



**BUREAU
VERITAS**

Attestation of compliance

Certificate No.: 2388AP100088001
Product: Photovoltaic (PV) and battery inverter
Brand Name: 
Test Model No.: SUN2000-4KTL-L1, SUN2000-4.6KTL-L1, SUN2000-5KTL-L1, SUN2000-6KTL-L1
Applicant: **Huawei Technologies Co., Ltd.**
Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian,
Longgang District, Shenzhen, 518129, P.R.C
Report No.: **PVGB2310WDG0088-1**

Use in accordance with regulations:

Automatic disconnection device with Single-phase mains surveillance in accordance with Engineering Recommendation G99/1 for photovoltaic systems with a three-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter. This serves as a replacement for the disconnection device with isolating function, which can be accessed the distribution network provider at any time.

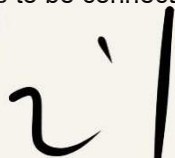
Applied rules and standards:

Engineering Recommendation G99/1-9:2022

Requirements for the connection of generation equipment in parallel with public distribution networks

DIN VDE V 0124-100:2020 (5.5.2.1 Functional safety of network and system protection)

Grid integration of generator plants - Low-voltage - Test requirements for generator units to be connected to and operated in parallel with low-voltage distribution networks


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Manager/ New Energy Team
Date: 2023-11-28

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Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch.
Information given in this document is related to the tested specimen of the described electrical sample

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99 Nr. PVGB2310WDG0088-1

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G99.

PGM Technology:	Photovoltaic (PV) and battery inverter		
Manufacturer / applicant:	Huawei Technologies Co., Ltd.		
Address:	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C		
Tel	-	Fax:	-
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Rated values	SUN2000-4KTL-L1	SUN2000-4.6KTL- L1	SUN2000-5KTL-L1	SUN2000-6KTL-L1
Max. Input PV voltage [V] :	600			
MPP PV voltage range [V]:	90-530			
Max. Input PV current [A] :	13,5 / 13,5			
Isc PV [A]:	20,0 / 20,0			
Output AC voltage [V] :	L/N/PE, 230Vac, 50Hz			
Max. Output AC current [A]:	20,0	23,0	25,0	27,3
Nominal Output power [kW]:	4,0	4,6	5,0	6,0
Max. Output power [kVA] :	4,4	5,0	5,5	6,0
Max. Battery voltage [V]:	600			
Max. Battery current [A] :	15,0			

Firmware version	Software version: V200R001
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Description of the structure of the power generation unit:
 The power generation unit is equipped with a PV and line-side EMC filter. The power generation unit has no galvanic isolation between DC input and AC output. Output switch-off is performed with single-fault tolerance based on two series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.

Differences between Generating Units:
 The models SUN2000-4KTL-L1, SUN2000-4.6KTL-L1, SUN2000-5KTL-L1 and SUN2000-6KTL-L1 are almost identical in hardware except current sampling circuit and the output power derated by software.

The above stated Generating Units are tested according the requirements in the Engineering Recommendation G99/1. Any modification that affects the stated tests must be named by the manufacturer/supplier of the product to ensure that the product meets all requirements of the Engineering Recommendation G99/1.

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99

Nr. PVGB2310WDG0088-1

Operating Range.	
Test 1	Voltage = 85% of nominal (195,5V) Frequency = 47Hz Power Factor = 1 Period of test 20 s
Connection:	Always connected
Limit:	Always connected
Test 2	Voltage = 85% of nominal (195,5V) Frequency = 47,5Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 3	Voltage = 110% of nominal (253V) Frequency = 51,5Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 4	Voltage = 110% of nominal (253V) Frequency = 52,0Hz Power Factor = 1 Period of test 15 minutes
Connection:	Always connected
Limit:	Always connected
Test 5	Voltage = 100% of nominal (230 V) Frequency = 50,0 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 6	Confirm that the Power Generating Module is capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs-1 as measured over a period of 500ms. Note that this is not expected to be demonstrated on site.
Connection:	Always connected
Limit:	Always connected

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99

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Protection. Voltage tests.

