



Form C: Type Test Verification Report

All Micro-generators connected to the **DNO Distribution Network** shall be **Fully Type Tested**. This form is the **Manufacturer's** 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 **Fully Type Tested** and 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		SUNSYNK-3.6K-SG01LP1	
Micro-generator technology		Hybrid Inverter	
Manufacturer name		SunSynk Ltd.	
Address		Flat A, 3/F Wai Yip Industrial Building, 171 Wai Yip Street, Kwun Tong, Hong Kong	
Tel	+852 2884 4318	Fax	/
E-mail	kgoughuk@globaltech-china.com	Web site	http://www.sunsynk.com/
Registered Capacity , use separate sheet if more than one connection option.		Connection Option	
		3.6	kW single phase
		N/A	kW three phase
		N/A	kW two phases in three phase system
		N/A	kW two phases split phase system
Manufacturer Type Test declaration. - I certify that all products supplied by the company with the above Fully 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	

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.

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

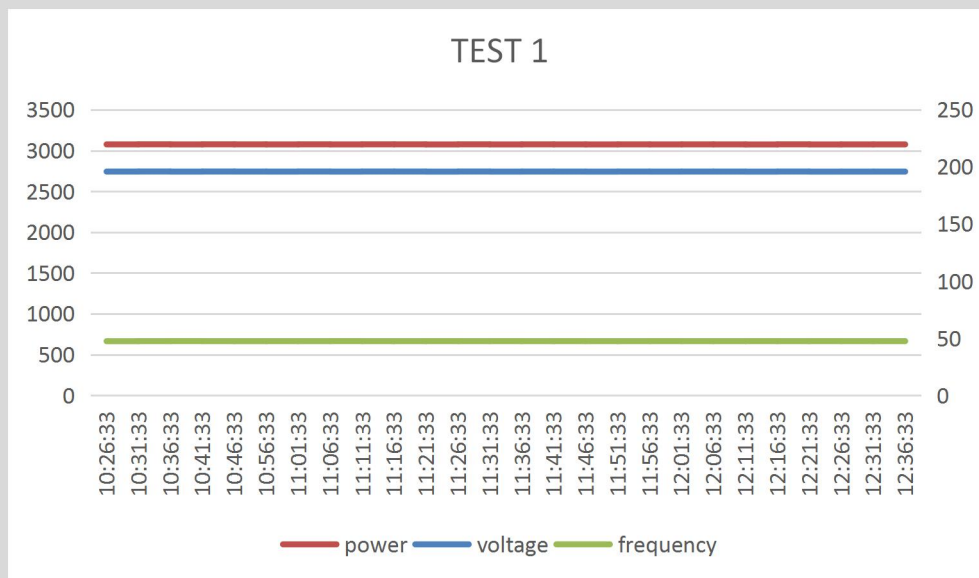
Voltage = 110% of nominal (253 V).

