



**BUREAU
VERITAS**

Certificate of compliance

Applicant: SMA Solar Technology AG
Sonnenallee 1
34266 Niestetal
Germany

Product: Photovoltaic (PV) inverter

Model: STP 15000TL-30, STP 20000TL-30, STP 25000TL-30

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with Engineering Recommendation G99/NI 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/NI-1:2019

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

EN 50549-1:2019

Requirements for parallel connection of installations with distribution networks - Part 1: Connection to an LV distribution network - Production of installations up to and including Type B

EN 50549-2:2019

Requirements for generating plants to be connected in parallel with distribution networks - Part 2: Connection to a MV distribution network - Generating plants up to and including Type B

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

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

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

Report number: 14TH0304-G99/NI-1_0
14TH0304-EN50549-1_4
14TH0304-EN50549-2_3
14TH0304-FRT_0

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

Certificate number: U21-0764

Date of issue: 2021-09-03

Certification body



Thomas Lammel

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



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Annex to the G99/NI certificate of compliance No. U21-0764

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

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

PGM Technology:	Photovoltaic Inverter / Battery Inverter		
Manufacturer / applicant:	SMA Solar Technology AG		
Address:	Sonnenallee 1 34266 Niestetal Germany		
Tel:	+49 561 9522-0	Fax:	+49 561 9522-100
Email:	info@SMA.de	Website:	www.sma.de

Rated values	STP 25000TL-30	STP 20000TL-30	STP 15000TL-30	--
MPP DC voltage range [V]	390 – 800	320 – 800	240 – 800	--
Input DC voltage range [V]	max 1000	max 1000	max 1000	--
Input DC current [A]	nom. 2 x 16 max. 2 x 33	nom. 2 x 16 max. 2 x 33	nom. 2 x 16 max. 2 x 33	--
Output AC voltage [V]	230V / 400V 3 wires, N, PE	230V / 400V 3 wires, N, PE	230V / 400V 3 wires, N, PE	--
Output AC current [A]	36,2	29	29	--
Output power [VA]	25000	20000	15000	--

Firmware version	Begining with 3.00.05.R
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Description of the structure of the power generation unit:

The power generation unit is equipped with a PV/DC 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 in series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of an error.

The above stated Generating Units are tested according the requirements in the Engineering Recommendation G99/NI. 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/NI.



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Operating Range.

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 2	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 3	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
UV stage 1	195,5	3,0	196,0	3,026	199,5V / 5s	No trip
UV stage 2	138,0	2,0	137,4	2,016	142,0V / 2,5s	No trip
					134,0V / 1,98s	No trip
O/V stage 1	253,0	0,5	254,7	0,526	249,0V / 5,0s	No trip
					257,0V / 0,45s	No trip



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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 stage 1	195,5	3,0	196,1	3,026	199,5V / 5s	No trip
U/V stage 2	138,0	2,0	137,4	2,027	142,0V / 2,5s	No trip
					134,0V / 1,98s	No trip
O/V stage 1	253,0	0,5	254,8	0,527	249,0V / 5,0s	No trip
					257,0V / 0,45s	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 stage 1	195,5	3,0	196,0	3,027	199,5V / 5s	No trip
U/V stage 2	138,0	2,0	138,6	2,026	142,0V / 2,5s	No trip
					134,0V / 1,98s	No trip
O/V stage 1	253,0	0,5	254,8	0,527	249,0V / 5,0s	No trip
					257,0V / 0,45s	No trip

Note. For Voltage tests the Voltage required to trip is the setting $\pm 3,45V$. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting $\pm 4V$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Frequency tests.

Function	Setting		Trip test		No trip test	
	Frequency [Hz]	Time delay [s]	Frequency [Hz]	Time delay [s]	Frequency / time	Confirm no trip
U/F stage 1	48,0	0,5	48,00	0,583	48,2Hz / 25s	No trip
					47,8Hz / 0,45s	No trip
O/F stage 1	52,0	1,0	52,05	1,076	51,8Hz / 120s	No trip
					52,2Hz / 0,98s	No trip

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



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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	0,131	0,157	0,149	0,148	0,153
Trip time. Ph2 fuse removed [s]	0,132	0,131	0,157	0,149	0,148	0,153
Trip time. Ph3 fuse removed [s]	0,132	0,131	0,157	0,149	0,148	0,153
Note. Trip time limit is 0,5s.						

