ATTESTATION OF CONFORMITY

Issued to:	Afore New Energy Technology (Shanghai) Co., Ltd. Building 7, No.333 Wanfang Rd, Minhang District, Shanghai, China.
For the product:	Hybrid inverter
Trade name:	Afore
Type/Model:	AF4K-SL, AF4.6K-SL, AF5K-SL, AF5.5K-SL, AF6K-SL, AF4K-SL-0, AF4.6K-SL-0, AF5K-SL-0, AF5.5K-SL-0, AF6K-SL-0, AF4K-SLP, AF4.6K-SLP, AF5K-SLP, AF5.5K-SLP, AF6K-SLP, AF4K-ASL, AF4.6K-ASL, AF5K-ASL, AF5.5K-ASL, AF6K-ASL, AF4K-ASL-0, AF4.6K-ASL-0, AF5K-ASL-0, AF5.5K-ASL-0, AF6K-ASL-0
Ratings:	See Annex
Manufactured by:	Afore New Energy Technology (Shanghai) Co., Ltd. Building 7, No.333 Wanfang Rd, Minhang District, Shanghai, China.
Subject:	Complete evaluation of electrical systems of the appliances
Requirements:	Engineering Recommendation G99 Issue 1 – Amendment 9:2022

This Attestation is granted on account of an examination by DEKRA, the results of which are laid down in a test file / test report no. 6190697.51

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 this production with the specimen tested by DEKRA is not the responsibility of DEKRA.

This document does not authorize the use of any DEKRA approved mark.

Arnhem, 4 November 2024 Number: 6190697.02AOC V1.1

DEKRA Testing and Certification (Shanghai) Ltd.

Kreny Lin
Certification Manager

DEKRA Testing and Certification (Shanghai) Ltd.
5F #250 Jiangchangsan Road Shibei Hi-Tech Park, 200436 Jing'an District, Shanghai, China
T +86 21 6056 7666 F +86 21 6056 7555 www.dekra-product-safety.com

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Ratings of the test product:

Operating temperature range: -25°C to + 60°C
Protective class: I
Ingress protection rating: IP65 / IP66
Over voltage category: III(AC), II(DC)
Power factor range (adjustable): 0.8 leading…0.8 lagging

Specifications table										
Model	AF4K-SL-0	AF4K-ASL-0	AF4.6K-SL-0	AF4.6K-ASL-0	AF5K-SL-0	AF5K-ASL-0	AF5.5K-SL-0	AF5.5K-ASL-0	AF6K-SL-0	AF6K-ASL-0
Battery (charge/discharge***)***										
Battery type	Li-ion/Lead-acid etc.									
Battery Normal Voltage (Range) (Vdc)	51.2V (40-60V)									
Max charge/discharge Current(A)	120		120		120		120		120	
Max charge/discharge Power(W)	4000		4600		5000		5500		6000	
AC Grid (input and output)										
Normal AC Voltage (VAC)	L/N/PE, 220Vac, 230Vac									
Frequency (Hz)	50 / 60									
Normal AC Current (A)	17.4		20		21.8		24		26.1	
Max. cont. input/output current (A)	19		22		23		26		28	
Normal Power (W)	4000		4600		5000		5500		6000	
Rated Apparent Power (VA)	4000		4600		5000		5500		6000	
Max. cont. input/output Power (W)	4000		4600		5000		5500		6000	
Max. cont. Apparent Power (VA)	4000		4600		5000		5500		6000	
Power factor(adjustable)	1.0(-0.8~ +0.8)									
AC Load output (stand alone)										
Normal Voltage (VAC)	L/N/PE, 220Vac, 230Vac									
Frequency (Hz)	50 / 60									
Nominal Current (A)	17.4		20		21.8		24		26.1	
Max. cont. current (A)	19		22		23		26		28	
Max. cont. Power (W)	4000		4600		5000		5500		6000	
Max. cont. Apparent Power (VA)	4000		4600		5000		5500		6000	
Power factor	1.0									
Others										
Ingress protection (IP)	IP65	IP66	IP65	IP66	IP65	IP66	IP65	IP66	IP65	IP66
Protective class	Class I									
Temperature (°C)	-25°C to +60°C (Derating 45°C)									
Inverter Isolation	Non-isolated (AC-BAT)									
Overvoltage category	OVC III (AC Main)									

