



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

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with Engineering Recommendation G59/3 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 G59/3:2013, G59/3-1:2014, G59/3-2:2015, G59/3-3:2018, G59/3-4:2018
Recommendation for the Connection of Generating Plant to the Distribution Systems of licensed Distribution Network Operators.

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

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

The STP3.0-3AV-40, STP4.0-3AV-40, STP5.0-3AV-40 and STP6.0-3AV-40 are rated <16A per phase and <= 50kW (3 phase). The default values for "Small Power Stations" on the low-voltage grid were verified.

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: PVUKM171108C05_1
Certificate number: U18-0468
Date of issue: 2018-08-17

Certification body



Holger Schaffer

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



Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. PVUKM171108C05_1

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G59/3.

Manufacturer / applicant:	SMA Solar Technology AG X Sonnenallee 1 34266 Niestetal Germany			
Generating Unit technology	Grid-tied photovoltaic inverter			
Rated values	STP3.0-3AV-40	STP4.0-3AV-40	STP5.0-3AV-40	STP6.0-3AV-40
Maximum rated capacity	3 kW	4 kW	5 kW	6 kW
Rated voltage	230V	230V	230V	230V
Firmware version	From V2.10			
Measurement period:	2017-11-08 to 2017-12-22; 2018-06-10 to 2018-08-13			

Description of the structure of the power generation unit:

The input and output are protected by Varistors to Earth. The unit is providing EMC filtering at the output toward mains. The unit does provide galvanic separation from input to output (transformer). The output is switched off redundant by the high power switching bridge and a relay in series. This assures that the opening of the output circuit will also operate in case of one error.

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. PVUKM171108C05_1

Protection. Voltage tests.						
STP6.0-3AV-40 Phase 1						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	201,1V	2,538s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	185,2V	0,542s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	263,9V	1,055s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	275,4V	0,536s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

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

Protection. Voltage tests.						
STP6.0-3AV-40 Phase 2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	201,4V	2,528s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	185,2V	0,531s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	264,4V	1,060s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	275,8V	0,540s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

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

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Nr. PVUKM171108C05_1

Protection. Voltage tests.						
STP6.0-3AV-40 Phase 3						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	201,1V	2,548s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	185,2V	0,536s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	264,0V	1,068s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	275,4V	0,534s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

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

Protection. Frequency tests.						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,49Hz	20,095s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	47,00Hz	0,587s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,52Hz	90,107s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,01Hz	0,583s	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting $\pm 0,1Hz$. 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.						
Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.						
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	0,128s	0,138s	0,169s	0,114s	0,108s	0,142s
Trip time. Ph2 fuse removed	0,128s	0,138s	0,169s	0,114s	0,108s	0,142s
Trip time. Ph3 fuse removed	0,128s	0,138s	0,169s	0,114s	0,108s	0,142s

Protection. Re-connection timer.					
Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.5.7.1.					
Voltage					
Time delay setting		Measured delay			
20s		64,6s			
Frequency					
Time delay setting		Measured delay			
20s		64s			
		Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
		At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection	

Protection. Frequency change, Stability test.				
G59/3, G59/3-1, G59/3-2	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49,5Hz	+9 degrees		No trip
Negative Vector Shift	50,5Hz	- 9 degrees		No trip
Positive Frequency drift	49,5Hz	+0,19Hz/sec	51,5Hz	No trip
Negative Frequency drift	50,5Hz	-0,19Hz/sec	47,5Hz	No trip
G59/3-3, G59/3-4	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49,5Hz	+50 degrees		No trip
Negative Vector Shift	50,5Hz	- 50 degrees		No trip
Positive Frequency drift	49,0Hz	+0,95Hz/sec	51,5Hz	No trip
Negative Frequency drift	51,0Hz	-0,95Hz/sec	47,5Hz	No trip

