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Certificate of compliance

Applicant: SolarEdge Technologies Ltd.
1 HaMada Street
Herzliya 4673335
Israel

Product: Photovoltaic (PV) inverter

Model: SE33.3K
SE30K
SE27.6K
SE25K
SE20K

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, 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 V VDE V 0126-1-1:2006 (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: 19TH0534-G99/1_3

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

Certificate number: U23-0680

Date of issue: 2023-08-09

Certification body



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

Testing laboratory accredited according to DIN EN ISO/IEC 17025

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

Nr. 19TH0534-G99/1_3

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

PGM Technology:	Photovoltaic (PV) inverter		
Manufacturer / applicant:	SolarEdge Technologies Ltd.		
Address:	1 HaMada Street Herzliya 4673335 Israel		
Tel	+972-9-957-6620	Fax:	+972-9-957-6591
Email:	info@solaredge.com	Website:	www.solaredge.com

Rated values	SE20K	SE25K	SE27.6K	SE30K
MPP DC voltage range [V]	680 – 1000	680 – 1000	680 – 1000	680 – 1000
Input DC voltage range [V]	29,0	36,25	40,0	43,5
Input DC current [A]	220/230 Vac, L-N 380/400 Vac, L-L	220/230 Vac, L-N 380/400 Vac, L-L	220/230 Vac, L-N 380/400 Vac, L-L	220/230 Vac, L-N 380/400 Vac, L-L
Output AC voltage [V]	29,0	36,25	40	43,5
Output AC current [A]	20001	25000	27600	30000
Output power [VA]	20001	25000	27600	30000

Rated values	SE33.3K	--	--	--
MPP DC voltage range [V]	680 – 1000	--	--	--
Input DC voltage range [V]	48,25	--	--	--
Input DC current [A]	220/230 Vac, L-N 380/400 Vac, L-L	--	--	--
Output AC voltage [V]	48,25	--	--	--
Output AC current [A]	33300	--	--	--
Output power [VA]	33300	--	--	--

Firmware version	Main DSP software version is 1.20 Aux DSP software version is 2.20
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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 inverters of the SExx.xK series consist of following models: SE33.3K, SE30K, SE27.6K, SE25K and SE20K. All the models use the same hardware and software. The different powers between SE20K, SE25K, SE27.6k SE30K and SE33.3K is realized by software derating. The all models are equipped with four DC input.

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.

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Operating Range.

Test 1	Voltage = 85% of nominal (195,5V) Frequency = 47,0 Hz Power Factor = 1 Period of test 20 s
Connection:	Always connected
Limit:	Always connected
Test 2	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 3	Voltage = 110% of nominal (253,0 V) Frequency = 51,5Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 4	Voltage = 110% of nominal (253,0 V) Frequency = 52,0 Hz Power Factor = 1 Period of test 15 minutes
Connection:	Always connected
Limit:	Always connected
Test 5	Voltage = 100% of nominal (230,0 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 500 ms. Note that this is not expected to be demonstrated on site.
Connection:	Always connected
Limit:	Always connected



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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	184,0	2,5	183,6	2,578	188,0 V / 5,0 s	No trip
					180,0 V / 2,45 s	No trip
O/V stage 1	262,2	1,0	262,1	1,078	258,2 V 5,0 s	No trip
O/V stage 2	273,7	0,5	273,7	0,578	269,7 V 0,95s	No trip
					277,7 V 0,45 s	No trip

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	184,0	2,5	183,2	2,578	188,0 V / 5,0 s	No trip
					180,0 V / 2,45 s	No trip
O/V stage 1	262,2	1,0	261,9	1,072	258,2 V 5,0 s	No trip
O/V stage 2	273,7	0,5	273,5	0,572	269,7 V 0,95 s	No trip
					277,7 V 0,45 s	No trip



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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	184,0	2,5	183,5	2,571	188,0 V / 5,0 s	No trip
					180,0 V / 2,45 s	No trip
O/V stage 1	262,2	1,0	262,1	1,065	258,2 V / 5,0 s	No trip
O/V stage 2	273,7	0,5	273,5	0,565	269,7 V / 0,95 s	No trip
					277,7 V / 0,45 s	No trip

Note. For Voltage tests the Voltage required to trip is the setting $\pm 3,45$ V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ± 4 V 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	20,0	47,50	20,083	47,7 Hz / 30 s	No trip
U/F stage 2	47,0	0,5	46,99	0,592	47,2 Hz / 19,5 s	No trip
					46,8 Hz / 0,45 s	No trip
O/F stage 2	52,0	0,5	52,0	0,578	51,8 Hz / 120 s	No trip
					52,2 Hz / 0,45 s	No trip

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



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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]	0,132	0,150	0,274	0,172	0,097	0,193

Note. Trip time limit is 0,5 s.

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

20 s

Measured delay

35,0 s

Under Voltage

Time delay setting

20 s

Measured delay

37,0 s

Over Frequency

Time delay setting

20 s

Measured delay

35,5 s

Under Frequency

Time delay setting

20 s

Measured delay

34,0 s

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

At 266,2 V

At 180,0 V

At 47,4 Hz

At 52,1 Hz

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	+0,95 Hz/sec	2,1s	No trip
Negative Frequency drift	51,0 to 49,0	-0,95 Hz/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% Pn							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P_{expected} [kW]:	33096	32725	31076	28105	31085	32741	33124
P_{measured} [kW]:	33100	32755	31101	28120	31101	32755	33100
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_{expected} [kW]:	16764	16437	14779	11797	14778	16434	24950
P_{measured} [kW]:	16764	16418	14765	11785	14764	16418	19400

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	49,50	48,00	47,60	41,00
Active power [kW]:	32841	32850	32862	32870	32881	32884
ΔP/P_{max} [%]:		0,03	0,07	0,10	0,11	0,13

Note.

No Power reduction takes place for electronic inverter



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Power Quality. Harmonics.