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Specifications table					
Model	AF4K-SL	AF4.6K-SL	AF5K-SL	AF5.5K-SL	AF6K-SL
Input					
PV Max (W)	6000	6900	7500	8300	9000
Vmax PV (V)	550	550	550	550	550
Isc PV (absolute Max.) (A)	26 x 2	26 x 2	26 x 2	26 x 2	26 x 2
Number of MPP trackers	2	2	2	2	2
Number of input strings	1/1	1/1	1/1	1/1	1/1
Max. PV input range (A)	18.5 x 2	18.5 x 2	18.5 x 2	18.5 x 2	18.5 x 2
MPPT Voltage Range (V)	80-500	80-500	80-500	80-500	80-500
Vdc range @ full power (V)	120-500	130-500	150-500	160-500	170-500
Battery (charge/discharge***)***					
Battery type	Li-ion/Lead-acid etc.				
Battery Nominal Voltage (V)	51.2				
Battery Voltage Range (V)	40-60				
Max charge/discharge Current(A)	80	80	80	80	80
Max charge/discharge Power(W)	4000	4600	4800	4800	4800
AC Grid (input and output)					
Normal AC Voltage (VAC)	L/N/PE, 220Vac, 230Vac				
Frequency (Hz)	50 / 60				
Max. cont. Current (A)	19	22	23	26	28
Nominal Power (VA)	4000	4600	5000	5500	6000
Max. Power (W)	4000	4600	5000	5500	6000
Max. apparent Power (VA)	4000	4600	5000	5500	6000
Power factor(adjustable)	1.0(-0.8~ +0.8)				
AC Load output					
Normal Voltage (VAC)	L/N/PE, 220Vac, 230Vac				
Frequency (Hz)	50 / 60				
Max. cont. Current (A)	19	22	23	26	28
Nominal Output Power (W)	4000	4600	5000	5500	6000
Max. output Power (W)	4000	4600	5000	5500	6000
Max. apparent Power (VA)	4000	4600	5000	5500	6000
Power factor	1.0				
Others					
Ingress protection (IP)	IP65				
Protective class	Class I				
Temperature (°C)	-25°C to +60°C (Derating 45°C)				
Inverter Isolation	Non-isolated (PV-AC-BAT)				
Overvoltage category	OVC III (AC Main), OVC II (PV)				

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Specifications table										
Model	AF4 K-SLP	AF4 K-ASL	AF4. 6K-SLP	AF4. 6K-ASL	AF5 K-SLP	AF5 K-ASL	AF5. 5K-SLP	AF5. 5K-ASL	AF6 K-SLP	AF6 K-ASL
Input										
PV Max (W)	6000		6900		7500		8300		9000	
Vmax PV (V)	550		550		550		550		550	
Isc PV (absolute Max.) (A)	26 x 2		26 x 2		26 x 2		26 x 2		26 x 2	
Number of MPP trackers	2		2		2		2		2	
Number of input strings	1/1		1/1		1/1		1/1		1/1	
Max. PV input range (A)	18.5 x 2		18.5 x 2		18.5 x 2		18.5 x 2		18.5 x 2	
MPPT Voltage Range (V)	80-500		80-500		80-500		80-500		80-500	
Vdc range @ full power (V)	120-500		130-500		150-500		160-500		170-500	
Battery (charge/discharge***)***										
Battery type	Li-ion/Lead-acid etc.									
Battery Nominal Voltage (V)	51.2									
Battery Voltage Range (V)	40-60									
Max charge/discharge Current(A)	120		120		120		120		120	
Max charge/discharge Power(W)	4000		4600		5000		5500		6000	
AC Grid (input and output)										
Normal AC Voltage (VAC)	L/N/PE, 220Vac, 230Vac									
Frequency (Hz)	50 / 60									
Max. cont. Current (A)	19		22		23		26		28	
Nominal Power (VA)	4000		4600		5000		5500		6000	
Max. Power (W)	4000		4600		5000		5500		6000	
Max. apparent Power (VA)	4000		4600		5000		5500		6000	
Power factor(adjustable)	1.0(-0.8~ +0.8)									
AC Load output										
Normal Voltage (VAC)	L/N/PE, 220Vac, 230Vac									
Frequency (Hz)	50 / 60									
Max. cont. Current (A)	19		22		23		26		28	
Nominal Output Power (W)	4000		4600		5000		5500		6000	
Max. output Power (W)	4000		4600		5000		5500		6000	
Max. apparent Power (VA)	4000		4600		5000		5500		6000	
Power factor	1.0									
Others										
Ingress protection (IP)	IP65	IP66	IP65	IP66	IP65	IP66	IP65	IP66	IP65	IP66
Protective class	Class I									
Temperature (°C)	-25°C to +60°C (Derating 45°C)									
Inverter Isolation	Non-isolated (PV-AC-BAT)									
Overvoltage category	OVC III (AC Main), OVC II (PV)									

