

# **Certificate of compliance**

**Applicant:** 

SolarEdge Technologies Ltd. 1 HaMada Street Herzeliya 4673335

**Product:** 

Compact photovoltaic inverter

Model:

SE1000M SE1500M SE2000M SE2500M

Israel

# Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G98/1 for photovoltaic 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 that can access the distribution network provider at any time.

# Applied rules and standards:

# Engineering Recommendation G98/1-4:2019

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 (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.

Certification program: Report number: Certificate number: Date of issue: NSOP-0032-DEU-ZE-V01 17TH0251-G98/1\_4 U20-0094 2020-02-25

**Certification body** 

Holger Schaffer

Certification body of Bureau Veritas Consumer Products Services Germany GmbH Accredited according to DIN EN ISO/IEC 17065

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Annendix C Type Test Verification Report									
Extract from test report according to the Engineering Recommendation G98 Nr. 17TH0251-G98/1_4									
Type Approval and declaration of compliance with the requirements of Engineering Recommendation G98									
PGM Technology	Photovoltaic inverter								
Manufacturer:	SolarEdge Technologies	s Ltd.							
Address	1 HaMada Street Herzeliya 4673335 Israel	HaMada Street Ierzeliya I673335 srael							
Tel	+972-9-957-6620		Fax		+972-9	-957-6591			
Email	info@solaredge.com		Website		www.so	blaredge.com			
					<u> </u>				
Rated values	SE1000M		SE1500M	SE2000	N	SE2500M			
Maximum rated capacity	1000W		1500W	2000W		2500W			
Rated voltage	220/230 60Hz/50Hz								
Firmware version	Main DSP software vers Aux DSP software versi	sion is 1. on is 2.(	.00 01						
Measurement period:	2017-12-10 to 2018-02- 2019-01-10 to 2019-02- 2019-05-16	20 05							

Description of the structure of the power generation unit:

2019-06-18 2019-07-03

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 an error.

#### **Differences between Generating Units:**

The inverters SE1000M, SE1500M and SE20000M and are based on the inverter SE2500M. They use the same controller unit, control system and software. Therefore testing of the SE2000M only based on the control functions are identical in the SE1000M, SE1500M and SE2500M.

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 Re	Appendix C Type Test Verification Report						
Extract from test report according to	the Engineering Recommendation G98	Nr. 17TH0251-G98/1_4					
Operating Range.							
Connection:	Always connected						
Limit:	Always connected						
Test 1	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 2	Voltage = 110% of nominal (253 V) Frequency = 51.5 Hz Power Factor = 1 Period of test 90 minutes						
Connection:	Always connected						
Limit:	Always connected						
Voltage = 110% of nominal (253 V)   Frequency = 52.0 Hz   Power Factor = 1   Period of test 15 minutes							
Connection:	Always connected						
Limit:	Always connected						

Protection. Voltage tests.										
Phase 1										
Function	Set	ting	Trip	test	No trip	test				
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip				
U/V	184	2,5	184,6	2,757	188V / 5s	No trip				
					180V / 2,45s	No trip				
O/V stage 1	262,2	1,0	261,9	1,259	258,2V 5,0s	No trip				
O/V stage 2	269,7V 0,95s	No trip								
					277,7V 0,45s	No trip				

Note. For Voltage tests the Voltage required to trip is the setting  $\pm 3,45V$ . 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  $\pm 4V$  and for the relevant times as shown in the table above to ensure that the protection will not trip in error.



## Appendix C Type Test Verification Report

#### Extract from test report according to the Engineering Recommendation G98

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Protection. Frequency tests.									
Function	Sett	ting	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	47,52	20,271	47,7Hz / 30s	No trip			
U/F stage 2	47	0,5	47,01	0,786	47,2Hz / 19,5s	No trip			
					46,8Hz / 0,45s	No trip			
O/F stage 2	52	0,5	52,01	0,784	51,8Hz / 120s	No trip			
52,2Hz / 0,45s No trip									
Note For Frequency	v Trip tests the Fre	quency required to	o trip is the setting	+0 1Hz In order to	measure the time	e delav a larger			

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.

