MIN 2500~6000 TL-X

- Maximum efficiency 98.4%
- Dual MPP trackers
- Type II SPD on DC side
- Supports export control
- Touch key and OLED display
- Data storage up to 25 years

POWER-ING TOMO-RROW

GROWATT

www.ginverter.com

Datasheet	MIN 2500TL-X	MIN 3000TL-X	MIN 3600TL-X	MIN 4200TL-X	MIN 4600TL-X	MIN 5000TL-X	MIN 6000TL-X
Input Data (DC)							
Max. recommended PV power (for module STC)	3500W	4200W	5040W	5880W	6440W	7000W	8100W
Max. DC voltage	500V	500V	550V	550V	550V	550V	550V
Start voltage	100V						
Nominal voltage	360V						
MPP voltage range	80V-500V	80V-500V	80V-550V	80V-550V	80V-550V	80V-550V	80V-550V
No. of MPP trackers	2						
No. of PV strings per MPP tracker	1						
Max. input current per MPP tracker	13.5A*						
Max. short-circuit current per MPP tracker	16.9A						
Output data (AC)							
AC nominal power	2500W	3000W	3600W	4200W	4600W	5000W	6000W
Max. AC apparent power	2500VA	3000VA	3600VA	4200VA	4600VA	5000VA	6000VA
Nominal AC voltage（range*）	230V (180-280V)						
AC grid frequency（range*）	50/60 Hz (45-55Hz/55-65 Hz)						
Max. output current	11.3A	13.6A	16A	19A	20.9A	22.7A	27.2A
Adjustable power factor	0.8leading…0.8lagging						
THDi	<3%						
AC grid connection type	Single phase						
Efficiency							
Max.efficiency	98.2%	98.2%	98.2%	98.4%	98.4%	98.4%	98.4%
European efficiency	97.1%	97.1%	97.2%	97.5%	97.5%	97.5%	97.5%
MPPT efficiency	99.9%						
Protection Devices							
DC reverse polarity protection	yes						
DC switch	yes						
AC/DC surge protection	Type III / Type II						
Insulation resistance monitoring	yes						
AC short-circuit protection	yes						
Ground fault monitoring	yes						
Grid monitoring	yes						
Anti-islanding protection	yes						
Residual-current monitoring unit	yes						
AFCI protection	Optional						
General Data							
Dimensions (W / H / D)	375/350/160mm						
Weight	10.8kg						
Operating temperature range	–25℃ ... +60℃						
Noise emission (typical)	≤35 dB(A)						
Nighttime power consumption	< 1W						
Topology	Transformerless						
Cooling	Natural convection						
Protection degree	IP65						
Relative humidity	0-100%						
Altitude	4000m						
DC connection	H4/MC4(Optional)						
AC connection	Connector						
Display	OLED+LED/WIFI+APP						
Interfaces: RS485 / USB/Wi-Fi/ GPRS/ RF/LAN	Yes/Yes/Optional/Optional/Optional /Optional						
Warranty: 5 years / 10 years	Yes /Optional						
CE, IEC62109, VDE0126-1-1, AS4777, AS/NZS 3100, VDE-AR-N4105, CQC, IEC61683, IEC60068, IEC61727, IEC62116, INMETRO							

* Only the latest version with max. input current 13.5A per MPP tracker, for details please contact Growatt.
* The AC voltage and frequency range may vary depending on specific country grid standard.
All specifications are subject to change without notice.

SHENZHEN GROWATT NEW ENERGY CO.,LTD. A:4-13/F,Building A,Sino-German(Europe)Industrial Park,Hangcheng Ave,Bao'an District,Shenzhen,China
T: + 86 755 2747 1900 F: + 86 755 2749 1460 E: info@ginverter.com

Warranty claim procedure:

Please report the potentially defective devices to your supplier to identify.

Supplier is required to send the warranty claim form to Growatt or authorized service partner with all the necessary information.

Customers must present this warranty card, inverter purchasing & Installation invoice, and other related materials as well if required.

Please fill in the required information below when your device is defective, scan and send or email it to your supplier with all the information or contact Growatt service team directly.

Please note Growatt reserve the ultimate explanation right on this warranty card.

End User Information
Customer name:
Phone number:
Email:
Detailed address:

Product Information
Inverter Model:
Serial No.(S/N):
Purchase date:
Dealer/Installer:
Commissioning data:

Warranty Card

powering tomorrow Growatt

Growatt New Energy Co.,Ltd
www.ginverter.com
T: +86 755 2747 1942
F: +86 755 2749 1460
service@ginverter.com

Growatt Factory Warranty

For the inverter with this warranty card you purchased, you receive a Growatt factory warranty valid for 10 years from the date of installation and no more than five and a half years from the delivery date from Growatt New Energy Co.,Ltd.

Warranty Exclusions

- Breaking the product seal (opening the casing) without proper approval
- Failure to observe the user manual, the installation guide, and the maintenance regulations
- Unauthorized Modifications, changes, or attempted repairs
- Incorrect use or inappropriate operation
- Insufficient ventilation of the device
- Failure to observe the applicable safety regulations
- Force majeure (e.g., lightning, over voltage, storm, fire)
- Goods bought from one-off sales by private sellers, such as a private garage sale or school fetes
- Goods purchased at a traditional auction
- Goods purchased to be resold or transformed into a product that is on-sold
- Services for transportation or storage of business goods, or
- Fitness for purpose of professional services provided by a qualified architect or engineer

If you would like to purchase an extension of Growatt factory warranty based on the 5 year term of Growatt factory warranty, please contact Growatt to get the price and an extending warranty card for apply.

