Certificate of compliance

Applicant:	**SMA Solar Technology AG** **Sonnenallee 1** **34266 Niestetal** **Germany**
Product:	**Grid-tied photovoltaic (PV) inverter**
Model:	**STP3.0-3AV-40** **STP4.0-3AV-40** **STP5.0-3AV-40** **STP6.0-3AV-40** **STP8.0-3AV-40** **STP10.0-3AV-40**

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with Engineering Recommendation G98/1 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 G98/1-4:2019
Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks

DIN V VDE V 0126-1-1:2006-02 (4.1 Functional safety)
Automatic disconnection device between a generator and the public low-voltage grid

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

Report number:	**18TH0325-G98/1-4_0**	**Certification program:**	**NSOP-0032-DEU-ZE-V01**
Certificate number:	**U19-0467**	**Date of issue:**	**2019-08-08**

Certification body

Holger Schaffer

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

A partial representation of the certificate requires the written approval of Bureau Veritas Consumer Products Services Germany GmbH

Appendix C Type Test Verification Report	
Extract from test report according to the Engineering Recommendation G98/1	**Nr. 18TH0325-G98/1-4_0**

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G98/1.				
PGM Technology	Photovoltaic inverter			
Manufacturer	SMA Solar Technology AG			
Address	Sonnenallee 1 34266 Niestetal Germany			
Tel	+49 5619522-0	**Fax**	+49 5619522-100	
Email	info@SMA.de	**Website**	www.SMA.de	
Rated values	STP3.0-3AV-40	STP4.0-3AV-40	STP5.0-3AV-40	STP6.0-3AV-40
Maximum rated capacity	3,0 kW	4,0 kW	5,0 kW	6,0 kW
Rated voltage	230V / 400V (3P,N,PE)			
Firmware version	beginning with V3.00.01.R			
Rated values	STP8.0-3AV-40	STP10.0-3AV-40		
Maximum rated capacity	8,0 kW	10,0 kW		
Rated voltage	230V / 400V (3P,N,PE)			
Firmware version	beginning with V3.00.01.R			
Measurement period:	2019-07-11 to 2019-08-05			

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 all lines and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.

Differences between Generating Units:

The models STP3.0-3AV-40, STP4.0-3AV-40, STP5.0-3AV-40 and STP6.0-3AV-40 are based on the same hardware platform, use the same control unit and software. The models STP8.0-3AV-40 and STP10.0-3AV-40 are based on the same hardware platform, use the same control unit and software. Therefore Tests according to G99/1 were performed on the models STP6.0-3AV-40 and STP 10.0-3AV-40 to cover to complete series.

The above stated Generating Units are tested according the requirements in the Engineering Recommendation G98/1. 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 G98/1.

Appendix C Type Test Verification Report	
Extract from test report according to the Engineering Recommendation G98/1	**Nr. 18TH0325-G98/1-4_0**

Operating Range.	
STP6.0-3AV-40 and STP10.0-3AV-40	
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 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.						
STP6.0-3AV-40						
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	185,2	2,540	188V / 5s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	265,2	1,042	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	277,0	0,533	269,7V 0,95s	No trip
					277,7V 0,45s	No trip

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

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	185,2	2,545	188V / 5s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	265,2	1,042	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	277,0	0,533	269,7V 0,95s	No trip
					277,7V 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	184	2,5	185,2	2,545	188V / 5s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	265,5	1,033	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	277,1	0,536	269,7V 0,95s	No trip
					277,7V 0,45s	No trip

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

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Protection. Voltage tests.						
STP10.0-3AV-40						
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	184,6	2,534	188V / 5s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	263,3	1,025	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	274,9	0,529	269,7V 0,95s	No trip
					277,7V 0,45s	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	2,5	184,8	2,527	188V / 5s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	263,6	1,028	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	275,2	0,533	269,7V 0,95s	No trip
					277,7V 0,45s	No trip

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

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	184,6	2,522	188V / 5s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	263,3	1,022	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	274,9	0,522	269,7V 0,95s	No trip
					277,7V 0,45s	No trip
Note. For Voltage tests the Voltage required to trip is the setting ±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 ±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.						
STP6.0-3AV-40						
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	47,50	20,107	47,7Hz / 30s	No trip
U/F stage 2	47	0,5	46,99	0,596	47,2Hz / 19,5s	No trip
					46,8Hz / 0,45s	No trip
O/F stage 2	52	0,5	52,01	0,592	51,8Hz / 120s	No trip
					52,2Hz / 0,45s	No trip

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Protection. Frequency tests.