Phase 1

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V	184	2,5	183,6	2,540	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	261,5	1,080	258,2V / 5,0s	No trip
O/V stage 2	273,7	0,5	273,0	0,540	269,7V / 0,95s	No trip
					277,7V / 0,45s	No trip

Note. For Voltage tests the Voltage required to trip is the setting $\pm 3,45V$. 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 $\pm 4V$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Frequency tests.

Function	Setting		Trip test		No trip test	
	Frequency [Hz]	Time delay [s]	Frequency [Hz]	Time delay [s]	Frequency / time	Confirm no trip
U/F stage 1	47,5	20	47,5	20,000	47,7Hz / 30s	No trip
U/F stage 2	47	0,5	47,0	0,532	47,2Hz / 19,5s	No trip
					46,8Hz / 0,45s	No trip
O/F stage 2	52	0,5	52,0	0,550	51,8Hz / 120s	No trip
					52,2Hz / 0,45s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting $\pm 0,1Hz$. 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 $\pm 0,2Hz$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99

Nr. PVGB2310WDG0088-1

Protection. Loss of Mains.

Inverters tested according to BS EN 62116.

Balancing load on islanded network	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
Trip time [ms]	284	275	316	297	287	297

Note. Trip time limit is 0,5s.

Protection. Re-connection timer.

Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.1.

Over Voltage

Time delay setting

60 s

Measured delay

71 s

Under Voltage

Time delay setting

60 s

Measured delay

70 s

Over Frequency

Time delay setting

60 s

Measured delay

71 s

Under Frequency

Time delay setting

60 s

Measured delay

71 s

Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.

At 266,2V

At 180,0V

At 47,4Hz

At 52,1Hz

Confirmation that the Generating Unit does not re-connect.

No reconnection

No reconnection

No reconnection

No reconnection

Protection. Frequency change, Stability test.

	Start Frequency [Hz]	Change	Test Duration	Confirm no trip
Positive Vector Shift	49,5	+50 degrees		No trip
Negative Vector Shift	50,5	-50 degrees		No trip
Positive Frequency drift	49,0 to 51,0	+0,95Hz/sec	2,1s	No trip
Negative Frequency drift	51,0 to 49,0	-0,95Hz/sec	2,1s	No trip



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Limited Frequency Sensitive Mode – Over Frequency							
1-min mean value [Hz]:	a) 50,00	b) 50,45	c) 50,70	d) 51,15	e) 50,70	f) 50,45	g) 50,00
1. Measurement a) to g): Active power output > 80% P_n							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P _{expected} [W]:	6000	5940	5640	5100	5640	5940	6000
P _{measured} [W]:	5998	5939	5638	5101	5637	5936	5996
2. Measurement a) to g): Active power output 40% and 60% P_n							
Frequency [Hz]:	50,00	50,46	50,70	51,15	50,70	50,45	50,00
P _{expected} [W]:	3000	2940	2640	2100	2640	2940	6000
P _{measured} [W]:	3002	2943	2643	2102	2642	2943	5994

Output Power with falling Frequency						
Frequency setpoint [Hz]:	50,00	49,50	49,00	48,00	47,60	47,10
Frequency [Hz]:	50,00	49,50	49,00	48,00	47,60	47,10
Active power [kW]:	5988	5985	5986	5984	5982	5983
ΔP/P _{max} [%]:	-0,20	-0,25	-0,24	-0,27	-0,30	-0,29
Note. No power reduction takes place in electronic inverter.						