Protection. Re-connection timer.				
Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.1.				
Over Voltage				
Time delay setting	Measured delay			
60s	68s			
Under Voltage				
Time delay setting	Measured delay			
60s	67s			
Over Frequency				
Time delay setting	Measured delay			
60s	71s			
Under Frequency				
Time delay setting	Measured delay			
60s	68s			
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 257,0V	At 191,5V	At 47,9Hz	At 52,1Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

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



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Limited Frequency Sensitive Mode – Over Frequency

1-min mean value [Hz]:	a) 50,00	b) 50,25	c) 50,70	d) 51,15	e) 50,70	f) 50,25	g) 50,00
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1. Measurement a) to g): Active power output > 80% P_n

Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
P _{expected} [kW]:	24992	24346	18723	13099	18723	24346	24992
P _{measured} [kW]:	24991	24424	18776	13158	18779	24388	24991

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

Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
P _{expected} [kW]:	12484	12161	9353	6544	9352	12161	12484
P _{measured} [kW]:	12484	12197	9423	6634	9542	12245	12484

Output Power with falling Frequency

Frequency setpoint [Hz]:	50,00	49,50	49,00	48,00	47,60	47,10
Frequency [Hz]:	50,00	49,50	49,00	48,00	47,60	47,10
Active power [kW]:	25,40	25,43	25,42	25,42	25,42	0,00

Note.

Electronic inverter, no power reduction take place.

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Power Quality. Harmonics.

Phase 1 STP 15000TL-30

Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 2,53 kW		100% of rated output 5,35 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,046	0,198	0,055	0,239	8%	8%
3rd	0,050	0,218	0,069	0,299	21,6%	N/A
4th	0,031	0,135	0,034	0,148	4%	4%
5th	0,103	0,442	0,097	0,418	10,7%	10,7%
6th	0,028	0,122	0,031	0,132	2,67%	2,67%
7th	0,071	0,307	0,098	0,423	7,2%	7,2%
8th	0,025	0,106	0,028	0,122	2%	2%
9th	0,025	0,109	0,027	0,116	3,8%	N/A
10th	0,021	0,092	0,024	0,104	1,6%	1,6%
11th	0,044	0,191	0,063	0,273	3,1%	3,1%
12th	0,019	0,080	0,020	0,088	1,33%	1,33%
13th	0,037	0,159	0,058	0,251	2%	2%
14th	0,017	0,072	0,017	0,075	N/A	N/A
15th	0,017	0,075	0,017	0,075	N/A	N/A
16th	0,015	0,064	0,015	0,065	N/A	N/A
17th	0,024	0,105	0,040	0,170	N/A	N/A
18th	0,013	0,056	0,013	0,056	N/A	N/A
19th	0,022	0,093	0,033	0,144	N/A	N/A
20th	0,012	0,051	0,011	0,049	N/A	N/A
21th	0,013	0,057	0,011	0,049	N/A	N/A
22th	0,011	0,046	0,010	0,043	N/A	N/A
23th	0,019	0,081	0,026	0,110	N/A	N/A
24th	0,010	0,043	0,009	0,037	N/A	N/A
25th	0,022	0,095	0,023	0,100	N/A	N/A
26th	0,009	0,038	0,008	0,033	N/A	N/A
27th	0,010	0,042	0,008	0,034	N/A	N/A
28th	0,008	0,036	0,007	0,032	N/A	N/A
29th	0,012	0,053	0,020	0,084	N/A	N/A
30th	0,008	0,034	0,007	0,030	N/A	N/A
31th	0,010	0,043	0,018	0,079	N/A	N/A
32th	0,008	0,032	0,007	0,028	N/A	N/A
33th	0,008	0,035	0,007	0,029	N/A	N/A
34th	0,007	0,030	0,006	0,027	N/A	N/A
35th	0,010	0,043	0,017	0,072	N/A	N/A
36th	0,007	0,028	0,006	0,027	N/A	N/A
37th	0,008	0,036	0,016	0,069	N/A	N/A
38th	0,006	0,028	0,006	0,026	N/A	N/A
39th	0,007	0,031	0,007	0,028	N/A	N/A
40th	0,006	0,026	0,006	0,027	N/A	N/A
THD ₄₀ [%]	1,63		0,92		23%	13%
PWHD [%]	0,004		0,002		23%	22%



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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. Harmonics.