Phase 1

Generating Unit rating per phase (rpp)		SE25K				
At 45-55% of rated output 4201 W		100% of rated output 8364 W				
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	0,04	0,100	0,04	0,110	8%	8%
3rd	0,05	0,140	0,05	0,130	21,6%	N/A
4th	0,02	0,050	0,02	0,060	4%	4%
5th	0,19	0,510	0,15	0,420	10,7%	10,7%
6th	0,02	0,050	0,02	0,040	2,67%	2,67%
7th	0,13	0,350	0,11	0,300	7,2%	7,2%
8th	0,01	0,040	0,01	0,040	2%	2%
9th	0,04	0,110	0,04	0,100	3,8%	N/A
10th	0,01	0,030	0,01	0,030	1,6%	1,6%
11th	0,10	0,270	0,10	0,270	3,1%	3,1%
12th	0,01	0,030	0,01	0,030	1,33%	1,33%
13th	0,06	0,180	0,05	0,150	2%	2%
14th	0,01	0,030	0,01	0,030	N/A	N/A
15th	0,02	0,070	0,03	0,070	N/A	N/A
16th	0,01	0,030	0,01	0,030	N/A	N/A
17th	0,05	0,130	0,04	0,120	N/A	N/A
18th	0,01	0,020	0,01	0,020	N/A	N/A
19th	0,03	0,090	0,03	0,070	N/A	N/A
20th	0,01	0,030	0,01	0,030	N/A	N/A
21th	0,01	0,020	0,01	0,020	N/A	N/A
22th	0,01	0,020	0,01	0,020	N/A	N/A
23th	0,02	0,060	0,02	0,050	N/A	N/A
24th	0,01	0,020	0,01	0,020	N/A	N/A
25th	0,01	0,040	0,01	0,030	N/A	N/A
26th	0,01	0,020	0,01	0,020	N/A	N/A
27th	0,00	0,010	0,01	0,010	N/A	N/A
28th	0,01	0,020	0,01	0,020	N/A	N/A
29th	0,01	0,030	0,01	0,020	N/A	N/A
30th	0,01	0,020	0,01	0,020	N/A	N/A
31th	0,01	0,010	0,01	0,020	N/A	N/A
32th	0,01	0,020	0,01	0,020	N/A	N/A
33th	0,01	0,020	0,01	0,010	N/A	N/A
34th	0,01	0,020	0,01	0,020	N/A	N/A
35th	0,01	0,020	0,01	0,020	N/A	N/A
36th	0,00	0,010	0,01	0,010	N/A	N/A
37th	0,01	0,010	0,01	0,030	N/A	N/A
38th	0,01	0,020	0,01	0,020	N/A	N/A
39th	0,00	0,010	0,00	0,010	N/A	N/A
40th	0,01	0,020	0,01	0,020	N/A	N/A
THD ₄₀ [%]	0,76		0,67		23%	13%
PWHD [%]	0,009		0,009		23%	22%



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Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 2

Generating Unit rating per phase (rpp)		SE25K				
At 45-55% of rated output 4179 W		100% of rated output 8340 W				
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	0,05	0,130	0,08	0,05	8%	8%
3rd	0,04	0,120	0,05	0,04	21,6%	N/A
4th	0,01	0,040	0,02	0,01	4%	4%
5th	0,16	0,450	0,14	0,16	10,7%	10,7%
6th	0,02	0,050	0,02	0,02	2,67%	2,67%
7th	0,11	0,300	0,09	0,11	7,2%	7,2%
8th	0,01	0,030	0,01	0,01	2%	2%
9th	0,03	0,100	0,04	0,03	3,8%	N/A
10th	0,01	0,030	0,01	0,01	1,6%	1,6%
11th	0,08	0,210	0,09	0,08	3,1%	3,1%
12th	0,01	0,040	0,01	0,01	1,33%	1,33%
13th	0,05	0,140	0,04	0,05	2%	2%
14th	0,01	0,030	0,01	0,01	N/A	N/A
15th	0,02	0,060	0,02	0,02	N/A	N/A
16th	0,01	0,030	0,01	0,01	N/A	N/A
17th	0,03	0,090	0,03	0,03	N/A	N/A
18th	0,01	0,030	0,01	0,01	N/A	N/A
19th	0,03	0,080	0,02	0,03	N/A	N/A
20th	0,01	0,020	0,01	0,01	N/A	N/A
21th	0,01	0,020	0,01	0,01	N/A	N/A
22th	0,01	0,020	0,01	0,01	N/A	N/A
23th	0,02	0,050	0,01	0,02	N/A	N/A
24th	0,01	0,020	0,01	0,01	N/A	N/A
25th	0,02	0,050	0,01	0,02	N/A	N/A
26th	0,01	0,020	0,01	0,01	N/A	N/A
27th	0,01	0,020	0,01	0,01	N/A	N/A
28th	0,01	0,020	0,01	0,01	N/A	N/A
29th	0,01	0,030	0,01	0,01	N/A	N/A
30th	0,01	0,020	0,01	0,01	N/A	N/A
31th	0,01	0,020	0,01	0,01	N/A	N/A
32th	0,01	0,020	0,01	0,01	N/A	N/A
33th	0,01	0,010	0,01	0,01	N/A	N/A
34th	0,01	0,020	0,01	0,01	N/A	N/A
35th	0,01	0,020	0,00	0,01	N/A	N/A
36th	0,01	0,010	0,00	0,01	N/A	N/A
37th	0,00	0,010	0,01	0,00	N/A	N/A
38th	0,01	0,020	0,01	0,01	N/A	N/A
39th	0,00	0,010	0,00	0,00	N/A	N/A
40th	0,01	0,020	0,01	0,01	N/A	N/A
THD ₄₀ [%]	0,62		0,62		23%	13%
PWHD [%]	0,008		0,001		23%	22%



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Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 3

Generating Unit rating per phase (rpp)		SE25K				
	At 45-55% of rated output 4208 W		100% of rated output 8392 W			
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	0,04	0,120	0,08	0,210	8%	8%
3rd	0,02	0,060	0,02	0,060	21,6%	N/A
4th	0,02	0,040	0,02	0,050	4%	4%
5th	0,15	0,400	0,11	0,300	10,7%	10,7%
6th	0,01	0,040	0,01	0,040	2,67%	2,67%
7th	0,13	0,360	0,11	0,310	7,2%	7,2%
8th	0,01	0,040	0,01	0,040	2%	2%
9th	0,01	0,030	0,01	0,030	3,8%	N/A
10th	0,01	0,030	0,01	0,030	1,6%	1,6%
11th	0,08	0,210	0,08	0,210	3,1%	3,1%
12th	0,01	0,030	0,01	0,020	1,33%	1,33%
13th	0,06	0,160	0,05	0,140	2%	2%
14th	0,01	0,030	0,01	0,030	N/A	N/A
15th	0,01	0,020	0,01	0,020	N/A	N/A
16th	0,01	0,030	0,01	0,020	N/A	N/A
17th	0,04	0,100	0,03	0,080	N/A	N/A
18th	0,01	0,020	0,01	0,020	N/A	N/A
19th	0,03	0,080	0,02	0,050	N/A	N/A
20th	0,01	0,030	0,01	0,030	N/A	N/A
21th	0,01	0,010	0,01	0,010	N/A	N/A
22th	0,01	0,020	0,01	0,020	N/A	N/A
23th	0,02	0,060	0,01	0,040	N/A	N/A
24th	0,01	0,020	0,01	0,020	N/A	N/A
25th	0,02	0,040	0,01	0,030	N/A	N/A
26th	0,01	0,020	0,01	0,030	N/A	N/A
27th	0,01	0,010	0,00	0,010	N/A	N/A
28th	0,01	0,020	0,01	0,020	N/A	N/A
29th	0,01	0,020	0,01	0,020	N/A	N/A
30th	0,00	0,010	0,00	0,010	N/A	N/A
31th	0,01	0,020	0,01	0,020	N/A	N/A
32th	0,01	0,020	0,01	0,020	N/A	N/A
33th	0,00	0,010	0,00	0,010	N/A	N/A
34th	0,01	0,020	0,01	0,020	N/A	N/A
35th	0,00	0,010	0,01	0,020	N/A	N/A
36th	0,00	0,010	0,00	0,010	N/A	N/A
37th	0,00	0,010	0,01	0,020	N/A	N/A
38th	0,01	0,020	0,01	0,020	N/A	N/A
39th	0,00	0,010	0,00	0,010	N/A	N/A
40th	0,01	0,020	0,01	0,020	N/A	N/A
THD ₄₀ [%]	0,65		0,57		23%	13%
PWHD [%]	0,008		0,001		23%	22%



