



**BUREAU  
VERITAS**

# Świadectwo zgodności

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

**Produkt:** Siatka wiązanej fotowoltaicznych (PV) falownik

**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  
KACO blueplanet 50.0 TL3 M1 WM OD FRGX

## Zastosowanie zgodnie z przepisami:

Automatyczne urządzenie wyłączające, monitorujące sieć trójfazową w systemach fotowoltaicznych z obwodem równoległym trójfazowym poprzez przetwornicę w publicznej sieci zasilania. Automatyczne urządzenie wyłączające stanowi część wyżej wymienionej przetwornicy.

## Zastosowane przepisy i normy:

**EN 50438:2013, PN-EN 50438:2014**

Wymagania dla instalacji mikrogeneracyjnych przeznaczonych do równoległego przyłączenia do publicznych sieci dystrybucyjnych niskiego napięcia

**DIN V VDE V 0126-1-1:2006-02 (bezpieczeństwo funkcjonalne)**

Automatyczne urządzenie odłączające między generatorem a publiczną siecią niskiego napięcia

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 i KACO blueplanet 50.0 TL3 M1 WM OD FRGX jest zaprojektowane na >16 A na fazę, ale wszystkie podstawowe wymagania normy są spełnione.

W momencie wydania niniejszego certyfikatu pojęcie zabezpieczenia interfejsu wyżej wymienionego, reprezentatywnego produktu spełnia wymagania bezpieczeństwa obowiązujące dla określonego zastosowania zgodnie z przepisami.

**Numer raportu:** 15TH0250-EN50438\_1  
**Numer świadectwa:** U17-0467  
**Data wydania:** 2017-09-07



Institut certyfikacji Bureau Veritas Consumer Products Services Germany GmbH  
Akredytowane zgodnie z normą DIN EN ISO/IEC 17065

**Appendix E Type Verification Test Report**  
 Extract from test report according to EN 50438 Nr. 15TH0250

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

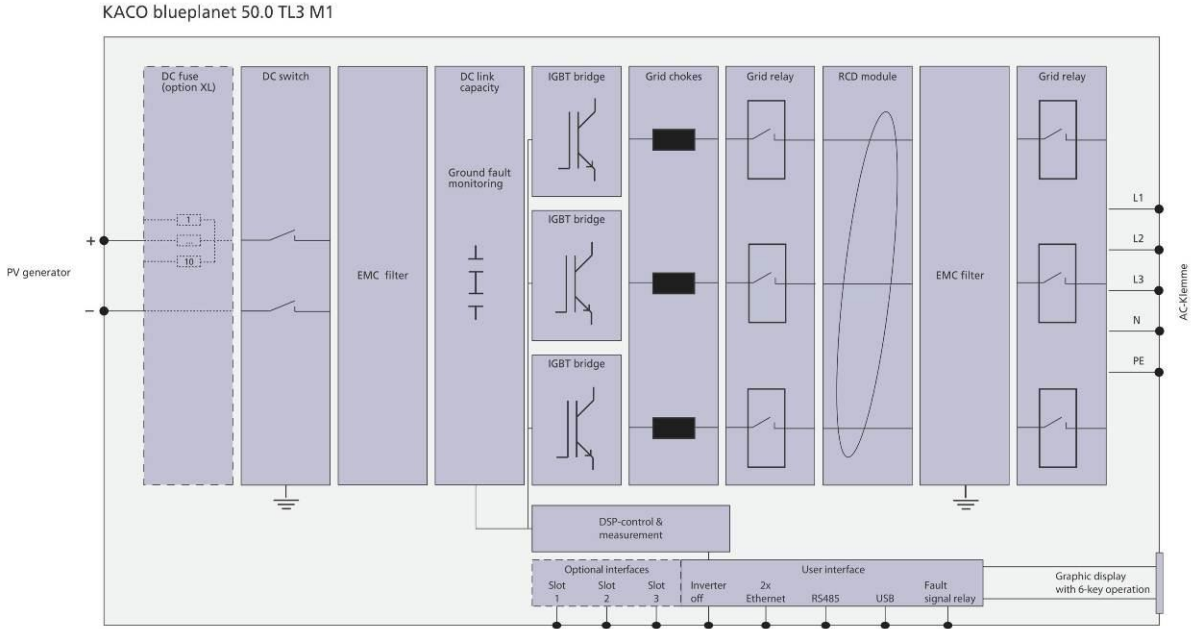
|                                  |  |
|----------------------------------|--|
| <b>Manufacturer / applicant:</b> | <b>KACO new energy GmbH</b><br>Carl-Zeiss-Straße 1<br>74172 Neckarsulm<br><b>Germany</b>   |
| <b>Micro-generator Type</b>      | <b>Grid-tied photovoltaic inverter</b>   |
| <b>Rated values</b>              | KACO blueplanet 50.0 TL3 M1 WM OD IIGM<br>KACO blueplanet 50.0 TL3 M1 WM OD IIGB<br>KACO blueplanet 50.0 TL3 M1 WM OD IIGX<br>KACO blueplanet 50.0 TL3 M1 WM OD FRGX |
| <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>          | <b>PKT: V4.09; ARM: V5.08; CFG: V6.0572; DSP-AC: V4.09, DSP-DC: V4.02</b>  |