Phase 2 STP 15000TL-30

Generating Unit rating per phase (rpp)							
At 45-55% of rated output 2,54 kW		100% of rated output 5,38 kW					
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %		
					1 phase	3 phase	
2nd	0,053	0,228	0,057	0,243	8%	8%	
3rd	0,059	0,253	0,074	0,316	21,6%	N/A	
4th	0,034	0,145	0,038	0,162	4%	4%	
5th	0,126	0,541	0,134	0,573	10,7%	10,7%	
6th	0,030	0,130	0,033	0,140	2,67%	2,67%	
7th	0,068	0,293	0,093	0,401	7,2%	7,2%	
8th	0,027	0,117	0,030	0,129	2%	2%	
9th	0,030	0,127	0,030	0,131	3,8%	N/A	
10th	0,023	0,099	0,027	0,114	1,6%	1,6%	
11th	0,041	0,177	0,057	0,243	3,1%	3,1%	
12th	0,020	0,086	0,022	0,096	1,33%	1,33%	
13th	0,039	0,167	0,061	0,262	2%	2%	
14th	0,018	0,077	0,019	0,081	N/A	N/A	
15th	0,020	0,085	0,019	0,083	N/A	N/A	
16th	0,016	0,067	0,016	0,069	N/A	N/A	
17th	0,026	0,111	0,039	0,165	N/A	N/A	
18th	0,014	0,058	0,014	0,059	N/A	N/A	
19th	0,021	0,091	0,033	0,142	N/A	N/A	
20th	0,012	0,052	0,012	0,051	N/A	N/A	
21th	0,015	0,065	0,012	0,053	N/A	N/A	
22th	0,011	0,047	0,010	0,045	N/A	N/A	
23th	0,016	0,070	0,025	0,109	N/A	N/A	
24th	0,011	0,046	0,009	0,039	N/A	N/A	
25th	0,033	0,141	0,022	0,096	N/A	N/A	
26th	0,010	0,041	0,008	0,036	N/A	N/A	
27th	0,011	0,045	0,008	0,036	N/A	N/A	
28th	0,009	0,037	0,008	0,034	N/A	N/A	
29th	0,011	0,048	0,019	0,080	N/A	N/A	
30th	0,008	0,035	0,007	0,032	N/A	N/A	
31th	0,011	0,047	0,018	0,079	N/A	N/A	
32th	0,008	0,033	0,007	0,030	N/A	N/A	
33th	0,009	0,038	0,007	0,030	N/A	N/A	
34th	0,007	0,032	0,007	0,029	N/A	N/A	
35th	0,009	0,040	0,016	0,069	N/A	N/A	
36th	0,007	0,030	0,006	0,027	N/A	N/A	
37th	0,009	0,039	0,016	0,070	N/A	N/A	
38th	0,007	0,028	0,006	0,027	N/A	N/A	
39th	0,008	0,036	0,007	0,030	N/A	N/A	
40th	0,006	0,027	0,006	0,028	N/A	N/A	
THD ₄₀ [%]	1,81		1,00		23%	13%	
PWHD [%]	0,006		0,002		23%	22%	