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Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 1

Generating Unit rating per phase (rpp)		SE27.6K				
At 45-55% of rated output 4638 W		100% of rated output 9229 W				
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	0,04	0,091	0,04	0,099	8%	8%
3rd	0,05	0,125	0,05	0,125	21,6%	N/A
4th	0,02	0,040	0,02	0,049	4%	4%
5th	0,17	0,434	0,14	0,338	10,7%	10,7%
6th	0,02	0,040	0,02	0,039	2,67%	2,67%
7th	0,12	0,309	0,10	0,249	7,2%	7,2%
8th	0,01	0,032	0,01	0,034	2%	2%
9th	0,04	0,101	0,04	0,111	3,8%	N/A
10th	0,01	0,028	0,01	0,027	1,6%	1,6%
11th	0,09	0,233	0,10	0,240	3,1%	3,1%
12th	0,01	0,025	0,01	0,024	1,33%	1,33%
13th	0,06	0,147	0,05	0,128	2%	2%
14th	0,01	0,026	0,01	0,028	N/A	N/A
15th	0,02	0,059	0,03	0,065	N/A	N/A
16th	0,01	0,024	0,01	0,023	N/A	N/A
17th	0,04	0,107	0,05	0,119	N/A	N/A
18th	0,01	0,019	0,01	0,019	N/A	N/A
19th	0,03	0,076	0,03	0,063	N/A	N/A
20th	0,01	0,022	0,01	0,023	N/A	N/A
21th	0,01	0,022	0,01	0,024	N/A	N/A
22th	0,01	0,021	0,01	0,021	N/A	N/A
23th	0,02	0,045	0,02	0,042	N/A	N/A
24th	0,01	0,016	0,01	0,016	N/A	N/A
25th	0,01	0,032	0,01	0,034	N/A	N/A
26th	0,01	0,021	0,01	0,021	N/A	N/A
27th	0,01	0,013	0,01	0,014	N/A	N/A
28th	0,01	0,020	0,01	0,020	N/A	N/A
29th	0,01	0,023	0,01	0,018	N/A	N/A
30th	0,01	0,014	0,01	0,015	N/A	N/A
31th	0,01	0,013	0,01	0,026	N/A	N/A
32th	0,01	0,019	0,01	0,020	N/A	N/A
33th	0,01	0,014	0,01	0,014	N/A	N/A
34th	0,01	0,017	0,01	0,018	N/A	N/A
35th	0,01	0,021	0,01	0,020	N/A	N/A
36th	0,00	0,012	0,01	0,013	N/A	N/A
37th	0,01	0,015	0,01	0,026	N/A	N/A
38th	0,01	0,017	0,01	0,017	N/A	N/A
39th	0,00	0,010	0,00	0,011	N/A	N/A
40th	0,01	0,017	0,01	0,017	N/A	N/A
THD ₄₀ [%]	0,66		0,057		23%	13%
PWHD [%]	0,008		0,008		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 2

Generating Unit rating per phase (rpp)		SE27.6K				
At 45-55% of rated output 4615 W		100% of rated output 9203 W				
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	0,04	0,109	0,08	0,193	8%	8%
3rd	0,05	0,113	0,05	0,123	21,6%	N/A
4th	0,01	0,035	0,02	0,048	4%	4%
5th	0,16	0,391	0,13	0,319	10,7%	10,7%
6th	0,02	0,044	0,02	0,038	2,67%	2,67%
7th	0,10	0,258	0,09	0,237	7,2%	7,2%
8th	0,01	0,028	0,01	0,029	2%	2%
9th	0,04	0,093	0,05	0,114	3,8%	N/A
10th	0,01	0,026	0,01	0,027	1,6%	1,6%
11th	0,07	0,187	0,09	0,222	3,1%	3,1%
12th	0,01	0,031	0,01	0,026	1,33%	1,33%
13th	0,04	0,111	0,03	0,079	2%	2%
14th	0,01	0,023	0,01	0,024	N/A	N/A
15th	0,02	0,053	0,03	0,063	N/A	N/A
16th	0,01	0,023	0,01	0,023	N/A	N/A
17th	0,03	0,076	0,04	0,090	N/A	N/A
18th	0,01	0,023	0,01	0,020	N/A	N/A
19th	0,03	0,066	0,02	0,051	N/A	N/A
20th	0,01	0,020	0,01	0,021	N/A	N/A
21th	0,01	0,022	0,01	0,027	N/A	N/A
22th	0,01	0,021	0,01	0,022	N/A	N/A
23th	0,02	0,038	0,01	0,034	N/A	N/A
24th	0,01	0,019	0,01	0,017	N/A	N/A
25th	0,02	0,039	0,01	0,034	N/A	N/A
26th	0,01	0,019	0,01	0,019	N/A	N/A
27th	0,01	0,017	0,01	0,016	N/A	N/A
28th	0,01	0,019	0,01	0,021	N/A	N/A
29th	0,01	0,028	0,01	0,013	N/A	N/A
30th	0,01	0,015	0,01	0,015	N/A	N/A
31th	0,01	0,014	0,01	0,023	N/A	N/A
32th	0,01	0,018	0,01	0,019	N/A	N/A
33th	0,01	0,014	0,01	0,015	N/A	N/A
34th	0,01	0,018	0,01	0,019	N/A	N/A
35th	0,01	0,015	0,00	0,012	N/A	N/A
36th	0,00	0,012	0,00	0,012	N/A	N/A
37th	0,00	0,011	0,01	0,018	N/A	N/A
38th	0,01	0,017	0,01	0,017	N/A	N/A
39th	0,00	0,010	0,00	0,011	N/A	N/A
40th	0,01	0,017	0,01	0,018	N/A	N/A
THD ₄₀ [%]	0,58		0,56		23%	13%
PWHD [%]	0,007		0,007		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 3

