



**BUREAU  
VERITAS**

# Certificado de conformidade

**Requerente:** KACO new energy GmbH  
Carl-Zeiss-Straße 1  
74172 Neckarsulm  
Alemanha

**Produto:** Microgerador em paralelo com redes de distribuição pública de baixa tensão

**Modelo:** Powador 39.0 TL3 - M 1  
Powador 39.0 TL3 - M- INT  
Powador 39.0 TL3 - XL - F - SPD 1+2  
Powador 39.0 TL3 - XL INT  
Powador 48.0 TL3 - M - INT - Park  
Powador 48.0 TL3 - XL - F - SPD 1+2 - Park  
Powador 60.0 TL3 - M - INT  
Powador 60.0 TL3 - XL - INT  
Powador 60.0 TL3 - XL - F - SPD 1+2  
Powador 72.0 TL3 - M - INT - Park  
Powador 72.0 TL3 - XL - INT - Park  
Powador 72.0 TL3 - XL - F - SPD 1+2 - Park

## Utilização de acordo com os regulamentos:

Dispositivo de desconexão automática com monitorização da rede trifásica para sistemas fotovoltaicos com um circuito paralelo trifásico através de um inversor na alimentação pela rede pública. O dispositivo de desconexão automática é parte integrante do inversor anteriormente mencionado.

## Regras e normas aplicadas:

EN 50438:2013 com as definições de protecção de interface padrão para Portugal.  
O Powador 39.0 TL3 - M 1, Powador 39.0 TL3 - M- INT, Powador 39.0 TL3 - XL - F - SPD 1+2,  
Powador 39.0 TL3 - XL INT, Powador 48.0 TL3 - M - INT - Park, Powador 48.0 TL3 - XL - F - SPD 1+2 - Park  
Powador 60.0 TL3 - M - INT, Powador 60.0 TL3 - XL - INT, Powador 60.0 TL3 - XL - F - SPD 1+2  
Powador 72.0 TL3 - M - INT - Park, Powador 72.0 TL3 - XL - INT - Park  
Powador 72.0 TL3 - XL - F - SPD 1+2 - Park é dimensionado para uma corrente máxima >16 A por fase, mas todos os requisitos básicos da norma estão cumpridos.

Aquando da emissão deste certificado, o conceito de protecção de interface de um produto representativo anteriormente mencionado corresponde a especificações de segurança válidas para a utilização especificada, de acordo com os regulamentos. Os testes e certificação foram realizados de acordo com a norma ISO / IEC sistema 5 – Guia 67:2004.

**Número de relatório:** 12TH0351-EN50438\_2  
**Número de certificado:** U17-0568  
**Data de emissão:** 2017-10-13 **Válido até:** 2022-10-12

## Órgão de certificação



Holger Schaffer



Órgão de certificação da Bureau Veritas Consumer Products Services Germany GmbH  
Acreditado nos termos da norma DIN EN ISO/IEC 17065

**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>	<b>KACO new energy GmbH</b> Carl-Zeiss-Straße 1 74172 Neckarsulm <b>Germany</b>	
<b>Micro-generator Type:</b>	<b>Grid-tied photovoltaic inverter</b>	
<b>Rated values:</b>	<b>Powador 39.0 TL3 - M 1</b> <b>Powador 39.0 TL3 - M- INT</b> <b>Powador 39.0 TL3 - XL - F - SPD 1+2</b> <b>Powador 39.0 TL3 - XL INT</b> <b>Powador 60.0 TL3 - M - INT</b> <b>Powador 60.0 TL3 - XL - INT</b> <b>Powador 60.0 TL3 - XL - F - SPD 1+2</b>	<b>Powador 48.0 TL3 - M - INT - Park</b> <b>Powador 48.0 TL3 - XL - F - SPD 1+2 - Park</b> <b>Powador 72.0 TL3 - M - INT - Park</b> <b>Powador 72.0 TL3 - XL - INT - Park</b> <b>Powador 72.0 TL3 - XL - F - SPD 1+2 - Park</b>
<b>Maximum rated capacity:</b>	<b>Powador 39.0 TL3: 33,60kW</b> <b>Powador 60.0 TL3: 51,96kW</b>	<b>Powador 48.0 TL3: 41,54kW</b> <b>Powador 72.0 TL3: 62,42kW</b>
<b>Rated voltage:</b>	<b>400 V; N; PE</b>	<b>480 V; N; PE</b>
<b>Firmware version:</b>	<b>PKT: V4.12; ARM: V5.10; CFG: V6.0692; DSP-AC: V4.11, DSP-DC: V4.02</b>	
<b>Measurement period:</b>	<b>2017-10-09 to 2017-10-12</b>	
<p>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.</p>		

**Appendix E Type Verification Test Report**

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**Type testing of the interface protection**

