



**BUREAU
VERITAS**

Certificate of compliance

Applicant: SolarEdge Technologies Ltd.
1 HaMada St.
Herzliya, 4673335
Israel

Product: Grid-tied photovoltaic (PV) inverter

Model: SE1000M
SE1500M
SE2000M
SE2500M

Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with EN 50438:2013 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.

Applied rules and standards:

EN 50438:2013

Requirements for micro-generating plants to be connected 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.

Report number: 17TH0251_EN50438_0
Certificate number: U19-0175
Date of issue: 2019-03-19

Certification body



Holger Schaffer

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



Appendix E Type Verification Test Report

Extract from test report according to EN 50438

Nr. 17TH0251_EN50438_0

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

Manufacturer / applicant:	SolarEdge Technologies Ltd. 1 HaMada St. Herzliya, 4673335 Israel			
Micro-generator Type	Grid-tied photovoltaic inverter			
Rated values	SE1000M	SE1500M	SE2000M	SE2500M
Maximum rated capacity	1,0 kW	1,5 kW	2,0 kW	2,5 kW
Rated voltage	230V	230V	230V	230V
Firmware version	Main DSP: Version 1.00 Aux DSP: Version 2.01			
Measurement period:	2017-12-10 to 2018-03-05			

Description of the structure of the power generation unit:

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

Phase1						
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	253,0	3* / 600*	253,0	3* / 600*	253,0	3,000* / 491*
Over-voltage stage 2	264,5	0,2	264,5	0,2	263,8	0,167
Under-voltage stage 1	195,5	1,5	195,5	1,5	193,6	1,407

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	52,00	0,5	52,00	0,487
Under-frequency	47,5	0,5	47,50	0,5	47,50	0,495

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]	93	80	113	117	115	126

Indicate additional shut down time included in above results.
 (Integrated interface switch)

Type of switching equipment 1:
 Relay with 30ms
 Type of switching equipment 2:
 Relay with 30ms

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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	195,6	47,50	2289	0,997
2	253,9	51,00	2314	0,995

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	49,50	47,50
Active power [kW]:	2299	2298	2298
ΔP/PM [%] per 1 Hz:			0,05

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	g) 50,00
1. Measurement a) to g): Active power output > 80% P_n							
Frequency [Hz]:	50,09	50,24	50,69	51,13	50,68	50,24	49,98
PM [kW]:	N/A	2,42	1,98	1,54	1,98	2,42	N/A
PE60 [kW]:	2,46	2,44	2,00	1,57	2,01	2,44	2,46
ΔPE60/PM [%]:	N/A	0,97	1,12	1,52	1,26	0,85	N/A
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P_n							
Frequency [Hz]:	50,10	50,24	50,69	51,12	50,68	50,24	49,98
PM [kW]:	N/A	1,23	1,01	0,78	1,01	1,23	N/A
PE60 [kW]:	1,25	1,24	1,02	0,64	0,84	1,24	1,35
ΔPE60/PM [%]:	N/A	0,48	0,82	-7,08	-8,09	0,73	N/A
Limit ΔP/P _{1min} :	+ 10 % of P _M						

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Reactive power			
Uncontrollable reactive power			
Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,996	0,995	0,995
50% PN	0,996	0,997	0,997
75% PN	0,997	0,997	0,997
100% PN	0,998	0,997	0,997
Limit	>0,95	>0,95	>0,95

Controllable reactive power				
Inductive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	AC voltage [V]
0% - 10%	109,39	210,02	0,46	111,63
10% - 20%	349,23	194,64	0,87	356,36
20% - 30%	565,56	291,04	0,89	577,10
30% - 40%	789,64	400,63	0,89	805,76
40% - 50%	1010,61	494,22	0,90	1031,24
50% - 60%	1246,43	601,28	0,90	1271,87
60% - 70%	1458,68	710,80	0,90	1488,45
70% - 80%	1671,22	797,36	0,90	1705,32
80% - 90%	1905,37	905,60	0,90	1944,25
90% - 100%	2241,19	1061,04	0,90	2286,92

