



**BUREAU  
VERITAS**

# Certificate of compliance

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

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

**Model:** KACO blueplanet 50.0 TL3 M1 WM OD IIGM  
KACO blueplanet 50.0 TL3 M1 WM OD IIGB  
KACO blueplanet 50.0 TL3 M1 WM OD IIGX

## Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with Engineering Recommendation G59/3 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. This serves as a replacement for the disconnection device with isolating function that can access the distribution network provider at any time.

## Applied rules and standards:

### Engineering Recommendation G59/3:2014

Recommendation for the Connection of Generating Plant to the Distribution Systems of licensed Distribution Network Operators.

### DIN V VDE V 0126-1-1:2006-02 (Functional safety)

Automatic disconnection device between a generator and the public low-voltage grid

The KACO blueplanet 50.0 TL3 M1 WM OD IIGM, KACO blueplanet 50.0 TL3 M1 WM OD IIGB and KACO blueplanet 50.0 TL3 M1 WM OD IIGX are rated >16A per phase and ≤ 50kW. The default values for "Small Power Stations" on the low-voltage grid were verified.

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:** 15TH0250-G59/3  
**Certificate number:** U16-0029  
**Date of issue:** 2016-02-12

## Certification body



Deutsche  
Akkreditierungsstelle  
D-ZE-12024-01-00

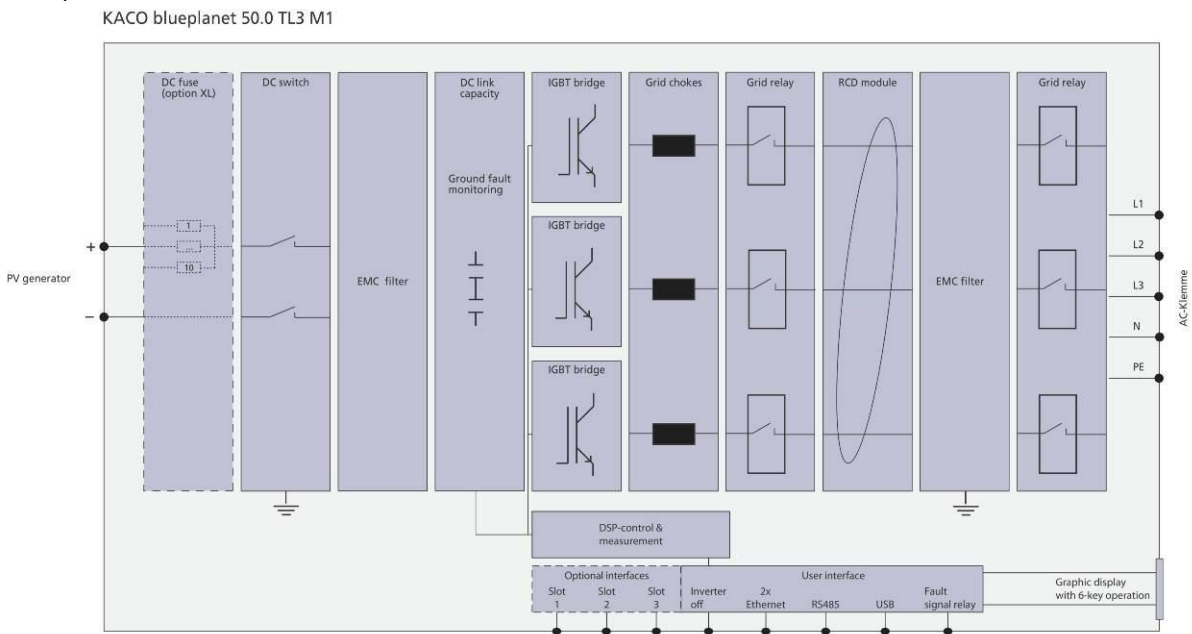
Certification body of Bureau Veritas Consumer Products Services Germany GmbH  
Accredited according to DIN EN ISO/IEC 17065

**Appendix 13.1 Type Testing a Generating Unit**  
 Extract from test report according the Engineering Recommendation G59/3 Nr. 15TH0250

