



# Certificate of compliance

**Applicant:** KACO new energy GmbH  
Carl-Zeiss-Straße 1  
74172 Neckarsulm  
Germany

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

**Model:** Powador 12.0TL3-INT  
Powador 14.0TL3-INT  
Powador 18.0TL3-INT  
Powador 20.0TL3 INT  
Blueplanet 20.0 TL3 M2 WM OD IIG0

## 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 Powador 14.0TL3-INT, Powador 18.0TL3-INT, Powador 20.0TL3-INT, Blueplanet 20.0 TL3 M2 WM OD IIG0 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:** 10TH0306-EN50438  
**Certificate number:** U16-0486  
**Date of issue:** 2016-08-26

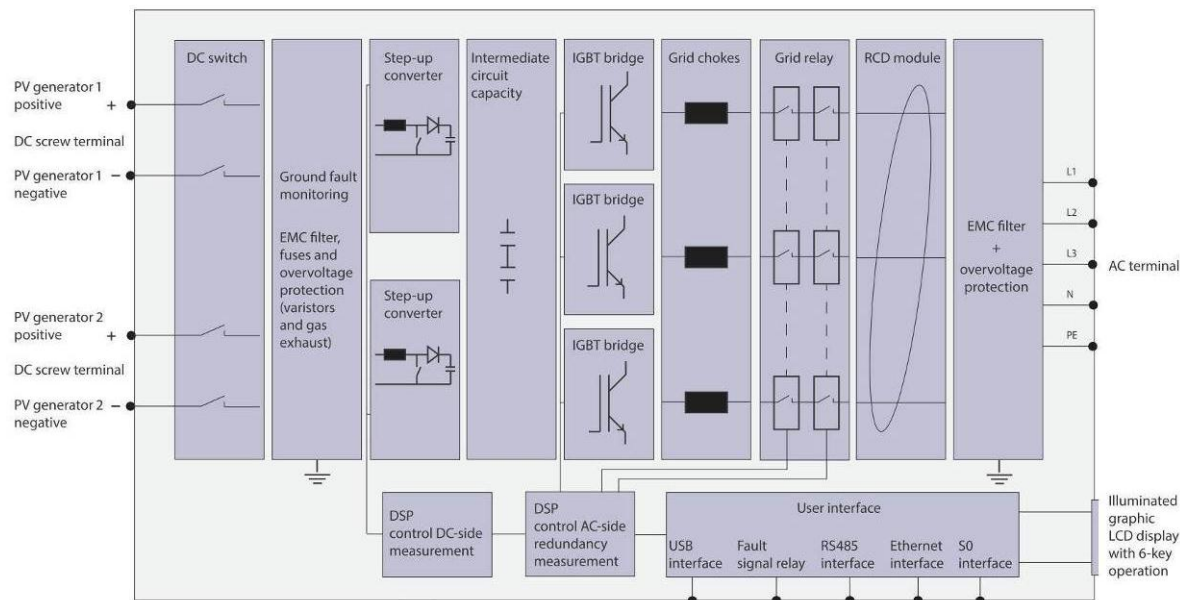


Certification body of Bureau Veritas Consumer Products Services Germany GmbH  
Accredited according to DIN EN ISO/IEC 17065

