



**BUREAU
VERITAS**

Certificate of compliance

Applicant: **Huawei Technologies Co., Ltd**
Administration Building, Headquarters of Huawei Technologies Co.,
Ltd., Bantian, Longgang District, Shenzhen, 518129
P.R. China

Product: **Grid-tied photovoltaic (PV) and battery inverter**

Model: **SUN2000L-2KTL
SUN2000L-3KTL
SUN2000L-3.68KTL
SUN2000L-4KTL
SUN2000L-4.6KTL
SUN2000L-5KTL**

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

The generators SUN2000L-3.68KTL, SUN2000L-4KTL, SUN2000L-4.6KTL, SUN2000L-5KTL 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: **PVTR180214N001**

Certificate number: **U18-0067**

Date of issue: **2018-02-28**

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. PVTR180214N001

Type Approval and declaration of compliance with the requirements of EN 50438.						
Manufacturer / applicant:	Huawei Technologies Co., Ltd Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129 P.R. China					
Micro-generator Type	Grid-tied photovoltaic (PV) and battery inverter					
Rated values	SUN2000L-2KTL	SUN2000L-3KTL	SUN2000L-3.68KTL	SUN2000L-4KTL	SUN2000L-4.6KTL	SUN2000L-5KTL
Maximum rated capacity	2 kW	3 kW	3,68 kW	4 kW	4,6 kW	5 kW
Rated voltage	220 / 230 / 240Va.c., 50/60Hz					
Firmware version	V100R001					
Measurement period:	2017-02-14 to 2017-08-07					

Description of the structure of the power generation unit (Figure 1):

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.

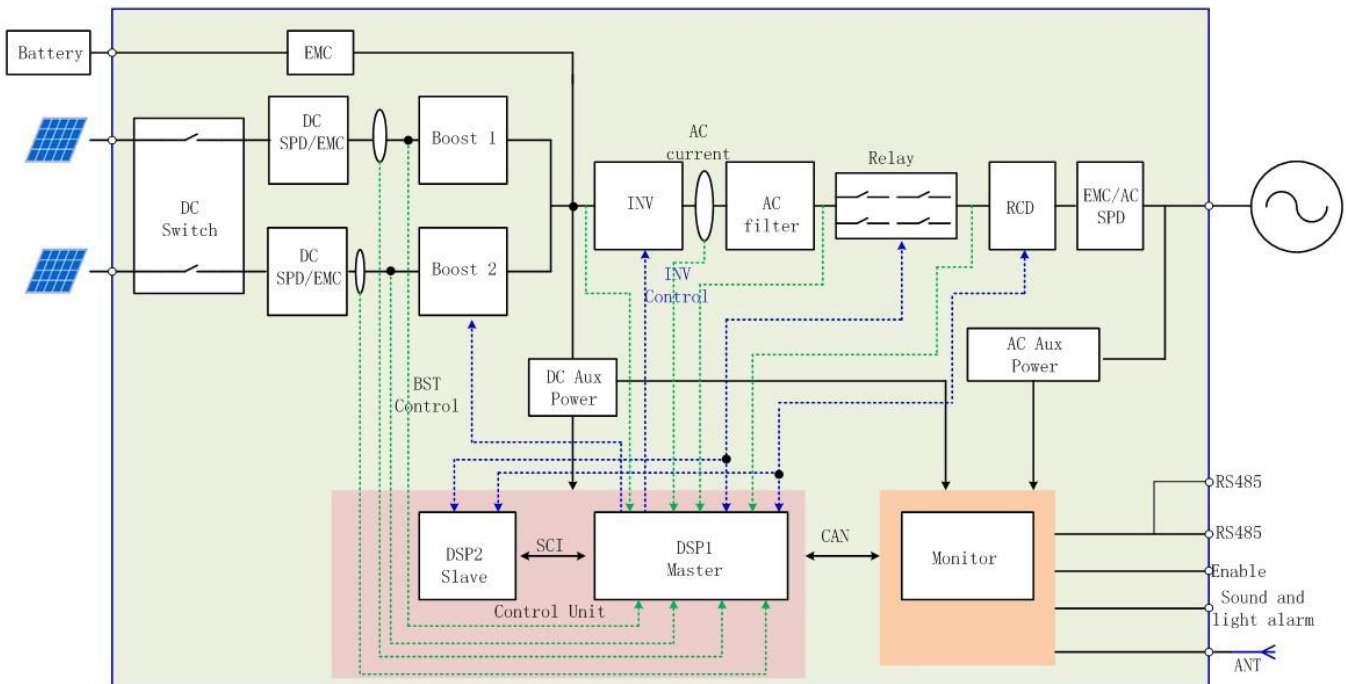


Figure 1 – Schematic structure of the power generation unit

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	600*	253,0	600*	--	477*
Over-voltage stage 2	264,5	0,2	264,5	0,2	264,0	0,190
Under-voltage stage 1	195,5	1,5	195,5	1,5	195,9	1,495