Generating Unit rating per phase (rpp)		SE27.6K				
	At 45-55% of rated output 4646 W	100% of rated output 9258 W				
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	0,04	0,106	0,08	0,198	8%	8%
3rd	0,02	0,060	0,02	0,057	21,6%	N/A
4th	0,02	0,038	0,02	0,038	4%	4%
5th	0,13	0,329	0,10	0,245	10,7%	10,7%
6th	0,01	0,036	0,01	0,036	2,67%	2,67%
7th	0,13	0,318	0,11	0,275	7,2%	7,2%
8th	0,01	0,033	0,01	0,034	2%	2%
9th	0,01	0,025	0,02	0,040	3,8%	N/A
10th	0,01	0,028	0,01	0,028	1,6%	1,6%
11th	0,07	0,176	0,07	0,162	3,1%	3,1%
12th	0,01	0,024	0,01	0,022	1,33%	1,33%
13th	0,05	0,131	0,05	0,115	2%	2%
14th	0,01	0,027	0,01	0,027	N/A	N/A
15th	0,01	0,018	0,01	0,021	N/A	N/A
16th	0,01	0,023	0,01	0,022	N/A	N/A
17th	0,03	0,084	0,04	0,091	N/A	N/A
18th	0,01	0,018	0,01	0,017	N/A	N/A
19th	0,02	0,061	0,02	0,053	N/A	N/A
20th	0,01	0,023	0,01	0,024	N/A	N/A
21th	0,01	0,014	0,01	0,019	N/A	N/A
22th	0,01	0,020	0,01	0,020	N/A	N/A
23th	0,02	0,044	0,01	0,032	N/A	N/A
24th	0,01	0,015	0,01	0,013	N/A	N/A
25th	0,02	0,038	0,01	0,024	N/A	N/A
26th	0,01	0,021	0,01	0,022	N/A	N/A
27th	0,01	0,014	0,01	0,013	N/A	N/A
28th	0,01	0,019	0,01	0,019	N/A	N/A
29th	0,01	0,021	0,01	0,023	N/A	N/A
30th	0,00	0,012	0,00	0,012	N/A	N/A
31th	0,01	0,014	0,01	0,018	N/A	N/A
32th	0,01	0,020	0,01	0,020	N/A	N/A
33th	0,00	0,010	0,00	0,010	N/A	N/A
34th	0,01	0,017	0,01	0,017	N/A	N/A
35th	0,01	0,014	0,01	0,020	N/A	N/A
36th	0,00	0,010	0,00	0,010	N/A	N/A
37th	0,01	0,014	0,01	0,022	N/A	N/A
38th	0,01	0,018	0,01	0,018	N/A	N/A
39th	0,00	0,009	0,00	0,009	N/A	N/A
40th	0,01	0,017	0,01	0,017	N/A	N/A
THD ₄₀ [%]	0,55		0,49		23%	13%
PWHD [%]	0,007		0,007		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 1

Generating Unit rating per phase (rpp)		SE30K				
At 45-55% of rated output 5043 W		100% of rated output 10022 W				
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	0,03	0,080	0,05	0,110	8%	8%
3rd	0,05	0,109	0,05	0,120	21,6%	N/A
4th	0,02	0,039	0,02	0,050	4%	4%
5th	0,17	0,387	0,13	0,301	10,7%	10,7%
6th	0,02	0,037	0,02	0,038	2,67%	2,67%
7th	0,12	0,270	0,10	0,223	7,2%	7,2%
8th	0,01	0,032	0,01	0,031	2%	2%
9th	0,04	0,093	0,04	0,102	3,8%	N/A
10th	0,01	0,028	0,01	0,027	1,6%	1,6%
11th	0,09	0,210	0,10	0,229	3,1%	3,1%
12th	0,01	0,024	0,01	0,024	1,33%	1,33%
13th	0,06	0,129	0,05	0,116	2%	2%
14th	0,01	0,025	0,01	0,025	N/A	N/A
15th	0,02	0,053	0,03	0,065	N/A	N/A
16th	0,01	0,023	0,01	0,023	N/A	N/A
17th	0,04	0,095	0,05	0,112	N/A	N/A
18th	0,01	0,019	0,01	0,019	N/A	N/A
19th	0,03	0,066	0,03	0,063	N/A	N/A
20th	0,01	0,022	0,01	0,022	N/A	N/A
21th	0,01	0,019	0,01	0,022	N/A	N/A
22th	0,01	0,020	0,01	0,022	N/A	N/A
23th	0,02	0,039	0,02	0,046	N/A	N/A
24th	0,01	0,015	0,01	0,016	N/A	N/A
25th	0,01	0,025	0,01	0,034	N/A	N/A
26th	0,01	0,020	0,01	0,020	N/A	N/A
27th	0,00	0,011	0,01	0,013	N/A	N/A
28th	0,01	0,019	0,01	0,020	N/A	N/A
29th	0,01	0,017	0,01	0,019	N/A	N/A
30th	0,01	0,013	0,01	0,015	N/A	N/A
31th	0,00	0,011	0,01	0,027	N/A	N/A
32th	0,01	0,018	0,01	0,019	N/A	N/A
33th	0,01	0,012	0,01	0,013	N/A	N/A
34th	0,01	0,016	0,01	0,018	N/A	N/A
35th	0,01	0,018	0,01	0,019	N/A	N/A
36th	0,00	0,011	0,01	0,013	N/A	N/A
37th	0,01	0,014	0,01	0,025	N/A	N/A
38th	0,01	0,017	0,01	0,016	N/A	N/A
39th	0,00	0,008	0,00	0,010	N/A	N/A
40th	0,01	0,016	0,01	0,016	N/A	N/A
THD ₄₀ [%]	0,58		0,56		23%	13%
PWHD [%]	0,007		0,008		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 2

Generating Unit rating per phase (rpp)		SE30K				
	At 45-55% of rated output 5018 W		100% of rated output 9994 W			
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	0,05	0,106	0,09	0,202	8%	8%
3rd	0,04	0,103	0,05	0,117	21,6%	N/A
4th	0,01	0,033	0,02	0,047	4%	4%
5th	0,15	0,345	0,12	0,287	10,7%	10,7%
6th	0,02	0,043	0,02	0,039	2,67%	2,67%
7th	0,10	0,226	0,09	0,207	7,2%	7,2%
8th	0,01	0,025	0,01	0,028	2%	2%
9th	0,04	0,086	0,05	0,109	3,8%	N/A
10th	0,01	0,023	0,01	0,025	1,6%	1,6%
11th	0,07	0,167	0,09	0,207	3,1%	3,1%
12th	0,01	0,031	0,01	0,026	1,33%	1,33%
13th	0,04	0,094	0,03	0,079	2%	2%
14th	0,01	0,021	0,01	0,023	N/A	N/A
15th	0,02	0,048	0,03	0,061	N/A	N/A
16th	0,01	0,021	0,01	0,022	N/A	N/A
17th	0,03	0,066	0,04	0,089	N/A	N/A
18th	0,01	0,023	0,01	0,021	N/A	N/A
19th	0,02	0,056	0,02	0,044	N/A	N/A
20th	0,01	0,019	0,01	0,020	N/A	N/A
21th	0,01	0,018	0,01	0,025	N/A	N/A
22th	0,01	0,019	0,01	0,021	N/A	N/A
23th	0,01	0,030	0,02	0,035	N/A	N/A
24th	0,01	0,018	0,01	0,017	N/A	N/A
25th	0,01	0,033	0,01	0,034	N/A	N/A
26th	0,01	0,018	0,01	0,019	N/A	N/A
27th	0,01	0,013	0,01	0,013	N/A	N/A
28th	0,01	0,018	0,01	0,020	N/A	N/A
29th	0,01	0,022	0,01	0,012	N/A	N/A
30th	0,01	0,014	0,01	0,014	N/A	N/A
31th	0,00	0,011	0,01	0,023	N/A	N/A
32th	0,01	0,017	0,01	0,018	N/A	N/A
33th	0,01	0,012	0,01	0,014	N/A	N/A
34th	0,01	0,017	0,01	0,018	N/A	N/A
35th	0,01	0,013	0,00	0,011	N/A	N/A
36th	0,01	0,012	0,01	0,012	N/A	N/A
37th	0,00	0,010	0,01	0,017	N/A	N/A
38th	0,01	0,016	0,01	0,017	N/A	N/A
39th	0,00	0,009	0,00	0,010	N/A	N/A
40th	0,01	0,016	0,01	0,017	N/A	N/A
THD ₄₀ [%]	0,51		0,52		23%	13%
PWHD [%]	0,006		0,007		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 3

