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Amtsgericht Kassel (District Court) HRB (registration number) 3972
Vorsitzender des Aufsichtsrats (Chairman of the Supervisory Board): Dr. Erik Ehrentraut
Managing Board: Ulrich Hadding, Dr.-Ing. Jürgen Reinert

Compliance Verification Report with the G98 Issue 1 Amendment 3 2018

Test record for Type A Inverter Connected Power Generating Modules

Manufacturer	**SMA Solar Technology AG**
Address	Sonnenallee 1, 34266 Niestetal (Germany)

Type Tested reference number	ZE_G98-1_SBx.x-1AV-41_en_10
Generating Unit technology	Single phase inverter
Test house details	**SMA Solar Technology AG**
Test period	From 2019-03-18 until 2019-04-29

Type reference	Max. apparent AC power (VA)	Rated AC power (W)	From FW Pack
SB6.0-1AV-41	6000	6000	1.01.32.R*
SB5.0-1AV-41	5000	5000	1.01.32.R*
SB4.0-1AV-41	4000	4000	1.01.32.R*
SB3.6-1AV-41	3680	3680	1.01.32.R*
SB3.0-1AV-41	3000	3000	1.01.32.R*

The results of the G98/1 are summarized in this certificate. SMA declares that all units shipped to the UK, with at least the aforementioned FW version, are within the specifications and parameters set by the G98/1 Engineering Recommendation, Amendment 3 2018.
* only in combination with the configuration file (*.bck)
These settings cannot be changed by an installer, user or by any person without authorization from SMA.
Note that all tests were carried out with the biggest inverter of the family under test. The results for the other inverters of the family are equivalent.

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Test Results

Power quality

Harmonics as per BS EN 61000-3-2								
Order	Frequency [Hz]	Thresholds [A]	P/Pn [%]					
			50		100		Max. NV / Limit [%]	
			MV [A]	NV [A]	MV [A]	NV [A]		
2	100	1,08	0,014	0,026	0,020	0,037	3,41%	✓
3	150	2,3	0,167	0,307	0,522	0,960	41,76%	✓
4	200	0,43	0,006	0,011	0,006	0,011	2,57%	✓
5	250	1,14	0,118	0,217	0,239	0,440	38,58%	✓
6	300	0,3	0,006	0,011	0,006	0,011	3,68%	✓
7	350	0,77	0,042	0,077	0,077	0,142	18,40%	✓
8	400	0,23	0,004	0,007	0,005	0,009	4,00%	✓
9	450	0,4	0,028	0,052	0,035	0,064	16,10%	✓
10	500	0,184	0,004	0,007	0,005	0,009	5,00%	✓
11	550	0,33	0,019	0,035	0,023	0,042	12,82%	✓
12	600	0,153	0,003	0,006	0,004	0,007	4,80%	✓
13	650	0,21	0,020	0,037	0,020	0,037	17,52%	✓
14	700	0,131	0,003	0,006	0,004	0,007	5,60%	✓
15	750	0,15	0,015	0,028	0,017	0,031	20,85%	✓
16	800	0,115	0,003	0,006	0,003	0,006	4,80%	✓
17	850	0,132	0,015	0,028	0,015	0,028	20,85%	✓
18	900	0,102	0,002	0,004	0,003	0,006	5,40%	✓
19	950	0,118	0,012	0,022	0,010	0,018	18,65%	✓
20	1000	0,092	0,002	0,004	0,003	0,006	6,00%	✓
21	1050	0,107	0,013	0,024	0,010	0,018	22,33%	✓
22	1100	0,084	0,002	0,004	0,002	0,004	4,40%	✓
23	1150	0,098	0,010	0,018	0,008	0,015	18,81%	✓
24	1200	0,077	0,002	0,004	0,002	0,004	4,80%	✓
25	1250	0,09	0,009	0,017	0,008	0,015	18,40%	✓
26	1300	0,071	0,002	0,004	0,002	0,004	5,20%	✓
27	1350	0,083	0,007	0,013	0,007	0,013	15,46%	✓
28	1400	0,066	0,002	0,004	0,002	0,004	5,60%	✓
29	1450	0,078	0,008	0,015	0,007	0,013	18,97%	✓
30	1500	0,061	0,002	0,004	0,002	0,004	6,00%	✓
31	1550	0,073	0,008	0,015	0,006	0,011	20,28%	✓
32	1600	0,058	0,002	0,004	0,002	0,004	6,40%	✓
33	1650	0,068	0,009	0,017	0,007	0,013	24,29%	✓
34	1700	0,054	0,002	0,004	0,002	0,004	6,80%	✓
35	1750	0,064	0,008	0,015	0,006	0,011	22,90%	✓
36	1800	0,051	0,002	0,004	0,002	0,004	7,20%	✓
37	1850	0,061	0,007	0,013	0,006	0,011	21,18%	✓
38	1900	0,048	0,002	0,004	0,002	0,004	7,60%	✓
39	1950	0,058	0,006	0,011	0,006	0,011	19,14%	✓
40	2000	0,046	0,002	0,004	0,003	0,006	12,00%	✓

MV - Measured Value NV - Normalized Value NV=MV*3,68/power per phase

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Active power operating range					
Test	Voltage	Frequency	cosphi	Time	Verification
1	195,5 V	47,5 Hz	1	90 min	✓
2	253 V	51,5 Hz	1	90 min	✓
3	253 V	52 Hz	1	15 min	✓

