

# Uygunluk Belgesi

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

**Ürün:** Şebekeye bağlı fotovoltaik invertör

**Model:** SUN2000-168KTL-H1  
SUN2000-185KTL-H1

## Yönetmeliklere uygun kullanım:

EN 50438:2013, TS EN 50438:2014 'ye uygun üç fazlı şebeke denetlemeli otomatik bağlantı kesme cihazı, ana şebekedeki bir inverter aracılığıyla paralel bağlanan üç fazlı fotovoltaik sistemler içindir. Otomatik bağlantı kesme cihazı sözü geçen inverterin tümleşik bir parçasıdır. Bu, ağ tedarikçisinin her zaman ulaşabileceği yalıtım işlevli bağlantı kesme cihazının yerini alır.

## Geçerli kurallar ve standartlar:

**EN 50438:2013, TS EN 50438:2014**

Mikro jeneratörlerin alçak gerilim dağıtım şebekeleri ile paralel bağlanması için kurallar

**VDE 0126-1-1:2006:2006-02 (Fonksiyonel güvenlik)**

Bir şebeke bağlantılı jeneratör ve kamu alçak gerilim şebekesine arasında otomatik bağlantı kesme cihazı

Jeneratör SUN2000-168KTL-H1, SUN2000-185TKL-H1 faz başına 16A üzerinde bir akım için kullanılır. Ancak EN 50438:2013, TS EN 50438:2014 tüm gereklilikleri yerine getirilir.

Yukarıda bahsedilen temsili ürünün güvenlik özellikleri, bu belgenin tanzim tarihinde yönetmeliklere uygun olarak belirlenen kullanım için geçerli güvenlik özelliklerine uygundur.

**Rapor numarası:** PVTR190201N024

**Belge numarası:** U19-0386

**Tanzim tarihi:** 2019-06-27

**Sertifikasyon enstitüsü**



Holger Schaffer

Sertifikasyon enstitüsü Bureau Veritas Consumer Products Services Germany GmbH  
göre akredite DIN EN ISO/IEC 17065



Deutsche  
Akkreditierungsstelle  
D-ZE-12024-01-00

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

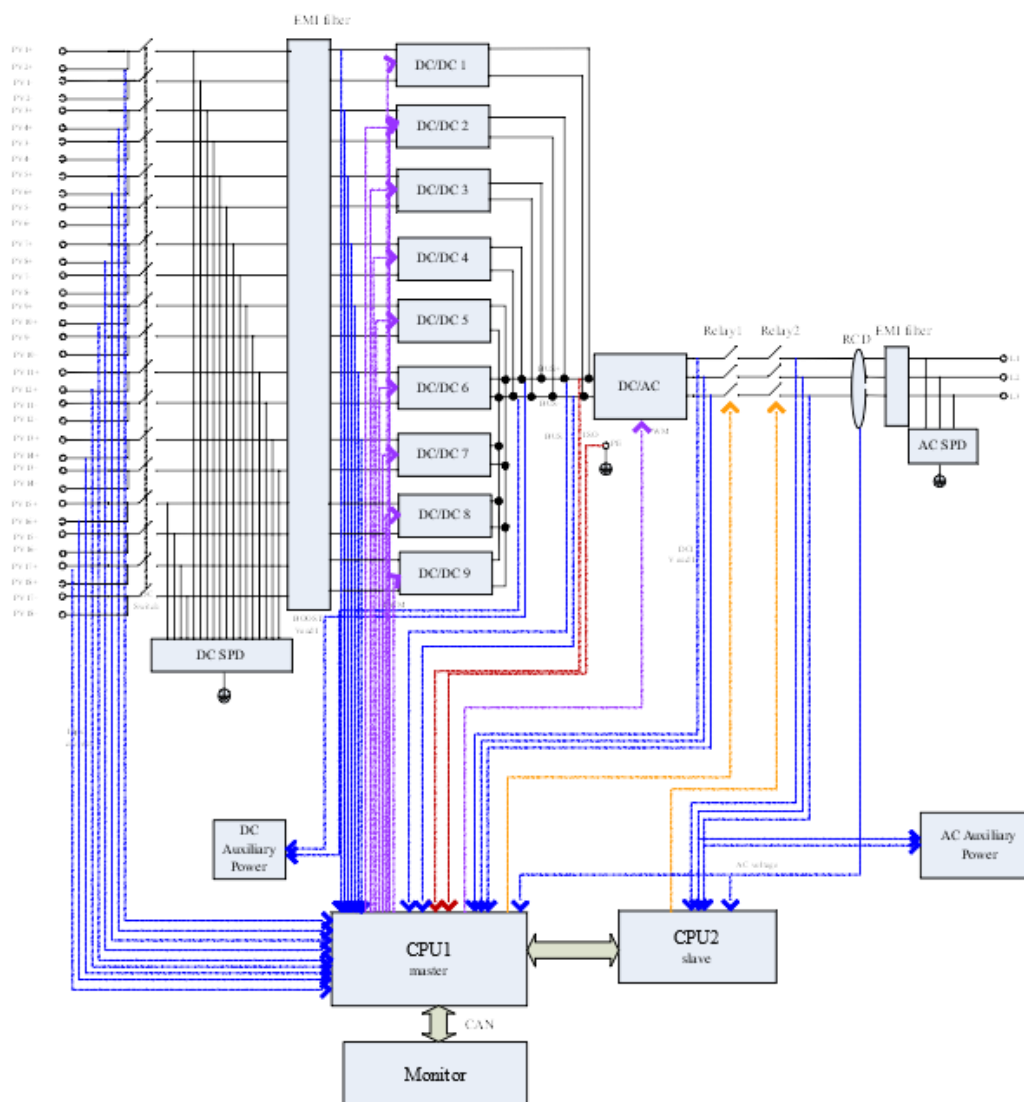
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**Type Approval and declaration of compliance with the requirements of EN 50438.**

