


<b>Applicant:</b>	<b>GD Midea Air-Conditioning Equipment Co., Ltd.</b> Lingang Road, Beijiao, Shunde, Foshan, 528311, Guangdong, China		
<b>Device Category:</b>	Inverter		
<b>Device Type:</b>	Hybrid (PV with DC coupled Electricity Storage)		
<b>PGM categories:</b>	<input checked="" type="checkbox"/> Type A	<input type="checkbox"/> Type B	<input type="checkbox"/> Type C <input type="checkbox"/> Type D
<b>Model(s):</b>	<b>EH-3K-A-M0, EH-3.6K-A-M0, EH-4K-A-M0,</b> <b>EH-4.6K-A-M0, EH-5K-A-M0, EH-5.5K-A-M0,</b> <b>EH-6K-A-M0</b>		
<b>Trademark:</b>			
<b>Technical data:</b>	Product family: EH-3K ~ 6K-A-M0 Registered Capacity [kW]: 3.0 ~ 6.0 (For further details see A.2 Technical data of the Generating Unit(s) on p.2)		
<b>Firmware version:</b>	V000001		
<b>Grid connection code:</b>	<b>Engineering Recommendation G99/N1</b> Issue 1 April 2019 Requirements for the connection of generation equipment in parallel with public distribution networks in Northern Ireland on or after 27 April 2019		
<b>Test report no.:</b>	<b>HC23100801-EG-NI-001 (2023-10-19)</b>		

This verification confirms that the above-mentioned generating unit(s) with corresponding software meet the requirements of the referenced grid connection code at the time the tests were conducted.

This verification relates to type testing and does not imply LYNS's endorsement, approval, certification or on-going control of the product(s), either in terms of performance, design, manufacture or materials used. This verification and the results stated herein relate solely to the sample product(s) tested and to the specific tests undertaken.

The verification will remain valid for the stated period providing no changes are made to the product, production method etc. This certificate is only valid when this is also found at <http://www.huachuang-ts.com/plus/list.php?tid=62> or contact Lync-tci Technology Guangdong Co., Ltd.

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**Jack Shi**

Sr. Project Manager

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**A.1 Revision history of the verification**

Revision	Date	Changes	Status
0 (HC23100801-EG-NI-V001)	2023-10-19	Initial issue	Active

**A.2 Technical data of the Generating Unit(s)**

Model	EH-3K-A-M0	EH-3.6K-A-M0	EH-4K-A-M0	EH-4.6K-A-M0
DC input (PV)				
Max. DC input voltage [V]	600			
Operating MPPT voltage range [V]	90 ~ 550			
Input DC current [A]	max. 13 / 13			
Battery connection				
Battery voltage range [V]	42 ~ 58			
Battery charging current [A]	max. 75	max. 80	max. 85	max. 100
Battery discharging current [A]	max. 75	max. 80	max. 85	max. 100
AC connection				
Nominal output AC voltage [V]	230 (L + N + PE, 50/60 Hz)			
Output AC current [A]	max. 15	max. 16	max. 20.0	max. 20.9
Nominal active output power P <sub>n</sub> [kW]	3.0	3.68	4.0	4.6
Registered Capacity <sup>1</sup> P <sub>max</sub> [kW]	3.0	3.68	4.0	4.6
Max. apparent power [kVA]	3.3	3.68	4.4	4.6

Model	EH-5K-A-M0	EH-5.5K-A-M0	EH-6K-A-M0
DC input (PV)			
Max. DC input voltage [V]	600		
Operating MPPT voltage range [V]	90 ~ 550		
Input DC current [A]	max. 13 / 13		
Battery connection			
Battery voltage range [V]	42 ~ 58		
Battery charging current [A]	max. 100		
Battery discharging current [A]	max. 100		
AC connection			
Nominal output AC voltage [V]	230 (L + N + PE, 50/60 Hz)		
Output AC current [A]	max. 21.7	max. 25	max. 27.3
Nominal active output power P <sub>n</sub> [kW]	5.0	5.0	6.0
Registered Capacity <sup>1</sup> P <sub>max</sub> [kW]	5.0	5.0	6.0
Max. apparent power [kVA]	5.0	5.5	6.0

Operating temperature range	-30°C ~ +60°C
Degree of protection	IP65 (according to EN 60529)
Protection class	I (according to IEC 62109-1)
Type of internal transformer	No internal transformer (transformerless)
Firmware version	V000001

<sup>1</sup> The stated values of "registered capacity" related to single Generating Unit.

