ATTESTATION OF CONFORMITY

Issued to:	Ningbo Sunways Technologies Co., Ltd. No. 1, Second Road, Green Industrial Zone, Chongshou Town 315334 Cixi, Ningbo, Zhejiang, P.R. China
For the product:	Grid-connected PV Inverter
Trade name:	sunways
Type/Model:	STT-29.9KTL, STT-30KTL, STT-33KTL, STT-36KTL, STT-40KTL, STT-45KTL, STT-50KTL-M, STT-60KTL-M
Ratings:	See Annex
Manufactured by:	Ningbo Sunways Technologies Co., Ltd. No. 1, Second Road, Green Industrial Zone, Chongshou Town 315334 Cixi, Ningbo, Zhejiang, P.R. China
Requirements:	Engineering Recommendation G99 Issue 1 – Amendment 9:2022 (G99/1-9)

This Attestation is granted on account of an examination by DEKRA, the results of which are laid down in a confidential file no. 6178948.50.

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, 1 March 2024 Number: 6178948.01AOC

DEKRA Testing and Certification (Shanghai) Ltd.

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Ratings of the test product:

Operating temperature range: - 30°C to + 60°C
Protective class: I
Ingress protection rating: IP65
Power factor range (adjustable): 0.8 leading…0.8 lagging
Overvoltage category: III(Mains), II(DC)
Operating altitude: 3000m
Inverter Topology: Transformerless

STT-29.9KTL:
PV input: Max 1100 Vdc, MPPT voltage range: 180-1000 Vdc, max. 4*26 A, Isc PV: 4*40 A
AC output: 3/N/PE, 380 / 400 Vac, 50 / 60 Hz, rated power: 29.9 kW, rated apparent power: 29.9 kVA, max. apparent power: 29.9 kVA, rated current: 43.3 A, max. current: 43.3 A

STT-30KTL:
PV input: Max 1100 Vdc, MPPT voltage range: 180-1000 Vdc, max. 4*26 A, Isc PV: 4*40 A
AC output: 3/N/PE, 380 / 400 Vac, 50 / 60 Hz, rated power: 30 kW, rated apparent power: 30 kVA, max. apparent power: 33 kVA, rated current: 43.5 A, max. current: 47.8 A

STT-33KTL:
PV input: Max 1100 Vdc, MPPT voltage range: 180-1000 Vdc, max. 4*26 A, Isc PV: 4*40 A
AC output: 3/N/PE, 380 / 400 Vac, 50 / 60 Hz, rated power: 33 kW, rated apparent power: 33 kVA, max. apparent power: 36.3 kVA, rated current: 47.8 A, max. current: 52.6 A

STT-36KTL:
PV input: Max 1100 Vdc, MPPT voltage range: 180-1000 Vdc, max. 4*26 A, Isc PV: 4*40 A
AC output: 3/N/PE, 380 / 400 Vac, 50 / 60 Hz, rated power: 36 kW, rated apparent power: 36 kVA, max. apparent power: 39.6 kVA, rated current: 52.2 A, max. current: 57.4 A

STT-40KTL:
PV input: Max 1100 Vdc, MPPT voltage range: 180-1000 Vdc, max. 4*26 A, Isc PV: 4*40 A
AC output: 3/N/PE, 380 / 400 Vac, 50 / 60 Hz, rated power: 40 kW, rated apparent power: 40 kVA, max. apparent power: 44 kVA, rated current: 58 A, max. current: 63.8 A

STT-45KTL:
PV input: Max 1100 Vdc, MPPT voltage range: 180-1000 Vdc, max. 4*26 A, Isc PV: 4*40 A
AC output: 3/N/PE, 380 / 400 Vac, 50 / 60 Hz, rated power: 45 kW, rated apparent power: 45 kVA, max. apparent power: 49.5 kVA, rated current: 65.2 A, max. current: 71.7 A

STT-50KTL-M:
PV input: Max 1100 Vdc, MPPT voltage range: 180-1000 Vdc, max. 4*26 A, Isc PV: 4*40 A
AC output: 3/N/PE, 380 / 400 Vac, 50 / 60 Hz, rated power: 50 kW, rated apparent power: 50 kVA, max. apparent power: 55 kVA, rated current: 72.5 A, max. current: 79.7 A

STT-60KTL-M:
PV input: Max 1100 Vdc, MPPT voltage range: 180-1000 Vdc, max. 4*26 A, Isc PV: 4*40 A

