



**BUREAU
VERITAS**

Certificate of compliance

Applicant: SMA Solar Technology AG
Sonnenallee 1
34266 Niestetal
Germany

Product: Grid-tied battery storage inverter

Model: SBS2.5-1VL-10

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

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 SBS2.5-1VL-10 is rated $<16\text{A}$ per phase and $\leq 17\text{kW}$ (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: 14TH0397-G59/3
Certificate number: U16-0489
Date of issue: 2016-08-31

Certification body



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 EN 50438

Nr. 14TH0397

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

Manufacturer / applicant:	SMA Solar Technology AG Sonnenallee 1 34266 Niestetal Germany
Generating Unit technology	Grid-tied battery storage inverter
Rated values	SBS2.5-1VL-10
Maximum rated capacity	2500 VA
Rated voltage	220/230/240
Firmware version	2.04
Measurement period:	2016-04-12 to 2016-05-19

Description of the electrical circuit

Special lockable battery connectors are provided to connect the DC source. An EMC filter consisting of x-, y-capacitors and an inductance is provided to remove distortions coming from the inverter to the DC side. The input current is measured via current sensors. The step up converters consist of inductances, transistors and diodes which increase the DC input voltage to the DC link which consists of electrolytic capacitors in parallel. The sine wave is generated from the IGBT bridges which receive a PWM signal from the internal processor. The generated sine is smoothed by inductances and routed through redundant relay contacts in each line to the output filter. For safety purposes a fault current and earth leakage monitoring is provided. The EMC filter consists of x-, y-capacitors and inductances

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	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	198,6V	2,5261s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	182,6V	0,5275s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	261,2V	1,0165s	258,2V / 2,0s	No trip
O/V stage 2	273,7V	0,5s	272,3V	0,5275s	269,7V / 0,98s	No trip
					277,7V / 0,48s	No trip

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	47,50Hz	20,05s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	47,00Hz	0,532s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	No trip	51,51Hz	90,02s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,01Hz	0,5325s	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 $\pm 0,1\text{Hz}$. 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 $\pm 0,2\text{Hz}$ 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.

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	170ms	176ms	210ms	188ms	188ms	191ms

Note for technologies which have a substantial shut down time this can be added to the 0,5 seconds in establishing that the trip occurred in less than 0,5s. Maximum shut down time could therefore be up to 1,0 seconds for these technologies.

Indicate additional shut down time included in above results.
(Integrated interface switch)

Type of switching equipment 1:
ZETTLER electronics AZ733W-2A-12DE with 10ms
Type of switching equipment 2:
ZETTLER electronics AZ733W-2A-12DE with 10ms

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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		23,44			
Frequency					
Time delay setting		Measured delay			
20s		23,44			
		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	No reconnection

Protection. Frequency change, Stability test.				
	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

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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						
Phase 1						
SSEG rating per phase (rpp)			NV=MV*3,68/rpp			
	At 45-55% of rated ouput 1,25kW		100% of rated output 2,5kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,020	0,089	0,025	0,111	1,080	
3rd	0,048	0,213	0,96	0,426	2,300	
4th	0,003	0,013	0,002	0,009	0,430	
5th	0,029	0,129	0,035	0,155	1,140	
6th	0,003	0,013	0,002	0,009	0,300	
7th	0,019	0,084	0,023	0,102	0,770	
8th	0,002	0,009	0,002	0,009	0,230	
9th	0,014	0,062	0,015	0,067	0,400	
10th	0,002	0,009	0,002	0,009	0,184	
11th	0,012	0,053	0,009	0,040	0,330	
12th	0,001	0,004	0,002	0,009	0,153	
13th	0,012	0,053	0,011	0,049	0,210	
14th	0,131	0,001	0,004	0,001	0,131	
15th	0,150	0,011	0,049	0,010	0,150	
16th	0,115	0,001	0,004	0,001	0,115	
17th	0,132	0,010	0,044	0,010	0,132	
18th	0,102	0,001	0,004	0,001	0,102	
19th	0,118	0,008	0,035	0,007	0,118	
20th	0,092	0,001	0,004	0,001	0,092	
21th	0,107	0,007	0,031	0,007	0,107	0,160
22th	0,084	0,001	0,004	0,001	0,084	
23th	0,098	0,006	0,027	0,007	0,098	0,147
24th	0,077	0,001	0,004	0,001	0,077	
25th	0,090	0,005	0,022	0,008	0,090	0,135
26th	0,071	0,001	0,004	0,001	0,071	
27th	0,083	0,003	0,013	0,008	0,083	0,124
28th	0,066	0,001	0,004	0,001	0,066	
29th	0,078	0,003	0,013	0,007	0,078	0,117
30th	0,061	0,001	0,004	0,001	0,061	
31th	0,073	0,002	0,009	0,006	0,073	0,109
32th	0,058	0,001	0,004	0,001	0,058	
33th	0,058	0,001	0,009	0,006	0,068	0,102
34th	0,054	0,001	0,004	0,001	0,054	
35th	0,064	0,001	0,004	0,007	0,064	0,096
36th	0,051	0,001	0,004	0,001	0,051	
37th	0,061	0,002	0,009	0,007	0,061	0,091
38th	0,048	0,001	0,004	0,001	0,048	
39th	0,058	0,004	0,013	0,007	0,058	0,087
40th	0,046	0,001	0,004	0,001	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.				
	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	0,2%	0,1%	0	0,0%	0,0%	0	0,07	0,07
Normalised to standard impedance	0,7%	0,1%	0	0,0%	0,0%	0	0,31	0,31
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%	55%	100%
Recorded value	3 mA	2 mA	8 mA
As % of rated AC current	0,03 %	0,01 %	0,08 %
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	Amps
Peak Short Circuit current	I_p	N/A	20ms	230,3	12,76
Initial Value of aperiodic current	A	N/A	100ms	12,59	0,04
Initial symmetrical short-circuit current*	I_k	N/A	250ms	10,35	0,04
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	11,35	0,04
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,52	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.

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.	