



Certificate of compliance

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

Product: SOLAR INVERTER

Model: SUN2000-8KTL-M0, SUN2000-10KTL-M0, SUN2000-12KTL-M0, SUN2000-15KTL-M0, SUN2000-17KTL-M0, SUN2000-20KTL-M0, SUN2000-8KTL-M2, SUN2000-10KTL-M2, SUN2000-12KTL-M2, SUN2000-15KTL-M2, SUN2000-17KTL-M2, SUN2000-20KTL-M2

Use in accordance with regulations:

Automatic disconnection device with three-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 that can access the distribution network provider at any time.

Applied rules and standards:

Engineering Recommendation G99/1-3:2018

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

DIN V VDE V 0126-1-1:2006-02 (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: PVUK190424N048-1
Certificate number: U19-0364
Date of issue: 2019-06-12

Certification body



Holger Schaffer

Certification body of Bureau Veritas Consumer Products Services Germany GmbH
Accredited according to DIN EN ISO/IEC 17065

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G99			
PGM Technology	Photovoltaic inverter		
Manufacturer:	Huawei Technologies Co., Ltd.		
Address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C		
Rated values	SUN2000-8KTL-M0, SUN2000-8KTL-M2	SUN2000-10KTL-M0, SUN2000-10KTL-M2	SUN2000-12KTL-M0, SUN2000-12KTL-M2
Nominal rated capacity	8,0 kW	10 kW	12 kW
Maximum capacity	8,8 kVA	11,0 kVA	13,2 kVA
Rated voltage	220/380, 230/400, 3(N)~ + PE, 50Hz/60Hz		
Rated values	SUN2000-15KTL-M0, SUN2000-15KTL-M2	SUN2000-17KTL-M0, SUN2000-17KTL-M2	SUN2000-20KTL-M0, SUN2000-20KTL-M2
Nominal rated capacity	15 kW	17 kW	20,0 kW
Maximum capacity	16,5 kVA	18,7 kVA	22,0 kVA
Rated voltage	220/380, 230/400, 3(N)~ + PE, 50Hz/60Hz		
Firmware version	V100R001		
Measurement period:	2019-04-24 to 2019-05-30		
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.			
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. PVUK190424N048-1

Operating Range.	
Test 1	Voltage = 85% of nominal (195,5 V) Frequency = 47 Hz Power Factor = 1 Period of test 20 s
Connection:	Always connected
Limit:	Always connected
Test 1	Voltage = 85% of nominal (195,5 V) Frequency = 47.5 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 1	Voltage = 110% of nominal (253 V) Frequency = 51.5 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 1	Voltage = 110% of nominal (253 V) Frequency = 52.0 Hz Power Factor = 1 Period of test 15 minutes
Connection:	Always connected
Limit:	Always connected

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	183,3	2,515	188V / 3,5s	No trip
					180V / 2,48s	No trip
O/V stage 1	262,2	1,0	261,9	1,042	258,2V 2,0s	No trip
O/V stage 2	273,7	0,5	273,5	0,528	269,7V 0,98s	No trip
					277,7V 0,48s	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.

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Protection. Voltage tests.						
Phase 2						
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	184,4	2,525	188V / 3,5s	No trip
					180V / 2,48s	No trip
O/V stage 1	262,2	1,0	262,0	1,026	258,2V 2,0s	No trip
O/V stage 2	273,7	0,5	273,6	0,531	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

Protection. Voltage tests.						
Phase 3						
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	183,5	2,550	188V / 3,5s	No trip
					180V / 2,48s	No trip
O/V stage 1	262,2	1,0	262,3	1,032	258,2V 2,0s	No trip
O/V stage 2	273,7	0,5	274,0	0,521	269,7V 0,98s	No trip
					277,7V 0,48s	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.

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

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	47,40	20,050	47,7Hz / 25s	No trip
U/F stage 2	47	0,5	46,90	0,539	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 2	52	0,5	52,00	0,540	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting $\pm 0,1\text{Hz}$. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No-trip tests" need to be carried out at the setting $\pm 0,2\text{Hz}$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

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. Ph1 fuse removed [s]	0,237	0,253	0,482	0,272	0,243	0,434
Trip time. Ph2 fuse removed [s]	0,237	0,253	0,482	0,272	0,243	0,434
Trip time. Ph3 fuse removed [s]	0,237	0,253	0,482	0,272	0,243	0,434

Note. Trip time limit is 0,5s. For technologies which have a substantial shut down time this can be added to the 0,5s in establishing that the trip occurred in less than 0,5s maximum. Shut down time could therefore be up to 1,0s for these technologies.

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

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 10.5.7.1.

Under Voltage (182V)				
Time delay setting		Measured delay		
20s		305s		
Over Voltage (266,2V)				
Time delay setting		Measured delay		
20s		305s		
Under Frequency(47,4Hz)				
Time delay setting		Measured delay		
20s		306s		
Over Frequency(52,1Hz)				
Time delay setting		Measured delay		
20s		306s		
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 196,1V	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

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

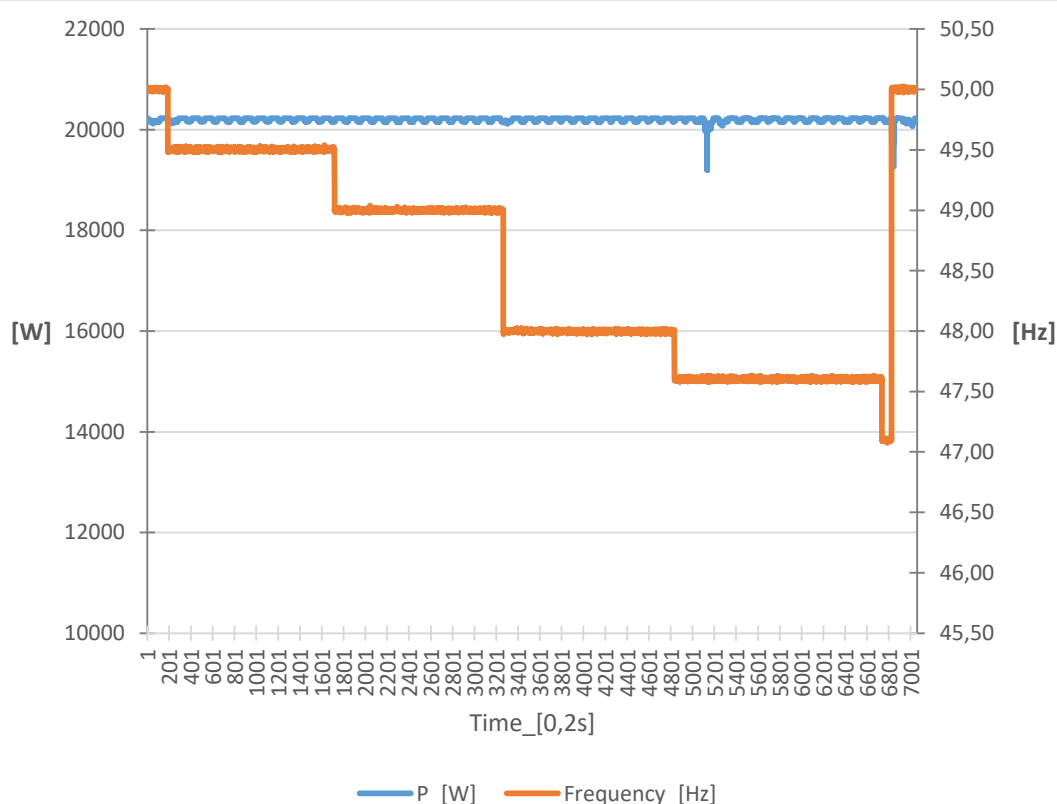
Limited Frequency Sensitive Mode – Over Frequency

