

**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) 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.

<b>PGM</b> technology		MID 33KTL3-X2, MID 36KTL3-X2, MID 40KTL3-X2, MID 50KTL3-X2.	
<b>Manufacturer</b> name		Shenzhen Growatt New Energy Co., Ltd.	
Address		4-13th Floor, Building A, Sino-German Europe Industrial Demonstration Park, No. 1, Hangcheng Avenue, Bao'an District, Shenzhen, Guangdong, China.	
Tel	+86 755 2951 5888	Web site	www.ginverter.com
E:mail	Peng.zhu@growatt.com		
<b>Registered Capacity</b>		<b>50kW</b>	

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

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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).

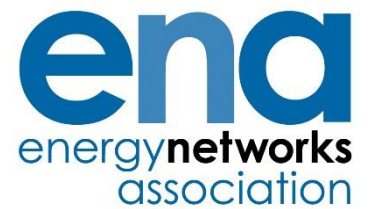
Tested option:	1. Fully Type Tested	2. Partially Type Tested	3. One-off Man. Info.	4. Tested on Site at time of Commissioning
0. <b>Fully Type Tested</b> - all tests detailed below completed and evidence attached to this submission		N/A	N/A	N/A
1. Operating Range	<b>N/A</b>			
2. PQ – Harmonics				
3. PQ – Voltage Fluctuation and Flicker				
4. PQ – DC Injection ( <b>Power Park Modules</b> only)				
5. <b>Power Factor (PF)*</b>				
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. <b>LFSM-O</b> 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:**

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**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	Shenzhen Growatt New Energy Co., Ltd.
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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  $\pm 5\%$  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.

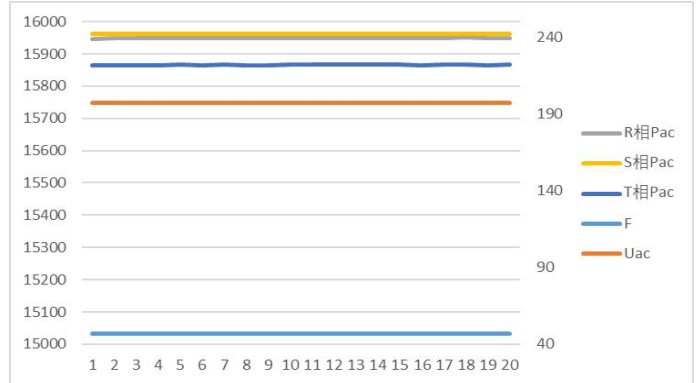
The **Interface Protection** shall be disabled during the tests.

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 **Inverter/rectifier** may be replaced by a DC source.

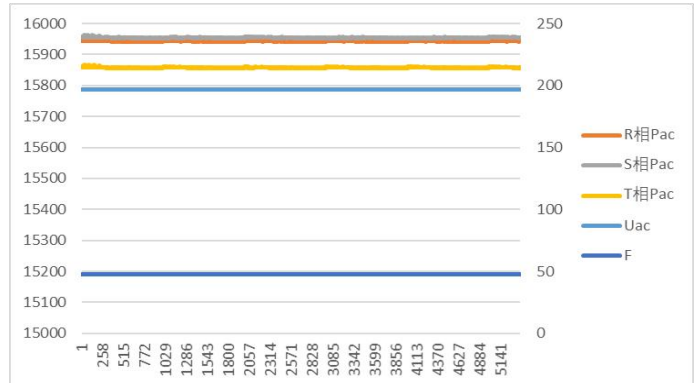
**Test 1**

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



**Test 2**

Voltage = 85% of nominal (195.5 V),  
 Frequency = 47.5 Hz,  
**Power Factor** = 1,  
 Period of test 90 minutes



<p>Test 3</p> <p>Voltage = 110% of nominal (253 V),                  Frequency = 51.5 Hz,  <b>Power Factor = 1</b>,                  Period of test 90 minutes</p>	
<p>Test 4</p> <p>Voltage = 110% of nominal (253 V),                  Frequency = 52.0 Hz,  <b>Power Factor = 1</b>,                  Period of test 15 minutes</p>	
<p>Test 5</p> <p>Voltage = 100% of nominal (230 V),                  Frequency = 50.0 Hz,                  Power Factor = 1,                  Period of test = 90 minutes</p>	
<p>Test 6 RoCoF withstand</p> <p>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 Hz/s as measured over a period of 500 ms.</p>	

