

## Declaration of Conformity

We manufacturer

sonnen GmbH

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declare that the product

sonnenBatterie 10

is in conformity with the applicable essential requirements of the following standard:

Engineering Recommendation G98/NI Issue 1 - April 2019

Wildpoldsried, 07.12.2021



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Norbert Hinz (CTO)

Firmware v1.34 is currently implemented at field applications. The following results were measured at firmware v1.38 (or higher) at sonnen test lab and will be released soon to the field applications.

**Applicant:** sonnen GmbH  
Im Innovationspark Allgäu  
87499 Wildpoldsried  
Germany

**Product:** Battery Storage System with integrated automatic disconnection device between a generator and the public low-voltage grid

<b>Model:</b>	sonnenBatterie 10/5,5 sonnenBatterie 10/11 sonnenBatterie 10/16,5 sonnenBatterie 10/22 sonnenBatterie 10/27,5
<b>Rating:</b>	230 Vac, 3680 W / 3680 VA, 16,0 A

**Intended use:**

Battery Storage system with an automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G98 Issue 1 – Amendment 4 for 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 afore mentioned inverter.

**Applied standards and guidelines:**

**Engineering Recommendation G98/NI Issue 1 - April 2019**

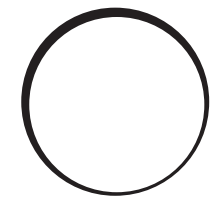
Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16A per phase) in parallel with public Low Voltage Distribution Networks in Northern Ireland on or after 27 April 2019.

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

**Limitation:**

The unit did not comply with the requirements of EN 61000-3-3 for Voltage flicker on a normalised standard impedance. The unit comply with a maximum impedance of R:0,34, X:0,21

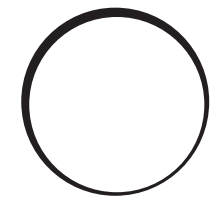
Power Quality: Continuous voltage operation range					
Continuous frequency operation range					
Generating Unit tested to EN 50438:2013					
	U [V]	f [Hz]	Cos $\varphi$	P [kW]	Limit [%Sn]:
Test 1	85%Un	47,50 Hz	1,00	100%Sn	P $\geq$ 85%Sn
Measured 90min avg	195,6	47,50 Hz	1,000	3,67	100,0
Test 2	110%Un	51,50 Hz	1,00	100%Sn	-
Measured 90min avg	253,0	51,50 Hz	0,999	3,68	100,3
Test 3	110%Un	52,00 Hz	1,00	100%Sn	-
Measured 15min avg	253,0	52,10 Hz	0,999	3,66	100,3



**Power Quality: Harmonics**

Micro-Generator tested to BS EN 61000-3-2

Micro-Generator rating per phase (rpp)		3,68	kW	
Harmonic	At 45-55% of Registered capacity	100% of Registered capacity		
	Measured Value (MV) in Amps	Measured Value (MV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0,010	0,010	1,080	
3	0,040	0,140	2,300	
4	0,000	0,010	0,430	
5	0,010	0,040	1,140	
6	0,000	0,010	0,300	
7	0,010	0,020	0,770	
8	0,000	0,010	0,230	
9	0,010	0,010	0,400	
10	0,000	0,000	0,184	
11	0,000	0,010	0,330	
12	0,000	0,000	0,153	
13	0,000	0,010	0,210	
14	0,000	0,000	0,131	
15	0,010	0,010	0,150	
16	0,000	0,000	0,115	
17	0,010	0,020	0,132	
18	0,000	0,000	0,102	
19	0,020	0,020	0,188	
20	0,000	0,000	0,092	
21	0,020	0,020	0,107	0,160
22	0,000	0,000	0,084	
23	0,020	0,020	0,098	0,147
24	0,000	0,000	0,077	
25	0,020	0,020	0,090	0,135
26	0,000	0,000	0,071	
27	0,010	0,010	0,083	0,124
28	0,000	0,000	0,066	
29	0,010	0,010	0,078	0,117
30	0,000	0,000	0,061	
31	0,010	0,010	0,073	0,109
32	0,000	0,000	0,058	
33	0,010	0,010	0,068	0,102
34	0,000	0,000	0,054	
35	0,010	0,010	0,064	0,096
36	0,000	0,000	0,051	
37	0,010	0,010	0,061	0,091
38	0,000	0,000	0,048	
39	0,020	0,020	0,058	0,087
40	0,000	0,000	0,046	



