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Certificate of compliance

Applicant: KACO new energy GmbH
Carl-Zeiss-Str. 1
74172 Neckarsulm
Germany

Product: Grid-tied photovoltaic (PV) inverter

Model:

Powador 60.0 TL3 – M – INT	Powador 72.0 TL3 – M – INT – Park
Powador 60.0 TL3 – XL – INT	Powador 72.0 TL3 – XL – INT – Park
Powador 60.0 TL3 – XL – INT – SPD 1+2	Powador 72.0 TL3 – XL – INT – SPD 1+2
Powador 60.0 TL3 – XL – F – INT	Powador 72.0 TL3 – XL – F – INT – Park
Powador 60.0 TL3 – XL – F – SPD 1+2	Powador 72.0 TL3 – XL – F – SPD 1+2 – Park

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 Powador 60.0 TL3 and Powador 72.0 TL3 are rated >16A per phase. 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: 12TH0351-G59/3

Certificate number: U16-0316

Date of issue: 2016-06-10

Certification body



Dieter Zitzmann



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. 12TH0351

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G59/3.

Manufacturer / applicant:	KACO new energy GmbH Carl-Zeiss-Str. 1 74172 Neckarsulm Germany		
Generating Unit technology	Grid-tied photovoltaic inverter		
Rated values	Powador 60.0 TL3 – M – INT Powador 60.0 TL3 – XL – INT Powador 60.0 TL3 – XL – INT – SPD 1+2 Powador 60.0 TL3 – XL – F – 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 – INT – SPD 1+2 Powador 72.0 TL3 – XL – F – INT – Park Powador 72.0 TL3 – XL – F – SPD 1+2 – Park	
Maximum rated capacity [kW]	50		60
Rated voltage	400 V; N; PE		480 V; N; PE
Firmware version	PKT: v. 3.25 CFG: v. 5.1700 DSP-DC: v. 2.04 7740 Rev. 785	ARM: v. 3.78.2780 Rev. 10240 DSP-AC: v. 2.18 4CBA Rev. 3574	

* The tests were performed with Firmwareversion v.3.25 Changes in the Firmwareversion on position v.3.2x has no effect on the required electrical properties.
x = could be any number or sign

Measurement period: 2016-05-04 to 2016-05-27

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 based on two series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.