**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 61000-3-12 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

<b>Power Generating Module</b> rating per phase (rpp)	11.00	kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)			
<b>Average harmonic current results – Phase 1</b>						
Harmonic	At 45-55% of <b>Registered Capacity</b>		100% of <b>Registered Capacity</b>		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0259	0.0541	0.0257	0.0538	8%	8%
3	0.0399	0.0833	0.0400	0.0837	21.6%	Not stated
4	0.0261	0.0546	0.0255	0.0533	4%	4%
5	0.0370	0.0775	0.0359	0.0751	10.7%	10.7%
6	0.0216	0.0452	0.0217	0.0454	2.67%	2.67%
7	0.0682	0.1425	0.0683	0.1428	7.2%	7.2%
8	0.0226	0.0473	0.0223	0.0467	2%	2%
9	0.0246	0.0514	0.0248	0.0518	3.8%	Not stated
10	0.0218	0.0455	0.0218	0.0456	1.6%	1.6%
11	0.0777	0.1625	0.0785	0.1640	3.1%	3.1%
12	0.0218	0.0455	0.0219	0.0457	1.33%	1.33%
13	0.0448	0.0937	0.0452	0.0945	2%	2%
THD		0.2253	-	0.2266	23%	13%

PWHD		0.9116	-	0.9187	23%	22%
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Average harmonic current results – Phase 2						
Harmonic	At 45-55% of <b>Registered Capacity</b>		100% of <b>Registered Capacity</b>		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0259	0.0541	0.0258	0.0539	8%	8%
3	0.0398	0.0833	0.0399	0.0834	21.6%	Not stated
4	0.0261	0.0546	0.0258	0.0539	4%	4%
5	0.0371	0.0775	0.0360	0.0752	10.7%	10.7%
6	0.0216	0.0453	0.0218	0.0456	2.67%	2.67%
7	0.0682	0.1425	0.0684	0.1430	7.2%	7.2%
8	0.0226	0.0473	0.0224	0.0468	2%	2%
9	0.0246	0.0515	0.0247	0.0516	3.8%	Not stated
10	0.0218	0.0455	0.0219	0.0457	1.6%	1.6%
11	0.0777	0.1625	0.0784	0.1640	3.1%	3.1%
12	0.0218	0.0455	0.0220	0.0460	1.33%	1.33%
13	0.0448	0.0936	0.0452	0.0944	2%	2%
THD	-	0.2253	-	0.2267	23%	13%
PWHD	-	0.9116	-	0.9194	23%	22%

Average harmonic current results – Phase 3						
Harmonic	At 45-55% of <b>Registered Capacity</b>		100% of <b>Registered Capacity</b>		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0258	0.0540	0.0258	0.0540	8%	8%

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3	0.0398	0.0833	0.0400	0.0835	21.6%	Not stated
4	0.0261	0.0546	0.0256	0.0535	4%	4%
5	0.0371	0.0775	0.0360	0.0752	10.7%	10.7%
6	0.0216	0.0452	0.0218	0.0457	2.67%	2.67%
7	0.0682	0.1425	0.0683	0.1429	7.2%	7.2%
8	0.0226	0.0473	0.0223	0.0467	2%	2%
9	0.0246	0.0515	0.0247	0.0517	3.8%	Not stated
10	0.0218	0.0455	0.0219	0.0457	1.6%	1.6%
11	0.0777	0.1625	0.0785	0.1641	3.1%	3.1%
12	0.0218	0.0456	0.0219	0.0458	1.33%	1.33%
13	0.0448	0.0937	0.0451	0.0942	2%	2%
THD <sup>1</sup>	-	0.2253	-	0.2267	23%	13%
PWHD <sup>2</sup>	-	0.9116	-	0.9194	23%	22%

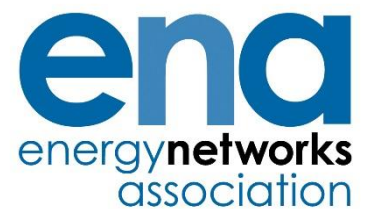
<b>Power Generating Module</b> rating per phase (rpp)		12.00	kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)		
<b>Average harmonic current results – Phase 1</b>						
Harmonic	At 45-55% of <b>Registered Capacity</b>		100% of <b>Registered Capacity</b>		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0253	0.0485	0.0261	0.0501	8%	8%
3	0.0399	0.0766	0.0401	0.0768	21.6%	Not stated
4	0.0255	0.0490	0.0256	0.0490	4%	4%
5	0.0351	0.0673	0.0356	0.0683	10.7%	10.7%
6	0.0219	0.0419	0.0218	0.0417	2.67%	2.67%