Warranty condition

If a device becomes defective during the agreed Growatt factory warranty period and provided that it will not be impossible or unreasonable, the device will be, as selected by Growatt:

- repaired by Growatt, or
- repaired on-site, or
- exchanged for a replacement device of equivalent value according to model and age.

Note： UK models only provide warranty service for UK and Ireland client.

In the latter case, the remainder of the warranty entitlement will be transferred to the replacement device. In this case, you do not receive a new certificate since your entitlement is documented at Growatt.

Excessiveness in the meaning above exists in particular if the cost of the measures for Growatt would be unreasonable

- after consideration of alternative workaround possibilities that Growatt customers could revert to without significant inconvenience.

Form C: Type Test Verification Report

Type Approval and **Manufacturer** declaration of compliance with the requirements of G98.

This form should be used when making a Type Test submission to the Energy Networks Association (ENA).

If the **Micro-generator** is **Fully Type Tested** and already registered with the ENA **Type Test Verification Report** Register, the **Installation Document** should include the **Manufacturer**'s Reference Number (the Product ID), and this form does not need to be submitted.

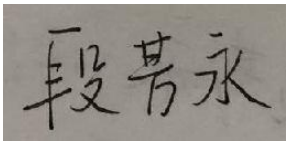
Where the **Micro-generator** is not registered with the ENA **Type Test Verification Report** Register this form needs to be completed and provided to the **DNO**, to confirm that the **Micro-generator** has been tested to satisfy the requirements of this EREC G98.

Manufacturer's reference number	Growatt MIN 3600TL-XE 2020
Micro-generator technology	Growatt MIN 2500TL-XE，Growatt MIN 3000TL-XE，Growatt MIN 3600TL-XE
Manufacturer name	Growatt New Energy Technology Co., Ltd.
Address	1st East & 3rd Floor of Building A,Building B,Jiayu Industrial Park,#28,GuangHui Road,LongTeng Community,Shiyan Street, Baoan District,Shenzhen,P.R.China

Tel	+86 755 2951 5888	Fax	+86 755 2747 2131
E-mail	FangYong.Duan@growatt.com	Web site	www.ginverter.com

Registered Capacity, use separate sheet if more than one connection option.	Connection Option	
	2.5-3.6	kW single phase, single, split or three phase system
	NA	kW three phase
	NA	kW two phases in three phase system
	NA	kW two phases split phase system

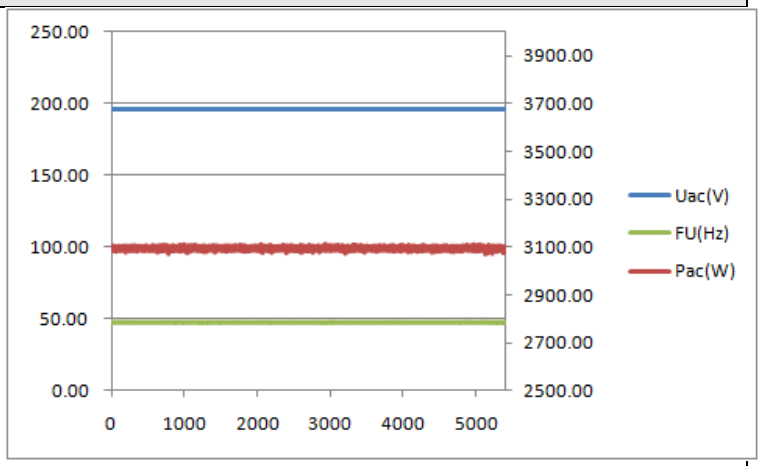
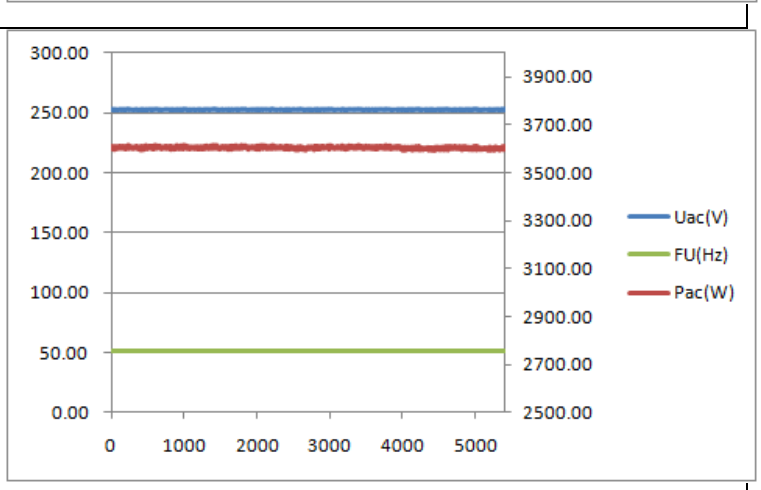
Manufacturer Type Test declaration. - I certify that all products supplied by the company with the above **Type Tested** reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site modifications are required to ensure that the product meets all the requirements of EREC G98.

