating Module rating per phase (rpp)			5.0	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	0.0450	0.2070%	0.1105	0.5083%	8%	8%
3	0.1659	0.7631%	0.1955	0.8993%	21.6%	Not stated
4	0.0259	0.1191%	0.0332	0.1527%	4%	4%
5	0.0833	0.3832%	0.0657	0.3022%	10.7%	10.7%
6	0.0056	0.0258%	0.0095	0.0437%	2.67%	2.67%
7	0.0447	0.2056%	0.0226	0.1040%	7.2%	7.2%
8	0.0073	0.0336%	0.0077	0.0354%	2%	2%
9	0.0405	0.1863%	0.0226	0.1040%	3.8%	Not stated
10	0.0037	0.0170%	0.0066	0.0304%	1.6%	1.6%
11	0.0200	0.0920%	0.0250	0.1150%	3.1%	3.1%
12	0.0050	0.0230%	0.0065	0.0299%	1.33%	1.33%
13	0.0291	0.1339%	0.0196	0.0902%	2%	2%
THD[1]		1.72%		0.98%	23%	13%
PWHD[2]					23%	22%

3. Power Quality – Voltage fluctuations and Flicker:

For **Power Generating Modules** 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 Modules** of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation must 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	0.63%	0.04%	0%	0.1%	0.09%	0%	0.29	0.16
Normalised to standard impedance	NA	NA	NA	NA	NA	NA	NA	NA
Normalised to required maximum impedance	NA	NA	NA	NA	NA	NA	NA	NA
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		Ω	Xl		Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	Xl	0.15 * 0.25 ^	Ω
Maximum Impedance	R		Ω	Xl		Ω

* Applies to three phase and split single phase **Power Generating Modules.**

^ Applies to single phase **Power Generating Module** and **Power Generating Modules** 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	2017-05-10	Test end date	2017-05-10
Test location	Building 4, No. 518, Xinzhuan Road, Caohejing Songjiang High- Tech Park, Shanghai, P.R. China (201705)		

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 50 kW three phase **Inverter** has a current output of 217 A so DC limit is 543 mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.			
4.6K			
Test power level	10%	55%	100%
Recorded value in Amps	0.0038	0.0080	0.0102
as % of rated AC current	0.02%	0.04%	0.05%
Limit	0.25%	0.25%	0.25%
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 50 kW three phase **Inverter** has a current output of 217 A so DC limit is 543 mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.			
5.0K			
Test power level	10%	55%	100%
Recorded value in Amps	0.0028	0.0066	0.0063
as % of rated AC current	0.01%	0.03%	0.03%
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.			
4.6K			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.999	0.999	0.999

Power Factor Limit	>0.95	>0.95	>0.95
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.			
5.0K			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.999	0,999	0.999
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	47.49hz	20.1s	47.7 Hz 25 s	no trip
U/F stage 2	47 Hz	0.5 s	46.95hz	0.561s	47.2 Hz 19.98 s	no trip
					46.8 Hz 0.48 s	no trip
O/F	52 Hz	0.5 s	52.03hz	0.571s	51.8 Hz 89.98 s	no trip
					52.2 Hz 0.48 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	183.3v	2.58s	188 V 3.50 s	no trip
					180 V 2.48 s	no trip

O/V stage 1	1.14 pu (262.2 V)	1.0 s	263.4v	1.07s	258.2 V 2.0 s	no trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	274.9v	0.573s	269.7 V 0.98s	no trip
					277.7 V 0.48 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	0.122s	0.382s	0.342s	0.173s	0.196s	0.166s

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	5010	50.00		-
Step b) 50.45Hz ±0.05Hz	4946	50.45		-
Step c) 50.70Hz ±0.10Hz	4714	50.70		-
Step d) 51.15Hz ±0.05Hz	4288	51.15		-
Step e) 50.70Hz ±0.10Hz	4676	50.70		-
Step f) 50.45Hz ±0.05Hz	4916	50.45		-
Step g) 50.00Hz ±0.01Hz	5004	50.00		
Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00Hz ±0.01Hz	2530	50.00		-
Step b) 50.45Hz ±0.05Hz	2499	50.45		-
Step c) 50.70Hz ±0.10Hz	2386	50.70		-
Step d) 51.15Hz ±0.05Hz	2175	51.15		-
Step e) 50.70Hz ±0.10Hz	2358	50.70		-

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	35s	At 1.16 pu (266.2 V)	At 0.85 pu (196.1 V)	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Power Generating Module** does not re-connect.		No-reconnection	No-reconnection	No-reconnection	No-reconnection

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	155 V	28.6A
100ms	NA	NA
250ms	NA	NA
500ms	NA	NA
Time to trip	0.557 s	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.	Yes
Additional comments.	