AC output: 3/N/PE, 380 / 400 Vac, 50 / 60 Hz, rated power: 60 kW, rated apparent power: 60 kVA, max. apparent power: 66 kVA, rated current: 87 A, max. current: 95.7 A

Annex

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G99/1-9 A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules	
Extract form test report number:	**6178948.50**

Model: STT-60KTL-M					**P**
Test 1:					
Measured Voltage (V)		Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (seconds)
L1	195.96	47.00	59652.32	0.9995	20
L2	195.97				
L3	195.93				
Test 2:					
Measured Voltage (V)		Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
L1	195.77	47.50	60097.3	1.0000	90
L2	195.76				
L3	195.77				
Test 3:					
Measured Voltage (V)		Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
L1	252.71	51.50	60272.1	0.9998	90
L2	252.74				
L3	252.74				
Test 4:					
Measured Voltage (V)		Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
L1	252.71	52.00	59962.3	0.9997	15
L2	252.71				
L3	252.71				
Test 5:					
Measured Voltage (V)		Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
L1	230.56	50.00	59525.7	0.9987	90
L2	230.31				
L3	230.35				
Test 6:					
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}	3.0 s	No trip

2. Power Quality – Harmonics:	**P**

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, and measurements for the 2nd – 13th harmonics should be provided. The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 61000-3-12 for three phase equipment. For three phase **Power Generating Modules**, measurements for all phases should be provided.

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.

The rating of the **Power Generating Module** (per phase) should be provided below, and the Total Harmonic Distortion (THD) and Partial Weighted Harmonic Distortion (PWHD) should be provided at the bottom of this section.

Model: STT-60KTL-M

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

Power Generating Module rating per phase (rpp)	20	kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)
Single or three phase measurements (for single phase measurements, only complete L1 columns below)	Three-phase inverter		

Harmonic	At 45-55% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.1969	0.2825	0.1158	0.226	0.325	0.133	8%	8%
3	0.0850	0.6082	0.5297	0.098	0.699	0.609	21.6%	Not stated
4	0.2317	0.1797	0.3054	0.266	0.207	0.351	4%	4%
5	1.3050	0.8944	1.3326	1.500	1.028	1.532	10.7%	10.7%
6	0.0351	0.1169	0.1009	0.040	0.134	0.116	2.67%	2.67%
7	0.7681	0.7763	0.5581	0.883	0.892	0.641	7.2%	7.2%
8	0.3114	0.3722	0.3967	0.358	0.428	0.456	2%	2%
9	0.2767	0.2970	0.1255	0.318	0.341	0.144	3.8%	Not stated
10	0.3467	0.4419	0.4223	0.399	0.508	0.485	1.6%	1.6%
11	0.1940	0.2706	0.3795	0.223	0.311	0.436	3.1%	3.1%
12	0.0514	0.0881	0.0798	0.059	0.101	0.092	1.33%	1.33%
13	0.1627	0.2717	0.1595	0.187	0.312	0.183	2%	2%
THD	-	-	-	1.91	1.81	1.99	23%	13%
PWHD	-	-	-	4.66	4.51	4.81	23%	22%

THD = Total Harmonic Distortion

PWHD = Partial Weighted Harmonic Distortion

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Harmonic	At 100% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.259	0.036	0.255	0.298	0.041	0.293	8%	8%
3	0.175	0.577	0.601	0.201	0.663	0.691	21.6%	Not stated
4	0.493	0.640	0.690	0.567	0.736	0.793	4%	4%
5	1.484	1.191	1.463	1.706	1.369	1.682	10.7%	10.7%
6	0.078	0.142	0.146	0.090	0.163	0.168	2.67%	2.67%
7	0.967	0.906	0.812	1.111	1.041	0.933	7.2%	7.2%
8	0.242	0.314	0.334	0.278	0.361	0.384	2%	2%
9	0.241	0.288	0.132	0.277	0.331	0.152	3.8%	Not stated
10	0.516	0.606	0.586	0.593	0.697	0.674	1.6%	1.6%
11	0.489	0.564	0.700	0.562	0.648	0.805	3.1%	3.1%
12	0.049	0.108	0.087	0.056	0.124	0.100	1.33%	1.33%
13	0.488	0.599	0.426	0.561	0.689	0.490	2%	2%
THD	-	-	-	2.40	2.37	2.54	23%	13%
PWHD	-	-	-	6.10	6.20	6.39	23%	22%