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. Harmonics.						
Phase 3 STP 15000TL-30						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated ouput 2,54 kW		100% of rated output 5,37 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,039	0,169	0,051	0,218	8%	8%
3rd	0,029	0,124	0,032	0,138	21,6%	N/A
4th	0,030	0,130	0,035	0,150	4%	4%
5th	0,116	0,499	0,112	0,482	10,7%	10,7%
6th	0,026	0,112	0,029	0,125	2,67%	2,67%
7th	0,069	0,296	0,095	0,407	7,2%	7,2%
8th	0,024	0,102	0,027	0,116	2%	2%
9th	0,025	0,108	0,028	0,120	3,8%	N/A
10th	0,021	0,091	0,024	0,103	1,6%	1,6%
11th	0,038	0,165	0,058	0,248	3,1%	3,1%
12th	0,019	0,081	0,021	0,090	1,33%	1,33%
13th	0,034	0,144	0,057	0,245	2%	2%
14th	0,017	0,074	0,018	0,078	N/A	N/A
15th	0,018	0,075	0,017	0,074	N/A	N/A
16th	0,015	0,066	0,015	0,065	N/A	N/A
17th	0,023	0,098	0,036	0,154	N/A	N/A
18th	0,014	0,059	0,013	0,056	N/A	N/A
19th	0,019	0,082	0,030	0,130	N/A	N/A
20th	0,012	0,053	0,012	0,050	N/A	N/A
21th	0,013	0,057	0,011	0,047	N/A	N/A
22th	0,011	0,049	0,010	0,044	N/A	N/A
23th	0,020	0,088	0,024	0,104	N/A	N/A
24th	0,011	0,046	0,009	0,039	N/A	N/A
25th	0,022	0,096	0,021	0,092	N/A	N/A
26th	0,010	0,041	0,008	0,036	N/A	N/A
27th	0,010	0,042	0,008	0,035	N/A	N/A
28th	0,009	0,038	0,008	0,034	N/A	N/A
29th	0,011	0,049	0,019	0,081	N/A	N/A
30th	0,008	0,035	0,007	0,032	N/A	N/A
31th	0,010	0,044	0,017	0,072	N/A	N/A
32th	0,008	0,034	0,007	0,030	N/A	N/A
33th	0,008	0,036	0,007	0,030	N/A	N/A
34th	0,007	0,032	0,007	0,028	N/A	N/A
35th	0,009	0,041	0,016	0,070	N/A	N/A
36th	0,007	0,030	0,006	0,028	N/A	N/A
37th	0,008	0,035	0,014	0,058	N/A	N/A
38th	0,007	0,029	0,006	0,027	N/A	N/A
39th	0,008	0,033	0,007	0,031	N/A	N/A
40th	0,006	0,027	0,006	0,027	N/A	N/A
THD ₄₀ [%]	1,60		0,89		23%	13%
PWHD [%]	0,004		0,002		23%	22%

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. Harmonics.

Phase 1 STP 20000TL-30

Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 3,32 kW		100% of rated output 6,67 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,045	0,154	0,051	0,176	8%	8%
3rd	0,054	0,186	0,085	0,294	21,6%	N/A
4th	0,031	0,108	0,033	0,114	4%	4%
5th	0,104	0,360	0,088	0,305	10,7%	10,7%
6th	0,028	0,098	0,027	0,095	2,67%	2,67%
7th	0,077	0,266	0,093	0,322	7,2%	7,2%
8th	0,025	0,086	0,025	0,086	2%	2%
9th	0,025	0,087	0,025	0,087	3,8%	N/A
10th	0,021	0,074	0,022	0,077	1,6%	1,6%
11th	0,052	0,179	0,065	0,225	3,1%	3,1%
12th	0,019	0,065	0,020	0,069	1,33%	1,33%
13th	0,044	0,154	0,065	0,225	2%	2%
14th	0,017	0,057	0,018	0,061	N/A	N/A
15th	0,018	0,062	0,019	0,067	N/A	N/A
16th	0,015	0,051	0,016	0,055	N/A	N/A
17th	0,030	0,104	0,048	0,164	N/A	N/A
18th	0,013	0,046	0,014	0,048	N/A	N/A
19th	0,027	0,094	0,043	0,149	N/A	N/A
20th	0,012	0,041	0,013	0,044	N/A	N/A
21th	0,013	0,046	0,015	0,051	N/A	N/A
22th	0,011	0,037	0,012	0,040	N/A	N/A
23th	0,023	0,081	0,036	0,123	N/A	N/A
24th	0,010	0,035	0,011	0,037	N/A	N/A
25th	0,025	0,088	0,037	0,128	N/A	N/A
26th	0,009	0,031	0,010	0,034	N/A	N/A
27th	0,010	0,033	0,010	0,036	N/A	N/A
28th	0,008	0,029	0,009	0,031	N/A	N/A
29th	0,015	0,053	0,027	0,092	N/A	N/A
30th	0,008	0,027	0,008	0,029	N/A	N/A
31th	0,013	0,044	0,024	0,082	N/A	N/A
32th	0,007	0,026	0,008	0,027	N/A	N/A
33th	0,008	0,028	0,009	0,030	N/A	N/A
34th	0,007	0,024	0,007	0,025	N/A	N/A
35th	0,012	0,042	0,021	0,074	N/A	N/A
36th	0,007	0,023	0,007	0,024	N/A	N/A
37th	0,010	0,035	0,020	0,068	N/A	N/A
38th	0,006	0,022	0,007	0,023	N/A	N/A
39th	0,007	0,025	0,008	0,028	N/A	N/A
40th	0,006	0,021	0,006	0,022	N/A	N/A
THD ₄₀ [%]	1,31		0,77		23%	13%
PWHD [%]	0,003		0,002		23%	22%

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. Harmonics.