<b>Manufacturer / applicant:</b>	Huawei Technologies Co., Ltd. Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129 P.R. China	
<b>Micro-generator Type</b>	Grid-tied photovoltaic inverter	
<b>Rated values</b>	SUN2000-168KTL-H1	SUN2000-185KTL-H1
<b>Maximum rated capacity</b>	168 kW	185 kW
<b>Rated voltage</b>	800, 3~ + PE, 50/60Hz	
<b>Firmware version</b>	V300R001	
<b>Measurement period:</b>	2019-02-01 to 2019-06-24	

**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	880,0	3 / 600*	880,0	3 / 600*	882,2	2,979 / 503*
Over-voltage stage 2	920	0,2	920	0,2	919,8	0,189
Under-voltage stage 1	680	1,5	680	1,5	679,2	1,488
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	880,0	3 / 600*	880,0	3 / 600*	881,8	2,986 / 503*
Over-voltage stage 2	920	0,2	920	0,2	919,8	0,188
Under-voltage stage 1	680	1,5	680	1,5	679,4	1,488
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	880,0	3 / 600*	880,0	3 / 600*	882,5	2,986 / 503*
Over-voltage stage 2	920	0,2	920	0,2	920,4	0,184
Under-voltage stage 1	680	1,5	680	1,5	679,9	1,496

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.

The inverters are intended for the use at 800Vac. Therefore an AC transformer is necessary in the plant to get them connected to the grid.

The inverters have no neutral wire. Therefore phase to phase voltages where used.

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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	51,99	0,480
Under-frequency	47,5	0,5	47,5	0,5	47,49	0,482

**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]	263	195	193	371	200	217
Trip time. Phase 2 fuse removed [ms]	263	195	193	371	200	217
Trip time. Phase 3 fuse removed [ms]	263	195	193	371	200	217

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**Type testing of a micro-generator**

**Operating range**

Test 1: U = 880 V; f = 47,5 Hz; P = 1,00 Sn; cosφ = 1

Test 2: U = 920 V; f = 51,5 Hz; P = 1,00 Sn; cosφ = 1

Test sequence	Voltage [V]	Frequency [Hz]	Output power [W]	Cos φ [1]
1	688,20	47,55	160273	0,9999
2	879,85	51,50	184685	0,9999

**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]:	175259	175255	175241
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
<b>1. Measurement a) to g): Active power output &gt; 80% P<sub>n</sub></b>							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
PM [kW]:	N/A	171,973	140,386	108,799	140,386	171,973	N/A
PE60 [kW]:	175,483	171,868	140,344	108,848	140,364	171,877	175,475
ΔPE60/PM [%]:	N/A	-0,060	-0,024	0,028	-0,013	-0,055	N/A
<b>2. Measurement a) to g): Active power output 40% and 60% after freezing &gt; 80% P<sub>n</sub></b>							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
PM [kW]:	N/A	86,213	70,378	54,543	70,378	86,213	N/A
PE60 [kW]:	87,972	85,889	70,114	54,307	70,112	85,890	N/A
ΔPE60/PM [%]:	N/A	-0,185	-0,151	-0,135	-0,152	-0,185	N/A
Limit ΔP/P <sub>1min</sub> :	+ 10 % of P <sub>M</sub>						

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Reactive power			
Uncontrollable reactive power			
SUN2000-185KTL-H1			
Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,9992	0,9990	0,9986
50% PN	0,9999	0,9998	0,9998
75% PN	0,9999	0,9999	0,9999
100% PN	0,9999	0,9999	0,9999
Limit	>0,95	>0,95	>0,95
SUN2000-168KTL-H1			
Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,9977	0,9969	0,9968
50% PN	0,9993	0,9992	0,9994
75% PN	0,9996	0,9997	0,9998
100% PN	0,9999	0,9999	0,9999
Limit	>0,95	>0,95	>0,95