<sup>1</sup> THD = Total Harmonic Distortion

<sup>2</sup> PWHD = Partial Weighted Harmonic Distortion

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7	0.0675	0.1293	0.0676	0.1296	7.2%	7.2%
8	0.0223	0.0428	0.0224	0.0429	2%	2%
9	0.0247	0.0473	0.0248	0.0475	3.8%	Not stated
10	0.0218	0.0419	0.0219	0.0420	1.6%	1.6%
11	0.0777	0.1490	0.0780	0.1495	3.1%	3.1%
12	0.0220	0.0422	0.0221	0.0423	1.33%	1.33%
13	0.0450	0.0863	0.0454	0.0871	2%	2%
THD		0.2256	-	0.2268	23%	13%
PWHD		0.9171	-	0.9219	23%	22%

Average harmonic current results – Phase 2						
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	0.0253	0.0485	0.0261	0.0501	8%	8%
3	0.0399	0.0765	0.0400	0.0767	21.6%	Not stated
4	0.0256	0.0491	0.0256	0.0491	4%	4%
5	0.0351	0.0673	0.0357	0.0684	10.7%	10.7%
6	0.0218	0.0417	0.0220	0.0422	2.67%	2.67%
7	0.0675	0.1294	0.0675	0.1293	7.2%	7.2%
8	0.0224	0.0429	0.0225	0.0432	2%	2%
9	0.0247	0.0473	0.0248	0.0475	3.8%	Not stated
10	0.0218	0.0418	0.0219	0.0421	1.6%	1.6%
11	0.0779	0.1493	0.0778	0.1491	3.1%	3.1%
12	0.0220	0.0422	0.0220	0.0422	1.33%	1.33%
13	0.0452	0.0867	0.0455	0.0872	2%	2%

THD	-	0.2258	-	0.2267	23%	13%
PWHD	-	0.9176	-	0.9215	23%	22%

Average harmonic current results – Phase 3						
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	0.0253	0.0484	0.0261	0.0500	8%	8%
3	0.0399	0.0764	0.0401	0.0768	21.6%	Not stated
4	0.0256	0.0490	0.0258	0.0494	4%	4%
5	0.0350	0.0671	0.0358	0.0686	10.7%	10.7%
6	0.0218	0.0417	0.0220	0.0422	2.67%	2.67%
7	0.0676	0.1295	0.0676	0.1295	7.2%	7.2%
8	0.0223	0.0427	0.0227	0.0434	2%	2%
9	0.0247	0.0473	0.0247	0.0473	3.8%	Not stated
10	0.0218	0.0418	0.0218	0.0419	1.6%	1.6%
11	0.0779	0.1493	0.0781	0.1497	3.1%	3.1%
12	0.0219	0.0421	0.0220	0.0421	1.33%	1.33%
13	0.0451	0.0864	0.0453	0.0869	2%	2%
THD <sup>3</sup>	-	0.2256	-	0.2267	23%	13%
PWHD <sup>4</sup>	-	0.9170	-	0.9205	23%	22%
<b>Power Generating Module</b> rating per phase (rpp)			13.33	kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	

Average harmonic current results – Phase 1

<sup>3</sup> THD = Total Harmonic Distortion

<sup>4</sup> PWHD = Partial Weighted Harmonic Distortion

Harmonic	At 45-55% of <b>Registered Capacity</b>		100% of <b>Registered Capacity</b>		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0255	0.0439	0.0260	0.0448	8%	8%
3	0.0400	0.0691	0.0401	0.0691	21.6%	Not stated
4	0.0256	0.0442	0.0256	0.0441	4%	4%
5	0.0347	0.0599	0.0356	0.0615	10.7%	10.7%
6	0.0216	0.0373	0.0217	0.0374	2.67%	2.67%
7	0.0678	0.1170	0.0678	0.1170	7.2%	7.2%
8	0.0225	0.0388	0.0223	0.0385	2%	2%
9	0.0248	0.0428	0.0247	0.0426	3.8%	Not stated
10	0.0220	0.0379	0.0220	0.0380	1.6%	1.6%
11	0.0778	0.1342	0.0779	0.1344	3.1%	3.1%
12	0.0221	0.0381	0.0220	0.0380	1.33%	1.33%
13	0.0451	0.0779	0.0453	0.0782	2%	2%
THD	-	0.2259	-	0.2266	23%	13%
PWHD	-	0.9178	-	0.9109	23%	22%

Average harmonic current results – Phase 2						
Harmonic	At 45-55% of <b>Registered Capacity</b>		100% of <b>Registered Capacity</b>		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0256	0.0441	0.0259	0.0447	8%	8%
3	0.0400	0.0690	0.0401	0.0692	21.6%	Not stated
4	0.0254	0.0439	0.0256	0.0441	4%	4%
5	0.0348	0.0601	0.0356	0.0614	10.7%	10.7%

