



Certificate of compliance

Applicant: SMA Solar Technology AG
Sonnenallee 1
34266 Niestetal
Germany

Product: Grid-tied photovoltaic (PV) inverter

Model: STP 15000TL-30
STP 17000TL-30
STP 20000TL-30
STP 25000TL-30

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with EN 50438:2013 for photovoltaic systems with a three-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

The generators STP 15000TL-30, STP17000TL-30, STP 20000TL-30 and STP 25000TL-30 are rated >16A per phase. However all requirements of the EN 50438:2013 are fulfilled.

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: 14TH0304-EN50438:2013_0
Certificate number: U17-0031
Date of issue: 2017-02-03



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. 14TH0304-EN50438:2013_0

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

Manufacturer / applicant:	SMA Solar Technology AG Sonnenallee 1 34266 Niestetal Germany			
Micro-generator Type	Grid-tied photovoltaic inverter			
Rated values	STP 15000TL-30	STP 17000TL-30	STP 20000TL-30	STP 25000TL-30
Maximum rated capacity	15 kW	17 kW	20 kW	25 kW
Rated voltage	230V	230V	230V	230V
From Firmware version	HP 1.00.04.R; HP 1.00.05.R			
Measurement period:	2016-08-12 to 2016-08-30			

Description of the structure of the power generation unit:

The input and output are protected by Varistors to Earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformer). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit will also operate in case of one 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	495
Over-voltage stage 2	264,5	0,2	264,5	0,2	264,7	0,18
Under-voltage stage 1	195,5	1,5	195,5	1,5	195,0	1,48

Phase2

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	495
Over-voltage stage 2	264,5	0,2	264,5	0,2	264,7	0,18
Under-voltage stage 1	195,5	1,5	195,5	1,5	195,05	1,48

Phase3

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	495
Over-voltage stage 2	264,5	0,2	264,5	0,2	264,86	0,18
Under-voltage stage 1	195,5	1,5	195,5	1,5	195,2	1,48

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.

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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	52,00	0,486
Under-frequency	47,5	0,5	47,5	0,5	45,50	0,486
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	531	527	1977	484	484	980
Trip time. Phase 2 fuse removed	531	527	1977	484	484	980
Trip time. Phase 3 fuse removed	531	527	1977	484	484	980
Indicate additional shut down time included in above results. (Integrated interface switch)				Type of switching equipment 1: Relay Type of switching equipment 2: Relay		

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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	47,5	15101,3	1,0
2	253,0	51,5	15085,8	1,0

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]:	22,53	22,52	22,53

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
1. Measurement a) to g): Active power output > 80% P _n						
Frequency [Hz]:	50,002	50,251	50,701	51,151	50,701	50,251
PM [kW]:	22,52	22,33	20,64	18,95	20,64	22,33
PE60 [kW]:	22,52	22,34	20,61	18,88	20,60	22,33
ΔPE60/PM [%]:	0,0	0,043	-0,142	-0,274	-0,156	0,016
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P _n						
Frequency [Hz]:	50,002	50,251	50,701	51,151	50,701	50,251
PM [kW]:	12,51	12,40	11,46	10,52	11,46	12,40
PE60 [kW]:	12,51	12,40	11,49	10,54	11,49	12,44
ΔPE60/PM [%]:	-0,00	0,021	0,114	0,069	0,112	0,165
Limit ΔP/P1min:	+ 10 % of P _M					