Frequency = 52.0 Hz

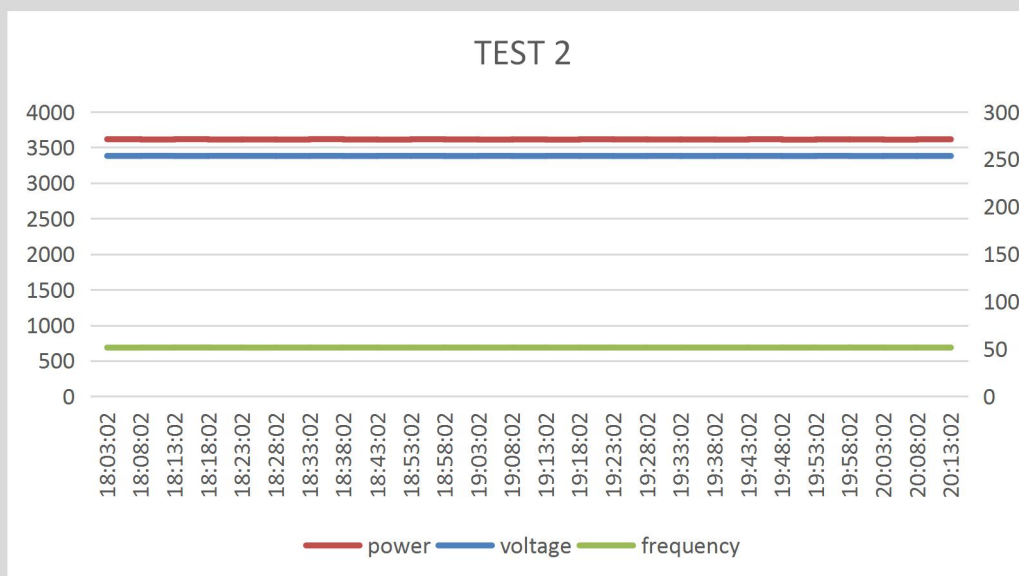
Power factor = 1

Period of test 15 minutes

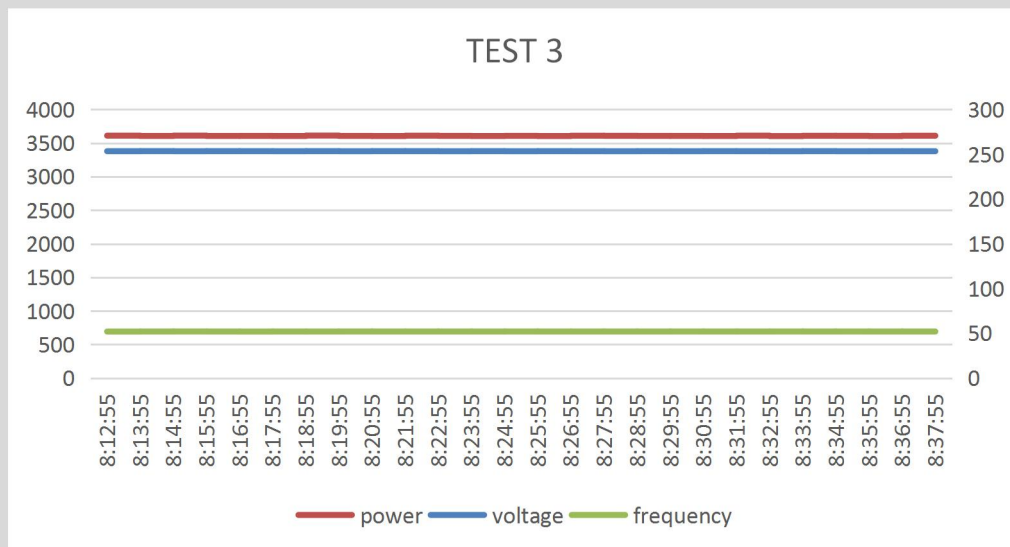
TEST1



TEST2



TEST3



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		NV=MV*3.68/rpp	
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	0.082	0.485	0.173	0.901	1.091	
3	0.026	0.142	0.065	0.234	2.400	
4	0.014	0.082	0.029	0.077	0.435	
5	0.008	0.055	0.021	0.045	1.139	
6	0.007	0.053	0.017	0.041	0.302	
7	0.008	0.055	0.015	0.031	0.765	
8	0.008	0.042	0.013	0.025	0.229	
9	0.007	0.037	0.012	0.027	0.399	
10	0.004	0.035	0.010	0.022	0.179	
11	0.005	0.033	0.008	0.015	0.328	

12	0.005	0.025	0.009	0.017	0.156	
13	0.006	0.026	0.006	0.016	0.209	
14	0.004	0.020	0.008	0.013	0.136	
15	0.003	0.019	0.008	0.025	0.142	
16	0.004	0.019	0.007	0.018	0.121	
17	0.003	0.015	0.009	0.007	0.140	
18	0.002	0.016	0.013	0.013	0.109	
19	0.003	0.014	0.008	0.009	0.125	
20	0.003	0.015	0.004	0.011	0.090	
21	0.002	0.009	0.004	0.019	0.106	0.160
22	0.004	0.008	0.005	0.017	0.089	
23	0.003	0.009	0.007	0.012	0.097	0.147
24	0.002	0.010	0.006	0.008	0.085	
25	0.002	0.015	0.007	0.008	0.088	0.135
26	0.001	0.023	0.006	0.009	0.069	
27	0.003	0.012	0.004	0.013	0.080	0.124
28	0.002	0.015	0.005	0.014	0.059	
29	0.002	0.017	0.006	0.015	0.074	0.117
30	0.001	0.019	0.004	0.019	0.059	
31	0.002	0.011	0.003	0.005	0.069	0.109
32	0.004	0.009	0.004	0.007	0.057	
33	0.002	0.008	0.007	0.013	0.052	0.102
34	0.003	0.005	0.003	0.015	0.060	
35	0.003	0.008	0.004	0.016	0.065	0.096
36	0.002	0.007	0.006	0.005	0.049	
37	0.002	0.011	0.005	0.005	0.069	0.091
38	0.003	0.012	0.004	0.011	0.047	
39	0.002	0.003	0.005	0.008	0.062	0.087

40	0.002	0.005	0.003	0.007	0.059	
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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.