6	0.0219	0.0378	0.0217	0.0374	2.67%	2.67%
7	0.0677	0.1167	0.0678	0.1169	7.2%	7.2%
8	0.0223	0.0385	0.0224	0.0386	2%	2%
9	0.0247	0.0427	0.0248	0.0427	3.8%	Not stated
10	0.0219	0.0378	0.0220	0.0380	1.6%	1.6%
11	0.0777	0.1340	0.0780	0.1346	3.1%	3.1%
12	0.0220	0.0379	0.0221	0.0381	1.33%	1.33%
13	0.0450	0.0776	0.0452	0.0780	2%	2%
THD	-	0.2258	-	0.2267	23%	13%
PWHD	-	0.9184	-	0.9219	23%	22%

Average harmonic current results – Phase 3						
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	0.0257	0.0443	0.0259	0.0447	8%	8%
3	0.0401	0.0692	0.0400	0.0690	21.6%	Not stated
4	0.0256	0.0441	0.0257	0.0443	4%	4%
5	0.0348	0.0600	0.0356	0.0615	10.7%	10.7%
6	0.0217	0.0374	0.0219	0.0377	2.67%	2.67%
7	0.0677	0.1168	0.0679	0.1171	7.2%	7.2%
8	0.0224	0.0387	0.0226	0.0390	2%	2%
9	0.0247	0.0427	0.0247	0.0426	3.8%	Not stated
10	0.0218	0.0376	0.0219	0.0378	1.6%	1.6%
11	0.0778	0.1342	0.0780	0.1346	3.1%	3.1%
12	0.0220	0.0380	0.0219	0.0378	1.33%	1.33%

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13	0.0452	0.0779	0.0452	0.0780	2%	2%
THD <sup>5</sup>	-	0.2259	-	0.2269	23%	13%
PWHD <sup>6</sup>	-	0.9185	-	0.9224	23%	22%
<b>Power Generating Module</b> rating per phase (rpp)			16.67	kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
<b>Average harmonic current results – Phase 1</b>						
Harmonic	At 45-55% of <b>Registered Capacity</b>		100% of <b>Registered Capacity</b>		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0253	0.0349	0.0256	0.0354	8%	8%
3	0.0403	0.0556	0.0405	0.0559	21.6%	Not stated
4	0.0252	0.0348	0.0251	0.0346	4%	4%
5	0.0363	0.0501	0.0375	0.0517	10.7%	10.7%
6	0.0217	0.0300	0.0216	0.0298	2.67%	2.67%
7	0.0675	0.0932	0.0688	0.0949	7.2%	7.2%
8	0.0222	0.0306	0.0223	0.0307	2%	2%
9	0.0246	0.0340	0.0248	0.0342	3.8%	Not stated
10	0.0219	0.0302	0.0218	0.0301	1.6%	1.6%
11	0.0775	0.1070	0.0777	0.1072	3.1%	3.1%
12	0.0218	0.0301	0.0218	0.0301	1.33%	1.33%
13	0.0450	0.0621	0.0451	0.0622	2%	2%
THD		0.2251	-	0.2259	23%	13%
PWHD		0.9133	-	0.9136	23%	22%

<sup>5</sup> THD = Total Harmonic Distortion

<sup>6</sup> PWHD = Partial Weighted Harmonic Distortion

Average harmonic current results – Phase 2						
Harmonic	At 45-55% of <b>Registered Capacity</b>		100% of <b>Registered Capacity</b>		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0253	0.0349	0.0256	0.0354	8%	8%
3	0.0403	0.0556	0.0405	0.0559	21.6%	Not stated
4	0.0253	0.0348	0.0251	0.0346	4%	4%
5	0.0363	0.0501	0.0375	0.0518	10.7%	10.7%
6	0.0218	0.0300	0.0218	0.0301	2.67%	2.67%
7	0.0676	0.0933	0.0687	0.0948	7.2%	7.2%
8	0.0222	0.0307	0.0223	0.0307	2%	2%
9	0.0249	0.0343	0.0247	0.0341	3.8%	Not stated
10	0.0218	0.0301	0.0219	0.0302	1.6%	1.6%
11	0.0775	0.1070	0.0777	0.1072	3.1%	3.1%
12	0.0219	0.0302	0.0219	0.0301	1.33%	1.33%
13	0.0450	0.0620	0.0450	0.0621	2%	2%
THD	-	0.2252	-	0.2259	23%	13%
PWHD	-	0.9134	-	0.9135	23%	22%