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99

Nr. PVGB2310WDG0088-1

Power Quality. Harmonics.						
Test: SUN2000-4KTL-L1						
Phase 1						
SSEG rating per phase (rpp)			4,0 kW			
At 45-55% of rated output 2 kW			100% of rated output 4 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (%) in [A]	Measured Value (MV) in [A]	Measured Value (%) in [A]	Limit in BS EN61000-3-12	
					1 phase	3 phase
2nd	0,013	0,145	0,011	0,065	1	8,00
3rd	0,053	0,613	0,051	0,297	4	N/A
4th	0,007	0,080	0,007	0,043	1	4,00
5th	0,037	0,422	0,014	0,078	4	10,70
6th	0,006	0,066	0,010	0,059	1	2,67
7th	0,030	0,341	0,015	0,088	4	7,20
8th	0,006	0,067	0,011	0,064	1	2,00
9th	0,021	0,245	0,018	0,105	4	N/A
10th	0,005	0,061	0,010	0,059	0,5	1,60
11th	0,022	0,257	0,014	0,084	2	3,10
12th	0,005	0,058	0,012	0,073	0,5	1,33
13th	0,020	0,235	0,015	0,089	2	2,00
14th	0,005	0,055	0,014	0,082	0,5	N/A
15th	0,019	0,219	0,016	0,094	2	N/A
16th	0,005	0,058	0,014	0,081	0,5	N/A
17th	0,020	0,230	0,018	0,103	1,5	N/A
18th	0,005	0,056	0,015	0,089	0,5	N/A
19th	0,019	0,220	0,023	0,135	1,5	N/A
20th	0,005	0,057	0,015	0,090	0,5	N/A
21th	0,014	0,160	0,023	0,131	1,5	N/A
22th	0,006	0,064	0,013	0,075	0,5	N/A
23th	0,013	0,151	0,023	0,133	0,6	N/A
24th	0,005	0,058	0,012	0,072	0,5	N/A
25th	0,015	0,167	0,027	0,158	0,6	N/A
26th	0,005	0,062	0,012	0,068	0,5	N/A
27th	0,012	0,140	0,028	0,164	0,6	N/A
28th	0,005	0,061	0,009	0,054	0,5	N/A
29th	0,011	0,125	0,030	0,173	0,6	N/A
30th	0,005	0,059	0,009	0,050	0,5	N/A
31th	0,010	0,118	0,028	0,164	0,6	N/A
32th	0,005	0,061	0,008	0,047	0,5	N/A
33th	0,009	0,100	0,032	0,186	0,6	N/A
34th	0,006	0,063	0,009	0,049	N/A	N/A
35th	0,008	0,095	0,031	0,178	N/A	N/A
36th	0,006	0,063	0,010	0,056	N/A	N/A
37th	0,009	0,103	0,031	0,179	N/A	N/A
38th	0,006	0,064	0,010	0,061	N/A	N/A
39th	0,008	0,097	0,027	0,159	N/A	N/A
40th	0,006	0,066	0,012	0,071	N/A	N/A
41th	0,008	0,094	0,026	0,149	N/A	N/A
42th	0,006	0,065	0,013	0,078	N/A	N/A
43th	0,008	0,097	0,022	0,128	N/A	N/A
44th	0,006	0,064	0,014	0,079	N/A	N/A
45th	0,008	0,095	0,021	0,125	N/A	N/A

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Extract from test report according to the Engineering Recommendation G99

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46th	0,005	0,063	0,013	0,076	N/A	N/A
47th	0,008	0,092	0,019	0,112	N/A	N/A
48th	0,006	0,064	0,014	0,079	N/A	N/A
49th	0,008	0,091	0,008	0,046	N/A	N/A
50th	0,005	0,062	0,005	0,031	N/A	N/A
THD_ [%]	--	1,151	--	0,616	23	13
PWHD_ [%}	--	10,318	--	10,950	23	22