Capacitive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	AC voltage [V]
0% - 10%	109,62	-102,71	-0,73	111,85
10% - 20%	349,12	-155,12	-0,90	336,25
20% - 30%	565,29	-254,91	-0,90	556,83
30% - 40%	788,34	-375,37	-0,90	804,43
40% - 50%	1009,20	-474,53	-0,91	1029,79
50% - 60%	1245,70	-592,48	-0,90	1271,13
60% - 70%	1458,27	-714,84	-0,90	1488,03
70% - 80%	1669,65	-806,72	-0,90	1703,72
80% - 90%	1903,82	-925,51	-0,90	1942,67
90% - 100%	2209,20	-1077,86	-0,90	2254,29

Reactive power supply with set point Q=0				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	AC voltage [V]
0% - 10%	109,40	170,80	0,54	111,64
10% - 20%	349,17	85,86	0,97	356,30
20% - 30%	565,21	86,11	0,99	576,74
30% - 40%	788,20	142,43	0,99	804,29
40% - 50%	1009,96	90,29	1,00	1030,57
50% - 60%	1247,04	84,98	1,00	1272,49
60% - 70%	1460,41	159,34	0,99	1490,22
70% - 80%	1673,63	82,98	1,00	1707,78
80% - 90%	1909,43	80,30	1,00	1948,39
90% - 100%	2246,99	78,76	1,00	2292,85

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Q adjustment				
	Reactive power set point Q [Var]	Measured reactive power Q [Var]	Measured cos φ	Deviation compared to setpoint $\Delta Q / P_N$ [%]
- Qmin	-1090,8	-1085	-0,901	0,19
0	0	3,8	0,998	0,17
+ Qmax	1090,8	1084	0,901	-0,25

Connection and starting to generate electrical power		
Test according EN 50438 with standard setting	Min. voltage for connection to grid:	195,5V
	Max. voltage for connection to grid:	253,0V
	Min. frequency for connection to grid:	47,50Hz
	Max. frequency for connection to grid:	50,15Hz
	Observation time ($\geq 60s$)	60s
Connection and starting to generate electrical power		
	Voltage conditions	
a) Start up for voltage range	<84% U_n for twice of observation time	>111% U_n for twice of observation time
Connection:	No connection	No connection
Limit:	No connection allowed	
b) In voltage range at start-up	$\geq 84\% U_n$ within twice setting observation time	$\leq 111\% U_n$ within twice setting observation time
Reconnection time [s]	68	69
Limit:	Connected after setting observation time ($\geq 60s$)	
Gradient:	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% P_n /min. For recorded gradient see diagram below.	
c) In voltage range after voltage failure	$\geq 84\% U_n$ for twice of setting observation time	$\leq 111\% U_n$ for twice of setting observation time
Reconnection time [s]	68	69
Limit:	Reconnection after setting observation time ($\geq 60s$)	
Gradient:	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% P_n /min. For recorded gradient see diagram below.	
	Frequency conditions	
d) Start up for frequency range	<47,45 Hz for twice of setting observation time	>50,15 Hz for twice of setting observation time
Connection:	No connection	No connection
Limit	No connection allowed	

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e) In frequency range at start-up	≥47,45 Hz within twice of setting observation time	≤51,15 Hz within twice of setting observation time
Reconnection time [s]	68	68
Limit:	Connected after setting delay time(≥60s)	
Gradient:	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.	
f) In frequency range after frequency failure	≥47,45 Hz for twice of setting observation time	≤51,15 Hz for twice of setting observation time
Reconnection time [s]	68	68
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	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.	

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	51,1	12,7
Initial Value of aperiodic current	A	N/A	100ms	34,97	9,63
Initial symmetrical short-circuit current*	I_k	N/A	250ms	31,91	9,64
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	30,86	10,16
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,606	In seconds