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	52,00	0,5	52,00	0,5	52,02	0,470
Under-frequency	47,50	0,5	47,50	0,5	47,51	0,466

LoM test

Method used	EN 62116					
	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]	167	230	420	248	275	449

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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	196,5	47,55	5007	0,999
2	252,1	51,45	5437	0,999

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 [W]:	5001	5000	5000
ΔP/PM [%] per 1 Hz:			0

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]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
PM [W]:	N/A	4929	4024	3119	4024	4929	N/A
PE60 [W]:	5030	4924	4012	3103	4010	4924	5036
ΔPE60/PM [%]:	N/A	0,10	0,24	0,32	0,28	0,10	N/A
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P_n							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	N/A
PM [W]:	N/A	2490	2033	1575	2033	2490	N/A
PE60 [W]:	2541	2473	2014	1556	2012	2472	N/A
ΔPE60/PM [%]:	N/A	0,34	0,38	0,38	0,42	0,36	N/A
Limit ΔP/P _{1min} :	+ 10 % of P _M						



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Reactive power			
Uncontrollable reactive power			
SUN2000L-2KTL			
Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,999i	0,999i	0,999i
50% PN	0,999i	0,999i	0,999i
75% PN	0,999i	0,999i	0,999i
100% PN	0,999i	0,999i	0,999i
Limit	>0,95	>0,95	>0,95
SUN2000L-5KTL			
Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,999i	0,999i	0,999i
50% PN	0,999i	0,999i	0,999i
75% PN	0,999i	0,999i	0,999i
100% PN	0,999i	0,999i	0,999i
Limit	>0,95	>0,95	>0,95

Controllable reactive power				
SUN2000L-2KTL				
Inductive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	176	141	0,780	200
10% - 20%	381	294	0,792	406
20% - 30%	588	448	0,795	613
30% - 40%	788	598	0,796	818
40% - 50%	990	750	0,797	1023
50% - 60%	1192	903	0,797	1227
60% - 70%	1394	1055	0,797	1432
70% - 80%	1597	1208	0,797	1638
80% - 90%	1783	1348	0,798	1829
90% - 100%	1783	1349	0,798	1828
Capacitive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	185	-137	-0,804	199
10% - 20%	386	-282	-0,808	402
20% - 30%	590	-432	-0,807	607
30% - 40%	793	-580	-0,807	812
40% - 50%	998	-730	-0,807	1018
50% - 60%	1200	-879	-0,807	1223
60% - 70%	1401	-1026	-0,807	1425
70% - 80%	1604	-1175	-0,807	1631
80% - 90%	1786	-1309	-0,807	1823
90% - 100%	1786	-1309	-0,806	1816

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Reactive power supply with set point Q = 0				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	200	32	0,987	214
10% - 20%	388	32	0,997	402
20% - 30%	636	36	0,998	652
30% - 40%	855	41	0,999	872
40% - 50%	1074	46	0,999	1093
50% - 60%	1291	51	0,999	1312
60% - 70%	1510	61	0,999	1533
70% - 80%	1726	71	0,999	1751
80% - 90%	1943	78	0,999	1970
90% - 100%	2159	84	0,999	2189

Controllable reactive power				
SUN2000L-5KTL				
Inductive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	471	362	0,793	500
10% - 20%	959	471	0,792	1000
20% - 30%	1451	1107	0,795	1500
30% - 40%	1940	1486	0,794	2000
40% - 50%	2426	1863	0,793	2500
50% - 60%	3008	2328	0,791	3100
60% - 70%	3413	2430	0,792	3480
70% - 80%	4019	3072	0,794	4100
80% - 90%	4408	3404	0,792	4500
90% - 100%	4528	3350	0,804	4600
Capacitive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	465	-318	0,803	498
10% - 20%	1050	-766	0,808	1100
20% - 30%	1441	-1056	0,807	1500
30% - 40%	1928	-1417	0,806	2000
40% - 50%	2412	-1777	0,805	2500
50% - 60%	2991	-2190	0,807	3100
60% - 70%	3412	-2518	0,805	3500
70% - 80%	3898	-2880	0,804	4000
80% - 90%	4259	-3275	0,793	4400
90% - 100%	4260	-3275	0,793	4400