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

Test: SUN2000-4.6KTL-L1

Phase 1

SSEG rating per phase (rpp)			4,6 kW		Limit in BS EN61000-3-12	
At 45-55% of rated output 2,3 kW			100% of rated output 4.6 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (%) in [A]	Measured Value (MV) in [A]	Measured Value (%) in [A]	1 phase	3 phase
2nd	0,024	0,245	0,012	0,059	1	8,00
3rd	0,082	0,822	0,172	0,858	4	N/A
4th	0,013	0,127	0,022	0,111	1	4,00
5th	0,025	0,246	0,024	0,118	4	10,70
6th	0,013	0,126	0,008	0,039	1	2,67
7th	0,039	0,393	0,020	0,101	4	7,20
8th	0,007	0,074	0,010	0,050	1	2,00
9th	0,028	0,277	0,026	0,129	4	N/A
10th	0,007	0,067	0,006	0,029	0,5	1,60
11th	0,029	0,288	0,020	0,100	2	3,10
12th	0,003	0,034	0,006	0,030	0,5	1,33
13th	0,022	0,220	0,014	0,069	2	2,00
14th	0,004	0,039	0,008	0,038	0,5	N/A
15th	0,013	0,125	0,008	0,040	2	N/A
16th	0,004	0,036	0,005	0,025	0,5	N/A
17th	0,018	0,176	0,005	0,023	1,5	N/A
18th	0,005	0,047	0,005	0,025	0,5	N/A
19th	0,018	0,182	0,005	0,026	1,5	N/A
20th	0,004	0,036	0,006	0,030	0,5	N/A
21th	0,012	0,121	0,004	0,020	1,5	N/A
22th	0,005	0,047	0,005	0,026	0,5	N/A
23th	0,016	0,157	0,005	0,023	0,6	N/A
24th	0,004	0,041	0,005	0,027	0,5	N/A
25th	0,022	0,222	0,006	0,028	0,6	N/A
26th	0,004	0,041	0,006	0,029	0,5	N/A
27th	0,023	0,226	0,005	0,025	0,6	N/A
28th	0,005	0,046	0,005	0,024	0,5	N/A
29th	0,023	0,226	0,006	0,032	0,6	N/A
30th	0,004	0,038	0,005	0,024	0,5	N/A
31th	0,023	0,233	0,008	0,038	0,6	N/A
32th	0,004	0,038	0,005	0,023	0,5	N/A
33th	0,022	0,221	0,009	0,045	0,6	N/A
34th	0,004	0,040	0,005	0,023	N/A	N/A
35th	0,022	0,218	0,009	0,046	N/A	N/A
36th	0,004	0,043	0,005	0,024	N/A	N/A
37th	0,022	0,223	0,011	0,055	N/A	N/A

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99

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38th	0,004	0,043	0,005	0,023	N/A	N/A
39th	0,020	0,201	0,012	0,058	N/A	N/A
40th	0,004	0,042	0,005	0,023	N/A	N/A
41th	0,019	0,186	0,012	0,059	N/A	N/A
42th	0,004	0,041	0,005	0,023	N/A	N/A
43th	0,018	0,182	0,012	0,062	N/A	N/A
44th	0,004	0,041	0,005	0,023	N/A	N/A
45th	0,016	0,163	0,013	0,067	N/A	N/A
46th	0,004	0,042	0,004	0,022	N/A	N/A
47th	0,014	0,143	0,014	0,068	N/A	N/A
48th	0,004	0,041	0,005	0,025	N/A	N/A
49th	0,013	0,130	0,015	0,073	N/A	N/A
50th	0,004	0,041	0,005	0,024	N/A	N/A
THD [%]	--	1,370	--	0,931	23	13
PWHD [%]	--	11,485	--	6,567	23	22

Test result: SUN2000-5KTL-L1

Phase 1

SSEG rating per phase (rpp)			5,0 kW			
	At 45-55% of rated output 2,5 kW		100% of rated output 5 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (%) in [A]	Measured Value (MV) in [A]	Measured Value (%) in [A]	Limit in BS EN61000-3-12	
					1 phase	3 phase
2nd	0,007	0,064	0,010	0,046	1	8,00
3rd	0,028	0,257	0,064	0,295	4	N/A
4th	0,007	0,064	0,008	0,037	1	4,00
5th	0,015	0,138	0,010	0,046	4	10,70
6th	0,008	0,073	0,009	0,041	1	2,67
7th	0,018	0,165	0,016	0,074	4	7,20
8th	0,007	0,064	0,008	0,037	1	2,00
9th	0,017	0,156	0,015	0,069	4	N/A
10th	0,008	0,073	0,009	0,041	0,5	1,60
11th	0,019	0,174	0,014	0,065	2	3,10
12th	0,008	0,073	0,010	0,046	0,5	1,33
13th	0,021	0,193	0,014	0,065	2	2,00
14th	0,007	0,064	0,011	0,051	0,5	N/A
15th	0,018	0,165	0,016	0,074	2	N/A
16th	0,008	0,073	0,011	0,051	0,5	N/A
17th	0,020	0,184	0,012	0,055	1,5	N/A
18th	0,008	0,073	0,012	0,055	0,5	N/A
19th	0,018	0,165	0,018	0,083	1,5	N/A
20th	0,007	0,064	0,013	0,060	0,5	N/A
21th	0,020	0,184	0,022	0,101	1,5	N/A
22th	0,008	0,073	0,012	0,055	0,5	N/A
23th	0,019	0,174	0,025	0,115	0,6	N/A
24th	0,008	0,073	0,013	0,060	0,5	N/A
25th	0,016	0,147	0,025	0,115	0,6	N/A
26th	0,007	0,064	0,013	0,060	0,5	N/A
27th	0,015	0,138	0,029	0,134	0,6	N/A
28th	0,008	0,073	0,011	0,051	0,5	N/A
29th	0,010	0,092	0,030	0,138	0,6	N/A
30th	0,008	0,073	0,012	0,055	0,5	N/A
31th	0,010	0,092	0,033	0,152	0,6	N/A