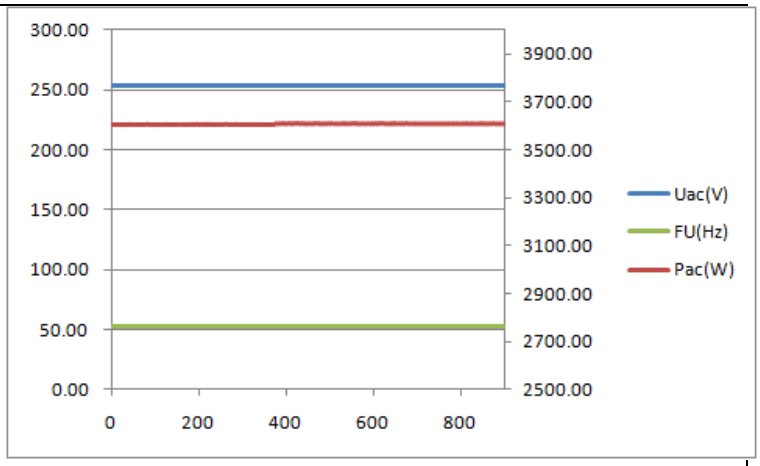
Signed		On behalf of	Growatt New Energy Technology Co., Ltd.

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.
1.Operating Range: This test should be carried out as specified in EN 50438 D.3.1. **Active Power** shall be recorded every second. The tests will verify that the **Micro-generator** 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 **Micro-generator** the PV primary source may be replaced by a **DC** source. In case of a full converter **Micro-generator** (eg wind) the primary source and the prime mover **Inverter**/rectifier may be replaced by a **DC** source. In case of a DFIG **Micro-generator** the mechanical drive system may be replaced by a test bench motor.

Test 1 Voltage = 85% of nominal (195.5 V) Frequency = 47.5 Hz Power factor = 1 Period of test 90 minutes	
Test 2 Voltage = 110% of nominal (253 V). Frequency = 51.5 Hz Power factor = 1 Period of test 90 minutes	

Test 3 Voltage = 110% of nominal (253 V). Frequency = 52.0 Hz Power factor = 1 Period of test 15 minutes	

2.Power Quality – Harmonics: These tests should be carried out as specified in BS EN 61000-3-2. The chosen test should be undertaken with a fixed source of energy at two power levels a) between 45 and 55% and b) at 100% of Registered Capacity. The test requirements are specified in Annex A1 A.1.3.1 (Inverter connected) or Annex A2 A.2.3.1 (Synchronous).

Micro-generator tested to BS EN 61000-3-2

Micro-generator rating per phase (rpp)			3.6	kW		
Harmonic	At 45-55% of **Registered Capacity**		100% of **Registered Capacity**			
	Measured Value MV in Amps	Normalised Value (NV) in Amps	Measured Value MV in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.0409	0.080	0.0422	0.135	1.080	
3	0.1247	0.229	0.2275	0.258	2.300	
4	0.0265	0.033	0.0286	0.049	0.430	
5	0.0362	0.139	0.0208	0.161	1.140	
6	0.0100	0.023	0.0126	0.036	0.300	
7	0.0128	0.085	0.0799	0.097	0.770	
8	0.0139	0.009	0.0233	0.011	0.230	
9	0.0484	0.055	0.0888	0.072	0.400	

10	0.0203	0.006	0.0338	0.023	0.184	
11	0.0507	0.033	0.0433	0.060	0.330	
12	0.0164	0.009	0.0187	0.011	0.153	
13	0.0678	0.009	0.0532	0.063	0.210	
14	0.0375	0.009	0.0330	0.026	0.131	
15	0.0485	0.010	0.0358	0.038	0.150	
16	0.0278	0.010	0.0164	0.026	0.115	
17	0.0329	0.021	0.0770	0.060	0.132	
18	0.0256	0.009	0.0222	0.023	0.102	
19	0.0604	0.033	0.0580	0.060	0.118	
20	0.0233	0.009	0.0291	0.023	0.092	
21	0.0312	0.045	0.0418	0.085	0.107	0.160
22	0.0406	0.021	0.0215	0.023	0.084	
23	0.0326	0.033	0.0462	0.072	0.098	0.147
24	0.0172	0.009	0.0150	0.036	0.077	
25	0.0254	0.045	0.0249	0.072	0.090	0.135
26	0.0135	0.009	0.0158	0.011	0.071	
27	0.0219	0.033	0.0298	0.045	0.083	0.124
28	0.0277	0.009	0.0217	0.009	0.066	
29	0.0450	0.047	0.0441	0.060	0.078	0.117
30	0.0071	0.010	0.0115	0.011	0.061	
31	0.0086	0.022	0.0240	0.036	0.073	0.109
32	0.0144	0.009	0.0084	0.021	0.058	
33	0.0102	0.021	0.0163	0.033	0.068	0.102
34	0.0136	0.009	0.0086	0.023	0.054	

35	0.0148	0.021	0.0242	0.036	0.064	0.096
36	0.0139	0.009	0.0154	0.011	0.051	
37	0.0109	0.009	0.0262	0.023	0.061	0.091
38	0.0170	0.009	0.0178	0.011	0.048	
39	0.0104	0.009	0.0121	0.023	0.058	0.087
40	0.0091	0.010	0.0089	0.013	0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

3.Power Quality – Voltage fluctuations and Flicker: These tests should be undertaken in accordance with EREC G98 Annex A1 A.1.3.3 (**Inverter** connected) or Annex A2 A.2.3.3 (Synchronous).