**Appendix E Type Verification Test Report**  
 Extract from test report according to EN 50438 Nr. 10TH0306

Type Approval and declaration of compliance with the requirements of EN 50438.	
<b>Manufacturer / applicant:</b>	KACO new energy GmbH Carl-Zeiss-Straße 1 74172 Neckarsulm Germany
<b>Micro-generator Type</b>	Grid-tied photovoltaic inverter
<b>Rated values</b>	Powador 12.0TL3-INT Powador 14.0TL3-INT Powador 18.0TL3-INT Powador 20.0TL3 INT Blueplanet 20.0 TL3 M2 WM OD IIG0
<b>Maximum rated capacity</b>	Powador 12.0 TL3 : 10 kW      Powador 14.0 TL3: 12,5 kW Powador 18.0 TL3 : 15 kW      Powador 20.0 TL3: 17 kW Blueplanet 20.0 TL3 : 20 kW
<b>Rated voltage</b>	400 V <sub>AC</sub> (P-P) / 230 V <sub>AC</sub> (3/PEN), 50 Hz
<b>Firmware version</b>	PKT: v3.24; ARM: V3.82 3854(Rev. 10378); CFG: v5.1316 (25E3) DSP-AC: v2.06 B6C6(Rev. 3792); DSP-DC: v2.03 59AD (Rev. 808)
<b>Measurement period:</b>	2016-08-02 to 2016-08-26

**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 thanks to the inverter bridge and two series-connected relays. 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**

Blueplanet 20.0

**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*	253,0	431*
Over-voltage stage 2	264,5	0,2	264,5	0,2	263,7	177
Under-voltage stage 1	195,5	1,5	195,5	1,5	196,4	1477

**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	600*	253,0	600*	253,0	431*
Over-voltage stage 2	264,5	0,2	264,5	0,2	264,4	181
Under-voltage stage 1	195,5	1,5	195,5	1,5	197,0	1481

**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	600*	253,0	600*	253,0	431*
Over-voltage stage 2	264,5	0,2	264,5	0,2	264,6	174
Under-voltage stage 1	195,5	1,5	195,5	1,5	197,1	1474

Note.  
 Minimum operation time according to default interface protection:  
 Over-voltage stage 1 -  
 Over-voltage stage 2 0,1s  
 Under-voltage 1,2s  
 \*over-voltage-stage 1: 10 min-mean-value corresponding to EN 50160. The disconnection after a 10min mean value is detected 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	52,00	0,5	52,00	0,5	52,01	0,467
Under-frequency	47,50	0,5	47,50	0,5	47,50	0,485

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 L1 [ms]	184	170	164	185	201	188
Trip time L2 [ms]	184	170	164	185	201	188
Trip time L3 [ms]	184	170	164	185	201	188

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

Type of switching equipment 1:  
Relay with 20ms  
Type of switching equipment 2:  
Relay with 20ms

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]
Blueplanet 20.0				
1	195,5	47,49	18460	0,999
2	253,0	51,50	20086	0,999

Active power at under-frequency			
Blueplanet 20.0			
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	49,60	47,60
Active power [W]:	20,02	20,01	20,0
ΔP/PM [%] per 1 Hz:			0

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**Power response to over-frequency**

Powador 14.0

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
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**1. Measurement a) to g): Active power output > 80% P<sub>n</sub>**

Frequency [Hz]:	49,98	50,24	50,68	51,13	50,68	50,23	49,98
PM [kW]:	N/A	14,82	12,13	9,44	12,13	14,81	N/A
PE60 [kW]:	15,04	14,88	12,48	9,86	12,37	14,80	15,05
ΔPE60/PM [%]:	N/A	0,37	2,32	2,78	1,57	-0,07	N/A

**2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P<sub>n</sub>**

Frequency [Hz]:	49,98	50,24	50,68	51,13	50,68	50,23	49,98
PM [kW]:	N/A	7,49	6,13	4,77	6,13	7,48	N/A
PE60 [kW]:	7,60	7,11	5,85	4,55	5,77	7,04	8,30
ΔPE60/PM [%]:	N/A	-2,48	-1,87	-1,44	-2,38	-2,91	N/A

Limit ΔP/P1min: + 10 % of P<sub>M</sub>

**Reactive power**

**Uncontrollable reactive power**

Blueplanet 20.0

Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,999	0,999	0,998
50% PN	0,999	0,999	0,999
75% PN	0,999	0,999	0,999
100% PN	0,999	0,999	0,999
Limit	>0,95	>0,95	>0,95