Generating Unit rating per phase (rpp)		SE30K				
At 45-55% of rated output 5053 W		100% of rated output 10058 W				
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	0,05	0,106	0,09	0,200	8%	8%
3rd	0,02	0,052	0,03	0,058	21,6%	N/A
4th	0,02	0,037	0,02	0,039	4%	4%
5th	0,13	0,298	0,09	0,212	10,7%	10,7%
6th	0,01	0,032	0,01	0,033	2,67%	2,67%
7th	0,12	0,280	0,11	0,241	7,2%	7,2%
8th	0,01	0,033	0,01	0,033	2%	2%
9th	0,01	0,021	0,01	0,030	3,8%	N/A
10th	0,01	0,026	0,01	0,027	1,6%	1,6%
11th	0,07	0,157	0,07	0,168	3,1%	3,1%
12th	0,01	0,021	0,01	0,020	1,33%	1,33%
13th	0,05	0,114	0,05	0,113	2%	2%
14th	0,01	0,026	0,01	0,027	N/A	N/A
15th	0,01	0,015	0,01	0,018	N/A	N/A
16th	0,01	0,022	0,01	0,022	N/A	N/A
17th	0,03	0,072	0,03	0,074	N/A	N/A
18th	0,01	0,016	0,01	0,015	N/A	N/A
19th	0,02	0,051	0,02	0,048	N/A	N/A
20th	0,01	0,022	0,01	0,024	N/A	N/A
21th	0,01	0,012	0,01	0,014	N/A	N/A
22th	0,01	0,019	0,01	0,020	N/A	N/A
23th	0,02	0,037	0,02	0,035	N/A	N/A
24th	0,01	0,013	0,01	0,012	N/A	N/A
25th	0,01	0,029	0,01	0,024	N/A	N/A
26th	0,01	0,020	0,01	0,022	N/A	N/A
27th	0,01	0,012	0,01	0,012	N/A	N/A
28th	0,01	0,018	0,01	0,019	N/A	N/A
29th	0,01	0,016	0,01	0,021	N/A	N/A
30th	0,00	0,011	0,00	0,010	N/A	N/A
31th	0,00	0,010	0,01	0,019	N/A	N/A
32th	0,01	0,018	0,01	0,020	N/A	N/A
33th	0,00	0,009	0,00	0,010	N/A	N/A
34th	0,01	0,017	0,01	0,017	N/A	N/A
35th	0,01	0,012	0,01	0,019	N/A	N/A
36th	0,00	0,009	0,00	0,009	N/A	N/A
37th	0,01	0,014	0,01	0,022	N/A	N/A
38th	0,01	0,017	0,01	0,018	N/A	N/A
39th	0,00	0,008	0,00	0,008	N/A	N/A
40th	0,01	0,016	0,01	0,016	N/A	N/A
THD ₄₀ [%]	0,49		0,46		23%	13%
PWHD [%]	0,006		0,006		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 1

Generating Unit rating per phase (rpp)		SE33.3K				
At 45-55% of rated output 5576 W		100% of rated output 10022 W				
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	0,04	0,080	0,03	0,068	8%	8%
3rd	0,05	0,097	0,05	0,107	21,6%	N/A
4th	0,02	0,032	0,03	0,053	4%	4%
5th	0,15	0,305	0,18	0,376	10,7%	10,7%
6th	0,02	0,034	0,02	0,032	2,67%	2,67%
7th	0,10	0,210	0,13	0,275	7,2%	7,2%
8th	0,01	0,028	0,02	0,044	2%	2%
9th	0,04	0,074	0,04	0,086	3,8%	N/A
10th	0,01	0,024	0,02	0,039	1,6%	1,6%
11th	0,08	0,176	0,11	0,238	3,1%	3,1%
12th	0,01	0,022	0,01	0,024	1,33%	1,33%
13th	0,05	0,103	0,06	0,127	2%	2%
14th	0,01	0,023	0,02	0,034	N/A	N/A
15th	0,02	0,040	0,02	0,051	N/A	N/A
16th	0,01	0,020	0,01	0,030	N/A	N/A
17th	0,04	0,073	0,05	0,109	N/A	N/A
18th	0,01	0,017	0,01	0,019	N/A	N/A
19th	0,02	0,051	0,03	0,064	N/A	N/A
20th	0,01	0,020	0,01	0,026	N/A	N/A
21th	0,01	0,013	0,01	0,017	N/A	N/A
22th	0,01	0,018	0,01	0,024	N/A	N/A
23th	0,01	0,030	0,02	0,050	N/A	N/A
24th	0,01	0,014	0,01	0,016	N/A	N/A
25th	0,01	0,018	0,02	0,039	N/A	N/A
26th	0,01	0,018	0,01	0,020	N/A	N/A
27th	0,00	0,010	0,01	0,012	N/A	N/A
28th	0,01	0,016	0,01	0,020	N/A	N/A
29th	0,01	0,014	0,01	0,025	N/A	N/A
30th	0,01	0,012	0,01	0,014	N/A	N/A
31th	0,00	0,010	0,02	0,031	N/A	N/A
32th	0,01	0,016	0,01	0,017	N/A	N/A
33th	0,00	0,010	0,01	0,012	N/A	N/A
34th	0,01	0,015	0,01	0,016	N/A	N/A
35th	0,01	0,016	0,01	0,023	N/A	N/A
36th	0,01	0,011	0,01	0,011	N/A	N/A
37th	0,01	0,013	0,01	0,027	N/A	N/A
38th	0,01	0,015	0,01	0,013	N/A	N/A
39th	0,00	0,007	0,00	0,010	N/A	N/A
40th	0,01	0,014	0,01	0,014	N/A	N/A
THD ₄₀ [%]	0,47		0,59		23%	13%
PWHD [%]	0,006		0,008		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering
Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 2