Controllable reactive power				
SUN2000-185KTL-H1				
Inductive (supply reactive power)				
Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	AC voltage [kW]
0% - 10%	18,610	-80,622	0,2249	19,852
10% - 20%	37,091	-80,539	0,4183	38,419
20% - 30%	55,522	-80,482	0,5678	56,981
30% - 40%	73,969	-80,459	0,6768	75,589
40% - 50%	92,395	-80,381	0,7544	94,211
50% - 60%	110,863	-80,353	0,8097	112,921
60% - 70%	129,242	-80,267	0,8495	131,561
70% - 80%	147,698	-80,247	0,8787	150,268
80% - 90%	166,079	-80,184	0,9005	168,871
90% - 100%	168,042	-80,167	0,9025	170,895
Capacitive (supply reactive power)				
Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	AC voltage [kW]
0% - 10%	18,068	80,431	0,2192	19,151
10% - 20%	36,514	80,524	0,4130	37,658
20% - 30%	54,961	80,614	0,5633	56,218
30% - 40%	73,383	80,684	0,6728	74,794
40% - 50%	91,828	80,756	0,7509	93,425
50% - 60%	110,227	80,815	0,8065	112,047
60% - 70%	128,679	80,879	0,8466	130,718
70% - 80%	147,056	80,942	0,8760	149,317
80% - 90%	165,524	81,031	0,8981	168,615
90% - 100%	167,544	81,038	0,9002	170,725

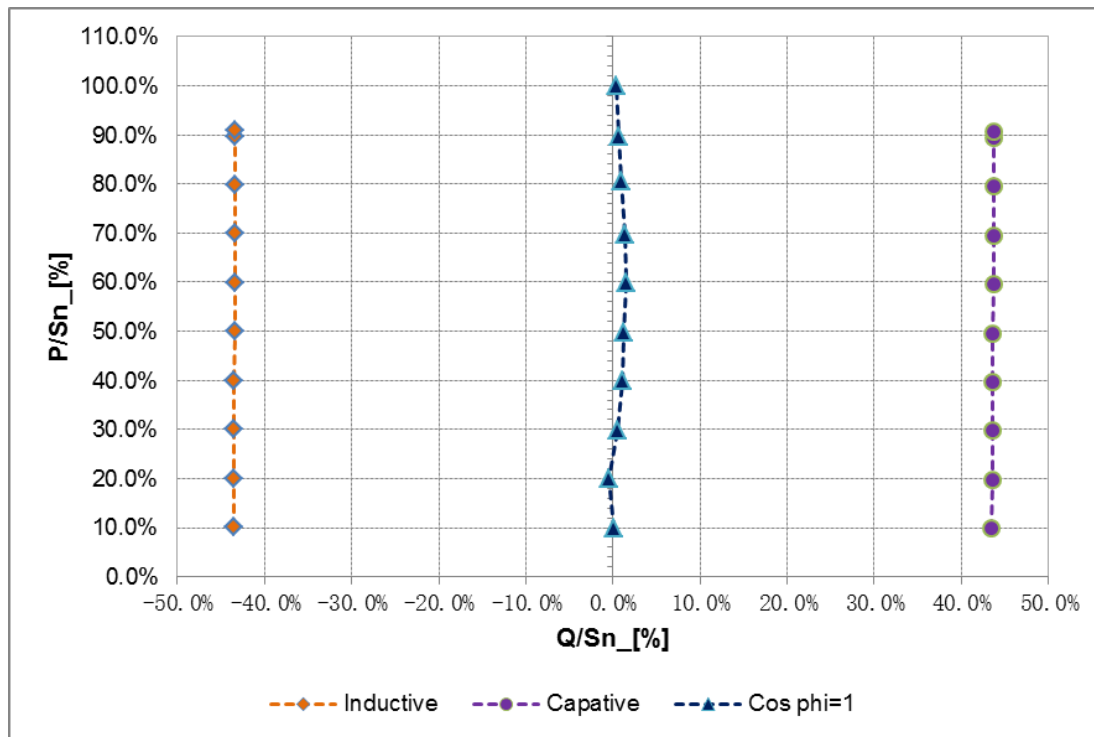
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Reactive power supply with set point Q=0				
Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	AC voltage [kV]
0% - 10%	18,400	0,194	0,9866	18,751
10% - 20%	36,868	-0,855	0,9966	37,375
20% - 30%	55,342	0,909	0,9987	56,049
30% - 40%	73,742	2,140	0,9992	74,671
40% - 50%	92,187	2,219	0,9994	93,358
50% - 60%	110,612	2,754	0,9996	112,038
60% - 70%	129,031	2,478	0,9997	130,724
70% - 80%	148,933	1,697	0,9997	150,908
80% - 90%	165,827	1,136	0,9999	167,989
90% - 100%	185,213	0,805	0,9998	188,542

**Diagram of inductive reactive power absorption**



**Controllable reactive power**

SUN2000-168KTL-H1

**Inductive (supply reactive power)**

Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	AC voltage [kV]
0% - 10%	16,930	-73,159	0,2255	18,022
10% - 20%	33,666	-73,092	0,4183	34,816
20% - 30%	50,396	-73,039	0,5679	51,657
30% - 40%	67,120	-73,018	0,6767	68,523
40% - 50%	83,840	-72,947	0,7544	85,425
50% - 60%	100,558	-72,895	0,8096	102,349
60% - 70%	117,248	-72,842	0,8494	119,255
70% - 80%	133,952	-72,802	0,8786	136,175
80% - 90%	150,652	-72,763	0,9005	153,183
90% - 100%	150,650	-72,764	0,9004	153,166