### Power Quality: Voltage fluctuations and flicker

	Starting			Stopping			Running	
	d <sub>max</sub> [%]	d <sub>c</sub> [%]	d <sub>(t)</sub> [ms]	d <sub>max</sub> [%]	d <sub>c</sub> [%]	d <sub>(t)</sub> [ms]	P <sub>st</sub>	P <sub>it</sub> 2 hours
Measured Values at test impedance	-3,608	-2,810	0	3,665	3,133	0	0,137	0,137
Normalised to standard impedance	-3,608	-2,810	0	3,665	3,133	0	0,137	0,137
Normalised to required maximum impedance	-3,449	3,300	0	3,077	3,051	0	0,115	0,115
Limits set under BS EN 61000-3-11	4 %	3,3 %	3,3 %	4 %	3,3 %	3,3 %	1,00	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	0,34	Ω	XI		0,21	Ω	
Test start date	2021-02-01		Test end date			2021-04-22		
Test Location	sonnen GmbH, Am Riedbach 1, 87499 Wildpoldsried, Germany							

### Power Quality: DC injection

Test power level	20 %	50 %	75 %	100 %
Recorded value in Amps	-0,015	-0,015	-0,016	-0,013
As % of rated AC current	-0,10 %	-0,10 %	-0,11 %	-0,09 %
Limit	0,25 %	0,25 %	0,25 %	0,25 %

### Power Quality: Power factor

	216,2 V	230 V	253 V
20% of Registered Capacity	0,999	0,999	0,999
50% of Registered Capacity	1,000	1,000	1,000
75% of Registered Capacity	1,000	1,000	1,000
100% of Registered Capacity	1,000	1,000	1,000
Limit	>0,95	>0,95	>0,95

Protection: Frequency tests							
Function	Setting		Trip test		"No trip tests"		
	Frequency	Time delay	Frequency	Time delay	Frequency/time		Confirm no trip
U/F stage	48,0 Hz	0,5 s	48,0 Hz	0,578 s	48,2 Hz	25 s	No Trip
					47,8 Hz	0,45 s	No Trip
O/F stage	52,0 Hz	1,0 s	52,00 Hz	1,089 s	51,8 Hz	120 s	No Trip
					52,2 Hz	0,98 s	No Trip

Protection: Voltage tests							
Function	Setting		Trip test		"No trip tests"		
	Voltage	Time delay	Voltage	Time delay	Voltage/time		Confirm no trip
U/V stage 1	195,5 V	3,0 s	195,5 V	3,046 s	199,5 V	5 s	No trip
U/V stage 2	138,0 V	2,0 s	138,0 V	2,046 s	142,0 V	2,5 s	No trip
					134,0 V	1,98 s	No trip
O/V stage 1	253,0 V	0,5 s	253,0 V	0,546 s	249,0 V	5,0 s	No trip
					257,7 V	0,45 s	No trip

Protection: Loss of Mains test and single phase test							
Note as an alternative, inverters can be tested to BS EN 62116. The following subset of tests should be recorded in the following table.							
Test power and imbalance	33 %	66 %	100 %	33 %	66 %	100 %	
	-5 % Q (Tests 22)	-5 % Q (Test 12)	-5 % Q (Test 5)	+5 % Q (Test 31)	+5 % Q (Test 21)	+5 % P (Test 10)	
Trip time	401 ms	375 ms	355 ms	434 ms	435 ms	420 ms	
Ph 1 removed	Conform trip	Ph2 removed	N/A	Ph 3 removed	N/A		
Note: for technologies which have substantial shut down time this can be added to the 0,5 s in establishing that the trip occurred in less than 0,5 s. Maximum shut down time could therefore be up to 1.0 s for these technologies.							