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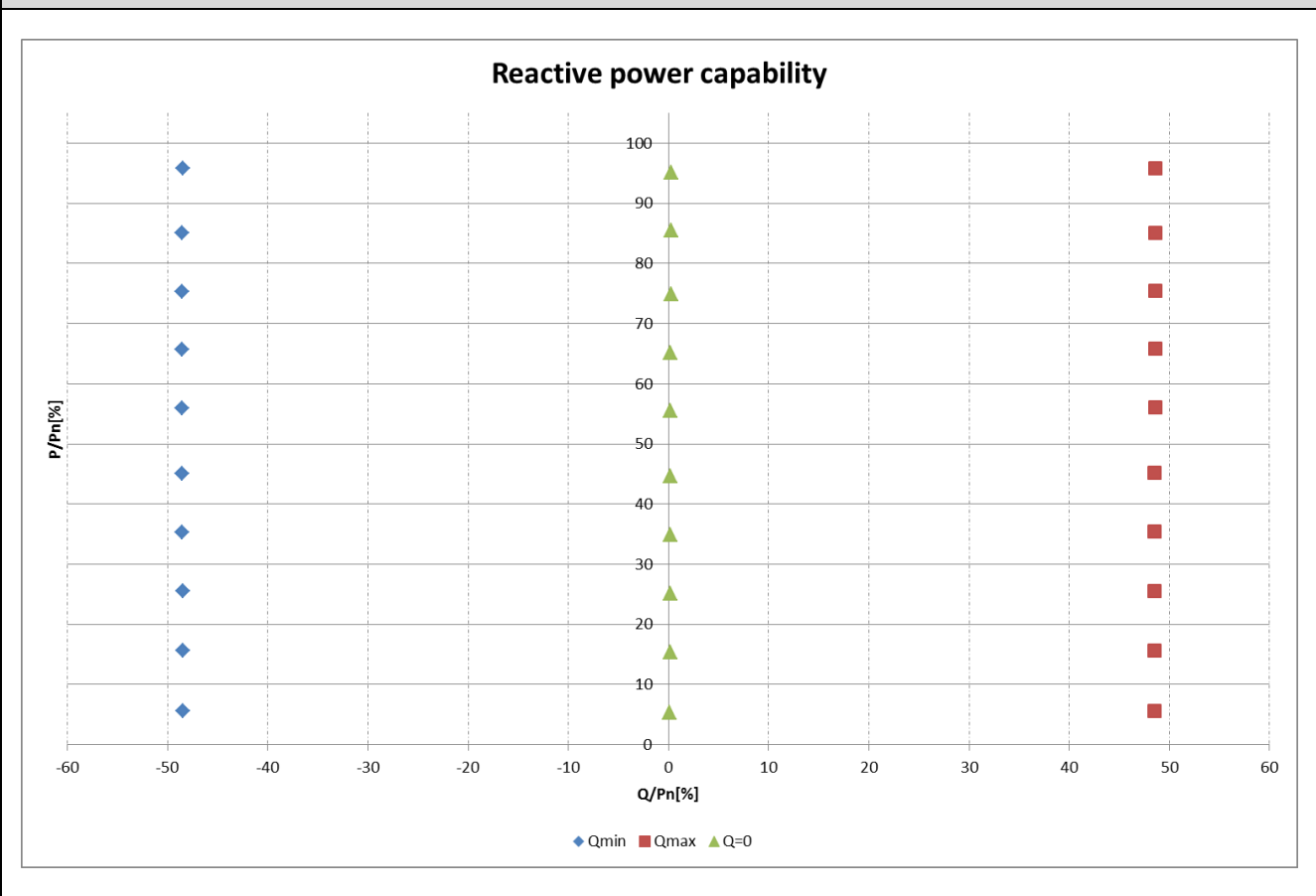
Controllable reactive power				
Blueplanet 20.0				
Inductive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	1004,01	-8723,41	-0,11	1256,62
10% - 20%	2805,75	-8722,23	-0,31	3077,73
20% - 30%	4589,45	-8730,20	-0,47	4893,12
30% - 40%	6361,63	-8734,69	-0,59	6701,83
40% - 50%	8115,89	-8736,93	-0,68	8498,54
50% - 60%	10075,03	-8737,87	-0,76	10515,25
60% - 70%	11825,64	-8738,86	-0,80	12322,06
70% - 80%	13566,18	-8738,36	-0,84	14124,77
80% - 90%	15303,04	-8735,30	-0,87	15932,06
90% - 100%	17236,08	-8729,50	-0,89	17948,10
Capacitive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	1013,26	8732,09	0,12	1247,56
10% - 20%	2814,76	8733,87	0,31	3067,26
20% - 30%	4603,47	8735,24	0,47	4885,63
30% - 40%	6377,62	8735,96	0,59	6696,12
40% - 50%	8132,24	8737,49	0,68	8494,89
50% - 60%	10091,17	8739,78	0,76	10508,49
60% - 70%	11841,03	8742,13	0,80	12316,39
70% - 80%	13582,34	8744,89	0,84	14123,94
80% - 90%	15319,83	8747,07	0,87	15928,07
90% - 100%	17245,45	8752,38	0,89	17940,75
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%	962,18	25,79	0,97	1060,43
10% - 20%	2754,84	29,64	0,99	2888,08
20% - 30%	4521,66	32,07	1,00	4694,71
30% - 40%	6287,98	33,55	1,00	6507,71
40% - 50%	8030,21	36,07	1,00	8298,33
50% - 60%	9981,73	38,57	1,00	10311,42
60% - 70%	11727,07	40,44	1,00	12120,94
70% - 80%	13470,27	44,48	1,00	13930,14
80% - 90%	15399,02	45,41	1,00	15939,91
90% - 100%	17132,19	52,29	1,00	17751,27