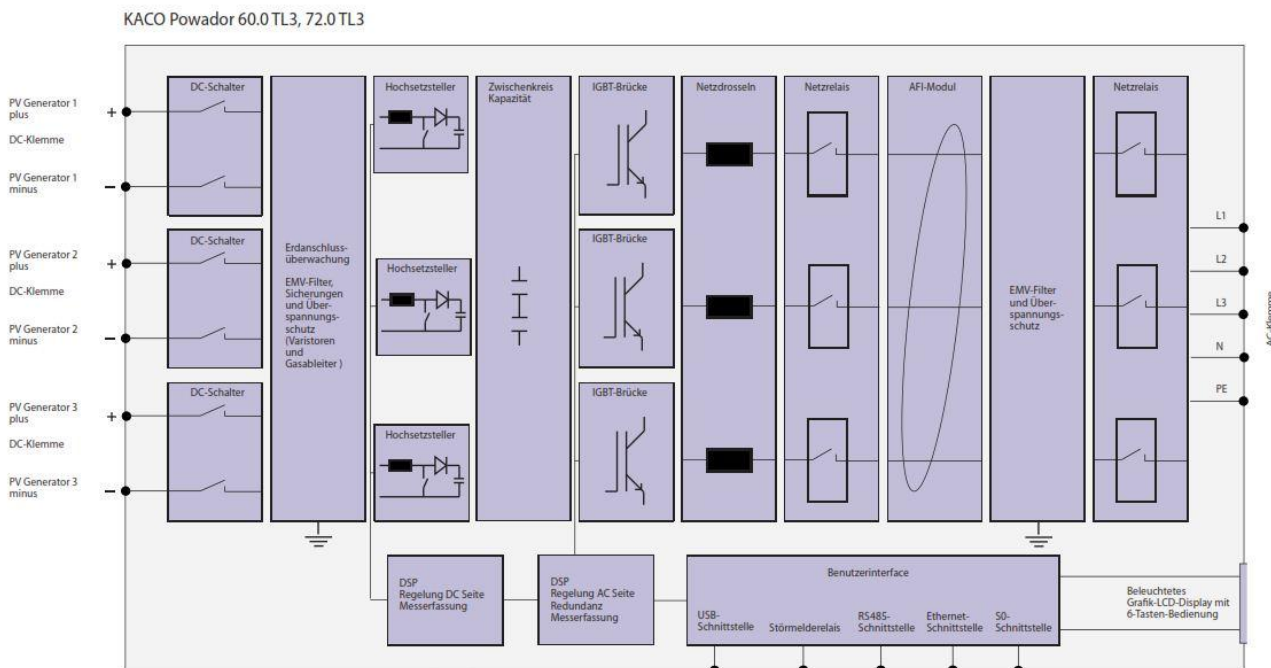


Figure 1 – Schematic structure of the power generation unit

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

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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	201,8V	2,59s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	186,0V	0,58s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	264,6V	1,09s	258,2V / 2,0s	No trip
O/V stage 2	273,7V	0,5s	275,5V	0,59s	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	200,2V	2,59s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	185,1V	0,58s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	262,9V	1,19s	258,2V / 2,0s	No trip
O/V stage 2	273,7V	0,5s	273,9V	0,60s	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

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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	2,59s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	186,3V	0,58s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	262,8V	1,09s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	273,7V	0,58s	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	47,45Hz	20,12s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	46,98Hz	0,62s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,58Hz	90,0s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,01Hz	0,61s	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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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.

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. Ph1 fuse removed	132	138	188	193	169	314
Trip time. Ph2 fuse removed	132	138	188	193	169	314
Trip time. Ph3 fuse removed	132	138	188	193	169	314

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:

Relay with 30ms

Type of switching equipment 2:

Relay with 30ms

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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Protection. Re-connection timer.					
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		30s			
Frequency					
Time delay setting		Measured delay			
20s		30s			
		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
Confirmation that the Generating Unit does not re-connect.	no reconnection	no reconnection	no reconnection	no reconnection	no reconnection

Protection. Frequency change, Stability test.				
	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49,5Hz	+9 degrees		no trip
Negative Vector Shift	50,5Hz	- 9 degrees		no trip
Positive Frequency drift	49,5Hz	+0,19Hz/sec	51,5Hz	no trip
Negative Frequency drift	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. 12TH0351

Power Quality. Harmonics: Powador 60.0 TL3						
Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output		100% of rated output			
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	0,128	0,177	0,181	0,249	8%	8%
3rd	0,053	0,073	0,061	0,084	21,6%	N/A
4th	0,087	0,120	0,082	0,114	4%	4%
5th	0,377	0,520	0,429	0,593	10,7%	10,7%
6th	0,040	0,055	0,038	0,053	2,67%	2,67%
7th	0,237	0,328	0,257	0,355	7,2%	7,2%
8th	0,044	0,061	0,040	0,055	2%	2%
9th	0,036	0,050	0,026	0,035	3,8%	N/A
10th	0,041	0,057	0,036	0,050	1,6%	1,6%
11th	0,200	0,277	0,214	0,296	3,1%	3,1%
12th	0,031	0,042	0,020	0,028	1,33%	1,33%
13th	0,196	0,271	0,210	0,290	2%	2%
14th	0,033	0,046	0,030	0,042	N/A	N/A
15th	0,027	0,037	0,021	0,029	N/A	N/A
16th	0,030	0,041	0,025	0,035	N/A	N/A
17th	0,195	0,270	0,217	0,299	N/A	N/A
18th	0,028	0,038	0,020	0,028	N/A	N/A
19th	0,198	0,273	0,214	0,296	N/A	N/A
20th	0,030	0,042	0,023	0,032	N/A	N/A
21th	0,029	0,040	0,020	0,028	N/A	N/A
22th	0,037	0,051	0,023	0,032	N/A	N/A
23th	0,192	0,266	0,210	0,290	N/A	N/A
24th	0,032	0,044	0,021	0,029	N/A	N/A
25th	0,187	0,258	0,206	0,284	N/A	N/A
26th	0,025	0,034	0,021	0,029	N/A	N/A
27th	0,022	0,030	0,023	0,032	N/A	N/A
28th	0,025	0,035	0,025	0,034	N/A	N/A
29th	0,178	0,245	0,195	0,269	N/A	N/A
30th	0,026	0,035	0,023	0,032	N/A	N/A
31th	0,165	0,227	0,185	0,255	N/A	N/A
32th	0,024	0,033	0,023	0,032	N/A	N/A
33th	0,024	0,033	0,029	0,040	N/A	N/A
34th	0,028	0,038	0,026	0,036	N/A	N/A
35th	0,138	0,190	0,142	0,196	N/A	N/A
36th	0,027	0,037	0,025	0,035	N/A	N/A
37th	0,120	0,166	0,137	0,189	N/A	N/A
38th	0,027	0,037	0,023	0,032	N/A	N/A
39th	0,027	0,038	0,026	0,036	N/A	N/A
40th	0,028	0,039	0,022	0,031	N/A	N/A
41	0,061	0,085	0,056	0,078	N/A	N/A
42	0,027	0,037	0,021	0,029	N/A	N/A
43	0,041	0,057	0,056	0,077	N/A	N/A