Average harmonic current results – Phase 3						
Harmonic	At 45-55% of <b>Registered Capacity</b>		100% of <b>Registered Capacity</b>		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0254	0.0350	0.0256	0.0353	8%	8%
3	0.0403	0.0556	0.0405	0.0559	21.6%	Not stated
4	0.0253	0.0348	0.0250	0.0344	4%	4%

5	0.0363	0.0501	0.0375	0.0517	10.7%	10.7%
6	0.0218	0.0300	0.0217	0.0299	2.67%	2.67%
7	0.0674	0.0931	0.0688	0.0949	7.2%	7.2%
8	0.0223	0.0307	0.0222	0.0307	2%	2%
9	0.0248	0.0343	0.0248	0.0342	3.8%	Not stated
10	0.0219	0.0303	0.0218	0.0300	1.6%	1.6%
11	0.0775	0.1069	0.0777	0.1072	3.1%	3.1%
12	0.0218	0.0301	0.0219	0.0301	1.33%	1.33%
13	0.0450	0.0621	0.0451	0.0622	2%	2%
THD <sup>7</sup>	-	0.2252	-	0.2259	23%	13%
PWHD <sup>8</sup>	-	0.9133	-	0.9137	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 It 2 hours
Measured Values at test impedance	1.05	0.75	0	1.07	0.70	0	0.54	0.54
Normalised to standard impedance	1.05	0.75	0	1.07	0.70	0	0.54	0.54
Normalised to required maximum impedance	-	-	-	-	-	-	-	-

<sup>7</sup> THD = Total Harmonic Distortion

<sup>8</sup> PWHD = Partial Weighted Harmonic Distortion

Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65
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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 Impedance	R	-	Ω	XI	-	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 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

Test start date	10,Jan, 2023	Test end date	10,Jan, 2023
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Test location	Growatt certified testing laboratory
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**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 72.4 A so DC limit is 181.0mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.

Test power level (33K)	10%	55%	100%
Recorded value in Amps	50mA/52mA/51mA	54mA/55mA/57mA	56mA/59mA/57mA
as % of rated AC current	0.10%/0.11%/0.11%	0.11%/0.12%/0.12%	0.12%/0.12%/0.12%
Limit	0.25%	0.25%	0.25%
Test power level (36K)	10%	55%	100%

Recorded value in Amps	76mA/79mA/80mA	83mA/84mA/84mA	86mA/85mA/85mA
as % of rated AC current	0.15%/0.15%/0.15%	0.16%/0.16%/0.16%	0.16%/0.16%/0.16%
Limit	0.25%	0.25%	0.25%
Test power level (40K)	10%	55%	100%
Recorded value in Amps	92mA/93mA/95mA	98mA/99mA/102mA	106mA/105mA/106mA
as % of rated AC current	0.16%/0.16%/0.16%	0.17%/0.17%/0.18%	0.18%/0.18%/0.18%
Limit	0.25%	0.25%	0.25%
Test power level (50K)	10%	55%	100%
Recorded value in Amps	120mA/123mA/122mA	126mA/126mA/128mA	129mA/132mA/130mA
as % of rated AC current	0.17%/0.17%/0.17%	0.17%/0.17%/0.18%	0.18%/0.18%/0.18%
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  $\pm 1.5\%$  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 (253V)
Measured value	0.9981/0.9985/0.9987	0.9998/0.9999/0.9997	0.9985/0.9986/0.9983
<b>Power Factor Limit</b>	>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	20.015s	47.7 30 s	Hz No trip
U/F stage 2	47 Hz	0.5 s	47.00Hz	0.511s	47.2 19.5 s	Hz No trip
					46.8 0.45 s	Hz No trip
O/F	52 Hz	0.5 s	52.00Hz	0.512s	51.8 120 s	Hz No trip

					52.2 0.45 s	Hz	No trip
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Note. For frequency trip tests the frequency required to trip is the setting  $\pm 0.1$  Hz. In order to measure the time delay a larger deviation than the minimum required to operate the protection can be used. The “No trip tests” need to be carried out at the setting  $\pm 0.2$  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	184.69	2.509s	188 5.0 s	V	No trip
					180 2.45 s	V	No trip
O/V stage 1	1.14 pu (262.2V)	1.0 s	262.54V	1.015s	258.2 5.0 s	V	No trip
O/V stage 2	1.19 pu (273.7V)	0.5 s	274.05V	0.517s	269.7 0.95s	V	No trip
					277.7 0.45 s	V	No trip

Note for Voltage tests the Voltage required to trip is the setting  $\pm 3.45$  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  $\pm 4$  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	0.355s	0.368s	0.388s	0.362s	0.368s	0.398s

**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 <sup>-1</sup>	2.1 s	No trip
51.0 Hz to 49.0 Hz	-0.95 Hzs <sup>-1</sup>	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.