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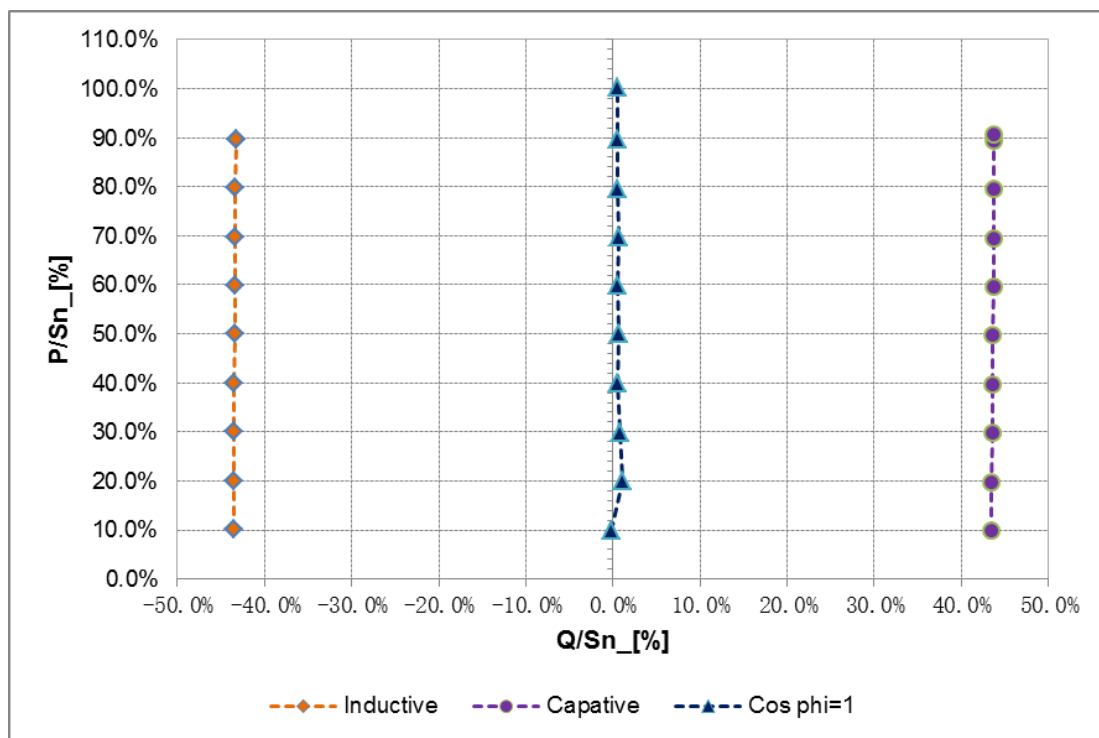
**Capacitive (supply reactive power)**

Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	AC voltage [kV]
0% - 10%	16,434	73,005	0,2196	17,416
10% - 20%	33,189	73,082	0,4135	34,232
20% - 30%	49,934	73,151	0,5638	51,085
30% - 40%	66,679	73,214	0,6733	67,975
40% - 50%	83,410	73,277	0,7512	84,885
50% - 60%	100,152	73,363	0,8067	101,829
60% - 70%	116,853	73,416	0,8467	118,760
70% - 80%	133,573	73,501	0,8761	135,704
80% - 90%	150,296	73,548	0,8982	152,984
90% - 100%	152,145	73,556	0,9003	154,891

**Reactive power supply with set point Q=0**

Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	AC voltage [kV]
0% - 10%	16,699	-0,204	0,9829	17,036
10% - 20%	33,469	1,882	0,9951	33,937
20% - 30%	50,234	1,288	0,9984	50,876
30% - 40%	66,960	0,881	0,9992	67,800
40% - 50%	84,132	1,013	0,9995	85,195
50% - 60%	100,435	1,003	0,9996	101,716
60% - 70%	117,151	1,043	0,9997	118,682
70% - 80%	133,827	0,948	0,9998	135,559
80% - 90%	150,559	0,903	0,9999	152,535
90% - 100%	168,448	0,991	0,9999	171,393

**Diagram of inductive reactive power absorption**





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Q adjustment				
	Reactive power set point Q [Var]	Measured reactive power Q [Var]	Measured cos φ	Deviation compared to setpoint ΔQ / PN [%]
- Qmin	-84753	-84469	0,7193	-0,16
0	0	-916	0,9986	0,52
+ Qmax	84753	85032	0,7174	-0,16

Connection and starting to generate electrical power		
Test according EN 50438 with standard setting	Min. voltage for connection to grid:	680,0 V
	Max. voltage for connection to grid:	880,0 V
	Min. frequency for connection to grid:	47,50 Hz
	Max. frequency for connection to grid:	50,05 Hz
	Observation time (≥60s)	50,1 Hz
Connection and starting to generate electrical power		
<b>Voltage conditions</b>		
a) Start up for voltage range	<85% Un for twice of observation time	>110% Un for twice of observation time
Connection:	No connection	No connection
Limit:	No connection allowed	
b) In voltage range at start-up	≥85% Un within twice setting observation time	≤110% Un within twice setting observation time
Reconnection time [s]	62	62
Limit:	Connected 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.	
c) In voltage range after voltage failure	≥85% Un for twice of setting observation time	≤110% Un for twice of setting observation time
Reconnection time [s]	62	62
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.	
<b>Frequency conditions</b>		
d) Start up for frequency range	<47,5 Hz for twice of setting observation time	>50,1 Hz for twice of setting observation time
Connection:	No connection	No connection
Limit:	No connection allowed	
e) In frequency range at start-up	≥47,5 Hz within twice of setting observation time	≤50,1 Hz within twice of setting observation time
Reconnection time [s]	62	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.	

