



**BUREAU
VERITAS**

Certificate of compliance

Applicant: **Renac Power Technology Co., Ltd**
Building 6, No.2, West Jinzhi Road, High-Tech District,
Suzhou City, Jiangsu Province
China

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

Model: **ESC3000-DS**
ESC3680-DS
ESC5000-DS

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 generator ESC5000-DS is 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: **ABRE-18NO2465FCSHP**

Certificate number: **U19-0266**

Date of issue: **2019-05-07**

Certification body



Holger Schaffer

Certification body of Bureau Veritas Consumer Products Services Germany GmbH
Accredited according to 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

Nr. ABRE-18NO2465FCSHP

Type Approval and declaration of compliance with the requirements of EN 50438.			
Manufacturer / applicant:	Renac Power Technology Co., Ltd Building 6, No.2, West Jinzhi Road, High-Tech District, Suzhou City, Jiangsu Province China		
Micro-generator Type	Grid-tied photovoltaic inverter		
Rated values	ESC3000-DS	ESC3680-DS	ESC5000-DS
Maximum rated capacity	3 kW	3,68 kW	4,6 kW
Rated voltage	230V	230V	230V
Firmware version	01		
Measurement period:	2018-08-03 to 2019-03-20		
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.			
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	1,62 / 493
Over-voltage stage 2	264,5	0,2	264,5	0,2	265	0,198
Under-voltage stage 1	195,5	1,5	195,5	1,5	195	1,06

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	52,0	0,5	52,00	0,216
Under-frequency	47,5	0,5	47,5	0,5	47,475	0,360

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]	101,5	87,5	104,3	84,9	76,9	94,8

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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	195,8	47,49	4,844	0,9842
2	253,4	51,49	4,641	0,9774

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]:	4,668	4,646	4,651
ΔP/PM [%] per 1 Hz:			0,934

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 [kW]:	N/A	4,51	3,68	2,86	2,86	2,86	N/A
PE60 [kW]:	4,53	4,55	3,67	2,87	2,87	2,85	3,81
ΔPE60/PM [%]:	N/A	0,87	0,22	0,22	0,22	0,22	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	50,00
PM [kW]:	N/A	2,25	1,84	1,43	1,43	1,43	N/A
PE60 [kW]:	2,28	2,28	1,97	1,44	1,44	1,44	3,11
ΔPE60/PM [%]:	N/A	1,30	5,65	0,43	0,43	0,43	N/A
Limit ΔP/P _{1min} :	+ 10 % of P _M						

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Reactive power

Uncontrollable reactive power

ESC3000-DS

Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,9706i	0,9672i	0,9658i
50% PN	0,9917i	0,9912i	0,9908i
75% PN	0,9957i	0,9956i	0,9954i
100% PN	0,9973i	0,9972i	0,9971i
Limit	>0,95	>0,95	>0,95

ESC3680-DS

Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,9820i	0,9973i	0,9797i
50% PN	0,9949i	0,9940i	0,9942i
75% PN	0,9973i	0,9970i	0,9970i
100% PN	0,9976i	0,9981i	0,9978
Limit	>0,95	>0,95	>0,95

ESC5000-DS

Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,9871i	0,9858i	0,9871i
50% PN	0,9963i	0,9959i	0,9963i
75% PN	0,9978i	0,9977i	0,9977i
100% PN	0,9984i	0,9996i	0,9983 i
Limit	>0,95	>0,95	>0,95

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Controllable reactive power				
Inductive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	AC voltage [V]
0% - 10%	434,4	-325,1	0,7906	240,1
10% - 20%	903,9	-701,8	0,8000	240,3
20% - 30%	1366,2	-963,2	0,8000	240,4
30% - 40%	1840,9	-1306,6	0,8000	240,6
40% - 50%	2064,8	-1473,4	0,8000	240,7
50% - 60%	2753,5	-1978,7	0,8000	240,9
60% - 70%	3215,7	-2316,9	0,8000	241,1
70% - 80%	3669,1	-2650,5	0,7996	241,2
80% - 90%	4123,7	-2986,2	0,7950	241,4
90% - 100%	4380,9	-3174,8	0,7926	241,5
Capacitive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	AC voltage [V]
0% - 10%	431,1	316,7	0,8023	240,1
10% - 20%	672,4	129,1	0,7944	240,3
20% - 30%	1367,1	1068,9	0,7903	240,4
30% - 40%	1834,1	1428,8	0,7901	240,6
40% - 50%	2295,5	1783,9	0,7902	240,8
50% - 60%	2757,4	2141,3	0,7901	240,9
60% - 70%	3214,7	2494,1	0,7902	241,1
70% - 80%	3669,3	2846,8	0,7901	241,3
80% - 90%	4123,3	3199,4	0,7903	241,5
90% - 100%	4391,0	3407,3	0,7902	241,6
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%	430,7	146,2	0,9469	240,1
10% - 20%	905,2	129,2	0,9900	240,3
20% - 30%	1374,6	131,6	0,9954	240,4
30% - 40%	1841,8	135,7	0,9973	240,6
40% - 50%	2306,3	141,3	0,9981	240,8
50% - 60%	2773,2	150,6	0,9985	240,9
60% - 70%	3236,9	160,8	0,9988	241,1
70% - 80%	3696,1	175,7	0,9989	241,3
80% - 90%	4155,4	191,2	0,9989	241,5
90% - 100%	4557,3	208,7	0,9990	241,6