Generating Unit rating per phase (rpp)		SE33.3K				
	At 45-55% of rated output 5553 W		100% of rated output 11042 W			
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	0,04	0,089	0,06	0,122	8%	8%
3rd	0,04	0,093	0,05	0,097	21,6%	N/A
4th	0,01	0,029	0,03	0,060	4%	4%
5th	0,12	0,258	0,17	0,360	10,7%	10,7%
6th	0,02	0,037	0,01	0,026	2,67%	2,67%
7th	0,09	0,182	0,13	0,264	7,2%	7,2%
8th	0,01	0,023	0,02	0,042	2%	2%
9th	0,04	0,079	0,04	0,090	3,8%	N/A
10th	0,01	0,021	0,02	0,042	1,6%	1,6%
11th	0,07	0,144	0,11	0,224	3,1%	3,1%
12th	0,01	0,026	0,01	0,021	1,33%	1,33%
13th	0,04	0,078	0,05	0,095	2%	2%
14th	0,01	0,019	0,01	0,031	N/A	N/A
15th	0,02	0,038	0,02	0,044	N/A	N/A
16th	0,01	0,018	0,02	0,032	N/A	N/A
17th	0,03	0,053	0,05	0,096	N/A	N/A
18th	0,01	0,020	0,01	0,017	N/A	N/A
19th	0,02	0,045	0,02	0,050	N/A	N/A
20th	0,01	0,017	0,01	0,023	N/A	N/A
21th	0,01	0,014	0,01	0,019	N/A	N/A
22th	0,01	0,017	0,01	0,026	N/A	N/A
23th	0,01	0,026	0,02	0,043	N/A	N/A
24th	0,01	0,016	0,01	0,015	N/A	N/A
25th	0,01	0,027	0,02	0,039	N/A	N/A
26th	0,01	0,016	0,01	0,018	N/A	N/A
27th	0,01	0,013	0,01	0,015	N/A	N/A
28th	0,01	0,016	0,01	0,022	N/A	N/A
29th	0,01	0,017	0,01	0,017	N/A	N/A
30th	0,01	0,013	0,01	0,013	N/A	N/A
31th	0,00	0,009	0,01	0,026	N/A	N/A
32th	0,01	0,015	0,01	0,015	N/A	N/A
33th	0,00	0,010	0,01	0,014	N/A	N/A
34th	0,01	0,015	0,01	0,017	N/A	N/A
35th	0,01	0,011	0,01	0,016	N/A	N/A
36th	0,00	0,010	0,01	0,011	N/A	N/A
37th	0,01	0,011	0,01	0,021	N/A	N/A
38th	0,01	0,014	0,01	0,012	N/A	N/A
39th	0,00	0,008	0,01	0,011	N/A	N/A
40th	0,01	0,015	0,01	0,014	N/A	N/A
THD ₄₀ [%]	0,41		0,57		23%	13%
PWHD [%]	0,005		0,009		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 3

Generating Unit rating per phase (rpp)		SE33.3K				
	At 45-55% of rated output 5591 W		100% of rated output 11106 W			
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	0,04	0,092	0,06	0,125	8%	8%
3rd	0,02	0,049	0,02	0,039	21,6%	N/A
4th	0,02	0,032	0,03	0,053	4%	4%
5th	0,10	0,217	0,14	0,296	10,7%	10,7%
6th	0,01	0,028	0,01	0,023	2,67%	2,67%
7th	0,10	0,212	0,14	0,297	7,2%	7,2%
8th	0,01	0,029	0,02	0,047	2%	2%
9th	0,01	0,019	0,01	0,024	3,8%	N/A
10th	0,01	0,024	0,02	0,037	1,6%	1,6%
11th	0,06	0,134	0,09	0,188	3,1%	3,1%
12th	0,01	0,018	0,01	0,017	1,33%	1,33%
13th	0,05	0,095	0,06	0,133	2%	2%
14th	0,01	0,023	0,02	0,036	N/A	N/A
15th	0,01	0,016	0,01	0,016	N/A	N/A
16th	0,01	0,020	0,01	0,027	N/A	N/A
17th	0,03	0,052	0,04	0,081	N/A	N/A
18th	0,01	0,013	0,01	0,014	N/A	N/A
19th	0,02	0,038	0,03	0,057	N/A	N/A
20th	0,01	0,020	0,01	0,028	N/A	N/A
21th	0,01	0,011	0,01	0,012	N/A	N/A
22th	0,01	0,017	0,01	0,021	N/A	N/A
23th	0,01	0,029	0,02	0,044	N/A	N/A
24th	0,01	0,011	0,01	0,011	N/A	N/A
25th	0,01	0,022	0,02	0,031	N/A	N/A
26th	0,01	0,017	0,01	0,023	N/A	N/A
27th	0,00	0,010	0,01	0,012	N/A	N/A
28th	0,01	0,016	0,01	0,018	N/A	N/A
29th	0,01	0,011	0,01	0,025	N/A	N/A
30th	0,00	0,009	0,00	0,010	N/A	N/A
31th	0,00	0,008	0,01	0,024	N/A	N/A
32th	0,01	0,016	0,01	0,020	N/A	N/A
33th	0,00	0,008	0,00	0,010	N/A	N/A
34th	0,01	0,015	0,01	0,013	N/A	N/A
35th	0,01	0,012	0,01	0,023	N/A	N/A
36th	0,00	0,008	0,00	0,009	N/A	N/A
37th	0,01	0,013	0,01	0,025	N/A	N/A
38th	0,01	0,014	0,01	0,016	N/A	N/A
39th	0,00	0,007	0,00	0,008	N/A	N/A
40th	0,01	0,015	0,01	0,012	N/A	N/A
THD ₄₀ [%]	0,38		0,52		23%	13%
PWHD [%]	0,005		0,007		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 1

Generating Unit rating per phase (rpp)		SE20K				
At 45-55% of rated output 3707 W		100% of rated output 6743 W				
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	16,072	54,916	29,266	100,000	8%	8%
3rd	0,076	0,259	0,143	0,488	21,6%	N/A
4th	0,033	0,114	0,051	0,176	4%	4%
5th	0,017	0,058	0,024	0,083	10,7%	10,7%
6th	0,158	0,540	0,124	0,422	2,67%	2,67%
7th	0,019	0,065	0,026	0,090	7,2%	7,2%
8th	0,109	0,374	0,087	0,296	2%	2%
9th	0,013	0,046	0,016	0,054	3,8%	N/A
10th	0,013	0,045	0,015	0,051	1,6%	1,6%
11th	0,011	0,038	0,011	0,038	3,1%	3,1%
12th	0,095	0,323	0,084	0,288	1,33%	1,33%
13th	0,011	0,036	0,013	0,045	2%	2%
14th	0,058	0,198	0,032	0,110	N/A	N/A
15th	0,011	0,037	0,012	0,040	N/A	N/A
16th	0,009	0,030	0,008	0,029	N/A	N/A
17th	0,010	0,033	0,009	0,030	N/A	N/A
18th	0,045	0,153	0,037	0,128	N/A	N/A
19th	0,008	0,027	0,009	0,030	N/A	N/A
20th	0,029	0,098	0,014	0,047	N/A	N/A
21th	0,009	0,031	0,009	0,032	N/A	N/A
22th	0,007	0,024	0,007	0,023	N/A	N/A
23th	0,008	0,028	0,008	0,027	N/A	N/A
24th	0,024	0,082	0,022	0,074	N/A	N/A
25th	0,006	0,021	0,007	0,024	N/A	N/A
26th	0,016	0,055	0,008	0,028	N/A	N/A
27th	0,008	0,028	0,008	0,028	N/A	N/A
28th	0,006	0,021	0,006	0,021	N/A	N/A
29th	0,008	0,026	0,007	0,025	N/A	N/A
30th	0,013	0,043	0,010	0,036	N/A	N/A
31th	0,005	0,018	0,006	0,020	N/A	N/A
32th	0,009	0,030	0,006	0,020	N/A	N/A
33th	0,007	0,025	0,008	0,026	N/A	N/A
34th	0,005	0,017	0,005	0,017	N/A	N/A
35th	0,007	0,024	0,007	0,023	N/A	N/A
36th	0,006	0,020	0,005	0,018	N/A	N/A
37th	0,005	0,015	0,005	0,016	N/A	N/A
38th	0,006	0,019	0,005	0,016	N/A	N/A
39th	0,007	0,024	0,007	0,024	N/A	N/A
40th	0,004	0,015	0,004	0,014	N/A	N/A
THD ₄₀ [%]	0,85		0,83		23%	13%
PWHD [%]	0,011		0,009		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 2