Powador 60.0

**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	253,0	2,0	253,0	2,0	251,4	1,992
Under-voltage	184,0	2,0	184,0	2,0	183,1	1,991

**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	253,0	2,0	253,0	2,0	251,1	1,994
Under-voltage	184,0	2,0	184,0	2,0	183,1	1,995

**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	253,0	2,0	253,0	2,0	252,2	1,989
Under-voltage	184,0	2,0	184,0	2,0	183,2	1,988

**Type testing of the interface protection**

Powador 72.0

**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	304,7	2,0	305,0	2,0	304,8	1,990
Under-voltage	221,6	2,0	222,0	2,0	221,5	1,975

**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	304,7	2,0	305,0	2,0	304,7	1,989
Under-voltage	221,6	2,0	222,0	2,0	221,2	1,976

**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	304,7	2,0	305,0	2,0	304,7	1,990
Under-voltage	221,6	2,0	222,0	2,0	221,8	1,980

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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	51,00	2,0	51,00	2,0	51,00	1,954
Under-frequency	48,00	2,0	48,00	2,0	48,00	1,979
Note. Over-frequency 2,0 s Under-frequency 2,0 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 [ms]	132	138	204	193	169	159
Indicate additional shut down time included in above results. (Integrated interface switch)				Type of switching equipment 1: Relay with 30ms Type of switching equipment 2: Relay with 30ms		

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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 [kW]	Cos φ [1]
Powador 60.0				
1	195,5	47,50	42,90	0,999
2	253,0	51,50	49,95	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]:	49,99	49,59	47,59
Active power [kW]:	49,9	49,9	49,6
ΔP/PM [%] per 1 Hz:			0

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Power response to over-frequency							
Powador 60.0							
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
<b>1. Measurement a) to g): Active power output &gt; 80% P<sub>n</sub></b>							
Frequency [Hz]:	50,09	50,24	50,69	51,13	50,69	50,24	49,98
PM [kW]:	N/A	48,95	40,05	31,16	40,05	48,95	N/A
PE60 [kW]:	49,70	49,27	40,46	31,55	40,12	49,02	49,25
ΔPE60/PM [%]:	N/A	0,64	0,82	0,78	0,15	0,14	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]:	50,09	50,24	50,69	51,13	50,69	50,24	49,98
PM [kW]:	N/A	24,74	20,24	15,75	20,24	24,74	N/A
PE60 [kW]:	25,12	24,98	20,41	15,93	20,25	24,74	27,05
ΔPE60/PM [%]:	N/A	0,48	0,33	0,36	0,03	0,00	N/A
Limit ΔP/P1min:	+ 10 % of P <sub>M</sub>						

Power response to over-frequency							
Powador 72.0							
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
<b>1. Measurement a) to g): Active power output &gt; 80% P<sub>n</sub></b>							
Frequency [Hz]:	50,11	50,25	50,70	51,15	50,70	50,25	50,00
PM [kW]:	N/A	58,88	48,02	37,29	48,02	58,88	N/A
PE60 [kW]:	60,02	59,33	48,53	37,72	48,13	59,06	58,92
ΔPE60/PM [%]:	N/A	0,75	0,84	0,71	0,18	0,30	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]:	50,11	50,25	50,70	51,15	50,70	50,25	50,00
PM [kW]:	N/A	29,35	23,94	18,59	23,94	29,35	N/A
PE60 [kW]:	29,92	29,50	24,40	18,83	24,04	29,51	31,75
ΔPE60/PM [%]:	N/A	0,24	0,76	0,40	0,17	0,27	N/A
Limit ΔP/P1min:	+ 10 % of P <sub>M</sub>						

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**Reactive power**

**Uncontrollable reactive power**

Powador 60.0

Test Voltage	211,6V	230V	248,4V
<b>Output power</b>			
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

**Reactive power**

**Uncontrollable reactive power**

Powador 72.0

Test Voltage	254,8V	277V	299,2V
<b>Output power</b>			
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				
Powador 60.0				
Inductive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	2478	22022	0,110	2981
10% - 20%	6925	21955	0,300	7430
20% - 30%	11371	21888	0,460	11908
30% - 40%	15736	21809	0,580	16337
40% - 50%	20070	21829	0,680	20758
50% - 60%	24455	21752	0,750	25230
60% - 70%	29249	21670	0,800	30150
70% - 80%	33603	21696	0,840	34627
80% - 90%	38336	21773	0,870	39517
90% - 100%	42632	21712	0,890	43956
Capacitive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	2479	-21812	-0,110	2988
10% - 20%	6911	-21855	-0,300	7433
20% - 30%	11334	-21868	-0,460	11894
30% - 40%	15729	-21856	-0,580	16341
40% - 50%	20094	-21866	-0,680	20782
50% - 60%	24438	-21828	-0,750	25221
60% - 70%	29249	-21844	-0,800	30167
70% - 80%	33570	-21817	-0,840	34619
80% - 90%	38367	-21839	-0,870	39564
90% - 100%	42629	-21871	-0,890	43981
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%	2393	141	0,99	2487
10% - 20%	6849	100	1	6989
20% - 30%	11691	54	1	11918
30% - 40%	16051	96	1	16367
40% - 50%	20418	178	1	20846
50% - 60%	25190	249	1	25733
60% - 70%	29046	305	1	29704
70% - 80%	33831	387	1	34646
80% - 90%	38563	469	1	39559
90% - 100%	42831	533	1	43984