THD = Total Harmonic Distortion
PWHD = Partial Weighted Harmonic Distortion

Annex

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Model: STT-29.9KTL								
Power Generating Module tested to BS EN 61000-3-12								
Power Generating Module rating per phase (rpp)				10		kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
Single or three phase measurements (for single phase measurements, only complete L1 columns below)				Three-phase inverter				
Harmonic	At 45-55% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.226	0.288	0.124	0.523	0.665	0.286	8%	8%
3	0.097	0.604	0.505	0.223	1.395	1.166	21.6%	Not stated
4	0.215	0.149	0.268	0.496	0.344	0.619	4%	4%
5	1.175	0.784	1.246	2.714	1.811	2.878	10.7%	10.7%
6	0.045	0.123	0.092	0.105	0.284	0.212	2.67%	2.67%
7	0.619	0.655	0.403	1.430	1.513	0.931	7.2%	7.2%
8	0.310	0.370	0.405	0.716	0.855	0.935	2%	2%
9	0.244	0.286	0.142	0.564	0.661	0.328	3.8%	Not stated
10	0.326	0.428	0.402	0.752	0.988	0.928	1.6%	1.6%
11	0.092	0.198	0.231	0.212	0.457	0.533	3.1%	3.1%
12	0.049	0.086	0.080	0.114	0.199	0.185	1.33%	1.33%
13	0.054	0.152	0.108	0.125	0.351	0.249	2%	2%
THD	-	-	-	3.39	3.27	3.64	23%	13%
PWHD	-	-	-	8.15	8.00	8.63	23%	22%

THD = Total Harmonic Distortion
PWHD = Partial Weighted Harmonic Distortion

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Harmonic	At 100% of **Registered Capacity**						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.155	0.157	0.109	0.358	0.363	0.252	8%	8%
3	0.186	0.602	0.583	0.430	1.390	1.346	21.6%	Not stated
4	0.337	0.447	0.520	0.778	1.032	1.201	4%	4%
5	1.449	1.110	1.428	3.346	2.564	3.298	10.7%	10.7%
6	0.058	0.130	0.148	0.134	0.300	0.342	2.67%	2.67%
7	0.943	0.889	0.788	2.178	2.053	1.820	7.2%	7.2%
8	0.283	0.346	0.363	0.654	0.799	0.838	2%	2%
9	0.259	0.298	0.126	0.598	0.688	0.291	3.8%	Not stated
10	0.443	0.527	0.515	1.023	1.217	1.189	1.6%	1.6%
11	0.430	0.489	0.639	0.993	1.129	1.476	3.1%	3.1%
12	0.052	0.104	0.081	0.120	0.240	0.187	1.33%	1.33%
13	0.436	0.538	0.361	1.007	1.242	0.834	2%	2%
THD	-	-	-	4.55	4.41	4.77	23%	13%
PWHD	-	-	-	11.57	11.50	11.98	23%	22%

THD = Total Harmonic Distortion
PWHD = Partial Weighted Harmonic Distortion

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 must be designed in accordance with EREC P28.
The standard test impedance is 0.4 Ω for a single phase **Power Generating Module** (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase **Power Generating Module** (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) is different to the standard impedance, it must be normalised to the standard impedance as follows (where the **Power Factor** of the generation output is 0.98 or above):
d max normalised value = (Standard impedance / Measured impedance) x Measured value.
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 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.

Annex

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Test start date	2024-02-04	Test end date	2024-02-04
Test location	No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China		

Model: STT-60KTL-M

		Starting			Stopping			Running	
		d(max) [%]	d(c) [%]	d(t) [%]	d(max) [%]	d(c) [%]	d(t) [%]	Pst [%]	Plt 2 hours [%]
Measured Values at test impedance	L1	0.77	0.74	0	0.39	0.24	0	0.21	0.19
	L2	1.21	0.87	0	0.39	0.31	0	0.21	0.20
	L3	0.78	0.78	0	0.29	0.26	0	0.19	0.19
Normalised to standard impedance	L1	0.77	0.74	0	0.39	0.24	0	0.21	0.19
	L2	1.21	0.87	0	0.39	0.31	0	0.21	0.20
	L3	0.78	0.78	0	0.29	0.26	0	0.19	0.19
Normalised to required maximum impedance	L1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	L2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	L3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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	0.24	Ω	Xl	0.15	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	Xl	0.15 * 0.25 ^	Ω
Maximum Impedance	R	N/A #	Ω	Xl	N/A #	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

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Test start date	2024-01-12	Test end date	2024-02-04
Test location	No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China		