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Nr. PVUKM171108C05_1

Power Quality. Harmonics.						
Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)			STP6.0-3AV-40			
	At 45-55% of rated output 1,027kW		100% of rated output 1,995kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,140	1,61	0,021	0,24	8%	8%
3rd	0,469	5,40	0,059	0,67	21,6%	N/A
4th	0,193	2,22	0,049	0,56	4%	4%
5th	0,087	1,00	0,016	0,18	10,7%	10,7%
6th	0,078	0,89	0,033	0,38	2,67%	2,67%
7th	0,059	0,68	0,014	0,16	7,2%	7,2%
8th	0,036	0,42	0,027	0,32	2%	2%
9th	0,059	0,68	0,024	0,28	3,8%	N/A
10th	0,023	0,26	0,019	0,22	1,6%	1,6%
11th	0,092	1,05	0,149	1,71	3,1%	3,1%
12th	0,020	0,23	0,024	0,28	1,33%	1,33%
13th	0,041	0,47	0,064	0,73	2%	2%
14th	0,016	0,18	0,014	0,16	N/A	N/A
15th	0,025	0,29	0,025	0,29	N/A	N/A
16th	0,015	0,17	0,015	0,17	N/A	N/A
17th	0,032	0,36	0,037	0,42	N/A	N/A
18th	0,013	0,15	0,011	0,12	N/A	N/A
19th	0,030	0,35	0,044	0,50	N/A	N/A
20th	0,010	0,11	0,010	0,12	N/A	N/A
21th	0,015	0,17	0,015	0,18	N/A	N/A
22th	0,009	0,11	0,010	0,12	N/A	N/A
23th	0,015	0,17	0,022	0,25	N/A	N/A
24th	0,008	0,09	0,008	0,09	N/A	N/A
25th	0,016	0,18	0,016	0,18	N/A	N/A
26th	0,006	0,07	0,007	0,08	N/A	N/A
27th	0,011	0,12	0,010	0,11	N/A	N/A
28th	0,006	0,07	0,007	0,07	N/A	N/A
29th	0,008	0,09	0,015	0,17	N/A	N/A
30th	0,005	0,06	0,004	0,05	N/A	N/A
31th	0,012	0,14	0,013	0,15	N/A	N/A
32th	0,005	0,06	0,005	0,05	N/A	N/A
33th	0,007	0,08	0,006	0,06	N/A	N/A
34th	0,005	0,06	0,004	0,04	N/A	N/A
35th	0,008	0,09	0,011	0,12	N/A	N/A
36th	0,005	0,06	0,005	0,05	N/A	N/A
37th	0,008	0,09	0,017	0,20	N/A	N/A
38th	0,004	0,05	0,003	0,04	N/A	N/A
39th	0,006	0,07	0,007	0,08	N/A	N/A
40th	0,004	0,04	0,004	0,05	N/A	N/A
THD ₄₀	6,448%		2,384%		23%	13%
PWHD	0,44%		0,48%		23%	22%

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. PVUKM171108C05_1

Power Quality. Harmonics.						
Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)			STP6.0-3AV-40			
	At 45-55% of rated output 1,001kW		100% of rated output 1,998kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,150	1,73	0,032	0,36	8%	8%
3rd	0,468	5,38	0,063	0,73	21,6%	N/A
4th	0,184	2,12	0,050	0,57	4%	4%
5th	0,086	0,99	0,015	0,17	10,7%	10,7%
6th	0,089	1,03	0,028	0,32	2,67%	2,67%
7th	0,049	0,56	0,014	0,16	7,2%	7,2%
8th	0,040	0,46	0,029	0,34	2%	2%
9th	0,047	0,54	0,017	0,19	3,8%	N/A
10th	0,021	0,24	0,020	0,23	1,6%	1,6%
11th	0,106	1,22	0,162	1,87	3,1%	3,1%
12th	0,017	0,20	0,020	0,23	1,33%	1,33%
13th	0,056	0,64	0,085	0,98	2%	2%
14th	0,013	0,15	0,011	0,12	N/A	N/A
15th	0,027	0,31	0,020	0,23	N/A	N/A
16th	0,010	0,11	0,007	0,08	N/A	N/A
17th	0,024	0,28	0,044	0,50	N/A	N/A
18th	0,011	0,12	0,007	0,08	N/A	N/A
19th	0,027	0,30	0,053	0,61	N/A	N/A
20th	0,008	0,09	0,008	0,09	N/A	N/A
21th	0,015	0,17	0,012	0,14	N/A	N/A
22th	0,007	0,08	0,006	0,07	N/A	N/A
23th	0,021	0,24	0,024	0,28	N/A	N/A
24th	0,006	0,07	0,005	0,05	N/A	N/A
25th	0,012	0,14	0,006	0,07	N/A	N/A
26th	0,005	0,06	0,006	0,07	N/A	N/A
27th	0,010	0,11	0,009	0,10	N/A	N/A
28th	0,005	0,06	0,007	0,08	N/A	N/A
29th	0,010	0,11	0,013	0,15	N/A	N/A
30th	0,005	0,05	0,004	0,04	N/A	N/A
31th	0,013	0,15	0,014	0,16	N/A	N/A
32th	0,005	0,05	0,003	0,03	N/A	N/A
33th	0,008	0,10	0,004	0,05	N/A	N/A
34th	0,004	0,05	0,004	0,04	N/A	N/A
35th	0,011	0,12	0,012	0,14	N/A	N/A
36th	0,004	0,04	0,003	0,03	N/A	N/A
37th	0,006	0,06	0,016	0,19	N/A	N/A
38th	0,004	0,04	0,003	0,03	N/A	N/A
39th	0,007	0,08	0,005	0,06	N/A	N/A
40th	0,003	0,04	0,003	0,03	N/A	N/A
THD ₄₀	6,471%		2,609%		23%	13%
PWHD	0,40%		0,51%		23%	22%