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	50,45	50,7	51,15	50,7	50,45	50
P _M [kW]:	N/A	19,800	18,800	17,000	18,800	19,800	N/A
P _{E60} [kW]:	20,000	19,805	18,700	16,722	17,901	19,799	20,000
$\Delta P_{E60}/P_M$ [%]:	N/A	0,03%	-0,50%	-1,39%	-4,98%	0,00%	N/A
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P _n							
Frequency [Hz]:	50	50,45	50,7	51,15	50,7	50,45	50
P _M [kW]:	N/A	9,800	8,800	7,000	8,800	9,800	N/A
P _{E60} [kW]:	10,003	9,797	8,692	6,716	8,692	9,795	10,000
$\Delta P_{E60}/P_M$ [%]:	N/A	-0,01%	-0,54%	-1,42%	-0,54%	-0,03%	N/A
Limit $\Delta P/P_{1min}$:	+ 10 % of P _M						

Note:

The test was performed with a droop of 8% (25%P_n/Hz). The default droop setting 8% and is adjustable in the range between 2% and 10% at intervals of 1%.

Output Power with falling Frequency



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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-8KTL-M0

Phase 1

SSEG rating per phase (rpp)					
	At 45-55% of rated output 1,33kW		100% of rated output 2,66kW		
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic Limit in BS EN61000-3-2 in [A]
2nd	0,024	0,207	0,029	0,249	1,080
3rd	0,011	0,098	0,013	0,112	2,300
4th	0,015	0,128	0,016	0,134	0,430
5th	0,036	0,312	0,048	0,413	1,140
6th	0,010	0,088	0,017	0,150	0,300
7th	0,018	0,156	0,036	0,313	0,770
8th	0,009	0,079	0,009	0,079	0,230
9th	0,013	0,110	0,012	0,106	0,400
10th	0,012	0,107	0,010	0,082	0,184
11th	0,030	0,263	0,032	0,273	0,330
12th	0,011	0,097	0,014	0,119	0,153
13th	0,038	0,327	0,022	0,186	0,210
14th	0,012	0,105	0,009	0,075	0,131
15th	0,013	0,113	0,012	0,100	0,150
16th	0,011	0,097	0,009	0,077	0,115
17th	0,021	0,177	0,021	0,178	0,132
18th	0,011	0,094	0,012	0,107	0,102
19th	0,014	0,121	0,020	0,176	0,118
20th	0,013	0,115	0,011	0,096	0,092
21th	0,011	0,098	0,011	0,097	0,107
22th	0,009	0,080	0,010	0,086	0,084
23th	0,011	0,095	0,008	0,073	0,098
24th	0,009	0,074	0,008	0,071	0,077
25th	0,013	0,114	0,014	0,121	0,090
26th	0,011	0,094	0,013	0,109	0,071
27th	0,010	0,083	0,010	0,087	0,083
28th	0,006	0,052	0,008	0,073	0,066
29th	0,008	0,067	0,006	0,055	0,078
30th	0,007	0,058	0,007	0,058	0,061
31th	0,006	0,053	0,007	0,058	0,073
32th	0,008	0,068	0,010	0,089	0,058
33th	0,008	0,066	0,008	0,072	0,068
34th	0,005	0,046	0,007	0,061	0,054
35th	0,008	0,065	0,007	0,063	0,064
36th	0,007	0,057	0,008	0,069	0,051
37th	0,007	0,061	0,014	0,125	0,061
38th	0,006	0,049	0,007	0,058	0,048
39th	0,007	0,056	0,008	0,066	0,058
40th	0,005	0,042	0,006	0,052	0,046

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Power Quality. Harmonics.
SUN2000-8KTL-M0
Phase 2

SSEG rating per phase (rpp)					
	At 45-55% of rated output 1,33kW		100% of rated output 2,66kW		
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic Limit in BS EN61000-3-2 in [A]
2nd	0,030	0,263	0,040	0,347	1,080
3rd	0,024	0,210	0,018	0,151	2,300
4th	0,015	0,130	0,019	0,165	0,430
5th	0,039	0,335	0,054	0,463	1,140
6th	0,012	0,103	0,014	0,120	0,300
7th	0,019	0,164	0,054	0,467	0,770
8th	0,012	0,107	0,012	0,100	0,230
9th	0,015	0,127	0,021	0,177	0,400
10th	0,014	0,123	0,012	0,107	0,184
11th	0,029	0,250	0,027	0,229	0,330
12th	0,014	0,125	0,013	0,116	0,153
13th	0,039	0,335	0,028	0,239	0,210
14th	0,014	0,120	0,011	0,096	0,131
15th	0,013	0,112	0,015	0,127	0,150
16th	0,012	0,107	0,011	0,096	0,115
17th	0,018	0,154	0,019	0,167	0,132
18th	0,014	0,122	0,011	0,097	0,102
19th	0,019	0,162	0,016	0,136	0,118
20th	0,015	0,127	0,012	0,104	0,092
21th	0,015	0,129	0,019	0,166	0,107
22th	0,010	0,088	0,011	0,092	0,084
23th	0,012	0,102	0,010	0,088	0,098
24th	0,011	0,094	0,010	0,085	0,077
25th	0,013	0,110	0,011	0,092	0,090
26th	0,013	0,109	0,012	0,107	0,071
27th	0,010	0,089	0,012	0,107	0,083
28th	0,009	0,079	0,010	0,085	0,066
29th	0,009	0,073	0,011	0,091	0,078
30th	0,009	0,075	0,009	0,079	0,061
31th	0,009	0,078	0,009	0,078	0,073
32th	0,010	0,084	0,011	0,098	0,058
33th	0,009	0,078	0,012	0,103	0,068
34th	0,008	0,070	0,009	0,076	0,054
35th	0,009	0,076	0,012	0,100	0,064
36th	0,009	0,079	0,009	0,079	0,051
37th	0,009	0,080	0,013	0,116	0,061
38th	0,008	0,069	0,009	0,075	0,048
39th	0,010	0,087	0,012	0,106	0,058
40th	0,008	0,071	0,009	0,076	0,046

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Power Quality. Harmonics.
SUN2000-8KTL-M0
Phase 3