STP10.0-3AV-40

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	47,50	20,090	47,7Hz / 30s	No trip
U/F stage 2	47	0,5	46,99	0,571	47,2Hz / 19,5s	No trip
					46,8Hz / 0,45s	No trip
O/F stage 2	52	0,5	52,01	0,590	51,8Hz / 120s	No trip
					52,2Hz / 0,45s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting ±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 ±0,2Hz 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.

STP6.0-3AV-40

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 [ms]	335	306	355	355	338	360
Trip time. Ph2 fuse removed [ms]	335	306	355	355	338	360
Trip time. Ph3 fuse removed [ms]	335	306	355	355	338	360

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 C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Protection. Loss of Mains.

STP10.0-3AV-40

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 [ms]	232	199	308	276	218	248
Trip time. Ph2 fuse removed [ms]	232	199	308	276	218	248
Trip time. Ph3 fuse removed [ms]	232	199	308	276	218	248

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.

Protection. Re-connection timer.

STP6.0-3AV-40

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 2.

Over Voltage	
Time delay setting	**Measured delay**
20s	27,0
Under Voltage	
Time delay setting	**Measured delay**
20s	30,0
Over Frequency	
Time delay setting	**Measured delay**
20s	27,0
Under Frequency	
Time delay setting	**Measured delay**
20s	25,0

	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 180,0V	At 47,4Hz	At 52,1Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Appendix C Type Test Verification Report	
Extract from test report according to the Engineering Recommendation G98/1	**Nr. 18TH0325-G98/1-4_0**

Protection. Re-connection timer.	
STP10.0-3AV-40	
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 2.	
Over Voltage	
Time delay setting	**Measured delay**
20s	31,0
Under Voltage	
Time delay setting	**Measured delay**
20s	31,0
Over Frequency	
Time delay setting	**Measured delay**
20s	29,0
Under Frequency	
Time delay setting	**Measured delay**
20s	30,0

	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 180,0V	At 47,4Hz	At 52,1Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Protection. Frequency change, Stability test.				
STP6.0-3AV-40				
	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
	Ramp range	**Test frequency ramp**	**Test Duration**	**Confirm 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 C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Protection. Frequency change, Stability test.				
STP10.0-3AV-40				
	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
	Ramp range	**Test frequency ramp**	**Test Duration**	**Confirm 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

Limited Frequency Sensitive Mode – Over Frequency							
STP6.0-3AV-40							
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]:	N/A	5,98	5,68	5,14	5,68	5,98	N/A
$P_{measured}$ [kW]:	6,04	5,91	5,61	5,08	5,62	5,92	6,00
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% Pn							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
$P_{expected}$ [kW]:	N/A	3,05	2,90	2,62	2,90	3,05	N/A
$P_{measured}$ [kW]:	3,08	3,04	2,88	2,60	2,88	3,04	3,35

Limited Frequency Sensitive Mode – Over Frequency							
STP6.0-3AV-40							
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]:	N/A	9,82	9,32	8,43	9,32	9,82	N/A
$P_{measured}$ [kW]:	9,91	9,86	9,36	8,46	9,36	9,87	9,91
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% Pn							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
$P_{expected}$ [kW]:	N/A	4,99	4,74	4,29	4,74	4,99	N/A
$P_{measured}$ [kW]:	5,04	4,98	4,72	4,27	4,73	4,98	5,04

Appendix C Type Test Verification Report	
Extract from test report according to the Engineering Recommendation G98/1	**Nr. 18TH0325-G98/1-4_0**

