

# ATTESTATION OF CONFORMITY

Issued to: Afore New Energy Technology (Shanghai) Co., Ltd.  
Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China

For the product: Hybrid inverter

Trade name: 

Type/Model: AF4K-SL, AF4K-SH, AF4.6K-SL, AF4.6K-SH,  
AF5K-SL, AF5K-SH, AF5.5K-SL, AF5.5K-SH,  
AF6K-SL, AF6K-SH

Ratings: See Annex

Manufactured by: Afore New Energy Technology (Shanghai) Co., Ltd.  
Build No.7, 333 Wanfang Road, Minhang District, Shanghai, China

Requirements: Engineering Recommendation G99 Issue 1 – Amendment 6: 2020

This Attestation is granted on account of an examination by DEKRA, the results of which are laid down in a confidential file no 6098057.53.

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, 10 March 2021

Number: 6098057.04AOC

DEKRA Testing and Certification (Shanghai) Ltd.

  
Kreny Lin  
Certification Manager

© Integral publication of this attestation and adjoining reports is allowed

Page 1 of 11

DEKRA Testing and Certification (Shanghai) Ltd.  
3F #250 Jiangchangsan Road Building 16 Headquarter Economy Park Shibe Hi-Tech Park, Jing'an District, Shanghai 200436 China  
T +86 21 6056 7600 F +86 21 6056 7555 www.dekra-certification.com



Annex to 6098057.04AOC

Ratings of the products:

Model / Type	AF4K-SL	AF4.6K-SL	AF5K-SL	AF5.5K-SL	AF6K-SL
Rating	See below	See below	See below	See below	See below
<b>PV input</b>					
Max. DC voltage [V]	580				
MPPT DC voltage range [V]	50-550	50-550	50-550	50-550	50-550
Rated DC voltage [V]	360				
Input DC current [A]	20*2				
Isc PV [A]	26*2				
<b>AC output &amp; AC input</b>					
Nominal AC power [VA]	4000	4600	5000	5500	6000
Rated AC voltage [V]	230	230	230	230	230
Rated AC current [A]	17.5	20	22	24	26
Max AC current [A]	20	23	25.5	27.5	30
Frequency [Hz]	50	50	50	50	50
<b>Battery parameter</b>					
Rated voltage [V]	48				
Voltage operation range [V]	40-60				
Max charge and discharge current [A]	66	66	66	66	66
Max charge and discharge power [W]	3600	3600	3600	3600	3600
<b>EPS output</b>					
Rated output power [VA]	4000	4600	5000	5500	6000
Rated voltage [V]	230	230	230	230	230
Rated current [A]	17.5	20	22	24	26
Frequency [Hz]	50	50	50	50	50

Model / Type	AF4K-SH	AF4.6K-SH	AF5K-SH	AF5.5K-SH	AF6K-SH
<b>Rating</b>	See below	See below	See below	See below	See below
<b>PV input</b>					
Max. DC voltage [V]	580				
MPPT DC voltage range [V]	50-550	50-550	50-550	50-550	50-550
Rated DC voltage [V]	360				
Input DC current [A]	20*2				
Isc PV [A]	26*2				
<b>AC output &amp; AC input</b>					
Nominal AC power [VA]	4000	4600	5000	5500	6000
Rated AC voltage [V]	230	230	230	230	230
Rated AC current [A]	17.5	20	22	24	26
Max AC current [A]	20	23	25.5	27.5	30
Frequency [Hz]	50	50	50	50	50
<b>Battery parameter</b>					
Rated voltage [V]	288				
Voltage operation range [V]	85-360				
Max charge and discharge current [A]	30	30	30	30	30
Max charge and discharge power [W]	8000/4000	9000/4600	10000/5000	10000/5500	10000/6000
<b>EPS output</b>					
Rated output power [VA]	4000	4600	5000	5500	6000
Rated voltage [V]	230	230	230	230	230
Rated current [A]	17.5	20	22	24	26
Frequency [Hz]	50	50	50	50	50

**G99/1-6 Form A2-3: Type Verification Test Report Type A inverter**

Extract form test report number.:

6098057.53

**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  $\pm 5\%$  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  $1 \text{ Hzs}^{-1}$  as measured over a period of 500 ms. Note that this is not expected to be demonstrated on site.

