



**BUREAU  
VERITAS**

# Certificate of compliance

**Applicant:** **Huawei Technologies Co., Ltd.**  
Administration Building, Headquarters of Huawei Technologies Co., Ltd.,  
Bantian, Longgang District, Shenzhen, 518129,  
P.R. China

**Product:** **SOLAR INVERTER**

**Model:** **SUN2000-4KTL-L1**  
**SUN2000-4.6KTL-L1**  
**SUN2000-5KTL-L1**  
**SUN2000-6KTL-L1**

## 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 single-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 G99/1-6:2020

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

### DIN V VDE V 0126-1-1:2006-02 (4.1 Functional safety)

Automatic disconnection device between a generator and the public low-voltage grid

At the time of issue of this certificate the safety concept of an aforementioned representative product corresponds to the valid safety specifications for the specified use in accordance with regulations.

**Report number:** PVUK191217N030-1-R3

**Certification program:** NSOP-0032-DEU-ZE-V01

**Certificate number:** U20-0821

**Date of issue:** 2020-10-21

**Certification body**



Thomas Lammel

*Certification body Bureau Veritas Consumer Products Services Germany GmbH accredited according to DIN EN ISO/IEC 17065  
A partial representation of the certificate requires the written approval of Bureau Veritas Consumer Products Services Germany GmbH*

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

Extract from test report according to the Engineering Recommendation G99

No. PVUK191217N030-1-R3

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

<b>PGM Technology:</b>	Photovoltaic and battery inverter		
<b>Manufacturer / applicant:</b>	Huawei Technologies Co., Ltd.		
<b>Address:</b>	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R. China		
<b>Tel</b>	+86 755 28780808	<b>Fax:</b>	+86 755 28780808
<b>Email:</b>	support@huawei.com	<b>Website:</b>	http://www.huawei.com.cn

Rated values	SUN2000-4KTL-L1	SUN2000-4.6KTL-L1	SUN2000-5KTL-L1	SUN2000-6KTL-L1
<b>MPP DC voltage range [V]</b>	90-560V			
<b>Input DC voltage range [V]</b>	Max 600V			
<b>Input DC current [A]</b>	Max.12,5A / 12,5A			
<b>Output AC voltage [V]</b>	220 / 230 / 240Va.c., 50/60Hz			
<b>Output AC current [A]</b>	20,0	23,0	25,0	27,3
<b>Output power [VA]</b>	4,4	5,0	5,5	6,0
<b>Battery input voltage [V]</b>	max. 600	max. 600	max. 600	max. 600
<b>Battery current [A]</b>	max. 15	max. 15	max. 15	max. 15

<b>Firmware version</b>	V200R001
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<b>Measurement period:</b>	2019-12-17 - 2020-04-23, 2020-07-21 - 2020-09-16
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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 use the same hardware platform, use the same control unit and 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

No. PVUK191217N030-1-R3

<b>Operating Range.</b>	
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	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 <sup>-1</sup> 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

No. PVUK191217N030-1-R3

**Protection. Voltage tests.**

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	183,6V	2,540s	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	261,5V	1,080s	258,2V / 5,0s	No trip
O/V stage 2	273,7	0,5	273,0V	0,540s	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	20,000s	47,7Hz / 30s	No trip
U/F stage 2	47	0,5	47,0	0,532s	47,2Hz / 19,5s	No trip
					46,8Hz / 0,45s	No trip
O/F stage 2	52	0,5	52,0Hz	0,550s	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 No. PVUK191217N030-1-R3

**Protection. Loss of Mains.  
SUN2000-5KTL-L1**

Inverters tested according to BS EN 62116.

<b>Balancing load on islanded network</b>	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
<b>Trip time. Ph1 fuse removed [s]</b>	0,364	0,359	0,459	0,329	0,328	0,431

Note. Trip time limit is 0,5s.

**Protection. Loss of Mains.  
SUN2000-6KTL-L1**

Inverters tested according to BS EN 62116.

<b>Balancing load on islanded network</b>	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
<b>Trip time. Ph1 fuse removed [s]</b>	0,284	0,275	0,316	0,297	0,287	0,297

Note. Trip time limit is 0,5s.