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Manufacturer	<b>Dongguan SOFAR SOLAR Co., Ltd.</b> 1F-6F, Building E, No.1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City, Guangdong Province, P.R. China (The manufacturer has provided proof of certification of the quality management system of his production facility in accordance with ISO 9001)
Testing laboratory	<b>Lyns-tci Technology Guangdong Co., Ltd.</b> Room 1201, Unit 2, Building 18, No. 7, Science and Technology Boulevard, Houjie Town, Dongguan City, Guangdong, 523960 P.R. China (Accredited acc. ISO/IEC 17025: A2LA Accreditation no. 5200.02)
Testing location	Same as above
Date(s) of performance of tests	2023-04-10 - 2023-06-30

### Note:

- The Power Park Modules (Generating Units):  
*EH-3K-A-M0*, *EH-4K-A-M0* and *EH-5.5K-A-M0* are designed to be capable of operating within the range  $\pm 0.95$  Power Factor at Registered Capacity.  
Max. operating range of Power Factor at Registered Capacity: 0.909 lagging to 0.909 leading.
- For Power Park Module (Generating Unit) *EH-3.6K-A-M0*, *EH-4.6K-A-M0*, *EH-5K-A-M0* and *EH-6K-A-M0* to meet the requirement:  
"When operating at Registered Capacity the Power Generating Module shall be capable of operating at a Power Factor within the range 0.95 lagging to 0.95 leading relative to the voltage waveform"
  - a semi-permanent active power reduction to a value:
  - EH-3.6K-A-M0*:  $P_{max} \leq 3.496 \text{ kW}$
  - EH-4.6K-A-M0*:  $P_{max} \leq 4.37 \text{ kW}$
  - EH-5K-A-M0*:  $P_{max} \leq 4.75 \text{ kW}$
  - EH-6K-A-M0*:  $P_{max} \leq 5.70 \text{ kW}$   
can be applied by software (the parameter setting needs to follow the manufacturer's guidance)
  - or this need to be considered in the Power Generating Module design
  - or otherwise agreed with the DNO
- Setting range of the Power Factor:  
0.800 lagging to 0.800 leading

### A.3 Extract of the test report no. HC23100801-EG-NI-001 (EREC G99/Ni, Form A2-3)

#### Note:

- The (full) tests were performed on EUT *EH-6K-A-M0*.
- The product was tested on:
  - EH-6K-A-M0* (full testing)
    - Serial No.: SM2ES0600P2K80
    - Hardware version: V001
    - Firmware version: V000001
- According to EREC G99, section 15.6.1 the following applies:  
since the rated power of *EH-3K-A-M0*, *EH-3.6K-A-M0*, *EH-4K-A-M0*, *EH-4.6K-A-M0*, *EH-5K-A-M0* and *EH-5.5K-A-M0* is between  $1/\sqrt{10} \cdot P_{n, EH-6K-A-M0}$  and  $2 \cdot P_{n, EH-6K-A-M0}$ , a family approach to type testing is acceptable.
- A transfer of measurement results from the *EH-6K-A-M0* to other units in the product series according to EREC G99, section 15.6.2 is allowed.

According to EREC G99, section 15.6.2 the following applies:

*All absolute values (e.g. operating range tests) shall be transferred directly in the compliance forms of an assumed compliant Generating Unit of the same family. All relative results related to design Active Power or current (e.g. power quality fluctuation and flicker) from the tested Generating Unit shall be transferred to the compliance form of a Generating Unit in the same family according to the ratio of the respective nameplate rating (W) of the tested Generating Unit and the assumed compliant Generating Unit. For the avoidance of doubt, the Manufacturer shall register each Generating Unit in the family on the Energy Networks Association Type Test register.*

In general, the **relative results** of EUT *EH-6K-A-M0* can be applied to other units in the product series scaled by the factor  $P_{n, EH-6K-A-M0} / P_{n, \text{unit-not-tested}}$ . Exceptions are detailed in the results table below.

- Technical justification for transferability of measurement results:

The units in der product series:

- sharing the same control electronics,
- with the same implemented control and firmware,
- with the same construction solutions including the power part,

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- with the same number of phases,
- with the power electronics, filters and transducers designed for different sizes of voltage and current ratings.