Output Power with falling Frequency			
STP6.0-3AV-40			
5-min mean value (each)	**a) 50 ± 0,01 Hz**	**b) - 0,4 to - 0,5 Hz**	**c) - 2,4 to - 2,5 Hz**
Frequency [Hz]:	50,00	49,50	47,60
Active power [W]:	6049	6052	6055
ΔP/PM [%] per 1 Hz:			0,0

Output Power with falling Frequency			
STP10.0-3AV-40			
5-min mean value (each)	**a) 50 ± 0,01 Hz**	**b) - 0,4 to - 0,5 Hz**	**c) - 2,4 to - 2,5 Hz**
Frequency [Hz]:	50,00	49,50	47,60
Active power [W]:	10056	10057	10052
ΔP/PM [%] per 1 Hz:			0,0

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Power Quality. Harmonics.

STP6.0-3AV-40

Phase 1

SSEG rating per phase (rpp)						
	At 45-55% of rated output 0,99kW		**100% of rated output 2,00kW**			
Harmonic	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Limit in BS EN61000-3-2 in Amps**	**Higher limit for odd harmonics 21 and above**
2nd	0,025	0,285	0,008	0,095	1,080	
3rd	0,036	0,413	0,037	0,427	2,300	
4th	0,073	0,839	0,076	0,874	0,430	
5th	0,006	0,075	0,007	0,081	1,140	
6th	0,015	0,176	0,014	0,157	0,300	
7th	0,004	0,052	0,005	0,056	0,770	
8th	0,011	0,124	0,010	0,112	0,230	
9th	0,015	0,177	0,014	0,166	0,400	
10th	0,013	0,152	0,011	0,131	0,184	
11th	0,036	0,416	0,032	0,365	0,330	
12th	0,007	0,086	0,010	0,112	0,153	
13th	0,031	0,352	0,026	0,304	0,210	
14th	0,009	0,100	0,011	0,124	0,131	
15th	0,004	0,046	0,005	0,059	0,150	
16th	0,009	0,099	0,008	0,088	0,115	
17th	0,021	0,243	0,020	0,229	0,132	
18th	0,005	0,056	0,003	0,039	0,102	
19th	0,018	0,204	0,017	0,197	0,118	
20th	0,005	0,056	0,004	0,048	0,092	
21th	0,003	0,034	0,003	0,040	0,107	0,160
22th	0,007	0,075	0,005	0,057	0,084	
23th	0,017	0,200	0,018	0,203	0,098	0,147
24th	0,005	0,060	0,004	0,042	0,077	
25th	0,013	0,152	0,015	0,173	0,090	0,135
26th	0,003	0,036	0,003	0,032	0,071	
27th	0,003	0,031	0,003	0,035	0,083	0,124
28th	0,003	0,036	0,003	0,036	0,066	
29th	0,004	0,049	0,008	0,096	0,078	0,117
30th	0,003	0,039	0,002	0,024	0,061	
31th	0,002	0,027	0,007	0,083	0,073	0,109
32th	0,002	0,023	0,002	0,026	0,058	
33th	0,002	0,022	0,002	0,027	0,068	0,102
34th	0,003	0,029	0,003	0,033	0,054	
35th	0,003	0,029	0,006	0,066	0,064	0,096
36th	0,003	0,030	0,003	0,029	0,051	
37th	0,003	0,037	0,005	0,059	0,061	0,091
38th	0,001	0,014	0,002	0,026	0,048	
39th	0,002	0,020	0,002	0,024	0,058	0,087
40th	0,001	0,016	0,002	0,028	0,046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below. The test had been performed on the model STP6.0-3AV-40 test results are valid for STP3.0-3AV-40, STP4.0-3AV-40 and STP5.0-3AV-40, since they are identical in hardware and just power derated by software.

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Power Quality. Harmonics.