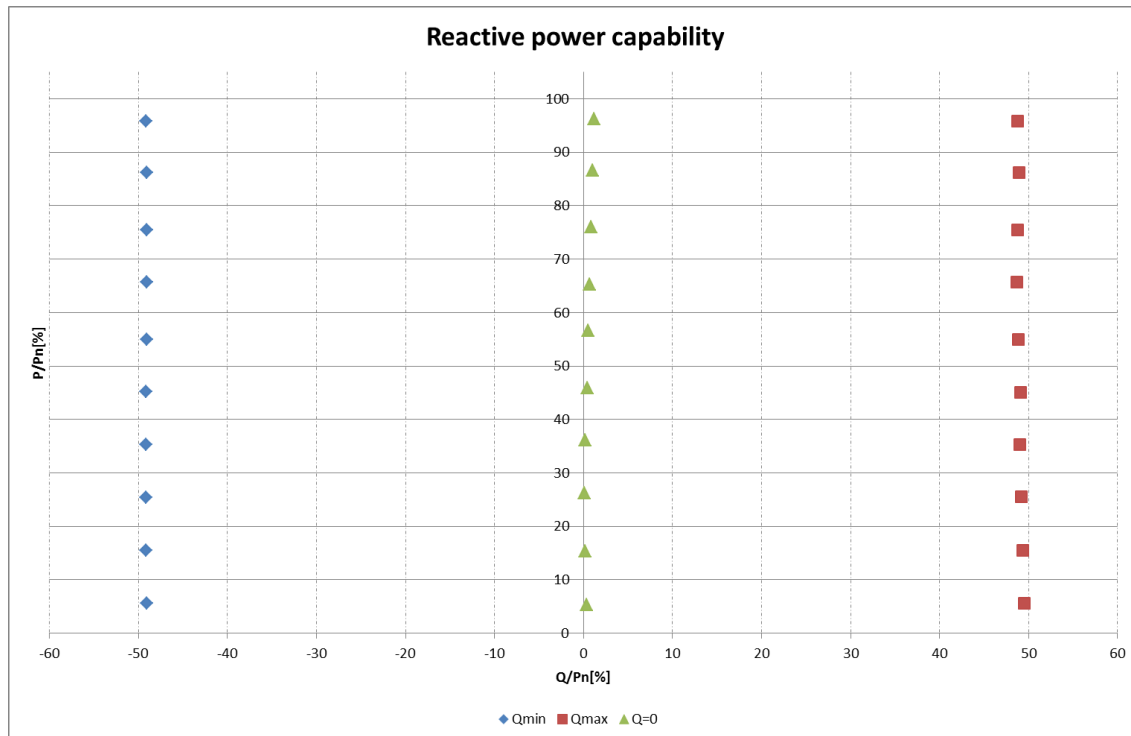


Appendix E Type Verification Test Report

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Diagram of inductive reactive power absorption



Q adjustment				
	Reactive power set point Q [kVar]	Measured reactive power Q [kVar]	Measured $\cos \varphi$	Deviation compared to setpoint $\Delta Q / P_N$ [%]
- Qmin	-48.43	-48,52	0,7174	-0,09%
0	0	0,47	1,00	0,47%
+ Qmax	+48,43	48,52	0,7182	0,09%