Phase 2 STP 20000TL-30

Generating Unit rating per phase (rpp)		100% of rated output		Limit in BS EN61000-3-12 in %		
At 45-55% of rated output 3,33 kW		6,69 kW		1 phase	3 phase	
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]		
2nd	0,054	0,187	0,070	0,242	8%	8%
3rd	0,059	0,202	0,088	0,302	21,6%	N/A
4th	0,034	0,118	0,037	0,127	4%	4%
5th	0,127	0,438	0,129	0,445	10,7%	10,7%
6th	0,030	0,104	0,029	0,099	2,67%	2,67%
7th	0,075	0,258	0,091	0,314	7,2%	7,2%
8th	0,027	0,093	0,027	0,092	2%	2%
9th	0,030	0,102	0,030	0,105	3,8%	N/A
10th	0,023	0,080	0,024	0,084	1,6%	1,6%
11th	0,046	0,158	0,059	0,203	3,1%	3,1%
12th	0,020	0,070	0,022	0,076	1,33%	1,33%
13th	0,047	0,162	0,067	0,231	2%	2%
14th	0,018	0,062	0,020	0,067	N/A	N/A
15th	0,020	0,069	0,022	0,076	N/A	N/A
16th	0,016	0,054	0,017	0,059	N/A	N/A
17th	0,030	0,103	0,046	0,157	N/A	N/A
18th	0,014	0,048	0,015	0,053	N/A	N/A
19th	0,027	0,092	0,042	0,145	N/A	N/A
20th	0,012	0,043	0,014	0,048	N/A	N/A
21th	0,015	0,052	0,017	0,059	N/A	N/A
22th	0,011	0,038	0,013	0,044	N/A	N/A
23th	0,021	0,071	0,033	0,113	N/A	N/A
24th	0,011	0,037	0,012	0,042	N/A	N/A
25th	0,035	0,122	0,045	0,154	N/A	N/A
26th	0,010	0,034	0,011	0,037	N/A	N/A
27th	0,011	0,037	0,012	0,040	N/A	N/A
28th	0,009	0,030	0,010	0,034	N/A	N/A
29th	0,014	0,048	0,024	0,083	N/A	N/A
30th	0,008	0,028	0,009	0,031	N/A	N/A
31th	0,014	0,047	0,024	0,083	N/A	N/A
32th	0,008	0,027	0,008	0,029	N/A	N/A
33th	0,009	0,031	0,010	0,034	N/A	N/A
34th	0,007	0,025	0,008	0,028	N/A	N/A
35th	0,012	0,040	0,020	0,068	N/A	N/A
36th	0,007	0,024	0,008	0,026	N/A	N/A
37th	0,011	0,037	0,020	0,070	N/A	N/A
38th	0,007	0,023	0,007	0,025	N/A	N/A
39th	0,008	0,029	0,010	0,033	N/A	N/A
40th	0,006	0,022	0,007	0,024	N/A	N/A
THD ₄₀ [%]	1,44		0,86		23%	13%
PWHD [%]	0,004		0,002		23%	22%