	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	0.69	0.38	0	0.69	0.38	0	0.09	0.09
Normalised to standard impedance	0.69	0.38	0	0.69	0.38	0	0.09	0.09

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

Test Impedance	R	0.4	Ω	X	0.25	Ω
Standard Impedance	R	0.4	Ω	X	0.25	Ω
Maximum Impedance	R	-	Ω	X	-	Ω

Applies to three phase and split single phase **Micro-generators**.

^ Applies to single phase **Micro-generators** and **Micro-generators** using two phases on a three phase system.

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

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

Single phase units reference source resistance is 0.4 Ω

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

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

Three phase units reference source resistance is 0.24 Ω.

Where the power factor of the output is under 0.98 then the X 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 conform to 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	11. JUNE.2020	Test end date	11. JUNE.2020
Test location	Growatt R&D Test Lab		

4.Power quality – DC injection: This test should be carried out in accordance with EN 50438 Annex D.3.10

Test power level(3.6k)	20%	50%	75%	100%
Recorded value in Amps	0.0246A	0.0244A	0.0267A	0.0281A
as % of rated AC current	0.15%	0.15%	0.17%	0.18%
Limit	0.25%	0.25%	0.25%	0.25%
Test power level(3k)	20%	50%	75%	100%
Recorded value in Amps	24.5mA	24.1 mA	24.2 mA	24.1mA
as % of rated AC current	0.18%	0.18%	0.18%	0.18%
Limit	0.25%	0.25%	0.25%	0.25%
Test power level(2.5k)	20%	50%	75%	100%
Recorded value in Amps	16.5mA	17.1 mA	17.2 mA	17.7mA
as % of rated AC current	0.15%	0.16%	0.16%	0.16%
Limit	0.25%	0.25%	0.25%	0.25%
5.Power Quality – Power factor: This test shall be carried out in accordance with EN 50548 Annex D.3.4.1 but with nominal voltage -6% and +10%. Voltage to be maintained within ±1.5% of the stated level during the test.				
	216.2 V		230 V	253 V
20% of **Registered Capacity**	0.9866		0.9855	0.9826
50% of **Registered**	0.9977		0.9975	0.9974

Capacity			
75% of **Registered Capacity**	0.9988	0.9988	0.9987
100% of **Registered Capacity**	0.9989	0.9990	0.9991
Limit	>0.95	>0.95	>0.95

6.Protection – Frequency tests: These tests should be carried out in accordance with EN 50438 Annex D.2.4 and the notes in EREC G98 Annex A1 A.1.2.3 (**Inverter** connected) or Annex A2 A.2.2.3 (Synchronous)

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	47.46Hz	20.36s	47.7 Hz 30 s	No trip
U/F stage 2	47 Hz	0.5 s	46.96Hz	0.971s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F stage 1	52 Hz	0.5 s	52Hz	0.894s	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 EN 50438 Annex D.2.3 and the notes in EREC G98 Annex A1 A.1.2.2 (**Inverter** connected) or Annex A2 A.2.2.2 (Synchronous)

Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	184 V	2.5 s	182.5V	2.834s	188 V 5.0 s	No trip
					180 V 2.45 s	No trip

O/V stage 1	262.2 V	1.0 s	262.4V	1.430s	258.2 V 5.0 s	No trip
O/V stage 2	273.7 V	0.5 s	274.6V	0.930	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: For PV Inverters shall be tested in accordance with BS EN 62116. Other Inverters should be tested in accordance with EN 50438 Annex D.2.5 at 10%, 55% and 100% of rated power.

To be carried out at three output power levels with a tolerance of plus or minus 5% in Test Power levels.

Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Limit is 0.5 s						

For Multi phase **Micro-generators** confirm that the device shuts down correctly after the removal of a single fuse as well as operation of all phases.

Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Ph1 fuse removed	-	-	-	-	-	-
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Ph2 fuse removed	-	-	-	-	-	-
Test Power	10%	55%	100%	10%	55%	100%
Balancing load on islanded network	95% of **Registered Capacity**	95% of **Registered Capacity**	95% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**	105% of **Registered Capacity**
Trip time. Ph3 fuse removed	-	-	-	-	-	-

Note for technologies which have a substantial shut down time this can be added to the 0.5 s in establishing that the trip occurred in less than 0.5 s. Maximum shut down time could therefore be up to 1.0 s for these technologies.						
Indicate additional shut down time included in above results.			0.3ms			
For **Inverters** tested to BS EN 62116 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 0.5 s	0.140s	0.165s	0.211s	0.127s	0.139s	0.118s

9.Protection – Frequency change, Vector Shift Stability test: This test should be carried out in accordance with EREC G98 Annex A1 A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous).			
	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.0 Hz	+50 degrees	No trip
Negative Vector Shift	50.0 Hz	- 50 degrees	No trip