SSEG rating per phase (rpp)					
	At 45-55% of rated output 1,33kW		100% of rated output 2,66kW		
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic Limit in BS EN61000-3-2 in [A]
2nd	0,036	0,309	0,046	0,398	1,080
3rd	0,030	0,262	0,029	0,252	2,300
4th	0,015	0,131	0,021	0,182	0,430
5th	0,040	0,346	0,040	0,341	1,140
6th	0,014	0,117	0,016	0,141	0,300
7th	0,023	0,202	0,042	0,366	0,770
8th	0,015	0,127	0,013	0,112	0,230
9th	0,014	0,121	0,017	0,149	0,400
10th	0,014	0,125	0,013	0,116	0,184
11th	0,023	0,197	0,038	0,327	0,330
12th	0,013	0,114	0,014	0,124	0,153
13th	0,029	0,253	0,023	0,201	0,210
14th	0,014	0,123	0,011	0,098	0,131
15th	0,013	0,116	0,012	0,107	0,150
16th	0,014	0,121	0,011	0,096	0,115
17th	0,024	0,210	0,022	0,190	0,132
18th	0,012	0,106	0,013	0,113	0,102
19th	0,016	0,136	0,021	0,177	0,118
20th	0,014	0,121	0,013	0,110	0,092
21th	0,014	0,120	0,016	0,140	0,107
22th	0,012	0,106	0,011	0,095	0,084
23th	0,013	0,111	0,010	0,086	0,098
24th	0,010	0,087	0,010	0,088	0,077
25th	0,013	0,113	0,013	0,110	0,090
26th	0,012	0,100	0,012	0,108	0,071
27th	0,010	0,090	0,010	0,088	0,083
28th	0,010	0,084	0,010	0,083	0,066
29th	0,011	0,093	0,011	0,091	0,078
30th	0,010	0,083	0,009	0,075	0,061
31th	0,009	0,077	0,010	0,088	0,073
32th	0,009	0,075	0,011	0,092	0,058
33th	0,009	0,079	0,010	0,090	0,068
34th	0,008	0,072	0,009	0,076	0,054
35th	0,010	0,085	0,009	0,082	0,064
36th	0,010	0,083	0,009	0,081	0,051
37th	0,009	0,075	0,013	0,113	0,061
38th	0,008	0,068	0,009	0,074	0,048
39th	0,009	0,082	0,012	0,103	0,058
40th	0,009	0,074	0,009	0,077	0,046

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-10KTL-M0

Phase 1

SSEG rating per phase (rpp)					
	At 45-55% of rated output 1,66kW		100% of rated output 3,33kW		
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic Limit in BS EN61000-3-2 in [A]
2nd	0,030	0,204	0,043	0,297	1,080
3rd	0,012	0,083	0,019	0,134	2,300
4th	0,016	0,111	0,015	0,103	0,430
5th	0,027	0,188	0,037	0,258	1,140
6th	0,013	0,088	0,015	0,105	0,300
7th	0,010	0,070	0,013	0,088	0,770
8th	0,011	0,077	0,014	0,099	0,230
9th	0,013	0,087	0,020	0,141	0,400
10th	0,012	0,082	0,013	0,090	0,184
11th	0,035	0,242	0,044	0,302	0,330
12th	0,013	0,090	0,016	0,109	0,153
13th	0,033	0,225	0,022	0,149	0,210
14th	0,009	0,063	0,011	0,079	0,131
15th	0,012	0,084	0,019	0,132	0,150
16th	0,010	0,070	0,013	0,087	0,115
17th	0,016	0,112	0,024	0,163	0,132
18th	0,011	0,075	0,016	0,111	0,102
19th	0,023	0,159	0,020	0,141	0,118
20th	0,010	0,070	0,010	0,068	0,092
21th	0,010	0,069	0,017	0,115	0,107
22th	0,008	0,057	0,012	0,083	0,084
23th	0,011	0,077	0,015	0,104	0,098
24th	0,010	0,069	0,014	0,100	0,077
25th	0,008	0,058	0,012	0,083	0,090
26th	0,012	0,080	0,012	0,081	0,071
27th	0,008	0,055	0,013	0,089	0,083
28th	0,007	0,047	0,009	0,065	0,066
29th	0,008	0,052	0,012	0,083	0,078
30th	0,007	0,048	0,011	0,076	0,061
31th	0,008	0,058	0,015	0,103	0,073
32th	0,011	0,074	0,011	0,073	0,058
33th	0,006	0,043	0,011	0,079	0,068
34th	0,006	0,038	0,007	0,048	0,054
35th	0,006	0,045	0,011	0,078	0,064
36th	0,007	0,051	0,009	0,060	0,051
37th	0,010	0,070	0,013	0,088	0,061
38th	0,008	0,057	0,008	0,053	0,048
39th	0,006	0,041	0,009	0,064	0,058
40th	0,005	0,033	0,007	0,045	0,046

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-10KTL-M0

Phase 2

SSEG rating per phase (rpp)					
	At 45-55% of rated output 1,66kW		100% of rated output 3,33kW		
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic Limit in BS EN61000-3-2 in [A]
2nd	0,034	0,233	0,047	0,325	1,080
3rd	0,024	0,168	0,033	0,230	2,300
4th	0,016	0,107	0,016	0,107	0,430
5th	0,024	0,166	0,040	0,278	1,140
6th	0,013	0,090	0,016	0,113	0,300
7th	0,020	0,135	0,023	0,162	0,770
8th	0,013	0,090	0,017	0,116	0,230
9th	0,018	0,125	0,027	0,187	0,400
10th	0,013	0,091	0,013	0,090	0,184
11th	0,035	0,243	0,056	0,389	0,330
12th	0,014	0,099	0,015	0,105	0,153
13th	0,033	0,226	0,021	0,144	0,210
14th	0,011	0,075	0,013	0,090	0,131
15th	0,013	0,090	0,022	0,153	0,150
16th	0,012	0,083	0,014	0,095	0,115
17th	0,011	0,079	0,023	0,162	0,132
18th	0,014	0,094	0,015	0,106	0,102
19th	0,026	0,179	0,019	0,128	0,118
20th	0,012	0,081	0,012	0,082	0,092
21th	0,011	0,078	0,018	0,124	0,107
22th	0,011	0,076	0,015	0,101	0,084
23th	0,012	0,082	0,015	0,106	0,098
24th	0,012	0,082	0,015	0,104	0,077
25th	0,010	0,068	0,013	0,089	0,090
26th	0,013	0,087	0,014	0,096	0,071
27th	0,011	0,075	0,016	0,110	0,083
28th	0,009	0,065	0,012	0,084	0,066
29th	0,009	0,065	0,012	0,082	0,078
30th	0,010	0,067	0,013	0,089	0,061
31th	0,010	0,067	0,015	0,101	0,073
32th	0,012	0,086	0,013	0,092	0,058
33th	0,010	0,069	0,012	0,083	0,068
34th	0,008	0,058	0,009	0,065	0,054
35th	0,010	0,066	0,016	0,113	0,064
36th	0,009	0,064	0,011	0,074	0,051
37th	0,011	0,075	0,015	0,100	0,061
38th	0,011	0,075	0,010	0,071	0,048
39th	0,010	0,070	0,015	0,102	0,058
40th	0,008	0,054	0,009	0,061	0,046

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-10KTL-M0

Phase 3

SSEG rating per phase (rpp)					
	At 45-55% of rated output 1,66kW		100% of rated output 3,33kW		
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic Limit in BS EN61000-3-2 in [A]
2nd	0,039	0,271	0,054	0,370	1,080
3rd	0,032	0,220	0,044	0,303	2,300
4th	0,018	0,124	0,015	0,106	0,430
5th	0,029	0,197	0,043	0,296	1,140
6th	0,015	0,104	0,018	0,124	0,300
7th	0,016	0,112	0,023	0,158	0,770
8th	0,015	0,103	0,017	0,115	0,230
9th	0,015	0,105	0,021	0,146	0,400
10th	0,015	0,107	0,014	0,096	0,184
11th	0,030	0,204	0,053	0,366	0,330
12th	0,015	0,105	0,017	0,117	0,153
13th	0,026	0,180	0,021	0,142	0,210
14th	0,012	0,080	0,013	0,090	0,131
15th	0,013	0,089	0,019	0,128	0,150
16th	0,014	0,094	0,013	0,092	0,115
17th	0,015	0,104	0,025	0,175	0,132
18th	0,015	0,103	0,017	0,116	0,102
19th	0,020	0,141	0,019	0,130	0,118
20th	0,012	0,084	0,013	0,092	0,092
21th	0,012	0,084	0,017	0,114	0,107
22th	0,010	0,071	0,013	0,091	0,084
23th	0,016	0,112	0,020	0,137	0,098
24th	0,013	0,087	0,015	0,104	0,077
25th	0,013	0,088	0,014	0,099	0,090
26th	0,013	0,090	0,014	0,099	0,071
27th	0,011	0,075	0,014	0,097	0,083
28th	0,009	0,063	0,012	0,083	0,066
29th	0,009	0,065	0,016	0,110	0,078
30th	0,010	0,066	0,013	0,088	0,061
31th	0,010	0,069	0,014	0,094	0,073
32th	0,012	0,081	0,012	0,082	0,058
33th	0,009	0,065	0,011	0,076	0,068
34th	0,008	0,055	0,010	0,072	0,054
35th	0,010	0,066	0,017	0,114	0,064
36th	0,010	0,067	0,011	0,075	0,051
37th	0,010	0,066	0,014	0,098	0,061
38th	0,010	0,066	0,010	0,069	0,048
39th	0,010	0,068	0,014	0,096	0,058
40th	0,008	0,058	0,010	0,068	0,046