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**Diagram of inductive reactive power absorption**



Q adjustment				
	Reactive power set point Q [kVar]	Measured reactive power Q [kVar]	Measured cos φ	Deviation compared to setpoint ΔQ / PN [%]
- Qmin	-48,43%	-48,51%	0,724	-0,08%
0	0,00%	0,18%	0,999	0,18%
+ Qmax	+48,43%	48,54%	0,719	0,11%

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Connection and starting to generate electrical power		
	Voltage conditions	
a) Start up for voltage range	<84% Un for twice of observation time	>111% Un for twice of observation time
Connection:	no connection	no connection
Limit:	No connection allowed	
b) In voltage range at start-up	≥84% Un within twice setting observation time	≤111% Un within twice setting observation time
Reconnection time [s]	117	118
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. For recorded gradient see diagram below.	
c) In voltage range after voltage failure	≥84% Un for twice of setting observation time	≤111% Un for twice of setting observation time
Reconnection time [s]	108	108
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.	
	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	≥47,45 Hz within twice of setting observation time	≤51,15 Hz within twice of setting observation time
Reconnection time [s]	114	116
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]	114	116
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.	



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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	64,82 V	24,77 A
Initial Value of aperiodic current	A	N/A	100ms	61,49 V	26,76 A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	61,20 V	27,66 A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	61,12 V	28,24 A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,570 s	In seconds