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G59/3.	
<b>Manufacturer / applicant:</b>	<b>KACO new energy GmbH</b> Carl-Zeiss-Straße 1 74172 Neckarsulm <b>Germany</b>
<b>Generating Unit technology</b>	<b>Grid-tied photovoltaic inverter</b>
<b>Rated values</b>	KACO blueplanet 50.0 TL3 M1 WM OD IIGM KACO blueplanet 50.0 TL3 M1 WM OD IIGB KACO blueplanet 50.0 TL3 M1 WM OD IIGX
<b>Maximum rated capacity</b>	50 kW
<b>Rated voltage</b>	400 V <sub>AC</sub> (P-P) / 230 V <sub>AC</sub> (3/PEN), 42-68 Hz
<b>Firmware version</b>	PKT: V3.12; ARM: V3.70; CFG: V5.1608; DSP: V2.11
* The tests were performed with Firmwareversion V3.12. Changes in the Firmwareversion on position 3.1.x have no effect on the required electrical properties. x = could be any number or sign	

**Measurement period:** 2015-12-15 to 2016-01-26

**Description of the structure of the power generation unit (Figure 1):**  
 The input and output are protected by varistors to earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformer-less). The output is switched off redundant by the high power switching bridge and two relays in series. This assures that the opening of the output circuit will also operate in case of one error.



**Figure 1 – Schematic structure of the power generation unit**

The above stated Generating Units are tested according the requirements in the Engineering Recommendation G59/3. 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 Engineering Recommendation G59/3.

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 15TH0250

Protection. Voltage tests.						
Phase 1						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	200,3V	2,5551s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,3V	0,5559s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	261,8V	1,0561s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	272,7V	0,6564s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

Protection. Voltage tests.						
Phase 2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	200,0V	2,5594	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,4V	0,5589s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	262,7V	2,5589s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	272,6V	0,5593s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 15TH0250

Protection. Voltage tests.						
Phase 3						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	200,2V	2,5516s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,3V	0,5518s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	262,7V	2,5521s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	272,5V	0,5515s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

Note. For Voltage tests the Voltage required to trip is the setting  $\pm 3,45V$ . The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting  $\pm 4V$  and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Frequency tests.						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,49Hz	20,085s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	46,99Hz	0,582s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,51Hz	90,07s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,00Hz	0,575s	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting  $\pm 0,1Hz$ . In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No-trip tests" need to be carried out at the setting  $\pm 0,2Hz$  and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

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Nr. 15TH0250

**Protection. Loss of Mains.**

Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.

<b>Balancing load on islanded network</b>	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
<b>Trip time</b>	211,6	210,3	601,6	235,5	229,9	363,4

Note for technologies which have a substantial shut down time this can be added to the 0,5 seconds in establishing that the trip occurred in less than 0,5s. Maximum shut down time could therefore be up to 1,0 seconds for these technologies.

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

Type of switching equipment 1:  
Finder 67.23 with 35ms  
Type of switching equipment 2:  
Finder 67.23 with 35ms

Note. All relays are direct coupled and open directly by receiving the islanding signal from the controller. Therefore the measured disconnection time on all phase is valid for three phases of the inverter.

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 15TH0250

<b>Protection. Re-connection timer.</b>					
Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.5.7.1.					
Voltage					
Time delay setting		Measured delay			
20s		81,0s			
Frequency					
Time delay setting		Measured delay			
20s		77,0s			
		Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
		At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
<b>Confirmation that the Generating Unit does not re-connect.</b>	No reconnection	No reconnection	No reconnection	No reconnection	

<b>Protection. Frequency change, Stability test.</b>				
	Start Frequency	Change	End Frequency	Confirm no trip
<b>Positive Vector Shift</b>	49,5Hz	+9 degrees		No trip
<b>Negative Vector Shift</b>	50,5Hz	- 9 degrees		No trip
<b>Positive Frequency drift</b>	49,5Hz	+0,19Hz/sec	51,5Hz	No trip
<b>Negative Frequency drift</b>	50,5Hz	-0,19Hz/sec	47,5Hz	No trip