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-12KTL-M0

Phase 1

SSEG rating per phase (rpp)						
	At 45-55% of rated output 2,0kW		100% of rated output 4,0kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,033	0,190	0,046	0,262	8%	8%
3rd	0,012	0,070	0,022	0,125	21,6%	N/A
4th	0,016	0,091	0,010	0,059	4%	4%
5th	0,029	0,166	0,099	0,568	10,7%	10,7%
6th	0,015	0,088	0,015	0,087	2,67%	2,67%
7th	0,018	0,103	0,048	0,278	7,2%	7,2%
8th	0,011	0,065	0,011	0,062	2%	2%
9th	0,012	0,072	0,015	0,089	3,8%	N/A
10th	0,012	0,071	0,011	0,062	1,6%	1,6%
11th	0,038	0,217	0,030	0,174	3,1%	3,1%
12th	0,015	0,084	0,014	0,083	1,33%	1,33%
13th	0,024	0,138	0,029	0,168	2%	2%
14th	0,009	0,050	0,014	0,080	N/A	N/A
15th	0,012	0,070	0,014	0,082	N/A	N/A
16th	0,009	0,055	0,011	0,063	N/A	N/A
17th	0,020	0,116	0,028	0,162	N/A	N/A
18th	0,012	0,071	0,014	0,078	N/A	N/A
19th	0,029	0,168	0,022	0,124	N/A	N/A
20th	0,010	0,055	0,014	0,083	N/A	N/A
21th	0,011	0,064	0,012	0,067	N/A	N/A
22th	0,008	0,048	0,008	0,049	N/A	N/A
23th	0,011	0,063	0,017	0,096	N/A	N/A
24th	0,010	0,060	0,012	0,068	N/A	N/A
25th	0,009	0,054	0,010	0,055	N/A	N/A
26th	0,012	0,067	0,011	0,061	N/A	N/A
27th	0,008	0,049	0,009	0,053	N/A	N/A
28th	0,007	0,039	0,005	0,030	N/A	N/A
29th	0,008	0,045	0,012	0,068	N/A	N/A
30th	0,008	0,043	0,009	0,050	N/A	N/A
31th	0,008	0,044	0,007	0,039	N/A	N/A
32th	0,011	0,063	0,006	0,036	N/A	N/A
33th	0,007	0,038	0,006	0,037	N/A	N/A
34th	0,006	0,035	0,005	0,027	N/A	N/A
35th	0,007	0,040	0,006	0,037	N/A	N/A
36th	0,007	0,039	0,008	0,048	N/A	N/A
37th	0,006	0,036	0,007	0,039	N/A	N/A
38th	0,008	0,049	0,005	0,029	N/A	N/A
39th	0,006	0,035	0,005	0,030	N/A	N/A
40th	0,005	0,029	0,005	0,030	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-12KTL-M0

Phase 2

SSEG rating per phase (rpp)						
	At 45-55% of rated output 2,0kW		100% of rated output 4,0kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,037	0,213	0,051	0,295	8%	8%
3rd	0,021	0,121	0,023	0,132	21,6%	N/A
4th	0,016	0,094	0,018	0,103	4%	4%
5th	0,023	0,134	0,111	0,640	10,7%	10,7%
6th	0,014	0,078	0,013	0,073	2,67%	2,67%
7th	0,032	0,185	0,065	0,375	7,2%	7,2%
8th	0,013	0,077	0,012	0,069	2%	2%
9th	0,020	0,113	0,020	0,117	3,8%	N/A
10th	0,013	0,076	0,014	0,079	1,6%	1,6%
11th	0,037	0,214	0,015	0,085	3,1%	3,1%
12th	0,015	0,084	0,016	0,091	1,33%	1,33%
13th	0,024	0,137	0,035	0,204	2%	2%
14th	0,011	0,063	0,015	0,086	N/A	N/A
15th	0,014	0,081	0,015	0,083	N/A	N/A
16th	0,012	0,067	0,013	0,076	N/A	N/A
17th	0,018	0,102	0,022	0,125	N/A	N/A
18th	0,014	0,078	0,016	0,090	N/A	N/A
19th	0,027	0,156	0,024	0,139	N/A	N/A
20th	0,011	0,066	0,016	0,093	N/A	N/A
21th	0,016	0,090	0,014	0,078	N/A	N/A
22th	0,011	0,065	0,011	0,064	N/A	N/A
23th	0,011	0,066	0,016	0,095	N/A	N/A
24th	0,012	0,069	0,013	0,073	N/A	N/A
25th	0,014	0,082	0,013	0,075	N/A	N/A
26th	0,013	0,074	0,013	0,073	N/A	N/A
27th	0,010	0,059	0,011	0,062	N/A	N/A
28th	0,010	0,057	0,009	0,051	N/A	N/A
29th	0,010	0,058	0,014	0,082	N/A	N/A
30th	0,010	0,059	0,010	0,055	N/A	N/A
31th	0,009	0,051	0,012	0,069	N/A	N/A
32th	0,013	0,075	0,009	0,052	N/A	N/A
33th	0,009	0,054	0,009	0,053	N/A	N/A
34th	0,008	0,049	0,008	0,044	N/A	N/A
35th	0,010	0,058	0,009	0,053	N/A	N/A
36th	0,009	0,054	0,010	0,055	N/A	N/A
37th	0,010	0,055	0,012	0,071	N/A	N/A
38th	0,011	0,063	0,008	0,045	N/A	N/A
39th	0,012	0,069	0,008	0,048	N/A	N/A
40th	0,008	0,045	0,008	0,048	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-12KTL-M0