**Protection. Re-connection timer.  
SUN2000-5KTL-L1**

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.

<b>Over Voltage</b>	
<b>Time delay setting</b>	<b>Measured delay</b>
20s	67s
<b>Under Voltage</b>	
<b>Time delay setting</b>	<b>Measured delay</b>
20s	67s
<b>Over Frequency</b>	
<b>Time delay setting</b>	<b>Measured delay</b>
20s	67s
<b>Under Frequency</b>	
<b>Time delay setting</b>	<b>Measured delay</b>
20s	66s

	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
<b>Confirmation that the Generating Unit does not re-connect.</b>	No reconnection	No reconnection	No reconnection	No reconnection

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

Extract from test report according to the Engineering Recommendation G99

No. PVUK191217N030-1-R3

**Protection. Re-connection timer.**

**SUN2000-6KTL-L1**

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**

20s

**Measured delay**

70s

**Under Voltage**

**Time delay setting**

20s

**Measured delay**

71s

**Over Frequency**

**Time delay setting**

20s

**Measured delay**

71s

**Under Frequency**

**Time delay setting**

20s

**Measured delay**

71s

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.**

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

**Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules**  
 Extract from test report according to the Engineering Recommendation G99 No. PVUK191217N030-1-R3

**Limited Frequency Sensitive Mode – Over Frequency**  
**SUN2000-5KTL-L1**

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
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**1. Measurement a) to g): Active power output > 80% Pn**

Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P <sub>expected</sub> [kW]:	N/A	4946	4696	4247	4696	4946	N/A
P <sub>measured</sub> [kW]:	4996	4936	4665,81	4171	4665	4939	4995

**2. Measurement a) to g): Active power output 40% and 60% Pn**

Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P <sub>expected</sub> [kW]:	N/A	2499	2372	2145	2372	2499	N/A
P <sub>measured</sub> [kW]:	2524	2498	2375	2144	2371	2498	4983

**Limited Frequency Sensitive Mode – Over Frequency**  
**SUN2000-6KTL-L1**

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
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**1. Measurement a) to g): Active power output > 80% Pn**

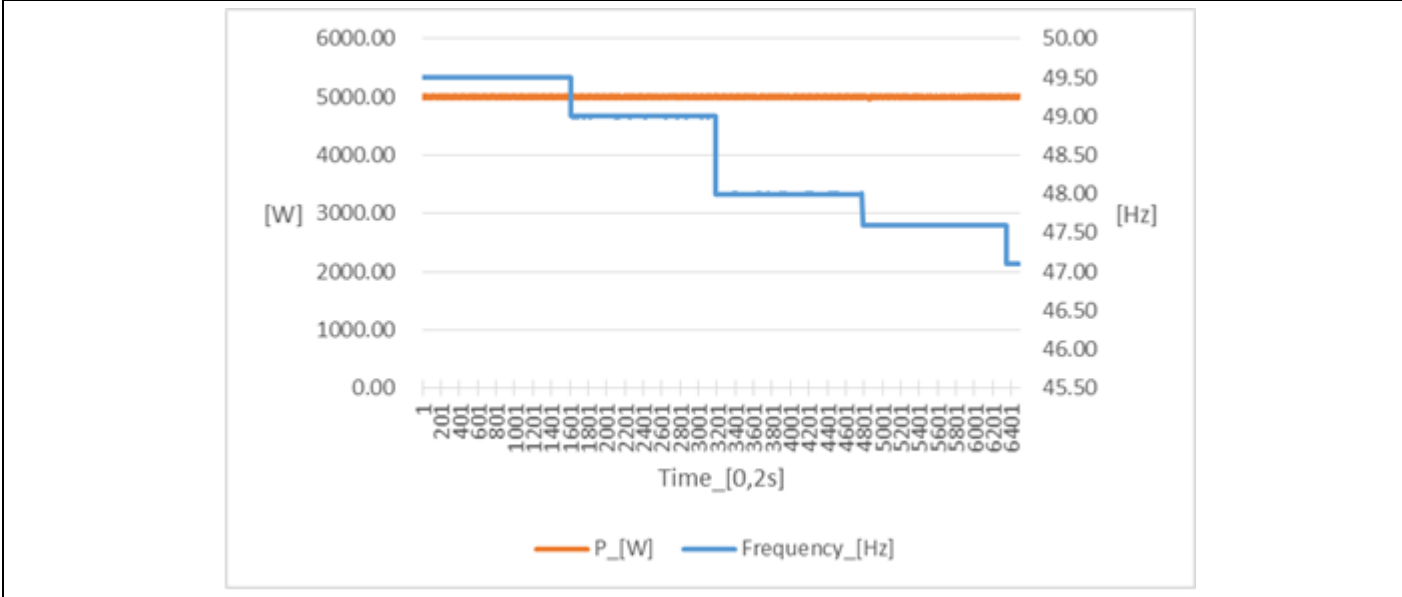
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P <sub>expected</sub> [kW]:	N/A	5900	5602	5066	5602	5900	N/A
P <sub>measured</sub> [kW]:	5960	5897	5585	5055	5593	5912	5960