STP6.0-3AV-40

Phase 2

	SSEG rating per phase (rpp)					
	At 45-55% of rated output 0,99kW		100% of rated output 1,99kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,068	0,790	0,067	0,774	1,080	
3rd	0,054	0,625	0,043	0,500	2,300	
4th	0,034	0,394	0,040	0,457	0,430	
5th	0,014	0,161	0,018	0,209	1,140	
6th	0,013	0,146	0,010	0,116	0,300	
7th	0,013	0,153	0,019	0,218	0,770	
8th	0,021	0,242	0,020	0,232	0,230	
9th	0,020	0,227	0,021	0,240	0,400	
10th	0,032	0,367	0,030	0,350	0,184	
11th	0,033	0,383	0,020	0,235	0,330	
12th	0,011	0,125	0,012	0,137	0,153	
13th	0,032	0,366	0,023	0,270	0,210	
14th	0,011	0,125	0,010	0,112	0,131	
15th	0,014	0,161	0,018	0,206	0,150	
16th	0,003	0,031	0,004	0,046	0,115	
17th	0,025	0,293	0,027	0,307	0,132	
18th	0,006	0,071	0,003	0,035	0,102	
19th	0,023	0,266	0,023	0,262	0,118	
20th	0,003	0,040	0,004	0,043	0,092	
21th	0,010	0,110	0,012	0,134	0,107	0,160
22th	0,005	0,058	0,004	0,042	0,084	
23th	0,020	0,228	0,020	0,228	0,098	0,147
24th	0,004	0,052	0,004	0,049	0,077	
25th	0,015	0,177	0,016	0,182	0,090	0,135
26th	0,003	0,040	0,003	0,037	0,071	
27th	0,006	0,071	0,007	0,085	0,083	0,124
28th	0,003	0,037	0,003	0,031	0,066	
29th	0,003	0,029	0,007	0,077	0,078	0,117
30th	0,004	0,043	0,003	0,031	0,061	
31th	0,006	0,069	0,006	0,073	0,073	0,109
32th	0,002	0,023	0,002	0,020	0,058	
33th	0,005	0,055	0,004	0,052	0,068	0,102
34th	0,003	0,037	0,003	0,030	0,054	
35th	0,003	0,032	0,008	0,097	0,064	0,096
36th	0,003	0,029	0,003	0,030	0,051	
37th	0,003	0,033	0,006	0,073	0,061	0,091
38th	0,002	0,023	0,001	0,017	0,048	
39th	0,003	0,037	0,004	0,046	0,058	0,087
40th	0,002	0,024	0,002	0,027	0,046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below. The test had been performed on the model STP6.0-3AV-40 test results are valid for STP3.0-3AV-40, STP4.0-3AV-40 and STP5.0-3AV-40, since they are identical in hardware and just power derated by software.

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Power Quality. Harmonics.

STP6.0-3AV-40

Phase 3

SSEG rating per phase (rpp)						
	At 45-55% of rated output 0,99kW		**100% of rated output 2,00kW**			
Harmonic	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Limit in BS EN61000-3-2 in Amps**	**Higher limit for odd harmonics 21 and above**
2nd	0,071	0,815	0,068	0,785	1,080	
3rd	0,059	0,677	0,060	0,693	2,300	
4th	0,040	0,458	0,037	0,428	0,430	
5th	0,014	0,157	0,018	0,204	1,140	
6th	0,007	0,085	0,007	0,080	0,300	
7th	0,014	0,159	0,019	0,219	0,770	
8th	0,013	0,150	0,017	0,197	0,230	
9th	0,007	0,081	0,008	0,097	0,400	
10th	0,026	0,301	0,031	0,353	0,184	
11th	0,035	0,405	0,028	0,321	0,330	
12th	0,009	0,105	0,009	0,108	0,153	
13th	0,017	0,198	0,014	0,166	0,210	
14th	0,012	0,138	0,012	0,137	0,131	
15th	0,012	0,138	0,014	0,163	0,150	
16th	0,008	0,091	0,008	0,097	0,115	
17th	0,012	0,143	0,011	0,121	0,132	
18th	0,005	0,057	0,004	0,050	0,102	
19th	0,027	0,310	0,026	0,297	0,118	
20th	0,008	0,087	0,007	0,081	0,092	
21th	0,011	0,128	0,014	0,162	0,107	0,160
22th	0,005	0,056	0,004	0,050	0,084	
23th	0,025	0,282	0,026	0,303	0,098	0,147
24th	0,004	0,044	0,005	0,062	0,077	
25th	0,024	0,279	0,024	0,275	0,090	0,135
26th	0,006	0,073	0,005	0,059	0,071	
27th	0,006	0,071	0,006	0,068	0,083	0,124
28th	0,003	0,032	0,003	0,033	0,066	
29th	0,004	0,043	0,004	0,046	0,078	0,117
30th	0,002	0,028	0,003	0,033	0,061	
31th	0,008	0,089	0,010	0,114	0,073	0,109
32th	0,004	0,042	0,003	0,040	0,058	
33th	0,005	0,052	0,006	0,064	0,068	0,102
34th	0,002	0,026	0,003	0,029	0,054	
35th	0,005	0,056	0,008	0,088	0,064	0,096
36th	0,002	0,024	0,003	0,030	0,051	
37th	0,005	0,058	0,003	0,037	0,061	0,091
38th	0,003	0,034	0,003	0,038	0,048	
39th	0,004	0,050	0,004	0,049	0,058	0,087
40th	0,002	0,026	0,002	0,026	0,046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below. The test had been performed on the model STP6.0-3AV-40 test results are valid for STP3.0-3AV-40, STP4.0-3AV-40 and STP5.0-3AV-40, since they are identical in hardware and just power derated by software.