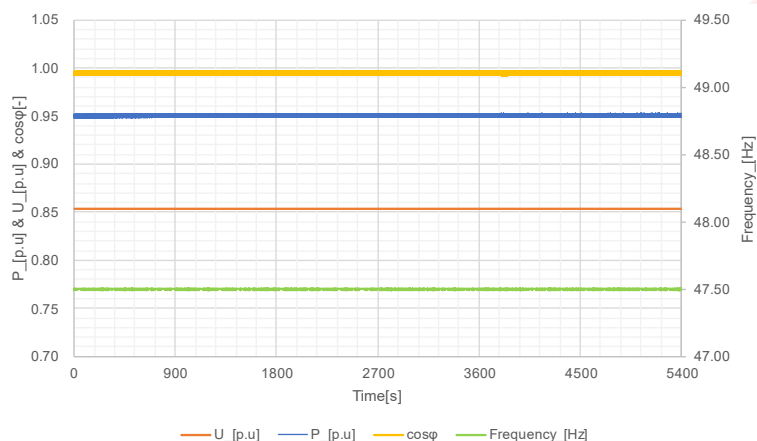
The differences between the units in the product series are documented in detail in the test report no. HC23100801-EG-NI-001.

### 1. Operating Range

#### Test 1

Voltage = 85% of nominal (195.5 V),  
Frequency = 47.5 Hz,  
**Power Factor = 1**,  
Period of test 90 minutes

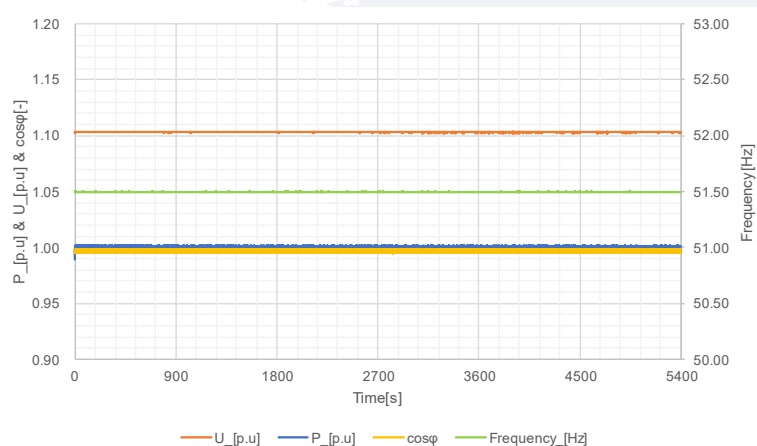
Pass, no disconnection occurs.



#### Test 2

Voltage = 110% of nominal (253 V),  
Frequency = 51.5 Hz,  
**Power Factor = 1**,  
Period of test 90 minutes

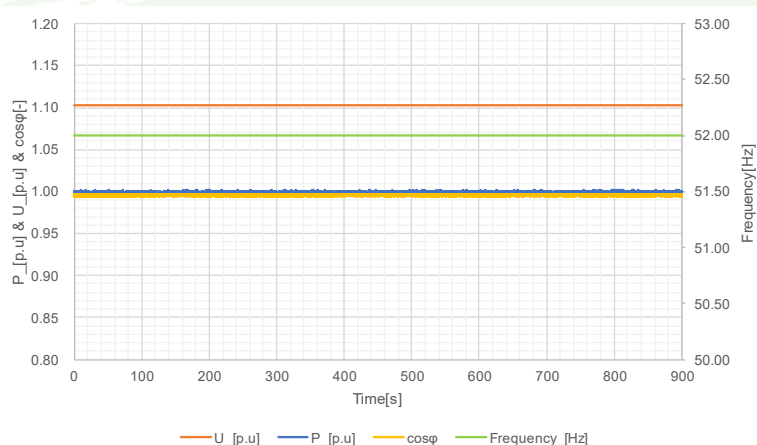
Pass, no disconnection occurs.



#### Test 3

Voltage = 110% of nominal (253 V),  
Frequency = 52.0 Hz,  
**Power Factor = 1**,  
Period of test 15 minutes

Pass, no disconnection occurs.



#### Note:

The verified operating range of the EH-6K-A-M0 can be applied to other units in the product series directly.