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. Harmonics.						
Phase 3 STP 20000TL-30						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 3,33 kW		100% of rated output 6,68 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,047	0,162	0,062	0,214	8%	8%
3rd	0,029	0,101	0,039	0,136	21,6%	N/A
4th	0,031	0,106	0,034	0,116	4%	4%
5th	0,113	0,388	0,103	0,356	10,7%	10,7%
6th	0,027	0,092	0,027	0,092	2,67%	2,67%
7th	0,075	0,258	0,087	0,299	7,2%	7,2%
8th	0,024	0,082	0,025	0,085	2%	2%
9th	0,025	0,087	0,027	0,093	3,8%	N/A
10th	0,022	0,074	0,022	0,077	1,6%	1,6%
11th	0,045	0,155	0,061	0,209	3,1%	3,1%
12th	0,019	0,065	0,020	0,069	1,33%	1,33%
13th	0,042	0,145	0,063	0,216	2%	2%
14th	0,017	0,059	0,018	0,062	N/A	N/A
15th	0,018	0,061	0,018	0,064	N/A	N/A
16th	0,015	0,053	0,016	0,055	N/A	N/A
17th	0,028	0,095	0,043	0,149	N/A	N/A
18th	0,014	0,048	0,015	0,051	N/A	N/A
19th	0,024	0,083	0,038	0,133	N/A	N/A
20th	0,012	0,043	0,013	0,045	N/A	N/A
21th	0,013	0,046	0,014	0,048	N/A	N/A
22th	0,011	0,039	0,012	0,042	N/A	N/A
23th	0,024	0,082	0,034	0,119	N/A	N/A
24th	0,011	0,036	0,011	0,039	N/A	N/A
25th	0,025	0,088	0,036	0,123	N/A	N/A
26th	0,010	0,033	0,010	0,035	N/A	N/A
27th	0,010	0,034	0,010	0,036	N/A	N/A
28th	0,009	0,030	0,009	0,031	N/A	N/A
29th	0,014	0,049	0,025	0,086	N/A	N/A
30th	0,008	0,028	0,009	0,030	N/A	N/A
31th	0,013	0,043	0,022	0,077	N/A	N/A
32th	0,008	0,027	0,008	0,028	N/A	N/A
33th	0,008	0,029	0,009	0,030	N/A	N/A
34th	0,007	0,025	0,008	0,026	N/A	N/A
35th	0,011	0,039	0,020	0,070	N/A	N/A
36th	0,007	0,023	0,007	0,025	N/A	N/A
37th	0,009	0,032	0,017	0,060	N/A	N/A
38th	0,007	0,023	0,007	0,023	N/A	N/A
39th	0,008	0,027	0,008	0,029	N/A	N/A
40th	0,006	0,022	0,007	0,023	N/A	N/A
THD ₄₀ [%]	1,28		0,74		23%	13%
PWHD [%]	0,003		0,002		23%	22%



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Annex to the G99/NI certificate of compliance No. U21-0764

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. Harmonics.

Phase 1 STP 25000TL-30

Generating Unit rating per phase (rpp)						
At 45-55% of rated output 4,13 kW		100% of rated output 8,20 kW				
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,046	0,129	0,052	0,146	8%	8%
3rd	0,058	0,163	0,123	0,346	21,6%	N/A
4th	0,032	0,090	0,036	0,100	4%	4%
5th	0,101	0,282	0,067	0,189	10,7%	10,7%
6th	0,028	0,079	0,014	0,040	2,67%	2,67%
7th	0,084	0,237	0,105	0,294	7,2%	7,2%
8th	0,025	0,070	0,013	0,036	2%	2%
9th	0,025	0,071	0,016	0,044	3,8%	N/A
10th	0,022	0,061	0,012	0,033	1,6%	1,6%
11th	0,057	0,159	0,070	0,196	3,1%	3,1%
12th	0,019	0,054	0,011	0,031	1,33%	1,33%
13th	0,052	0,145	0,075	0,211	2%	2%
14th	0,017	0,047	0,010	0,028	N/A	N/A
15th	0,018	0,050	0,014	0,039	N/A	N/A
16th	0,015	0,042	0,009	0,026	N/A	N/A
17th	0,035	0,099	0,053	0,150	N/A	N/A
18th	0,013	0,037	0,008	0,023	N/A	N/A
19th	0,032	0,090	0,050	0,141	N/A	N/A
20th	0,012	0,034	0,007	0,021	N/A	N/A
21th	0,014	0,038	0,011	0,030	N/A	N/A
22th	0,011	0,030	0,007	0,019	N/A	N/A
23th	0,027	0,075	0,041	0,114	N/A	N/A
24th	0,010	0,028	0,007	0,019	N/A	N/A
25th	0,029	0,081	0,043	0,121	N/A	N/A
26th	0,009	0,026	0,006	0,017	N/A	N/A
27th	0,010	0,027	0,008	0,021	N/A	N/A
28th	0,008	0,023	0,005	0,015	N/A	N/A
29th	0,018	0,051	0,031	0,088	N/A	N/A
30th	0,008	0,022	0,005	0,014	N/A	N/A
31th	0,016	0,045	0,029	0,081	N/A	N/A
32th	0,007	0,021	0,005	0,013	N/A	N/A
33th	0,008	0,023	0,006	0,018	N/A	N/A
34th	0,007	0,019	0,004	0,012	N/A	N/A
35th	0,014	0,040	0,026	0,072	N/A	N/A
36th	0,007	0,019	0,004	0,011	N/A	N/A
37th	0,012	0,035	0,023	0,065	N/A	N/A
38th	0,006	0,018	0,004	0,011	N/A	N/A
39th	0,007	0,021	0,006	0,017	N/A	N/A
40th	0,006	0,017	0,004	0,010	N/A	N/A
THD ₄₀ [%]	1,09		0,68		23%	13%
PWHD [%]	0,003		0,002		23%	22%