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Power Quality. Harmonic current emission				
micro-generator		SE2500M		
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	10,772	100,000	Phase 1	-
2nd	0,011	0,101	Phase 1	1,080
3rd	0,073	0,677	Phase 1	2,300
4th	0,011	0,105	Phase 1	0,430
5th	0,029	0,270	Phase 1	1,140
6th	0,012	0,109	Phase 1	0,300
7th	0,022	0,204	Phase 1	0,770
8th	0,012	0,109	Phase 1	0,230
9th	0,027	0,252	Phase 1	0,400
10th	0,012	0,112	Phase 1	0,184
11th	0,025	0,237	Phase 1	0,330
12th	0,013	0,118	Phase 1	0,153
13th	0,023	0,211	Phase 1	0,210
14th	0,012	0,110	Phase 1	0,131
15th	0,023	0,215	Phase 1	0,150
16th	0,013	0,120	Phase 1	0,115
17th	0,027	0,248	Phase 1	0,132
18th	0,014	0,134	Phase 1	0,102
19th	0,026	0,239	Phase 1	0,118
20th	0,015	0,141	Phase 1	0,092
21th	0,023	0,213	Phase 1	0,107
22th	0,014	0,134	Phase 1	0,084
23th	0,023	0,215	Phase 1	0,098
24th	0,015	0,139	Phase 1	0,077
25th	0,024	0,225	Phase 1	0,090
26th	0,014	0,132	Phase 1	0,071
27th	0,025	0,230	Phase 1	0,083
28th	0,013	0,124	Phase 1	0,066
29th	0,023	0,210	Phase 1	0,078
30th	0,012	0,110	Phase 1	0,061
31th	0,018	0,168	Phase 1	0,073
32th	0,011	0,099	Phase 1	0,058
33th	0,017	0,157	Phase 1	0,068
34th	0,010	0,089	Phase 1	0,054
35th	0,018	0,164	Phase 1	0,064
36th	0,009	0,080	Phase 1	0,051
37th	0,016	0,145	Phase 1	0,061
38th	0,008	0,070	Phase 1	0,048
39th	0,013	0,125	Phase 1	0,058
40th	0,007	0,067	Phase 1	0,046

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Power Quality. Harmonic current emission				
micro-generator		SE2000M		
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	8,750	100,000	Phase 1	-
2nd	0,029	0,328	Phase 1	1,080
3rd	0,077	0,879	Phase 1	2,300
4th	0,020	0,225	Phase 1	0,430
5th	0,025	0,284	Phase 1	1,140
6th	0,012	0,139	Phase 1	0,300
7th	0,022	0,251	Phase 1	0,770
8th	0,013	0,154	Phase 1	0,230
9th	0,024	0,272	Phase 1	0,400
10th	0,012	0,138	Phase 1	0,184
11th	0,020	0,233	Phase 1	0,330
12th	0,013	0,149	Phase 1	0,153
13th	0,021	0,235	Phase 1	0,210
14th	0,012	0,135	Phase 1	0,131
15th	0,021	0,244	Phase 1	0,150
16th	0,013	0,153	Phase 1	0,115
17th	0,023	0,260	Phase 1	0,132
18th	0,014	0,160	Phase 1	0,102
19th	0,020	0,228	Phase 1	0,118
20th	0,015	0,169	Phase 1	0,092
21th	0,021	0,244	Phase 1	0,107
22th	0,014	0,155	Phase 1	0,084
23th	0,022	0,254	Phase 1	0,098
24th	0,014	0,161	Phase 1	0,077
25th	0,021	0,245	Phase 1	0,090
26th	0,013	0,148	Phase 1	0,071
27th	0,020	0,224	Phase 1	0,083
28th	0,013	0,146	Phase 1	0,066
29th	0,020	0,230	Phase 1	0,078
30th	0,011	0,126	Phase 1	0,061
31th	0,018	0,204	Phase 1	0,073
32th	0,010	0,113	Phase 1	0,058
33th	0,016	0,180	Phase 1	0,068
34th	0,009	0,101	Phase 1	0,054
35th	0,014	0,165	Phase 1	0,064
36th	0,009	0,102	Phase 1	0,051
37th	0,015	0,171	Phase 1	0,061
38th	0,007	0,083	Phase 1	0,048
39th	0,014	0,156	Phase 1	0,058
40th	0,007	0,075	Phase 1	0,046