G99/1-9 A2-3 Compliance Verification Report –Tests for Type A Inverter Connected Power Generating Modules	
Extract form test report number.:	**6190697.51**

1. Operating Range:	**P**

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.
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.
Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Model: AF6K-SL	**P**

Test 1:

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (seconds)
195.66	47.00	5473.66	0.9995	20

Test 2:

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
195.68	47.50	5475.86	0.9994	90

Test 3:

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
2z53.22	51.50	6011.88	0.9993	90

Test 4:

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
253.20	52.00	6007.15	0.9992	15

Test 5:

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
230.56	50.00	6015.25	0.9989	90

Test 6:

Measured Voltage (V)	Ramp range	Test frequency ramp	Test Duration	Confirm no trip
196.5	47.0 Hz to 52.0 Hz	+1 Hzs^{-1}	5.0s	No trip
254.5	52.0 Hz to 49.0 Hz	-1 Hzs^{-1}	3.0s	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 610000-3-12 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: AF4K-SL

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

Power Generating Module rating per phase (rpp)	4	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)	Single phase PV 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	0.028	-	-	0.322	-	-	8%	8%
3	0.083	-	-	0.955	-	-	21.6%	Not stated
4	0.007	-	-	0.081	-	-	4%	4%
5	0.032	-	-	0.368	-	-	10.7%	10.7%
6	0.007	-	-	0.081	-	-	2.67%	2.67%
7	0.018	-	-	0.207	-	-	7.2%	7.2%
8	0.006	-	-	0.069	-	-	2%	2%
9	0.015	-	-	0.173	-	-	3.8%	Not stated
10	0.006	-	-	0.069	-	-	1.6%	1.6%
11	0.008	-	-	0.092	-	-	3.1%	3.1%
12	0.006	-	-	0.069	-	-	1.33%	1.33%
13	0.007	-	-	0.081	-	-	2%	2%
THD	-	-	-	1.163	-	-	23%	13%
PWHD	-	-	-	1.400	-	-	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	0.220	-	-	1.265	-	-	8%	8%
3	0.760	-	-	4.370	-	-	21.6%	Not stated
4	0.054	-	-	0.311	-	-	4%	4%
5	0.575	-	-	3.306	-	-	10.7%	10.7%
6	0.046	-	-	0.265	-	-	2.67%	2.67%
7	0.313	-	-	1.800	-	-	7.2%	7.2%
8	0.047	-	-	0.305	-	-	2%	2%
9	0.197	-	-	1.133	-	-	3.8%	Not stated
10	0.046	-	-	0.265	-	-	1.6%	1.6%
11	0.112	-	-	0.644	-	-	3.1%	3.1%
12	0.048	-	-	0.276	-	-	1.33%	1.33%
13	0.112	-	-	0.644	-	-	2%	2%
THD	-	-	-	1.726	-	-	23%	13%
PWHD	-	-	-	1.290	-	-	23%	22%

THD = Total Harmonic Distortion

PWHD = Partial Weighted Harmonic Distortion

Model: AF6K-SL								
Power Generating Module tested to BS EN 61000-3-12								
Power Generating Module rating per phase (rpp)			6	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)			Single phase PV 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	0.046	-	-	0.353	-	-	8%	8%
3	0.119	-	-	0.912	-	-	21.6%	Not stated
4	0.007	-	-	0.054	-	-	4%	4%
5	0.042	-	-	0.322	-	-	10.7%	10.7%
6	0.008	-	-	0.061	-	-	2.67%	2.67%
7	0.025	-	-	0.192	-	-	7.2%	7.2%
8	0.007	-	-	0.054	-	-	2%	2%
9	0.024	-	-	0.184	-	-	3.8%	Not stated
10	0.007	-	-	0.054	-	-	1.6%	1.6%
11	0.010	-	-	0.077	-	-	3.1%	3.1%
12	0.007	-	-	0.054	-	-	1.33%	1.33%
13	0.009	-	-	0.069	-	-	2%	2%
THD	-	-	-	1.131	-	-	23%	13%
PWHD	-	-	-	1.322	-	-	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	0.076	-	-	0.291	-	-	8%	8%
3	0.202	-	-	0.774	-	-	21.6%	Not stated
4	0.012	-	-	0.046	-	-	4%	4%
5	0.100	-	-	0.383	-	-	10.7%	10.7%
6	0.011	-	-	0.042	-	-	2.67%	2.67%
7	0.062	-	-	0.238	-	-	7.2%	7.2%
8	0.012	-	-	0.046	-	-	2%	2%
9	0.051	-	-	0.196	-	-	3.8%	Not stated
10	0.011	-	-	0.042	-	-	1.6%	1.6%
11	0.027	-	-	0.104	-	-	3.1%	3.1%
12	0.011	-	-	0.042	-	-	1.33%	1.33%
13	0.018	-	-	0.069	-	-	2%	2%
THD	-	-	-	1.728	-	-	23%	13%
PWHD	-	-	-	1.153	-	-	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.

