If the Generator is fully type tested the applicant should apply using Form A1-1 or A1-2; depending on the generation type.

If the generator is fully type tested and a product listed on the ENA approved list please complete Form A1-1 or A1-2.

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.

If the power generating modules are partially type tested the developer / installer will use this form to show what equipment is type tested, what equipment requires type test results to be submitted and what type tests will be undertaken & commissioned on site.

This form is used to inform SSEN what equipment within the Power Generating Module has been typed tested, what equipment requires type test results to be submitted and what type tests will be undertaken & commissioned on site.

PGM technology			
Manufacturer name			
Address			
Tel		Web site	
E:mail			
Registered Capacity		kW	

All boxes in this section must be completed.

Sections 1-3 & 11 must be evidenced and provided to SSEN ahead of on-site works. If the manufacturer does not provide this works should not be scheduled

Sections 4-10 & 12-13 can be completed on-site. All type tests must be undertaken and must meet G99 requirements.

On-site work must be recorded within Form A4.

If the manufacturer has stated some partial type testing they must state the ENA ID number in this box.

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 Commis sion-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				
13. Wiring functional tests if required by para 15.2.1 (attach relevant schedule of tests)*				
14. Logic Interface (input port)*				

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

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

Sections 1-3 & 11 must be evidenced and provided; this is captured within the table by inserting an "X" in the relevant column.

Sections 4-10 & 12-13 can be completed at the time of commissioning If type testing is occurring on site please enter an "X" in column 4 of the associated Test Option.

On site type testing will require Form A4 to be completed.

For any partially type tested evidence please insert the ENA ID number in this box

This declaration must be signed by the Manufacturer of the equipment

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	
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.			

This declaration must be signed by the Manufacturer of the equipment

This section is mandatory ahead of site testing.

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

This section is mandatory ahead of site testing.

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.

The Power Generating Module must be connected to a suitable test supply, grid simulation set or load bank as part of the test.

The evidence provided by the manufacturer must show that the Power Generating Module can fulfil the test requirements. The second by second evidence must be within the parameters set in column 1.

Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47 Hz, **Power Factor** = 1, Period of test 20 s	
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	

Compliance with the tests, detailed in column 1, must be evidenced. As per the requirements, evidence must demonstrate that all four test conditions have been met by providing the frequency, voltage and active power recordings for every second of each test.

This section is mandatory ahead of site testing.

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 61000-3-12 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 Modules** of **Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation must be designed in accordance with EREC G5.

This section is mandatory ahead of site testing.

Evidence from the manufacturer must confirm compliance with BS EN 61000-3-12. We won't accept compliance with an equivalent IEC or other standard.

Submitted evidence must confirm compliance with BS EN 61000-3-12.

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

Power Generating Module rating per phase (rpp)				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					8%	8%
3					21.6%	Not stated
4					4%	4%
5					10.7%	10.7%
6					2.67%	2.67%
7					7.2%	7.2%
8					2%	2%
9					3.8%	Not stated
10					1.6%	1.6%
11					3.1%	3.1%
12					1.33%	1.33%
13					2%	2%
THD[1]					23%	13%
PWHD[2]					23%	22%

To be G5 compliant the manufacturer must evidence that the harmonic contribution is less than the percentages shown in columns 6 & 7.

Harmonic test results must be entered in columns 2 – 5.

Columns 2 & 3 are for harmonic disturbance when the Power Generating Module is operating at 45-55% of its registered capacity.

Columns 4 & 5 are for harmonic disturbance when the Power Generating Module is operating at 100% registered capacity.

[1] THD = Total Harmonic Distortion

[2] PWHD = Partial Weighted Harmonic Distortion

This section is mandatory ahead of on-site.

This section is mandatory ahead of on-site testing.

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.

Evidence from the manufacturer must confirm compliance with BS EN 61000-3-11. We won't accept compliance with an equivalent IEC or other standard.

Submitted evidence must confirm compliance with BS EN 61000-3-11. Further guidance can be found within G99 under Annex A7.1.4.3 page 232 & 233.

All boxes to be completed

	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								
Normalised to standard impedance								
Normalised to required maximum impedance								
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65

To be P28 compliant the manufacturer / developer / installer must evidence that the impact of their connection does not create a voltage step change greater that the percentages & timings shown in row 6.

All boxes to be completed

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

If results don't align with expectations seek advice from Policy

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		Test end date	
Test location			

This section is mandatory ahead of site testing.

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.

This section is mandatory ahead of site testing.

Test power level	10%	55%	100%
Recorded value in Amps			
as % of rated AC current			
Limit	0.25%	0.25%	0.25%

Further guidance can be found within G99 under Annex A7.1.4.4 page 233.