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Power Quality. Harmonic current emission					
EUT		KACO Blueplanet 20.0			
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	27,928	100,000	Phase 1	-	-
2nd	0,063	0,226	Phase 1	8	8
3rd	0,036	0,130	Phase 1	21,6	N/A
4th	0,010	0,035	Phase 1	4	4
5th	0,027	0,097	Phase 1	10,7	10,7
6th	0,007	0,026	Phase 1	2,67	2,67
7th	0,052	0,187	Phase 1	7,2	7,2
8th	0,007	0,025	Phase 1	2	2
9th	0,017	0,060	Phase 1	3,8	N/A
10th	0,006	0,023	Phase 1	1,6	1,6
11th	0,040	0,144	Phase 1	3,1	3,1
12th	0,007	0,024	Phase 1	1,33	1,33
13th	0,030	0,109	Phase 1	2	2
14th	0,006	0,020	Phase 1	N/A	N/A
15th	0,019	0,068	Phase 1	N/A	N/A
16th	0,005	0,020	Phase 1	N/A	N/A
17th	0,022	0,080	Phase 1	N/A	N/A
18th	0,005	0,019	Phase 1	N/A	N/A
19th	0,026	0,094	Phase 1	N/A	N/A
20th	0,005	0,018	Phase 1	N/A	N/A
21th	0,016	0,057	Phase 1	N/A	N/A
22th	0,005	0,018	Phase 1	N/A	N/A
23th	0,019	0,069	Phase 1	N/A	N/A
24th	0,005	0,019	Phase 1	N/A	N/A
25th	0,024	0,086	Phase 1	N/A	N/A
26th	0,005	0,018	Phase 1	N/A	N/A
27th	0,011	0,041	Phase 1	N/A	N/A
28th	0,006	0,021	Phase 1	N/A	N/A
29th	0,017	0,061	Phase 1	N/A	N/A
30th	0,006	0,022	Phase 1	N/A	N/A
31th	0,017	0,060	Phase 1	N/A	N/A
32th	0,006	0,022	Phase 1	N/A	N/A
33th	0,009	0,032	Phase 1	N/A	N/A
34th	0,006	0,022	Phase 1	N/A	N/A
35th	0,014	0,048	Phase 1	N/A	N/A
36th	0,006	0,022	Phase 1	N/A	N/A
37th	0,015	0,055	Phase 1	N/A	N/A
38th	0,006	0,020	Phase 1	N/A	N/A
39th	0,008	0,028	Phase 1	N/A	N/A
40th	0,006	0,021	Phase 1	N/A	N/A
THD <sub>40</sub>	-	0,47	Phase 1	13	13
PWHD	-	0,001	Phase 1	22	22

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Power Quality. Harmonic current emission					
EUT		KACO Blueplanet 20.0			
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	27,870	100,000	Phase 2	-	-
2nd	0,058	0,207	Phase 2	8	8
3rd	0,018	0,065	Phase 2	21,6	N/A
4th	0,012	0,042	Phase 2	4	4
5th	0,048	0,174	Phase 2	10,7	10,7
6th	0,008	0,029	Phase 2	2,67	2,67
7th	0,045	0,162	Phase 2	7,2	7,2
8th	0,008	0,029	Phase 2	2	2
9th	0,013	0,048	Phase 2	3,8	N/A
10th	0,007	0,027	Phase 2	1,6	1,6
11th	0,036	0,129	Phase 2	3,1	3,1
12th	0,007	0,025	Phase 2	1,33	1,33
13th	0,030	0,107	Phase 2	2	2
14th	0,007	0,024	Phase 2	N/A	N/A
15th	0,016	0,058	Phase 2	N/A	N/A
16th	0,006	0,023	Phase 2	N/A	N/A
17th	0,021	0,077	Phase 2	N/A	N/A
18th	0,006	0,023	Phase 2	N/A	N/A
19th	0,025	0,088	Phase 2	N/A	N/A
20th	0,006	0,021	Phase 2	N/A	N/A
21th	0,017	0,060	Phase 2	N/A	N/A
22th	0,006	0,020	Phase 2	N/A	N/A
23th	0,020	0,072	Phase 2	N/A	N/A
24th	0,006	0,021	Phase 2	N/A	N/A
25th	0,023	0,081	Phase 2	N/A	N/A
26th	0,005	0,019	Phase 2	N/A	N/A
27th	0,010	0,037	Phase 2	N/A	N/A
28th	0,005	0,020	Phase 2	N/A	N/A
29th	0,015	0,055	Phase 2	N/A	N/A
30th	0,005	0,020	Phase 2	N/A	N/A
31th	0,016	0,058	Phase 2	N/A	N/A
32th	0,005	0,020	Phase 2	N/A	N/A
33th	0,007	0,025	Phase 2	N/A	N/A
34th	0,005	0,020	Phase 2	N/A	N/A
35th	0,014	0,049	Phase 2	N/A	N/A
36th	0,005	0,019	Phase 2	N/A	N/A
37th	0,014	0,049	Phase 2	N/A	N/A
38th	0,005	0,019	Phase 2	N/A	N/A
39th	0,007	0,025	Phase 2	N/A	N/A
40th	0,005	0,018	Phase 2	N/A	N/A
THD <sub>40</sub>	-	0,45	Phase 2	13	13
PWHD	-	0,001	Phase 2	22	22

