



**BUREAU  
VERITAS**

# Certificate of compliance

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

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

**Model:** blueplanet 5.0 TL3 M2 WM OD IIG0  
blueplanet 6.5 TL3 M2 WM OD IIG0  
blueplanet 7.5 TL3 M2 WM OD IIG0  
blueplanet 9.0 TL3 M2 WM OD IIG0  
blueplanet 10.0 TL3 M2 WM OD IIG0

## 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 G59/3:2013

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 blueplanet 5.0 TL3 M2 WM OD IIG0, blueplanet 6.5 TL3 M2 WM OD IIG0, blueplanet 7.5 TL3 M2 WM OD IIG0, blueplanet 9.0 TL3 M2 WM OD IIG0 and blueplanet 10.0 TL3 M2 WM OD IIG0 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:** 14TH0348-G59/3  
**Certificate number:** U16-0552  
**Date of issue:** 2016-09-23

## Certification body



Dieter Zitzmann



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**

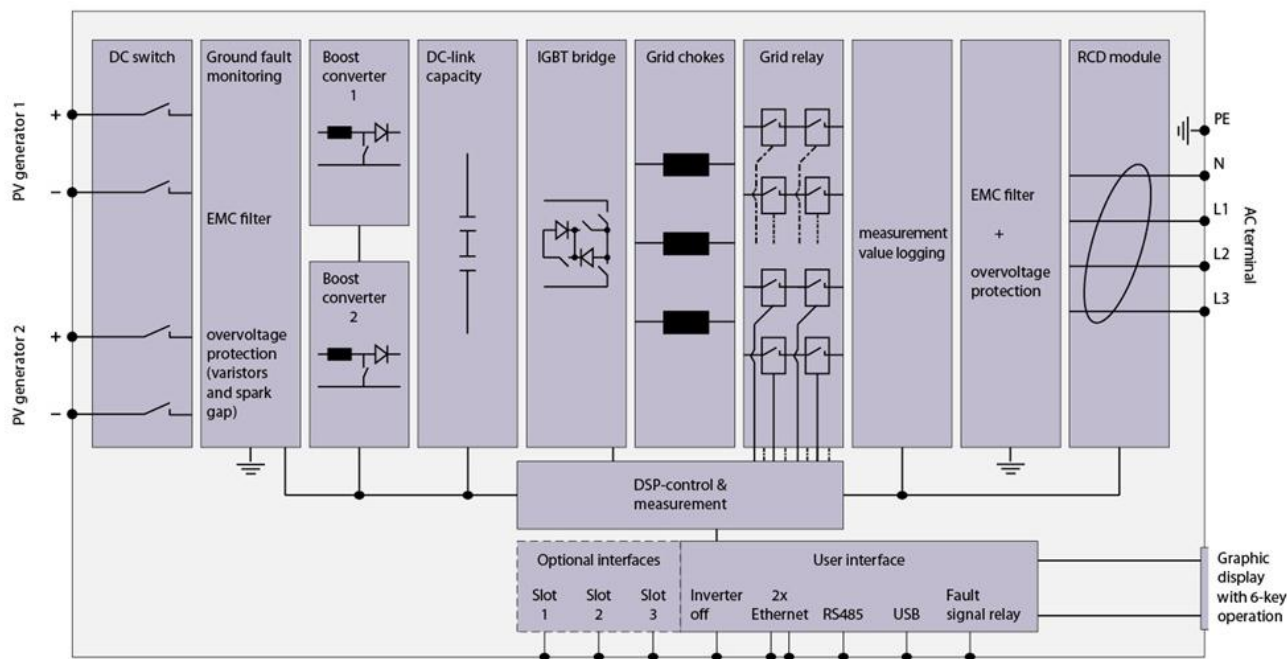
Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0348