Power quality

Voltage fluctuations and flicker as per BS EN 61000-3-3								
	Starting			Stopping			Running	
	dmax	dc	d(t) in ms	dmax	dc	d(t) in ms	Pst	Plt (2hours)
Limit	4,0%	3,3%	500	4,0%	3,3%	500	1	0,65
MV	0,0%	0,0%	0	0,0%	0,0%	0	0,09	0,09
Verification	✓	✓	✓	✓	✓	✓	✓	✓

DC injection					Power factor			
	P/Pn [%]				P/Pn [%]	Voltage [V]		
	20	50	75	100		216,2	230	253
Limit	0,25% In	0,25% In	0,25% In	0,25% In	Limit	>0,95	>0,95	>0,95
MV	0,00396 A	0,00792 A	0,0106 A	0,00646 A	20	1,00	1,00	1,00
%Inom	0,02%	0,03%	0,04%	0,02%	50	1,00	1,00	1,00
Verification	✓	✓	✓	✓	75	1,00	1,00	1,00
					100	1,00	1,00	1,00
					Verification	✓	✓	✓

MV - Measured value

Protection - Grid monitoring and reconnection time

Trip Tests	G98/1		Setting		Measures Values		Verification
Function	Magnitude	Time	Magnitude	Time	Magnitude	Time	
Undervoltage	184 V	2,5 s	184 V	0,5 s	183,246 V	2,54 s	✓
Overvoltage stage 1	262,2 V	1 s	262,2 V	1 s	262,841 V	1,04 s	✓
Overvoltage stage 2	273,7 V	0,5 s	273,7 V	0,5 s	274,355 V	0,54 s	✓
Underfrequency stage 1	47,5 Hz	20 s	47,5 Hz	20 s	47,502 Hz	20,12 s	✓
Underfrequency stage 2	47 Hz	0,5 s	47 Hz	0,5 s	47,004 Hz	0,6 s	✓
Overfrequency	52 Hz	0,5 s	52 Hz	0,5 s	52,054 Hz	0,59 s	✓

No trip test	G98/1		Verification
	Magnitude	Time	
U/V 1	188 V	5,0 s	✓
U/V 2	180 V	2,45 s	✓
O/V 1	258,2 V	5,0 s	✓
O/V 2	269,7 V	0,95 s	✓
O/V 3	277,7 V	0,45 s	✓

No trip test	G98/1		Verification
	Magnitude	Time	
U/F 1	47,7 Hz	30 s	✓
U/F 2	47,2 Hz	19,5 s	✓
U/F 3	46,8 Hz	0,45 s	✓
O/F 1	51,8 Hz	120 s	✓
O/F 2	52,2 Hz	0,45 s	✓

Reconnection time			
Limit	Setting	MV	Verification
20 s	20 s	23,46 s	✓

No reconnection			
At 266,2 V	At 180 V	At 47,4 Hz	At 52,1 Hz
✓	✓	✓	✓

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Protection - Loss of mains

Loss of mains test according to the BS EN 62116						
Test power and imbalance	28 % -5%Q (Test 22)	58 % -5%Q (Test 12)	100 % -5%P (Test 5)	28 % +5%Q (Test 31)	58 % +5%Q (Test 21)	100 % +5%P (Test 10)
Trip time limit (s)	0,5	0,5	0,5	0,5	0,5	0,5
Measured Value L1 (s)	0,3718	0,3666	0,4084	0,3824	0,3838	0,3968
Measured Value L1L2L3 (s)*	0	0	0	0	0	0
Verification	✓	✓	✓	✓	✓	✓

* Only applicable to three phase inverters

Frequency change - Stability test				
	Start frequency	Change	End frequency	Verification
Positive vector shift	49,0 Hz	+50 degrees	N/A	✓
Negative vector shift	50,0 Hz	-50 degrees	N/A	✓
Positive frequency drift	49 Hz	+0,95 Hz/s	51 Hz	✓
Negative frequency drift	51 Hz	-0,95 Hz/s	49 Hz	✓

Behavior in case of frequency changes

Over-frequency test								
Frequency	P > 80%				P 40% - 60%			
	PDC	P (W)	Gradient	Verification	PDC	P (W)	Gradient	Verification
50 Hz	6217,62	5844	N/A	✓	3108,808	2930,659	N/A	✓
50,45 Hz	6217,62	5779,46	N/A	✓	3108,808	2879,139	N/A	✓
50,70 Hz	6217,62	5472,49	-21,25%	✓	3108,808	2728,839	-20,88%	✓
51,15 Hz	6217,62	4955,23	-19,89%	✓	3108,808	2470,638	-19,93%	✓
50,70 Hz	6217,62	5477,12	20,07%	✓	3108,808	2733,697	20,30%	✓
50,45 Hz	6217,62	5783,24	21,19%	✓	3108,808	2877,882	20,03%	✓
50 Hz	6217,62	5844,16	N/A	✓	3108,808	2918,953	N/A	✓

Under-frequency test				
Frequency	P = Pn			
	PDC	P (W)	Gradient	Verification
50,00 Hz	5790	5835	N/A	✓
49,55 Hz	5790	5834	N/A	✓
47,55 Hz	5790	5828	0,10%	✓

Various requirements

Fault level contribution		
Time after fault	Voltage (V)	Current (A)
< 50 ms	232,22	27,43
100 ms	13,09	0,07
250 ms	11,4	0,07
500 ms	12,16	0,06
Time to Trip	0,53	in seconds

Self monitoring - solid state switching
Not applicable as electro-mechanical relays are used

Active power curtailment
A Modbus signal can be used to cease Active Power output within 5 s

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