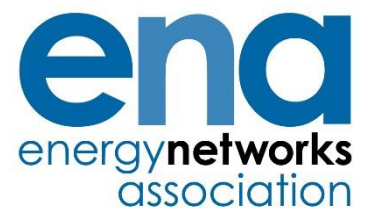
<b>Active Power</b> response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.	Y/N
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Alternatively, simulation results should be noted below:

Test sequence at <b>Registered Capacity</b> >80%	Measured <b>Active Power</b> Output	Frequency	Primary Power Source	<b>Active Power Gradient</b>
Step a) 50.00Hz ±0.01Hz	50453.25W	50.00Hz	51468.83W	-
Step b) 50.45Hz ±0.05Hz	49952.43W	50.46Hz		-
Step c) 50.70Hz ±0.10Hz	47456.95W	50.71Hz		-
Step d) 51.15Hz ±0.05Hz	42987.13W	51.15Hz		-
Step e) 50.70Hz ±0.10Hz	47462.86W	50.70Hz		-
Step f) 50.45Hz ±0.05Hz	49956.28W	50.44Hz		-

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Step g) 50.00Hz ±0.01Hz	50437.53W	50.01Hz		
Test sequence at <b>Registered Capacity</b> 40% - 60%	Measured <b>Active Power</b> Output	Frequency	Primary Power Source	<b>Active Power Gradient</b>
Step a) 50.00Hz ±0.01Hz	25308.46W	50.01Hz	25887.16W	-
Step b) 50.45Hz ±0.05Hz	25001.83W	50.45Hz		-
Step c) 50.70Hz ±0.10Hz	23752.56W	50.72Hz		-
Step d) 51.15Hz ±0.05Hz	21528.08W	51.15Hz		-
Step e) 50.70Hz ±0.10Hz	23769.12W	50.71Hz		-
Step f) 50.45Hz ±0.05Hz	25004.59W	50.45Hz		
Step g) 50.00Hz ±0.01Hz	25194.75W	50.01Hz		

**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.			
20s	30s	At 1.16 pu (266.2V)	At 0.78pu (180 V)	At 47.4 Hz	At 52.1 Hz
Confirmation that the <b>Power Generating Module</b> 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	134.2V	86.2A
100ms	72.5V	54.8A

250ms	58.7V	25.4A
500ms	16.8V	2.23A
Time to trip	0.312	In seconds
<b>12. Self-Monitoring solid state switching:</b> 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 <b>Power Park Module</b> , the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.		NA
<b>13. Wiring functional tests:</b> If required by para 15.2.1.		
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)		NA
<b>14. Logic interface (input port).</b>		
Confirm that an input port is provided and can be used to shut down the module.		Yes
Additional comments.		
This equipment is equipped with RJ45 terminal for logic interface that being received the signal from the DNO, the connection should be installed per installation manual, and the signal should be a simple binary output that captured by RJ45 terminal( PIN 5 and 1 for detecting the signal). Once the signal actived, the inverter will reduce its active power to zero within 5s.		
<b>15. Cyber security</b>		
Confirm that the Power Generating Module has been designed to comply with cyber security requirements, as detailed in 9.1.7.		Yes

**Manufacturer's declaration in accordance with the requirements of G98-Amd. 6 (2021-09) standard Sec.s 9.7.1, 9.7.2, and G99-Amd. 8 (2021-09) standard Sec.s 9.1.7, 9.1.8 regarding "Cyber Security"**