Phase 3

SSEG rating per phase (rpp)						
	At 45-55% of rated output 2,0kW		100% of rated output 4,0kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,043	0,247	0,058	0,336	8%	8%
3rd	0,032	0,181	0,043	0,245	21,6%	N/A
4th	0,018	0,106	0,014	0,080	4%	4%
5th	0,023	0,134	0,097	0,559	10,7%	10,7%
6th	0,016	0,092	0,017	0,098	2,67%	2,67%
7th	0,022	0,126	0,050	0,288	7,2%	7,2%
8th	0,015	0,084	0,014	0,083	2%	2%
9th	0,017	0,100	0,019	0,111	3,8%	N/A
10th	0,016	0,093	0,014	0,080	1,6%	1,6%
11th	0,037	0,215	0,028	0,163	3,1%	3,1%
12th	0,017	0,096	0,013	0,076	1,33%	1,33%
13th	0,023	0,132	0,021	0,119	2%	2%
14th	0,011	0,066	0,017	0,095	N/A	N/A
15th	0,013	0,074	0,015	0,088	N/A	N/A
16th	0,013	0,074	0,013	0,077	N/A	N/A
17th	0,013	0,076	0,035	0,200	N/A	N/A
18th	0,016	0,092	0,014	0,078	N/A	N/A
19th	0,022	0,127	0,019	0,107	N/A	N/A
20th	0,012	0,069	0,016	0,090	N/A	N/A
21th	0,014	0,081	0,014	0,082	N/A	N/A
22th	0,010	0,060	0,011	0,065	N/A	N/A
23th	0,014	0,081	0,023	0,133	N/A	N/A
24th	0,013	0,074	0,013	0,073	N/A	N/A
25th	0,012	0,069	0,012	0,070	N/A	N/A
26th	0,014	0,078	0,012	0,070	N/A	N/A
27th	0,010	0,060	0,010	0,059	N/A	N/A
28th	0,009	0,051	0,009	0,053	N/A	N/A
29th	0,012	0,067	0,016	0,090	N/A	N/A
30th	0,010	0,059	0,012	0,067	N/A	N/A
31th	0,010	0,060	0,012	0,068	N/A	N/A
32th	0,012	0,071	0,009	0,050	N/A	N/A
33th	0,010	0,055	0,009	0,052	N/A	N/A
34th	0,008	0,047	0,008	0,045	N/A	N/A
35th	0,009	0,053	0,009	0,050	N/A	N/A
36th	0,009	0,052	0,011	0,062	N/A	N/A
37th	0,008	0,048	0,011	0,063	N/A	N/A
38th	0,010	0,058	0,008	0,046	N/A	N/A
39th	0,011	0,066	0,008	0,046	N/A	N/A
40th	0,008	0,049	0,009	0,050	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-15KTL-M0

Phase 1

SSEG rating per phase (rpp)						
	At 45-55% of rated output 2,5kW		100% of rated output 5,0kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,034	0,158	0,057	0,260	8%	8%
3rd	0,013	0,061	0,026	0,119	21,6%	N/A
4th	0,013	0,058	0,017	0,080	4%	4%
5th	0,043	0,197	0,124	0,573	10,7%	10,7%
6th	0,016	0,073	0,026	0,121	2,67%	2,67%
7th	0,027	0,124	0,054	0,249	7,2%	7,2%
8th	0,016	0,074	0,020	0,093	2%	2%
9th	0,009	0,044	0,013	0,059	3,8%	N/A
10th	0,010	0,046	0,015	0,070	1,6%	1,6%
11th	0,031	0,144	0,027	0,125	3,1%	3,1%
12th	0,016	0,073	0,024	0,109	1,33%	1,33%
13th	0,013	0,059	0,033	0,151	2%	2%
14th	0,018	0,082	0,020	0,091	N/A	N/A
15th	0,009	0,041	0,011	0,049	N/A	N/A
16th	0,008	0,038	0,013	0,060	N/A	N/A
17th	0,023	0,107	0,027	0,126	N/A	N/A
18th	0,016	0,074	0,020	0,092	N/A	N/A
19th	0,024	0,108	0,028	0,129	N/A	N/A
20th	0,016	0,073	0,019	0,086	N/A	N/A
21th	0,009	0,042	0,009	0,043	N/A	N/A
22th	0,008	0,038	0,011	0,052	N/A	N/A
23th	0,010	0,047	0,019	0,089	N/A	N/A
24th	0,015	0,069	0,016	0,076	N/A	N/A
25th	0,016	0,074	0,013	0,059	N/A	N/A
26th	0,012	0,057	0,016	0,075	N/A	N/A
27th	0,008	0,036	0,009	0,040	N/A	N/A
28th	0,007	0,031	0,010	0,044	N/A	N/A
29th	0,007	0,033	0,014	0,065	N/A	N/A
30th	0,013	0,062	0,014	0,064	N/A	N/A
31th	0,008	0,035	0,009	0,041	N/A	N/A
32th	0,009	0,043	0,013	0,060	N/A	N/A
33th	0,006	0,027	0,007	0,032	N/A	N/A
34th	0,007	0,031	0,009	0,040	N/A	N/A
35th	0,006	0,026	0,009	0,041	N/A	N/A
36th	0,012	0,056	0,013	0,058	N/A	N/A
37th	0,007	0,033	0,011	0,050	N/A	N/A
38th	0,007	0,033	0,010	0,044	N/A	N/A
39th	0,006	0,026	0,006	0,028	N/A	N/A
40th	0,007	0,031	0,008	0,037	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-15KTL-M0

Phase 2

SSEG rating per phase (rpp)						
	At 45-55% of rated output 2,5kW		100% of rated output 5,0kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,039	0,178	0,063	0,292	8%	8%
3rd	0,017	0,077	0,022	0,100	21,6%	N/A
4th	0,016	0,072	0,022	0,101	4%	4%
5th	0,045	0,205	0,140	0,643	10,7%	10,7%
6th	0,015	0,068	0,026	0,121	2,67%	2,67%
7th	0,044	0,201	0,070	0,323	7,2%	7,2%
8th	0,018	0,082	0,021	0,098	2%	2%
9th	0,020	0,093	0,019	0,086	3,8%	N/A
10th	0,012	0,057	0,017	0,079	1,6%	1,6%
11th	0,031	0,142	0,013	0,059	3,1%	3,1%
12th	0,016	0,074	0,025	0,115	1,33%	1,33%
13th	0,020	0,090	0,037	0,170	2%	2%
14th	0,019	0,086	0,021	0,095	N/A	N/A
15th	0,013	0,062	0,013	0,059	N/A	N/A
16th	0,010	0,046	0,014	0,064	N/A	N/A
17th	0,022	0,101	0,018	0,082	N/A	N/A
18th	0,017	0,077	0,021	0,098	N/A	N/A
19th	0,020	0,091	0,026	0,119	N/A	N/A
20th	0,016	0,075	0,020	0,090	N/A	N/A
21th	0,020	0,091	0,013	0,062	N/A	N/A
22th	0,009	0,042	0,012	0,055	N/A	N/A
23th	0,010	0,047	0,017	0,079	N/A	N/A
24th	0,015	0,070	0,018	0,081	N/A	N/A
25th	0,013	0,059	0,012	0,057	N/A	N/A
26th	0,013	0,060	0,017	0,078	N/A	N/A
27th	0,010	0,048	0,010	0,047	N/A	N/A
28th	0,009	0,042	0,011	0,050	N/A	N/A
29th	0,010	0,044	0,014	0,066	N/A	N/A
30th	0,014	0,063	0,015	0,068	N/A	N/A
31th	0,010	0,047	0,012	0,056	N/A	N/A
32th	0,010	0,048	0,014	0,064	N/A	N/A
33th	0,009	0,043	0,009	0,044	N/A	N/A
34th	0,009	0,041	0,010	0,045	N/A	N/A
35th	0,009	0,043	0,012	0,054	N/A	N/A
36th	0,013	0,059	0,014	0,063	N/A	N/A
37th	0,010	0,046	0,015	0,071	N/A	N/A
38th	0,009	0,041	0,011	0,051	N/A	N/A
39th	0,009	0,043	0,011	0,048	N/A	N/A
40th	0,009	0,042	0,010	0,046	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-15KTL-M0