**2. Measurement a) to g): Active power output 40% and 60% Pn**

Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P <sub>expected</sub> [kW]:	N/A	2970	2820	2550	2820	2970	N/A
P <sub>measured</sub> [kW]:	3000	2980	2884	2551	2884	2980	5970

**Output Power with falling Frequency**  
**SUN2000-5KTL-L1**

Frequency setpoint [Hz]:	50,00	49,50	49,00	48,00	47,60	47,10
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ΔP/P <sub>max</sub> [%]:		0	0	0	0	0
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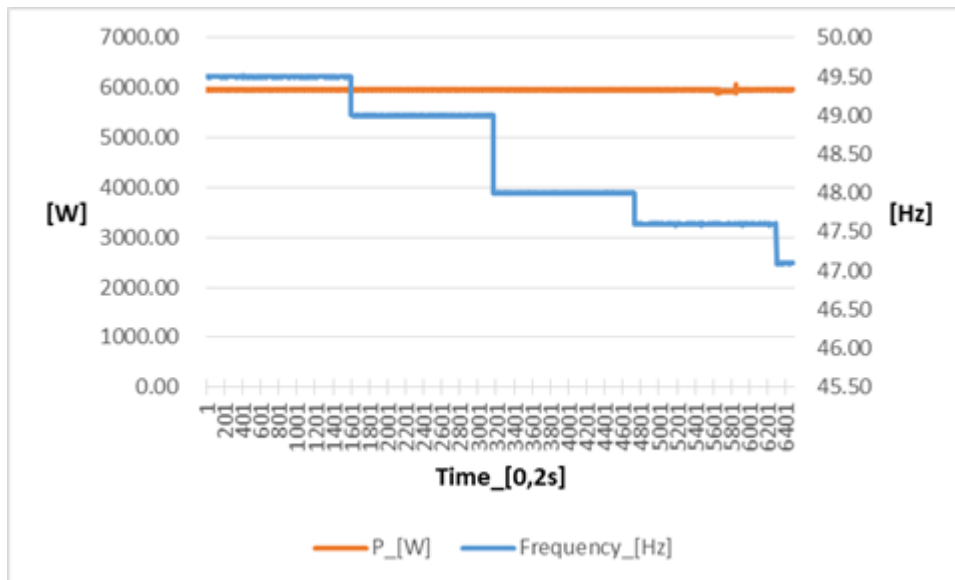
**Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules**

Extract from test report according to the Engineering Recommendation G99

No. PVUK191217N030-1-R3

**Output Power with falling Frequency  
SUN2000-6KTL-L1**

<b>Frequency setpoint [Hz]:</b>	50,00	49,50	49,00	48,00	47,60	47,10
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<b><math>\Delta P/P_{max}</math> [%]:</b>		0	0	0	0	0
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Note.

Electronic inverter no power reduction take place.



**Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules**  
 Extract from test report according to the Engineering Recommendation G99 No. PVUK191217N030-1-R3

Power Quality. Harmonics.						
SUN2000-4KTL-L1						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 2 kW		100% of rated output 4 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	8,709	--	17,221	--	8%	8%
3rd	0,013	0,145	0,011	0,065	21,6%	N/A
4th	0,053	0,613	0,051	0,297	4%	4%
5th	0,007	0,080	0,007	0,043	10,7%	10,7%
6th	0,037	0,422	0,014	0,078	2,67%	2,67%
7th	0,006	0,066	0,010	0,059	7,2%	7,2%
8th	0,030	0,341	0,015	0,088	2%	2%
9th	0,006	0,067	0,011	0,064	3,8%	N/A
10th	0,021	0,245	0,018	0,105	1,6%	1,6%
11th	0,005	0,061	0,010	0,059	3,1%	3,1%
12th	0,022	0,257	0,014	0,084	1,33%	1,33%
13th	0,005	0,058	0,012	0,073	2%	2%
14th	0,020	0,235	0,015	0,089	N/A	N/A
15th	0,005	0,055	0,014	0,082	N/A	N/A
16th	0,019	0,219	0,016	0,094	N/A	N/A
17th	0,005	0,058	0,014	0,081	N/A	N/A
18th	0,020	0,230	0,018	0,103	N/A	N/A
19th	0,005	0,056	0,015	0,089	N/A	N/A
20th	0,019	0,220	0,023	0,135	N/A	N/A
21th	0,005	0,057	0,015	0,090	N/A	N/A
22th	0,014	0,160	0,023	0,131	N/A	N/A
23th	0,006	0,064	0,013	0,075	N/A	N/A
24th	0,013	0,151	0,023	0,133	N/A	N/A
25th	0,005	0,058	0,012	0,072	N/A	N/A
26th	0,015	0,167	0,027	0,158	N/A	N/A
27th	0,005	0,062	0,012	0,068	N/A	N/A
28th	0,012	0,140	0,028	0,164	N/A	N/A
29th	0,005	0,061	0,009	0,054	N/A	N/A
30th	0,011	0,125	0,030	0,173	N/A	N/A
31th	0,005	0,059	0,009	0,050	N/A	N/A
32th	0,010	0,118	0,028	0,164	N/A	N/A
33th	0,005	0,061	0,008	0,047	N/A	N/A
34th	0,009	0,100	0,032	0,186	N/A	N/A
35th	0,006	0,063	0,009	0,049	N/A	N/A
36th	0,008	0,095	0,031	0,178	N/A	N/A
37th	0,006	0,063	0,010	0,056	N/A	N/A
38th	0,009	0,103	0,031	0,179	N/A	N/A
39th	0,006	0,064	0,010	0,061	N/A	N/A
40th	0,008	0,097	0,027	0,159	N/A	N/A
THD <sub>40</sub> [%]	1,151		0,616		23%	13%
PWHD [%]	10,318		10,950		23%	22%

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

Extract from test report according to the Engineering Recommendation G99 No. PVUK191217N030-1-R3

