



**BUREAU  
VERITAS**

# Certificado de conformidade

**Requerente:** SMA Solar Technology AG  
Sonnenallee 1  
34266 Niestetal  
Alemanha

**Produto:** Microgerador em paralelo com redes de distribuição pública de baixa tensão

**Modelo:** SB1.5-1VL-40  
SB2.0-1VL-40  
SB2.5-1VL-40

## Utilização de acordo com os regulamentos:

Dispositivo de desconexão automática com monitorização da rede monofásica para sistemas fotovoltaicos com um circuito paralelo monofásico através de um inversor na alimentação pela rede pública. O dispositivo de desconexão automática é parte integrante do inversor anteriormente mencionado.

## Regras e normas aplicadas:

EN 50438:2013 / PN EN 50438:2015

Requisitos para as instalações de microprodução destinadas a serem ligadas em paralelo com as redes públicas de distribuição de baixa tensão

EN 50438:2013 / PN EN 50438:2015 com as definições de protecção de interface padrão para Portugal.

*Limites básicos:*  
*sobretensão 264,5 V*  
*subtensão 195,5 V*  
*sobrefrequência 51,0 Hz*  
*subfrequência 47,0 Hz*

Aquando da emissão deste certificado, o conceito de protecção de interface de um produto representativo anteriormente mencionado corresponde a especificações de segurança válidas para a utilização especificada, de acordo com os regulamentos. Os testes e certificação foram realizados de acordo com a norma ISO / IEC sistema 5 – Guia 67:2004.

**Número de relatório:** 14TH0397-EN50438-2013\_1  
**Número de certificado:** U19-0015  
**Data de emissão:** 2019-01-11 **Válido até:** 2024-01-10

**Órgão de certificação**



Holger Schaffer



Deutsche  
Akkreditierungsstelle  
D-ZE-12024-01-00

Órgão de certificação da Bureau Veritas Consumer Products Services Germany GmbH  
Acreditado nos termos da norma DIN EN ISO/IEC 17065

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

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**Type Approval and declaration of compliance with the requirements of EN 50438.**

<b>Manufacturer / applicant:</b>	SMA Solar Technology AG Sonnenallee 1 34266 Niestetal Alemanha		
<b>Micro-generator Type</b>	Grid-tied photovoltaic inverter		
<b>Rated values</b>	<b>SB1.5-1VL-40</b>	<b>SB2.0-1VL-40</b>	<b>SB2.5-1VL-40</b>
<b>Maximum rated capacity</b>	1,50 kW	2,00 kW	2,50 kW
<b>Rated voltage</b>	230V		
<b>Firmware version</b>	2.05		
<b>Measurement period:</b>	2015-03-19 to 2015-03-20		

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 micro-generators are tested according to the requirements in the EN 50438. 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 EN 50438.

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**Type testing of the interface protection**

**Over-/under-voltage tests**

Parameter	Protection limit		Actual setting		Trip value (test result)	
	Voltage [V]	Disconnection time [s]	Voltage [V]	Disconnection time [s]	Voltage [V]	Disconnection time [s]
Over-voltage stage 1	253	3*	253	600*	253,0	506*
Over-voltage stage 2	264,5	0,2	264,5	0,2	265,7	0,177
Under-voltage stage 1	195,5	1,5	195,5	1,5	195,5	1,477

Note.  
 Minimum operation time according to default interface protection:  
 Over-voltage stage 1 -  
 Over-voltage stage 2 0,1s  
 Under-voltage 1,2s

\* The over-voltage-stage 1 is a 10-min-mean-value according to EN 50160. The disconnection after detection of an overvoltage at the 10-min-mean-value takes place within 200ms.

**Over-/under-frequency tests**

Parameter	Protection limit		Actual setting		Trip value (test result)	
	Frequency [Hz]	Disconnection time [s]	Frequency [Hz]	Disconnection time [s]	Frequency [Hz]	Disconnection time [s]
Over-frequency	52,0	0,5	52,0	0,5	52,02	487
Under-frequency	47,5	0,5	47,5	0,5	47,50	493

Note.  
 Minimum operation time according to default interface protection:  
 Over-frequency 0,5 s  
 Under-frequency 0,5 s

**LoM test**

Method used	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. Phase 1 fuse removed [ms]	516 ms	513 ms	991 ms	527 ms	516 ms	998 ms

Indicate additional shut down time included in above results. (Integrated interface switch)	Indicate additional shut down time included in above results. (Integrated interface switch)
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**Type testing of a micro-generator**