Phase 3

SSEG rating per phase (rpp)						
	At 45-55% of rated output 2,5kW		100% of rated output 5,0kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,045	0,206	0,069	0,317	8%	8%
3rd	0,031	0,144	0,042	0,194	21,6%	N/A
4th	0,016	0,075	0,020	0,092	4%	4%
5th	0,033	0,154	0,124	0,570	10,7%	10,7%
6th	0,017	0,080	0,026	0,121	2,67%	2,67%
7th	0,033	0,151	0,058	0,265	7,2%	7,2%
8th	0,019	0,089	0,022	0,099	2%	2%
9th	0,017	0,080	0,016	0,073	3,8%	N/A
10th	0,013	0,061	0,018	0,083	1,6%	1,6%
11th	0,038	0,174	0,025	0,114	3,1%	3,1%
12th	0,016	0,073	0,023	0,107	1,33%	1,33%
13th	0,017	0,080	0,022	0,099	2%	2%
14th	0,019	0,088	0,021	0,096	N/A	N/A
15th	0,011	0,049	0,012	0,056	N/A	N/A
16th	0,011	0,049	0,015	0,068	N/A	N/A
17th	0,022	0,102	0,033	0,152	N/A	N/A
18th	0,016	0,072	0,020	0,092	N/A	N/A
19th	0,021	0,096	0,022	0,101	N/A	N/A
20th	0,017	0,078	0,020	0,090	N/A	N/A
21th	0,016	0,073	0,014	0,065	N/A	N/A
22th	0,009	0,044	0,013	0,059	N/A	N/A
23th	0,009	0,043	0,026	0,121	N/A	N/A
24th	0,014	0,064	0,017	0,077	N/A	N/A
25th	0,013	0,061	0,013	0,059	N/A	N/A
26th	0,014	0,063	0,017	0,080	N/A	N/A
27th	0,009	0,042	0,009	0,042	N/A	N/A
28th	0,009	0,042	0,011	0,052	N/A	N/A
29th	0,012	0,054	0,019	0,087	N/A	N/A
30th	0,013	0,061	0,014	0,066	N/A	N/A
31th	0,010	0,046	0,011	0,050	N/A	N/A
32th	0,011	0,051	0,015	0,067	N/A	N/A
33th	0,008	0,038	0,009	0,040	N/A	N/A
34th	0,009	0,039	0,010	0,047	N/A	N/A
35th	0,009	0,043	0,013	0,062	N/A	N/A
36th	0,013	0,059	0,013	0,059	N/A	N/A
37th	0,008	0,037	0,012	0,055	N/A	N/A
38th	0,009	0,043	0,012	0,055	N/A	N/A
39th	0,009	0,041	0,010	0,045	N/A	N/A
40th	0,009	0,043	0,010	0,048	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-17KTL-M0

Phase 1

SSEG rating per phase (rpp)						
	At 45-55% of rated output 2,83kW		100% of rated output 5,66kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,034	0,137	0,045	0,181	8%	8%
3rd	0,014	0,059	0,024	0,098	21,6%	N/A
4th	0,016	0,064	0,020	0,079	4%	4%
5th	0,053	0,214	0,145	0,589	10,7%	10,7%
6th	0,019	0,077	0,028	0,112	2,67%	2,67%
7th	0,031	0,126	0,057	0,231	7,2%	7,2%
8th	0,018	0,071	0,022	0,089	2%	2%
9th	0,010	0,040	0,014	0,055	3,8%	N/A
10th	0,012	0,048	0,016	0,065	1,6%	1,6%
11th	0,028	0,116	0,031	0,124	3,1%	3,1%
12th	0,017	0,071	0,025	0,100	1,33%	1,33%
13th	0,017	0,067	0,032	0,132	2%	2%
14th	0,019	0,077	0,023	0,092	N/A	N/A
15th	0,008	0,034	0,011	0,044	N/A	N/A
16th	0,009	0,038	0,013	0,054	N/A	N/A
17th	0,025	0,101	0,027	0,109	N/A	N/A
18th	0,016	0,067	0,021	0,085	N/A	N/A
19th	0,016	0,067	0,026	0,104	N/A	N/A
20th	0,017	0,069	0,022	0,090	N/A	N/A
21th	0,009	0,035	0,010	0,040	N/A	N/A
22th	0,009	0,036	0,012	0,049	N/A	N/A
23th	0,011	0,045	0,020	0,083	N/A	N/A
24th	0,015	0,060	0,018	0,071	N/A	N/A
25th	0,016	0,066	0,014	0,058	N/A	N/A
26th	0,013	0,052	0,020	0,082	N/A	N/A
27th	0,008	0,032	0,009	0,037	N/A	N/A
28th	0,007	0,029	0,010	0,042	N/A	N/A
29th	0,008	0,031	0,018	0,073	N/A	N/A
30th	0,013	0,053	0,015	0,060	N/A	N/A
31th	0,011	0,043	0,009	0,038	N/A	N/A
32th	0,010	0,040	0,016	0,065	N/A	N/A
33th	0,006	0,026	0,007	0,030	N/A	N/A
34th	0,007	0,028	0,010	0,040	N/A	N/A
35th	0,005	0,020	0,012	0,049	N/A	N/A
36th	0,012	0,049	0,013	0,054	N/A	N/A
37th	0,006	0,025	0,009	0,035	N/A	N/A
38th	0,008	0,034	0,012	0,049	N/A	N/A
39th	0,006	0,024	0,007	0,027	N/A	N/A
40th	0,006	0,025	0,009	0,038	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-17KTL-M0

Phase 2

SSEG rating per phase (rpp)						
	At 45-55% of rated output 2,83kW		100% of rated output 5,66kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,043	0,174	0,058	0,234	8%	8%
3rd	0,016	0,063	0,030	0,123	21,6%	N/A
4th	0,018	0,075	0,023	0,095	4%	4%
5th	0,060	0,243	0,162	0,658	10,7%	10,7%
6th	0,017	0,068	0,028	0,112	2,67%	2,67%
7th	0,050	0,201	0,076	0,307	7,2%	7,2%
8th	0,018	0,074	0,021	0,087	2%	2%
9th	0,020	0,082	0,020	0,081	3,8%	N/A
10th	0,014	0,056	0,016	0,064	1,6%	1,6%
11th	0,024	0,099	0,019	0,078	3,1%	3,1%
12th	0,017	0,070	0,026	0,107	1,33%	1,33%
13th	0,026	0,104	0,038	0,154	2%	2%
14th	0,019	0,077	0,022	0,088	N/A	N/A
15th	0,013	0,053	0,014	0,056	N/A	N/A
16th	0,011	0,045	0,013	0,054	N/A	N/A
17th	0,023	0,092	0,017	0,067	N/A	N/A
18th	0,017	0,068	0,023	0,092	N/A	N/A
19th	0,016	0,065	0,023	0,095	N/A	N/A
20th	0,017	0,069	0,021	0,086	N/A	N/A
21th	0,019	0,077	0,016	0,064	N/A	N/A
22th	0,009	0,037	0,012	0,050	N/A	N/A
23th	0,012	0,047	0,019	0,075	N/A	N/A
24th	0,015	0,060	0,019	0,076	N/A	N/A
25th	0,012	0,049	0,011	0,043	N/A	N/A
26th	0,014	0,056	0,019	0,076	N/A	N/A
27th	0,012	0,050	0,010	0,042	N/A	N/A
28th	0,009	0,038	0,012	0,050	N/A	N/A
29th	0,009	0,036	0,016	0,064	N/A	N/A
30th	0,013	0,054	0,016	0,065	N/A	N/A
31th	0,010	0,039	0,011	0,045	N/A	N/A
32th	0,011	0,047	0,016	0,064	N/A	N/A
33th	0,010	0,039	0,011	0,043	N/A	N/A
34th	0,009	0,036	0,010	0,042	N/A	N/A
35th	0,010	0,042	0,011	0,046	N/A	N/A
36th	0,012	0,050	0,014	0,059	N/A	N/A
37th	0,010	0,041	0,013	0,055	N/A	N/A
38th	0,010	0,040	0,012	0,050	N/A	N/A
39th	0,012	0,048	0,013	0,055	N/A	N/A
40th	0,009	0,036	0,010	0,042	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-17KTL-M0