Power Quality. Harmonics.						
SUN2000-4.6KTL-L1						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 2,3 kW		100% of rated output 4,6 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	9,995	--	19,993	--	8%	8%
3rd	0,024	0,245	0,012	0,059	21,6%	N/A
4th	0,082	0,822	0,172	0,858	4%	4%
5th	0,013	0,127	0,022	0,111	10,7%	10,7%
6th	0,025	0,246	0,024	0,118	2,67%	2,67%
7th	0,013	0,126	0,008	0,039	7,2%	7,2%
8th	0,039	0,393	0,020	0,101	2%	2%
9th	0,007	0,074	0,010	0,050	3,8%	N/A
10th	0,028	0,277	0,026	0,129	1,6%	1,6%
11th	0,007	0,067	0,006	0,029	3,1%	3,1%
12th	0,029	0,288	0,020	0,100	1,33%	1,33%
13th	0,003	0,034	0,006	0,030	2%	2%
14th	0,022	0,220	0,014	0,069	N/A	N/A
15th	0,004	0,039	0,008	0,038	N/A	N/A
16th	0,013	0,125	0,008	0,040	N/A	N/A
17th	0,004	0,036	0,005	0,025	N/A	N/A
18th	0,018	0,176	0,005	0,023	N/A	N/A
19th	0,005	0,047	0,005	0,025	N/A	N/A
20th	0,018	0,182	0,005	0,026	N/A	N/A
21th	0,004	0,036	0,006	0,030	N/A	N/A
22th	0,012	0,121	0,004	0,020	N/A	N/A
23th	0,005	0,047	0,005	0,026	N/A	N/A
24th	0,016	0,157	0,005	0,023	N/A	N/A
25th	0,004	0,041	0,005	0,027	N/A	N/A
26th	0,022	0,222	0,006	0,028	N/A	N/A
27th	0,004	0,041	0,006	0,029	N/A	N/A
28th	0,023	0,226	0,005	0,025	N/A	N/A
29th	0,005	0,046	0,005	0,024	N/A	N/A
30th	0,023	0,226	0,006	0,032	N/A	N/A
31th	0,004	0,038	0,005	0,024	N/A	N/A
32th	0,023	0,233	0,008	0,038	N/A	N/A
33th	0,004	0,038	0,005	0,023	N/A	N/A
34th	0,022	0,221	0,009	0,045	N/A	N/A
35th	0,004	0,040	0,005	0,023	N/A	N/A
36th	0,022	0,218	0,009	0,046	N/A	N/A
37th	0,004	0,043	0,005	0,024	N/A	N/A
38th	0,022	0,223	0,011	0,055	N/A	N/A
39th	0,004	0,043	0,005	0,023	N/A	N/A
40th	0,020	0,201	0,012	0,058	N/A	N/A
THD <sub>40</sub> [%]	1,370		0,931		23%	13%
PWHD [%]	11,485		6,567		23%	22%

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

Extract from test report according to the Engineering Recommendation G99

No. PVUK191217N030-1-R3

Power Quality. Harmonics.						
SUN2000-5KTL-L1						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 2,5 kW		100% of rated output 5 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	10,896	--	21,704	--	8%	8%
3rd	0,007	0,064	0,010	0,046	21,6%	N/A
4th	0,028	0,257	0,064	0,295	4%	4%
5th	0,007	0,064	0,008	0,037	10,7%	10,7%
6th	0,015	0,138	0,010	0,046	2,67%	2,67%
7th	0,008	0,073	0,009	0,041	7,2%	7,2%
8th	0,018	0,165	0,016	0,074	2%	2%
9th	0,007	0,064	0,008	0,037	3,8%	N/A
10th	0,017	0,156	0,015	0,069	1,6%	1,6%
11th	0,008	0,073	0,009	0,041	3,1%	3,1%
12th	0,019	0,174	0,014	0,065	1,33%	1,33%
13th	0,008	0,073	0,010	0,046	2%	2%
14th	0,021	0,193	0,014	0,065	N/A	N/A
15th	0,007	0,064	0,011	0,051	N/A	N/A
16th	0,018	0,165	0,016	0,074	N/A	N/A
17th	0,008	0,073	0,011	0,051	N/A	N/A
18th	0,020	0,184	0,012	0,055	N/A	N/A
19th	0,008	0,073	0,012	0,055	N/A	N/A
20th	0,018	0,165	0,018	0,083	N/A	N/A
21th	0,007	0,064	0,013	0,060	N/A	N/A
22th	0,020	0,184	0,022	0,101	N/A	N/A
23th	0,008	0,073	0,012	0,055	N/A	N/A
24th	0,019	0,174	0,025	0,115	N/A	N/A
25th	0,008	0,073	0,013	0,060	N/A	N/A
26th	0,016	0,147	0,025	0,115	N/A	N/A
27th	0,007	0,064	0,013	0,060	N/A	N/A
28th	0,015	0,138	0,029	0,134	N/A	N/A
29th	0,008	0,073	0,011	0,051	N/A	N/A
30th	0,010	0,092	0,030	0,138	N/A	N/A
31th	0,008	0,073	0,012	0,055	N/A	N/A
32th	0,010	0,092	0,033	0,152	N/A	N/A
33th	0,008	0,073	0,012	0,055	N/A	N/A
34th	0,011	0,101	0,036	0,166	N/A	N/A
35th	0,008	0,073	0,012	0,055	N/A	N/A
36th	0,012	0,110	0,039	0,180	N/A	N/A
37th	0,007	0,064	0,013	0,060	N/A	N/A
38th	0,014	0,128	0,041	0,189	N/A	N/A
39th	0,007	0,064	0,014	0,065	N/A	N/A
40th	0,014	0,128	0,041	0,189	N/A	N/A
THD <sub>40</sub> [%]	0,846		0,802		23%	13%
PWHD [%]	3,884		4,420		23%	22%

