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 EREC G98.

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

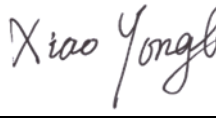
If the **Micro-generator** is **Fully Type Tested** and already registered with the ENA Type Test Register, the **Installation Document** should include the **Manufacturer**'s Reference Number (the system reference), and this form does not need to be submitted.

Manufacturer's reference number	X1-IES-2.5K,X1-IES-3K,X1-IES-3.7K		
Micro-generator technology	Grid Tied Inverter With Storage System		
Manufacturer name	SolaX Power Network Technology (Zhe jiang) Co., Ltd.		
Address	No. 288 Shizhu Road, Tonglu Economic Development Zone, Tonglu City, Zhejiang Province 310000, P.R. China		
Tel	+86(0571)-56260011	Fax	+86(0571)-56075753
E-mail	info@solaxpower.com	Website	www.solaxpower.com

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

Energy storage capacity for **Electricity Storage** devices	

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	SolaX Power Network Technology (Zhe jiang) 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.

Operating Range: This test should be carried out as specified in A.1.2.10.

Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement “Pass”, “No disconnection occurs”, etc. Graphical evidence is preferred.

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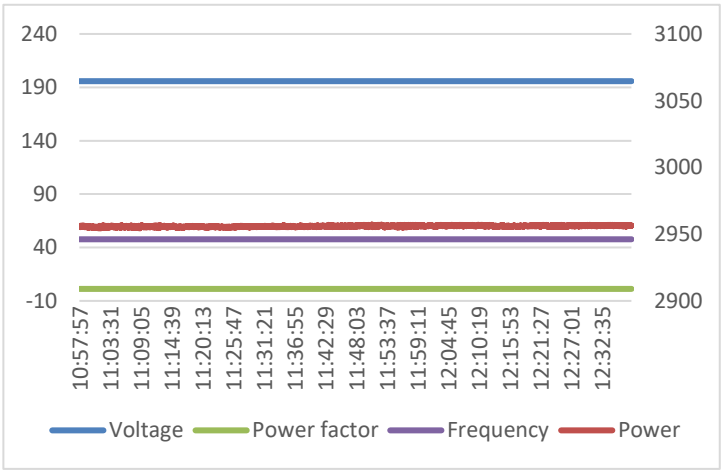
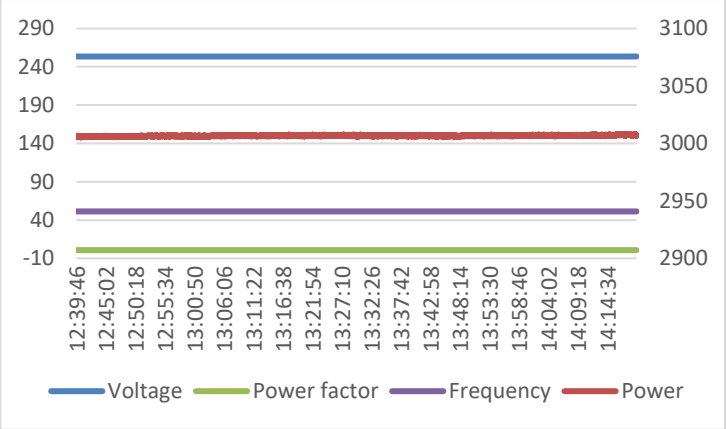
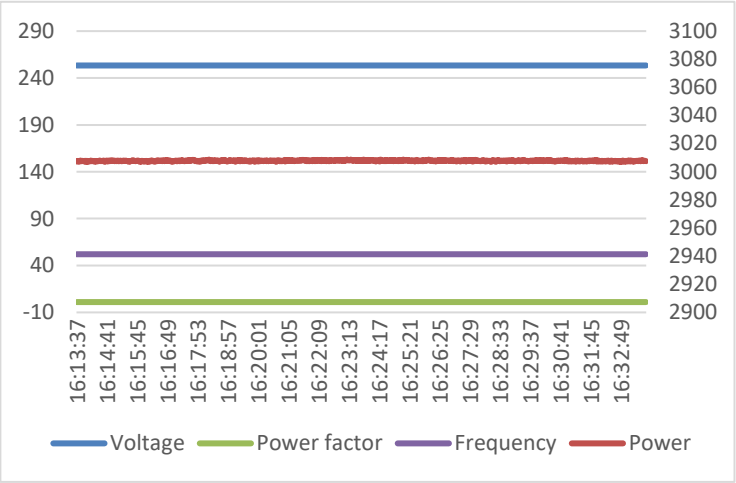
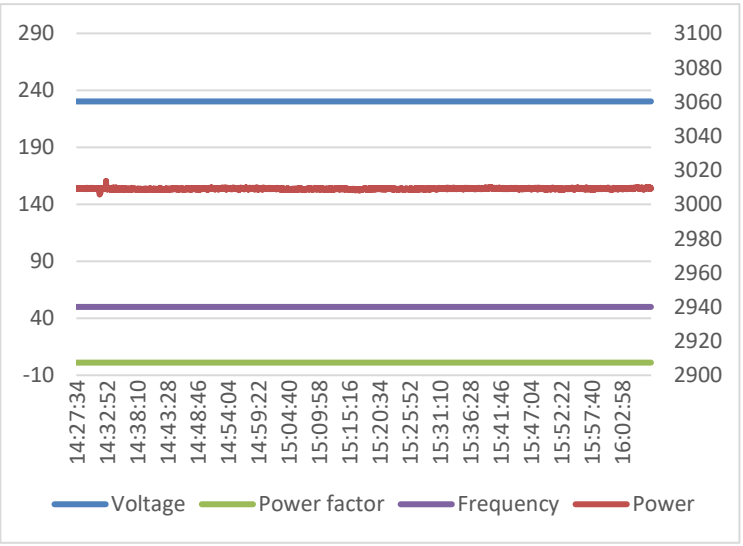
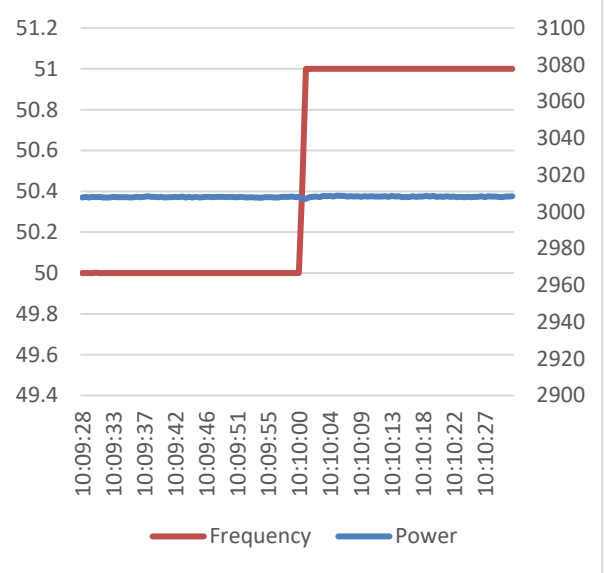
Test 1 Voltage = 85% of nominal (195.5 V) Frequency = 47.0 Hz Power factor = 1 Period of test 20 seconds	Test results or chart to confirm operation 
Test 2 Voltage = 85% of nominal (195.5 V) Frequency = 47.5 Hz Power factor = 1 Period of test 90 minutes	Test results or chart to confirm operation 