Protection: Frequency change, Vector Shift Stability test			
	Start frequency	Change	Confirm no trip
Positive vector shift	49,5 Hz	+50 degrees	No Trip
Negative vector shift	50,5 Hz	-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 Hz/s	2,1 s	No Trip
51,0 Hz to 49,0 Hz	-0,95 Hz/s	2,1 s	No Trip

Protection: Limited Frequency Sensitive Mode – Over frequency test (Threshold frequency of 50.2 Hz and Droop of 4 %)				
Test sequence at Registered Capacity >80 %	Measured Active Power Output	Frequency (Hz)	Primary Power Source	Active Power Gradient
Step a) 50,00 Hz ± 0,01 Hz	3,48 kW	50,00	N/A	-
Step b) 50,25 Hz ± 0,05 Hz	3,36 kW	50,25		-
Step c) 50,70 Hz ± 0,10 Hz	2,59 kW	50,70		-
Step d) 51,15 Hz ± 0,05 Hz	1,82 kW	51,14		-
Step e) 50,70 Hz ± 0,10 Hz	2,59 kW	50,69		-
Step f) 50,45 Hz ± 0,05 Hz	3,36 kW	50,24		-
Step g) 50,00 Hz ± 0,01 Hz	3,48 kW	50,00		-
Test sequence at Registered Capacity 40 % - 60 %	Measured Active Power Output	Frequency (Hz)	Primary Power Source	Active Power Gradient (≤ 10,0 %)
Step a) 50,00 Hz ± 0,01 Hz	1,89 kW	50,00	N/A	-
Step b) 50,25 Hz ± 0,05 Hz	1,82 kW	50,24		-
Step c) 50,70 Hz ± 0,10 Hz	1,40 kW	50,70		-
Step d) 51,15 Hz ± 0,05 Hz	0,98 kW	51,15		-
Step e) 50,70 Hz ± 0,10 Hz	1,40 kW	50,70		-
Step f) 50,25 Hz ± 0,05 Hz	1,82 kW	50,45		-
Step g) 50,00 Hz ± 0,01 Hz	3,61 kW	50,00		9,64 %

Protection: Power output with falling frequency test			
Test sequence	Measured Active Power output	Frequency	Primary power source
Test a) 50 Hz ± 0,01 Hz	3577 W	50,00 Hz	N/A
Test b) Point between 49,5 Hz and 49,6 Hz	3577W	49,55 Hz	
Test c) Point between 47,5 Hz and 47,6 Hz	3577 W	47,55 Hz	

Protection: Re-connection timer					
Time delay settings (s)	Measured delay (s)	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 10.5.7.1			
60	65	At 257,0 V	At 191,5 V	At 47,9 Hz	At 52,1 Hz
Confirmation that the <b>Micro-generator</b> does not re- connect		No reconnection	No reconnection	No reconnection	No reconnection

Fault Level contribution					
For machines with electro-magnetic output			For inverter output		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$i_p$	-	20 ms	74,4	23,05
Initial Value of aperiodic current	A	-	100 ms	24,6	0,03
Initial symmetrical short-circuit current	$I_k$	-	250 ms	23,8	0,03
Decaying (aperiodic) component of short-circuit current	$i_{DC}$	-	500 ms	23,8	0,03
Reactance/Resistance Ratio of source	X/R	-	Time to trip	0,095	in seconds

Logic Interface	Yes
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Self Monitoring solid state switching	
It has been verified that in the event of the solid state switching device failing to disconnect the Micro-Generator, the voltage on the output side of the switching device is reduced to a value below 50 volt within 0,5s.	N/A*
*The inverter provides mechanical relay.	