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>	blueplanet 5.0 TL3	blueplanet 6.5 TL3	blueplanet 7.5 TL3	blueplanet 9.0 TL3	blueplanet 10.0 TL3
<b>Maximum rated capacity</b>	5,0 kW	6,5 kW	7,5 kW	9,0 kW	10,0 kW
<b>Rated voltage</b>	230V	230V	230V	230V	230V
<b>Firmware version</b>	Pkt: V3.22				
<b>Measurement period:</b>	2015-02-17 to 2015-05-15				

**Description of the structure of the power generation unit (Figure 1):**

The power generation unit is equipped with a PV and line-side EMC filter. The power generation unit has no galvanic isolation between DC input and AC output. Output switch-off is performed with single-fault tolerance thanks to the inverter bridge and two series-connected relays. This enables a safe disconnection of the power generation unit from the network in case of error.



**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. 14TH0348

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	200,6V	2578 ms	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,5V	571 ms	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	261,7V	1081 ms	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	272,7V	581,5 ms	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	200,6V	2585 ms	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,3V	590 ms	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	261,8V	1095 ms	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	272,7V	590 ms	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. 14TH0348

Protection. Voltage tests.						
Phase 3						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
<b>U/V stage 1</b>	200,1V	2,5s	200,7V	2590 ms	204,1V / 3,5s	No trip
<b>U/V stage 2</b>	184V	0,5s	184,0V	590 ms	188V / 2,48s	No trip
					180V / 0,48s	No trip
<b>O/V stage 1</b>	262,2V	1,0s	262,1V	1090 ms	258,2V 2,0s	No trip
<b>O/V stage 2</b>	273,7V	0,5s	273,1V	585 ms	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
<b>U/F stage 1</b>	47,5Hz	20s	47,49Hz	20,09s	47,7Hz / 25s	No trip
<b>U/F stage 2</b>	47Hz	0,5s	46,99Hz	0,560s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
<b>O/F stage 1</b>	51,5Hz	90s	51,57Hz	90,08s	51,3Hz / 95s	No trip
<b>O/F stage 2</b>	52Hz	0,5s	52,02Hz	0,560s	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.

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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Protection. Loss of Mains.						
<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>	473,46	248,33	226,02	299,73	324,47	336,13
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 45.91 with 12ms Type of switching equipment 2: Finder 45.91 with 12ms		
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

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<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.					
<b>Voltage</b>					
<b>Time delay setting</b>		<b>Measured delay</b>			
20s		61,55s			
<b>Frequency</b>					
<b>Time delay setting</b>		<b>Measured delay</b>			
20s		56,4s			
		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>				
	<b>Start Frequency</b>	<b>Change</b>	<b>End Frequency</b>	<b>Confirm no trip</b>
<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. 14TH0348