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Power Quality. Harmonics.

STP10.0-3AV-40

Phase 1

SSEG rating per phase (rpp)						
	At 45-55% of rated output 1,65kW		**100% of rated output 3,32kW**			
Harmonic	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Limit in BS EN61000-3-2 in Amps**	**Higher limit for odd harmonics 21 and above**
2nd	0,035	0,245	0,038	0,266	1,080	
3rd	0,040	0,278	0,066	0,459	2,300	
4th	0,065	0,450	0,085	0,590	0,430	
5th	0,022	0,150	0,022	0,156	1,140	
6th	0,007	0,051	0,013	0,092	0,300	
7th	0,023	0,158	0,024	0,170	0,770	
8th	0,008	0,053	0,007	0,047	0,230	
9th	0,019	0,135	0,019	0,130	0,400	
10th	0,005	0,032	0,006	0,042	0,184	
11th	0,011	0,079	0,039	0,272	0,330	
12th	0,004	0,026	0,005	0,035	0,153	
13th	0,029	0,202	0,050	0,350	0,210	
14th	0,003	0,022	0,005	0,037	0,131	
15th	0,012	0,082	0,012	0,084	0,150	
16th	0,003	0,022	0,004	0,030	0,115	
17th	0,016	0,114	0,034	0,234	0,132	
18th	0,002	0,017	0,003	0,023	0,102	
19th	0,011	0,080	0,019	0,132	0,118	
20th	0,002	0,017	0,003	0,024	0,092	
21th	0,007	0,050	0,007	0,050	0,107	0,160
22th	0,002	0,014	0,003	0,024	0,084	
23th	0,011	0,076	0,018	0,123	0,098	0,147
24th	0,002	0,014	0,002	0,017	0,077	
25th	0,004	0,026	0,012	0,084	0,090	0,135
26th	0,002	0,012	0,002	0,016	0,071	
27th	0,005	0,034	0,005	0,034	0,083	0,124
28th	0,002	0,012	0,003	0,018	0,066	
29th	0,005	0,036	0,012	0,087	0,078	0,117
30th	0,002	0,011	0,002	0,013	0,061	
31th	0,008	0,058	0,010	0,068	0,073	0,109
32th	0,002	0,011	0,002	0,012	0,058	
33th	0,004	0,028	0,004	0,025	0,068	0,102
34th	0,002	0,011	0,002	0,014	0,054	
35th	0,008	0,053	0,008	0,054	0,064	0,096
36th	0,001	0,010	0,002	0,011	0,051	
37th	0,003	0,024	0,007	0,047	0,061	0,091
38th	0,001	0,009	0,001	0,010	0,048	
39th	0,004	0,030	0,005	0,032	0,058	0,087
40th	0,001	0,009	0,001	0,010	0,046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below. The test had been performed on the model STP10.0-3AV-40 test results are valid for STP8.0-3AV-40 since they are identical in hardware and just power derated by software.