Test 3 Voltage = 110% of nominal(253V). Frequency = 51.5 Hz Power factor = 1 Period of test 90 minutes	Test results or chart to confirm operation 
Test 4 Voltage = 110% of nominal(253V). Frequency = 52.0 Hz Power factor = 1 Period of test 15 minutes	Test results or chart to confirm operation 
Test 5 Voltage = 100% of nominal (230 V). Frequency = 50.0 Hz Power factor = 1 Period of test 90 minutes[i]	Test results or chart to confirm operation 

Test 6 RoCoF withstand	Test results or chart to confirm operation
Confirm that the **Micro-Generating Plant** 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.	

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)	3.0	kW	
For 3-phase **Micro-generator**s, tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.			

Harmonic	At 45-55% of **Registered Capacity**[1]			100% of **Registered Capacity**				
	Measured Value MV in Amps			Measured Value MV in Amps			Limit in BS EN 61000 -3-2 in Amps	Higher limit for odd harmonics 21 and above
	L1	L2	L3	L1	L2	L3		
2	0.038			0.068			1.080	
3	0.111			0.153			2.300	

[1] See the note in A.2.3.1 if 45-55% of **Registered Capacity** is below the minimum stable operating level. If an alternative loading level is chosen, the level should be indicated on the test form and the reason for not testing at 45-55% of **Registered Capacity** should be stated. The additional comments box at the end of the harmonics test sheet can be used for this.