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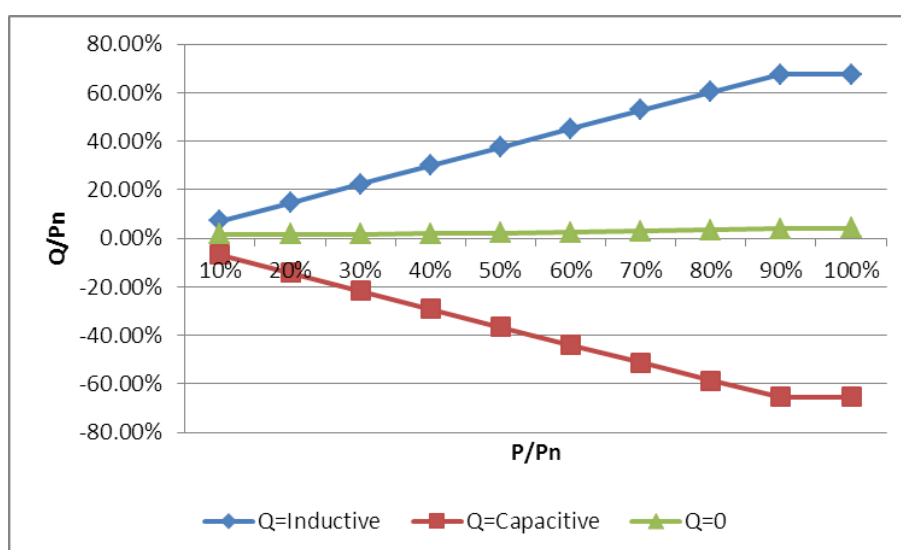
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Reactive power supply with set point Q = 0

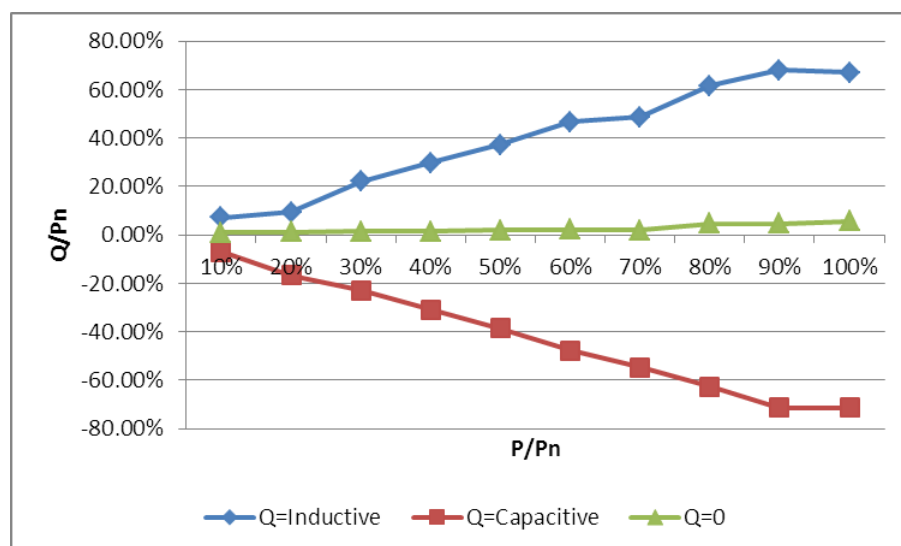
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	AC voltage [V]
0% - 10%	469	52	0,994	500
10% - 20%	957	62	0,998	1000
20% - 30%	1449	68	0,999	1500
30% - 40%	1920	77	0,999	1982
40% - 50%	2425	93	0,999	2500
50% - 60%	3009	115	0,999	3100
60% - 70%	3531	95	0,999	3500
70% - 80%	4024	230	0,998	4100
80% - 90%	4375	239	0,999	4461
90% - 100%	4903	240	0,999	5000

Diagram of inductive reactive power absorption

SUN2000L-2KTL



SUN2000L-5KTL



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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	-2422	-2461	0,7310	0,78
0	0	82	0,9999	-1,64
+ Qmax	2422	2478	0,7326	-1,12

Connection and starting to generate electrical power		
Test according EN 50438 with standard setting	Min. voltage for connection to grid:	197,8V
	Max. voltage for connection to grid:	250,7V
	Min. frequency for connection to grid:	47,55Hz
	Max. frequency for connection to grid:	50,05Hz
	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]	67	63
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]	67	63
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]	66	62
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]	67	64
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	33	22,9
Initial Value of aperiodic current	A	N/A	100ms	32	18,1
Initial symmetrical short-circuit current*	I_k	N/A	250ms	32	---
Decaying (aperiodic) component of short circuit current*	i_{dc}	N/A	500ms	32	---
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,068	In seconds