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Power Quality. Harmonics.

STP10.0-3AV-40

Phase 2

	SSEG rating per phase (rpp)					
	At 45-55% of rated output 1,66kW		100% of rated output 3,32kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,049	0,340	0,071	0,492	1,080	
3rd	0,014	0,098	0,025	0,171	2,300	
4th	0,045	0,314	0,045	0,309	0,430	
5th	0,008	0,057	0,009	0,062	1,140	
6th	0,009	0,061	0,013	0,087	0,300	
7th	0,008	0,057	0,011	0,078	0,770	
8th	0,008	0,056	0,006	0,044	0,230	
9th	0,006	0,042	0,009	0,061	0,400	
10th	0,005	0,035	0,006	0,040	0,184	
11th	0,025	0,171	0,053	0,369	0,330	
12th	0,004	0,029	0,006	0,042	0,153	
13th	0,016	0,108	0,039	0,272	0,210	
14th	0,003	0,022	0,004	0,031	0,131	
15th	0,004	0,025	0,005	0,034	0,150	
16th	0,003	0,021	0,004	0,025	0,115	
17th	0,009	0,061	0,027	0,187	0,132	
18th	0,003	0,018	0,004	0,026	0,102	
19th	0,005	0,038	0,018	0,126	0,118	
20th	0,002	0,016	0,003	0,021	0,092	
21th	0,002	0,017	0,003	0,024	0,107	0,160
22th	0,002	0,015	0,003	0,020	0,084	
23th	0,006	0,041	0,016	0,114	0,098	0,147
24th	0,002	0,014	0,003	0,019	0,077	
25th	0,005	0,036	0,012	0,083	0,090	0,135
26th	0,002	0,012	0,002	0,016	0,071	
27th	0,002	0,013	0,003	0,017	0,083	0,124
28th	0,002	0,012	0,002	0,016	0,066	
29th	0,007	0,047	0,012	0,087	0,078	0,117
30th	0,002	0,011	0,002	0,014	0,061	
31th	0,005	0,033	0,008	0,055	0,073	0,109
32th	0,002	0,011	0,002	0,014	0,058	
33th	0,002	0,011	0,002	0,015	0,068	0,102
34th	0,002	0,012	0,002	0,015	0,054	
35th	0,005	0,032	0,006	0,045	0,064	0,096
36th	0,001	0,010	0,002	0,011	0,051	
37th	0,005	0,033	0,007	0,049	0,061	0,091
38th	0,001	0,009	0,001	0,010	0,048	
39th	0,001	0,010	0,002	0,013	0,058	0,087
40th	0,002	0,011	0,002	0,012	0,046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below. The test had been performed on the model STP10.0-3AV-40 test results are valid for STP8.0-3AV-40 since they are identical in hardware and just power derated by software.

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Power Quality. Harmonics.