Model: STT-29.9KTL

		Starting			Stopping			Running	
		d(max) [%]	d(c) [%]	d(t) [%]	d(max) [%]	d(c) [%]	d(t) [%]	Pst [%]	Plt 2 hours [%]
Measured Values at test impedance	L1	0.77	0.15	0	0.78	0.16	0	0.11	0.10
	L2	0.59	0.55	0	0.46	0.43	0	0.12	0.11
	L3	0.61	0.57	0	0.43	0.43	0	0.12	0.11
Normalised to standard impedance	L1	0.77	0.15	0	0.78	0.16	0	0.11	0.10
	L2	0.59	0.55	0	0.46	0.43	0	0.12	0.11
	L3	0.61	0.57	0	0.43	0.43	0	0.12	0.11
Normalised to required maximum impedance	L1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	L2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	L3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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	0.24	Ω	Xl	0.15	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	Xl	0.15 * 0.25 ^	Ω
Maximum Impedance	R	N/A #	Ω	Xl	N/A #	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

4. Power quality – DC injection:									**P**
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. 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) / Vphase. The % DC injection should not be greater than 0.25%.									
Model: STT-60KTL-M									
Three-phase									
Test power level	10%			55%			100%		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Recorded DC injection value in Amps	0.161	0.124	0.136	0.168	0.140	0.119	0.150	0.170	0.086
as % of rated AC current	0.06%	0.05%	0.05	0.06%	0.05%	0.05%	0.06%	0.06%	0.03%
Limit	0.25%			0.25%			0.25%		
Model: STT-29.9KTL									
Three-phase									
Test power level	10%			55%			100%		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Recorded DC injection value in Amps	0.105	0.110	0.073	0.104	0.114	0.120	0.098	0.102	0.129
as % of rated AC current	0.08%	0.08%	0.06%	0.08%	0.09%	0.09%	0.08%	0.08%	0.10%
Limit	0.25%			0.25%			0.25%		

5. Power Factor:			**P**
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** 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. These tests should be undertaken in accordance with Annex A.7.1.4.2 Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.			
Model: STT-60KTL-M			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9984	0.9981	0.9975
Power Factor Limit	> 0.95	> 0.95	> 0.95
Model: STT-29.9KTL			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9988	0.9985	0.9979
Power Factor Limit	> 0.95	> 0.95	> 0.95

6. Protection – Frequency tests:						**P**
These tests should be carried out in accordance with the Annex A.7.1.2.3. For trip tests, frequency and time delay should be stated. For “no trip tests”, “no trip” can be stated.						
Model: STT-60KTL-M						
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	47.49 Hz	20.165 s	47.7 Hz 30 s	No trip
U/F stage 2	47.0 Hz	0.5 s	47.00 Hz	0.581 s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F	52.0Hz	0.5 s	52.00 Hz	0.536 s	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:						**P**
These tests should be carried out in accordance with Annex A.7.1.2.2. For trip tests, voltage and time delay should be stated. For “no trip tests”, “no trip” can be stated. Note that the value of voltage stated below assumes a **LV** connection This should be adjusted for **HV** taking account of the VT ratio as required.						
Model: STT-60KTL-M						
L1-N						
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	182.48 V	2.524 s	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	261.43 V	1.019 s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	273.41 V	0.539 s	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.						

Model: STT-60KTL-M						
L2-N						
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	182.34 V	2.530 s	188 V 5.0 s	No trip
					180 V 2.45 s	No trip
O/V stage	1.14 pu (262.2 V)	1.0 s	261.42 V	1.024 s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	273.00 V	0.525 s	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.						

Model: STT-60KTL-M						
L3-N						
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	182.65 V	2.559 s	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	262.50 V	1.035 s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	274.06 V	0.541 s	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:						P
These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4. For test condition A, EUT output = 100 % Pn, test condition B, EUT output = 50 % to 66 % Pn, and test condition C, EUT output = 25 % to 33 % Pn.						
Model: STT-60KTL-M						
The following subset of tests should be recorded in the following table.						
Test Power and imbalance	33% -5% Q	66% -5% Q	100% -5% P	33% +5% Q	66% +5% Q	100% +5% P
Trip time. Limit is 0.5 s	199 ms	177 ms	199 ms	169 ms	146 ms	202 ms

8. Loss of Mains Protection, Vector Shift Stability test:			P
This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip under positive / negative vector shift.			
Model: STT-60KTL-M			
	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

8. Loss of Mains Protection, RoCoF Stability test:			P
This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip for the duration of the ramp up and ramp down test.			
Model: STT-60KTL-M			
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.