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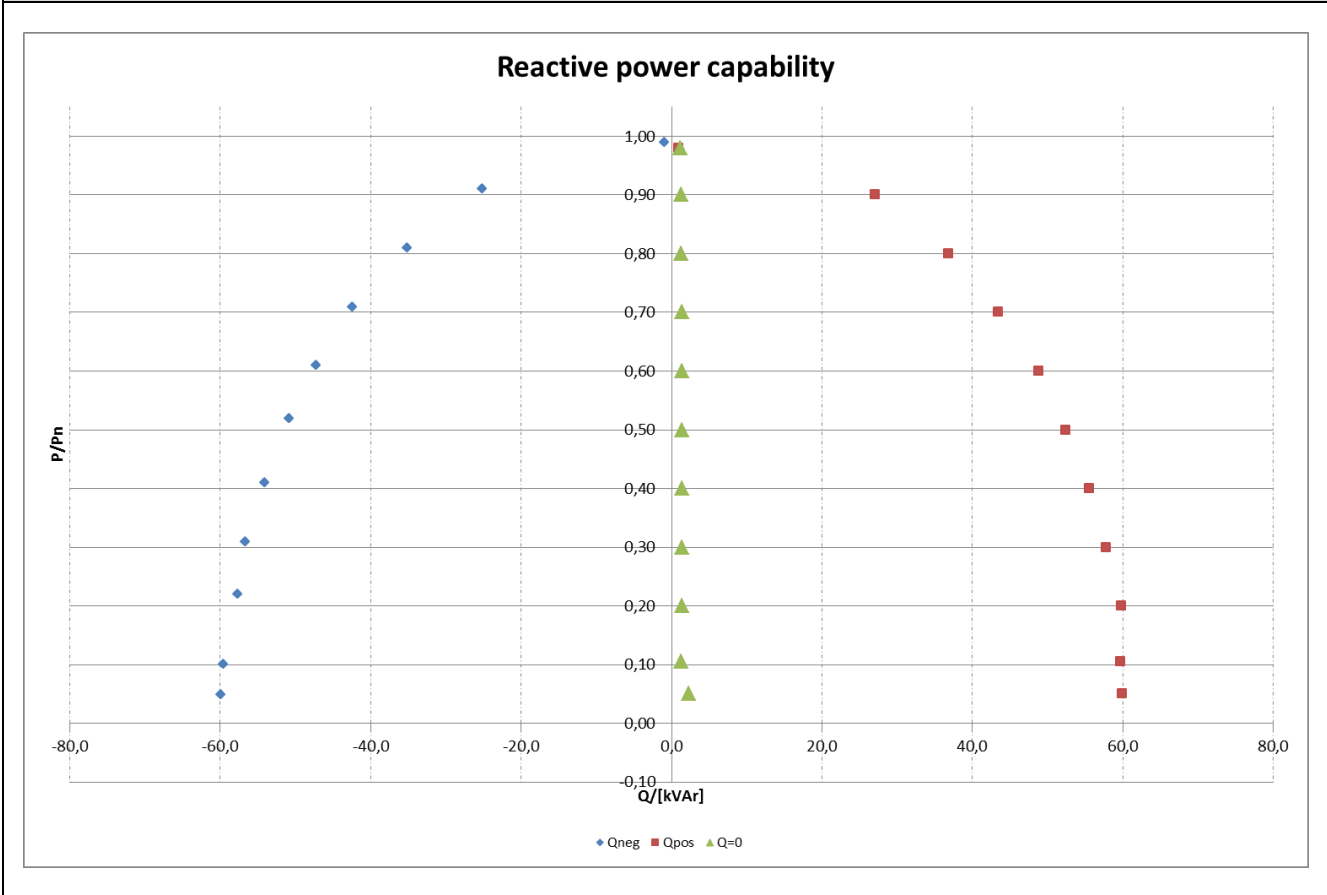
Controllable reactive power				
Powador 72.0				
Inductive (supply reactive power)				
Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	DC power [kW]
0% - 10%	2,94	-59,9	-0,049	4,5
10% - 20%	6,06	-59,6	-0,101	7,1
20% - 30%	13,20	-57,7	-0,223	14,7
30% - 40%	18,60	-56,6	-0,312	20,0
40% - 50%	24,60	-54,1	-0,414	26,0
50% - 60%	31,20	-50,8	-0,523	32,7
60% - 70%	36,60	-47,3	-0,612	38,1
70% - 80%	42,60	-42,5	-0,708	44,1
80% - 90%	48,60	-35,1	-0,811	50,1
90% - 100%	54,60	-25,2	-0,908	55,7
Capacitive (supply reactive power)				
Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	DC power [kW]
0% - 10%	3,00	59,9	0,050	5,0
10% - 20%	6,30	59,7	0,105	7,8
20% - 30%	12,00	59,8	0,197	13,4
30% - 40%	18,00	57,8	0,297	19,4
40% - 50%	24,00	55,6	0,396	25,4
50% - 60%	30,00	52,4	0,497	31,4
60% - 70%	36,00	48,8	0,594	37,5
70% - 80%	42,00	43,4	0,695	43,5
80% - 90%	48,00	36,8	0,793	49,5
90% - 100%	54,00	27,1	0,894	55,5
Reactive power supply with set point Q=0				
Power-BIN	Active power [kW]	Reactive power [kVar]	Power factor (cos φ)	DC power [kW]
0% - 10%	3,06	2,3	0,798	4,7
10% - 20%	6,43	1,3	0,981	7,6
20% - 30%	12,24	1,4	0,994	13,7
30% - 40%	18,36	1,4	0,997	19,8
40% - 50%	24,48	1,4	0,998	25,9
50% - 60%	30,60	1,4	0,999	32,1
60% - 70%	36,72	1,4	0,999	38,2
70% - 80%	42,84	1,4	1,000	44,3
80% - 90%	48,96	1,3	1,000	50,5
90% - 100%	55,08	1,3	1,000	56,2