\* The tests were performed with Firmwareversion V4.09. Changes in the Firmwareversion on position V4.x have no effect on the required electrical properties.  
 x = could be any number or sign

|                            |                                 |
|----------------------------|---------------------------------|
| <b>Measurement period:</b> | <b>2017-09-04 to 2017-09-08</b> |
|----------------------------|---------------------------------|

**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 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.

**Appendix E Type Verification Test Report**

Extract from test report according to 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            | 3,0                    | 253,0          | 3,0                    | 252,3                    | 2,961                  |
| Over-voltage stage 2  | 264,5            | 0,2                    | 264,5          | 0,2                    | 263,4                    | 0,170                  |
| Under-voltage stage 1   | 195,5            | 1,5                    | 195,5          | 1,5                    | 195,2                    | 1,458                  |
| 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            | 3,0                    | 253,0          | 3,0                    | 252,4                    | 2,964                  |
| Over-voltage stage 2  | 264,5            | 0,2                    | 264,5          | 0,2                    | 263,4                    | 0,160                  |
| Under-voltage stage 1   | 195,5            | 1,5                    | 195,5          | 1,5                    | 195,3                    | 1,459                  |
| 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            | 3,0                    | 253,0          | 3,0                    | 252,6                    | 2,966                  |
| Over-voltage stage 2  | 264,5            | 0,2                    | 264,5          | 0,2                    | 263,7                    | 0,152                  |
| Under-voltage stage 1   | 195,5            | 1,5                    | 195,5          | 1,5                    | 195,5                    | 1,462                  |
| Note.<br>Minimum operation time according to default interface protection:<br>Over-voltage stage 1 -<br>Over-voltage stage 2 0,1s<br>Under-voltage 1,2s |                  |                        |                |                        |                          |                        |

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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] |
| <b>Over-frequency</b>   | 52,00            | 0,5                    | 52,00          | 0,5                    | 52,00                    | 0,344                  |
| <b>Under-frequency</b>  | 47,50            | 0,5                    | 47,50          | 0,5                    | 47,50                    | 0,375                  |
| Note.<br>Minimum operation time according to default interface protection:<br>Over-frequency 0,5 s<br>Under-frequency 0,5 s |                  |                        |                |                        |                          |                        |

| LoM test   |                         |                         |                         |  |                         |                          |
|--|-------------------------|-------------------------|-------------------------|--|-------------------------|--------------------------|
| Method used  | EN 62116                |                         |                         |  |                         |                          |
| Balancing load on islanded network   | 33% of -5% Q<br>Test 22 | 66% of -5% Q<br>Test 12 | 100% of -5% P<br>Test 5 | 33% of +5% Q<br>Test 31  | 66% of +5% Q<br>Test 21 | 100% of +5% P<br>Test 10 |
| <b>Trip time [ms]</b>  | 211,6                   | 210,3                   | 601,6                   | 235,5  | 229,9                   | 363,4                    |
| Indicate additional shut down time included in above results.<br>(Integrated interface switch) |                         |                         |                         | Type of switching equipment 1:<br>Finder 67.23 with 35ms<br>Type of switching equipment 2:<br>Finder 67.23 with 35ms |                         |                          |

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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             | 195,5       | 47,50          | 44,30            | 0,999     |
| 2             | 253,0       | 51,50          | 50,10            | 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]:      | 49,6              | 49,60                  | 49,6                   |
| 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% Pn</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% Pn</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> |          |          |          |          |          |          |