Protection. Loss of Mains.										
SE2500M										
Inverters tested accord	Inverters tested according to BS EN 62116.									
Balancing load on islanded network	Balancing load on islanded network   33% of -5% Q   66% of -5% Q   100% of -5% Q   33% of +5% Q   66% of +5% Q   100% of +5% Q     Test 22   Test 12   Test 5   Test 31   Test 21   Test 10									
Trip time. Ph1 fuse removed [s]   0,093   0,080   0,113   0,043   0,115   0,117										
Note. Trip time limit is	0.5s. For technol	ogies which have	a substantial shut o	down time this can	be added to the 0.	5s in establishing				

Note. Trip time limit is 0,5s. For technologies which have a substantial shut down time this can be added to the 0,5s in establishing that the trip occurred in less than 0,5s maximum. Shut down time could therefore be up to 1,0s for these technologies.



Appendix C Type Test Verification	Appendix C Type Test Verification Report							
Extract from test report according	ig to the Engineering R	ecomm	endation G98	N	r. 17TH0251-G98/1_4			
Protection. Re-connection timer								
Test should prove that the reconn within the stage 1 settings of table	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 10.5.7.1.							
	0	ver Vo	ltage					
Time delay	setting			Measured delay				
20s				49,0s				
	Ui	nder Vo	oltage					
Time delay setting Measured delay								
20s	i			58,0s				
	Ov	er Freq	uency					
Time delay	setting			Measured delay				
20s				49,0s				
	Unc	der Free	quency					
Time delay	setting			Measured delay				
20s				53,0s				
	Checks on no reconnect of table 1.	tion wh	en voltage or frec	quency is brought to just	outside stage 1 limits			
At 266,2V   At 196,1V   At 47,4Hz   At 52,1Hz								
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	49,5	+50 degrees		No trip							
Negative Vector Shift	50,5	-50 degrees		No trip							
Positive Frequency drift	Positive Frequency drift   49,0 to 51,0   +0,95Hz/sec   2,1s   No trip										
Negative Frequency drift	51,0 to 49,0	-0,95Hz/sec	2,1s	No trip							

Appendix C Type Test Verification Report									
Extract from test report according to the Engineering Recommendation G98 Nr. 17TH0251-G98/1_4									
Limited Frequency Sensitive Mode – Over Frequency									
		S	E2000M						
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 outpu	t > 80% Pn							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00		
P <sub>expected</sub> [kW]:	N/A	1,88	1,79	1,62	1,79	1,88	N/A		
P <sub>measured</sub> [kW]:	1,90	1,88	1,79	1,62	1,79	1,88	1,90		
2. Measurement a) to g): Active	power outpu	t 40% and 60	% after freezi	ng > 80% Pn					
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00		
Pexpected [kW]:	N/A	1,00	0,95	0,86	0,95	1,00	N/A		
P <sub>measured</sub> [kW]:	1,01	1,00	0,95	0,86	0,95	1,00	1,01		

Output Power with falling Frequency								
SE2000M								
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 [W]:	1981	1980	1879					
ΔΡ/ΡΜ [%] per 1 Hz:			0					



# Appendix C Type Test Verification Report

#### Extract from test report according to the Engineering Recommendation G98

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Power Quality. Harmonics.