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 15TH0250

Power Quality. Harmonics.						
Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 25 kW		100% of rated output 50 kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,162	0,223	0,270	0,370	8%	8%
3rd	0,151	0,207	0,112	0,154	21,6%	N/A
4th	0,089	0,122	0,101	0,139	4%	4%
5th	0,345	0,474	0,373	0,511	10,7%	10,7%
6th	0,044	0,060	0,064	0,088	2,67%	2,67%
7th	0,271	0,372	0,270	0,370	7,2%	7,2%
8th	0,026	0,036	0,039	0,054	2%	2%
9th	0,050	0,068	0,051	0,070	3,8%	N/A
10th	0,022	0,030	0,034	0,047	1,6%	1,6%
11th	0,201	0,276	0,185	0,254	3,1%	3,1%
12th	0,028	0,039	0,041	0,056	1,33%	1,33%
13th	0,195	0,267	0,187	0,257	2%	2%
14th	0,027	0,037	0,031	0,042	N/A	N/A
15th	0,028	0,038	0,034	0,047	N/A	N/A
16th	0,025	0,034	0,029	0,040	N/A	N/A
17th	0,180	0,247	0,147	0,202	N/A	N/A
18th	0,026	0,035	0,035	0,048	N/A	N/A
19th	0,201	0,276	0,171	0,235	N/A	N/A
20th	0,031	0,043	0,036	0,049	N/A	N/A
21th	0,030	0,042	0,037	0,051	N/A	N/A
22th	0,031	0,042	0,034	0,047	N/A	N/A
23th	0,208	0,286	0,146	0,201	N/A	N/A
24th	0,026	0,036	0,035	0,048	N/A	N/A
25th	0,220	0,302	0,170	0,233	N/A	N/A
26th	0,036	0,049	0,040	0,055	N/A	N/A
27th	0,035	0,048	0,046	0,063	N/A	N/A
28th	0,034	0,046	0,040	0,054	N/A	N/A
29th	0,230	0,316	0,158	0,217	N/A	N/A
30th	0,028	0,038	0,034	0,047	N/A	N/A
31th	0,231	0,317	0,147	0,201	N/A	N/A
32th	0,033	0,045	0,038	0,052	N/A	N/A
33th	0,032	0,044	0,043	0,059	N/A	N/A
34th	0,027	0,037	0,034	0,047	N/A	N/A
35th	0,194	0,267	0,112	0,154	N/A	N/A
36th	0,023	0,032	0,024	0,033	N/A	N/A
37th	0,160	0,220	0,089	0,123	N/A	N/A
38th	0,019	0,027	0,023	0,032	N/A	N/A
39th	0,021	0,029	0,029	0,040	N/A	N/A
40th	0,015	0,020	0,020	0,027	N/A	N/A
THD <sub>40</sub>	2,28%		1,04%		23%	13%
PWHD	0,048%		0,006%		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 15TH0250

Power Quality. Harmonics.						
Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 25 kW		100% of rated output 50 kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,162	0,222	0,256	0,351	8%	8%
3rd	0,066	0,091	0,109	0,149	21,6%	N/A
4th	0,086	0,118	0,089	0,122	4%	4%
5th	0,336	0,461	0,365	0,499	10,7%	10,7%
6th	0,028	0,038	0,043	0,059	2,67%	2,67%
7th	0,241	0,330	0,239	0,328	7,2%	7,2%
8th	0,027	0,037	0,038	0,052	2%	2%
9th	0,040	0,055	0,051	0,070	3,8%	N/A
10th	0,022	0,031	0,033	0,045	1,6%	1,6%
11th	0,201	0,275	0,197	0,270	3,1%	3,1%
12th	0,021	0,029	0,023	0,031	1,33%	1,33%
13th	0,199	0,272	0,172	0,236	2%	2%
14th	0,023	0,031	0,029	0,040	N/A	N/A
15th	0,023	0,031	0,034	0,047	N/A	N/A
16th	0,019	0,026	0,028	0,039	N/A	N/A
17th	0,188	0,257	0,160	0,219	N/A	N/A
18th	0,030	0,041	0,027	0,036	N/A	N/A
19th	0,200	0,274	0,158	0,217	N/A	N/A
20th	0,024	0,033	0,031	0,043	N/A	N/A
21th	0,025	0,034	0,038	0,052	N/A	N/A
22th	0,023	0,031	0,030	0,041	N/A	N/A
23th	0,220	0,302	0,166	0,228	N/A	N/A
24th	0,038	0,052	0,037	0,051	N/A	N/A
25th	0,231	0,316	0,167	0,229	N/A	N/A
26th	0,027	0,037	0,035	0,048	N/A	N/A
27th	0,028	0,038	0,044	0,060	N/A	N/A
28th	0,029	0,040	0,034	0,047	N/A	N/A
29th	0,263	0,360	0,182	0,249	N/A	N/A
30th	0,039	0,054	0,039	0,054	N/A	N/A
31th	0,245	0,336	0,157	0,215	N/A	N/A
32th	0,026	0,036	0,030	0,041	N/A	N/A
33th	0,025	0,035	0,041	0,056	N/A	N/A
34th	0,025	0,034	0,027	0,037	N/A	N/A
35th	0,210	0,288	0,124	0,170	N/A	N/A
36th	0,027	0,037	0,027	0,036	N/A	N/A
37th	0,177	0,243	0,100	0,137	N/A	N/A
38th	0,018	0,024	0,020	0,027	N/A	N/A
39th	0,018	0,024	0,028	0,039	N/A	N/A
40th	0,015	0,020	0,017	0,023	N/A	N/A
THD <sub>40</sub>	2,28%		1,03%		23%	13%
PWHD	0,055%		0,007%		23%	22%