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| Reactive power                |        |       |        |
|-------------------------------|--------|-------|--------|
| Uncontrollable reactive power |        |       |        |
| 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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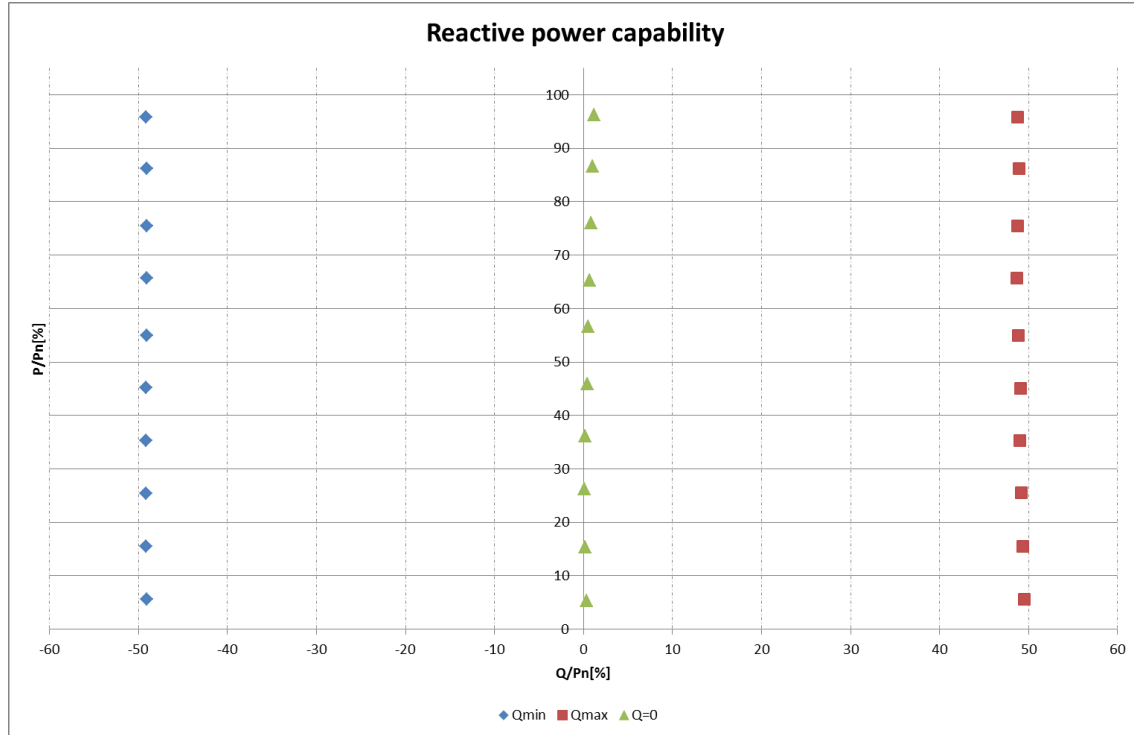
| <b>Controllable reactive power</b>              |                         |                             |                             |                     |
|---|-------------------------|-----------------------------|-----------------------------|---------------------|
| <b>Inductive (supply reactive power)</b>        |                         |                             |                             |                     |
| <b>Power-BIN</b>                                | <b>Active power [W]</b> | <b>Reactive power [Var]</b> | <b>Power factor (cos φ)</b> | <b>DC power [W]</b> |
| 0% - 10%  | 2478,20                 | 22021,98                    | 0,11                        | 2980,81             |
| 10% - 20%                                       | 6925,19                 | 21954,65                    | 0,30                        | 7429,73             |
| 20% - 30%                                       | 11370,51                | 21888,04                    | 0,46                        | 11907,90            |
| 30% - 40%                                       | 15735,82                | 21809,21                    | 0,58                        | 16336,77            |
| 40% - 50%                                       | 20069,68                | 21829,44                    | 0,68                        | 20758,09            |
| 50% - 60%                                       | 24454,56                | 21752,26                    | 0,75                        | 25229,66            |
| 60% - 70%                                       | 29248,89                | 21670,05                    | 0,80                        | 30150,18            |
| 70% - 80%                                       | 33602,72                | 21695,81                    | 0,84                        | 34627,38            |
| 80% - 90%                                       | 38336,25                | 21773,32                    | 0,87                        | 39516,68            |
| 90% - 100%                                      | 42632,39                | 21711,87                    | 0,89                        | 43955,73            |
| <b>Capacitive (supply reactive power)</b>       |                         |                             |                             |                     |
| <b>Power-BIN</b>                                | <b>Active power [W]</b> | <b>Reactive power [Var]</b> | <b>Power factor (cos φ)</b> | <b>DC power [W]</b> |
| 0% - 10%  | 2479,20                 | -21812,24                   | -0,11                       | 2988,39             |
| 10% - 20%                                       | 6910,81                 | -21855,21                   | -0,30                       | 7433,00             |