2. Power Quality – Harmonics									
Power Generating Module tested to BS EN 61000-3-12									
Power Generating Module rating per phase (rpp)				6.000		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 phases					
Harmonic	At 45-55% of Registered Capacity						Limit in BS EN 61000-3-12		
	Measured Value (MV) in Amps			Measured Value (MV) in %					
Order	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	1-phase	3-phases	
2	0.0217	--	--	0.083	--	--	8%	8%	
3	0.1296	--	--	0.497	--	--	21.6%	Not stated	
4	0.0098	--	--	0.038	--	--	4%	4%	
5	0.0630	--	--	0.241	--	--	10.7%	10.7%	
6	0.0069	--	--	0.026	--	--	2.67%	2.67%	
7	0.0347	--	--	0.133	--	--	7.2%	7.2%	
8	0.0054	--	--	0.021	--	--	2%	2%	
9	0.0224	--	--	0.086	--	--	3.8%	Not stated	
10	0.0045	--	--	0.017	--	--	1.6%	1.6%	
11	0.0194	--	--	0.074	--	--	3.1%	3.1%	
12	0.0036	--	--	0.014	--	--	1.33%	1.33%	
13	0.0110	--	--	0.042	--	--	2%	2%	
THD	--	--	--	0.601	--	--	23%	13%	
PWHD	--	--	--	0.570	--	--	23%	22%	

Harmonic	At 100% of Registered Capacity						Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps			Measured Value (MV) in %				
Order	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	1-phase	3-phases
2	0.0402	--	--	0.154	--	--	8%	8%
3	0.2841	--	--	1.089	--	--	21.6%	Not stated
4	0.0182	--	--	0.070	--	--	4%	4%
5	0.1867	--	--	0.716	--	--	10.7%	10.7%
6	0.0124	--	--	0.047	--	--	2.67%	2.67%
7	0.1190	--	--	0.456	--	--	7.2%	7.2%
8	0.0093	--	--	0.036	--	--	2%	2%
9	0.0680	--	--	0.261	--	--	3.8%	Not stated
10	0.0074	--	--	0.028	--	--	1.6%	1.6%
11	0.0303	--	--	0.116	--	--	3.1%	3.1%
12	0.0057	--	--	0.022	--	--	1.33%	1.33%
13	0.0222	--	--	0.085	--	--	2%	2%
THD	--	--	--	1.436	--	--	23%	13%
PWHD	--	--	--	0.801	--	--	23%	22%

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Note:

 The percentage harmonics results of the EH-6K-A-M0 can be applied to other units in the product series scaled by the factor  $P_n, EH-5K-A-M0 / P_n, \text{unit-not-tested.}$ 

(The transferred results are below the required limit values according to BS EN 61000-3-12.)

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

Test start date		2023-04-19			Test end date			2023-04-23	
Test location		Lyns-tci Technology Guangdong Co., Ltd. (see <i>Testing location</i> on p.3)							
	Phase no.	Starting			Stopping			Running	
		d <sub>max</sub> [%]	d <sub>c</sub> [%]	d(t) [ms]	d <sub>max</sub> [%]	d <sub>c</sub> [%]	d(t) [ms]	P <sub>st</sub>	P <sub>lt</sub> 2 hours
Measured Values at test impedance	L1	0.276	0.125	0.000	0.126	0.314	0.000	0.032	0.029
	L2	--	--	--	--	--	--	--	--
	L3	--	--	--	--	--	--	--	--
	Overall worst case	0.276	0.125	0.000	0.126	0.314	0.000	0.032	0.029
Measured Values at test impedance	L1	0.276	0.125	0.000	0.126	0.314	0.000	0.032	0.029
	L2	--	--	--	--	--	--	--	--
	L3	--	--	--	--	--	--	--	--
	Overall worst case	0.276	0.125	0.000	0.126	0.314	0.000	0.032	0.029
Measured Values at test impedance	L1	--	--	--	--	--	--	--	--
	L2	--	--	--	--	--	--	--	--
	L3	--	--	--	--	--	--	--	--
	Overall worst case	--	--	--	--	--	--	--	--
Limits set under BS EN 61000-3-11		4	3.3	500 (3.3%)	4	3.3	500 (3.3%)	1.0	0.65
Test Impedance	R: 0.4 Ω				X: 0.25 Ω				
Standard Impedance	R: <input type="checkbox"/> 0.24 * Ω <input checked="" type="checkbox"/> 0.4 ^ Ω				X: <input type="checkbox"/> 0.15 * Ω <input checked="" type="checkbox"/> 0.25 ^ Ω				
Maximum Impedance	R: -- Ω				X: -- Ω				
* <input type="checkbox"/> three-phase <b>Power Generating Modules</b> <input type="checkbox"/> split single phase <b>Power Generating Modules</b>									
^ <input checked="" type="checkbox"/> single phase <b>Power Generating Module</b> <input type="checkbox"/> <b>Power Generating Modules</b> using two phases on a three-phase system									