Test start date	2023-02-13	Test end date	2023-02-13
Test location	No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China		
Model:	AF6K-SL		

	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	0.56	0.27	0	1.43	0.27	0	0.22	0.19
Normalised to standard impedance	0.56	0.27	0	1.43	0.27	0	0.22	0.19
Normalised to required maximum impedance	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	0.4	Ω	Xl	0.25	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. Delete as appropriate.

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: AF4K-SL			
Single-phase			
Test power level	10%	55%	100%
Recorded DC injection value in Amps	0.030	0.030	0.029
as % of rated AC current	0.17%	0.17%	0.17%
Limit	0.25%	0.25%	0.25%
Model: AF6K-SL			
Single-phase			
Test power level	10%	55%	100%
Recorded DC injection value in Amps	0.040	0.042	0.042
as % of rated AC current	0.15%	0.16%	0.16%
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: AF4K-SL			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9996	0.9996	0.9989
Power Factor Limit	>0.95	>0.95	>0.95
Model: AF6K-SL			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.9996	0.9996	0.9987
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: AF6K-SL						
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	47.50 Hz	20.08s	47.7 Hz 30 s	No trip
U/F stage 2	47.0 Hz	0.5 s	46.99 Hz	0.540s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F	52.0 Hz	0.5 s	52.00 Hz	0.548s	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:						**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: AF6K-SL						
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	181.1V	2.536s	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	265.1V	1.052s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	276.6V	0.511s	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 % P_n, test condition B, EUT output = 50 % to 66 % P_n, and test condition C, EUT output = 25 % to 33 % P_n.						
Model: AF6K-SL						
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**	0.203s	0.222s	0.289s	0.160s	0.224s	0.280s

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: AF6K-SL			
	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: AF6K-SL			
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:	**P**
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 A.7.1.3, which also contains the measurement tolerances.	
Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4	N
Model: AF6K-SL	
Alternatively, simulation results should be noted below:	

Test sequence at **Registered Capacity** >80%	Measured **Active Power** Output (W)	Frequency (Hz)	Calculated droop (%)	Primary Power Source	**Active Power** Gradient
Step a) 50.00 Hz ±0.01 Hz	6002.40	50.00	-	Photovoltaic array simulator	-
Step b) 50.45 Hz ±0.05 Hz	5938.28	50.45	9.37		-
Step c) 50.70 Hz ±0.10 Hz	5629.81	50.70	9.66		-
Step d) 51.15 Hz ±0.05 Hz	5094.09	51.15	9.92		-
Step e) 50.70 Hz ±0.10 Hz	5615.82	50.70	9.30		-
Step f) 50.45 Hz ±0.05 Hz	5938.42	50.45	9.42		-
Step g) 50.00 Hz ±0.01 Hz	6001.91	50.00	-		-
Test sequence at **Registered Capacity** 40-60%	Measured **Active Power** Output (W)	Frequency (Hz)	Calculated droop (%)	Primary Power Source	**Active Power** Gradient
Step a) 50.00 Hz ±0.01 Hz	3002.87	50.00	-	Photovoltaic array simulator	-
Step b) 50.45 Hz ±0.05 Hz	2939.89	50.45	9.52		-
Step c) 50.70 Hz ±0.10 Hz	2618.29	50.70	9.36		-
Step d) 51.15 Hz ±0.05 Hz	2070.63	51.15	9.65		-
Step e) 50.70 Hz ±0.10 Hz	2620.65	50.70	9.42		-
Step f) 50.45 Hz ±0.05 Hz	2942.07	50.45	9.51		-
Step g) 50.00 Hz ±0.01 Hz	3004.03	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: AF6K-SL				
Test sequence	Measured **Active Power** Output (W)	Acceptable **Active Power**	Frequency (Hz)	Primary power source
49.5 Hz for 5 minutes	6004.11	100% **Registered Capacity**	49.50	Photovoltaic array simulator
49.0 Hz for 5 minutes	6003.79	99% **Registered Capacity**	49.00	Photovoltaic array simulator
48.0 Hz for 5 minutes	6004.05	97% **Registered Capacity**	48.00	Photovoltaic array simulator
47.6 Hz for 5 minutes	6004.19	96.2% **Registered Capacity**	47.60	Photovoltaic array simulator
47.1 Hz for 20 s	6004.52	95% **Registered Capacity**	47.10	Photovoltaic array simulator