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 4,5 kW		100% of rated output 9,0 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	0,115	0,853	0,098	0,729	8%	8%
3rd	0,069	0,508	0,057	0,425	21,6%	N/A
4th	0,120	0,893	0,090	0,667	4%	4%
5th	0,101	0,751	0,187	1,390	10,7%	10,7%
6th	0,119	0,879	0,038	0,279	2,67%	2,67%
7th	0,100	0,744	0,222	1,648	7,2%	7,2%
8th	0,108	0,803	0,035	0,256	2%	2%
9th	0,068	0,501	0,048	0,358	3,8%	N/A
10th	0,078	0,581	0,056	0,418	1,6%	1,6%
11th	0,124	0,924	0,056	0,419	3,1%	3,1%
12th	0,119	0,881	0,035	0,261	1,33%	1,33%
13th	0,069	0,509	0,109	0,810	2%	2%
14th	0,110	0,816	0,036	0,266	N/A	N/A
15th	0,054	0,400	0,041	0,302	N/A	N/A
16th	0,054	0,399	0,043	0,319	N/A	N/A
17th	0,060	0,447	0,043	0,321	N/A	N/A
18th	0,049	0,367	0,026	0,193	N/A	N/A
19th	0,034	0,251	0,022	0,161	N/A	N/A
20th	0,029	0,214	0,029	0,213	N/A	N/A
21th	0,041	0,302	0,036	0,264	N/A	N/A
22th	0,044	0,328	0,042	0,309	N/A	N/A
23th	0,025	0,189	0,030	0,225	N/A	N/A
24th	0,038	0,284	0,018	0,130	N/A	N/A
25th	0,023	0,169	0,040	0,299	N/A	N/A
26th	0,038	0,284	0,031	0,227	N/A	N/A
27th	0,039	0,286	0,027	0,203	N/A	N/A
28th	0,024	0,175	0,037	0,271	N/A	N/A
29th	0,017	0,127	0,033	0,246	N/A	N/A
30th	0,026	0,192	0,022	0,166	N/A	N/A
31th	0,031	0,229	0,026	0,195	N/A	N/A
32th	0,018	0,133	0,023	0,172	N/A	N/A
33th	0,015	0,113	0,013	0,098	N/A	N/A
34th	0,014	0,107	0,029	0,213	N/A	N/A
35th	0,024	0,175	0,019	0,140	N/A	N/A
36th	0,015	0,110	0,019	0,144	N/A	N/A
37th	0,019	0,140	0,026	0,193	N/A	N/A
38th	0,014	0,106	0,015	0,111	N/A	N/A
39th	0,019	0,142	0,020	0,145	N/A	N/A
40th	0,014	0,101	0,013	0,095	N/A	N/A
THD <sub>40</sub>	6,17 %		2,91 %		23%	13%
PWHD	0,13 %		0,01 %		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0348

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 4,5 kW		100% of rated output 9,0 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	0,119	0,887	0,109	0,807	8%	8%
3rd	0,090	0,666	0,054	0,398	21,6%	N/A
4th	0,118	0,878	0,095	0,708	4%	4%
5th	0,145	1,078	0,227	1,688	10,7%	10,7%
6th	0,132	0,982	0,028	0,206	2,67%	2,67%
7th	0,131	0,975	0,214	1,591	7,2%	7,2%
8th	0,116	0,860	0,053	0,393	2%	2%
9th	0,040	0,294	0,033	0,248	3,8%	N/A
10th	0,072	0,531	0,035	0,259	1,6%	1,6%
11th	0,065	0,480	0,080	0,595	3,1%	3,1%
12th	0,112	0,835	0,037	0,276	1,33%	1,33%
13th	0,058	0,434	0,109	0,810	2%	2%
14th	0,069	0,511	0,046	0,344	N/A	N/A
15th	0,068	0,502	0,050	0,370	N/A	N/A
16th	0,029	0,218	0,052	0,385	N/A	N/A
17th	0,033	0,241	0,067	0,495	N/A	N/A
18th	0,040	0,295	0,044	0,328	N/A	N/A
19th	0,043	0,319	0,042	0,314	N/A	N/A
20th	0,033	0,243	0,050	0,369	N/A	N/A
21th	0,029	0,217	0,026	0,191	N/A	N/A
22th	0,028	0,207	0,039	0,287	N/A	N/A
23th	0,035	0,261	0,032	0,238	N/A	N/A
24th	0,020	0,151	0,028	0,211	N/A	N/A
25th	0,039	0,289	0,018	0,135	N/A	N/A
26th	0,031	0,227	0,033	0,242	N/A	N/A
27th	0,028	0,209	0,032	0,236	N/A	N/A
28th	0,019	0,141	0,022	0,161	N/A	N/A
29th	0,028	0,207	0,023	0,170	N/A	N/A
30th	0,020	0,145	0,015	0,115	N/A	N/A
31th	0,021	0,159	0,026	0,191	N/A	N/A
32th	0,018	0,132	0,020	0,147	N/A	N/A
33th	0,021	0,153	0,017	0,126	N/A	N/A
34th	0,015	0,112	0,014	0,107	N/A	N/A
35th	0,017	0,129	0,024	0,179	N/A	N/A
36th	0,016	0,117	0,015	0,115	N/A	N/A
37th	0,019	0,143	0,033	0,246	N/A	N/A
38th	0,015	0,114	0,016	0,119	N/A	N/A
39th	0,015	0,111	0,017	0,126	N/A	N/A
40th	0,014	0,101	0,014	0,105	N/A	N/A
THD <sub>40</sub>	6,07 %		3,12 %		23%	13%
PWHD	0,07 %		0,02 %		23%	22%