Note:

 The Flicker results of the EH-6K-A-M0 can be applied to other units in the product series scaled by the factor  $P_n, EH-6K-A-M0 / P_n, \text{unit-not-tested.}$ 

(The transferred results (values at test and standard impedance) are below the required limit values according to BS EN 61000-3-11.)

**4. Power Quality – DC injection**

EH-6K-A-M0			
Test power level	10%	55%	100%
Recorded DC value in Amps	0.005	0.002	0.005
as % of rated AC current	0.019	0.008	0.019

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Limit [%]	0.25	0.25	0.25
Note: The percentage DC injection of the EH-6K-A-M0 can be considered as worst case results and applied to the EH-3K-A-M0, EH-3.6K-A-M0, EH-4K-A-M0, EH-4.6K-A-M0, EH-5K-A-M0 and EH-5.5K-A-M0 directly. (The transferred results are below the required limit of 0.25%.)			

5. Power Factor			
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.999	0.999	0.998
<b>Power Factor</b> Limit - leading	>0.95	>0.95	>0.95
<b>Power Factor</b> Limit - lagging	>0.98	>0.98	>0.98
Note: The Power Factor results of the EH-6K-A-M0 can be applied to other units in the product series directly.			

6. Protection – Frequency tests						
Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F	48.0 Hz	0.5 s	47.99 Hz	0.542 s	48.2 Hz 25 s	No trip occurred
					47.8 Hz 0.45 s	No trip occurred
O/F	52 Hz	1.0 s	52.00 Hz	1.050 s	51.8 Hz 120.0 s	No trip occurred
					52.2 Hz 0.98 s	No trip occurred
Note: The measurement results of the EH-6K-A-M0 can be applied to other units in the product series directly.						



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7. Protection – Voltage tests						
Function	Setting		Trip test		“No trip tests”	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	0.85 pu (195.5 V)	3.0 s	195.48 V	3.000 s	199.5 V 5.0 s	No trip occurred
U/V stage 2	0.60 pu (138.0 V)	2.0 s	137.99 V	2.020 s	142.0 V 2.5 s	No trip occurred
					180 V 2.45 s	No trip occurred
O/V stage 1	1.10 pu (253.0 V)	0.5 s	252.81 V	0.500 s	249.0 V 5.0 s	No trip occurred
					277.7 V 0.45 s	No trip occurred
Note: The measurement results of the EH-6K-A-M0 can be applied to other units in the product series directly.						

8. Protection – Loss of Mains test						
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 [s]	0.279	0.233	0.327	0.309	0.229	0.259
Trip time limit [s]	0.5					
Loss of Mains Protection, Vector Shift Stability test						
	Start Frequency		Change		Confirm no trip	
Positive Vector Shift	49.5 Hz		+50 degrees		No trip occurred	
Negative Vector Shift	50.5 Hz		- 50 degrees		No trip occurred	
Loss of Mains Protection, RoCoF Stability test						
Ramp range	Test frequency ramp:		Test Duration		Confirm no trip	
49.0 Hz to 51.0 Hz	+0.95 Hz/s		2.1 s		No trip occurred	
51.0 Hz to 49.0 Hz	-0.95 Hz/s		2.1 s		No trip occurred	
Note:						
The measurement results of the EH-6K-A-M0 can be applied to other units in the product series directly.						