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<b>f) In frequency range after frequency failure</b>	<b>≥47,5 Hz for twice of setting observation time</b>	<b>≤50,05 Hz for twice of setting observation time</b>
<b>Reconnection time [s]</b>	62	62
<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.	

Short-circuit current contribution					
Short-circuit current parameters					
Phase 1					
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	77,8	101,1
Initial Value of aperiodic current	A	N/A	100ms	72,2	91,1
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	0	0
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	0	0
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,187	In seconds
Phase 2					
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	72,2	95,6
Initial Value of aperiodic current	A	N/A	100ms	72,2	91,1
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	0	0
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	0	0
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,187	In seconds
Phase 3					
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	77,8	104,4
Initial Value of aperiodic current	A	N/A	100ms	72,2	91,1
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	0	0
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	0	0
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,187	In seconds

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Power Quality. Harmonic current emission					
micro-generator		SUN2000-168KTL-H1			
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	108,645	100,388	Phase 1	-	-
2nd	0,050	0,046	Phase 1	8	8
3rd	0,129	0,119	Phase 1	21,6	N/A
4th	0,103	0,095	Phase 1	4	4
5th	0,538	0,497	Phase 1	10,7	10,7
6th	0,012	0,011	Phase 1	2,67	2,67
7th	0,774	0,716	Phase 1	7,2	7,2
8th	0,041	0,038	Phase 1	2	2
9th	0,057	0,053	Phase 1	3,8	N/A
10th	0,167	0,154	Phase 1	1,6	1,6
11th	0,339	0,313	Phase 1	3,1	3,1
12th	0,045	0,041	Phase 1	1,33	1,33
13th	0,556	0,514	Phase 1	2	2
14th	0,189	0,175	Phase 1	N/A	N/A
15th	0,092	0,085	Phase 1	N/A	N/A
16th	0,182	0,168	Phase 1	N/A	N/A
17th	0,352	0,325	Phase 1	N/A	N/A
18th	0,036	0,033	Phase 1	N/A	N/A
19th	0,162	0,150	Phase 1	N/A	N/A
20th	0,136	0,125	Phase 1	N/A	N/A
21th	0,024	0,022	Phase 1	N/A	N/A
22th	0,115	0,106	Phase 1	N/A	N/A
23th	0,294	0,272	Phase 1	N/A	N/A
24th	0,057	0,053	Phase 1	N/A	N/A
25th	0,106	0,098	Phase 1	N/A	N/A
26th	0,099	0,091	Phase 1	N/A	N/A
27th	0,084	0,077	Phase 1	N/A	N/A
28th	0,083	0,076	Phase 1	N/A	N/A
29th	0,112	0,104	Phase 1	N/A	N/A
30th	0,021	0,019	Phase 1	N/A	N/A
31th	0,113	0,105	Phase 1	N/A	N/A
32th	0,120	0,111	Phase 1	N/A	N/A
33th	0,019	0,018	Phase 1	N/A	N/A
34th	0,028	0,026	Phase 1	N/A	N/A
35th	0,079	0,073	Phase 1	N/A	N/A
36th	0,025	0,023	Phase 1	N/A	N/A
37th	0,063	0,059	Phase 1	N/A	N/A
38th	0,045	0,041	Phase 1	N/A	N/A
39th	0,029	0,027	Phase 1	N/A	N/A
40th	0,028	0,026	Phase 1	N/A	N/A

