



**BUREAU
VERITAS**

Certificate of compliance

Applicant: SMA Solar Technology AG
Sonnenallee 1
34266 Niestetal
Germany

Product: Photovoltaic (PV) inverter

Model: SB1.5-1VL-40
SB2.0-1VL-40
SB2.5-1VL-40

Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G99/NI 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, 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

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.

Note:

Inverter current is below 16A per phase. Due to use of several inverters in one application is requested the 16A per phase can be exceeded. Therefore, testing according to G99/NI-1 was performed.

Report number: 14TH0397_G99/NI-1_0

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

Certificate number: U22-0260

Date of issue: 2022-05-04

Certification body



Thomas Lammel

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

Testing laboratory accredited according to DIN EN ISO/IEC 17025

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

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

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

Nr. 14TH0397_G99/NI-1_0

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

PGM Technology:	Photovoltaic Inverter		
Manufacturer / applicant:	SMA Solar Technology AG		
Address:	Sonnenallee 1 34266 Niestetal Germany		
Tel	+49 5619522-0	+49 5619522-0	+49 5619522-0
Email:	info@SMA.de	info@SMA.de	info@SMA.de

Rated values	SB1.5-1VL-40	SB2.0-1VL-40	SB2.5-1VL-40	--
MPP DC voltage range [V]	160 – 500	210 – 500	260 – 500	--
Input DC voltage range [V]	Max. 600	Max. 600	Max. 600	--
Input DC current [A]	10	10	10	--
Output AC voltage [V]	230 @ 50Hz / 60Hz (N,PE)	230 @ 50Hz / 60Hz (N,PE)	230 @ 50Hz / 60Hz (N,PE)	--
Output AC current [A]	7	9	11	--
Output power [VA]	1500	2000	2500	--

Firmware version	beginning with 03.10.09.R
-------------------------	---------------------------

Measurement period:	2021-08-02 – 2021-08-03
----------------------------	-------------------------

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 to 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.



BUREAU
VERITAS

Annex to the G99/NI certificate of compliance No. U22-0260

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

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

Nr. 14TH0397_G99/NI-1_0

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

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

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

Nr. 14TH0397_G99/NI-1_0

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	195,5	3,0	196,1	3,028	199,5V / 5s	No trip
U/V stage 2	138,0	2,0	137,4	2,028	142,0 / 2,5s	No trip
					134V / 1,98s	No trip
O/V stage 1	262,2	0,5	254,7	0,528	249V 5,0s	No trip
					257V 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	47,95	0,585	48,2Hz / 25s	No trip
					47,8Hz / 0,45s	No trip
O/F stage 1	52	1,0	52,00	1,078	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.



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

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

Nr. 14TH0397_G99/NI-1_0

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]	0,372	0,372	0,398	0,378	0,380	0,385

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

60s

Measured delay

63,44

Under Voltage

Time delay setting

60s

Measured delay

63,45

Over Frequency

Time delay setting

60s

Measured delay

63,50

Under Frequency

Time delay setting

60s

Measured delay

63,50

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



BUREAU
VERITAS

Annex to the G99/NI certificate of compliance No. U22-0260

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

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

Nr. 14TH0397_G99/NI-1_0

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
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} [W]:	N/A	2410	1846	1285	1848	2410	2472
P _{measured} [W]:	2483	2416	1858	1301	1861	2419	2483
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P_n							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
P _{expected} [W]:	N/A	1214	933	654	933	1214	2500
P _{measured} [W]:	1248	1213	932	653	935	1216	2482

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 [W]:	2480	2481	2480	2480	2480	2452

Note.

Electronic inverter no power reduction take place.