This section isn't mandatory ahead of on-site type testing.

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.

This section can be completed as part of on-site type testing or provided as part of the original application.

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

Commissioning Engineer to confirm compliance on-site

The Power Generating Module must be capable of operating within +/-1.5% of the voltage stated.

This section isn't mandatory ahead of on-site type testing.

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

This section can be completed as part of on-site type testing or provided as part of the original application.

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			47.7 Hz 25 s	
U/F stage 2	47 Hz	0.5 s			47.2 Hz 19.98 s	
					46.8 Hz 0.48 s	
O/F	52 Hz	0.5 s			51.8 Hz 89.98 s	
					52.2 Hz 0.48 s	

Commissioning Engineer to confirm compliance

The test requirements are declared within G99 A.7.1.2.3 (page 230)

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.

This section isn't mandatory ahead of on-site type testing.

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

This section can be completed as part of on-site type testing or provided as part of the original application.

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			188 V 3.50 s	
					180 V 2.48 s	
O/V stage 1	1.14 pu (262.2 V)	1.0 s			258.2 V 2.0 s	
O/V stage 2	1.19 pu (273.7 V)	0.5 s			269.7 V 0.98s	
					277.7 V 0.48 s	

Commissioning Engineer to confirm compliance

The test requirements are declared within G99 A.7.1.2.2 (page 228)

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						

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	
Negative Vector Shift	50.5 Hz	- 50 degrees	

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	
51.0 Hz to 49.0 Hz	-0.95 Hzs^{-1}	2.1 s	

This section isn't mandatory ahead of on-site type testing.

This section can be completed as part of on-site type testing or provided as part of the original application.

The information provided must show that the results are within the trip time limit of 0.5s. The tests do allow for a tolerance of ±5% in Test Power levels

The test requirements are declared within G99 A.7.1.2.4 (page 230 & 231)

To comply with G99 the Power Generating Module must not trip under the conditions studied.

The test requirements are declared within G99 A.7.1.2.6 (page 231)

To comply with G99 the Power Generating Module must not trip under the conditions studied.

The test requirements are declared within G99 A.7.1.2.6 (page 231)

This section isn't mandatory ahead of on-site type testing.

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/N**

If demonstrating G99 compliance by use of plots please select "Y" and attached plots to the application

The manufacturer has 3 options, provide frequency/time plots, undertake simulations or undertake on-site testing to confirm compliance.

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				-
Step b) 50.45Hz ±0.05Hz				-
Step c) 50.70Hz ±0.10Hz				-
Step d) 51.15Hz ±0.05Hz				-
Step e) 50.70Hz ±0.10Hz				-
Step f) 50.45Hz ±0.05Hz				-
Step g) 50.00Hz ±0.01Hz				
Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00Hz ±0.01Hz				-
Step b) 50.45Hz ±0.05Hz				-
Step c) 50.70Hz ±0.10Hz				-
Step d) 51.15Hz ±0.05Hz				-
Step e) 50.70Hz ±0.10Hz				-

If plots aren't being used, then simulation based assessments can be used to evidence compliance. The results of the simulations should be confirm within this table.

To comply with G99 the Power Generating Module must not reconnect within 20s from when voltage or frequency limits are beyond those state in Table 10.1 on page 86 of G99.

This section can be completed as part of on-site type testing or provided as part of the original application.

Table 10.1 is found within G99 section 10.6.7.1 (page 86)

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.			
		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.					

This data must be provided to the NCD for study purposes. The NCD will confirm whether it is appropriate

This section is mandatory ahead of on-site testing.

All boxes to be completed

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		
100ms		
250ms		
500ms		
Time to trip		In seconds

It is expected that the manufacturer provides evidence that the failure of a solid-state device reacts in the required time.

If selecting "N/A" please state why in additional comments.

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.	Yes/ NA

If the developer / installer amends wiring and/or connects assets together that are not initially design to connect then additional test are required. Commissioning engineer to confirm on-site test requirements.

If wiring is undertaken on site between assets that are not initially designed to connect then additional testing will be required. See G99 15.2.1 (page 145)

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)	Yes / NA

Section 11.1.3 states the Power Generating Module "shall be equipped with a logic interface (input port) in order to cease Active Power Output within 5s". It is expected that one is installed. If not, the Control Centre must be advised.

Please confirm if a Logic Interface (input port) is installed. This is to reduce the Active Power Output of the Power Generating Module within 5s. If selecting "N/A" please state why in additional comments. See G99 11.1.3 & 11.1.3.1 (page 98)

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