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Power Quality. Harmonic current emission				
micro-generator		SUN2000L-2KTL		
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	9,344	100,00	Phase 1	-
2nd	0,009	0,10	Phase 1	1,080
3rd	0,258	2,76	Phase 1	2,300
4th	0,007	0,07	Phase 1	0,430
5th	0,035	0,38	Phase 1	1,140
6th	0,007	0,07	Phase 1	0,300
7th	0,026	0,28	Phase 1	0,770
8th	0,006	0,06	Phase 1	0,230
9th	0,025	0,26	Phase 1	0,400
10th	0,005	0,05	Phase 1	0,184
11th	0,018	0,19	Phase 1	0,330
12th	0,005	0,05	Phase 1	0,153
13th	0,008	0,09	Phase 1	0,210
14th	0,005	0,06	Phase 1	0,131
15th	0,009	0,10	Phase 1	0,150
16th	0,005	0,06	Phase 1	0,115
17th	0,009	0,09	Phase 1	0,132
18th	0,005	0,05	Phase 1	0,102
19th	0,011	0,12	Phase 1	0,118
20th	0,005	0,05	Phase 1	0,092
21th	0,012	0,13	Phase 1	0,107
22th	0,004	0,05	Phase 1	0,084
23th	0,011	0,12	Phase 1	0,098
24th	0,005	0,05	Phase 1	0,077
25th	0,015	0,16	Phase 1	0,090
26th	0,004	0,05	Phase 1	0,071
27th	0,011	0,12	Phase 1	0,083
28th	0,005	0,06	Phase 1	0,066
29th	0,012	0,13	Phase 1	0,078
30th	0,006	0,06	Phase 1	0,061
31th	0,011	0,12	Phase 1	0,073
32th	0,005	0,05	Phase 1	0,058
33th	0,008	0,08	Phase 1	0,068
34th	0,004	0,05	Phase 1	0,054
35th	0,006	0,06	Phase 1	0,064
36th	0,006	0,07	Phase 1	0,051
37th	0,006	0,06	Phase 1	0,061
38th	0,006	0,06	Phase 1	0,048
39th	0,008	0,08	Phase 1	0,058
40th	0,005	0,05	Phase 1	0,046

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Power Quality. Harmonic current emission				
micro-generator		SUN2000L-5KTL		
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	22,000	100,00	Phase 1	-
2nd	0,012	0,06	Phase 1	1,080
3rd	0,446	2,03	Phase 1	2,300
4th	0,012	0,06	Phase 1	0,430
5th	0,026	0,12	Phase 1	1,140
6th	0,010	0,05	Phase 1	0,300
7th	0,020	0,09	Phase 1	0,770
8th	0,009	0,04	Phase 1	0,230
9th	0,030	0,14	Phase 1	0,400
10th	0,008	0,04	Phase 1	0,184
11th	0,029	0,13	Phase 1	0,330
12th	0,007	0,03	Phase 1	0,153
13th	0,024	0,11	Phase 1	0,210
14th	0,007	0,03	Phase 1	0,131
15th	0,027	0,12	Phase 1	0,150
16th	0,007	0,03	Phase 1	0,115
17th	0,026	0,12	Phase 1	0,132
18th	0,008	0,03	Phase 1	0,102
19th	0,026	0,12	Phase 1	0,118
20th	0,007	0,03	Phase 1	0,092
21th	0,024	0,11	Phase 1	0,107
22th	0,007	0,03	Phase 1	0,084
23th	0,023	0,11	Phase 1	0,098
24th	0,007	0,03	Phase 1	0,077
25th	0,023	0,11	Phase 1	0,090
26th	0,006	0,03	Phase 1	0,071
27th	0,019	0,09	Phase 1	0,083
28th	0,007	0,03	Phase 1	0,066
29th	0,020	0,09	Phase 1	0,078
30th	0,007	0,03	Phase 1	0,061
31th	0,021	0,09	Phase 1	0,073
32th	0,006	0,03	Phase 1	0,058
33th	0,015	0,07	Phase 1	0,068
34th	0,007	0,03	Phase 1	0,054
35th	0,016	0,07	Phase 1	0,064
36th	0,007	0,03	Phase 1	0,051
37th	0,016	0,07	Phase 1	0,061
38th	0,007	0,03	Phase 1	0,048
39th	0,012	0,06	Phase 1	0,058
40th	0,006	0,03	Phase 1	0,046

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Voltage fluctuation and Flicker.					
SUN2000L-3.68KTL	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	0,14	0,12	0,00%	0,23%	0,49%
SUN2000L-5KTL	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	0,18	0,18	0,00%	0,00%	0,00%

DC-Injection.				
SUN2000L-2KTL				
Protection limit	Tested at four power levels, limit 0,5% of IAC _{nom} (43mA)			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [A]	0,011	0,013	0,014	0,014
SUN2000L-3.68KTL				
Protection limit	Tested at four power levels, limit 0,5% of IAC _{nom} (80mA)			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [A]	0,029	0,029	0,035	0,027
SUN2000L-5KTL				
Protection limit	Tested at four power levels, limit 0,5% of IAC _{nom} (109mA)			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [A]	0,012	0,016	0,017	0,023