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Diagram of inductive reactive power absorption



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Connection and starting to generate electrical power		
	Voltage conditions	
<b>a) Start up for voltage range</b>	<b>&lt;84% Un for twice of observation time</b>	<b>&gt;111% Un for twice of observation time</b>
<b>Connection:</b>	no connection	no connection
<b>Limit:</b>	No connection allowed	
<b>b) In voltage range at start-up</b>	<b>≥84% Un within twice setting observation time</b>	<b>≤111% Un within twice setting observation time</b>
<b>Reconnection time [s]</b>	78	89
<b>Limit:</b>	Connected 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. For recorded gradient see diagram below.	
<b>c) In voltage range after voltage failure</b>	<b>≥84% Un for twice of setting observation time</b>	<b>≤111% Un for twice of setting observation time</b>
<b>Reconnection time [s]</b>	81	91
<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. For recorded gradient see diagram below.	
	Frequency conditions	
<b>d) Start up for frequency range</b>	<b>&lt;47,45 Hz for twice of setting observation time</b>	<b>&gt;50,15 Hz for twice of setting observation time</b>
<b>Connection:</b>	no connection	no connection
<b>Limit:</b>	No connection allowed	
<b>e) In frequency range at start-up</b>	<b>≥47,45 Hz within twice of setting observation time</b>	<b>≤51,15 Hz within twice of setting observation time</b>
<b>Reconnection time [s]</b>	89	84
<b>Limit:</b>	Connected after setting delay 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. For recorded gradient see diagram below.	
<b>f) In frequency range after frequency failure</b>	<b>≥47,45 Hz for twice of setting observation time</b>	<b>≤51,15 Hz for twice of setting observation time</b>
<b>Reconnection time [s]</b>	91	84
<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. 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	46,9	94,6
Initial Value of aperiodic current	A	N/A	100ms	47,0	96,8
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	47,2	96,7
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	47,1	96,4
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,555	In seconds

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Power Quality. Harmonic current emission					
EUT		KACO Powador 60.0			
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	72,486	100,000	Phase 1	-	-
2nd	0,496	0,685	Phase 1	8	8
3rd	0,171	0,236	Phase 1	21,6	N/A
4th	0,126	0,174	Phase 1	4	4
5th	0,437	0,603	Phase 1	10,7	10,7
6th	0,064	0,088	Phase 1	2,67	2,67
7th	0,264	0,365	Phase 1	7,2	7,2
8th	0,055	0,076	Phase 1	2	2
9th	0,046	0,063	Phase 1	3,8	N/A
10th	0,042	0,058	Phase 1	1,6	1,6
11th	0,211	0,291	Phase 1	3,1	3,1
12th	0,021	0,028	Phase 1	1,33	1,33
13th	0,212	0,293	Phase 1	2	2
14th	0,035	0,048	Phase 1	N/A	N/A
15th	0,033	0,046	Phase 1	N/A	N/A
16th	0,034	0,047	Phase 1	N/A	N/A
17th	0,215	0,297	Phase 1	N/A	N/A
18th	0,029	0,040	Phase 1	N/A	N/A
19th	0,218	0,300	Phase 1	N/A	N/A
20th	0,040	0,055	Phase 1	N/A	N/A
21th	0,029	0,040	Phase 1	N/A	N/A
22th	0,028	0,039	Phase 1	N/A	N/A
23th	0,205	0,283	Phase 1	N/A	N/A
24th	0,033	0,045	Phase 1	N/A	N/A
25th	0,202	0,279	Phase 1	N/A	N/A
26th	0,022	0,030	Phase 1	N/A	N/A
27th	0,042	0,058	Phase 1	N/A	N/A
28th	0,045	0,062	Phase 1	N/A	N/A
29th	0,187	0,258	Phase 1	N/A	N/A
30th	0,035	0,048	Phase 1	N/A	N/A
31th	0,182	0,251	Phase 1	N/A	N/A
32th	0,022	0,030	Phase 1	N/A	N/A
33th	0,026	0,036	Phase 1	N/A	N/A
34th	0,023	0,031	Phase 1	N/A	N/A
35th	0,138	0,190	Phase 1	N/A	N/A
36th	0,025	0,035	Phase 1	N/A	N/A
37th	0,130	0,179	Phase 1	N/A	N/A
38th	0,048	0,066	Phase 1	N/A	N/A
39th	0,062	0,086	Phase 1	N/A	N/A
40th	0,053	0,073	Phase 1	N/A	N/A
THD <sub>40</sub>	-	1,361	Phase 1	13	13
PWHD	-	0,010	Phase 1	22	22