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Power Quality. Harmonic current emission					
micro-generator		SUN2000-168KTL-H1			
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	108,833	100,561	Phase 2	-	-
2nd	0,161	0,149	Phase 2	8	8
3rd	0,218	0,202	Phase 2	21,6	N/A
4th	0,043	0,040	Phase 2	4	4
5th	0,528	0,488	Phase 2	10,7	10,7
6th	0,052	0,048	Phase 2	2,67	2,67
7th	0,681	0,629	Phase 2	7,2	7,2
8th	0,081	0,075	Phase 2	2	2
9th	0,085	0,079	Phase 2	3,8	N/A
10th	0,173	0,160	Phase 2	1,6	1,6
11th	0,348	0,322	Phase 2	3,1	3,1
12th	0,060	0,056	Phase 2	1,33	1,33
13th	0,537	0,496	Phase 2	2	2
14th	0,137	0,127	Phase 2	N/A	N/A
15th	0,149	0,137	Phase 2	N/A	N/A
16th	0,139	0,129	Phase 2	N/A	N/A
17th	0,269	0,248	Phase 2	N/A	N/A
18th	0,055	0,051	Phase 2	N/A	N/A
19th	0,299	0,277	Phase 2	N/A	N/A
20th	0,087	0,080	Phase 2	N/A	N/A
21th	0,052	0,048	Phase 2	N/A	N/A
22th	0,097	0,090	Phase 2	N/A	N/A
23th	0,309	0,285	Phase 2	N/A	N/A
24th	0,070	0,065	Phase 2	N/A	N/A
25th	0,180	0,166	Phase 2	N/A	N/A
26th	0,069	0,064	Phase 2	N/A	N/A
27th	0,112	0,104	Phase 2	N/A	N/A
28th	0,085	0,079	Phase 2	N/A	N/A
29th	0,110	0,101	Phase 2	N/A	N/A
30th	0,033	0,031	Phase 2	N/A	N/A
31th	0,121	0,111	Phase 2	N/A	N/A
32th	0,094	0,087	Phase 2	N/A	N/A
33th	0,053	0,049	Phase 2	N/A	N/A
34th	0,019	0,017	Phase 2	N/A	N/A
35th	0,067	0,062	Phase 2	N/A	N/A
36th	0,035	0,032	Phase 2	N/A	N/A
37th	0,073	0,067	Phase 2	N/A	N/A
38th	0,038	0,035	Phase 2	N/A	N/A
39th	0,041	0,038	Phase 2	N/A	N/A
40th	0,020	0,018	Phase 2	N/A	N/A

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. PVTR190201N024

Power Quality. Harmonic current emission					
micro-generator		SUN2000-168KTL-H1			
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	108,735	100,471	Phase 3	-	-
2nd	0,199	0,184	Phase 3	8	8
3rd	0,069	0,064	Phase 3	21,6	N/A
4th	0,069	0,064	Phase 3	4	4
5th	0,660	0,610	Phase 3	10,7	10,7
6th	0,052	0,048	Phase 3	2,67	2,67
7th	0,700	0,647	Phase 3	7,2	7,2
8th	0,060	0,055	Phase 3	2	2
9th	0,061	0,056	Phase 3	3,8	N/A
10th	0,218	0,201	Phase 3	1,6	1,6
11th	0,393	0,363	Phase 3	3,1	3,1
12th	0,032	0,030	Phase 3	1,33	1,33
13th	0,486	0,449	Phase 3	2	2
14th	0,140	0,129	Phase 3	N/A	N/A
15th	0,061	0,056	Phase 3	N/A	N/A
16th	0,152	0,141	Phase 3	N/A	N/A
17th	0,316	0,292	Phase 3	N/A	N/A
18th	0,022	0,020	Phase 3	N/A	N/A
19th	0,208	0,192	Phase 3	N/A	N/A
20th	0,118	0,109	Phase 3	N/A	N/A
21th	0,060	0,056	Phase 3	N/A	N/A
22th	0,165	0,152	Phase 3	N/A	N/A
23th	0,213	0,197	Phase 3	N/A	N/A
24th	0,027	0,025	Phase 3	N/A	N/A
25th	0,119	0,110	Phase 3	N/A	N/A
26th	0,096	0,088	Phase 3	N/A	N/A
27th	0,046	0,043	Phase 3	N/A	N/A
28th	0,118	0,109	Phase 3	N/A	N/A
29th	0,094	0,086	Phase 3	N/A	N/A
30th	0,027	0,025	Phase 3	N/A	N/A
31th	0,055	0,051	Phase 3	N/A	N/A
32th	0,099	0,091	Phase 3	N/A	N/A
33th	0,052	0,048	Phase 3	N/A	N/A
34th	0,030	0,028	Phase 3	N/A	N/A
35th	0,056	0,052	Phase 3	N/A	N/A
36th	0,025	0,023	Phase 3	N/A	N/A
37th	0,022	0,021	Phase 3	N/A	N/A
38th	0,039	0,036	Phase 3	N/A	N/A
39th	0,048	0,044	Phase 3	N/A	N/A
40th	0,039	0,036	Phase 3	N/A	N/A