Generating Unit rating per phase (rpp)		SE20K				
At 45-55% of rated output 3684 W		100% of rated output 6692 W				
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	15,962	54,995	29,025	100,000	8%	8%
3rd	0,089	0,308	0,141	0,487	21,6%	N/A
4th	0,029	0,101	0,053	0,182	4%	4%
5th	0,018	0,062	0,033	0,113	10,7%	10,7%
6th	0,137	0,471	0,103	0,356	2,67%	2,67%
7th	0,019	0,065	0,022	0,076	7,2%	7,2%
8th	0,109	0,377	0,090	0,309	2%	2%
9th	0,012	0,040	0,013	0,046	3,8%	N/A
10th	0,013	0,044	0,012	0,040	1,6%	1,6%
11th	0,011	0,039	0,011	0,040	3,1%	3,1%
12th	0,082	0,283	0,073	0,250	1,33%	1,33%
13th	0,013	0,043	0,014	0,049	2%	2%
14th	0,054	0,186	0,032	0,109	N/A	N/A
15th	0,009	0,032	0,010	0,034	N/A	N/A
16th	0,011	0,039	0,009	0,029	N/A	N/A
17th	0,010	0,034	0,009	0,032	N/A	N/A
18th	0,040	0,138	0,032	0,110	N/A	N/A
19th	0,009	0,032	0,010	0,035	N/A	N/A
20th	0,027	0,092	0,014	0,049	N/A	N/A
21th	0,009	0,029	0,008	0,028	N/A	N/A
22th	0,008	0,027	0,006	0,022	N/A	N/A
23th	0,008	0,029	0,008	0,028	N/A	N/A
24th	0,021	0,071	0,017	0,058	N/A	N/A
25th	0,007	0,025	0,008	0,028	N/A	N/A
26th	0,015	0,052	0,008	0,028	N/A	N/A
27th	0,008	0,027	0,008	0,026	N/A	N/A
28th	0,006	0,021	0,005	0,019	N/A	N/A
29th	0,008	0,027	0,008	0,026	N/A	N/A
30th	0,009	0,032	0,007	0,025	N/A	N/A
31th	0,006	0,021	0,007	0,024	N/A	N/A
32th	0,008	0,026	0,005	0,016	N/A	N/A
33th	0,007	0,025	0,007	0,025	N/A	N/A
34th	0,005	0,018	0,005	0,017	N/A	N/A
35th	0,007	0,025	0,007	0,024	N/A	N/A
36th	0,005	0,017	0,004	0,015	N/A	N/A
37th	0,005	0,018	0,006	0,020	N/A	N/A
38th	0,005	0,018	0,004	0,015	N/A	N/A
39th	0,007	0,025	0,007	0,024	N/A	N/A
40th	0,005	0,016	0,004	0,015	N/A	N/A
THD ₄₀ [%]	0,81		0,79		23%	13%
PWHD [%]	0,010		0,008		23%	22%



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Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Harmonics.

Phase 3

Generating Unit rating per phase (rpp)		SE20K				
At 45-55% of rated output 3603 W		100% of rated output 6564 W				
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	15,602	54,821	28,460	100,000	8%	8%
3rd	0,053	0,186	0,087	0,304	21,6%	N/A
4th	0,030	0,104	0,025	0,086	4%	4%
5th	0,020	0,070	0,028	0,099	10,7%	10,7%
6th	0,149	0,524	0,111	0,392	2,67%	2,67%
7th	0,014	0,049	0,016	0,055	7,2%	7,2%
8th	0,112	0,394	0,088	0,310	2%	2%
9th	0,012	0,043	0,013	0,045	3,8%	N/A
10th	0,016	0,056	0,016	0,056	1,6%	1,6%
11th	0,010	0,037	0,012	0,041	3,1%	3,1%
12th	0,090	0,316	0,074	0,261	1,33%	1,33%
13th	0,009	0,032	0,009	0,033	2%	2%
14th	0,054	0,191	0,032	0,114	N/A	N/A
15th	0,010	0,034	0,010	0,036	N/A	N/A
16th	0,010	0,034	0,010	0,036	N/A	N/A
17th	0,009	0,031	0,009	0,032	N/A	N/A
18th	0,044	0,155	0,032	0,112	N/A	N/A
19th	0,007	0,026	0,008	0,027	N/A	N/A
20th	0,026	0,090	0,015	0,053	N/A	N/A
21th	0,008	0,028	0,008	0,029	N/A	N/A
22th	0,006	0,021	0,007	0,025	N/A	N/A
23th	0,008	0,028	0,008	0,029	N/A	N/A
24th	0,024	0,084	0,017	0,059	N/A	N/A
25th	0,006	0,022	0,006	0,022	N/A	N/A
26th	0,014	0,051	0,009	0,031	N/A	N/A
27th	0,007	0,026	0,007	0,025	N/A	N/A
28th	0,005	0,018	0,006	0,020	N/A	N/A
29th	0,007	0,025	0,008	0,027	N/A	N/A
30th	0,012	0,041	0,008	0,027	N/A	N/A
31th	0,006	0,019	0,006	0,020	N/A	N/A
32th	0,008	0,028	0,006	0,020	N/A	N/A
33th	0,007	0,024	0,007	0,024	N/A	N/A
34th	0,004	0,015	0,004	0,016	N/A	N/A
35th	0,007	0,024	0,007	0,024	N/A	N/A
36th	0,007	0,023	0,005	0,018	N/A	N/A
37th	0,005	0,017	0,005	0,018	N/A	N/A
38th	0,005	0,018	0,005	0,016	N/A	N/A
39th	0,007	0,024	0,006	0,022	N/A	N/A
40th	0,004	0,014	0,004	0,014	N/A	N/A
THD ₄₀ [%]	0,83		0,70		23%	13%
PWHD [%]	0,011		0,008		23%	22%



Annex to the G99/1 certificate of compliance No. U23-0680

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

Extract from test report according to the Engineering Recommendation G99

Nr. 19TH0534-G99/1_3

Power Quality. Power factor.

SE20K

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%	0,992	0,991	0,991	
50%	0,998	0,998	0,998	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	

Power Quality. Power factor.

SE25K

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%	0,993	0,992	0,992	
50%	0,999	0,999	0,999	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	

Power Quality. Power factor.

SE27.6K

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%	0,994	0,993	0,993	
50%	0,999	0,999	0,999	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	> 0,95	> 0,95	> 0,95	

Power Quality. Power factor.

SE30K

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%	216,2 V	230,0 V	253,0 V	
50%	0,996	0,995	0,995	
75%	0,999	0,999	0,999	
100%	1,000	1,000	1,000	
Limit	> 0,95	> 0,95	> 0,95	

Power Quality. Power factor.