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. 12TH0351

Power Quality. Harmonic current emission					
EUT		KACO Powador 60.0			
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	72,465	100,000	Phase 2	-	-
2nd	0,602	0,831	Phase 2	8	8
3rd	0,252	0,348	Phase 2	21,6	N/A
4th	0,161	0,222	Phase 2	4	4
5th	0,430	0,593	Phase 2	10,7	10,7
6th	0,111	0,154	Phase 2	2,67	2,67
7th	0,276	0,381	Phase 2	7,2	7,2
8th	0,073	0,101	Phase 2	2	2
9th	0,066	0,091	Phase 2	3,8	N/A
10th	0,058	0,080	Phase 2	1,6	1,6
11th	0,212	0,293	Phase 2	3,1	3,1
12th	0,061	0,084	Phase 2	1,33	1,33
13th	0,220	0,304	Phase 2	2	2
14th	0,056	0,078	Phase 2	N/A	N/A
15th	0,044	0,061	Phase 2	N/A	N/A
16th	0,041	0,056	Phase 2	N/A	N/A
17th	0,215	0,297	Phase 2	N/A	N/A
18th	0,036	0,050	Phase 2	N/A	N/A
19th	0,217	0,300	Phase 2	N/A	N/A
20th	0,050	0,069	Phase 2	N/A	N/A
21th	0,039	0,054	Phase 2	N/A	N/A
22th	0,052	0,071	Phase 2	N/A	N/A
23th	0,209	0,289	Phase 2	N/A	N/A
24th	0,029	0,040	Phase 2	N/A	N/A
25th	0,206	0,284	Phase 2	N/A	N/A
26th	0,042	0,058	Phase 2	N/A	N/A
27th	0,042	0,058	Phase 2	N/A	N/A
28th	0,045	0,062	Phase 2	N/A	N/A
29th	0,179	0,247	Phase 2	N/A	N/A
30th	0,040	0,055	Phase 2	N/A	N/A
31th	0,177	0,244	Phase 2	N/A	N/A
32th	0,030	0,042	Phase 2	N/A	N/A
33th	0,027	0,038	Phase 2	N/A	N/A
34th	0,033	0,046	Phase 2	N/A	N/A
35th	0,132	0,182	Phase 2	N/A	N/A
36th	0,036	0,049	Phase 2	N/A	N/A
37th	0,112	0,154	Phase 2	N/A	N/A
38th	0,025	0,035	Phase 2	N/A	N/A
39th	0,054	0,075	Phase 2	N/A	N/A
40th	0,047	0,064	Phase 2	N/A	N/A
THD <sub>40</sub>	-	1,486	Phase 2	13	13
PWHD	-	0,009	Phase 2	22	22

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. 12TH0351

Power Quality. Harmonic current emission					
EUT		KACO Powador 60.0			
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	72,526	100,000	Phase 3	-	-
2nd	0,739	1,019	Phase 3	8	8
3rd	0,358	0,493	Phase 3	21,6	N/A
4th	0,249	0,343	Phase 3	4	4
5th	0,410	0,565	Phase 3	10,7	10,7
6th	0,148	0,204	Phase 3	2,67	2,67
7th	0,313	0,431	Phase 3	7,2	7,2
8th	0,111	0,153	Phase 3	2	2
9th	0,102	0,141	Phase 3	3,8	N/A
10th	0,086	0,118	Phase 3	1,6	1,6
11th	0,243	0,335	Phase 3	3,1	3,1
12th	0,069	0,096	Phase 3	1,33	1,33
13th	0,225	0,311	Phase 3	2	2
14th	0,073	0,101	Phase 3	N/A	N/A
15th	0,072	0,099	Phase 3	N/A	N/A
16th	0,059	0,082	Phase 3	N/A	N/A
17th	0,238	0,329	Phase 3	N/A	N/A
18th	0,052	0,072	Phase 3	N/A	N/A
19th	0,215	0,296	Phase 3	N/A	N/A
20th	0,078	0,107	Phase 3	N/A	N/A
21th	0,055	0,076	Phase 3	N/A	N/A
22th	0,067	0,092	Phase 3	N/A	N/A
23th	0,239	0,329	Phase 3	N/A	N/A
24th	0,054	0,074	Phase 3	N/A	N/A
25th	0,190	0,262	Phase 3	N/A	N/A
26th	0,050	0,068	Phase 3	N/A	N/A
27th	0,054	0,074	Phase 3	N/A	N/A
28th	0,058	0,080	Phase 3	N/A	N/A
29th	0,218	0,301	Phase 3	N/A	N/A
30th	0,055	0,076	Phase 3	N/A	N/A
31th	0,152	0,209	Phase 3	N/A	N/A
32th	0,037	0,052	Phase 3	N/A	N/A
33th	0,037	0,051	Phase 3	N/A	N/A
34th	0,036	0,049	Phase 3	N/A	N/A
35th	0,159	0,219	Phase 3	N/A	N/A
36th	0,041	0,056	Phase 3	N/A	N/A
37th	0,115	0,158	Phase 3	N/A	N/A
38th	0,037	0,051	Phase 3	N/A	N/A
39th	0,042	0,057	Phase 3	N/A	N/A
40th	0,047	0,065	Phase 3	N/A	N/A
THD <sub>40</sub>	-	1,714	Phase 3	13	13
PWHD	-	0,011	Phase 3	22	22