**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0348

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 4,5 kW		100% of rated output 9,0 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	0,141	1,043	0,111	0,824	8%	8%
3rd	0,064	0,471	0,035	0,257	21,6%	N/A
4th	0,127	0,944	0,103	0,766	4%	4%
5th	0,054	0,401	0,183	1,354	10,7%	10,7%
6th	0,137	1,013	0,043	0,321	2,67%	2,67%
7th	0,103	0,765	0,202	1,495	7,2%	7,2%
8th	0,123	0,915	0,041	0,307	2%	2%
9th	0,062	0,458	0,029	0,216	3,8%	N/A
10th	0,060	0,442	0,035	0,262	1,6%	1,6%
11th	0,077	0,571	0,087	0,641	3,1%	3,1%
12th	0,042	0,308	0,024	0,176	1,33%	1,33%
13th	0,043	0,318	0,096	0,713	2%	2%
14th	0,083	0,618	0,037	0,276	N/A	N/A
15th	0,036	0,266	0,021	0,156	N/A	N/A
16th	0,047	0,349	0,023	0,168	N/A	N/A
17th	0,072	0,533	0,062	0,460	N/A	N/A
18th	0,030	0,225	0,029	0,217	N/A	N/A
19th	0,042	0,315	0,036	0,264	N/A	N/A
20th	0,043	0,322	0,034	0,250	N/A	N/A
21th	0,029	0,214	0,025	0,188	N/A	N/A
22th	0,031	0,231	0,022	0,164	N/A	N/A
23th	0,040	0,300	0,035	0,261	N/A	N/A
24th	0,037	0,274	0,026	0,195	N/A	N/A
25th	0,044	0,324	0,043	0,322	N/A	N/A
26th	0,024	0,177	0,017	0,123	N/A	N/A
27th	0,024	0,181	0,020	0,152	N/A	N/A
28th	0,030	0,221	0,023	0,168	N/A	N/A
29th	0,028	0,205	0,024	0,175	N/A	N/A
30th	0,021	0,153	0,019	0,142	N/A	N/A
31th	0,033	0,243	0,020	0,148	N/A	N/A
32th	0,018	0,133	0,014	0,104	N/A	N/A
33th	0,019	0,139	0,016	0,119	N/A	N/A
34th	0,015	0,109	0,023	0,168	N/A	N/A
35th	0,022	0,165	0,022	0,166	N/A	N/A
36th	0,018	0,133	0,014	0,102	N/A	N/A
37th	0,015	0,113	0,031	0,230	N/A	N/A
38th	0,015	0,114	0,014	0,106	N/A	N/A
39th	0,016	0,117	0,017	0,124	N/A	N/A
40th	0,013	0,100	0,012	0,089	N/A	N/A
THD <sub>40</sub>	5,67 %		2,79 %		23%	13%
PWHD	0,09 %		0,01 %		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0348

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	1,290	1,150	0,0	1,290	1,150	0,0	0,20	0,141
Normalised to standard impedance	1,290	1,150	0,0	1,290	1,150	0,0	0,20	0,141
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Test impedance	R	0,24* 0,4^		$\Omega$	XI		0,15* 0,25	$\Omega$
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	13,19mA	23,86 mA	7,89 mA
As % of rated AC current	0,10%	0,18%	0,06%
Limit	0,25%	0,25%	0,25%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0348

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	64,25	3,79
Initial Value of aperiodic current	A	N/A	100ms	53,42	1,83
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	51,60	1,30
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	51,02	1,06
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,003	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.	