Model: AF6K-SL

Test 1

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (seconds)	P
193.21	47	6215.0	0.9995	20	

Test 2

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)	P
193.32	47.5	6219.3	0.9995	90	

Test 3

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)	P
253.11	51.5	6109.7	0.9995	90	



Test 4					P
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)	
252.98	52.0	6110.0	0.9996	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 <sup>-1</sup>	5.0 s	No trip	
253.0	52.0 Hz to 47.0 Hz	-1 Hzs <sup>-1</sup>	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 61000-3-12 for three phase equipment.

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.

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

Model: AF6K-SL

Power Generating Module rating per phase (rpp)		6.0	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	0.093	0.356	0.075	0.289	8%	8%
3	0.238	0.913	0.202	0.775	21.6%	Not stated
4	0.014	0.055	0.011	0.044	4%	4%
5	0.085	0.324	0.100	0.385	10.7%	10.7%
6	0.017	0.065	0.011	0.043	2.67%	2.67%
7	0.050	0.192	0.062	0.237	7.2%	7.2%
8	0.013	0.051	0.012	0.045	2%	2%
9	0.047	0.181	0.051	0.195	3.8%	Not stated
10	0.014	0.052	0.011	0.041	1.6%	1.6%
11	0.019	0.074	0.027	0.102	3.1%	3.1%
12	0.014	0.055	0.011	0.041	1.33%	1.33%
13	0.017	0.066	0.019	0.071	2%	2%
THD	--	1.31	--	1.86	23%	13%
PWHD	--	1.15	--	1.32	23%	22%

Model: AF4K-SL

Power Generating Module rating per phase (rpp)		4.0	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	0.054	0.311	0.038	0.220	8%	8%

3	0.163	0.937	0.132	0.760	21.6%	Not stated
4	0.014	0.081	0.009	0.054	4%	4%
5	0.063	0.360	0.100	0.575	10.7%	10.7%
6	0.014	0.082	0.008	0.046	2.67%	2.67%
7	0.036	0.207	0.054	0.313	7.2%	7.2%
8	0.011	0.065	0.008	0.047	2%	2%
9	0.029	0.169	0.034	0.197	3.8%	Not stated
10	0.011	0.062	0.008	0.046	1.6%	1.6%
11	0.016	0.091	0.020	0.112	3.1%	3.1%
12	0.011	0.064	0.008	0.048	1.33%	1.33%
13	0.013	0.075	0.020	0.112	2%	2%
THD	--	1.41	--	1.73	23%	13%
PWHD	--	1.40	--	1.29	23%	22%

### 3. Power Quality – Voltage fluctuations and Flicker:

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.

P

Model: AF6K-SL

	Starting			Stopping			Running	
	d max	d c	d(t)	d max	d c	d(t)	Pst	Plt 2 hours
Measured Values at test impedance	0.56%	0.27	0	1.43%	0.16	0	0.22	0.19
Normalised to standard impedance	0.56%	0.27	0	1.43%	0.16	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	0.24	$\Omega$	XI	0.15	$\Omega$
Standard Impedance	R	0.24 * 0.4 ^	$\Omega$	XI	0.15 * 0.25 ^	$\Omega$
Maximum Impedance	R	N/A	$\Omega$	XI	N/A	$\Omega$

\* 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  $\Omega$

Two phase units in a three phase system reference source resistance is 0.4  $\Omega$

Two phase units in a split phase system reference source resistance is 0.24  $\Omega$

Three phase units reference source resistance is 0.24  $\Omega$

Where the **Power Factor** of the output is under 0.98 then the XI 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.



<b>4. Power quality – DC injection:</b> The tests should be carried out on a single <b>Generating Unit</b> . Tests are to be carried out at three defined power levels $\pm 5\%$ . At 230 V a 50 kW three phase <b>Inverter</b> 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.			<b>P</b>
---	--	--	----------

Model: AF6K-SL			
Test power level	10%	55%	100%
Recorded 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%
Model: AF4K-SL			
Test power level	10%	55%	100%
Recorded 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%

<b>5. Power Factor:</b> The tests should be carried out on a single <b>Power Generating Module</b> . Tests are to be carried out at three voltage levels and at <b>Registered Capacity</b> . Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.1.4.2.			<b>P</b>
--	--	--	----------

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
<b>Power Factor</b> Limit	>0.95	>0.95	>0.95
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
<b>Power Factor</b> 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: 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	47.48 Hz	20.3 s	47.7 Hz 30 s	No trip
U/F stage 2	47 Hz	0.5 s	46.98 Hz	0.540 s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F	52.0 Hz	0.5 s	52.02 Hz	0.548 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  $\pm 0.1$  Hz. In order to measure the time delay a larger deviation than the minimum required to operate the protection can be used. The "No trip tests" need to be carried out at the setting  $\pm 0.2$  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: 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	180.6 V	2.520 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	265.1 V	1.052 s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	277.0 V	0.536 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  $\pm 3.45$  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  $\pm 4$  V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