9-3. Power output with falling frequency test (For Electricity Storage Device)				**P**
This test should be carried out in accordance with clause 11.2.3.3, 12.2.3.3, 13.2.3.2 and A.7.1.7				
Model: AF6K-SLP				
Test 1: 50 Hz to 49.0 Hz, from **100%** $P_{rated\text{-}import}$				
Test sequence (Hz)	Measured **Active Power** Output (W)	Steady frequency (Hz)	Calculated droop (%)	Primary power source
50.0	-5958.34	50.00	-	AC grid / Storage Battery
49.5	-5955.97	49.50	-	AC grid / Storage Battery
49.2	-2432.29	49.20	1.02%	AC grid / Storage Battery
49.0	-83.56	49.00	1.02%	AC grid / Storage Battery
Test 2: 50 Hz to 48.8 Hz, from **100%** $P_{rated\text{-}import}$				
Test sequence (Hz)	Measured **Active Power** Output (W)	Steady frequency (Hz)	Calculated droop (%)	Primary power source
50.0	-5959.16	50.00	-	AC grid / Storage Battery
49.5	-5952.96	49.50	-	AC grid / Storage Battery
49.2	-2443.98	49.20	1.03%	AC grid / Storage Battery
49.0	-91.85	49.00	1.02%	AC grid / Storage Battery
48.9	1136.83	48.90	1.02%	AC grid / Storage Battery

48.8	2365.22	48.80	1.01%	AC grid / Storage Battery
Test 3: 50 Hz to 49.0 Hz, from **40%** $P_{rated\text{-}import}$				
Test sequence (Hz)	Measured **Active Power** Output (W)	Steady frequency (Hz)	Calculated droop (%)	Primary power source
50.0	-2404.68	50.00	-	AC grid / Storage Battery
49.5	-2385.02	49.50	-	AC grid / Storage Battery
49.2	1225.17	49.20	1.00%	AC grid / Storage Battery
49.0	3683.47	49.00	0.99%	AC grid / Storage Battery

Test 4: 50 Hz to 48.8 Hz, from **40%** $P_{rated\text{-}import}$				
Test sequence (Hz)	Measured **Active Power** Output (W)	Steady frequency (Hz)	Calculated droop (%)	Primary power source
50.0	-2378.00	50.00	-	AC grid / Storage Battery
49.5	-2355.35	49.50	-	AC grid / Storage Battery
49.2	1210.60	49.20	1.01%	AC grid / Storage Battery
49.0	3641.10	49.00	1.00%	AC grid / Storage Battery
48.9	4856.54	48.90	1.00%	AC grid / Storage Battery
48.8	5992.53	48.80	1.01%	AC grid / Storage Battery

NOTE:

This paragraph provides a method for demonstrating compliance with the optional performance characteristic as discussed in the foreword. The tests shall be carried out to demonstrate how the Power Park Module Active Power when acting as a load (ie replenishing its energy store) responds to changes in system frequency.

In general four tests are proposed, one set of two at rated import capacity, and one set of two at 40% of rated import capacity.

In both cases the test is to reduce frequency from 50 Hz at rate of 2 Hz/s. In the first case the lower frequency reached will be 49.0 Hz and the second case the lower frequency will be 48.8 Hz.

In all cases the response shall meet the requirements of 11.2.3.3.

10. Protection – Re-connection timer					**P**
Model: AF6K-SL					
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. 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 **Power Generating Module** 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 10.1.			
30 s	30.8 s	At 1.16 pu (266.2 V **LV**)	At 0.78 pu (180.0 V **LV**)	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Power Generating Module** 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 30.8 s	Reconnection after 30.8 s	Reconnection after 30.8 s	Reconnection after 30.8 s

11. Fault level contribution:		**P**
These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5. Please complete each entry, even if the contribution to the fault level is zero.		
Model: AF6K-SL		
For Inverter output		
Time after fault	Volts	Amps
20ms	177.9 V	18.82 A
100ms	1.076 V	15.99 A
250ms	0	0
500ms	0	0
Time to trip	83 ms	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.	
To short or open pin1 and pin5 of logic interface port (Com 1) to control the inverter to normal or shutdown active power of output. A logic interface is provided that can be operated by an external switch or contactor. Users can install by themselves. Users install the switch connected to pin1 and pin5 of Com1 and just need control the switch signal causing the switch to open or short. 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. The signal from the inverter that is being switched is DC (maximum value 3.3V)	

End