ATTESTATION OF CONFORMITY

Issued to:	SolaX Power Network Technology (Zhejiang) Co., Ltd. No. 288 Shizhu Road, Tonglu Economic Development Zone, Dongxing District 311500, Tonglu City, Zhejiang Province, China
For the product:	Grid-connected photovoltaic inverter
Trade name:	
Type/Model:	X1-3.6-T-D(L), X1-3.6-T-D(O), X1-3.6-T-N(L), X1-3.6-T-N(O), X1-4.2-T-D(L), X1-4.2-T-D(O), X1-4.2-T-N(L), X1-4.2-T-N(O), X1-4.6-T-D(L), X1-4.6-T-D(O), X1-4.6-T-N(L), X1-4.6-T-N(O), X1-5.0-T-D(L), X1-5.0-T-D(O), X1-5.0-T-N(L), X1-5.0-T-N(O)
Ratings:	See Annex
Manufactured by:	SolaX Power Network Technology (Zhejiang) Co., Ltd. No. 288 Shizhu Road, Tonglu Economic Development Zone, Dongxing District 311500, Tonglu City, Zhejiang Province, China
Requirements:	Engineering Recommendation G99 Issue 1 – Amendment 4:2019 (G99/1-4:2019)

This Attestation is granted on account of an examination by DEKRA, the results of which are laid down in a confidential file no. 6050485.51

The examination has been carried out on one single specimen or several specimens of the product, submitted by the manufacturer. The Attestation does not include an assessment of the manufacturer's production. Conformity of his production with the specimen tested by DEKRA is not the responsibility of DEKRA.

Arnhem, 4 September 2019 Number: 6050485.02AOC

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Ratings of the test product:

X1-3.6-T-D(L), X1-3.6-T-D(O), X1-3.6-T-N(L), X1-3.6-T-N(O):
PV input: Max. 600 Vdc, MPPT voltage range: 70-580 Vdc, max 12 A/12 A, Isc PV: 12.8 A/12.8 A
Output: 230 Vac, 50 Hz, 3680 VA, max 16.8 A

X1-4.2-T-D(L), X1-4.2-T-D(O), X1-4.2-T-N(L), X1-4.2-T-N(O):
PV input: Max. 600 Vdc, MPPT voltage range: 70-580 Vdc, max 12 A/12 A, Isc PV: 12.8 A/12.8 A
Output: 230 Vac, 50 Hz, 4200 VA, max 19 A

X1-4.6-T-D(L), X1-4.6-T-D(O), X1-4.6-T-N(L), X1-4.6-T-N(O):
PV input: Max. 600 Vdc, MPPT voltage range: 70-580 Vdc, max 12 A/12 A, Isc PV: 12.8 A/12.8 A
Output: 230 Vac, 50 Hz, 4600 VA, max 21 A

X1-5.0-T-D(L), X1-5.0-T-D(O), X1-5.0-T-N(L), X1-5.0-T-N(O):
PV input: Max. 600 Vdc, MPPT voltage range: 70-580 Vdc, max 12 A/12 A, Isc PV: 12.8 A/12.8 A
Output: 230 Vac, 50 Hz, 4999 VA , max 22.7A

G99/1 Form C: Type Verification Test Report	
Extract form test report number.:	**6050485.51**

1. Operating Range: Four 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.

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.

Model: X1-5.0-T-D(L)

Test 1				P
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (seconds)
195.55	47	4280.86	0.9980	20

Test 2				P
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
195.55	47.5	3996.65	0.9975	90

Test 3				P
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
253.49	51.50	4938.12	0.9936	90

Test 4				P
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
253.25	52.00	4929.90	0.9938	15

Test 5				P
Measured Voltage (V)	Ramp range	Test frequency ramp	Test Duration	Confirm no trip
195.5	47.0 Hz to 52.0 Hz	+1 Hzs^{-1}	5.0 s	No trip
253.0	52.0 Hz to 49.0 Hz	-1 Hzs^{-1}	5.0 s	No trip

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 shall be designed in accordance with EREC G5.

P

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

Model: X1-5.0-T-D(L)

Power Generating Module rating per phase (rpp)			5.0	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	0.029	0.26	0.070	0.32	8%	8%
3	0.074	0.68	0.102	0.47	21.6%	Not stated
4	0.006	0.05	0.021	0.10	4%	4%
5	0.101	0.93	0.153	0.71	10.7%	10.7%
6	0.007	0.07	0.011	0.05	2.67%	2.67%
7	0.115	1.06	0.177	0.82	7.2%	7.2%
8	0.006	0.06	0.021	0.09	2%	2%
9	0.149	1.36	0.259	1.20	3.8%	Not stated
10	0.005	0.05	0.009	0.04	1.6%	1.6%
11	0.103	0.94	0.203	0.94	3.1%	3.1%
12	0.008	0.07	0.009	0.04	1.33%	1.33%
13	0.062	0.57	0.105	0.48	2%	2%
THD	--	1.25	---	2.08	23%	13%
PWHD	--	1.74	---	2.40	23%	22%

Model: X1-3.6-T-D(L)

Power **Generating Module** rating per phase (rpp)		3.6	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	0.031	0.39	0.117	0.75	8%	8%
3	0.058	0.73	0.066	0.43	21.6%	Not stated
4	0.005	0.07	0.004	0.03	4%	4%
5	0.087	1.11	0.123	0.79	10.7%	10.7%
6	0.017	0.21	0.034	0.22	2.67%	2.67%
7	0.112	1.42	0.153	0.98	7.2%	7.2%
8	0.007	0.08	0.011	0.07	2%	2%
9	0.118	1.49	0.237	1.52	3.8%	Not stated
10	0.001	0.01	0.003	0.02	1.6%	1.6%
11	0.070	0.88	0.096	0.61	3.1%	3.1%
12	0.010	0.12	0.003	0.02	1.33%	1.33%
13	0.047	0.59	0.062	0.40	2%	2%
THD	--	2.81	---	2.36	23%	13%
PWHD	--	3.55	---	2.85	23%	22%

3. Power Quality – Voltage fluctuations and Flicker: **P**

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 shall be designed in accordance with EREC P28.