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. Harmonics.						
Phase 2 STP 25000TL-30						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 4,20 kW		100% of rated output 8,23 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,058	0,162	0,092	0,257	8%	8%
3rd	0,058	0,163	0,142	0,397	21,6%	N/A
4th	0,036	0,101	0,036	0,102	4%	4%
5th	0,126	0,352	0,104	0,290	10,7%	10,7%
6th	0,030	0,084	0,014	0,040	2,67%	2,67%
7th	0,082	0,230	0,108	0,301	7,2%	7,2%
8th	0,027	0,076	0,013	0,036	2%	2%
9th	0,030	0,085	0,017	0,047	3,8%	N/A
10th	0,023	0,065	0,012	0,034	1,6%	1,6%
11th	0,050	0,140	0,072	0,202	3,1%	3,1%
12th	0,021	0,058	0,012	0,032	1,33%	1,33%
13th	0,055	0,153	0,071	0,198	2%	2%
14th	0,018	0,051	0,011	0,030	N/A	N/A
15th	0,021	0,058	0,013	0,035	N/A	N/A
16th	0,016	0,044	0,010	0,027	N/A	N/A
17th	0,034	0,096	0,053	0,148	N/A	N/A
18th	0,014	0,039	0,009	0,025	N/A	N/A
19th	0,031	0,088	0,047	0,132	N/A	N/A
20th	0,013	0,036	0,008	0,022	N/A	N/A
21th	0,016	0,045	0,011	0,030	N/A	N/A
22th	0,012	0,032	0,007	0,020	N/A	N/A
23th	0,024	0,068	0,038	0,105	N/A	N/A
24th	0,011	0,031	0,008	0,022	N/A	N/A
25th	0,038	0,106	0,050	0,139	N/A	N/A
26th	0,010	0,028	0,007	0,019	N/A	N/A
27th	0,011	0,030	0,008	0,022	N/A	N/A
28th	0,009	0,025	0,006	0,016	N/A	N/A
29th	0,017	0,047	0,029	0,081	N/A	N/A
30th	0,008	0,024	0,005	0,015	N/A	N/A
31th	0,017	0,047	0,028	0,078	N/A	N/A
32th	0,008	0,022	0,005	0,013	N/A	N/A
33th	0,009	0,026	0,007	0,019	N/A	N/A
34th	0,008	0,021	0,004	0,013	N/A	N/A
35th	0,014	0,039	0,023	0,065	N/A	N/A
36th	0,007	0,020	0,004	0,012	N/A	N/A
37th	0,013	0,036	0,024	0,066	N/A	N/A
38th	0,007	0,019	0,004	0,011	N/A	N/A
39th	0,009	0,024	0,006	0,017	N/A	N/A
40th	0,007	0,018	0,004	0,011	N/A	N/A
THD ₄₀ [%]	1,19		0,77		23%	13%
PWHD [%]	0,003		0,002		23%	22%