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

Extract from test report according to the Engineering Recommendation G99

No. PVUK191217N030-1-R3

**Power Quality. Harmonics.**

**SUN2000-6KTL-L1**

**Generating Unit rating per phase (rpp)**

Harmonic	At 45-55% of rated output 3 kW		100% of rated output 6 kW		Limit in BS EN61000-3-12 in %	
	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	1 phase	3 phase
2nd	13,104	--	25,894	--	8%	8%
3rd	0,010	0,074	0,017	0,064	21,6%	N/A
4th	0,111	0,850	0,185	0,716	4%	4%
5th	0,009	0,067	0,014	0,055	10,7%	10,7%
6th	0,012	0,094	0,049	0,190	2,67%	2,67%
7th	0,013	0,096	0,007	0,027	7,2%	7,2%
8th	0,032	0,241	0,024	0,091	2%	2%
9th	0,007	0,057	0,017	0,067	3,8%	N/A
10th	0,025	0,193	0,017	0,066	1,6%	1,6%
11th	0,008	0,058	0,007	0,025	3,1%	3,1%
12th	0,029	0,221	0,020	0,079	1,33%	1,33%
13th	0,004	0,029	0,005	0,021	2%	2%
14th	0,023	0,178	0,010	0,037	N/A	N/A
15th	0,003	0,026	0,006	0,022	N/A	N/A
16th	0,014	0,107	0,011	0,044	N/A	N/A
17th	0,004	0,028	0,004	0,016	N/A	N/A
18th	0,013	0,098	0,006	0,024	N/A	N/A
19th	0,004	0,029	0,004	0,016	N/A	N/A
20th	0,012	0,092	0,006	0,023	N/A	N/A
21th	0,003	0,026	0,003	0,013	N/A	N/A
22th	0,010	0,079	0,005	0,020	N/A	N/A
23th	0,004	0,029	0,004	0,014	N/A	N/A
24th	0,011	0,081	0,006	0,023	N/A	N/A
25th	0,003	0,026	0,004	0,015	N/A	N/A
26th	0,012	0,093	0,008	0,030	N/A	N/A
27th	0,004	0,031	0,003	0,012	N/A	N/A
28th	0,013	0,100	0,008	0,032	N/A	N/A
29th	0,003	0,026	0,004	0,015	N/A	N/A
30th	0,014	0,105	0,008	0,030	N/A	N/A
31th	0,003	0,025	0,003	0,011	N/A	N/A
32th	0,015	0,118	0,006	0,024	N/A	N/A
33th	0,003	0,025	0,003	0,012	N/A	N/A
34th	0,018	0,134	0,006	0,024	N/A	N/A
35th	0,003	0,024	0,003	0,011	N/A	N/A
36th	0,018	0,135	0,007	0,029	N/A	N/A
37th	0,003	0,024	0,003	0,011	N/A	N/A
38th	0,019	0,144	0,007	0,028	N/A	N/A
39th	0,003	0,025	0,003	0,012	N/A	N/A
40th	0,019	0,147	0,008	0,031	N/A	N/A
THD <sub>40</sub> [%]	1,112		0,776		23%	13%
PWHD [%]	3,292		4,949		23%	22%

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

Extract from test report according to the Engineering Recommendation G99

No. PVUK191217N030-1-R3

**Power Quality. Power factor.**

**SUN2000-5KTL-L1**

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%	0,9991	0,9990	0,9989	
50%	0,9998	0,9999	0,9998	
75%	0,9999	0,9999	0,9998	
100%	0,9998	0,9998	0,9996	
Limit	>0,95	>0,95	>0,95	