**Operating range**

Test 1: U = 195,5 V; f = 47,5 Hz; P = 1,00 Sn; cosφ = 1

Test 2: U = 253,0 V; f = 51,5 Hz; P = 1,00 Sn; cosφ = 1

Test sequence	Voltage [V]	Frequency [Hz]	Output power [W]	Cos φ [1]
1	195,5	47,50	2220	1
2	253,0	51,50	2524	1

**Active power at under-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	49,55	47,55
Active power [kW]:	2,22	2,22	2,22
ΔP/PM [%] per 1 Hz:			1,33

**Power response to 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
<b>1. Measurement a) to g): Active power output &gt; 80% Pn</b>						
P <sub>AC</sub> , 30s [W]:	2224	2208	2037	1867	2037	2208
P <sub>des</sub> [W]:	N/A	2211	2040	1870	2040	2211
ΔP [W]:	N/A	-2,571	-3,05	-2,58	-3,02	-2,50
ΔP [%P <sub>nom</sub> ]:	N/A	-0,10	-0,12	-0,10	-0,12	-0,10
P <sub>MPP</sub> [W]	2332	2332	2332	2332	2332	2332
<b>2. Measurement a) to g): Active power output 40% and 60% after freezing &gt; 80% Pn</b>						
P <sub>AC</sub> , 30s [W]:	1258	1247	1150	1054	1150	1246
P <sub>des</sub> [W]:	N/A	1246	1150	1054	1150	1246
ΔP [W]:	N/A	0,15	-0,21	-0,023	-0,18	-0,28
ΔP [%P <sub>nom</sub> ]:	N/A	0,006	-0,008	-0,001	-0,007	-0,011
P <sub>MPP</sub> [W]	1295	1295	2331	2331	2331	2331

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Controllable reactive power			
Inductive (supply reactive power)			
Power-BIN	Active power [%]	Reactive power [%]	Power factor (cos $\varphi$ )
0% - 10%	5,2	-3,5	0,823
10% - 20%	15,5	-9,8	0,845
20% - 30%	25,4	-15,9	0,849
30% - 40%	35,3	-21,9	0,850
40% - 50%	45,1	-27,9	0,851
50% - 60%	55,0	-33,9	0,851
60% - 70%	64,8	-39,9	0,851
70% - 80%	74,0	-45,6	0,851
80% - 90%	83,5	-51,3	0,852
90% - 100%	85,4	-52,8	0,851
Capacitive (supply reactive power)			
Power-BIN	Active power [%]	Reactive power [%]	Power factor (cos $\varphi$ )
0% - 10%	5,3	3,0	0,867
10% - 20%	15,6	9,6	0,853
20% - 30%	25,6	15,8	0,850
30% - 40%	35,4	22,0	0,849
40% - 50%	45,3	28,2	0,849
50% - 60%	55,1	34,5	0,848
60% - 70%	64,9	40,7	0,848
70% - 80%	74,2	46,4	0,848
80% - 90%	83,6	52,4	0,847
90% - 100%	84,7	52,9	0,848
Reactive power supply with set point Q=0			
Power-BIN	Active power [%]	Reactive power [%]	Power factor (cos $\varphi$ )
0% - 10%	5,2	0,27	0,999
10% - 20%	15,7	0,21	1,000
20% - 30%	25,6	0,15	1,000
30% - 40%	35,5	0,07	1,000
40% - 50%	45,5	0,01	1,000
50% - 60%	55,5	0,07	1,000
60% - 70%	65,3	0,13	1,000
70% - 80%	74,6	0,19	1,000
80% - 90%	84,1	0,25	1,000
90% - 100%	93,8	0,30	1,000
90% - 100%	5,2	0,27	0,999

Q adjustment				
	Reactive power set point Q [Var]	Measured reactive power Q [Var]	Measured cos $\varphi$	Deviation compared to setpoint $\Delta Q / PN$ [%]
- Qmin	-1250	-1252	-0,865	-0,07
0	0	2,08	0,999	0,08
+ Qmax	1250	1255	0,865	0,22