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Power Quality. Harmonic current emission				
micro-generator		SE1500M		
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	6,594	100,000	Phase 1	-
2nd	0,022	0,329	Phase 1	1,080
3rd	0,077	1,175	Phase 1	2,300
4th	0,020	0,306	Phase 1	0,430
5th	0,022	0,328	Phase 1	1,140
6th	0,015	0,226	Phase 1	0,300
7th	0,024	0,369	Phase 1	0,770
8th	0,013	0,203	Phase 1	0,230
9th	0,019	0,287	Phase 1	0,400
10th	0,009	0,130	Phase 1	0,184
11th	0,016	0,246	Phase 1	0,330
12th	0,017	0,258	Phase 1	0,153
13th	0,019	0,284	Phase 1	0,210
14th	0,013	0,201	Phase 1	0,131
15th	0,016	0,249	Phase 1	0,150
16th	0,013	0,197	Phase 1	0,115
17th	0,017	0,258	Phase 1	0,132
18th	0,013	0,193	Phase 1	0,102
19th	0,015	0,234	Phase 1	0,118
20th	0,017	0,258	Phase 1	0,092
21th	0,017	0,259	Phase 1	0,107
22th	0,018	0,273	Phase 1	0,084
23th	0,018	0,273	Phase 1	0,098
24th	0,014	0,215	Phase 1	0,077
25th	0,017	0,265	Phase 1	0,090
26th	0,014	0,214	Phase 1	0,071
27th	0,019	0,289	Phase 1	0,083
28th	0,016	0,247	Phase 1	0,066
29th	0,018	0,268	Phase 1	0,078
30th	0,013	0,190	Phase 1	0,061
31th	0,015	0,228	Phase 1	0,073
32th	0,011	0,164	Phase 1	0,058
33th	0,014	0,206	Phase 1	0,068
34th	0,011	0,170	Phase 1	0,054
35th	0,013	0,200	Phase 1	0,064
36th	0,010	0,147	Phase 1	0,051
37th	0,012	0,186	Phase 1	0,061
38th	0,008	0,117	Phase 1	0,048
39th	0,012	0,176	Phase 1	0,058
40th	0,009	0,136	Phase 1	0,046

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Power Quality. Harmonic current emission				
micro-generator		SE1000M		
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	4,390	100,000	Phase 1	-
2nd	0,026	0,598	Phase 1	1,080
3rd	0,074	1,689	Phase 1	2,300
4th	0,014	0,320	Phase 1	0,430
5th	0,027	0,606	Phase 1	1,140
6th	0,011	0,246	Phase 1	0,300
7th	0,022	0,502	Phase 1	0,770
8th	0,011	0,253	Phase 1	0,230
9th	0,022	0,507	Phase 1	0,400
10th	0,011	0,241	Phase 1	0,184
11th	0,022	0,505	Phase 1	0,330
12th	0,011	0,250	Phase 1	0,153
13th	0,022	0,502	Phase 1	0,210
14th	0,011	0,247	Phase 1	0,131
15th	0,024	0,541	Phase 1	0,150
16th	0,012	0,264	Phase 1	0,115
17th	0,024	0,557	Phase 1	0,132
18th	0,012	0,279	Phase 1	0,102
19th	0,023	0,519	Phase 1	0,118
20th	0,013	0,305	Phase 1	0,092
21th	0,024	0,552	Phase 1	0,107
22th	0,013	0,290	Phase 1	0,084
23th	0,023	0,528	Phase 1	0,098
24th	0,012	0,284	Phase 1	0,077
25th	0,024	0,546	Phase 1	0,090
26th	0,011	0,257	Phase 1	0,071
27th	0,023	0,525	Phase 1	0,083
28th	0,012	0,262	Phase 1	0,066
29th	0,022	0,492	Phase 1	0,078
30th	0,010	0,231	Phase 1	0,061
31th	0,019	0,439	Phase 1	0,073
32th	0,009	0,197	Phase 1	0,058
33th	0,017	0,376	Phase 1	0,068
34th	0,008	0,189	Phase 1	0,054
35th	0,017	0,377	Phase 1	0,064
36th	0,008	0,175	Phase 1	0,051
37th	0,015	0,348	Phase 1	0,061
38th	0,007	0,154	Phase 1	0,048
39th	0,014	0,316	Phase 1	0,058
40th	0,006	0,145	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) _{500ms}	dc	dmax
Limit	1,0	0,65	3,3%	3,3%	4%
Test value	0,213	0,166	0,0%	0,996%	1,195%

DC-Injection.

Protection limit	Tested at four power levels, limit 0,5% of IAC _{nom} (54mA)			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [mA]	10,06	7,79	1,0	9,59