



**BUREAU  
VERITAS**

# Certificate of compliance

**Applicant:** SMA Solar Technology AG  
Sonnenallee 1  
34266 Niestetal  
Germany

**Product:** Grid-tied photovoltaic (PV) inverter

**Model:** SB3.0-1AV-41  
SB3.6-1AV-41  
SB4.0-1AV-41  
SB5.0-1AV-41  
SB6.0-1AV-41

## Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G59/3 for photovoltaic systems with a single-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, G59/3-4:2018

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 SB4.0-1AV-41, SB5.0-1AV-41 and SB6.0-1AV-41 are rated >16A per phase and ≤50kW (3 phase) or 17kW (1 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:** PVUK181205N019-1  
**Certificate number:** U19-0096  
**Date of issue:** 2019-02-18

**Certification body**



Holger Schaffer

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



Deutsche  
Akkreditierungsstelle  
D-ZE-12024-01-00

**Appendix E Type Verification Test Report**

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

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

<b>Manufacturer / applicant:</b>	SMA Solar Technology AG Sonnenallee 1 34266 Niestetal Germany				
<b>Generating Unit technology</b>	Grid-tied photovoltaic inverter				
<b>Rated values</b>	SB3.0-1AV-41	SB3.6-1AV-41	SB4.0-1AV-41	SB5.0-1AV-41	SB6.0-1AV-41
<b>Maximum rated capacity</b>	3000 W	3680 W	4000 W	5000 W	6000 W
<b>Rated voltage</b>	230V	230V	230V	230V	230V
<b>Firmware version</b>	01.01				
<b>Measurement period:</b>	2018-12-05 to 2018-12-24				

**Description of the structure of the power generation unit:**

The power generation unit is equipped with a PV and line-side EMC filter. The power generation unit has no galvanic isolation between DC input and AC output. Output switch-off is performed with single-fault tolerance based on two series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.

The above stated Generating Units are tested according the requirements in the Engineering Recommendation G59/3. 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 G59/3.

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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 stage 1	200,1	2,5	200,2V	2,524s	204,1V / 3,5s	No trip
U/V stage 2	184	0,5	184,0V	0,530s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2	1,0	261,5V	1,026s	258,2V 2,0s	No trip
O/V stage 2	273,7	0,5	273,0V	0,523s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

**Protection. Frequency tests.**

Function	Setting		Trip test		No trip test	
	Frequency [Hz]	Time delay [s]	Frequency [Hz]	Time delay [s]	Frequency / time	Confirm no trip
U/F stage 1	47,5	20	47,5Hz	20,050s	47,7Hz / 25s	No trip
U/F stage 2	47	0,5	47,0Hz	0,578s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5	90	51,5Hz	90,100s	51,3Hz / 95s	No trip
O/F stage 2	52	0,5	52,0Hz	0,575s	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting  $\pm 0,1$ 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	479ms	148ms	159ms	150ms	476ms	188ms

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.**

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	38,6s			
Frequency				
Time delay setting	Measured delay			
20s	38,5s			
	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
<b>Confirmation that the Generating Unit does not re-connect.</b>	No reconnection	No reconnection	No reconnection	No reconnection

**Protection. Frequency change, Stability test.**

G59/3:2013	Start Frequency [Hz]	Change	End Frequency [Hz]	Confirm no trip
Positive Vector Shift	49,5	+9 degrees		No trip
Negative Vector Shift	50,5	-9 degrees		No trip
Positive Frequency drift	49,5	+0,19Hz/sec	51,5	No trip
Negative Frequency drift	50,5	-0,19Hz/sec	47,5	No trip
G59/3-4:2018	Start Frequency [Hz]	Change	End Frequency [Hz]	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	+0,95Hz/sec	51,0	No trip
Negative Frequency drift	51,0	-0,95Hz/sec	49,0	No trip

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**Power Quality. Harmonics.**