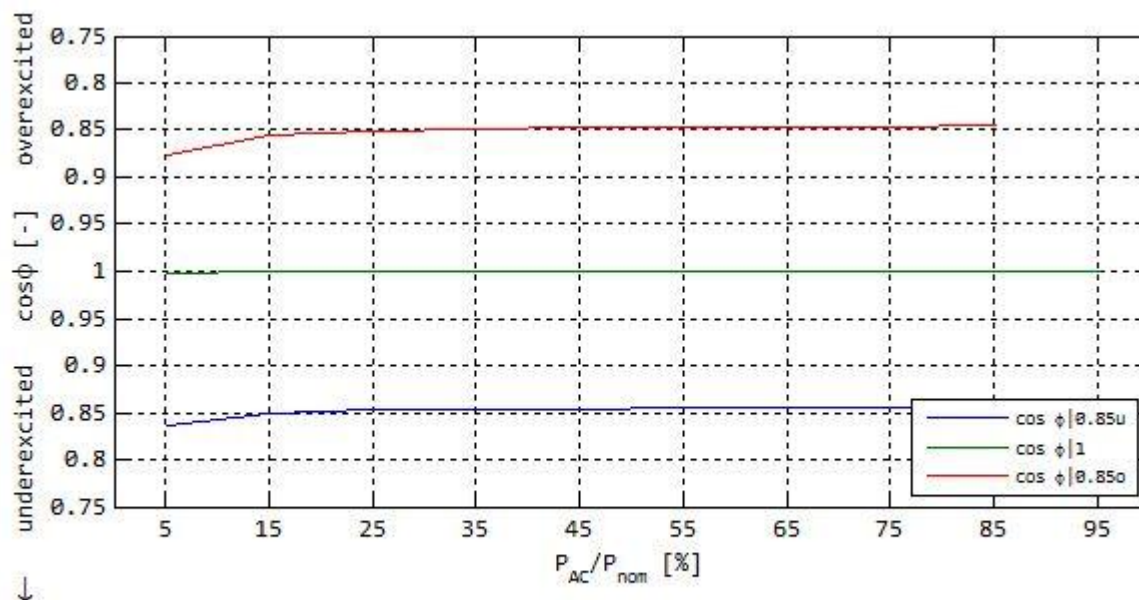
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Controllable reactive power

Diagram of inductive reactive power absorption



P_{DC}/P_{max}	$\cos \phi_{SetPt,u}$	$\cos \phi_u$	dev.	$\cos \phi_o$	dev.	$\cos \phi_{SetPt,o}$	$\cos \phi_o$	dev.
5 %	-0.850	-0.836	-0.014	-0.998	-0.002	0.850	0.877	-0.027
15 %	-0.850	-0.850	-0.000	-1.000	-0.000	0.850	0.854	-0.004
25 %	-0.850	-0.853	0.003	-1.000	-0.000	0.850	0.850	-0.000
35 %	-0.850	-0.854	0.004	1.000	0.000	0.850	0.848	0.002
45 %	-0.850	-0.854	0.004	1.000	0.000	0.850	0.847	0.003
55 %	-0.850	-0.854	0.004	1.000	0.000	0.850	0.847	0.003
65 %	-0.850	-0.855	0.005	1.000	0.000	0.850	0.846	0.004
75 %	-0.850	-0.855	0.005	1.000	0.000	0.850	0.846	0.004
85 %	-0.850	-0.855	0.005	1.000	0.000	0.850	0.846	0.004
95 %	-0.850	-0.855	0.005	1.000	0.000	0.850	0.846	0.004

Q adjustment

	Reactive power set point Q [%]	Measured reactive power Q [%]	Measured $\cos \phi$
- Qmin	-50	-49,839	-0,850
0	0	0,530	0,999
+ Qmax	50	50,877	0,850

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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:	253V
	Min. frequency for connection to grid:	47,50Hz
	Max. frequency for connection to grid:	51,15Hz
	Observation time ($\geq 60s$)	60s
Test		
	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]	77,43	77,33
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]	71,29	70,20
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	$<47,45 \text{ Hz}$ for twice of setting observation time	$>50,15 \text{ Hz}$ for twice of setting observation time
Connection:	no connection	no connection
Limit:	No connection allowed	
e) In frequency range at start-up	$\geq 47,45 \text{ Hz}$ within twice of setting observation time	$\leq 51,15 \text{ Hz}$ within twice of setting observation time
Reconnection time [s]	77,78	77,30
Limit:	Connected after setting delay 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.	

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f) In frequency range after frequency failure	$\geq 47,45$ Hz for twice of setting observation time	$\leq 51,15$ Hz for twice of setting observation time
Reconnection time [s]	71,18	70,28
Limit:	Reconnection after setting observation time (≥ 60 s)	
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	230,07	39,43
Initial Value of aperiodic current	A	N/A	100ms	11,35	0,04
Initial symmetrical short-circuit current*	I_k	N/A	250ms	11,29	0,04
Decaying (aperiodic) component of short circuit current*	i_{dc}	N/A	500ms	11,28	0,04
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	1,45	In seconds