| 20% - 30%                                       | 11334,46                | -21868,20                   | -0,46                       | 11893,89            |
| 30% - 40%                                       | 15728,76                | -21856,42                   | -0,58                       | 16341,43            |
| 40% - 50%                                       | 20094,06                | -21866,24                   | -0,68                       | 20781,77            |
| 50% - 60%                                       | 24437,80                | -21827,81                   | -0,75                       | 25220,90            |
| 60% - 70%                                       | 29248,98                | -21844,27                   | -0,80                       | 30166,71            |
| 70% - 80%                                       | 33570,48                | -21816,89                   | -0,84                       | 34619,02            |
| 80% - 90%                                       | 38367,36                | -21838,97                   | -0,87                       | 39563,54            |
| 90% - 100%                                      | 42629,34                | -21870,99                   | -0,89                       | 43980,60            |
| <b>Reactive power supply with set point Q=0</b> |                         |                             |                             |                     |
| <b>Power-BIN</b>                                | <b>Active power [W]</b> | <b>Reactive power [Var]</b> | <b>Power factor (cos φ)</b> | <b>DC power [W]</b> |
| 0% - 10%  | 2393,20                 | 141,49                      | 0,99                        | 2487,44             |
| 10% - 20%                                       | 6848,78                 | 100,40                      | 1,00                        | 6989,40             |
| 20% - 30%                                       | 11691,38                | 53,85                       | 1,00                        | 11917,69            |
| 30% - 40%                                       | 16051,04                | 96,13                       | 1,00                        | 16367,01            |
| 40% - 50%                                       | 20417,82                | 177,53                      | 1,00                        | 20846,33            |
| 50% - 60%                                       | 25189,59                | 249,12                      | 1,00                        | 25732,69            |
| 60% - 70%                                       | 29045,80                | 304,56                      | 1,00                        | 29704,15            |
| 70% - 80%                                       | 33831,39                | 386,88                      | 1,00                        | 34646,49            |
| 80% - 90%                                       | 38563,44                | 468,84                      | 1,00                        | 39558,70            |
| 90% - 100%                                      | 42831,00                | 532,82                      | 1,00                        | 43983,72            |