Phase 3

SSEG rating per phase (rpp)						
	At 45-55% of rated output 2,83kW		100% of rated output 5,66kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,048	0,193	0,062	0,251	8%	8%
3rd	0,032	0,129	0,047	0,189	21,6%	N/A
4th	0,019	0,076	0,020	0,080	4%	4%
5th	0,046	0,187	0,150	0,610	10,7%	10,7%
6th	0,021	0,084	0,029	0,116	2,67%	2,67%
7th	0,038	0,155	0,064	0,259	7,2%	7,2%
8th	0,019	0,078	0,023	0,095	2%	2%
9th	0,018	0,072	0,016	0,065	3,8%	N/A
10th	0,015	0,059	0,018	0,072	1,6%	1,6%
11th	0,034	0,139	0,021	0,085	3,1%	3,1%
12th	0,019	0,075	0,025	0,102	1,33%	1,33%
13th	0,017	0,070	0,020	0,079	2%	2%
14th	0,019	0,077	0,023	0,094	N/A	N/A
15th	0,011	0,045	0,013	0,052	N/A	N/A
16th	0,011	0,044	0,014	0,058	N/A	N/A
17th	0,027	0,111	0,030	0,122	N/A	N/A
18th	0,018	0,071	0,022	0,090	N/A	N/A
19th	0,018	0,072	0,017	0,068	N/A	N/A
20th	0,017	0,068	0,022	0,089	N/A	N/A
21th	0,016	0,065	0,016	0,063	N/A	N/A
22th	0,010	0,040	0,012	0,049	N/A	N/A
23th	0,011	0,046	0,028	0,113	N/A	N/A
24th	0,015	0,062	0,019	0,079	N/A	N/A
25th	0,013	0,054	0,013	0,053	N/A	N/A
26th	0,014	0,055	0,020	0,079	N/A	N/A
27th	0,010	0,043	0,010	0,040	N/A	N/A
28th	0,009	0,035	0,012	0,047	N/A	N/A
29th	0,010	0,042	0,023	0,092	N/A	N/A
30th	0,014	0,055	0,017	0,068	N/A	N/A
31th	0,011	0,045	0,012	0,048	N/A	N/A
32th	0,011	0,046	0,016	0,065	N/A	N/A
33th	0,009	0,035	0,010	0,039	N/A	N/A
34th	0,008	0,034	0,011	0,044	N/A	N/A
35th	0,011	0,043	0,016	0,067	N/A	N/A
36th	0,013	0,052	0,015	0,061	N/A	N/A
37th	0,009	0,037	0,011	0,045	N/A	N/A
38th	0,010	0,040	0,012	0,050	N/A	N/A
39th	0,010	0,042	0,012	0,049	N/A	N/A
40th	0,009	0,036	0,011	0,044	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-20KTL-M0

Phase 1

SSEG rating per phase (rpp)						
	At 45-55% of rated output 3,33kW		100% of rated output 6,66kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,041	0,141	0,082	0,282	8%	8%
3rd	0,015	0,053	0,027	0,092	21,6%	N/A
4th	0,014	0,049	0,013	0,044	4%	4%
5th	0,064	0,222	0,172	0,594	10,7%	10,7%
6th	0,019	0,065	0,022	0,076	2,67%	2,67%
7th	0,041	0,141	0,067	0,231	7,2%	7,2%
8th	0,019	0,065	0,011	0,036	2%	2%
9th	0,010	0,034	0,019	0,064	3,8%	N/A
10th	0,012	0,041	0,010	0,034	1,6%	1,6%
11th	0,024	0,082	0,033	0,113	3,1%	3,1%
12th	0,018	0,062	0,015	0,052	1,33%	1,33%
13th	0,025	0,087	0,031	0,107	2%	2%
14th	0,021	0,071	0,012	0,041	N/A	N/A
15th	0,009	0,032	0,018	0,062	N/A	N/A
16th	0,010	0,035	0,012	0,041	N/A	N/A
17th	0,023	0,078	0,028	0,097	N/A	N/A
18th	0,017	0,059	0,009	0,031	N/A	N/A
19th	0,015	0,051	0,025	0,087	N/A	N/A
20th	0,019	0,067	0,011	0,036	N/A	N/A
21th	0,008	0,028	0,017	0,059	N/A	N/A
22th	0,009	0,031	0,012	0,040	N/A	N/A
23th	0,011	0,039	0,020	0,070	N/A	N/A
24th	0,016	0,055	0,009	0,032	N/A	N/A
25th	0,010	0,033	0,013	0,046	N/A	N/A
26th	0,016	0,054	0,011	0,039	N/A	N/A
27th	0,007	0,025	0,014	0,049	N/A	N/A
28th	0,008	0,027	0,008	0,029	N/A	N/A
29th	0,007	0,022	0,018	0,063	N/A	N/A
30th	0,014	0,048	0,012	0,040	N/A	N/A
31th	0,010	0,033	0,012	0,042	N/A	N/A
32th	0,012	0,040	0,008	0,027	N/A	N/A
33th	0,006	0,022	0,011	0,037	N/A	N/A
34th	0,008	0,026	0,009	0,030	N/A	N/A
35th	0,005	0,019	0,015	0,051	N/A	N/A
36th	0,012	0,042	0,013	0,047	N/A	N/A
37th	0,005	0,018	0,017	0,059	N/A	N/A
38th	0,009	0,032	0,009	0,032	N/A	N/A
39th	0,006	0,020	0,008	0,029	N/A	N/A
40th	0,007	0,024	0,007	0,024	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.
SUN2000-20KTL-M0
Phase 2

SSEG rating per phase (rpp)						
	At 45-55% of rated output 3,33kW		100% of rated output 6,66kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,045	0,156	0,086	0,295	8%	8%
3rd	0,019	0,066	0,042	0,144	21,6%	N/A
4th	0,017	0,060	0,020	0,070	4%	4%
5th	0,077	0,265	0,194	0,669	10,7%	10,7%
6th	0,018	0,063	0,014	0,049	2,67%	2,67%
7th	0,059	0,205	0,086	0,295	7,2%	7,2%
8th	0,019	0,066	0,014	0,048	2%	2%
9th	0,019	0,066	0,023	0,079	3,8%	N/A
10th	0,014	0,048	0,013	0,043	1,6%	1,6%
11th	0,019	0,066	0,021	0,074	3,1%	3,1%
12th	0,019	0,066	0,013	0,047	1,33%	1,33%
13th	0,033	0,115	0,037	0,129	2%	2%
14th	0,020	0,070	0,015	0,052	N/A	N/A
15th	0,013	0,046	0,020	0,067	N/A	N/A
16th	0,012	0,040	0,014	0,049	N/A	N/A
17th	0,022	0,076	0,021	0,071	N/A	N/A
18th	0,019	0,064	0,014	0,047	N/A	N/A
19th	0,018	0,061	0,023	0,079	N/A	N/A
20th	0,018	0,063	0,014	0,048	N/A	N/A
21th	0,015	0,050	0,020	0,069	N/A	N/A
22th	0,010	0,034	0,015	0,051	N/A	N/A
23th	0,014	0,047	0,018	0,064	N/A	N/A
24th	0,017	0,060	0,012	0,042	N/A	N/A
25th	0,009	0,031	0,012	0,040	N/A	N/A
26th	0,015	0,051	0,011	0,036	N/A	N/A
27th	0,012	0,040	0,015	0,053	N/A	N/A
28th	0,009	0,032	0,014	0,047	N/A	N/A
29th	0,009	0,032	0,015	0,051	N/A	N/A
30th	0,015	0,053	0,011	0,039	N/A	N/A
31th	0,008	0,028	0,013	0,046	N/A	N/A
32th	0,012	0,042	0,010	0,036	N/A	N/A
33th	0,009	0,031	0,016	0,055	N/A	N/A
34th	0,009	0,030	0,010	0,036	N/A	N/A
35th	0,009	0,030	0,013	0,044	N/A	N/A
36th	0,014	0,049	0,012	0,041	N/A	N/A
37th	0,009	0,030	0,018	0,061	N/A	N/A
38th	0,010	0,034	0,012	0,042	N/A	N/A
39th	0,010	0,035	0,013	0,046	N/A	N/A
40th	0,009	0,030	0,010	0,034	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