4	0.010			0.013			0.430	
5	0.074			0.131			1.140	
6	0.010			0.019			0.300	
7	0.042			0.102			0.770	
8	0.011			0.019			0.230	
9	0.039			0.072			0.400	
10	0.008			0.019			0.184	
11	0.034			0.056			0.330	
12	0.007			0.019			0.153	
13	0.025			0.044			0.210	
14	0.007			0.021			0.131	
15	0.015			0.036			0.150	
16	0.006			0.020			0.115	
17	0.016			0.030			0.132	
18	0.007			0.015			0.102	
19	0.019			0.025			0.118	
20	0.007			0.018			0.092	
21	0.020			0.022			0.107	0.160
22	0.006			0.014			0.084	
23	0.020			0.017			0.098	0.147
24	0.008			0.013			0.077	
25	0.018			0.019			0.090	0.135
26	0.007			0.012			0.071	
27	0.015			0.012			0.083	0.124
28	0.006			0.011			0.066	
29	0.016			0.010			0.078	0.117
30	0.007			0.008			0.061	
31	0.016			0.011			0.073	0.109

32	0.007			0.009			0.058	
33	0.017			0.008			0.068	0.102
34	0.007			0.008			0.054	
35	0.014			0.008			0.064	0.096
36	0.006			0.007			0.051	
37	0.012			0.009			0.061	0.091
38	0.007			0.007			0.048	
39	0.012			0.007			0.058	0.087
40	0.006			0.006			0.046	

Additional comments:

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).

The standard test impedance is 0.4 Ω for a single phase **Micro-generating Plant** (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase **Micro-generating Plant** (and for a two phase unit in a split phase system). Please ensure that both test and standard impedance are completed on this form. If the test impedance (or the measured impedance)5/21/20245/21/20245/21/20245/21/20245/21/20245/21/20245/21/20245/21/2024ance 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 needs to comply with the particular requirements set out in the testing notes for the technology under test.

The test date and location must be declared.

Test start date	8.3.2024			Test end date			8.3.2024	
Test location	No. 288 Shizhu Road, Tonglu Economic Development Zone, Tonglu City, Zhejiang Province 310000, P.R. China							
	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	2.662%	2.462%	0	0.456%	0.301%	0	0.014	0.015
Normalised to standard impedance	NA	NA	NA	NA	NA	NA	NA	NA
Normalised to required maximum impedance	NA	NA	NA	NA	NA	NA	NA	NA
Limits set under BS EN 61000-3-11	4%	3.3%	500ms	4%	3.3%	500ms	1.0	0.65

Test Impedance	R	0.4	Ω	X	0.25	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	X	0.15 * 0.25 ^	Ω
Maximum Impedance	R	NA	Ω	X	NA	Ω

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

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

Power quality – DC injection: This test should be carried out in accordance with A 1.3.4 as applicable.

The % **DC** injection ("as % of rated AC current" below) is calculated as follows:

% **DC** injection = Recorded **DC** value in Amps / base current

where the base current is the **Registered Capacity** (W) / 230 V. The % **DC** injection should not be greater than 0.25%.

Test power level	20%	50%	75%	100%
Recorded **DC** value in Amps	0.027	0.032	0.019	0.023
as % of rated AC current	0.20%	0.24%	0.14%	0.18%
Limit	0.25%	0.25%	0.25%	0.25%

Power Quality – Power factor: This test shall be carried out in accordance with A.1.3.2 and A.2.3.2 at three voltage levels and at **Registered Capacity** and the measured **Power Factor** must be greater than 0.95 to pass. Voltage to be maintained within ±1.5% of the stated level during the test.

	216.2 V	230 V	253 V
Measured value	0.9999	0.9998	0.9999
Power Factor Limit	>0.95	>0.95	>0.95

Protection – Frequency tests: These tests should be carried out in accordance with Annex A1 A.1.2.3 (**Inverter** connected) or Annex A2 A.2.2.3 (Synchronous). For trip tests, frequency and time delay should be stated. For "no trip tests", "no trip" can be stated.

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	20.09s	47.7Hz 30s	No trip
U/F stage 2	47 Hz	0.5 s	46.98Hz	0.555s	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	52.01Hz	0.544s	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 Annex A1 A.1.2.2 (**Inverter** connected) or Annex A2 A.2.2.2 (Synchronous). For trip tests, voltage and time delay should be stated. For "no trip tests", "no trip" can be stated.