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Power Quality. Harmonic current emission					
micro-generator		STP25000TL-30			
Harmonic order n	Current Magnitude [A] at 100% rated output power	% of Fundamental	Phase	Harmonic current limit EN61000-3-12 [%]	
				1 phase	3 phase
1st	35,721	100,000	Phase 1	-	-
2nd	0,056	0,155	Phase 1	8	8
3rd	0,127	0,354	Phase 1	21,6	N/A
4th	0,038	0,106	Phase 1	4	4
5th	0,077	0,216	Phase 1	10,7	10,7
6th	0,015	0,041	Phase 1	2,67	2,67
7th	0,102	0,284	Phase 1	7,2	7,2
8th	0,013	0,037	Phase 1	2	2
9th	0,017	0,047	Phase 1	3,8	N/A
10th	0,012	0,034	Phase 1	1,6	1,6
11th	0,070	0,197	Phase 1	3,1	3,1
12th	0,011	0,031	Phase 1	1,33	1,33
13th	0,076	0,213	Phase 1	2	2
14th	0,010	0,029	Phase 1	N/A	N/A
15th	0,015	0,041	Phase 1	N/A	N/A
16th	0,009	0,026	Phase 1	N/A	N/A
17th	0,056	0,156	Phase 1	N/A	N/A
18th	0,009	0,024	Phase 1	N/A	N/A
19th	0,051	0,144	Phase 1	N/A	N/A
20th	0,008	0,022	Phase 1	N/A	N/A
21th	0,011	0,030	Phase 1	N/A	N/A
22th	0,007	0,020	Phase 1	N/A	N/A
23th	0,042	0,117	Phase 1	N/A	N/A
24th	0,007	0,019	Phase 1	N/A	N/A
25th	0,044	0,123	Phase 1	N/A	N/A
26th	0,006	0,018	Phase 1	N/A	N/A
27th	0,008	0,022	Phase 1	N/A	N/A
28th	0,005	0,015	Phase 1	N/A	N/A
29th	0,032	0,090	Phase 1	N/A	N/A
30th	0,005	0,014	Phase 1	N/A	N/A
31th	0,029	0,082	Phase 1	N/A	N/A
32th	0,005	0,013	Phase 1	N/A	N/A
33th	0,007	0,018	Phase 1	N/A	N/A
34th	0,004	0,012	Phase 1	N/A	N/A
35th	0,026	0,073	Phase 1	N/A	N/A
36th	0,004	0,012	Phase 1	N/A	N/A
37th	0,024	0,067	Phase 1	N/A	N/A
38th	0,004	0,011	Phase 1	N/A	N/A
39th	0,006	0,018	Phase 1	N/A	N/A
40th	0,004	0,010	Phase 1	N/A	N/A
THD ₄₀	-	0,71	Phase 1	13	13
PWHD	-	0,002	Phase 1	22	22

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Power Quality. Harmonic current emission					
micro-generator		STP25000TL-30			
Harmonic order n	Current Magnitude [A] at 100% rated output power	% of Fundamental	Phase	Harmonic current limit EN61000-3-12 [%]	
				1 phase	3 phase
1st	35,851	100,000	Phase 2	-	-
2nd	0,102	0,283	Phase 2	8	8
3rd	0,146	0,408	Phase 2	21,6	N/A
4th	0,041	0,115	Phase 2	4	4
5th	0,110	0,306	Phase 2	10,7	10,7
6th	0,014	0,039	Phase 2	2,67	2,67
7th	0,107	0,299	Phase 2	7,2	7,2
8th	0,013	0,037	Phase 2	2	2
9th	0,018	0,049	Phase 2	3,8	N/A
10th	0,012	0,035	Phase 2	1,6	1,6
11th	0,072	0,201	Phase 2	3,1	3,1
12th	0,012	0,032	Phase 2	1,33	1,33
13th	0,072	0,201	Phase 2	2	2
14th	0,011	0,030	Phase 2	N/A	N/A
15th	0,013	0,036	Phase 2	N/A	N/A
16th	0,010	0,027	Phase 2	N/A	N/A
17th	0,054	0,151	Phase 2	N/A	N/A
18th	0,009	0,025	Phase 2	N/A	N/A
19th	0,049	0,135	Phase 2	N/A	N/A
20th	0,008	0,023	Phase 2	N/A	N/A
21th	0,011	0,029	Phase 2	N/A	N/A
22th	0,008	0,021	Phase 2	N/A	N/A
23th	0,038	0,107	Phase 2	N/A	N/A
24th	0,008	0,022	Phase 2	N/A	N/A
25th	0,050	0,140	Phase 2	N/A	N/A
26th	0,007	0,019	Phase 2	N/A	N/A
27th	0,008	0,022	Phase 2	N/A	N/A
28th	0,006	0,016	Phase 2	N/A	N/A
29th	0,030	0,082	Phase 2	N/A	N/A
30th	0,005	0,015	Phase 2	N/A	N/A
31th	0,028	0,079	Phase 2	N/A	N/A
32th	0,005	0,014	Phase 2	N/A	N/A
33th	0,007	0,019	Phase 2	N/A	N/A
34th	0,004	0,012	Phase 2	N/A	N/A
35th	0,024	0,066	Phase 2	N/A	N/A
36th	0,004	0,012	Phase 2	N/A	N/A
37th	0,024	0,068	Phase 2	N/A	N/A
38th	0,004	0,012	Phase 2	N/A	N/A
39th	0,007	0,018	Phase 2	N/A	N/A
40th	0,004	0,011	Phase 2	N/A	N/A
THD ₄₀	-	0,80	Phase 2	13	13
PWHD	-	0,002	Phase 2	22	22