Q adjustment				
	Reactive power set point Q [Var]	Measured reactive power Q [Var]	Measured cos φ	Deviation compared to setpoint $\Delta Q / PN$ [%]
- Qmin	-48,43	-2956,7	0,7985	0,87
0	0	108,6	0,9996	2,17
+ Qmax	+48,43	2907,5	0,7986	1,85

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Connection and starting to generate electrical power		
Test according EN 50438 with standard setting	Min. voltage for connection to grid:	193,2V
	Max. voltage for connection to grid:	255,3V
	Min. frequency for connection to grid:	47,95Hz
	Max. frequency for connection to grid:	50,15Hz
	Observation time ($\geq 60s$)	60
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]	77,0	78,0
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%Pn/min.	
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]	77,0	79,0
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%Pn/min.	
	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	
e) In frequency range at start-up	$\geq 47,45$ Hz within twice of setting observation time	$\leq 50,15$ Hz within twice of setting observation time
Reconnection time [s]	78,0	76,0
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%Pn/min.	
f) In frequency range after frequency failure	$\geq 47,45$ Hz for twice of setting observation time	$\leq 50,15$ Hz for twice of setting observation time
Reconnection time [s]	78,0	78,0
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%Pn/min.	

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Short-circuit current contribution					
Short-circuit current parameters					
ESC3000-DS					
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	44,2V	13,6A
Initial Value of aperiodic current	A	N/A	100ms	N/A	N/A
Initial symmetrical short-circuit current*	I_k	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	i_{dc}	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	20,4ms	
ESC3680-DS					
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	33,6V	27,8A
Initial Value of aperiodic current	A	N/A	100ms	N/A	N/A
Initial symmetrical short-circuit current*	I_k	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	i_{dc}	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	20,2ms	
ESC5000-DS					
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	33,6V	24,8A
Initial Value of aperiodic current	A	N/A	100ms	N/A	N/A
Initial symmetrical short-circuit current*	I_k	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	i_{dc}	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	20,4ms	

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Power Quality. Harmonic current emission				
micro-generator		ESC3000-DS		
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	13,0108	--	Phase 1	-
2nd	0,1091	0,838	Phase 1	1,080
3rd	0,3577	2,748	Phase 1	2,300
4th	0,0219	0,169	Phase 1	0,430
5th	0,0826	0,634	Phase 1	1,140
6th	0,0192	0,148	Phase 1	0,300
7th	0,0366	0,281	Phase 1	0,770
8th	0,0116	0,089	Phase 1	0,230
9th	0,0088	0,067	Phase 1	0,400
10th	0,0085	0,065	Phase 1	0,184
11th	0,0280	0,215	Phase 1	0,330
12th	0,0112	0,086	Phase 1	0,153
13th	0,0136	0,105	Phase 1	0,210
14th	0,0119	0,091	Phase 1	0,131
15th	0,0155	0,119	Phase 1	0,150
16th	0,0042	0,032	Phase 1	0,115
17th	0,0157	0,120	Phase 1	0,132
18th	0,0034	0,026	Phase 1	0,102
19th	0,0233	0,179	Phase 1	0,118
20th	0,0060	0,046	Phase 1	0,092
21th	0,0149	0,114	Phase 1	0,107
22th	0,0110	0,084	Phase 1	0,084
23th	0,0039	0,030	Phase 1	0,098
24th	0,0128	0,099	Phase 1	0,077
25th	0,0066	0,051	Phase 1	0,090
26th	0,0124	0,095	Phase 1	0,071
27th	0,0096	0,074	Phase 1	0,083
28th	0,0032	0,025	Phase 1	0,066
29th	0,0107	0,082	Phase 1	0,078
30th	0,0099	0,076	Phase 1	0,061
31th	0,0073	0,056	Phase 1	0,073
32th	0,0193	0,015	Phase 1	0,058
33th	0,0077	0,059	Phase 1	0,068
34th	0,0039	0,030	Phase 1	0,054
35th	0,0061	0,047	Phase 1	0,064
36th	0,0416	0,320	Phase 1	0,051
37th	0,0061	0,047	Phase 1	0,061
38th	0,0060	0,046	Phase 1	0,048
39th	0,0061	0,014	Phase 1	0,058
40th	0,0084	0,064	Phase 1	0,046