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Diagram of inductive reactive power absorption



| Q adjustment |                                  |                                 |                |  |
|--------------|----------------------------------|---------------------------------|----------------|--|
|              | Reactive power set point Q [Var] | Measured reactive power Q [Var] | Measured cos φ | Deviation compared to setpoint ΔQ / PN [%] |
| - Qmin       | -48.43                           | -48,52%                         | 0,7174         | -0,09%                                     |
| 0            | 0                                | 0,47%                           | 1,0000         | 0,47%                                      |
| + Qmax       | +48,43                           | 48,52%                          | 0,7182         | 0,09%                                      |



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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.<br>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.<br>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.<br>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.<br>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 blueplanet 50.0 TL3 M1 WM OD IIGM |         |   |         |
| 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                                      | 72,813   | 100,000                                | Phase 1 | -                                       | -       |
| 2nd                                      | 0,317  | 0,436                                  | Phase 1 | 8                                       | 8       |
| 3rd                                      | 0,186  | 0,255                                  | Phase 1 | 21,6                                    | N/A     |
| 4th                                      | 0,145  | 0,199                                  | Phase 1 | 4                                       | 4       |
| 5th                                      | 0,362  | 0,496                                  | Phase 1 | 10,7                                    | 10,7    |
| 6th                                      | 0,074  | 0,102                                  | Phase 1 | 2,67                                    | 2,67    |
| 7th                                      | 0,265  | 0,364                                  | Phase 1 | 7,2                                     | 7,2     |
| 8th                                      | 0,056  | 0,077                                  | Phase 1 | 2                                       | 2       |
| 9th                                      | 0,058  | 0,079                                  | Phase 1 | 3,8                                     | N/A     |
| 10th                                     | 0,049  | 0,068                                  | Phase 1 | 1,6                                     | 1,6     |
| 11th                                     | 0,203  | 0,279                                  | Phase 1 | 3,1                                     | 3,1     |
| 12th                                     | 0,044  | 0,060                                  | Phase 1 | 1,33                                    | 1,33    |
| 13th                                     | 0,167  | 0,229                                  | Phase 1 | 2                                       | 2       |
| 14th                                     | 0,043  | 0,060                                  | Phase 1 | N/A                                     | N/A     |
| 15th                                     | 0,046  | 0,064                                  | Phase 1 | N/A                                     | N/A     |
| 16th                                     | 0,038  | 0,052                                  | Phase 1 | N/A                                     | N/A     |
| 17th                                     | 0,152  | 0,209                                  | Phase 1 | N/A                                     | N/A     |
| 18th                                     | 0,042  | 0,057                                  | Phase 1 | N/A                                     | N/A     |
| 19th                                     | 0,154  | 0,212                                  | Phase 1 | N/A                                     | N/A     |
| 20th                                     | 0,047  | 0,064                                  | Phase 1 | N/A                                     | N/A     |
| 21th                                     | 0,052  | 0,071                                  | Phase 1 | N/A                                     | N/A     |
| 22th                                     | 0,042  | 0,058                                  | Phase 1 | N/A                                     | N/A     |
| 23th                                     | 0,154  | 0,212                                  | Phase 1 | N/A                                     | N/A     |
| 24th                                     | 0,048  | 0,065                                  | Phase 1 | N/A                                     | N/A     |
| 25th                                     | 0,167  | 0,229                                  | Phase 1 | N/A                                     | N/A     |
| 26th                                     | 0,053  | 0,073                                  | Phase 1 | N/A                                     | N/A     |
| 27th                                     | 0,063  | 0,086                                  | Phase 1 | N/A                                     | N/A     |
| 28th                                     | 0,049  | 0,067                                  | Phase 1 | N/A                                     | N/A     |
| 29th                                     | 0,160  | 0,219                                  | Phase 1 | N/A                                     | N/A     |
| 30th                                     | 0,048  | 0,066                                  | Phase 1 | N/A                                     | N/A     |
| 31th                                     | 0,146  | 0,200                                  | Phase 1 | N/A                                     | N/A     |
| 32th                                     | 0,046  | 0,063                                  | Phase 1 | N/A                                     | N/A     |
| 33th                                     | 0,055  | 0,076                                  | Phase 1 | N/A                                     | N/A     |
| 34th                                     | 0,041  | 0,056                                  | Phase 1 | N/A                                     | N/A     |
| 35th                                     | 0,105  | 0,144                                  | Phase 1 | N/A                                     | N/A     |
| 36th                                     | 0,035  | 0,048                                  | Phase 1 | N/A                                     | N/A     |
| 37th                                     | 0,095  | 0,131                                  | Phase 1 | N/A                                     | N/A     |
| 38th                                     | 0,029  | 0,040                                  | Phase 1 | N/A                                     | N/A     |
| 39th                                     | 0,038  | 0,052                                  | Phase 1 | N/A                                     | N/A     |
| 40th                                     | 0,026  | 0,036                                  | Phase 1 | N/A                                     | N/A     |
| THD <sub>40</sub>                        | -  | 1,114                                  | Phase 1 | 13                                      | 13      |
| PWHD                                     | -  | 0,006                                  | Phase 1 | 22                                      | 22      |