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Power Quality. Harmonic current emission					
micro-generator		STP25000TL-30			
Harmonic order n	Current Magnitude [A] at 100% rated output power	% of Fundamental	Phase	Harmonic current limit EN61000-3-12 [%]	
				1 phase	3 phase
1st	35,832	100,000	Phase 3	-	-
2nd	0,136	0,379	Phase 3	8	8
3rd	0,056	0,157	Phase 3	21,6	N/A
4th	0,043	0,119	Phase 3	4	4
5th	0,084	0,233	Phase 3	10,7	10,7
6th	0,014	0,038	Phase 3	2,67	2,67
7th	0,093	0,261	Phase 3	7,2	7,2
8th	0,013	0,036	Phase 3	2	2
9th	0,015	0,040	Phase 3	3,8	N/A
10th	0,012	0,032	Phase 3	1,6	1,6
11th	0,070	0,196	Phase 3	3,1	3,1
12th	0,011	0,029	Phase 3	1,33	1,33
13th	0,068	0,189	Phase 3	2	2
14th	0,010	0,027	Phase 3	N/A	N/A
15th	0,010	0,029	Phase 3	N/A	N/A
16th	0,009	0,025	Phase 3	N/A	N/A
17th	0,055	0,154	Phase 3	N/A	N/A
18th	0,008	0,023	Phase 3	N/A	N/A
19th	0,047	0,130	Phase 3	N/A	N/A
20th	0,007	0,020	Phase 3	N/A	N/A
21th	0,009	0,025	Phase 3	N/A	N/A
22th	0,007	0,020	Phase 3	N/A	N/A
23th	0,042	0,118	Phase 3	N/A	N/A
24th	0,007	0,019	Phase 3	N/A	N/A
25th	0,041	0,115	Phase 3	N/A	N/A
26th	0,006	0,017	Phase 3	N/A	N/A
27th	0,006	0,018	Phase 3	N/A	N/A
28th	0,005	0,015	Phase 3	N/A	N/A
29th	0,032	0,090	Phase 3	N/A	N/A
30th	0,005	0,014	Phase 3	N/A	N/A
31th	0,027	0,076	Phase 3	N/A	N/A
32th	0,005	0,013	Phase 3	N/A	N/A
33th	0,006	0,016	Phase 3	N/A	N/A
34th	0,004	0,012	Phase 3	N/A	N/A
35th	0,026	0,072	Phase 3	N/A	N/A
36th	0,004	0,011	Phase 3	N/A	N/A
37th	0,022	0,061	Phase 3	N/A	N/A
38th	0,004	0,011	Phase 3	N/A	N/A
39th	0,006	0,016	Phase 3	N/A	N/A
40th	0,004	0,011	Phase 3	N/A	N/A
THD ₄₀	-	0,70	Phase 3	13	13
PWHD	-	0,002	Phase 3	22	22

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Voltage fluctuation and Flicker.

	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11				
Value	Pst	Plt 2 hours	d(t) _{500ms}	dc	dmax
Limit	1,0	0,65	3,3%	3,3%	4%
Test value	0,086	0,086	0,0%	3,3%	0,33%

DC-Injection.

STP25000TL-30

Protection limit	Tested at four power levels, limit 0,5% of IAC _{nom} (181mA)			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [mA]	1,21	2,54	3,30	4,04
Max. test value (phase L2) [mA]	1,31	1,61	3,19	5,86
Max. test value (phase L3) [mA]	1,21	1,16	2,10	1,12