Nr. PVUK190424N048-1

Power Quality. Harmonics.

SUN2000-20KTL-M0

Phase 3

SSEG rating per phase (rpp)						
	At 45-55% of rated output 3,33kW		100% of rated output 6,66kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Harmonic %	
					Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,052	0,179	0,092	0,316	8%	8%
3rd	0,037	0,129	0,057	0,197	21,6%	N/A
4th	0,017	0,059	0,015	0,050	4%	4%
5th	0,063	0,219	0,185	0,640	10,7%	10,7%
6th	0,021	0,072	0,023	0,080	2,67%	2,67%
7th	0,047	0,160	0,073	0,251	7,2%	7,2%
8th	0,020	0,069	0,015	0,053	2%	2%
9th	0,016	0,057	0,021	0,072	3,8%	N/A
10th	0,014	0,050	0,013	0,044	1,6%	1,6%
11th	0,031	0,107	0,022	0,076	3,1%	3,1%
12th	0,019	0,064	0,014	0,050	1,33%	1,33%
13th	0,020	0,071	0,019	0,067	2%	2%
14th	0,021	0,071	0,015	0,052	N/A	N/A
15th	0,011	0,037	0,019	0,064	N/A	N/A
16th	0,012	0,040	0,013	0,043	N/A	N/A
17th	0,031	0,105	0,031	0,109	N/A	N/A
18th	0,018	0,064	0,012	0,042	N/A	N/A
19th	0,017	0,058	0,017	0,057	N/A	N/A
20th	0,019	0,065	0,013	0,045	N/A	N/A
21th	0,014	0,048	0,019	0,065	N/A	N/A
22th	0,010	0,035	0,012	0,043	N/A	N/A
23th	0,017	0,059	0,026	0,091	N/A	N/A
24th	0,017	0,060	0,013	0,046	N/A	N/A
25th	0,012	0,041	0,014	0,048	N/A	N/A
26th	0,015	0,053	0,011	0,038	N/A	N/A
27th	0,011	0,037	0,014	0,048	N/A	N/A
28th	0,009	0,032	0,012	0,041	N/A	N/A
29th	0,009	0,032	0,022	0,075	N/A	N/A
30th	0,015	0,052	0,014	0,047	N/A	N/A
31th	0,011	0,038	0,014	0,048	N/A	N/A
32th	0,013	0,044	0,010	0,036	N/A	N/A
33th	0,009	0,030	0,013	0,046	N/A	N/A
34th	0,009	0,031	0,011	0,037	N/A	N/A
35th	0,009	0,031	0,018	0,063	N/A	N/A
36th	0,013	0,045	0,015	0,053	N/A	N/A
37th	0,009	0,031	0,015	0,051	N/A	N/A
38th	0,011	0,037	0,012	0,040	N/A	N/A
39th	0,010	0,034	0,013	0,043	N/A	N/A
40th	0,009	0,031	0,010	0,035	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

Nr. PVUK190424N048-1

Power Quality. Power factor.				
SUN2000-8KTL-M0				
Output power	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within ±1,5% of the stated level during the test.
20%	0,9999	0,9999	0,9999	
50%	0,9843	0,9847	0,9869	
75%	0,9929	0,9932	0,9943	
100%	0,9958	0,9962	0,9970	
Limit	>0,95	>0,95	>0,95	
SUN2000-20KTL-M0				
Output power	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within ±1,5% of the stated level during the test.
20%	0,9847	0,9847	0,9871	
50%	0,9986	0,9987	0,9981	
75%	0,9993	0,9994	0,9995	
100%	0,9996	0,9998	0,9998	
Limit	>0,95	>0,95	>0,95	

Power Quality. Voltage fluctuation and Flicker.								
SUN2000-8KTL-M0								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values at test impedance	0%	0%	0%	0%	0%	0%	0,07	0,07
Normalised to standard impedance	0%	0%	0%	0%	0%	0%	0,07	0,07
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
SUN2000-20KTL-M0								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values at test impedance	0%	0%	0%	0%	0%	0%	0,07	0,07
Normalised to standard impedance	0%	0%	0%	0%	0%	0%	0,07	0,07
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	0,24* 0,4^	Ω	XI	0,15* 0,25	Ω		
Standard impedance	R	0,24* 0,4^	Ω	XI	0,15* 0,25^	Ω		
Maximum impedance	R	0,24	Ω	XI	0,1	Ω		

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Power Quality. DC injection.			
SUN2000-8KTL-M0			
Phase 1			
Test level power [%]	10	55	100
Recorded value [mA]	6	8	7
Recorded value [%]	0,052	0,069	0,060
Limit [%]	0,25	0,25	0,25
Phase 2			
Test level power [%]	10	55	100
Recorded value [mA]	10	10	10
Recorded value [%]	0,086	0,086	0,086
Limit [%]	0,25	0,25	0,25
Phase 3			
Test level power [%]	10	55	100
Recorded value [mA]	10	10	10
Recorded value [%]	0,086	0,086	0,086
Limit [%]	0,25	0,25	0,25
SUN2000-20KTL-M0			
Phase 1			
Test level power [%]	10	55	100
Recorded value [mA]	6	10	18
Recorded value [%]	0,021	0,035	0,062
Limit [%]	0,25	0,25	0,25
Phase 2			
Test level power [%]	10	55	100
Recorded value [mA]	10	10	30
Recorded value [%]	0,035	0,035	0,104
Limit [%]	0,25	0,25	0,25
Phase 3			
Test level power [%]	10	55	100
Recorded value [mA]	10	10	20
Recorded value [%]	0,035	0,035	0,069
Limit [%]	0,25	0,25	0,25

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

Fault level Contribution.
Phase 1

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	61,02V	24,43A
Initial Value of aperiodic current	A	N/A	100ms	48,66V	24,81A
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]	0,074	

Phase 2

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	39,20V	26,61A
Initial Value of aperiodic current	A	N/A	100ms	42,39V	24,76A
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]	0,075	

Phase 3

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	62,48V	18,07A
Initial Value of aperiodic current	A	N/A	100ms	50,00V	23,35A
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]	0,079	

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.

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

Extract from test report according to the Engineering Recommendation G99

Nr. PVUK190424N048-1

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 (No solid state switching device)

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