**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. 12TH0351

Power Quality. Harmonic current emission					
EUT		KACO Powador 72.0			
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	72,016	100,00	Phase 1	-	-
2nd	0,042	0,058	Phase 1	8	8
3rd	0,026	0,036	Phase 1	21,6	N/A
4th	0,404	0,561	Phase 1	4	4
5th	0,028	0,039	Phase 1	10,7	10,7
6th	0,291	0,404	Phase 1	2,67	2,67
7th	0,032	0,044	Phase 1	7,2	7,2
8th	0,043	0,059	Phase 1	2	2
9th	0,034	0,047	Phase 1	3,8	N/A
10th	0,215	0,298	Phase 1	1,6	1,6
11th	0,024	0,033	Phase 1	3,1	3,1
12th	0,223	0,309	Phase 1	1,33	1,33
13th	0,036	0,050	Phase 1	2	2
14th	0,032	0,044	Phase 1	N/A	N/A
15th	0,022	0,030	Phase 1	N/A	N/A
16th	0,228	0,317	Phase 1	N/A	N/A
17th	0,022	0,030	Phase 1	N/A	N/A
18th	0,197	0,274	Phase 1	N/A	N/A
19th	0,023	0,032	Phase 1	N/A	N/A
20th	0,029	0,040	Phase 1	N/A	N/A
21th	0,031	0,043	Phase 1	N/A	N/A
22th	0,217	0,301	Phase 1	N/A	N/A
23th	0,023	0,032	Phase 1	N/A	N/A
24th	0,206	0,287	Phase 1	N/A	N/A
25th	0,027	0,037	Phase 1	N/A	N/A
26th	0,026	0,037	Phase 1	N/A	N/A
27th	0,030	0,041	Phase 1	N/A	N/A
28th	0,223	0,310	Phase 1	N/A	N/A
29th	0,026	0,036	Phase 1	N/A	N/A
30th	0,184	0,256	Phase 1	N/A	N/A
31th	0,026	0,036	Phase 1	N/A	N/A
32th	0,038	0,052	Phase 1	N/A	N/A
33th	0,027	0,038	Phase 1	N/A	N/A
34th	0,181	0,252	Phase 1	N/A	N/A
35th	0,024	0,033	Phase 1	N/A	N/A
36th	0,157	0,218	Phase 1	N/A	N/A
37th	0,023	0,031	Phase 1	N/A	N/A
38th	0,024	0,033	Phase 1	N/A	N/A
39th	0,021	0,029	Phase 1	N/A	N/A
40th	0,248	0,345	Phase 1	N/A	N/A
THD <sub>40</sub>	-	1,20	Phase 1	13	13
PWHD	-	0,011	Phase 1	22	22