**Power Quality. Power factor.**

**SUN2000-6KTL-L1**

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	

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

Extract from test report according to the Engineering Recommendation G99

No. PVUK191217N030-1-R3

**Power Quality. Voltage fluctuation and Flicker.**

SUN2000-4KTL-L1	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values at test impedance	0,71	0,46	--	0,80	0,30	--	0,31	0,32
Measured values at standard impedance	0,71	0,46	--	0,80	0,30	--	0,31	0,32
Values for 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	0,4	$\Omega$	XI	0,25	$\Omega$		
	Z	0,472	$\Omega$					
Standard impedance	R	0,4	$\Omega$	XI	0,25	$\Omega$		
	Z	0,472	$\Omega$					
Maximum impedance	R	0,4	$\Omega$	XI	0,25	$\Omega$		
	Zmax	0,472	$\Omega$					
SUN2000-4.6KTL-L1	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values at test impedance	0,01	0,01	--	0,01	0,01	--	0,12	0,12
Measured values at standard impedance	0,01	0,01	--	0,01	0,01	--	0,12	0,12
Values for maximum impedance	0,01	0,01	--	0,01	0,01	--	0,12	0,12
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	0,4	$\Omega$	XI	0,25	$\Omega$		
	Z	0,472	$\Omega$					
Standard impedance	R	0,4	$\Omega$	XI	0,25^	$\Omega$		
	Z	0,472	$\Omega$					
Maximum impedance	R	0,4	$\Omega$	XI	0,25^	$\Omega$		
	Zmax	0,472	$\Omega$					

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

Extract from test report according to the Engineering Recommendation G99

No. PVUK191217N030-1-R3

Power Quality. Voltage fluctuation and Flicker.								
SUN2000-5KTL-L1	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values at test impedance	0,55	0,36	--	0,81	0,29	--	0,56	0,45
Measured values at standard impedance	0,55	0,36	--	0,81	0,29	--	0,56	0,45
Values for 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	0,4	Ω	XI	0,25	Ω		
	Z	0,472	Ω					
Standard impedance	R	0,4	Ω	XI	0,25	Ω		
	Z	0,472	Ω					
Maximum impedance	R	0,4	Ω	XI	0,25 <sup>^</sup>	Ω		
	Zmax	0,472	Ω					
Power Quality. Voltage fluctuation and Flicker.								
SUN2000-6KTL-L1	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values at test impedance	0,01%	0,01%	--	0,01%	0,01%	--	0,12	0,12
Measured values at standard impedance	0,01%	0,01%	--	0,01%	0,01%	--	0,12	0,12
Values for maximum impedance	0,01%	0,01%	--	0,01%	0,01%	--	0,12	0,12
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	0,4	Ω	XI	0,25	Ω		
	Z	0,472	Ω					
Standard impedance	R	0,4	Ω	XI	0,25	Ω		
	Z	0,472	Ω					
Maximum impedance	R	0,4	Ω	XI	0,25	Ω		
	Zmax	0,472	Ω					

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

Extract from test report according to the Engineering Recommendation G99

No. PVUK191217N030-1-R3

**Power Quality. DC injection.  
SUN2000-5KTL-L1**

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

Note. DC-injection is tested at each phase of the inverter and a limit of 0,25% per phase was used as pass criteria.

**Power Quality. DC injection.  
SUN2000-6KTL-L1**

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. DC-injection is tested at each phase of the inverter and a limit of 0,25% per phase was used as pass criteria.

**Fault level Contribution.**

For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts [V]	Amps [A]
Peak Short Circuit current	$I_p$	N/A	20ms	37,79V	197,6A
Initial Value of aperiodic current	A	N/A	100ms	N/A	N/A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	0,004s	

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.

<b>Self Monitoring – Solid state switching.</b>	<b>N/A</b>
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 0126-1-1).	

<b>Logic Interface (input port)</b>	<b>P</b>
Confirm that an input port is provided and can be used to shut down the module.	Yes