The undersigned \*\*\*\*\*,

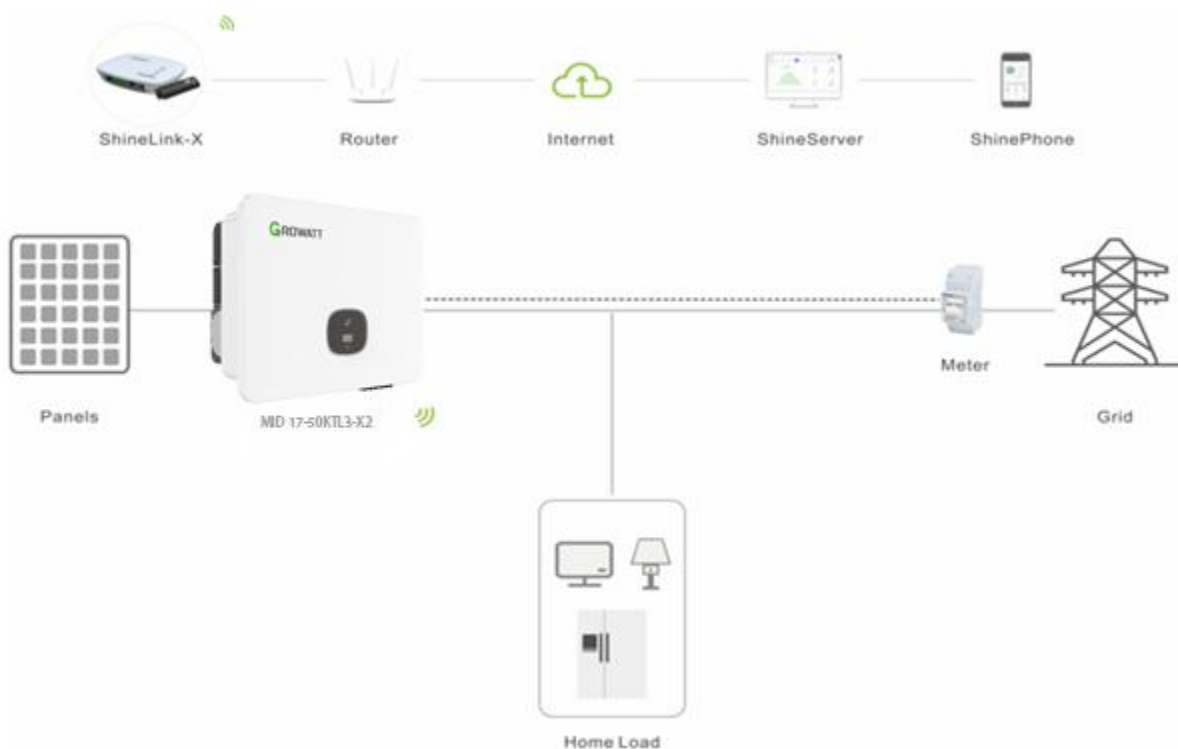
as Marketing department of the Company **ShenZhen Growatt New Energy Co.,Ltd.** ,

based in 4-13/F, Building A, Sino- German(Europe) Industrial Park, Hangcheng Ave,  
Guxing Community, Xixiang Subdistrict, Bao'an District, Shenzhen, China

**on behalf of the same Company declares the following:**

1) The ShenZhen Growatt New Energy Co.,Ltd company’s inverters include a system of internal and

external logic communications as summarized in the following scheme:



where the main components involved and their main functions are explained in the following table:

Name	Meaning	Function	Location
PMS	Power Management System	monitoring and management of power fluxes through the inverter, execution of local logic functions depending on grid parameters values	Inverter
Monitoring	WIFI/GPRS	Monitoring device to realize remote monitoring function	Monitoring device
Router	Router device	transmission of data to cloud	Third-party

		server, reception of commands/settings from external stakeholder	device
Meter	External Power Meter	meter at the AC input site, and possible meter at AC port of third party generator/inverter, for power measures	Third-party device

and the subjects/parties involved in communications with the Growatt inverters are listed in the following table, together with the purposes of the respective communications:

Subject	Meaning	Operations
End-user	mobile device (App), PC ( web portal)	monitoring of historical data, settings for special functions
Service	PC (via web portal)	remote diagnosis, system behaviour monitoring, remote updates, remote settings

2) All communications between internal components of the inverter, and supplied External Power Meter(s), take place via appropriate serial lines (RS485, CanBus) .

3) The only communication port between the inverter and the outside is constituted by the monitoring device on the system; the communication between inverter and the outside world can take place via an Ethernet line, WiFi or GPRS router according to the customer's request.

4) All communications between the Growatt server and the subjects/parties are cyber-protected by SSL technology.