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Power Quality. Harmonic current emission					
EUT		KACO Blueplanet 20.0			
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	27,854	100,000	Phase 3	-	-
2nd	0,031	0,111	Phase 3	8	8
3rd	0,025	0,089	Phase 3	21,6	N/A
4th	0,013	0,046	Phase 3	4	4
5th	0,044	0,157	Phase 3	10,7	10,7
6th	0,009	0,033	Phase 3	2,67	2,67
7th	0,045	0,162	Phase 3	7,2	7,2
8th	0,009	0,034	Phase 3	2	2
9th	0,015	0,054	Phase 3	3,8	N/A
10th	0,009	0,031	Phase 3	1,6	1,6
11th	0,028	0,102	Phase 3	3,1	3,1
12th	0,008	0,029	Phase 3	1,33	1,33
13th	0,027	0,097	Phase 3	2	2
14th	0,008	0,028	Phase 3	N/A	N/A
15th	0,015	0,053	Phase 3	N/A	N/A
16th	0,008	0,027	Phase 3	N/A	N/A
17th	0,019	0,069	Phase 3	N/A	N/A
18th	0,007	0,026	Phase 3	N/A	N/A
19th	0,023	0,083	Phase 3	N/A	N/A
20th	0,007	0,024	Phase 3	N/A	N/A
21th	0,013	0,046	Phase 3	N/A	N/A
22th	0,006	0,023	Phase 3	N/A	N/A
23th	0,018	0,065	Phase 3	N/A	N/A
24th	0,006	0,023	Phase 3	N/A	N/A
25th	0,022	0,078	Phase 3	N/A	N/A
26th	0,006	0,022	Phase 3	N/A	N/A
27th	0,010	0,035	Phase 3	N/A	N/A
28th	0,006	0,022	Phase 3	N/A	N/A
29th	0,015	0,053	Phase 3	N/A	N/A
30th	0,006	0,022	Phase 3	N/A	N/A
31th	0,015	0,055	Phase 3	N/A	N/A
32th	0,006	0,022	Phase 3	N/A	N/A
33th	0,008	0,029	Phase 3	N/A	N/A
34th	0,006	0,021	Phase 3	N/A	N/A
35th	0,012	0,042	Phase 3	N/A	N/A
36th	0,006	0,021	Phase 3	N/A	N/A
37th	0,013	0,046	Phase 3	N/A	N/A
38th	0,006	0,021	Phase 3	N/A	N/A
39th	0,007	0,026	Phase 3	N/A	N/A
40th	0,006	0,021	Phase 3	N/A	N/A
THD <sub>40</sub>	-	0,39	Phase 3	13	13
PWHD	-	0,001	Phase 3	22	22

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. 10TH0306

**Voltage fluctuation and Flicker.**

Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11					
Value	Pst	Plt 2 hours	d(t) <sub>500ms</sub>	dc	dmax
Limit	1,0	0,65	3,3%	3,3%	4%
Test value	0,079	0,079	3,03%	3,03%	0,30%

**DC-Injection.**

Protection limit	Tested at four power levels, limit 0,5% of IAC <sub>nom</sub> = 145 mA			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [mA]	38,30	33,30	37,61	32,98
Max. test value (phase L2) [mA]	57,70	57,40	54,04	47,20
Max. test value (phase L3) [mA]	13,74	10,16	14,67	8,71