The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1

SB6.0-1AV-41

SSEG rating per phase (rpp)					NV=MV*3,68/rpp	
At 45-55% of rated output 3030W		100% of rated output 5975W				
Harmonic	Measured Value (MV) in [A]	Normalised Value (NV) in [A]	Measured Value (MV) in [A]	Normalised Value (NV) in [A]	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,003	N/A	0,008	N/A	1,080	
3rd	0,353	N/A	0,637	N/A	2,300	
4th	0,006	N/A	0,006	N/A	0,430	
5th	0,175	N/A	0,292	N/A	1,140	
6th	0,005	N/A	0,004	N/A	0,300	
7th	0,066	N/A	0,099	N/A	0,770	
8th	0,004	N/A	0,004	N/A	0,230	
9th	0,045	N/A	0,052	N/A	0,400	
10th	0,003	N/A	0,003	N/A	0,184	
11th	0,031	N/A	0,036	N/A	0,330	
12th	0,002	N/A	0,003	N/A	0,153	
13th	0,026	N/A	0,030	N/A	0,210	
14th	0,003	N/A	0,004	N/A	0,131	
15th	0,019	N/A	0,024	N/A	0,150	
16th	0,004	N/A	0,005	N/A	0,115	
17th	0,020	N/A	0,021	N/A	0,132	
18th	0,003	N/A	0,004	N/A	0,102	
19th	0,012	N/A	0,015	N/A	0,118	
20th	0,002	N/A	0,002	N/A	0,092	
21th	0,013	N/A	0,015	N/A	0,107	0,160
22th	0,001	N/A	0,002	N/A	0,084	
23th	0,009	N/A	0,013	N/A	0,098	0,147
24th	0,001	N/A	0,001	N/A	0,077	
25th	0,009	N/A	0,011	N/A	0,090	0,135
26th	0,001	N/A	0,001	N/A	0,071	
27th	0,005	N/A	0,010	N/A	0,083	0,124
28th	0,001	N/A	0,002	N/A	0,066	
29th	0,004	N/A	0,010	N/A	0,078	0,117
30th	0,001	N/A	0,001	N/A	0,061	
31th	0,003	N/A	0,008	N/A	0,073	0,109
32th	0,001	N/A	0,001	N/A	0,058	
33th	0,002	N/A	0,009	N/A	0,068	0,102
34th	0,001	N/A	0,001	N/A	0,054	
35th	0,002	N/A	0,007	N/A	0,064	0,096
36th	0,001	N/A	0,002	N/A	0,051	
37th	0,002	N/A	0,008	N/A	0,061	0,091
38th	0,001	N/A	0,001	N/A	0,048	
39th	0,003	N/A	0,008	N/A	0,058	0,087
40th	0,001	N/A	0,001	N/A	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.

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Power Quality. Power factor.				
<b>SB3.0-1AV-41</b>	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	0,9999i	0,9999i	0,9999i	
Limit	>0,95	>0,95	>0,95	
<b>SB6.0-1AV-41</b>	216,2V	230V	253V	
Measured value	0,9999i	0,9999i	0,9999i	
Limit	>0,95	>0,95	>0,95	

Power Quality. Voltage fluctuation and Flicker.								
The requirement is specified in section 5.4.2, test procedure in Annex A or B 1.4.3								
SB3.0-1AV-41	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	0,064%	1,778%	0,000%	1,935%	1,857%	0,000%	0,073	0,073
Normalised to standard impedance and 3.68kW for multiple units	0,064%	1,778%	0,000%	1,935%	1,857%	0,000%	0,073	0,073
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
SB6.0-1AV-41	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	-0,430%	-0,290%	0,000%	1,490%	1,380%	0,000%	0,078	0,074
Normalised to standard impedance and 3.68kW for multiple units	-0,430%	-0,290%	0,000%	1,490%	1,380%	0,000%	0,078	0,074
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Power Quality. DC injection.			
The requirement is specified in section 5.5, test procedure in Annex A or B 1.4.4			
<b>SB3.0-1AV-41</b>			
Test level power	10%	55%	100%
Recorded value of phase 1	11,5 mA	15,2 mA	12,6 mA
As % of rated AC current phase 1	0,07 %	0,12 %	0,04 %
Limit	0,25%	0,25%	0,25%
<b>SB6.0-1AV-41</b>			
Test level power	10%	55%	100%
Recorded value of phase 1	17,6 mA	31,8 mA	10,0 mA
As % of rated AC current phase 1	0,07 %	0,12 %	0,04 %
Limit	0,25%	0,25%	0,25%

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**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	37,6	2,9
Initial Value of aperiodic current	A	N/A	100ms	37,3	1,6
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	0,032	

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 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.	