Alternatively, simulation results should be noted below:

Model: STT-60KTL-M

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	59671.26	50.00	-	Photovoltaic array simulator	10%
Step b) 50.45 Hz ±0.05 Hz	59038.91	50.45	9.49		
Step c) 50.70 Hz ±0.10 Hz	55736.70	50.70	9.15		
Step d) 51.15 Hz ±0.05 Hz	49816.10	51.15	9.13		
Step e) 50.70 Hz ±0.10 Hz	55717.91	50.70	9.11		
Step f) 50.45 Hz ±0.05 Hz	59000.79	50.45	8.95		
Step g) 50.00 Hz ±0.01 Hz	59647.35	50.00	-		
Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output (W)	Frequency (Hz)	Calculate droop (%)	Primary Power Source	**Active Power** Gradient
Step a) 50.00 Hz ±0.01 Hz	30185.00	50.00	--	Photovoltaic array simulator	10%
Step b) 50.45 Hz ±0.05 Hz	29872.46	50.45	9.60 ~~19.68~~		
Step c) 50.70 Hz ±0.10 Hz	26402.54	50.70	9.52		
Step d) 51.15 Hz ±0.05 Hz	20593.70	51.15	9.38		
Step e) 50.70 Hz ±0.10 Hz	26310.03	50.70	9.29		
Step f) 50.45 Hz ±0.05 Hz	29559.97	50.45	9.60		
Step g) 50.00 Hz ±0.01 Hz	30110.13	50.00	--		

The frequency at each step should be maintained for at least one minute and the Active Power reduction in the form of a gradient determined and assessed for compliance with paragraph 11.2.3. The Droop should be determined from the measurements between 50.4 Hz and 51.15 Hz. The allowed tolerance for the frequency measurement shall be ± 0.05 Hz. The allowed tolerance for Active Power output measurement shall be ±10% of the required change in Active Power.

The resulting overall tolerance range for a nominal 10% Droop is +2.8% and – 1.5%, ie a Droop less than 12.8% and greater than 8.5%.

9-2. Power output with falling frequency test (For PV Inverter):				**P**
Tests should prove that the **Power Generating Module** does not reduce output power as the frequency falls. These tests should be carried out in accordance with 11.2.3.1, 12.2.3.1, 13.2.3.1.				
Model: STT-60KTL-M				
Test sequence	Measured **Active Power** Output (W)	Acceptable **Active Power**	Frequency (Hz)	Primary power source
49.5 Hz for 5 minutes	60049.54	100% **Registered Capacity**	49.5	Photovoltaic array simulator
49.0 Hz for 5 minutes	60076.35	99% **Registered Capacity**	49.0	Photovoltaic array simulator
48.0 Hz for 5 minutes	60086.14	97% **Registered Capacity**	48.0	Photovoltaic array simulator
47.6 Hz for 5 minutes	60095.54	96.2% **Registered Capacity**	47.6	Photovoltaic array simulator
47.1 Hz for 20 s	60120.90	95% **Registered Capacity**	47.1	Photovoltaic array simulator

10. Protection – Re-connection timer.					**P**
Model: STT-60KTL-M					
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.			
60 s	87 s	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
Recover to normal operation range after confirmation of no connection		Yes	Yes	Yes	Yes
Confirmation that the Power Generating Module shall reconnect		Reconnection after 87.65 s	Reconnection after 88.35 s	Reconnection after 90.47 s	Reconnection after 88.12 s

11. Fault level contribution: These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5.		**P**
For **Inverter** output		
Time after fault	Volts	Amps
20ms	4.210 / 7.241 / 8.958	0.961
100ms	4.218 / 7.213 / 8.927	0.900
250ms	4.144 / 7.271 / 8.886	0.901
500ms	3.992 / 7.286 / 8.874	0.910
Time to trip	0.014 s	In seconds

12. Self-Monitoring solid state switching: No specified test requirements. Refer to Annex A.7.1.6.	
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
Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal (the additional comments box below can be used)	Yes
15. Cyber security	
Confirm that the Power Generating Module has been designed to comply with cyber security requirements, as detailed in 9.1.7.	Yes Manufacturer's declaration provided
Additional comments.	
Logic Interface: All communication ports are integrated in COM2 and COM3 ports at the bottom of inverter which including Meter port, RS485 port. Sunways grid connected PV inverter comes standard with a data-logger to connect with RS485 port, realize one key to shut off function, and you can use this function by connecting an external switch into the DRED interface on data-logger which connects to RS485 port at bottom of inverter, if it requires in the installation place. The external switch doesn't include in our accessory box. Connect DRED port 1 and port 2 with the external switch connection. When the switch is closed, the inverter will operate normally. When the switch is opened, the inverter will cease to export active power within 5 seconds.	

---End---