



**BUREAU
VERITAS**

Certificate of compliance

Applicant: SMA Solar Technology AG
Sonnenallee1
34266 Niestetal
Germany

Product: Grid-tied battery Inverter

Model: SI4.4M-13

Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G98/1 for 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 G98/1-6:2021

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.

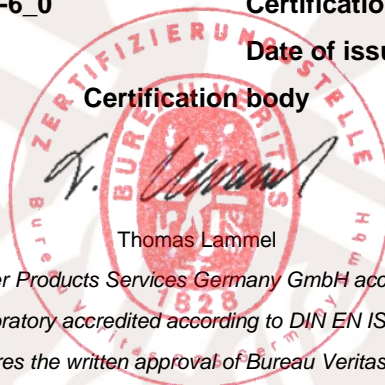
Report number: 13TH0287-G98-1-6_0

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

Certificate number: U22-0113

Date of issue: 2022-02-21

Certification body



Thomas Lammel



Certification body 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 approval of Bureau Veritas Consumer Products Services Germany GmbH



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Type Approval and declaration of compliance with the requirements of Engineering Recommendation G98/1.

PGM Technology	Battery inverter		
Manufacturer	SMA Solar Technology AG		
Address	Sonnenallee 1 34266 Niestetal Germany		
Tel	+49 561 9522-0	Fax	+49 561 9522-100
Email	info@SMA.de	Website	www.SMA.de

Rated values	SI4.4M-13	--	--	--
MPP DC voltage range [V]	41 – 63	--	--	--
Input DC voltage range [V]	48	--	--	--
Input DC current [A]	75	--	--	--
Output AC voltage [V]	230 N/PE @ 50Hz/60Hz	--	--	--
Output AC current [A]	14,5	--	--	--
Output power [VA]	3300	--	--	--
Battery DC voltage range [V]	41 – 63	--	--	--
Battery charge current [A]	63	--	--	--
Battery discharge current [A]	75	--	--	--

Firmware version	03.21.04.R or higher
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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 (HF transformer). Output switch-off is performed with single-fault tolerance based on two series-connected relays in (each) 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 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

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Operating Range.

Test 1	Voltage = 85% of nominal (195,5 V) Frequency = 47,0 Hz Power Factor = 1 Period of test 20 seconds
Connection:	Always connected
Limit:	Always connected
Test 2	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 3	Voltage = 110% of nominal (253,0 V) Frequency = 51,5 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 4	Voltage = 110% of nominal (253,0 V) Frequency = 52,0 Hz Power Factor = 1 Period of test 15 minutes
Connection:	Always connected
Limit:	Always connected
Test 5	Voltage = 100% of nominal (230,0 V) Frequency = 50,0 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 6 RoCoF withstand	Confirm that the Micro-Generating Plant is capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs-1 as measured over a period of 500 ms.
Connection:	Always connected
Limit:	Always connected



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Protection. Voltage tests.

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	184,0	2,5	183,4	2,640	188,0 V / 5,00 s	No trip
					180,0 V / 2,45 s	No trip
O/V stage 1	262,2	1,0	262,8	1,050	258,2 V / 5,00 s	No trip
O/V stage 2	273,7	0,5	274,3	0,540	269,7 V / 0,95 s	No trip
					277,7 V / 0,45 s	No trip

Note:

For Voltage tests the Voltage required to trip is the setting $\pm 3,45$ V. 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 ± 4 V 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	47,5	20	47,45	20,100	47,7 Hz / 30,00 s	No trip
U/F stage 2	47,0	0,5	46,95	0,570	47,2 Hz / 19,50 s	No trip
					46,8 Hz / 0,45 s	No trip
O/F stage 2	52,0	0,5	52,05	0,570	51,8 Hz / 120,00 s	No trip
					52,2 Hz / 0,45 s	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 [s]	0,180	0,173	0,243	0,179	0,171	0,242

Note:

Trip time limit is 0,5 s.

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 2.

Over Voltage

Time delay setting [s]

20

Measured delay [s]

38,6

Under Voltage

Time delay setting [s]

20

Measured delay [s]

38,6

Over Frequency

Time delay setting [s]

20

Measured delay [s]

38,6

Under Frequency

Time delay setting [s]

20

Measured delay [s]

38,6

Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.

At 266,2 V

At 180,0 V

At 47,4 Hz

At 52,1 Hz

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	49,0	+50 degrees		No trip
Negative Vector Shift	50,0	-50 degrees		No trip
Positive Frequency drift	49,0 to 51,0	+0,95 Hz/sec	2,1 s	No trip
Negative Frequency drift	51,0 to 49,0	-0,95 Hz/sec	2,1 s	No trip



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Limited Frequency Sensitive Mode – Over Frequency

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% P_n							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P_{expected} [W]:	N/A	3099	2935	2638	2935	3099	3133
P_{measured} [W]:	3291	3135	2963	2669	2958	3123	3283
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P_n							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P_{expected} [W]:	N/A	1529	1364	1068	1364	1529	3300
P_{measured} [W]:	1644	1548	1382	1088	1380	1537	3280

Power output with falling Frequency

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]:	3289	3279	3279
ΔP/P_{max} [%]:			0,6

Note:

Electronic inverter no power reduction take place.