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Extract from test report according the Engineering Recommendation G59/3

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44	0,027	0,037	0,021	0,029	N/A	N/A
45	0,024	0,033	0,032	0,045	N/A	N/A
46	0,019	0,026	0,019	0,026	N/A	N/A
47	0,019	0,027	0,024	0,033	N/A	N/A
48	0,017	0,024	0,016	0,022	N/A	N/A
49	0,016	0,023	0,017	0,024	N/A	N/A
50	0,013	0,018	0,014	0,019	N/A	N/A
THD ₄₀	--			2,080	--	1,147
PWHD	--			0,033	--	0,010



Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0351

Power Quality. Harmonics: Powador 60.0 TL3						
Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output		100% of rated output			
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	0,289	0,399	0,310	0,428	8%	8%
3rd	0,070	0,097	0,112	0,154	21,6%	N/A
4th	0,065	0,090	0,072	0,099	4%	4%
5th	0,367	0,507	0,414	0,572	10,7%	10,7%
6th	0,043	0,060	0,044	0,060	2,67%	2,67%
7th	0,243	0,335	0,269	0,371	7,2%	7,2%
8th	0,040	0,056	0,040	0,055	2%	2%
9th	0,037	0,051	0,032	0,045	3,8%	N/A
10th	0,037	0,051	0,033	0,046	1,6%	1,6%
11th	0,189	0,260	0,207	0,285	3,1%	3,1%
12th	0,033	0,045	0,027	0,037	1,33%	1,33%
13th	0,196	0,271	0,217	0,299	2%	2%
14th	0,038	0,052	0,035	0,048	N/A	N/A
15th	0,033	0,046	0,023	0,032	N/A	N/A
16th	0,033	0,046	0,027	0,037	N/A	N/A
17th	0,194	0,267	0,212	0,292	N/A	N/A
18th	0,030	0,042	0,021	0,029	N/A	N/A
19th	0,196	0,271	0,219	0,302	N/A	N/A
20th	0,041	0,057	0,029	0,040	N/A	N/A
21th	0,044	0,061	0,022	0,030	N/A	N/A
22th	0,057	0,078	0,026	0,036	N/A	N/A
23th	0,194	0,268	0,205	0,283	N/A	N/A
24th	0,039	0,054	0,019	0,026	N/A	N/A
25th	0,186	0,257	0,205	0,283	N/A	N/A
26th	0,031	0,042	0,025	0,034	N/A	N/A
27th	0,027	0,037	0,024	0,034	N/A	N/A
28th	0,029	0,040	0,026	0,037	N/A	N/A
29th	0,174	0,240	0,180	0,249	N/A	N/A
30th	0,023	0,032	0,021	0,030	N/A	N/A
31th	0,166	0,229	0,177	0,244	N/A	N/A
32th	0,028	0,038	0,023	0,032	N/A	N/A
33th	0,026	0,036	0,029	0,040	N/A	N/A
34th	0,028	0,039	0,026	0,035	N/A	N/A
35th	0,136	0,187	0,142	0,195	N/A	N/A
36th	0,025	0,035	0,025	0,034	N/A	N/A
37th	0,118	0,162	0,121	0,167	N/A	N/A
38th	0,027	0,037	0,022	0,031	N/A	N/A
39th	0,027	0,038	0,023	0,032	N/A	N/A
40th	0,026	0,036	0,020	0,028	N/A	N/A
41th	0,072	0,100	0,069	0,095	N/A	N/A
42th	0,022	0,031	0,020	0,028	N/A	N/A
43th	0,055	0,076	0,059	0,082	N/A	N/A
44th	0,031	0,043	0,025	0,035	N/A	N/A
45th	0,025	0,035	0,034	0,047	N/A	N/A
46th	0,019	0,026	0,020	0,028	N/A	N/A
47th	0,019	0,026	0,021	0,029	N/A	N/A