**9. Limited Frequency Sensitive Mode – Overfrequency test**

**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, test results should be noted below:

Test sequence at <b>Registered Capacity</b> >80%	Measured <b>Active Power</b> Output [W]	Frequency [Hz]	Primary Power Source [W]	<b>Active Power Gradient Droop</b>
Step a) 50.00Hz ± 0.01Hz	6050	50.00	6600	---
Step b) 50.45Hz ± 0.05Hz	6050	50.25		---
Step c) 50.70Hz ± 0.10Hz	4519	50.70		---
Step d) 51.15Hz ± 0.05Hz	3162	51.15		4.01% <sup>1)</sup>
Step e) 50.70Hz ± 0.10Hz	4519	50.70		---
Step f) 50.45Hz ± 0.05Hz	6050	50.25		4.01% <sup>2)</sup>
Step g) 50.00Hz ± 0.01Hz	6050	50.00		---
Test sequence at <b>Registered Capacity</b> 40% - 60%	Measured <b>Active Power</b> Output [W]	Frequency [Hz]	Primary Power Source [W]	<b>Active Power Gradient Droop</b>
Step a) 50.00Hz ± 0.01Hz	3030	50.00	3300	---
Step b) 50.45Hz ± 0.05Hz	3030	50.25		---
Step c) 50.70Hz ± 0.10Hz	1527	50.70		---
Step d) 51.15Hz ± 0.05Hz	176	51.15		4.03% <sup>1)</sup>
Step e) 50.70Hz ± 0.10Hz	1527	50.70		---
Step f) 50.45Hz ± 0.05Hz	3029	50.25		4.03% <sup>2)</sup>
Step g) 50.00Hz ± 0.01Hz	3029	50.00		---
Note:				
1) Droop calculated using frequency and power between steps d) & b)				
2) Droop calculated using frequency and power between steps f) & d)				
The determined droops of the EH-6K-A-M0 can be applied to other units in the product series directly.				

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10. Protection – Re-connection timer					
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	76 s	At 1.12 pu (257.0 V LV connection)	At 0.83 pu (191.5 V LV connection)	At 47.9 Hz	At 52.1 Hz
Confirmation that the <b>Power Generating Module</b> does not re-connect.		No reconnection occurred	No reconnection occurred	No reconnection occurred	No reconnection occurred
Note: The measurement results of the EH-6K-A-M0 can be applied to other units in the product series directly.					

11. Fault level contribution		
For <b>Inverter</b> output		
Time after fault	Volts	Amps
20 ms	22.5	26.43
100 ms	7.9	0.83
250 ms	7.7	0.63
500 ms	7.6	0.60
Time to trip	0.031	In seconds
Note: The measurement results of the EH-6K-A-M0 can be applied to other units in the product series directly.		

12. Self-Monitoring solid state switching	
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.	N/A

13. Wiring functional tests	
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 For details see "Additional comments." Below.
Note: The measurement results of the EH-6K-A-M0 can be applied to other units in the product series directly. The high-level description of logic interface applies to the whole product series.	

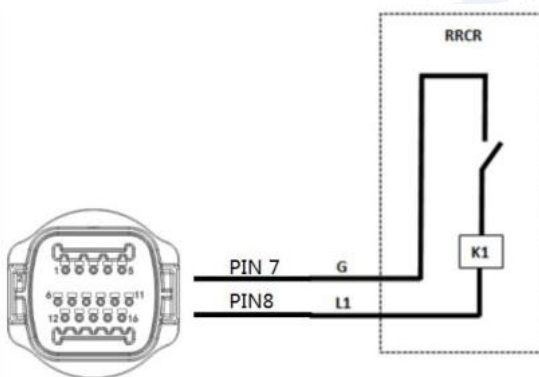
### 15. Cyber security

Confirm that the <b>Power Generating Module</b> has been designed to comply with cyber security requirements, as detailed in 9.1.7.	Yes.
Note: Manufacturer's declaration provided.	

### Additional comments:

High level description of logic interface:

The PGU equipped with a logic interface for ceasing active power output within 5 s following an instruction being received. The following is a possible configuration (if another configuration is required, this can be agreed with the manufacturer):



where RRCR = Radio Ripple Control Receiver.

The signal from the Power Generating Module that is being switched can be either AC (maximum value 240 V) or DC (maximum value 110 V)

Function description of the terminal:

Pin NO.	Pin name	Description	Connected to (RRCR)
8	L1	Relay contact 1 input	K1 - Relay 1 output
7	G	GND	K1 - Relay 1 output

Relay status: close is 1, open is 0

L1	Active Power	Power drop rate	Cos( $\varphi$ )
1	0%	< 5 seconds	1
0	100%	/	1