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. PVTR190201N024

Power Quality. Harmonic current emission					
micro-generator		SUN2000-185KTL-H1			
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	126,108	99,878	Phase 1	-	-
2nd	0,078	0,062	Phase 1	8	8
3rd	0,185	0,146	Phase 1	21,6	N/A
4th	0,091	0,072	Phase 1	4	4
5th	0,463	0,366	Phase 1	10,7	10,7
6th	0,018	0,014	Phase 1	2,67	2,67
7th	0,789	0,625	Phase 1	7,2	7,2
8th	0,046	0,037	Phase 1	2	2
9th	0,077	0,061	Phase 1	3,8	N/A
10th	0,173	0,137	Phase 1	1,6	1,6
11th	0,344	0,272	Phase 1	3,1	3,1
12th	0,050	0,040	Phase 1	1,33	1,33
13th	0,641	0,508	Phase 1	2	2
14th	0,168	0,133	Phase 1	N/A	N/A
15th	0,097	0,077	Phase 1	N/A	N/A
16th	0,177	0,140	Phase 1	N/A	N/A
17th	0,348	0,275	Phase 1	N/A	N/A
18th	0,046	0,036	Phase 1	N/A	N/A
19th	0,216	0,171	Phase 1	N/A	N/A
20th	0,113	0,089	Phase 1	N/A	N/A
21th	0,057	0,045	Phase 1	N/A	N/A
22th	0,158	0,125	Phase 1	N/A	N/A
23th	0,372	0,294	Phase 1	N/A	N/A
24th	0,026	0,021	Phase 1	N/A	N/A
25th	0,127	0,101	Phase 1	N/A	N/A
26th	0,115	0,091	Phase 1	N/A	N/A
27th	0,054	0,042	Phase 1	N/A	N/A
28th	0,084	0,067	Phase 1	N/A	N/A
29th	0,129	0,102	Phase 1	N/A	N/A
30th	0,017	0,013	Phase 1	N/A	N/A
31th	0,142	0,112	Phase 1	N/A	N/A
32th	0,122	0,097	Phase 1	N/A	N/A
33th	0,030	0,024	Phase 1	N/A	N/A
34th	0,032	0,026	Phase 1	N/A	N/A
35th	0,110	0,087	Phase 1	N/A	N/A
36th	0,032	0,025	Phase 1	N/A	N/A
37th	0,102	0,081	Phase 1	N/A	N/A
38th	0,060	0,047	Phase 1	N/A	N/A
39th	0,035	0,028	Phase 1	N/A	N/A
40th	0,033	0,026	Phase 1	N/A	N/A

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. PVTR190201N024

Power Quality. Harmonic current emission					
micro-generator		SUN2000-185KTL-H1			
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	126,300	100,030	Phase 2	-	-
2nd	0,223	0,177	Phase 2	8	8
3rd	0,220	0,174	Phase 2	21,6	N/A
4th	0,032	0,025	Phase 2	4	4
5th	0,519	0,411	Phase 2	10,7	10,7
6th	0,053	0,042	Phase 2	2,67	2,67
7th	0,707	0,560	Phase 2	7,2	7,2
8th	0,096	0,076	Phase 2	2	2
9th	0,079	0,063	Phase 2	3,8	N/A
10th	0,170	0,134	Phase 2	1,6	1,6
11th	0,344	0,272	Phase 2	3,1	3,1
12th	0,051	0,040	Phase 2	1,33	1,33
13th	0,577	0,457	Phase 2	2	2
14th	0,150	0,118	Phase 2	N/A	N/A
15th	0,181	0,143	Phase 2	N/A	N/A
16th	0,137	0,108	Phase 2	N/A	N/A
17th	0,290	0,230	Phase 2	N/A	N/A
18th	0,077	0,061	Phase 2	N/A	N/A
19th	0,341	0,270	Phase 2	N/A	N/A
20th	0,089	0,071	Phase 2	N/A	N/A
21th	0,104	0,082	Phase 2	N/A	N/A
22th	0,115	0,091	Phase 2	N/A	N/A
23th	0,369	0,292	Phase 2	N/A	N/A
24th	0,052	0,041	Phase 2	N/A	N/A
25th	0,219	0,173	Phase 2	N/A	N/A
26th	0,086	0,068	Phase 2	N/A	N/A
27th	0,093	0,074	Phase 2	N/A	N/A
28th	0,078	0,062	Phase 2	N/A	N/A
29th	0,150	0,119	Phase 2	N/A	N/A
30th	0,031	0,025	Phase 2	N/A	N/A
31th	0,167	0,132	Phase 2	N/A	N/A
32th	0,088	0,070	Phase 2	N/A	N/A
33th	0,066	0,052	Phase 2	N/A	N/A
34th	0,022	0,018	Phase 2	N/A	N/A
35th	0,082	0,065	Phase 2	N/A	N/A
36th	0,040	0,031	Phase 2	N/A	N/A
37th	0,134	0,106	Phase 2	N/A	N/A
38th	0,049	0,038	Phase 2	N/A	N/A
39th	0,050	0,040	Phase 2	N/A	N/A
40th	0,022	0,018	Phase 2	N/A	N/A