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Extract from test report according to the Engineering Recommendation G99

Nr. PVGB2310WDG0088-1

32th	0,008	0,073	0,012	0,055	0,5	N/A
33th	0,011	0,101	0,036	0,166	0,6	N/A
34th	0,008	0,073	0,012	0,055	N/A	N/A
35th	0,012	0,110	0,039	0,180	N/A	N/A
36th	0,007	0,064	0,013	0,060	N/A	N/A
37th	0,014	0,128	0,041	0,189	N/A	N/A
38th	0,007	0,064	0,014	0,065	N/A	N/A
39th	0,014	0,128	0,041	0,189	N/A	N/A
40th	0,008	0,073	0,017	0,078	N/A	N/A
41th	0,017	0,156	0,042	0,194	N/A	N/A
42th	0,007	0,064	0,019	0,088	N/A	N/A
43th	0,017	0,156	0,041	0,189	N/A	N/A
44th	0,008	0,073	0,022	0,101	N/A	N/A
45th	0,017	0,156	0,041	0,189	N/A	N/A
46th	0,008	0,073	0,023	0,106	N/A	N/A
47th	0,017	0,156	0,041	0,189	N/A	N/A
48th	0,008	0,073	0,025	0,115	N/A	N/A
49th	0,017	0,156	0,038	0,175	N/A	N/A
50th	0,009	0,083	0,027	0,124	N/A	N/A
THD [%]	--	0,846	--	0,802	23	13
PWHD [%]	--	3,884	--	4,420	23	22

Test: SUN2000-6KTL-L1

Phase 1

SSEG rating per phase (rpp)			6,0 kW			
	At 45-55% of rated output 3 kW		100% of rated output 6 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (%) in [A]	Measured Value (MV) in [A]	Measured Value (%) in [A]	Limit in BS EN61000-3-12	
					1 phase	3 phase
2nd	0,010	0,074	0,017	0,064	1	8,00
3rd	0,111	0,850	0,185	0,716	4	N/A
4th	0,009	0,067	0,014	0,055	1	4,00
5th	0,012	0,094	0,049	0,190	4	10,70
6th	0,013	0,096	0,007	0,027	1	2,67
7th	0,032	0,241	0,024	0,091	4	7,20
8th	0,007	0,057	0,017	0,067	1	2,00
9th	0,025	0,193	0,017	0,066	4	N/A
10th	0,008	0,058	0,007	0,025	0,5	1,60
11th	0,029	0,221	0,020	0,079	2	3,10
12th	0,004	0,029	0,005	0,021	0,5	1,33
13th	0,023	0,178	0,010	0,037	2	2,00
14th	0,003	0,026	0,006	0,022	0,5	N/A
15th	0,014	0,107	0,011	0,044	2	N/A
16th	0,004	0,028	0,004	0,016	0,5	N/A
17th	0,013	0,098	0,006	0,024	1,5	N/A
18th	0,004	0,029	0,004	0,016	0,5	N/A
19th	0,012	0,092	0,006	0,023	1,5	N/A
20th	0,003	0,026	0,003	0,013	0,5	N/A
21th	0,010	0,079	0,005	0,020	1,5	N/A
22th	0,004	0,029	0,004	0,014	0,5	N/A
23th	0,011	0,081	0,006	0,023	0,6	N/A
24th	0,003	0,026	0,004	0,015	0,5	N/A
25th	0,012	0,093	0,008	0,030	0,6	N/A



