



Applicant: **Sonnen GmbH**
 Am Riedbach 1 im Innovationspark Allgäu,
 87499 Wildpoldsried,
 Germany

Product: **Battery storage system with PV input**

Model:	SonnenBatterie hybrid 9.53					
	9.53/2.5	9.53/5	9.53/7.5	9.53/10	9.53/12.5	9.53/15
Rating:	1,1kW	2,5kW	3,3kW			

Intended use:

An automatic disconnection device with single phase mains surveillance in accordance with Engineering Recommendation G99-1 for photovoltaic systems with a single phase parallel coupling via an inverter to the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter.

Applied standards and guidelines:

Engineering Recommendation G99 Issue 1 – Amendment 3 May 2018

Requirements for the connection of generation equipment in parallel with public distribution networks on or after 17 May 2019

The safety concept of an aforementioned representative product corresponds at the time of issue of this certificate to the valid safety specifications for the specified use in accordance with regulations.

Report No: 17PP322-13

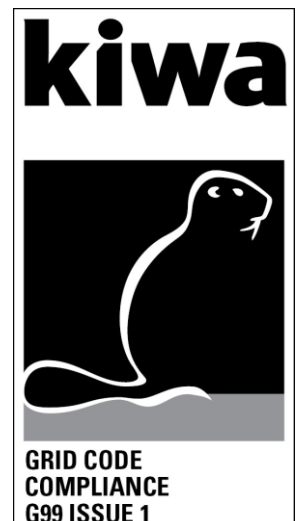
Certificate No: 19-076-00

Date of issue: 2019-06-17

CERTIFICATE

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Power Quality – Continuous voltage operation range					
Continuous frequency operation range					
	U [V]	f [Hz]	Cos ϕ	P [kW]	Limit [%Sn]:
Test 1	85%Un 195,5V	47,00Hz	1,00	100%Sn	—
Measured 20s avg	195,7	47,00	0,999	3,95	—
Test 2	85%Un 195,5V	47,50Hz	1,00	100%Sn	—
Measured 90min avg	195,6	47,50	0,999	3,66	—
Test 3	110%Un 253V	51,50Hz	1,00	100%Sn	—
Measured 90min avg	253,2	51,50	0,999	3,65	—
Test 4	110%Un 253V	52,00Hz	1,00	100%Sn	—
Measured 15min avg	253,1	52,10	0,999	3,65	—

Power Quality – Harmonics						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)			kVA		Harmonics % = Measured Value (Amps) x 23/rating per phase (kVA)	
Harmonic	At 45-55% of rated output		100% of rated output		Limit in BS EN 61000-3-12	
	Measured Value (MV) in Amps*	%	Measured Value (MV) in Amps*	%	1 phase	3 phase
2	0,016	0,080	0,016	0,080	8%	8%
3	0,042	0,210	0,034	0,170	21,6%	Not stated
4	0,006	0,030	0,006	0,030	4%	4%
5	0,042	0,210	0,034	0,170	10,7%	10,7%
6	0,004	0,020	0,004	0,020	2,67%	2,67%
7	0,026	0,130	0,014	0,070	7,2%	7,2%
8	0,002	0,010	0,004	0,020	2%	2%
9	0,026	0,130	0,008	0,040	3,8%	Not stated
10	0,002	0,010	0,004	0,020	1,6%	1,6%
11	0,016	0,080	0,024	0,120	3,1%	3,1%
12	0,002	0,010	0,002	0,010	1,33%	1,33%
13	0,032	0,160	0,024	0,120	2%	2%
THD	-	0,876	-	0,377	23%	13%
PWHD	-	1,656	-	0,913	23%	22%



Power Quality – Voltage Fluctuations and Flicker								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	-0,519	-0,314	-	4,607	3,207	270	0,192	0,191
Normalised to standard impedance	-0,519	-0,314	-	4,607	3,207	270	0,192	0,191
Normalised to required maximum impedance	-0,451	-0,273	-	4,000	2,784	-	0,167	0,166
Limit set under BS EN 61000-3-11	4%	3,3%	3,3%	4%	3,3%	3,3%	1,0	0,65
Limits	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Test Impedance	R	0,40	Ω	X	0,25	Ω		
Standard Impedance	R	0,40	Ω	X	0,25	Ω		
Maximum Impedance	R	0,35	Ω	X	0,22	Ω		
* Applies to three phase and split single phase Power Generating Modules.								
^ Applies to single phase Power Generating Module and Power Generating Modules using two phases on a three phase system.								