Model: X1-5.0-T-D(L)

	Starting			Stopping			Running	
	d max	d c	d(t)	d max	d c	d(t)	Pst	Plt 2 hours
Measured Values at test impedance	0.21%	0.10	0	0.25%	0.12	0	0.12	0.16
Normalised to standard impedance	0.21%	0.10	0	0.25%	0.12	0	0.12	0.16
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		Ω	XI		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 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.

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.			**P**
Model: X1-5.0-T-D(L)			
Test power level	10%	55%	100%
Recorded value in Amps	0.037	0.039	0.046
as % of rated AC current	0.17%	0.18%	0.21%
Limit	0.25%	0.25%	0.25%
Model: X1-3.6-T-D(L)			
Test power level	10%	55%	100%
Recorded value in Amps	0.030	0.037	0.034
as % of rated AC current	0.19%	0.23%	0.21%
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.			**P**
Model: X1-5.0-T-D(L)			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9965	0.9930	0.9963
Power Factor Limit	>0.95	>0.95	>0.95
Model: X1-3.6-T-D(L)			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9972	0.9973	0.9949
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.	P

Model: X1-5.0-T-D(L)

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	47.0Hz	0.526s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F	52.0Hz	0.5s	52.0Hz	0.529s	51.8 Hz 120 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.	P

Model: X1-5.0-T-D(L)

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)	2.5s	184.6V	2.558s	188 V 5.0 s	No trip
					180 V 2.45 s	No trip
O/V stage 1	1.14 pu (262.2 V)	1.0s	261.3V	1.058s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5s	272.4V	0.541s	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: These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.						**P**
The following sub set of tests should be recorded in the following table.						
Model: X1-5.0-T-D(L)						
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	118 ms	218 ms	104 ms	119 ms	99 ms	137 ms

Loss of Mains Protection, Vector Shift Stability test. This test should be carried out in accordance with Annex A.7.1.2.6.			**P**
Model: X1-5.0-T-D(L)			
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

Loss of Mains Protection, RoCoF Stability test: This test should be carried out in accordance with Annex A.7.1.2.6.			**P**
Model: X1-5.0-T-D(L)			
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.					**P**
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:					
Model: X1-5.0-T-D(L)					
Test sequence at **Registered Capacity** >80%	Measured **Active Power** Output (W)	Frequency (Hz)	Calculate droop (%)	Primary Power Source	**Active Power** Gradient
Step a) 50.00 Hz ±0.01 Hz	5008	50.00	-	Photovoltaic array simulator	-
Step b) 50.45 Hz ±0.05 Hz	4957	50.45	9.82%		-
Step c) 50.70 Hz ±0.10 Hz	4706	50.70	9.95%		-
Step d) 51.15 Hz ±0.05 Hz	4234	51.15	9.71%		-
Step e) 50.70 Hz ±0.10 Hz	4706	50.70	9.95%		-
Step f) 50.45 Hz ±0.05 Hz	4957	50.45	9.82%		-
Step g) 50.00 Hz ±0.01 Hz	5007	50.00	-		10%
Test sequence at **Registered Capacity** >80%	Measured **Active Power** Output (W)	Frequency (Hz)	Calculate droop (%)	Primary Power Source	**Active Power** Gradient
Step a) 50.00 Hz ±0.01 Hz	2500	50.00	-	Photovoltaic	-

Step b) 50.45 Hz ±0.05 Hz	2475	50.45	10.00%	array simulator	-
Step c) 50.70 Hz ±0.10 Hz	2344	50.70	9.62%		-
Step d) 51.15 Hz ±0.05 Hz	2103	51.15	9.45%		-
Step e) 50.70 Hz ±0.10 Hz	2344	50.70	9.62%		-
Step f) 50.45 Hz ±0.05 Hz	2475	50.45	10.00%		-
Step g) 50.00 Hz ±0.01 Hz	2501	50.00	-		10%

10. Protection – Re-connection timer.					**P**
Model: X1-5.0-T-D(L)					
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.			
60s	61.1s	At 1.16 pu (266.2 V)	At 0.78 pu (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

11. Fault level contribution: These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5.		**P**
For Inverter output		
Model: X1-5.0-T-D(L)		
Time after fault	Volts	Amps
20ms	153.8 V	20.8 A
100ms	53.7 V	0.9 A
250ms	32.1 V	0.5 A
500ms	19.5 V	0.1 A
Time to trip	0.05	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.	**N/A**
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)	**N/A**
14. Logic interface (input port).	
Confirm that an input port is provided and can be used to shut down the module.	**Yes**
Additional comments.	
No.	