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Extract from test report according the Engineering Recommendation G59/3

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48th	0,015	0,021	0,016	0,022	N/A	N/A
49th	0,016	0,022	0,017	0,023	N/A	N/A
50th	0,013	0,018	0,015	0,020	N/A	N/A
THD	--		1,188		--	2,185
PWHD	--		0,009		--	0,033



Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3 Nr. 12TH0351

Power Quality. Harmonics: Powador 60.0 TL3						
Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output		100% of rated output			
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	0,233	0,321	0,260	0,359	8%	8%
3rd	0,068	0,094	0,136	0,187	21,6%	N/A
4th	0,066	0,091	0,097	0,134	4%	4%
5th	0,354	0,488	0,374	0,516	10,7%	10,7%
6th	0,037	0,051	0,051	0,070	2,67%	2,67%
7th	0,242	0,334	0,304	0,420	7,2%	7,2%
8th	0,042	0,058	0,051	0,071	2%	2%
9th	0,033	0,045	0,042	0,057	3,8%	N/A
10th	0,031	0,042	0,041	0,057	1,6%	1,6%
11th	0,211	0,291	0,236	0,326	3,1%	3,1%
12th	0,028	0,038	0,031	0,043	1,33%	1,33%
13th	0,179	0,247	0,220	0,303	2%	2%
14th	0,035	0,049	0,041	0,057	N/A	N/A
15th	0,029	0,040	0,034	0,047	N/A	N/A
16th	0,028	0,038	0,030	0,041	N/A	N/A
17th	0,189	0,261	0,240	0,331	N/A	N/A
18th	0,028	0,038	0,027	0,037	N/A	N/A
19th	0,195	0,269	0,210	0,289	N/A	N/A
20th	0,036	0,049	0,033	0,045	N/A	N/A
21th	0,033	0,046	0,035	0,048	N/A	N/A
22th	0,038	0,053	0,029	0,040	N/A	N/A
23th	0,191	0,264	0,236	0,326	N/A	N/A
24th	0,031	0,043	0,027	0,037	N/A	N/A
25th	0,187	0,258	0,188	0,260	N/A	N/A
26th	0,031	0,043	0,027	0,037	N/A	N/A
27th	0,030	0,041	0,036	0,050	N/A	N/A
28th	0,028	0,039	0,029	0,041	N/A	N/A
29th	0,179	0,247	0,217	0,300	N/A	N/A
30th	0,025	0,034	0,026	0,035	N/A	N/A
31th	0,161	0,222	0,153	0,211	N/A	N/A
32th	0,026	0,036	0,027	0,037	N/A	N/A
33th	0,026	0,036	0,034	0,046	N/A	N/A
34th	0,026	0,036	0,030	0,041	N/A	N/A
35th	0,144	0,198	0,161	0,223	N/A	N/A
36th	0,025	0,034	0,029	0,040	N/A	N/A
37th	0,120	0,165	0,112	0,154	N/A	N/A
38th	0,023	0,032	0,026	0,036	N/A	N/A
39th	0,023	0,032	0,027	0,037	N/A	N/A
40th	0,024	0,034	0,026	0,035	N/A	N/A
41th	0,066	0,091	0,073	0,101	N/A	N/A
42th	0,023	0,032	0,025	0,035	N/A	N/A
43th	0,049	0,068	0,034	0,046	N/A	N/A
44th	0,026	0,036	0,022	0,030	N/A	N/A
45th	0,021	0,029	0,033	0,046	N/A	N/A
46th	0,015	0,021	0,017	0,024	N/A	N/A
47th	0,024	0,033	0,019	0,026	N/A	N/A