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Connection and starting to generate electrical power		
	Voltage conditions	
<b>a) Start up for voltage range</b>	<b>&lt;84% Un for twice of observation time</b>	<b>&lt;84% Un for twice of observation time</b>
<b>Connection:</b>	No connection	No connection
<b>Limit:</b>	No connection allowed	
<b>b) In voltage range at start-up</b>	<b>≥84% Un within twice setting observation time</b>	<b>≥84% Un within twice setting observation time</b>
<b>Reconnection time [s]</b>	75,91	75,91
<b>Limit:</b>	Connected after setting observation time (≥60s)	
<b>Gradient:</b>	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
<b>c) In voltage range after voltage failure</b>	<b>≥84% Un for twice of setting observation time</b>	<b>≥84% Un for twice of setting observation time</b>
<b>Reconnection time [s]</b>	66,3	66,3
<b>Limit:</b>	Reconnection after setting observation time (≥60s)	
<b>Gradient:</b>	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
	Frequency conditions	
<b>d) Start up for frequency range</b>	<b>&lt;47,45 Hz for twice of setting observation time</b>	<b>&lt;47,45 Hz for twice of setting observation time</b>
<b>Connection:</b>	No connection	No connection
<b>Limit:</b>	No connection allowed	
<b>e) In frequency range at start-up</b>	<b>≥47,45 Hz within twice of setting observation time</b>	<b>≥47,45 Hz within twice of setting observation time</b>
<b>Reconnection time [s]</b>	75,98	75,98
<b>Limit:</b>	Connected after setting delay time(≥60s)	
<b>Gradient:</b>	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
<b>f) In frequency range after frequency failure</b>	<b>≥47,45 Hz for twice of setting observation time</b>	<b>≥47,45 Hz for twice of setting observation time</b>
<b>Reconnection time [s]</b>	67,0	67,0
<b>Limit:</b>	Reconnection after setting observation time (≥60s)	
<b>Gradient:</b>	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	

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**Short-circuit current contribution**

**Short-circuit current parameters**

For a directly coupled micro-generator			For a Inverter micro-generator		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	76,89	12,37
Initial Value of aperiodic current	A	N/A	100ms	73,80	11,52
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	73,27	11,44
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	73,11	11,50
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	1,465	In seconds

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Power Quality. Harmonic current emission				
micro-generator		SB2.5-1VL-40		
Harmonic order n	Current Magnitude [A] at 100% rated output power	% of Fundamental	Phase	Harmonic current limit EN 61000-3-2, Class A [A]
1st	10,736	100,000	Phase 1	-
2nd	0,016	0,149	Phase 1	1,080
3rd	0,094	0,876	Phase 1	2,300
4th	0,003	0,028	Phase 1	0,430
5th	0,035	0,326	Phase 1	1,140
6th	0,003	0,028	Phase 1	0,300
7th	0,024	0,224	Phase 1	0,770
8th	0,002	0,019	Phase 1	0,230
9th	0,015	0,140	Phase 1	0,400
10th	0,002	0,019	Phase 1	0,184
11th	0,009	0,084	Phase 1	0,330
12th	0,002	0,019	Phase 1	0,153
13th	0,01	0,093	Phase 1	0,210
14th	0,002	0,019	Phase 1	0,131
15th	0,009	0,084	Phase 1	0,150
16th	0,001	0,009	Phase 1	0,115
17th	0,008	0,075	Phase 1	0,132
18th	0,001	0,009	Phase 1	0,102
19th	0,006	0,056	Phase 1	0,118
20th	0,001	0,009	Phase 1	0,092
21th	0,007	0,065	Phase 1	0,107
22th	0,001	0,009	Phase 1	0,084
23th	0,009	0,084	Phase 1	0,098
24th	0,001	0,009	Phase 1	0,077
25th	0,008	0,075	Phase 1	0,090
26th	0,001	0,009	Phase 1	0,071
27th	0,006	0,056	Phase 1	0,083
28th	0,001	0,009	Phase 1	0,066
29th	0,007	0,065	Phase 1	0,078
30th	0,001	0,009	Phase 1	0,061
31th	0,006	0,056	Phase 1	0,073
32th	0,001	0,009	Phase 1	0,058
33th	0,007	0,065	Phase 1	0,068
34th	0,001	0,009	Phase 1	0,054
35th	0,007	0,065	Phase 1	0,064
36th	0,001	0,009	Phase 1	0,051
37th	0,007	0,065	Phase 1	0,061
38th	0,001	0,009	Phase 1	0,048
39th	0,006	0,056	Phase 1	0,058
40th	0,001	0,009	Phase 1	0,046



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Voltage fluctuation and Flicker.					
	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-3				
Value	Pst	Plt 2 hours	d(t) <sub>500ms</sub>	dc	dmax
Limit	1,0	0,65	3,3%	3,3%	4%
Test value	0,07	0,07	0,00%	0,00%	0,00%

DC-Injection.				
Protection limit	Tested at four power levels limit 0,5% of IAC <sub>nom</sub>			
Output power	~20%	~20%	~20%	~20%
Max. test value (phase L1) [mA]	3,70	3,70	3,70	3,70