Active power feed-in at under-frequency for electricity storage

Note.

Self-declaration provided by the manufacture



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Power Quality. Harmonics.

SI4.4M-13

SSEG rating per phase (rpp)						
	At 45-55% of rated output 1448 W	100% of rated output 3228 W				
Harmonic	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Measured Value (MV) in [A]	Measured Value (MV) in [%]	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,035	0,039	0,055	0,061	1,080	--
3rd	0,017	0,019	0,341	0,380	2,300	--
4th	0,010	0,011	0,034	0,038	0,430	--
5th	0,077	0,086	0,239	0,267	1,140	--
6th	0,005	0,006	0,029	0,032	0,300	--
7th	0,028	0,031	0,198	0,221	0,770	--
8th	0,003	0,003	0,013	0,014	0,230	--
9th	0,015	0,017	0,034	0,038	0,400	--
10th	0,002	0,002	0,013	0,014	0,184	--
11th	0,013	0,014	0,057	0,064	0,330	--
12th	0,003	0,003	0,009	0,010	0,153	--
13th	0,010	0,011	0,027	0,030	0,210	--
14th	0,002	0,002	0,008	0,009	0,131	--
15th	0,006	0,007	0,028	0,031	0,150	--
16th	0,001	0,001	0,005	0,006	0,115	--
17th	0,004	0,004	0,011	0,012	0,132	--
18th	0,001	0,001	0,003	0,003	0,102	--
19th	0,003	0,003	0,010	0,011	0,118	--
20th	0,001	0,001	0,003	0,003	0,092	--
21th	0,003	0,003	0,009	0,010	0,107	0,160
22th	0,001	0,001	0,002	0,002	0,084	--
23th	0,002	0,002	0,006	0,007	0,098	0,147
24th	0,001	0,001	0,001	0,001	0,077	--
25th	0,002	0,002	0,002	0,002	0,090	0,135
26th	0,001	0,001	0,001	0,001	0,071	--
27th	0,002	0,002	0,003	0,003	0,083	0,124
28th	0,001	0,001	0,001	0,001	0,066	--
29th	0,001	0,001	0,002	0,002	0,078	0,117
30th	0,001	0,001	0,001	0,001	0,061	--
31th	0,001	0,001	0,002	0,002	0,073	0,109
32th	0,001	0,001	0,001	0,001	0,058	--
33th	0,001	0,001	0,001	0,001	0,068	0,102
34th	0,001	0,001	0,001	0,001	0,054	--
35th	0,001	0,001	0,000	0,000	0,064	0,096
36th	0,001	0,001	0,001	0,001	0,051	--
37th	0,001	0,001	0,001	0,001	0,061	0,091
38th	0,000	0,000	0,001	0,001	0,048	--
39th	0,001	0,001	0,002	0,002	0,058	0,087
40th	0,001	0,001	0,001	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.

Output power	216,2 V	230,0 V	253,0 V	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	
	d_{\max} [%]	d_c [%]	$d_{(t)}$ [ms]	d_{\max} [%]	d_c [%]	$d_{(t)}$ [ms]	P_{st}	P_{it} 2 hours
Measured values at test impedance	0,50	0,10	0,00	3,00	2,90	0,00	0,070	0,070
Measured values at standard impedance	0,50	0,10	0,00	3,00	2,90	0,00	0,070	0,070
Values for maximum impedance	0,57	0,11	0,00	3,41	3,30	0,0	0,080	0,080
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500 ms	4%	3,3%	3,3% 500 ms	1,0	0,65
Test impedance								
	R	0,400	Ω	X_l	0,250	Ω		
	Z	0,472	Ω					
Standard impedance								
	R	0,400	Ω	X_l	0,250	Ω		
	Z	0,472	Ω					
Maximum impedance								
	R	0,455	Ω	X_l	0,284	Ω		
	Z_{\max}	0,537	Ω					



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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	20 ms	230,1	15,5
Initial Value of aperiodic current	A	N/A	100 ms	27,3	0,1
Initial symmetrical short-circuit current*	I_k	N/A	250 ms	27,1	0,1
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500 ms	26,9	0,1
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	2,800	

For rotating machines and linear piston machines the test should produce a 0 s – 2 s 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.

N/A

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) Required by paragraph 11.1.3

P

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

Yes