BUREAU
VERITAS

Annex to the G99/1 certificate of compliance No. 2388AP100088001

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99

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26th	0,004	0,031	0,003	0,012	0,5	N/A
27th	0,013	0,100	0,008	0,032	0,6	N/A
28th	0,003	0,026	0,004	0,015	0,5	N/A
29th	0,014	0,105	0,008	0,030	0,6	N/A
30th	0,003	0,025	0,003	0,011	0,5	N/A
31th	0,015	0,118	0,006	0,024	0,6	N/A
32th	0,003	0,025	0,003	0,012	0,5	N/A
33th	0,018	0,134	0,006	0,024	0,6	N/A
34th	0,003	0,024	0,003	0,011	N/A	N/A
35th	0,018	0,135	0,007	0,029	N/A	N/A
36th	0,003	0,024	0,003	0,011	N/A	N/A
37th	0,019	0,144	0,007	0,028	N/A	N/A
38th	0,003	0,025	0,003	0,012	N/A	N/A
39th	0,019	0,147	0,008	0,031	N/A	N/A
40th	0,004	0,029	0,003	0,013	N/A	N/A
41th	0,021	0,157	0,008	0,031	N/A	N/A
42th	0,003	0,025	0,003	0,012	N/A	N/A
43th	0,020	0,153	0,008	0,030	N/A	N/A
44th	0,003	0,025	0,003	0,011	N/A	N/A
45th	0,021	0,159	0,008	0,030	N/A	N/A
46th	0,003	0,025	0,003	0,012	N/A	N/A
47th	0,021	0,164	0,008	0,031	N/A	N/A
48th	0,003	0,026	0,003	0,012	N/A	N/A
49th	0,020	0,153	0,009	0,035	N/A	N/A
50th	0,004	0,027	0,003	0,012	N/A	N/A
THD_ [%]	--	1,112	--	0,776	23	13
PWHD_ [%]	--	3,292	--	4,949	23	22

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.



Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules
 Extract from test report according to the Engineering Recommendation G99 Nr. PVGB2310WDG0088-1

Power Quality. Power factor.				
Output power	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1,5\%$ of the stated level during the test.
20%	0,9999	0,9999	0,9999	
50%	0,9999	0,9999	0,9999	
75%	0,9999	0,9999	0,9999	
100%	0,9999	0,9999	0,9999	
Limit	>0,95	>0,95	>0,95	

Power Quality. Voltage fluctuation and Flicker.									
SUN2000-4KTL-L1									
		Starting			Stopping			Running	
		dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Phase 1	Measured values at test impedance	0,71	0,46	--	0,80	0,30	--	0,31	0,32
	Normalised to standard impedance	0,71	0,46	--	0,80	0,30	--	0,31	0,32
	Normalised to required maximum impedance	0,71	0,46	--	0,80	0,30	--	0,31	0,32
Limits set under BS EN 61000-3-11		4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Test impedance		R	0,400	Ω	XI	0,250	Ω		
		Z	0,472	Ω					
Standard impedance		R	0,400	Ω	XI	0,250	Ω		
		Z	0,472	Ω					
Maximum impedance		R	0,400	Ω	XI	0,250	Ω		
		Z	0,472	Ω					

SUN2000-4.6KTL-L1									
		Starting			Stopping			Running	
		dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Phase 1	Measured values at test impedance	0,01	0,01	--	0,01	0,01	--	0,12	0,12
	Normalised to standard impedance	0,01	0,01	--	0,01	0,01	--	0,12	0,12
	Normalised to required maximum impedance	0,01	0,01	--	0,01	0,01	--	0,12	0,12