10.Protection – Frequency change, RoCoF Stability test: The requirement is specified in section 11.3, test procedure in Annex A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous).			
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

11.Limited Frequency Sensitive Mode – Overfrequency test: This test should be carried out in accordance with EN 50438 Annex D.3.3 Power response to over- frequency. The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%.				
Test sequence at **Registered Capacity** >80%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00 Hz ±0.01 Hz	3603.29W	50.007Hz	3698.31W	-
Step b) 50.45 Hz ±0.05 Hz	3564.86W	50.448Hz		-
Step c) 50.70 Hz ±0.10 Hz	3385.55W	50.708Hz		-
Step d) 51.15 Hz ±0.05 Hz	3060.48W	51.156Hz		-

Step e) 50.70 Hz ±0.10 Hz	3385.91W	50.697Hz		-
Step f) 50.45 Hz ±0.05 Hz	3566.79W	50.446Hz		-
Step g) 50.00 Hz ±0.01 Hz	3601.12W	50Hz		
Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00 Hz ±0.01 Hz	1801.98W	50Hz	1849.99W	-
Step b) 50.45 Hz ±0.05 Hz	1785.14W	50.443Hz		-
Step c) 50.70 Hz ±0.10 Hz	1695.03W	50.701Hz		-
Step d) 51.15 Hz ±0.05 Hz	1530.44W	51.15Hz		-
Step e) 50.70 Hz ±0.10 Hz	1692.18W	50.697Hz		-
Step f) 50.45 Hz ±0.05 Hz	1785.27W	50.445Hz		-
Step g) 50.00 Hz ±0.01 Hz	1800.14W	50.009Hz		
Steps as defined in EN 50438				

12.Power output with falling frequency test: This test should be carried out in accordance with EN 50438 Annex D.3.2 active power feed-in at under-frequency.

Test sequence	Measured **Active Power** Output	Frequency	Primary power source
Test a) 50 Hz ± 0.01 Hz	3591.48W	50Hz	3696.22W
Test b) Point between 49.5 Hz and 49.6 Hz	3598.32	49.55Hz	3703.79W
Test c) Point between 47.5 Hz and 47.6 Hz	3591.75W	47.556Hz	3697.37W
NOTE: The operating point in Test (b) and (c) shall be maintained for at least 5 minutes			

13.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 2.

Time delay setting	Measured delay		Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 2.			
20	25		At 266.2 V	At 180.0 V	At 47.4 Hz	At 52.1 Hz

Confirmation that the **Micro-generator** does not re-connect.	Yes	Yes	Yes	Yes

14.Fault level contribution: These tests shall be carried out in accordance with EREC G98 Annex A1 A.1.3.5 (**Inverter** connected) and Annex A2 A.2.3.4 (Synchronous).

For machines with electro-magnetic output			For **Inverter** output		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	-	20 ms	80.2V	29.3A
Initial Value of aperiodic current	A	-	100 ms	77.3V	22.5A
Initial symmetrical short-circuit current*	I_k	-	250 ms	76.9V	16.1A
Decaying (aperiodic) component of short circuit current*	i_{DC}	-	500 ms	73.5V	8.6A
Reactance/Resistance Ratio of source*	$^X/_R$	-	Time to trip	0.12s	In seconds

For rotating machines and linear piston machines the test should produce a 0 s – 2 s plot of the short circuit current as seen at the **Micro-generator** terminals.

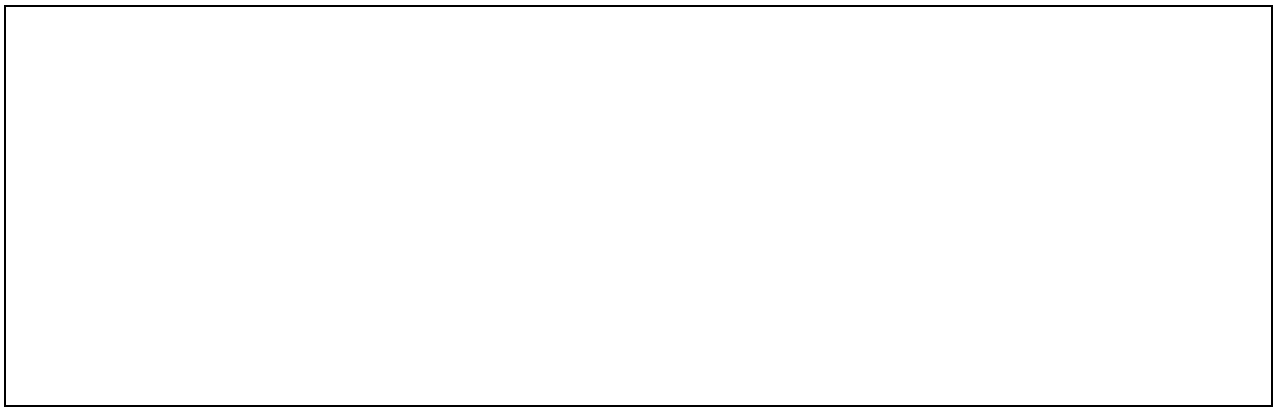
* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot

15.Logic Interface.	Yes

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.