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Power Quality. Harmonic current emission				
micro-generator		ESC3680-DS		
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	15,9572	--	Phase 1	-
2nd	0,1251	0,783	Phase 1	1,080
3rd	0,4662	2,920	Phase 1	2,300
4th	0,0397	0,249	Phase 1	0,430
5th	0,0871	0,546	Phase 1	1,140
6th	0,0101	0,063	Phase 1	0,300
7th	0,0361	0,226	Phase 1	0,770
8th	0,0166	0,104	Phase 1	0,230
9th	0,0031	0,019	Phase 1	0,400
10th	0,0319	0,200	Phase 1	0,184
11th	0,0202	0,126	Phase 1	0,330
12th	0,0064	0,040	Phase 1	0,153
13th	0,0158	0,099	Phase 1	0,210
14th	0,0047	0,029	Phase 1	0,131
15th	0,0244	0,153	Phase 1	0,150
16th	0,0106	0,066	Phase 1	0,115
17th	0,0055	0,035	Phase 1	0,132
18th	0,0177	0,111	Phase 1	0,102
19th	0,0148	0,093	Phase 1	0,118
20th	0,0067	0,042	Phase 1	0,092
21th	0,0044	0,027	Phase 1	0,107
22th	0,0144	0,090	Phase 1	0,084
23th	0,0446	0,279	Phase 1	0,098
24th	0,0154	0,097	Phase 1	0,077
25th	0,0218	0,137	Phase 1	0,090
26th	0,0107	0,067	Phase 1	0,071
27th	0,0293	0,184	Phase 1	0,083
28th	0,0022	0,014	Phase 1	0,066
29th	0,0139	0,087	Phase 1	0,078
30th	0,0074	0,047	Phase 1	0,061
31th	0,0100	0,062	Phase 1	0,073
32th	0,0048	0,030	Phase 1	0,058
33th	0,0090	0,056	Phase 1	0,068
34th	0,0024	0,015	Phase 1	0,054
35th	0,0117	0,073	Phase 1	0,064
36th	0,0707	0,443	Phase 1	0,051
37th	0,0109	0,068	Phase 1	0,061
38th	0,0079	0,050	Phase 1	0,048
39th	0,0039	0,024	Phase 1	0,058
40th	0,0132	0,083	Phase 1	0,046

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Power Quality. Harmonic current emission				
micro-generator		ESC5000-DS		
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	20,1019	--	Phase 1	-
2nd	0,1523	0,757	Phase 1	1,080
3rd	0,6269	3,117	Phase 1	2,300
4th	0,0292	0,145	Phase 1	0,430
5th	0,1085	0,539	Phase 1	1,140
6th	0,0119	0,059	Phase 1	0,300
7th	0,0881	0,438	Phase 1	0,770
8th	0,0123	0,061	Phase 1	0,230
9th	0,0536	0,266	Phase 1	0,400
10th	0,0086	0,043	Phase 1	0,184
11th	0,0433	0,215	Phase 1	0,330
12th	0,0100	0,049	Phase 1	0,153
13th	0,0126	0,063	Phase 1	0,210
14th	0,0096	0,048	Phase 1	0,131
15th	0,0354	0,716	Phase 1	0,150
16th	0,0058	0,029	Phase 1	0,115
17th	0,0203	0,101	Phase 1	0,132
18th	0,0210	0,104	Phase 1	0,102
19th	0,0320	0,149	Phase 1	0,118
20th	0,0077	0,038	Phase 1	0,092
21th	0,0224	0,111	Phase 1	0,107
22th	0,0051	0,025	Phase 1	0,084
23th	0,0203	0,101	Phase 1	0,098
24th	0,0116	0,058	Phase 1	0,077
25th	0,0097	0,048	Phase 1	0,090
26th	0,0126	0,063	Phase 1	0,071
27th	0,0203	0,101	Phase 1	0,083
28th	0,0161	0,080	Phase 1	0,066
29th	0,0181	0,090	Phase 1	0,078
30th	0,0035	0,017	Phase 1	0,061
31th	0,0224	0,111	Phase 1	0,073
32th	0,0015	0,007	Phase 1	0,058
33th	0,0180	0,089	Phase 1	0,068
34th	0,0067	0,033	Phase 1	0,054
35th	0,0084	0,042	Phase 1	0,064
36th	0,0151	0,075	Phase 1	0,051
37th	0,0099	0,049	Phase 1	0,061
38th	0,0035	0,017	Phase 1	0,048
39th	0,0128	0,063	Phase 1	0,058
40th	0,0064	0,032	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	0,23	0,18	0	0,18	1,08

DC-Injection.				
ESC-3000-DS				
Protection limit	Tested at four power levels, limit 0,5% of IAC _{nom} (65mA)			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [mA]	12,4	12,7	12,6	11,8
ESC-3680-DS				
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) [mA]	11,4	8,0	15,9	16,7
ESC-5000-DS				
Protection limit	Tested at four power levels, limit 0,5% of IAC _{nom} (100mA)			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [mA]	16,6	17,3	19,1	21,5