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. 12TH0351

Power Quality. Harmonic current emission					
EUT		KACO Powador 72.0			
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	72,011	100,00	Phase 2	-	-
2nd	0,115	0,160	Phase 2	8	8
3rd	0,027	0,038	Phase 2	21,6	N/A
4th	0,065	0,090	Phase 2	4	4
5th	0,419	0,582	Phase 2	10,7	10,7
6th	0,035	0,049	Phase 2	2,67	2,67
7th	0,289	0,402	Phase 2	7,2	7,2
8th	0,030	0,042	Phase 2	2	2
9th	0,025	0,035	Phase 2	3,8	N/A
10th	0,030	0,042	Phase 2	1,6	1,6
11th	0,190	0,264	Phase 2	3,1	3,1
12th	0,019	0,026	Phase 2	1,33	1,33
13th	0,223	0,309	Phase 2	2	2
14th	0,028	0,038	Phase 2	N/A	N/A
15th	0,020	0,028	Phase 2	N/A	N/A
16th	0,020	0,028	Phase 2	N/A	N/A
17th	0,208	0,288	Phase 2	N/A	N/A
18th	0,019	0,026	Phase 2	N/A	N/A
19th	0,217	0,301	Phase 2	N/A	N/A
20th	0,023	0,032	Phase 2	N/A	N/A
21th	0,021	0,029	Phase 2	N/A	N/A
22th	0,028	0,039	Phase 2	N/A	N/A
23th	0,217	0,301	Phase 2	N/A	N/A
24th	0,021	0,029	Phase 2	N/A	N/A
25th	0,228	0,316	Phase 2	N/A	N/A
26th	0,023	0,032	Phase 2	N/A	N/A
27th	0,022	0,030	Phase 2	N/A	N/A
28th	0,026	0,036	Phase 2	N/A	N/A
29th	0,217	0,301	Phase 2	N/A	N/A
30th	0,022	0,031	Phase 2	N/A	N/A
31th	0,214	0,297	Phase 2	N/A	N/A
32th	0,022	0,031	Phase 2	N/A	N/A
33th	0,024	0,033	Phase 2	N/A	N/A
34th	0,028	0,038	Phase 2	N/A	N/A
35th	0,170	0,236	Phase 2	N/A	N/A
36th	0,023	0,031	Phase 2	N/A	N/A
37th	0,161	0,223	Phase 2	N/A	N/A
38th	0,022	0,031	Phase 2	N/A	N/A
39th	0,030	0,041	Phase 2	N/A	N/A
40th	0,023	0,032	Phase 2	N/A	N/A
THD <sub>40</sub>	-	1,17	Phase 2	13	13
PWHD	-	0,012	Phase 2	22	22

Appendix E Type Verification Test Report

Extract from test report according to EN 50438

Nr. 12TH0351

Power Quality. Harmonic current emission					
EUT		KACO Powador 72.0			
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	72,038	100,00	Phase 3	-	-
2nd	0,331	0,459	Phase 3	8	8
3rd	0,057	0,079	Phase 3	21,6	N/A
4th	0,059	0,082	Phase 3	4	4
5th	0,417	0,579	Phase 3	10,7	10,7
6th	0,030	0,042	Phase 3	2,67	2,67
7th	0,318	0,441	Phase 3	7,2	7,2
8th	0,025	0,035	Phase 3	2	2
9th	0,022	0,030	Phase 3	3,8	N/A
10th	0,025	0,034	Phase 3	1,6	1,6
11th	0,180	0,250	Phase 3	3,1	3,1
12th	0,022	0,030	Phase 3	1,33	1,33
13th	0,224	0,311	Phase 3	2	2
14th	0,032	0,045	Phase 3	N/A	N/A
15th	0,025	0,035	Phase 3	N/A	N/A
16th	0,020	0,028	Phase 3	N/A	N/A
17th	0,211	0,293	Phase 3	N/A	N/A
18th	0,020	0,028	Phase 3	N/A	N/A
19th	0,216	0,300	Phase 3	N/A	N/A
20th	0,021	0,029	Phase 3	N/A	N/A
21th	0,019	0,027	Phase 3	N/A	N/A
22th	0,028	0,039	Phase 3	N/A	N/A
23th	0,214	0,297	Phase 3	N/A	N/A
24th	0,021	0,029	Phase 3	N/A	N/A
25th	0,213	0,296	Phase 3	N/A	N/A
26th	0,025	0,035	Phase 3	N/A	N/A
27th	0,023	0,031	Phase 3	N/A	N/A
28th	0,026	0,035	Phase 3	N/A	N/A
29th	0,216	0,300	Phase 3	N/A	N/A
30th	0,022	0,031	Phase 3	N/A	N/A
31th	0,195	0,270	Phase 3	N/A	N/A
32th	0,023	0,031	Phase 3	N/A	N/A
33th	0,024	0,033	Phase 3	N/A	N/A
34th	0,026	0,036	Phase 3	N/A	N/A
35th	0,191	0,266	Phase 3	N/A	N/A
36th	0,023	0,032	Phase 3	N/A	N/A
37th	0,155	0,215	Phase 3	N/A	N/A
38th	0,022	0,031	Phase 3	N/A	N/A
39th	0,035	0,049	Phase 3	N/A	N/A
40th	0,025	0,035	Phase 3	N/A	N/A
THD <sub>40</sub>	-	1,25	Phase 3	13	13
PWHD	-	0,011	Phase 3	22	22

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. 12TH0351

**Voltage fluctuation and Flicker.**

	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11				
Value	Pst	Pit 2 hours	d(t) <sub>500ms</sub>	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.**

Protection limit	Tested at four power levels limit 0,5% of IAC <sub>nom</sub>			
Output power	~20%	~50%	75%	~100%
Max. test value (phase L1) [mA]	48,33	54,83	48,79	25,72
Max. test value (phase L2) [mA]	11,83	18,13	20,72	29,41
Max. test value (phase L3) [mA]	66,91	71,52	59,57	29,74