16.Self-Monitoring solid state switching: No specified test requirements. Refer to EREC G98 Annex A1 A.1.3.6 (**Inverter** connected).	Yes/or NA
It has been verified that in the event of the solid state switching device failing to disconnect the **Micro-generator**, the voltage on the output side of the switching device is reduced to a value below 50 V within 0.5 s.	NA

Additional comments



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.

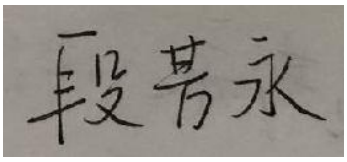
PGM technology		Growatt MIN 4200TL-XE, Growatt MIN 4600TL-XE, Growatt MIN 5000TL-XE, Growatt MIN 6000TL-XE	
Manufacturer name		Growatt New Energy Technology Co., Ltd.	
Address		1st East & 3rd Floor of Building A,Building B,Jiayu Industrial Park,#28,GuangHui Road,LongTeng Community,Shiyan Street,Baoan,District,Shenzhen, P.R.China	
Tel	+86 755 2951 5888	Web site	www.ginverter.com
E:mail	FangYong.Duan@growatt.com		
Registered Capacity		6kW	

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				
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:**

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	Growatt New Energy Technology 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

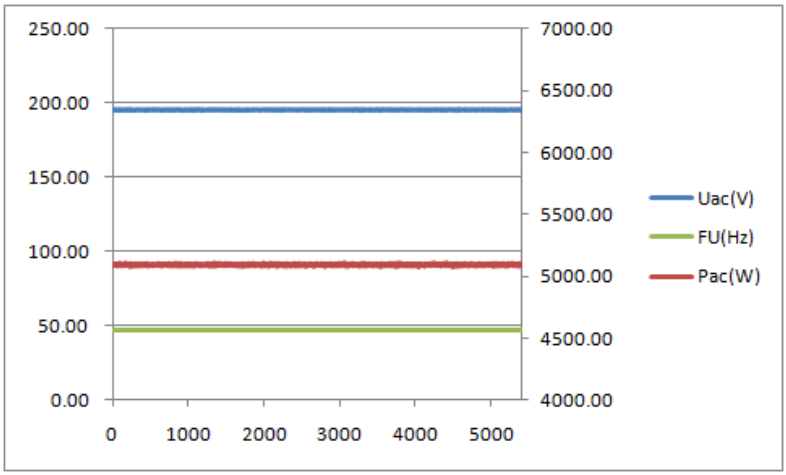
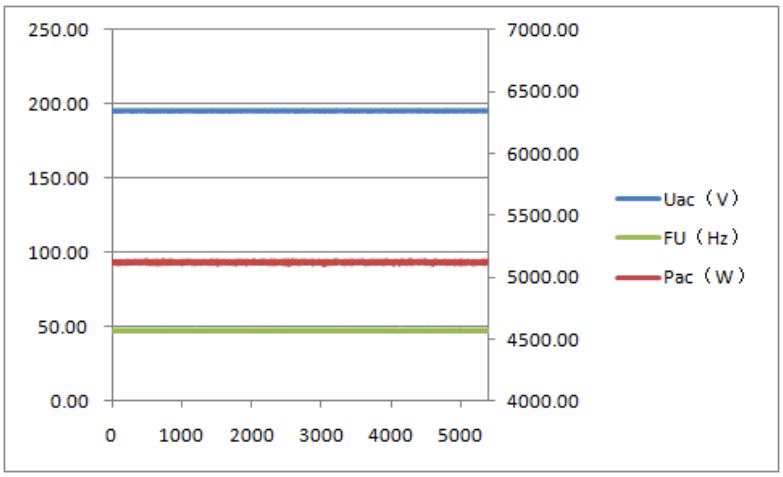
1. Operating Range: Two tests should be carried with the **Power Generating Module** operating at **Registered Capacity** and connected to a suitable test supply or grid simulation set. The power supplied by the primary source shall be kept stable within ± 5 % of the apparent power value set for the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