Power Quality – DC injection			
Test power level	10%	55%	100%
Recorded value in Amps	-6,1mA	-8,9mA	-9,9mA
As % of rated AC current	-0,03%	-0,04%	-0,05%
Limit	0,25%	0,25%	0,25%

Power Factor			
Voltage	0,94 pu (216.2 V)	1,0 pu (230 V)	1,1 pu (253 V)
Measured Value	1,000	1,000	1,000
Power Factor Limit	>0,95		



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	20 s	47,50 Hz	20,212 s	47,7Hz 25s	No trip
U/F stage 2	47,0Hz	0,5 s	47,00 Hz	717 ms	47,2 Hz 19,98s	No trip
					46,8 Hz 0,48 s	No trip
O/F	52,0Hz	0,5 s	52,10 Hz	736 ms	51,8 Hz 89,98 s	No trip
					52,2 Hz 0,48s	No trip

Protection – Voltage Tests.						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage time	Confirm no trip
U/V	0,8 pu (184V)	2,5s	184,5	2,745s	188 V 3,50 s	No trip
					180V 2,48 s	No trip
O/V stage 1	1,14 pu (262,2V)	1,0s	260,12	1,246s	258,2 V 2,0 s	No trip
O/V stage 2	1,19 pu (273,7V)	0,5s	271,3	743,4ms	269,7 V 0,98 s	No trip
					277,7 V 0,48 s	No trip



Protection – Loss of Mains Test according BS EN 62116 for Inverters.						
Test Power and imbalance	33% -5% Q	66% -5% Q	100% -5% Q	33% +5% Q	66% +5% Q	100% +5% Q
Trip time (s)	0,719	1,075	1,513	0,997	0,850	1,128
Protection – Frequency change, Vector Shift Stability test.						
	Start frequency	Change	Confirm no trip			
Positive vector shift	49,5Hz	+50 degrees	No trip			
Negative vector shift	50,5Hz	- 50 degrees	No trip			
Protection – Frequency Change, RoCoF Stability Test						
Ramp range	Test frequency ramp	Test duration	Confirm no Trip			
49,0 Hz to 51,0 Hz	+0,95 Hzs ⁻¹	2,1 s	No trip			
51,0 Hz to 49,0 Hz	-0,95 Hzs ⁻¹	2,1 s	No trip			
Protection – Limited Frequency Sensitive Mode – Over frequency Test						
Active Power response to rising frequency/time plots are attached						N
Protection – Power output with falling frequency test						
Test sequence at registered capacity >80%	Measured Active Power output	Frequency	Primary power source (if applicable)	Active Power Gradient		
Step a) 50,00Hz ± 0,01Hz	-4,20	50,01	Not applicable	-		
Step b) 50,45Hz ± 0,05Hz	-4,15	50,46		0,0%		
Step c) 50,70Hz ± 0,10Hz	-3,92	50,71		-0,4%		
Step d) 51,15Hz ± 0,05Hz	-3,50	51,15		-1,5%		
Step e) 51,70Hz ± 0,10Hz	-3,92	50,70		-0,7%		
Step f) 50,45Hz ± 0,05Hz	-4,15	50,45		-0,2%		
Step g) 50,00Hz ± 0,01Hz	-4,20	50,00		-		
Test sequence at registered capacity 40% - 60%	Measured Active Power output	Frequency	Primary power source (if applicable)	Active Power Gradient		
Step a) 50,00Hz ± 0,01Hz	-2,33	50,01	Not applicable	-		
Step b) 50,45Hz ± 0,05Hz	-2,28	50,46		-0,4%		
Step c) 50,70Hz ± 0,10Hz	-2,05	50,71		-3,0%		
Step d) 51,15Hz ± 0,05Hz	-1,63	51,15		-7,6%		
Step e) 50,70Hz ± 0,01Hz	-2,05	50,70		-3,0%		
Protection – Reconnection Timer						



Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
20 s	20 s	At 1,16 pu (266,2V)	At 0,85 pu (196,1V)	At 47,4 Hz	At 52,1 Hz
Confirmation that the Power Generating Module does not re-connect.		No reconnection	No reconnection	No reconnection	No reconnection

Fault Level Contribution

For Inverter Output

Parameter	Symbol	Time after fault	Volts	Amps
Peak short circuit current	i_p	20ms	61,9	18,7
Initial Value of aperiodic current	A	100ms	24,3	0,01
Initial symmetrical short-circuit current	I_k	250ms	24,1	0,01
Decaying (aperiodic) component of short-circuit current	i_{DC}	500ms	24,1	0,01
Time to trip			0,040	In seconds

As SSEGs (small-scale embedded generators) for PV are inverter-connected the max. short circuit current is the max. AC current.

Self-Monitoring Solid state switching

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 s.	NA
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Wiring functional Tests

Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	NA
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Logic interface (input port)

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

Not applicable