<b>8. Protection – Loss of Mains test:</b> These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.							<b>P</b>
The following sub set of tests should be recorded in the following table.							
Model: AF6K-SL							
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 0.5s	82.4 ms	75.6 ms	81.2 ms	74.4 ms	66.4 ms	75.6 ms	
<b>Loss of Mains Protection, Vector Shift Stability test.</b> This test should be carried out in accordance with Annex A.7.1.2.6.							<b>P</b>
Model: AF6K-SL							
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				
<b>Loss of Mains Protection, RoCoF Stability test:</b> This test should be carried out in accordance with Annex A.7.1.2.6.							<b>P</b>
Model: AF6K-SL							
Ramp range	Test frequency ramp:	Test Duration	Confirm no trip				
49.0 Hz to 51.0 Hz	+0.95 Hzs <sup>-1</sup>	2.1 s	No trip				
51.0 Hz to 49.0 Hz	-0.95 Hzs <sup>-1</sup>	2.1 s	No trip				

<b>9. Limited Frequency Sensitive Mode – Over frequency test:</b> The test should be carried out using the specific threshold frequency of 50.4 Hz and <b>Droop</b> of 10%.						<b>P</b>
This test should be carried out in accordance with Annex A.7.1.3.						
<b>Active Power</b> response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.						<b>Y/N</b>
Alternatively, simulation results should be noted below:						
Model: AF6K-SL						
Test sequence at <b>Registered Capacity &gt;80%</b>	Measured <b>Active Power</b> Output (W)	Frequency (Hz)	Calculate droop (%)	Primary Power Source	<b>Active Power Gradient</b>	
Step a) 50.00 Hz ±0.01 Hz	6028.0	50.00	-	Photovoltaic array simulator	-	
Step b) 50.45 Hz ±0.05 Hz	5963.3	50.45	9.32		-	
Step c) 50.70 Hz ±0.10 Hz	5640.7	50.70	9.34		-	
Step d) 51.15 Hz ±0.05 Hz	5100.6	51.15	9.74		-	
Step e) 50.70 Hz ±0.10 Hz	5641.9	50.70	9.36		-	
Step f) 50.45 Hz ±0.05 Hz	5965.6	50.45	9.66		-	
Step g) 50.00 Hz ±0.01 Hz	6010.3	50.00	-		-	10%
Test sequence at <b>Registered Capacity 40% - 60%</b>	Measured <b>Active Power</b> Output (W)	Frequency (Hz)	Calculate droop (%)	Primary Power Source	<b>Active Power Gradient</b>	



Step a) 50.00 Hz $\pm$ 0.01 Hz	3016.1	50.00	-	Photovoltaic array simulator	-
Step b) 50.45 Hz $\pm$ 0.05 Hz	2984.5	50.45	9.54		-
Step c) 50.70 Hz $\pm$ 0.10 Hz	2829.3	50.70	9.69		-
Step d) 51.15 Hz $\pm$ 0.05 Hz	2527.5	51.15	9.26		-
Step e) 50.70 Hz $\pm$ 0.10 Hz	2829.2	50.70	9.68		-
Step f) 50.45 Hz $\pm$ 0.05 Hz	2983.7	50.45	9.31		-
Step g) 50.00 Hz $\pm$ 0.01 Hz	3016.2	50.00	-		10%

<b>10. Protection – Re-connection timer.</b>					<b>P</b>
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.					
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	31 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 <b>Micro-generator</b> does not re-connect.		No reconnection	No reconnection	No reconnection	No reconnection

<b>11. Fault level contribution:</b> These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5.			<b>P</b>
For Inverter output			
Model: SL			
Time after fault	Volts	Amps	
20ms	177.9 V	18.82 A	
100ms	1.076 V	0.15 A	
250ms	0	0	
500ms	0	0	
Time to trip	0.083	In seconds	

<b>12. Self-Monitoring solid state switching:</b> 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 <b>Power Park Module</b> , the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.	<b>N/A</b>
<b>13. Wiring functional tests:</b> If required by para 15.2.1.	
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	<b>N/A</b>
<b>14. Logic interface (input port).</b>	
Confirm that an input port is provided and can be used to shut down the module.	<b>Yes</b>
Additional comments.	
No.	