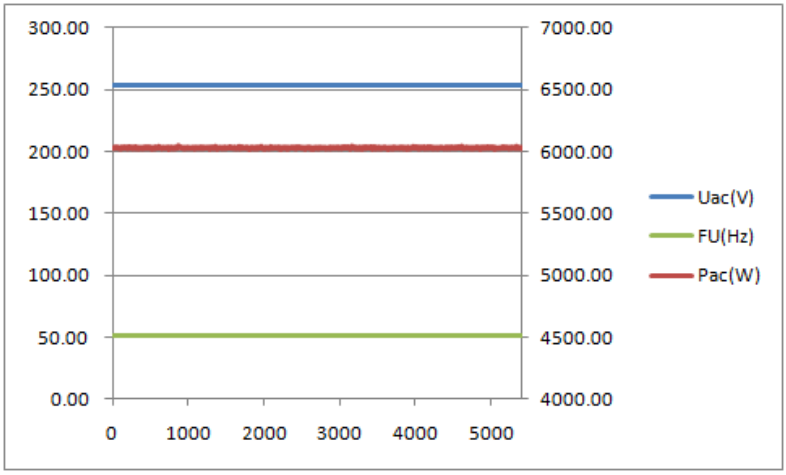
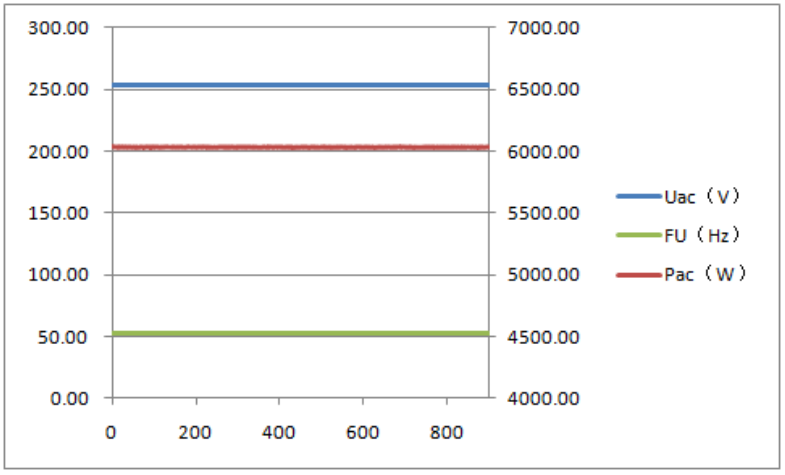
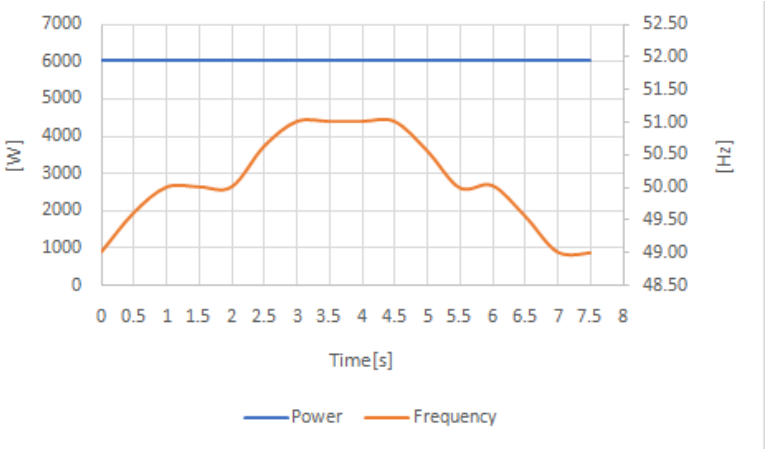
Frequency, voltage and **Active Power** measurements at the output terminals of the **Power Generating Module** shall be recorded every second. The tests will verify that the **Power Generating Module** can operate within the required ranges for the specified period of time.

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 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	
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.	

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.						
Power Generating Module tested to BS EN 61000-3-12						
Power Generating Module rating per phase (rpp)			4.2	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	0.0317	0.173	0.0348	0.191	8%	8%
3	0.0906	0.496	0.0797	0.437	21.6%	Not stated
4	0.0209	0.114	0.0338	0.185	4%	4%
5	0.0282	0.154	0.0290	0.159	10.7%	10.7%
6	0.0343	0.188	0.0363	0.199	2.67%	2.67%
7	0.0555	0.304	0.0472	0.259	7.2%	7.2%
8	0.0336	0.184	0.0307	0.168	2%	2%
9	0.0583	0.319	0.0587	0.321	3.8%	Not stated
10	0.0300	0.164	0.0338	0.185	1.6%	1.6%
11	0.0458	0.251	0.0590	0.323	3.1%	3.1%
12	0.0289	0.158	0.0586	0.321	1.33%	1.33%
13	0.0400	0.219	0.0542	0.297	2%	2%
THD[1]	-	1.402	-	0.923	23%	13%
PWHD[2]	-	1.653	-	1.211	23%	22%
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	

[1] THD = Total Harmonic Distortion

[2] PWHD = Partial Weighted Harmonic Distortion

	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.0262	0.131	0.0444	0.222	8%	8%
3	0.0726	0.363	0.1021	0.511	21.6%	Not stated
4	0.0195	0.097	0.0205	0.102	4%	4%
5	0.0188	0.094	0.0270	0.135	10.7%	10.7%
6	0.0373	0.187	0.0419	0.210	2.67%	2.67%
7	0.0364	0.182	0.0238	0.119	7.2%	7.2%
8	0.0429	0.214	0.0395	0.198	2%	2%
9	0.0428	0.214	0.3065	0.182	3.8%	Not stated
10	0.0357	0.179	0.0360	0. 180	1.6%	1.6%
11	0.0425	0.212	0.0484	0.242	3.1%	3.1%
12	0.0265	0.133	0.0539	0.269	1.33%	1.33%
13	0.0446	0.223	0.0565	0.282	2%	2%
THD[3]	-	1.298	-	0.825	23%	13%
PWHD[4]	-	1.509	-	1.044	23%	22%