**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 15TH0250

Power Quality. Harmonics.						
Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 25 kW		100% of rated output 50 kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,270	0,370	0,162	0,223	8%	8%
3rd	0,112	0,154	0,151	0,207	21,6%	N/A
4th	0,101	0,139	0,089	0,122	4%	4%
5th	0,373	0,511	0,345	0,474	10,7%	10,7%
6th	0,064	0,088	0,044	0,060	2,67%	2,67%
7th	0,270	0,370	0,271	0,372	7,2%	7,2%
8th	0,039	0,054	0,026	0,036	2%	2%
9th	0,051	0,070	0,050	0,068	3,8%	N/A
10th	0,034	0,047	0,022	0,030	1,6%	1,6%
11th	0,185	0,254	0,201	0,276	3,1%	3,1%
12th	0,041	0,056	0,028	0,039	1,33%	1,33%
13th	0,187	0,257	0,195	0,267	2%	2%
14th	0,031	0,042	0,027	0,037	N/A	N/A
15th	0,034	0,047	0,028	0,038	N/A	N/A
16th	0,029	0,040	0,025	0,034	N/A	N/A
17th	0,147	0,202	0,180	0,247	N/A	N/A
18th	0,035	0,048	0,026	0,035	N/A	N/A
19th	0,171	0,235	0,201	0,276	N/A	N/A
20th	0,036	0,049	0,031	0,043	N/A	N/A
21th	0,037	0,051	0,030	0,042	N/A	N/A
22th	0,034	0,047	0,031	0,042	N/A	N/A
23th	0,146	0,201	0,208	0,286	N/A	N/A
24th	0,035	0,048	0,026	0,036	N/A	N/A
25th	0,170	0,233	0,220	0,302	N/A	N/A
26th	0,040	0,055	0,036	0,049	N/A	N/A
27th	0,046	0,063	0,035	0,048	N/A	N/A
28th	0,040	0,054	0,034	0,046	N/A	N/A
29th	0,158	0,217	0,230	0,316	N/A	N/A
30th	0,034	0,047	0,028	0,038	N/A	N/A
31th	0,147	0,201	0,231	0,317	N/A	N/A
32th	0,038	0,052	0,033	0,045	N/A	N/A
33th	0,043	0,059	0,032	0,044	N/A	N/A
34th	0,034	0,047	0,027	0,037	N/A	N/A
35th	0,112	0,154	0,194	0,267	N/A	N/A
36th	0,024	0,033	0,023	0,032	N/A	N/A
37th	0,089	0,123	0,160	0,220	N/A	N/A
38th	0,023	0,032	0,019	0,027	N/A	N/A
39th	0,029	0,040	0,021	0,029	N/A	N/A
40th	0,020	0,027	0,015	0,020	N/A	N/A
THD <sub>40</sub>	2,28%		1,04%		23%	13%
PWHD	0,048%		0,006%		23%	22%

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Power Quality. Power factor.				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0,999	0,999	0,999	
Limit	>0,95	>0,95	>0,95	

Power Quality. Voltage fluctuation and Flicker.								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values at test impedance	0,33%	3,3%	0,0%	0,33%	3,3%	0,0%	0,086	0,086
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Standard impedance	R	0,24* 0,4^	$\Omega$	XI	0,15* 0,25^	$\Omega$		

Power Quality. DC injection.			
Test level power	10%	55%	100%
Recorded value	59,15 mA	71,52 mA	29,74 mA
As % of rated AC current	0,08 %	0,10%	0,04%
Limit	0,25%	0,25%	0,25%

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Extract from test report according the Engineering Recommendation G59/3

Nr. 15TH0250

Fault level Contribution.					
For a directly coupled SSEG			For a Inverter SSEG		
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

For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.

\* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.

Self Monitoring – Solid state switching.	N/A
It has been verified that in the event of the solid state switching device failing to disconnect the Generating Unit, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.	
Note. Unit do not provide solid state switching relays. In case the semiconductor bridge is switched off, then the voltage on the output drops to 0. In this case the relays on the output will also open.	