STP10.0-3AV-40

Phase 3

	SSEG rating per phase (rpp)					
	At 45-55% of rated output 1,65kW		100% of rated output 3,31kW			
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,031	0,217	0,040	0,279	1,080	
3rd	0,031	0,216	0,044	0,309	2,300	
4th	0,074	0,514	0,080	0,554	0,430	
5th	0,023	0,158	0,022	0,156	1,140	
6th	0,009	0,060	0,011	0,077	0,300	
7th	0,017	0,121	0,017	0,120	0,770	
8th	0,007	0,048	0,007	0,049	0,230	
9th	0,017	0,118	0,017	0,117	0,400	
10th	0,005	0,035	0,007	0,052	0,184	
11th	0,023	0,159	0,049	0,342	0,330	
12th	0,004	0,029	0,006	0,040	0,153	
13th	0,021	0,149	0,039	0,268	0,210	
14th	0,003	0,024	0,006	0,039	0,131	
15th	0,013	0,088	0,013	0,088	0,150	
16th	0,003	0,022	0,005	0,033	0,115	
17th	0,019	0,131	0,036	0,254	0,132	
18th	0,003	0,020	0,004	0,029	0,102	
19th	0,013	0,092	0,025	0,173	0,118	
20th	0,003	0,019	0,004	0,029	0,092	
21th	0,008	0,053	0,008	0,055	0,107	0,160
22th	0,002	0,017	0,004	0,024	0,084	
23th	0,007	0,048	0,011	0,078	0,098	0,147
24th	0,002	0,016	0,004	0,025	0,077	
25th	0,003	0,020	0,008	0,056	0,090	0,135
26th	0,002	0,015	0,003	0,023	0,071	
27th	0,005	0,034	0,005	0,035	0,083	0,124
28th	0,002	0,015	0,003	0,021	0,066	
29th	0,009	0,061	0,015	0,106	0,078	0,117
30th	0,002	0,014	0,003	0,021	0,061	
31th	0,009	0,060	0,012	0,083	0,073	0,109
32th	0,002	0,014	0,003	0,020	0,058	
33th	0,004	0,029	0,004	0,030	0,068	0,102
34th	0,002	0,014	0,003	0,019	0,054	
35th	0,005	0,035	0,004	0,031	0,064	0,096
36th	0,002	0,013	0,003	0,019	0,051	
37th	0,002	0,015	0,004	0,028	0,061	0,091
38th	0,002	0,013	0,003	0,019	0,048	
39th	0,004	0,030	0,004	0,031	0,058	0,087
40th	0,002	0,014	0,003	0,019	0,046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below. The test had been performed on the model STP10.0-3AV-40 test results are valid for STP8.0-3AV-40 since they are identical in hardware and just power derated by software.

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Power Quality. Power factor.				
STP6.0-3AV-40				
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%	0,997	0,998	0,993	
50%	1,000	1,000	0,999	
75%	1,000	1,000	0,999	
100%	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	
STP6.0-3AV-40				
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%	1,000	0,999	0,999	
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.								
STP6.0-3AV-40								
Phase L1								
	Starting			**Stopping**			**Running**	
	dmax	**dc**	**d(t)**	**dmax**	**dc**	**d(t)**	**Pst**	**Plt 2 hours**
Measured values at test impedance	0,10%	0,00%	0,00%	0,10%	0,00%	0,00%	0,064	0,064
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Phase L2								
	Starting			**Stopping**			**Running**	
	dmax	**dc**	**d(t)**	**dmax**	**dc**	**d(t)**	**Pst**	**Plt 2 hours**
Measured values at test impedance	0,12%	0,00%	0,00%	0,12%	0,00%	0,00%	0,064	0,064
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Phase L3								
	Starting			**Stopping**			**Running**	
	dmax	**dc**	**d(t)**	**dmax**	**dc**	**d(t)**	**Pst**	**Plt 2 hours**
Measured values at test impedance	0,11%	0,00%	0,00%	0,11%	0,00%	0,00%	0,064	0,064
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Test impedance	R	0,24	Ω	Xl	0,15	Ω

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Power Quality. Voltage fluctuation and Flicker.

STP10.0-3AV-40

Phase L1

	Starting			Stopping			Running	
	dmax	**dc**	**d(t)**	**dmax**	**dc**	**d(t)**	**Pst**	**Plt 2 hours**
Measured values at test impedance	-0,20%	0,00%	0,00%	-0,20%	0,00%	0,00%	0,132	0,105
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Phase L2

	Starting			Stopping			Running	
	dmax	**dc**	**d(t)**	**dmax**	**dc**	**d(t)**	**Pst**	**Plt 2 hours**
Measured values at test impedance	-0,22%	0,00%	0,00%	-0,22%	0,00%	0,00%	0,149	0,107
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Phase L3

	Starting			Stopping			Running	
	dmax	**dc**	**d(t)**	**dmax**	**dc**	**d(t)**	**Pst**	**Plt 2 hours**
Measured values at test impedance	0,20%	0,00%	0,00%	0,20%	0,00%	0,00%	0,141	0,105
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Test impedance	R	0,24	Ω	Xl	0,15	Ω