[3] THD = Total Harmonic Distortion

[4] PWHD = Partial Weighted Harmonic Distortion

Power Generating Module rating per phase (rpp)			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	0.0196	0.090	0.0462	0.213	8%	8%
3	0.0522	0.240	0.1265	0.582	21.6%	Not stated
4	0.0288	0.133	0.0544	0.250	4%	4%
5	0.0188	0.086	0.0326	0.150	10.7%	10.7%
6	0.0523	0.241	0.0813	0.374	2.67%	2.67%
7	0.0485	0.223	0.0228	0.105	7.2%	7.2%
8	0.0411	0.189	0.0434	0.200	2%	2%
9	0.0442	0.203	0.032	0.147	3.8%	Not stated
10	0.0438	0.201	0.0441	0.203	1.6%	1.6%
11	0.0419	0.193	0.0474	0.218	3.1%	3.1%
12	0.0437	0.201	0.0533	0.245	1.33%	1.33%
13	0.0640	0.294	0.0562	0.259	2%	2%
THD[5]	-	1.074	-	0.836	23%	13%
PWHD[6]	-	1.304	-	1.059	23%	22%

[5] THD = Total Harmonic Distortion

[6] PWHD = Partial Weighted Harmonic Distortion

Power Generating Module rating per phase (rpp)			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	0.0312	0.119	0.0885	0.339	8%	8%
3	0.0543	0.208	0.1669	0.640	21.6%	Not stated
4	0.0294	0.113	0.1043	0.400	4%	4%
5	0.0166	0.064	0.0798	0.306	10.7%	10.7%
6	0.0362	0.139	0.0811	0.311	2.67%	2.67%
7	0.0305	0.117	0.0421	0.161	7.2%	7.2%
8	0.0427	0.164	0.0631	0.242	2%	2%
9	0.0342	0.131	0.0318	0.122	3.8%	Not stated
10	0.0293	0.112	0.0373	0.143	1.6%	1.6%
11	0.0380	0.146	0.0475	0.182	3.1%	3.1%
12	0.0526	0.202	0.0406	0.156	1.33%	1.33%
13	0.0443	0.170	0.0473	0.181	2%	2%
THD[7]	-	0.943	-	0.914	23%	13%
PWHD[8]	-	1.125	-	1.064	23%	22%

[7] THD = Total Harmonic Distortion

[8] PWHD = Partial Weighted Harmonic Distortion

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	1.07	0.36	0	1.07	0.36	0	0.13	0.11
Normalised to standard impedance	1.07	0.36	0	1.07	0.36	0	0.13	0.11
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

Test Impedance	R	0. 4	Ω	Xl	0.25 ^	Ω
Standard Impedance	R	0.4 ^	Ω	Xl	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	12. June.2020	Test end date	12. June.2020
Test location	Growatt R&D Test Lab		
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.			
Test power level（4.2K）	10%	55%	100%
Recorded value in Amps	24.9mA	28.5mA	30mA
as % of rated AC current	0.14%	0.16%	0.16%
Limit	0.25%	0.25%	0.25%
Test power level（4.6K）	10%	55%	100%
Recorded value in Amps	28.6mA	30.1mA	31.6mA
as % of rated AC current	0.14%	0.15%	0.16%
Limit	0.25%	0.25%	0.25%
Test power level（5K）	10%	55%	100%
Recorded value in Amps	29.8mA	30.5mA	32.2mA
as % of rated AC current	0.14%	0.14%	0.15%
Limit	0.25%	0.25%	0.25%
Test power level（6K）	10%	55%	100%
Recorded value in Amps	34.7mA	36.6mA	38.2mA
as % of rated AC current	0.13%	0.14%	0.15%
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	0.9987	0.9989	0.9992
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	47.48	20.430s	47.7 Hz 30 s	No trip
U/F stage 2	47 Hz	0.5 s	46.96	0.970s	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	0.894s	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	183.1V	2.844s	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	262.34V	1.42s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	274.25V	0.94s	269.7 V 0.95s	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	0.12s	0.13s	0.13s	0.14s	0.13s	0.12s

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/N**
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	6022.22W	50.007 Hz	6172.63W	-
Step b) 50.45Hz ±0.05Hz	5965.12W	50.445 Hz		-
Step c) 50.70Hz ±0.10Hz	5654.39W	50.704 Hz		-
Step d) 51.15Hz ±0.05Hz	5058.46W	51.152 Hz		-
Step e) 50.70Hz ±0.10Hz	5664.7W	50.698Hz		-
Step f) 50.45Hz ±0.05Hz	5965.99W	50.452Hz		-

Step g) 50.00Hz ±0.01Hz	6022.37W	50.001 Hz		
Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00Hz ±0.01Hz	3013.1W	49.999 Hz	3036.38W	-
Step b) 50.45Hz ±0.05Hz	2980.17W	50.451Hz		-
Step c) 50.70Hz ±0.10Hz	2820.69W	50.703Hz		-
Step d) 51.15Hz ±0.05Hz	2575.93W	51.151Hz		-
Step e) 50.70Hz ±0.10Hz	2823.17W	50.701 Hz		-
Step f) 50.45Hz ±0.05Hz	2980.25W	50.451 Hz		
Step g) 50.00Hz ±0.01Hz	3015.2W	50 Hz		

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	20s	At 1.16 pu (266.2 V)	At 0. 78pu (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	85.2V	29.7A
100ms	79.6V	24A

250ms	76.3V	17.8A
500ms	72.5V	9.4A
Time to trip	0.17s	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.		
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.		