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99

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Limits set under BS EN 61000-3-11		4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Test impedance	R		0,400		Ω		XI	0,250	Ω
	Z		0,472		Ω				
Standard impedance	R		0,400		Ω		XI	0,250	Ω
	Z		0,472		Ω				
Maximum impedance	R		0,400		Ω		XI	0,250	Ω
	Z		0,472		Ω				
SUN2000-5KTL-L1									
		Starting			Stopping			Running	
		dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Phase 1	Measured values at test impedance	0,55	0,36	--	0,81	0,29	--	0,56	0,45
	Normalised to standard impedance	0,55	0,36	--	0,81	0,29	--	0,56	0,45
	Normalised to required maximum impedance	0,55	0,36	--	0,81	0,29	--	0,56	0,45
Limits set under BS EN 61000-3-11		4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Test impedance	R		0,400		Ω		XI	0,250	Ω
	Z		0,472		Ω				
Standard impedance	R		0,400		Ω		XI	0,250	Ω
	Z		0,472		Ω				
Maximum impedance	R		0,400		Ω		XI	0,250	Ω
	Z		0,472		Ω				
SUN2000-6KTL-L1									
		Starting			Stopping			Running	
		dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Phase 1	Measured values at test impedance	0,01	0,01	--	0,01	0,01	--	0,12	0,12
	Normalised to standard impedance	0,01	0,01	--	0,01	0,01	--	0,12	0,12
	Normalised to required maximum impedance	0,01	0,01	--	0,01	0,01	--	0,12	0,12

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99

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Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Test impedance	R	0,400	Ω	XI	0,250	Ω		
	Z	0,472	Ω					
Standard impedance	R	0,400	Ω	XI	0,250	Ω		
	Z	0,472	Ω					
Maximum impedance	R	0,400	Ω	XI	0,250	Ω		
	Z	0,472	Ω					

Power Quality. DC injection.

Test: SUN2000-4KTL-L1

Phase 1

Test level power [%]	10	55	100
Recorded value [mA]	3	5	5
Recorded value [%]	0,02	0,03	0,03
Limit [%]	0,25	0,25	0,25

Note. Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.

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 4 kW single phase Inverter has a current output of 17,39 A so DC limit is 43,4 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) / V phase. The % DC injection should not be greater than 0,25%.

Power Quality. DC injection.

Test: SUN2000-6KTL-L1

Phase 1

Test level power [%]	10	55	100
Recorded value [mA]	20	22	22
Recorded value [%]	0,09	0,10	0,10
Limit [%]	0,25	0,25	0,25

Note. Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.

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 6 kW single phase Inverter has a current output of 26,09 A so DC limit is 65,2 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) / V phase. The % DC injection should not be greater than 0,25%.

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99

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Fault level Contribution.					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts [V]	Amps [A]
Phase 1					
Peak Short Circuit current	I_p	N/A	20ms	9,96V	-11,80A
Initial Value of aperiodic current	A	N/A	100ms	-0,41V	0,06A
Initial symmetrical short-circuit current*	I_k	N/A	250ms	-0,16V	0,06A
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	-0,04V	0,06A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	0,070	In seconds

For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.
* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.

Self Monitoring – Solid state switching.	N/A
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 seconds.	N/A
Note. Unit do not provide solid state switching relays. In case the semiconductor bridge is switched off, then the voltage on the output drops to 0. In this case the relays on the output will also open (Functional safety of the internal automatic disconnection device according to VDE 0124-100).	

Cyber security	P
Confirm that the Manufacturer or Installer of the Micro-generator has provided a statement describing how the Micro-generator has been designed to comply with cyber security requirements, as detailed in 9.7.	Yes
Note. Different levels of access, all are password protected, only certain parameters can be changed on maintenance level. Manufacturer information provided, see test report.	

Wiring functional tests if required by para. 15.2.1	N/A
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning).	N/A
Note. Type test of components wired correct together on site is part of the commissioning test. The inverter was tested in a test laboratory. The correct wiring functional test in the field has to be done by the responsible person for the installation of the plant.	

Logic Interface (input port) Required by paragraph 11.1.3.1	P
Confirm that an input port is provided and can be used to reduce the Active Power output to zero	Yes
Note. Manufacturer information provided. A Modbus signal can be used to cease Active Power output within 5 s. See test report.	
Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal	Yes
The DNO logic interface use COM port, control the on and off of DI1 and GND by switch. When the switch is opened, the Power Generating Module can operate normally. When the switch is closed, the Power Generating Module will reduce its active power to zero within 5s. The signal from the Power Generating Module that is being switched is DC(value 12V).	

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering
Recommendation G99

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Additional comments