Appendix E Type Verification Test Report

Extract from test report according to EN 50438

Nr. 15TH0250

| Power Quality. Harmonic current emission |  |  |         |   |         |
|--|--|--|---------|---|---------|
| EUT                                      |  | KACO blueplanet 50.0 TL3 M1 WM OD IIGM |         |   |         |
| 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                                      | 72,834   | 100,000                                | Phase 2 | -                                       | -       |
| 2nd                                      | 0,255  | 0,350                                  | Phase 2 | 8                                       | 8       |
| 3rd                                      | 0,099  | 0,136                                  | Phase 2 | 21,6                                    | N/A     |
| 4th                                      | 0,079  | 0,109                                  | Phase 2 | 4                                       | 4       |
| 5th                                      | 0,369  | 0,506                                  | Phase 2 | 10,7                                    | 10,7    |
| 6th                                      | 0,041  | 0,057                                  | Phase 2 | 2,67                                    | 2,67    |
| 7th                                      | 0,241  | 0,330                                  | Phase 2 | 7,2                                     | 7,2     |
| 8th                                      | 0,034  | 0,047                                  | Phase 2 | 2                                       | 2       |
| 9th                                      | 0,050  | 0,069                                  | Phase 2 | 3,8                                     | N/A     |
| 10th                                     | 0,031  | 0,042                                  | Phase 2 | 1,6                                     | 1,6     |
| 11th                                     | 0,198  | 0,272                                  | Phase 2 | 3,1                                     | 3,1     |
| 12th                                     | 0,021  | 0,028                                  | Phase 2 | 1,33                                    | 1,33    |
| 13th                                     | 0,173  | 0,238                                  | Phase 2 | 2                                       | 2       |
| 14th                                     | 0,028  | 0,038                                  | Phase 2 | N/A                                     | N/A     |
| 15th                                     | 0,033  | 0,046                                  | Phase 2 | N/A                                     | N/A     |
| 16th                                     | 0,027  | 0,037                                  | Phase 2 | N/A                                     | N/A     |
| 17th                                     | 0,161  | 0,222                                  | Phase 2 | N/A                                     | N/A     |
| 18th                                     | 0,026  | 0,036                                  | Phase 2 | N/A                                     | N/A     |
| 19th                                     | 0,159  | 0,219                                  | Phase 2 | N/A                                     | N/A     |
| 20th                                     | 0,030  | 0,042                                  | Phase 2 | N/A                                     | N/A     |
| 21th                                     | 0,036  | 0,050                                  | Phase 2 | N/A                                     | N/A     |
| 22th                                     | 0,030  | 0,042                                  | Phase 2 | N/A                                     | N/A     |
| 23th                                     | 0,168  | 0,231                                  | Phase 2 | N/A                                     | N/A     |
| 24th                                     | 0,037  | 0,050                                  | Phase 2 | N/A                                     | N/A     |
| 25th                                     | 0,169  | 0,232                                  | Phase 2 | N/A                                     | N/A     |
| 26th                                     | 0,034  | 0,047                                  | Phase 2 | N/A                                     | N/A     |
| 27th                                     | 0,043  | 0,058                                  | Phase 2 | N/A                                     | N/A     |
| 28th                                     | 0,034  | 0,046                                  | Phase 2 | N/A                                     | N/A     |
| 29th                                     | 0,185  | 0,254                                  | Phase 2 | N/A                                     | N/A     |
| 30th                                     | 0,039  | 0,053                                  | Phase 2 | N/A                                     | N/A     |
| 31th                                     | 0,157  | 0,216                                  | Phase 2 | N/A                                     | N/A     |
| 32th                                     | 0,029  | 0,040                                  | Phase 2 | N/A                                     | N/A     |
| 33th                                     | 0,040  | 0,055                                  | Phase 2 | N/A                                     | N/A     |
| 34th                                     | 0,027  | 0,037                                  | Phase 2 | N/A                                     | N/A     |
| 35th                                     | 0,127  | 0,174                                  | Phase 2 | N/A                                     | N/A     |
| 36th                                     | 0,026  | 0,036                                  | Phase 2 | N/A                                     | N/A     |
| 37th                                     | 0,101  | 0,139                                  | Phase 2 | N/A                                     | N/A     |
| 38th                                     | 0,019  | 0,026                                  | Phase 2 | N/A                                     | N/A     |
| 39th                                     | 0,028  | 0,039                                  | Phase 2 | N/A                                     | N/A     |
| 40th                                     | 0,017  | 0,024                                  | Phase 2 | N/A                                     | N/A     |
| THD <sub>40</sub>                        | -  | 1,039                                  | Phase 2 | 13                                      | 13      |
| PWHD                                     | -  | 0,007                                  | Phase 2 | 22                                      | 22      |