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. PVTR190201N024

Power Quality. Harmonic current emission					
micro-generator		SUN2000-185KTL-H1			
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	126,189	99,941	Phase 3	-	-
2nd	0,157	0,124	Phase 3	8	8
3rd	0,121	0,096	Phase 3	21,6	N/A
4th	0,070	0,056	Phase 3	4	4
5th	0,664	0,526	Phase 3	10,7	10,7
6th	0,049	0,039	Phase 3	2,67	2,67
7th	0,694	0,550	Phase 3	7,2	7,2
8th	0,062	0,049	Phase 3	2	2
9th	0,076	0,061	Phase 3	3,8	N/A
10th	0,209	0,165	Phase 3	1,6	1,6
11th	0,405	0,321	Phase 3	3,1	3,1
12th	0,035	0,027	Phase 3	1,33	1,33
13th	0,526	0,417	Phase 3	2	2
14th	0,133	0,105	Phase 3	N/A	N/A
15th	0,097	0,077	Phase 3	N/A	N/A
16th	0,172	0,136	Phase 3	N/A	N/A
17th	0,311	0,247	Phase 3	N/A	N/A
18th	0,032	0,025	Phase 3	N/A	N/A
19th	0,266	0,211	Phase 3	N/A	N/A
20th	0,151	0,120	Phase 3	N/A	N/A
21th	0,081	0,065	Phase 3	N/A	N/A
22th	0,181	0,144	Phase 3	N/A	N/A
23th	0,247	0,195	Phase 3	N/A	N/A
24th	0,040	0,031	Phase 3	N/A	N/A
25th	0,172	0,136	Phase 3	N/A	N/A
26th	0,103	0,081	Phase 3	N/A	N/A
27th	0,066	0,052	Phase 3	N/A	N/A
28th	0,138	0,109	Phase 3	N/A	N/A
29th	0,151	0,120	Phase 3	N/A	N/A
30th	0,030	0,024	Phase 3	N/A	N/A
31th	0,101	0,080	Phase 3	N/A	N/A
32th	0,107	0,085	Phase 3	N/A	N/A
33th	0,055	0,044	Phase 3	N/A	N/A
34th	0,040	0,031	Phase 3	N/A	N/A
35th	0,096	0,076	Phase 3	N/A	N/A
36th	0,022	0,018	Phase 3	N/A	N/A
37th	0,076	0,061	Phase 3	N/A	N/A
38th	0,046	0,037	Phase 3	N/A	N/A
39th	0,041	0,033	Phase 3	N/A	N/A
40th	0,049	0,039	Phase 3	N/A	N/A



**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. PVTR190201N024

Voltage fluctuation and Flicker.					
<b>SUN2000-185KTL-H1 - Phase 1</b>	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11				
<b>Value</b>	<b>Pst</b>	<b>Plt 2 hours</b>	<b>d(t)<sub>500ms</sub></b>	<b>dc</b>	<b>dmax</b>
<b>Limit</b>	1,0	0,65	3,3%	3,3%	4%
<b>Test value</b>	0,60	0,58	---	0,00	1,60
<b>SUN2000-185KTL-H1 - Phase 2</b>	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11				
<b>Value</b>	<b>Pst</b>	<b>Plt 2 hours</b>	<b>d(t)<sub>500ms</sub></b>	<b>dc</b>	<b>dmax</b>
<b>Limit</b>	1,0	0,65	3,3%	3,3%	4%
<b>Test value</b>	0,54	0,51	---	0,00	1,38
<b>SUN2000-185KTL-H1 - Phase 3</b>	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11				
<b>Value</b>	<b>Pst</b>	<b>Plt 2 hours</b>	<b>d(t)<sub>500ms</sub></b>	<b>dc</b>	<b>dmax</b>
<b>Limit</b>	1,0	0,65	3,3%	3,3%	4%
<b>Test value</b>	0,56	0,54	---	0,00	1,75
<b>SUN2000-168KTL-H1 - Phase 1</b>	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11				
<b>Value</b>	<b>Pst</b>	<b>Plt 2 hours</b>	<b>d(t)<sub>500ms</sub></b>	<b>dc</b>	<b>dmax</b>
<b>Limit</b>	1,0	0,65	3,3%	3,3%	4%
<b>Test value</b>	0,64	0,63	---	0,00	1,54
<b>SUN2000-168KTL-H1 - Phase 2</b>	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11				
<b>Value</b>	<b>Pst</b>	<b>Plt 2 hours</b>	<b>d(t)<sub>500ms</sub></b>	<b>dc</b>	<b>dmax</b>
<b>Limit</b>	1,0	0,65	3,3%	3,3%	4%
<b>Test value</b>	0,53	0,53	---	0,00	1,10
<b>SUN2000-168KTL-H1 - Phase 3</b>	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11				
<b>Value</b>	<b>Pst</b>	<b>Plt 2 hours</b>	<b>d(t)<sub>500ms</sub></b>	<b>dc</b>	<b>dmax</b>
<b>Limit</b>	1,0	0,65	3,3%	3,3%	4%
<b>Test value</b>	0,58	0,58	---	0,00	1,66

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. PVTR190201N024

DC-Injection.				
SUN2000-185KTL-H1				
Protection limit	Tested at four power levels, limit 0,5% of IAC <sub>nom</sub> (63mA)			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [mA]	184,3	255,2	254,0	246,0
Max. test value (phase L2) [mA]	250,3	265,4	224,0	254,0
Max. test value (phase L3) [mA]	228,3	313,8	327,0	350,0
SUN2000-168KTL-H1				
Protection limit	Tested at four power levels, limit 0,5% of IAC <sub>nom</sub> (54mA)			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [mA]	177,1	204,9	225,0	220,0
Max. test value (phase L2) [mA]	324,6	219,9	226,0	235,0
Max. test value (phase L3) [mA]	366,0	247,6	305,0	348,0

**Comments**

Note. Inverter use a grid voltage of 800V. For connection to the grid an AC Transformer will be necessary in the plant.