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

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

Nr. 14TH0397_G99/NI-1_0

Power Quality. Harmonics.						
Phase 1						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 1250 W		100% of rated output 2500 W			
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	0,020	0,089	0,025	0,111	8%	8%
3rd	0,048	0,213	0,096	0,426	21,6%	N/A
4th	0,003	0,013	0,002	0,009	4%	4%
5th	0,029	0,129	0,035	0,155	10,7%	10,7%
6th	0,003	0,013	0,002	0,009	2,67%	2,67%
7th	0,019	0,084	0,023	0,102	7,2%	7,2%
8th	0,002	0,009	0,002	0,009	2%	2%
9th	0,014	0,062	0,015	0,067	3,8%	N/A
10th	0,002	0,009	0,002	0,009	1,6%	1,6%
11th	0,012	0,053	0,009	0,040	3,1%	3,1%
12th	0,001	0,004	0,002	0,009	1,33%	1,33%
13th	0,012	0,053	0,011	0,049	2%	2%
14th	0,001	0,004	0,001	0,004	N/A	N/A
15th	0,011	0,049	0,010	0,044	N/A	N/A
16th	0,001	0,004	0,001	0,004	N/A	N/A
17th	0,010	0,044	0,010	0,044	N/A	N/A
18th	0,001	0,004	0,001	0,004	N/A	N/A
19th	0,008	0,035	0,007	0,031	N/A	N/A
20th	0,001	0,004	0,001	0,004	N/A	N/A
21th	0,007	0,031	0,007	0,031	N/A	N/A
22th	0,001	0,004	0,001	0,004	N/A	N/A
23th	0,006	0,027	0,007	0,031	N/A	N/A
24th	0,001	0,004	0,001	0,004	N/A	N/A
25th	0,005	0,022	0,008	0,035	N/A	N/A
26th	0,001	0,004	0,001	0,004	N/A	N/A
27th	0,003	0,013	0,008	0,035	N/A	N/A
28th	0,001	0,004	0,001	0,004	N/A	N/A
29th	0,003	0,013	0,007	0,031	N/A	N/A
30th	0,001	0,004	0,001	0,004	N/A	N/A
31th	0,002	0,009	0,006	0,027	N/A	N/A
32th	0,001	0,004	0,001	0,004	N/A	N/A
33th	0,002	0,009	0,007	0,031	N/A	N/A
34th	0,001	0,004	0,001	0,004	N/A	N/A
35th	0,001	0,004	0,007	0,031	N/A	N/A
36th	0,001	0,004	0,001	0,004	N/A	N/A
37th	0,002	0,009	0,007	0,031	N/A	N/A
38th	0,001	0,004	0,001	0,004	N/A	N/A
39th	0,004	0,018	0,007	0,031	N/A	N/A
40th	0,001	0,004	0,001	0,004	N/A	N/A
THD ₄₀ [%]	0,060		0,064		23%	13%
PWHD [%]	2,175		1,555		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. 14TH0397_G99/NI-1_0

Power Quality. Power factor.				
Output power	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.
20%	0,999	0,999	0,999	
50%	0,999	0,999	0,999	
75%	0,999	0,999	0,999	
100%	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	0,00	0,00	0,00	0,00	0,00	0,00	0,07	0,07
Measured values at standard impedance	0,00	0,00	0,00	0,00	0,00	0,00	0,07	0,07
Values for maximum impedance	0,00	0,00	0,00	0,00	0,00	0,00	1,98	1,98
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	0,400	Ω	XI	0,250	Ω		
	Z	0,472	Ω					
Standard impedance	R	0,400	Ω	XI	0,250	Ω		
	Z	0,472	Ω					
Maximum impedance	R	3,715	Ω	XI	2,321	Ω		
	Zmax	4,380	Ω					

Power Quality. DC injection.			
Test level power [%]	10	55	100
Recorded value [mA]	3	2	8
Recorded value [%]	0,03	0,01	0,08
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.



BUREAU
VERITAS

Annex to the G99/NI certificate of compliance No. U22-0260

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

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

Nr. 14TH0397_G99/NI-1_0

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	28,6	11,7
Initial Value of aperiodic current	A	N/A	100ms	28,4	11,9
Initial symmetrical short-circuit current*	I_k	N/A	250ms	28,4	11,8
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	28,5	11,8
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	2,028	

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.

(No solid-state switching device)

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).

Logic Interface (input port)

P

Confirm that an input port is provided and can be used to shut down the module.

Yes