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Power Quality. DC injection.				
STP6.0-3AV-40				
Phase 1				
Test level power [%]	20	50	75	100
Recorded value [mA]	0,73	1,00	3,02	4,59
Recorded value [%]	0,01	0,01	0,03	0,05
Limit [%]	0,25	0,25	0,25	0,25
Phase 2				
Test level power [%]	20	50	75	100
Recorded value [mA]	13,85	13,17	15,07	13,88
Recorded value [%]	0,15	0,15	0,17	0,15
Limit [%]	0,25	0,25	0,25	0,25
Phase 3				
Test level power [%]	20	50	75	100
Recorded value [mA]	10,70	9,60	7,36	6,01
Recorded value [%]	0,12	0,11	0,08	0,07
Limit [%]	0,25	0,25	0,25	0,25
STP10.0-3AV-40				
Phase 1				
Test level power [%]	20	50	75	100
Recorded value [mA]	10,27	6,51	4,61	2,67
Recorded value [%]	0,07	0,05	0,03	0,02
Limit [%]	0,25	0,25	0,25	0,25
Phase 2				
Test level power [%]	20	50	75	100
Recorded value [mA]	10,21	9,53	10,15	11,38
Recorded value [%]	0,07	0,07	0,07	0,08
Limit [%]	0,25	0,25	0,25	0,25
Phase 3				
Test level power [%]	20	50	75	100
Recorded value [mA]	3,36	6,82	8,75	9,82
Recorded value [%]	0,02	0,05	0,06	0,07
Limit [%]	0,25	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.				

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Fault level Contribution.

STP6.0-3AV-40

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	90,24	9,37
Initial Value of aperiodic current	A	N/A	100ms	47,64	9,08
Initial symmetrical short-circuit current*	I_k	N/A	250ms	37,34	9,08
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	33,09	6,71
Reactance/Resistance Ratio of source*	X/R	N/A	**Time to Trip [s]**	0,266	

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	28,13	8,34
Initial Value of aperiodic current	A	N/A	100ms	28,24	8,92
Initial symmetrical short-circuit current*	I_k	N/A	250ms	28,32	9,02
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	28,25	7,09
Reactance/Resistance Ratio of source*	X/R	N/A	**Time to Trip [s]**	0,299	

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	32,90	10,19
Initial Value of aperiodic current	A	N/A	100ms	29,34	9,00
Initial symmetrical short-circuit current*	I_k	N/A	250ms	28,80	9,09
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	28,49	7,09
Reactance/Resistance Ratio of source*	X/R	N/A	**Time to Trip [s]**	0,296	

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 C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 18TH0325-G98/1-4_0**

Fault level Contribution.

STP10.0-3AV-40

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	28,55	2,45
Initial Value of aperiodic current	A	N/A	100ms	28,33	1,21
Initial symmetrical short-circuit current*	I_k	N/A	250ms	28,32	0,802
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	28,31	1,90
Reactance/Resistance Ratio of source*	X/R	N/A	**Time to Trip [s]**	0,361	

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	38,44	2,35
Initial Value of aperiodic current	A	N/A	100ms	40,16	2,57
Initial symmetrical short-circuit current*	I_k	N/A	250ms	33,52	1,76
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	31,03	2,45
Reactance/Resistance Ratio of source*	X/R	N/A	**Time to Trip [s]**	0,364	

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	39,31	10,61
Initial Value of aperiodic current	A	N/A	100ms	30,80	14,67
Initial symmetrical short-circuit current*	I_k	N/A	250ms	29,28	15,24
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	28,78	13,10
Reactance/Resistance Ratio of source*	X/R	N/A	**Time to Trip [s]**	0,367	

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 C Type Test Verification Report	
Extract from test report according to the Engineering Recommendation G98/1	**Nr. 18TH0325-G98/1-4_0**

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 Generating Unit, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.	
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 0126-100).	

Logic Interface (input port) Required by paragraph 11.1.3	**P**
Confirm that an input port is provided and can be used to shut down the module.	Yes