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Extract from test report according the Engineering Recommendation G59/3

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48th	0,015	0,021	0,017	0,023	N/A	N/A
49th	0,017	0,023	0,017	0,024	N/A	N/A
50th	0,013	0,018	0,015	0,021	N/A	N/A
THD	--		1,204		--	2,110
PWHD	--		0,011		--	0,033

Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3

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Power Quality. Harmonics: Powador 72.0 TL3

Phase 1

Generating Unit tested to BS EN 61000-3-12

Generating Unit rating per phase (rpp)						
	At 45-55% of rated output		100% of rated output			
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	0,211	0,293	0,248	0,345	8%	8%
3rd	0,026	0,036	0,042	0,058	21,6%	N/A
4th	0,044	0,061	0,026	0,036	4%	4%
5th	0,332	0,461	0,404	0,561	10,7%	10,7%
6th	0,029	0,040	0,028	0,039	2,67%	2,67%
7th	0,270	0,375	0,291	0,404	7,2%	7,2%
8th	0,038	0,052	0,032	0,044	2%	2%
9th	0,038	0,053	0,043	0,059	3,8%	N/A
10th	0,026	0,036	0,034	0,047	1,6%	1,6%
11th	0,209	0,291	0,215	0,298	3,1%	3,1%
12th	0,024	0,033	0,024	0,033	1,33%	1,33%
13th	0,189	0,262	0,223	0,309	2%	2%
14th	0,027	0,038	0,036	0,050	N/A	N/A
15th	0,028	0,039	0,032	0,044	N/A	N/A
16th	0,026	0,037	0,022	0,030	N/A	N/A
17th	0,183	0,253	0,228	0,317	N/A	N/A
18th	0,026	0,035	0,022	0,030	N/A	N/A
19th	0,210	0,292	0,197	0,274	N/A	N/A
20th	0,029	0,040	0,023	0,032	N/A	N/A
21th	0,027	0,038	0,029	0,040	N/A	N/A
22th	0,027	0,038	0,031	0,043	N/A	N/A
23th	0,203	0,282	0,217	0,301	N/A	N/A
24th	0,025	0,035	0,023	0,032	N/A	N/A
25th	0,210	0,291	0,206	0,287	N/A	N/A
26th	0,026	0,035	0,027	0,037	N/A	N/A
27th	0,026	0,036	0,026	0,037	N/A	N/A
28th	0,024	0,033	0,030	0,041	N/A	N/A
29th	0,211	0,293	0,223	0,310	N/A	N/A
30th	0,024	0,033	0,026	0,036	N/A	N/A
31th	0,189	0,263	0,184	0,256	N/A	N/A
32th	0,026	0,037	0,026	0,036	N/A	N/A
33th	0,030	0,041	0,038	0,052	N/A	N/A
34th	0,025	0,035	0,027	0,038	N/A	N/A
35th	0,182	0,252	0,181	0,252	N/A	N/A
36th	0,024	0,034	0,024	0,033	N/A	N/A
37th	0,155	0,215	0,157	0,218	N/A	N/A
38th	0,025	0,035	0,023	0,031	N/A	N/A
39th	0,023	0,032	0,024	0,033	N/A	N/A
40th	0,024	0,033	0,021	0,029	N/A	N/A
41th	0,089	0,124	0,071	0,098	N/A	N/A
42th	0,017	0,024	0,017	0,024	N/A	N/A
43th	0,078	0,109	0,088	0,122	N/A	N/A



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Annex to the G59/3 certificate of compliance No. U16-0316

Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0351

44th	0,014	0,020	0,016	0,022	N/A	N/A
45th	0,016	0,023	0,017	0,024	N/A	N/A
46th	0,012	0,017	0,014	0,020	N/A	N/A
47th	0,036	0,050	0,031	0,043	N/A	N/A
48th	0,010	0,014	0,013	0,018	N/A	N/A
49th	0,027	0,037	0,029	0,041	N/A	N/A
50th	0,008	0,011	0,011	0,016	N/A	N/A
THD	-			1,20	--	1,147
PWHD	-			0,011	--	0,010



Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3 Nr. 12TH0351

Power Quality. Harmonics: Powador 72.0 TL3						
Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output		100% of rated output			
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	0,117	0,163	0,115	0,160	8%	8%
3rd	0,034	0,047	0,027	0,038	21,6%	N/A
4th	0,071	0,098	0,065	0,090	4%	4%
5th	0,347	0,482	0,419	0,582	10,7%	10,7%
6th	0,034	0,047	0,035	0,049	2,67%	2,67%
7th	0,288	0,400	0,289	0,402	7,2%	7,2%
8th	0,034	0,048	0,030	0,042	2%	2%
9th	0,030	0,042	0,025	0,035	3,8%	N/A
10th	0,033	0,045	0,030	0,042	1,6%	1,6%
11th	0,186	0,259	0,190	0,264	3,1%	3,1%
12th	0,025	0,034	0,019	0,026	1,33%	1,33%
13th	0,203	0,282	0,223	0,309	2%	2%
14th	0,025	0,035	0,028	0,038	N/A	N/A
15th	0,024	0,033	0,020	0,028	N/A	N/A
16th	0,026	0,036	0,020	0,028	N/A	N/A
17th	0,191	0,266	0,208	0,288	N/A	N/A
18th	0,023	0,032	0,019	0,026	N/A	N/A
19th	0,209	0,290	0,217	0,301	N/A	N/A
20th	0,025	0,035	0,023	0,032	N/A	N/A
21th	0,022	0,030	0,021	0,029	N/A	N/A
22th	0,024	0,033	0,028	0,039	N/A	N/A
23th	0,204	0,283	0,217	0,301	N/A	N/A
24th	0,021	0,029	0,021	0,029	N/A	N/A
25th	0,209	0,290	0,228	0,316	N/A	N/A
26th	0,021	0,029	0,023	0,032	N/A	N/A
27th	0,021	0,029	0,022	0,030	N/A	N/A
28th	0,020	0,028	0,026	0,036	N/A	N/A
29th	0,201	0,280	0,217	0,301	N/A	N/A
30th	0,020	0,028	0,022	0,031	N/A	N/A
31th	0,198	0,275	0,214	0,297	N/A	N/A
32th	0,020	0,028	0,022	0,031	N/A	N/A
33th	0,022	0,030	0,024	0,033	N/A	N/A
34th	0,022	0,030	0,028	0,038	N/A	N/A
35th	0,170	0,236	0,170	0,236	N/A	N/A
36th	0,019	0,027	0,023	0,031	N/A	N/A
37th	0,151	0,210	0,161	0,223	N/A	N/A
38th	0,020	0,028	0,022	0,031	N/A	N/A
39th	0,022	0,031	0,030	0,041	N/A	N/A
40th	0,021	0,030	0,023	0,032	N/A	N/A
41th	0,097	0,135	0,116	0,162	N/A	N/A
42th	0,016	0,022	0,020	0,028	N/A	N/A
43th	0,081	0,112	0,076	0,106	N/A	N/A
44th	0,014	0,020	0,018	0,025	N/A	N/A
45th	0,014	0,019	0,018	0,026	N/A	N/A
46th	0,013	0,018	0,016	0,022	N/A	N/A
47th	0,037	0,052	0,041	0,057	N/A	N/A



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Annex to the G59/3 certificate of compliance No. U16-0316

Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0351

48th	0,010	0,013	0,014	0,019	N/A	N/A
49th	0,026	0,037	0,029	0,040	N/A	N/A
50th	0,008	0,011	0,013	0,018	N/A	N/A
THD	-		1,17		--	2,185
PWHD	-		0,012		--	0,033



Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0351

Power Quality. Harmonics: Powador 72.0 TL3						
Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output		100% of rated output			
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	0,312	0,433	0,331	0,459	8%	8%
3rd	0,053	0,073	0,057	0,079	21,6%	N/A
4th	0,062	0,086	0,059	0,082	4%	4%
5th	0,348	0,483	0,417	0,579	10,7%	10,7%
6th	0,035	0,048	0,030	0,042	2,67%	2,67%
7th	0,296	0,411	0,318	0,441	7,2%	7,2%
8th	0,031	0,043	0,025	0,035	2%	2%
9th	0,035	0,048	0,022	0,030	3,8%	N/A
10th	0,027	0,038	0,025	0,034	1,6%	1,6%
11th	0,183	0,254	0,180	0,250	3,1%	3,1%
12th	0,024	0,033	0,022	0,030	1,33%	1,33%
13th	0,200	0,277	0,224	0,311	2%	2%
14th	0,024	0,034	0,032	0,045	N/A	N/A
15th	0,026	0,035	0,025	0,035	N/A	N/A
16th	0,025	0,035	0,020	0,028	N/A	N/A
17th	0,193	0,267	0,211	0,293	N/A	N/A
18th	0,024	0,033	0,020	0,028	N/A	N/A
19th	0,201	0,278	0,216	0,300	N/A	N/A
20th	0,025	0,035	0,021	0,029	N/A	N/A
21th	0,023	0,032	0,019	0,027	N/A	N/A
22th	0,023	0,032	0,028	0,039	N/A	N/A
23th	0,203	0,281	0,214	0,297	N/A	N/A
24th	0,020	0,028	0,021	0,029	N/A	N/A
25th	0,198	0,275	0,213	0,296	N/A	N/A
26th	0,021	0,030	0,025	0,035	N/A	N/A
27th	0,021	0,028	0,023	0,031	N/A	N/A
28th	0,020	0,028	0,026	0,035	N/A	N/A
29th	0,204	0,283	0,216	0,300	N/A	N/A
30th	0,019	0,026	0,022	0,031	N/A	N/A
31th	0,185	0,257	0,195	0,270	N/A	N/A
32th	0,023	0,032	0,023	0,031	N/A	N/A
33th	0,022	0,031	0,024	0,033	N/A	N/A
34th	0,022	0,031	0,026	0,036	N/A	N/A
35th	0,172	0,238	0,191	0,266	N/A	N/A
36th	0,019	0,026	0,023	0,032	N/A	N/A
37th	0,151	0,209	0,155	0,215	N/A	N/A
38th	0,018	0,025	0,022	0,031	N/A	N/A
39th	0,026	0,037	0,035	0,049	N/A	N/A
40th	0,018	0,024	0,025	0,035	N/A	N/A
41th	0,126	0,175	0,122	0,170	N/A	N/A
42th	0,016	0,022	0,019	0,027	N/A	N/A
43th	0,083	0,115	0,073	0,101	N/A	N/A
44th	0,014	0,019	0,017	0,023	N/A	N/A
45th	0,013	0,017	0,018	0,025	N/A	N/A
46th	0,011	0,016	0,014	0,020	N/A	N/A
47th	0,041	0,057	0,034	0,048	N/A	N/A

Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0351

48th	0,010	0,013	0,013	0,018	N/A	N/A
49th	0,024	0,033	0,022	0,031	N/A	N/A
50th	0,009	0,012	0,012	0,016	N/A	N/A
THD	-		1,25		--	2,110
PWHD	-		0,011		--	0,033

Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0351

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%	3,3%	0,33%	3,3%	3,3%	0,0856	0,0856
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	0,09	Ω	XI	0,06	Ω		

Power Quality. DC injection.			
Phase1			
Test level power	10%	55%	100%
Recorded value	1,96 mA	9,74 mA	36,51 mA
As % of rated AC current	0,00 %	0,01 %	0,05 %
Limit	0,25%	0,25%	0,25%
Phase2			
Test level power	10%	55%	100%
Recorded value	30,42 mA	20,83 mA	14,04 mA
As % of rated AC current	0,04 %	0,03 %	0,02 %
Limit	0,25%	0,25%	0,25%
Phase3			
Test level power	10%	55%	100%
Recorded value	6,31 mA	11,14 mA	34,52 mA
As % of rated AC current	0,01 %	0,02 %	0,05 %
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

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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	95,09	72,66
Initial Value of aperiodic current	A	N/A	100ms	62,19	73,41
Initial symmetrical short-circuit current*	I_k	N/A	250ms	55,58	73,40
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	53,20	73,10
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,512s	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.	