SE33.3K

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%	0,997	0,996	0,995	
50%	0,999	0,999	1,000	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	



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Extract from test report according to the Engineering
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Power Quality. Voltage fluctuation and Flicker.

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values at test impedance	2,99	2,04	0,00	2,81	1,98	0,00	0,24	0,24
Measured values at standard impedance	3,34	2,28	0,00	3,14	2,28	0,00	0,27	0,27
Values for maximum impedance	4,00	2,73	0,00	3,76	2,73	0,00	0,32	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	0,19	Ω	XI	0,12	Ω		
	Z	0,23	Ω					
Standard impedance	R	0,24	Ω	XI	0,15	Ω		
	Z	0,25	Ω					
Maximum impedance	R	0,30	Ω	XI	0,26	Ω		
	Zmax	0,16	Ω					



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Power Quality. DC injection.

SE20K

Phase 1

Test level power [%]	10	55	100
Recorded value [mA]	-55,7	-60,1	-59,1
Recorded value [%]	-0,19	-0,21	-0,20
Limit [%]	0,25	0,25	0,25

Phase 2

Test level power [%]	10	55	100
Recorded value [mA]	14,0	11,4	20,4
Recorded value [%]	0,05	0,04	0,07
Limit [%]	0,25	0,25	0,25

Phase 3

Test level power [%]	10	55	100
Recorded value [mA]	17,5	22,1	21,0
Recorded value [%]	0,06	0,08	0,07
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.

Sum of all Phases

Tests are carried out at three defined power levels $\pm 5\%$. At 230 V a 20,0 kW three phase Inverter has a current output of 86,96 A so DC limit is 217,4 mA. These tests is 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%.

Sum of all Phases

Test level power [%]	10	55	100
Recorded value [mA]	-24,2	-26,6	-17,7
Recorded value [%]	-0,028	-0,031	-0,020
Limit [%]	0,25	0,25	0,25

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Extract from test report according to the Engineering Recommendation G99

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Power Quality. DC injection.

SE25K

Phase 1

Test level power [%]	10	55	100
Recorded value [mA]	-61,7	-65,5	-65,1
Recorded value [%]	-0,15	-0,16	-0,16
Limit [%]	0,25	0,25	0,25

Phase 2

Test level power [%]	10	55	100
Recorded value [mA]	15	13	23,1
Recorded value [%]	0,04	0,03	0,06
Limit [%]	0,25	0,25	0,25

Phase 3

Test level power [%]	10	55	100
Recorded value [mA]	-19,5	-28,8	-41
Recorded value [%]	-0,05	-0,07	-0,1
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.

Sum of all Phases

Tests are carried out at three defined power levels $\pm 5\%$. At 230 V a 25,0 kW three phase Inverter has a current output of 108,70 A so DC limit is 271,7 mA. These tests is 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%.

Sum of all Phases

Test level power [%]	10	55	100
Recorded value [mA]	-66,2	-81,3	-83,0
Recorded value [%]	-0,076	-0,093	-0,095
Limit [%]	0,25	0,25	0,25

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Extract from test report according to the Engineering Recommendation G99

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Power Quality. DC injection.

SE27.6K

Phase 1

Test level power [%]	10	55	100
Recorded value [mA]	-61,7	-65,5	-65,1
Recorded value [%]	-0,15	-0,16	-0,16
Limit [%]	0,25	0,25	0,25

Phase 2

Test level power [%]	10	55	100
Recorded value [mA]	15	13	23,1
Recorded value [%]	0,04	0,03	0,06
Limit [%]	0,25	0,25	0,25

Phase 3

Test level power [%]	10	55	100
Recorded value [mA]	-19,5	-28,8	-41
Recorded value [%]	-0,05	-0,07	-0,1
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.

Sum of all Phases

Tests are carried out at three defined power levels $\pm 5\%$. At 230 V a 27,6 kW three phase Inverter has a current output of 120,0 A so DC limit is 300,0 mA. These tests is 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%.

Sum of all Phases

Test level power [%]	10	55	100
Recorded value [mA]	-66,2	-81,3	-83,0
Recorded value [%]	-0,055	-0,068	-0,069
Limit [%]	0,25	0,25	0,25

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Extract from test report according to the Engineering Recommendation G99

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Power Quality. DC injection.

SE30K

Phase 1

Test level power [%]	10	55	100
Recorded value [mA]	-64,2	-63,8	-66
Recorded value [%]	-0,15	-0,15	-0,15
Limit [%]	0,25	0,25	0,25

Phase 2

Test level power [%]	10	55	100
Recorded value [mA]	15,8	16,2	24,6
Recorded value [%]	0,04	0,04	0,06
Limit [%]	0,25	0,25	0,25

Phase 3

Test level power [%]	10	55	100
Recorded value [mA]	-20,6	-27,2	-40,8
Recorded value [%]	-0,05	-0,06	-0,09
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.

Sum of all Phases

Tests are carried out at three defined power levels $\pm 5\%$. At 230 V a 30,0 kW three phase Inverter has a current output of 130,43 A so DC limit is 326,1 mA. These tests is 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%.

Sum of all Phases

Test level power [%]	10	55	100
Recorded value [mA]	-69,0	-74,8	-82,2
Recorded value [%]	0,084	-0,062	-0,069
Limit [%]	0,25	0,25	0,25



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Power Quality. DC injection.

SE33.3K

Phase 1

Test level power [%]	10	55	100
Recorded value [mA]	-62,9	-68,5	-70,4
Recorded value [%]	-0,13	-0,14	-0,15
Limit [%]	0,25	0,25	0,25

Phase 2

Test level power [%]	10	55	100
Recorded value [mA]	15,4	18,7	28,8
Recorded value [%]	0,03	0,04	0,06
Limit [%]	0,25	0,25	0,25

Phase 3

Test level power [%]	10	55	100
Recorded value [mA]	-20,7	-27,9	-43,3
Recorded value [%]	-0,04	-0,06	-0,09
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.

Sum of all Phases

Tests are carried out at three defined power levels $\pm 5\%$. At 230 V a 33,3 kW three phase Inverter has a current output of 144,78 A so DC limit is 362,0 mA. These tests is 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%.

Sum of all Phases

Test level power [%]	10	55	100
Recorded value [mA]	-68,2	-77,7	-84,9
Recorded value [%]	-0,078	-0,089	-0,098
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

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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	33,16	48,74
Initial Value of aperiodic current	A	N/A	100ms	32,82	48,11
Initial symmetrical short-circuit current*	I_k	N/A	250ms	32,89	48,19
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	32,81	48,14
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	2,578	In seconds

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	120,33	48,09
Initial Value of aperiodic current	A	N/A	100ms	61,15	48,15
Initial symmetrical short-circuit current*	I_k	N/A	250ms	46,28	48,48
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	40,03	48,52
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	2,578	In seconds

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	53,07	45,81
Initial Value of aperiodic current	A	N/A	100ms	37,51	47,56
Initial symmetrical short-circuit current*	I_k	N/A	250ms	34,63	47,97
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	33,58	48,05
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	2,578	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.



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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 0126-1-1 / 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. 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
Note: Detailed high level description see test report.	