	SE2500M									
			Phase 1							
SSE	G rating per phase	(rpp)								
	At 45-55% of 1,21	rated ouput kW	100% of ra 2,20	ited output DkW						
Harmonic	Measured Value (MV) in [A]	Measured Value (%) in [A]	Measured Value (MV) in [A]	Measured Value (%) in [A]	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above				
2nd	0,022	0,206	0,011	0,100	1,080					
3rd	0,075	0,696	0,073	0,679	2,300					
4th	0,014	0,129	0,011	0,104	0,430					
5th	0,026	0,243	0,029	0,271	1,140					
6th	0,011	0,098	0,012	0,109	0,300					
7th	0,024	0,223	0,022	0,206	0,770					
8th	0,011	0,105	0,012	0,108	0,230					
9th	0,022	0,208	0,027	0,253	0,400					
10th	0,011	0,098	0,012	0,112	0,184					
11th	0,022	0,206	0,026	0,237	0,330					
12th	0,011	0,104	0,013	0,118	0,153					
13th	0,023	0,217	0,023	0,212	0,210					
14th	0,011	0,104	0,012	0,109	0,131					
15th	0,023	0,214	0,023	0,216	0,150					
16th	0,012	0,112	0,013	0,119	0,115					
17th	0,024	0,227	0,027	0,249	0,132					
18th	0,013	0,117	0,014	0,133	0,102					
19th	0,024	0,219	0,026	0,240	0,118					
20th	0,014	0,131	0,015	0,141	0,092					
21th	0,023	0,217	0,023	0,213	0,107	0,160				
22th	0,013	0,122	0,014	0,134	0,084					
23th	0,024	0,221	0,023	0,217	0,098	0,147				
24th	0,013	0,120	0,015	0,138	0,077					
25th	0,024	0,224	0,024	0,226	0,090	0,135				
26th	0,012	0,113	0,014	0,131	0,071					
27th	0,023	0,212	0,025	0,231	0,083	0,124				
28th	0,012	0,108	0,013	0,123	0,066					
29th	0,022	0,203	0,023	0,210	0,078	0,117				
30th	0,010	0,097	0,012	0,109	0,061					
31th	0,019	0,179	0,018	0,169	0,073	0,109				
32th	0,009	0,087	0,011	0,098	0,058					
33th	0,017	0,154	0,017	0,157	0,068	0,102				
34th	0,008	0,076	0,010	0,088	0,054					
35th	0,016	0,152	0,018	0,165	0,064	0,096				
36th	0,008	0,074	0,009	0,079	0,051					
37th	0,016	0,146	0,015	0,144	0,061	0,091				
38th	0,007	0,066	0,007	0,069	0,048					
39th	0,014	0,129	0,014	0,127	0,058	0,087				
40th	0.006	0.056	0.007	0.067	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. The test had been performed on the model SE3680H, SE2200H and SE10000H the test results are valid for the SE3000H, SE3500H, SE3680H, SE4000H, SE4600H, SE5000H\* (4985W), SE5000H, SE6000H and SE8000H since it is identical in hardware and just the output power derated by software.



Appendix C Type Test Verification Report								
Extract from test report according to the Engineering Recommendation G98 Nr. 17TH0251-G98/1								
Power Quality. Power factor.								
Output power	216,2V	230V	253V	Measured at three voltage levels and at full				
20%	0,999	0,999	0,999	output. Voltage to be maintained within $\pm 1,5\%$ of the stated level during the test.				
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.										
SE2500M										
	Starting Stopping Running							ning		
	dmax	dc		d(t)	dmax	c	lc	d(t)	Pst	Plt 2 hours
Measured values at test impedance	1,195%	0,996	5%	0,00%	1,195%	0,9	96%	0,00%	0,213	0,166
Values for standard impedance	1,195%	0,996	5%	0,00%	1,195%	0,9	96%	0,00%	0,213	0,166
Limits set under BS EN 61000-3-11	4%	3,3%	6	3,3% 500ms	4%	3,:	3%	3,3% 500ms	1,0	0,65
Testimpodanco	R		(	0,4	Ω			XI	0,25	Ω
	Z		0,	,472	Ω					
Standard impodance	R		(	0,4	Ω			XI	0,25	Ω
Standard impedance   Z   0,472   Ω										
Note: For the test, the reference impe	dance acco	ording to	IECe	61000-3-3	was used					

Power Quality. DC injection.							
SE2500M							
Test level power [%]	10	55	100				
Recorded value [mA]	8,78	7,79	9,59				
Recorded value [%]	0,08	0,07	0,09				
Limit [%]	0,25	0,25	0,25				



### Appendix C Type Test Verification Report

#### Extract from test report according to the Engineering Recommendation G98

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Fault level Contribution.

SE2500M								
For a directly coupled SSEG			For a Inverter SSEG					
Parameter	Symbol	Value	Time after fault	Volts [V]	Amps [A]			
Peak Short Circuit current	Ιp	N/A	20ms	51,1	12,7			
Initial Value of aperiodic current	А	N/A	100ms	34,97	9,63			
Initial symmetrical short-circuit current*	I <sub>k</sub>	N/A	250ms	31,91	9,64			
Decaying (aperiodic) component of short circuit current*	İDC	N/A	500ms	30,86	10,16			
Reactance/Resistance Ratio of source*	X/R	N/A	Time to Trip [s]	0,606				

For rotating machines and linear piston machines the test should produce a 0s – 2s 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 Power Park Module, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.	N/A (No solid state switching device)		
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)	Р
Confirm that an input port is provided and can be used to shut down the module.	Yes