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. Harmonics.						
Phase 3 STP 25000TL-30						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated ouput 4,20 kW		100% of rated output 8,22 kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,052	0,145	0,130	0,363	8%	8%
3rd	0,030	0,085	0,050	0,141	21,6%	N/A
4th	0,032	0,090	0,039	0,109	4%	4%
5th	0,111	0,310	0,088	0,245	10,7%	10,7%
6th	0,027	0,075	0,014	0,039	2,67%	2,67%
7th	0,083	0,232	0,094	0,262	7,2%	7,2%
8th	0,024	0,068	0,012	0,035	2%	2%
9th	0,027	0,075	0,014	0,039	3,8%	N/A
10th	0,022	0,061	0,011	0,032	1,6%	1,6%
11th	0,050	0,139	0,070	0,197	3,1%	3,1%
12th	0,019	0,054	0,011	0,029	1,33%	1,33%
13th	0,050	0,140	0,067	0,189	2%	2%
14th	0,017	0,048	0,009	0,026	N/A	N/A
15th	0,018	0,050	0,010	0,029	N/A	N/A
16th	0,015	0,043	0,009	0,025	N/A	N/A
17th	0,032	0,090	0,053	0,148	N/A	N/A
18th	0,014	0,040	0,008	0,022	N/A	N/A
19th	0,029	0,082	0,046	0,127	N/A	N/A
20th	0,013	0,035	0,007	0,020	N/A	N/A
21th	0,014	0,038	0,008	0,024	N/A	N/A
22th	0,012	0,033	0,007	0,019	N/A	N/A
23th	0,027	0,075	0,041	0,116	N/A	N/A
24th	0,011	0,030	0,007	0,019	N/A	N/A
25th	0,029	0,081	0,040	0,113	N/A	N/A
26th	0,010	0,027	0,006	0,016	N/A	N/A
27th	0,010	0,028	0,006	0,017	N/A	N/A
28th	0,009	0,025	0,005	0,014	N/A	N/A
29th	0,017	0,048	0,031	0,087	N/A	N/A
30th	0,008	0,023	0,005	0,013	N/A	N/A
31th	0,016	0,043	0,027	0,075	N/A	N/A
32th	0,008	0,022	0,004	0,012	N/A	N/A
33th	0,008	0,023	0,006	0,016	N/A	N/A
34th	0,007	0,020	0,004	0,012	N/A	N/A
35th	0,014	0,038	0,025	0,070	N/A	N/A
36th	0,007	0,019	0,004	0,011	N/A	N/A
37th	0,011	0,031	0,021	0,060	N/A	N/A
38th	0,007	0,018	0,004	0,011	N/A	N/A
39th	0,008	0,022	0,005	0,015	N/A	N/A
40th	0,006	0,018	0,004	0,010	N/A	N/A
THD ₄₀ [%]	1,07		0,68		23%	13%
PWHD [%]	0,003		0,002		23%	22%



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Annex to the G99/NI certificate of compliance No. U21-0764

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. Power factor.

Output power	216,2 V	230 V	253 V	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%	1,000	1,000	1,000	
50%	1,000	1,000	1,000	
75%	1,000	1,000	1,000	
100%	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	

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	2,36%	2,26%	0,00ms	3,01%	2,71%	0,00ms	0,19	0,18
Measured values at standard impedance	3,15%	3,01%	--	4,01%	3,61%	--	0,25	0,24
Values for maximum impedance	2,92%	2,80%	--	3,73%	3,30%	--	0,24	0,22
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	0,15	Ω	XI	0,15	Ω		
	Z	0,21	Ω					
Standard impedance	R	0,24	Ω	XI	0,15	Ω		
	Z	0,28	Ω					
Maximum impedance	R	0,22	Ω	XI	0,13	Ω		
	Zmax	0,26	Ω					



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Annex to the G99/NI certificate of compliance No. U21-0764

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

Extract from test report according to the Engineering Recommendation G99/NI

Nr. 14TH0304-G99/NI-1_0

Power Quality. DC injection.

Phase 1

Test level power [%]	10	55	100
Recorded value [mA]	5,53	4,39	3,19
Recorded value [%]	0,02	0,01	0,01
Limit [%]	0,25	0,25	0,25

Phase 2

Test level power [%]	10	55	100
Recorded value [mA]	2,23	6,15	6,44
Recorded value [%]	0,01	0,02	0,02
Limit [%]	0,25	0,25	0,25

Phase 3

Test level power [%]	10	55	100
Recorded value [mA]	1,56	5,32	6,92
Recorded value [%]	0,01	0,01	0,02
Limit [%]	0,25	0,25	0,25

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

Fault level Contribution.

For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts [V]	Amps [A]
Peak Short Circuit current	I_p	N/A	20ms	229,97	39,79
Initial Value of aperiodic current	A	N/A	100ms	12,88	37,22
Initial symmetrical short-circuit current*	I_k	N/A	250ms	12,94	37,64
Decaying (aperiodic) component of short circuit current*	i_{dc}	N/A	500ms	12,92	37,56
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	2,52	

For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.

* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.

Self Monitoring – Solid state switching.

N/A

It has been verified that in the event of the solid state switching device failing to disconnect the Power Park Module, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.

N/A

Note. Unit do not provide solid state switching relays. In case the semiconductor bridge is switched off, then the voltage on the output drops to 0. In this case the relays on the output will also open (Functional safety of the internal automatic disconnection device according to VDE 0126-1-1).



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Wiring functional tests if required by para. 15.2.1	N/A
Type test of components wired correct together on site is part of the commissioning test.	
Logic Interface (input port)	P
Confirm that an input port is provided and can be used to shut down the module.	Yes