5) The cyber-security assessment of the Growatt was performed according to the ETSI EN 303 645

standard, and it is reported according to the Table B.1 form of the same standard:

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EN 303 645 v2.1.1 (2020-06) Table B.1: Implementation of provisions for consumer IoT security			
Clause number and title			
Reference	Status	Support	Detail
5.1 No universal default passwords			
Provision 5.1-1	M C (1)	N/A	There is no default passwords for users
Provision 5.1-2	M C (1)	N/A	
Provision 5.1-3	M	N/A	
Provision 5.1-4	M C (8)	N/A	
Provision 5.1-5	M C (5)	N/A	
5.2 Implement a means to manage reports of vulnerabilities			
Provision 5.2-1	M	Y	
Provision 5.2-2	R	Y	
Provision 5.2-3	R	Y	
5.3 Keep software updated			
Provision 5.3-1	R	Y	
Provision 5.3-2	MC (5)	Y	
Provision 5.3-3	MC (12)	N/A	
Provision 5.3-4	RC (12)	Y	The manufacturer manages the updates of the systems by means of remote automatic, selectively by type of machine or by activating special functions at the request of the user
Provision 5.3-5	RC (12)	N	Check note at 5.3-4
Provision 5.3-6	RC (9,12)	N	Check note at 5.3-4
Provision 5.3-7	M C (12)	Y	
Provision 5.3-8	M C (12)	N	note at 5.3-4
Provision 5.3-9	R C (12)	N	
Provision 5.3-10	M (11,12)	Y	
Provision 5.3-11	RC (12)	N	
Provision 5.3-12	RC (12)	N	
Provision 5.3-13	M	Y	
Provision 5.3-14	R C (3,4)	N/A	
Provision 5.3-15	R C (3,4)	N/A	
Provision 5.3-16	M	Y	
5.4 Securely store sensitive security parameters			
Provision 5.4-1	M	Y	
Provision 5.4-2	M(10)	Y	
Provision 5.4-3	M	N/A	hard-coded identity not used in source code
Provision 5.4-4	M	Y	
5.5 Communicate securely			
Provision 5.5-1	M	Y	
Provision 5.5-2	R	Y	
Provision 5.5-3	R	Y	
Provision 5.5-4	R	N	
Provision 5.5-5	M	Y	
Provision 5.5-6	R	Y	
Provision 5.5-7	M	Y	
Provision 5.5-8	M	Y	
5.6 Minimize exposed attack surfaces			
Provision 5.6-1	M	Y	

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Provision 5.6-2	M	Y	
Provision 5.6-3	R	Y	
Provision 5.6-4	MC(13)	N/A	
Provision 5.6-5	R	Y	
Provision 5.6-6	R	Y	
Provision 5.6-7	R	Y	
Provision 5.6-8	R	N	
Provision 5.6-9	R	Y	
5.7 Ensure software integrity			
Provision 5.7-1	R	N	
Provision 5.7-2	R	N	
5.8 Ensure that personal data is secure			
Provision 5.8-1	R	N/A	
Provision 5.8-2	M	Y	applicable to server/cloud services and to the customer App for mobile devices
Provision 5.8-3	M	Y	
5.9 Make systems resilient to outages			
Provision 5.9-1	R	Y	
Provision 5.9-2	R	Y	
Provision 5.9-3	R	Y	
5.10 Examine system telemetry data			
Provision 5.10-1	RC (6)	N	
5.11 Make it easy for users to delete user data			
Provision 5.11-1	M	N/A	
Provision 5.11-2	R	N/A	
Provision 5.11-3	R	N/A	
Provision 5.11-4	R	N/A	
5.12 Make installation and maintenance of devices easy			
Provision 5.12-1	R	N/A	no installation/maintenance operations are available to the final user
Provision 5.12-2	R	N/A	no installation/maintenance operations are available to the final user
Provision 5.12-3	R	N/A	check note at 5.3-4
5.13 Validate input data			
Provision 5.13-1	M	Y	
6 Data protection provisions for consumer IoT			
Provision 6.1	M	Y	it only applies to the server/cloud side of the service
Provision 6.2	MC (7)	Y	it only applies to the server/cloud side of the service
Provision 6.3	M	Y	it only applies to the server/cloud side of the service
Provision 6.4	RC (6)	Y	
Provision 6.5	MC(6)	Y	
Conditions:			
<ol style="list-style-type: none"> <li>1) passwords are used;</li> <li>2) pre-installed passwords are used;</li> <li>3) software components are not updateable;</li> <li>4) the device is constrained;</li> <li>5) the device is not constrained;</li> <li>6) telemetry data being collected;</li> <li>7) personal data is processed on the basis of consumers' consent;</li> </ol>			

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### Type A Power Generating Modules



- 8) the device allowing user authentication;
- 9) the device supports automatic updates and/or update notifications;
- 10) a hard-coded unique per device identity is used for security purposes;
- 11) updates are delivered over a network interface;
- 12) an update mechanism is implemented;
- 13) a debug interface is physically accessible.

#### Status' Column:

M: Mandatory provision

R: Recommended provision

M C: Mandatory and conditional provision

R C: Recommended and conditional provision

#### Support' Column:

Y: Implemented

N: Not implemented

N/A: Not applicable