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	183.9V	2.570s	188 V 5.0 s	No trip
					180 V 2.45 s	No trip
O/V stage 1	262.2 V	1.0 s	262.5V	1.068s	258.2 V 5.0 s	No trip
O/V stage 2	273.7 V	0.5 s	273.7V	0.567s	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.

Protection – Loss of Mains test: For PV **Inverter**s shall be tested in accordance with BS EN 62116. Other **Micro-generator**s should be tested in accordance with A.2.2.4 at 10%, 55% and 100% of rated power.

For **Inverter**s 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[2]	0.231s	0.228s	0.262s	0.277s	0.262s	0.330s

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). Confirmation is required that the **Micro-generating Plant** does not trip under positive / negative vector shift.

	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

[2] If the device requires additional shut down time (beyond 0.5 s but less than 1 s) then this should be stated on this form

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). Confirmation is required that the **Micro-generating Plant** does not trip for the duration of the ramp up and ramp down test.

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

Limited Frequency Sensitive Mode – Overfrequency test: This test should be carried out in accordance with A.1.2.8. The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%. The measurement tolerances are contained in A.1.2.8.

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	3002.7W	50.00Hz		-
Step b) 50.45 Hz ±0.05 Hz	2973.9W	50.45 Hz		-
Step c) 50.70 Hz ±0.10 Hz	2821.6W	50.70 Hz		-
Step d) 51.15 Hz ±0.05 Hz	2547.7W	51.15 Hz		-
Step e) 50.70 Hz ±0.10 Hz	2821.8W	50.70 Hz		-
Step f) 50.45 Hz ±0.05 Hz	2974.1W	50.45 Hz		-
Step g) 50.00 Hz ±0.01 Hz	3003.1W	50.00 Hz		-
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	1469.5W	50.00 Hz		-
Step b) 50.45 Hz ±0.05 Hz	1445.9W	50.45 Hz		-
Step c) 50.70 Hz ±0.10 Hz	1293.8W	50.70 Hz		-
Step d) 51.15 Hz ±0.05 Hz	1017.2W	51.15 Hz		-
Step e) 50.70 Hz ±0.10 Hz	1293.5W	50.70 Hz		-
Step f) 50.45 Hz ±0.05 Hz	1446.8W	50.45 Hz		-
Step g) 50.00 Hz ±0.01 Hz	1469.7W	50.00 Hz		-

Power output with falling frequency test: This test should be carried out in accordance with A.1.2.7.

Test sequence	Measured **Active Power** Output	Frequency	Primary power source
Test a) 50 Hz ± 0.01 Hz	3005W	50.00Hz	
Test b) Point between 49.5 Hz and 49.6 Hz	3004W	49.55Hz	
Test c) Point between 47.5 Hz and 47.6 Hz	3002W	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. Both the time delay setting and the measured delay should be provided in this form; both should be greater than 20 s to pass. Confirmation should be provided that the **Micro-generating Plant** does not reconnect at the voltage and frequency settings below; a statement of "no reconnection" can be made.

Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 2.			
60s	63s	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). Please complete each entry, even if the fault contribution is zero.

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	28.41V	3.52A
Initial Value of aperiodic current	A		100 ms	26.99V	0.03A
Initial symmetrical short-circuit current*	I_k		250 ms	27.00V	0.04A
Decaying (aperiodic) component of short circuit current*	i_{DC}		500 ms	26.99V	0.03A
Reactance/Resistance Ratio of source*	X/R		Time to trip	0.052s	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

Logic Interface (input port)	
Confirm that an input port is provided and can be used to reduce the **Active Power** output to zero	Yes
Provide high level description of logic interface, e.g. details in 9.4.3 such as AC or **DC** signal (the additional comments box below can be used)	Yes
Self-Monitoring solid state switching: No specified test requirements. Refer to EREC G98 Annex A1 A.1.3.6 (**Inverter** connected).	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.	
Cyber security	
Confirm that the **Manufacturer** or **Installer** of the **Micro-generator** has provided a statement describing how the **Micro-generator** has been designed to comply with cyber security requirements, as detailed in 9.7.	Yes
Additional comments	
Logic interface (input port) External equipment relay, short-circuit inverter communication signal port 15#, 16#, DC voltage signal 12V, the inverter will reduce its active power to zero within 2 seconds. **Cyber security** In accordance with the provisions of the relevant specific protocol PDPP_A_001, In reference with General Data Protection Regulation (EU) 2016/679.	

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