Appendix E Type Verification Test Report

Extract from test report according to EN 50438

Nr. 15TH0250

| Power Quality. Harmonic current emission |  |  |         |   |         |
|--|--|--|---------|---|---------|
| EUT                                      |  | KACO blueplanet 50.0 TL3 M1 WM OD IIGM |         |   |         |
| 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                                      | 72,773   | 100,000                                | Phase 3 | -                                       | -       |
| 2nd                                      | 0,258  | 0,354                                  | Phase 3 | 8                                       | 8       |
| 3rd                                      | 0,129  | 0,177                                  | Phase 3 | 21,6                                    | N/A     |
| 4th                                      | 0,091  | 0,125                                  | Phase 3 | 4                                       | 4       |
| 5th                                      | 0,374  | 0,514                                  | Phase 3 | 10,7                                    | 10,7    |
| 6th                                      | 0,064  | 0,088                                  | Phase 3 | 2,67                                    | 2,67    |
| 7th                                      | 0,271  | 0,372                                  | Phase 3 | 7,2                                     | 7,2     |
| 8th                                      | 0,039  | 0,054                                  | Phase 3 | 2                                       | 2       |
| 9th                                      | 0,049  | 0,067                                  | Phase 3 | 3,8                                     | N/A     |
| 10th                                     | 0,034  | 0,046                                  | Phase 3 | 1,6                                     | 1,6     |
| 11th                                     | 0,188  | 0,258                                  | Phase 3 | 3,1                                     | 3,1     |
| 12th                                     | 0,040  | 0,055                                  | Phase 3 | 1,33                                    | 1,33    |
| 13th                                     | 0,187  | 0,258                                  | Phase 3 | 2                                       | 2       |
| 14th                                     | 0,031  | 0,042                                  | Phase 3 | N/A                                     | N/A     |
| 15th                                     | 0,034  | 0,047                                  | Phase 3 | N/A                                     | N/A     |
| 16th                                     | 0,029  | 0,040                                  | Phase 3 | N/A                                     | N/A     |
| 17th                                     | 0,148  | 0,204                                  | Phase 3 | N/A                                     | N/A     |
| 18th                                     | 0,034  | 0,047                                  | Phase 3 | N/A                                     | N/A     |
| 19th                                     | 0,173  | 0,237                                  | Phase 3 | N/A                                     | N/A     |
| 20th                                     | 0,036  | 0,049                                  | Phase 3 | N/A                                     | N/A     |
| 21th                                     | 0,037  | 0,051                                  | Phase 3 | N/A                                     | N/A     |
| 22th                                     | 0,034  | 0,047                                  | Phase 3 | N/A                                     | N/A     |
| 23th                                     | 0,149  | 0,205                                  | Phase 3 | N/A                                     | N/A     |
| 24th                                     | 0,034  | 0,047                                  | Phase 3 | N/A                                     | N/A     |
| 25th                                     | 0,172  | 0,237                                  | Phase 3 | N/A                                     | N/A     |
| 26th                                     | 0,041  | 0,056                                  | Phase 3 | N/A                                     | N/A     |
| 27th                                     | 0,045  | 0,062                                  | Phase 3 | N/A                                     | N/A     |
| 28th                                     | 0,039  | 0,054                                  | Phase 3 | N/A                                     | N/A     |
| 29th                                     | 0,161  | 0,222                                  | Phase 3 | N/A                                     | N/A     |
| 30th                                     | 0,033  | 0,046                                  | Phase 3 | N/A                                     | N/A     |
| 31th                                     | 0,148  | 0,204                                  | Phase 3 | N/A                                     | N/A     |
| 32th                                     | 0,038  | 0,052                                  | Phase 3 | N/A                                     | N/A     |
| 33th                                     | 0,043  | 0,058                                  | Phase 3 | N/A                                     | N/A     |
| 34th                                     | 0,034  | 0,046                                  | Phase 3 | N/A                                     | N/A     |
| 35th                                     | 0,114  | 0,156                                  | Phase 3 | N/A                                     | N/A     |
| 36th                                     | 0,024  | 0,033                                  | Phase 3 | N/A                                     | N/A     |
| 37th                                     | 0,089  | 0,122                                  | Phase 3 | N/A                                     | N/A     |
| 38th                                     | 0,023  | 0,032                                  | Phase 3 | N/A                                     | N/A     |
| 39th                                     | 0,029  | 0,039                                  | Phase 3 | N/A                                     | N/A     |
| 40th                                     | 0,020  | 0,027                                  | Phase 3 | N/A                                     | N/A     |
| THD <sub>40</sub>                        | -  | 1,055                                  | Phase 3 | 13                                      | 13      |
| PWHD                                     | -  | 0,006                                  | Phase 3 | 22                                      | 22      |

**Appendix E Type Verification Test Report**

Extract from test report according to EN 50438

Nr. 15TH0250

| 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                       | 0,086  | 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> (362mA) |       |       |       |
| 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 |