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Nr. PVUKM171108C05_1

Power Quality. Harmonics.						
Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)			STP6.0-3AV-40			
	At 45-55% of rated output 0,957kW		100% of rated output 1,994kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,133	1,52	0,030	0,35	8%	8%
3rd	0,292	3,36	0,018	0,21	21,6%	N/A
4th	0,171	1,97	0,017	0,19	4%	4%
5th	0,086	0,99	0,011	0,12	10,7%	10,7%
6th	0,091	1,04	0,033	0,38	2,67%	2,67%
7th	0,052	0,60	0,008	0,09	7,2%	7,2%
8th	0,041	0,47	0,025	0,29	2%	2%
9th	0,059	0,67	0,015	0,17	3,8%	N/A
10th	0,019	0,22	0,014	0,16	1,6%	1,6%
11th	0,090	1,04	0,157	1,80	3,1%	3,1%
12th	0,014	0,16	0,010	0,12	1,33%	1,33%
13th	0,051	0,58	0,074	0,85	2%	2%
14th	0,012	0,14	0,009	0,10	N/A	N/A
15th	0,025	0,28	0,009	0,11	N/A	N/A
16th	0,013	0,15	0,014	0,16	N/A	N/A
17th	0,021	0,24	0,031	0,36	N/A	N/A
18th	0,010	0,12	0,007	0,08	N/A	N/A
19th	0,021	0,24	0,043	0,50	N/A	N/A
20th	0,009	0,11	0,006	0,07	N/A	N/A
21th	0,014	0,16	0,006	0,07	N/A	N/A
22th	0,008	0,09	0,007	0,08	N/A	N/A
23th	0,016	0,18	0,021	0,24	N/A	N/A
24th	0,007	0,07	0,007	0,07	N/A	N/A
25th	0,012	0,14	0,013	0,15	N/A	N/A
26th	0,005	0,06	0,005	0,05	N/A	N/A
27th	0,006	0,07	0,005	0,05	N/A	N/A
28th	0,006	0,06	0,003	0,04	N/A	N/A
29th	0,010	0,11	0,015	0,17	N/A	N/A
30th	0,005	0,06	0,004	0,04	N/A	N/A
31th	0,008	0,09	0,006	0,07	N/A	N/A
32th	0,005	0,06	0,004	0,05	N/A	N/A
33th	0,007	0,08	0,004	0,04	N/A	N/A
34th	0,004	0,05	0,003	0,03	N/A	N/A
35th	0,008	0,09	0,010	0,11	N/A	N/A
36th	0,004	0,05	0,004	0,05	N/A	N/A
37th	0,006	0,07	0,014	0,16	N/A	N/A
38th	0,004	0,04	0,003	0,03	N/A	N/A
39th	0,005	0,05	0,003	0,04	N/A	N/A
40th	0,003	0,04	0,004	0,05	N/A	N/A
THD ₄₀	4,743%		2,260%		23%	13%
PWHD	0,33%		0,33%		23%	22%

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Nr. PVUKM171108C05_1

Power Quality. Power factor.				
Test: STP6.0-3AV-40				
	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.
Measured value	0,999	0,999	0,999	
Limit	>0,95	>0,95	>0,95	
Test: STP3.0-3AV-40				
	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.
Measured value	0,999	0,999	0,999	
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	0,348%	0,177%	0,0%	0,348%	0,177%	0,0%	0,05	0,04
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Power Quality. DC injection.			
Test level power	10%		100%
Recorded value L1	-9mA		-18mA
Recorded value L2	-4mA		4mA
Recorded value L3	1mA		5mA
As % of rated AC current L1	0,10%		-0,21%
As % of rated AC current L2	0,05%		0,05%
As % of rated AC current L3	0,01%		0,06%
Limit	0,25%		0,25%

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Nr. PVUKM171108C05_1

Fault level Contribution.					
L1					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	I_p	N/A	20ms	34,586	2,5603
Initial Value of aperiodic current	A	N/A	100ms	--	--
Initial symmetrical short-circuit current*	I_k	N/A	250ms	--	--
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	--	--
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,0081	In seconds
L2					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	I_p	N/A	20ms	33,876	3,1947
Initial Value of aperiodic current	A	N/A	100ms	--	--
Initial symmetrical short-circuit current*	I_k	N/A	250ms	--	--
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	--	--
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,0072	In seconds
L3					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	I_p	N/A	20ms	25,866	1,9754
Initial Value of aperiodic current	A	N/A	100ms	--	--
Initial symmetrical short-circuit current*	I_k	N/A	250ms	--	--
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	--	--
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,0073	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.

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. PVUKM171108C05_1

Self Monitoring – Solid state switching.	N/A
It has been verified that in the event of the solid state switching device failing to disconnect the 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.	