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	0.45	0.38	0	0.36	0.3	0	0.173	0.069
Normalised to standard impedance	2.80	2.4	0	2.75	1.84	0	0.89	0.38
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	2019-10-12	Test end date	2019-10-12
Test location	No.26 South YongJiang Road, Daqi, Beilun, NingBo, China.		

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

Test power level	20%	50%	75%	100%
Recorded value in Amps	7.2 mA	9.93 mA	10.12mA	10.05mA
as % of rated AC current	0.046%	0.063%	0.064%	0.064%
Limit	0.25%	0.25%	0.25%	0.25%

Power Quality – Power factor: This test shall be carried out in accordance with EN 50538 Annex D.3.4.1 but with nominal voltage -6% and +10%. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.

	216.2 V	230 V	253 V
20% of Registered Capacity	0.9785	0.9750	0.9742
50% of Registered Capacity	0.9962	0.9942	0.9935
75% of Registered Capacity	0.9970	0.9962	0.9955
100% of Registered Capacity	0.9975	0.9973	0.9970

Limit	>0.95	>0.95	>0.95
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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	47.5Hz	20.05s	47.7 Hz 30 s	NO trip
U/F stage 2	47 Hz	0.5 s	47Hz	0.53s	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	0.55s	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.

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	183.4V	2.50s	188 V 5.0 s	NO trip
					180 V 2.45 s	NO trip
O/V stage 1	262.2 V	1.0 s	262.8V	1.03s	258.2 V 5.0 s	NO trip
O/V stage 2	273.7 V	0.5 s	274.4V	0.53s	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.

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	20.50ms	401.25ms	413.55ms	22.15ms	426.22ms	436.41ms

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

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
Positive Frequency drift	49Hz to 51Hz	+0.95 Hzs ⁻¹	2.1 s	No trip
Negative Frequency drift	51Hz to 49Hz	-0.95 Hzs ⁻¹	2.1 s	No trip

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	3600W	50Hz	3730W	-
Step b) 50.45 Hz ±0.05 Hz	3573W	50.45Hz		-
Step c) 50.70 Hz ±0.10 Hz	3320W	50.7Hz		-
Step d) 51.15 Hz ±0.05 Hz	3077W	51.15Hz		-
Step e) 50.70 Hz ±0.10 Hz	3316W	50.7Hz		-
Step f) 50.45 Hz ±0.05 Hz	3568W	50.45Hz		-

Step g) 50.00 Hz ±0.01 Hz	3600W	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	1803W	50Hz	1850W	-		
Step b) 50.45 Hz ±0.05 Hz	1794W	50.45Hz		-		
Step c) 50.70 Hz ±0.10 Hz	1688W	50.7Hz		-		
Step d) 51.15 Hz ±0.05 Hz	1548W	51.15Hz		-		
Step e) 50.70 Hz ±0.10 Hz	1685W	50.7Hz		-		
Step f) 50.45 Hz ±0.05 Hz	1795W	50.45Hz		-		
Step g) 50.00 Hz ±0.01 Hz	1800W	50Hz				
Steps as defined in EN 50438						
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	3601W	50Hz				
Test b) Point between 49.5 Hz and 49.6 Hz	3600.8W	49.55Hz				
Test c) Point between 47.5 Hz and 47.6 Hz	3659.9W	47.55Hz				
NOTE: The operating point in Test (b) and (c) shall be maintained for at least 5 minutes						
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.				
40s	39.9s		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.		No reconnection	No reconnection	No reconnection	No reconnection	
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	N/A	20 ms	20.15V	0.182A
Initial Value of aperiodic current	A	N/A	100 ms	11.15V	0.148A
Initial symmetrical short-circuit current*	I_k	N/A	250 ms	8.59V	0.128A
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500 ms	7.13V	0.109A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0.0020	In seconds
<p>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.</p> <p>* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot</p>					
Logic Interface.					Yes
Self-Monitoring solid state switching: No specified test requirements. Refer to EREC G98 Annex A1 A.1.3.6 (Inverter connected).					Yes
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.					Yes
Additional comments					