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Certification body of BV CPS GmbH  
Accredited according to EN 45011 -  
ISO / IEC Guide 65

## Certificate of compliance

**Applicant:** AEI Power GmbH  
Uracher Straße 91  
72555 Metzingen  
Germany

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

**Model:** 867R017  
867R020  
867R023

### 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 867R017, 867R020 and 867R023 are rated >16A per phase and ≤ 50kW (3 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:** 17TH0086-G59/3  
**Certificate number:** U14-0333  
**Date of issue:** 2014-07-15

### Certification body

Dieter Zitzmann



Deutsche  
Akkreditierungsstelle  
D-ZE-12024-01-01



QUALITY



HEALTH



SAFETY



ENVIRONMENT



SOCIAL  
ACCOUNTABILITY

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0086

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G59/3.			
Manufacturer / applicant:	AEI Power GmbH Uracher Straße 91 72555 Metzingen Germany		
Generating Unit technology	Grid-tied photovoltaic inverter		
Rated values	867R017	867R020	867R023
Maximum rated capacity	17 kW	20 kW	23 kW
Rated voltage	230V	230V	265V
Firmware version	AEFP_300-01-01-24-S		

\* The tests were performed with Firmwareversion AEFP\_300-01-01-24-S. Changes in the Firmwareversion on position AEFP\_300-01-01-xx-S has no effect on the required electrical properties.  
 x = could be any number or sign

Measurement period: 2014-06-02 to 2014-06-10

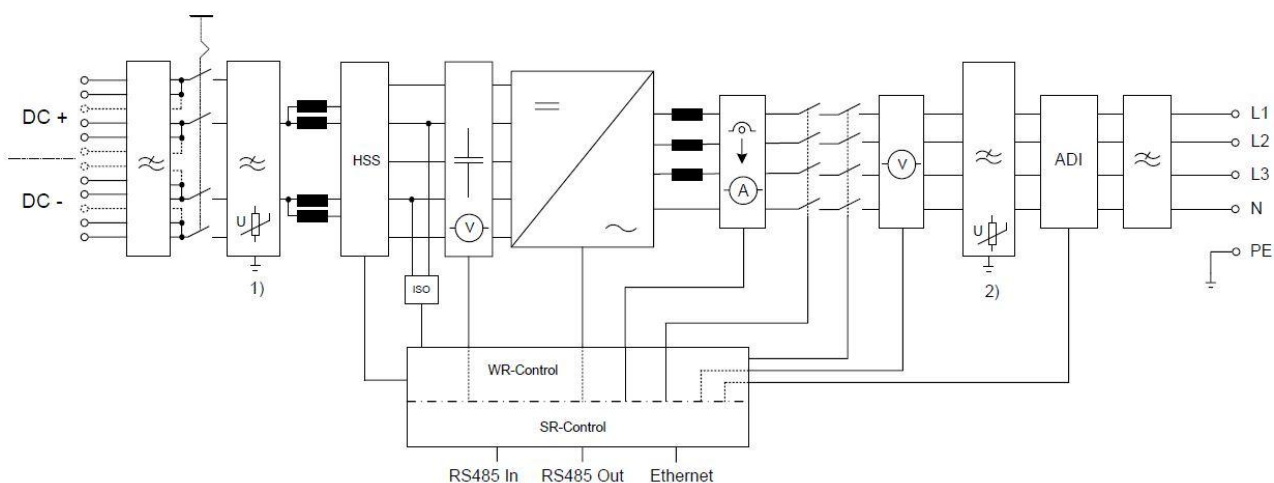
**Description of the structure of the power generation unit (Figure 1):**

The Solar Inverter converts DC voltage into AC voltage.

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). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit will also operate in case of one error.

Description of the electrical circuit:

block diagram of inverter series 866R0xx and 867R0xx



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

**Differences between Generating Units:**

The hardware from the 867R017, 867R020 and 867R023 is identical and only software derated, because the inverter topology and the controlling software is identical. Only the 867R023 has another grid voltage.

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	202,6V	2,755s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,8V	0,649s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	264,7V	1,150s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	274,4V	0,668s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip
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	201,3V	2,750s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,3V	0,657s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	263,5V	1,170s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	274,7V	0,659s	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. 14TH0086

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	201,0V	2,745s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	185,9V	0,668s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	263,2V	1,154s	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	275,7V	0,656s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip
Note. For Voltage tests the Voltage required to trip is the setting $\pm 3,45V$ . The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting $\pm 4V$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

Protection. Frequency tests.						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,49Hz	20,214s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	46,99	0,664	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,51Hz	90,301s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,01Hz	0,660s	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

Nr. 14TH0086

<b>Protection. Loss of Mains.</b>						
<b>867R017, 867R020, 867R023</b>						
BS EN 62116						
<b>867R020</b>						
<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. Ph1 fuse removed</b>	211ms	195ms	297ms	218ms	260ms	194ms
<b>Trip time. Ph2 fuse removed</b>	211ms	195ms	297ms	218ms	260ms	194ms
<b>Trip time. Ph3 fuse removed</b>	211ms	1995ms	297ms	218ms	260ms	194ms
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 66.22-1700S with 20ms Type of switching equipment 2: Relay 66.22-1700S with 20ms		
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 all 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		52,238s			
<b>Frequency</b>					
<b>Time delay setting</b>		<b>Measured delay</b>			
20s		47,852s			
		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. 14TH0086

Power Quality. Harmonics.						
867R017 Phase 1						
SSEG rating per phase (rpp)						
	At 45-55% of rated output 8,5kW		100% of rated output 17kW			
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	0,005	0,019	0,008	0,032	8%	8%
3rd	0,035	0,143	0,068	0,277	21,6%	N/A
4th	0,005	0,021	0,004	0,016	4%	4%
5th	0,020	0,082	0,031	0,127	10,7%	10,7%
6th	0,004	0,016	0,005	0,022	2,67%	2,67%
7th	0,019	0,079	0,003	0,013	7,2%	7,2%
8th	0,004	0,017	0,002	0,009	2%	2%
9th	0,020	0,080	0,003	0,013	3,8%	N/A
10th	0,004	0,017	0,002	0,010	1,6%	1,6%
11th	0,019	0,079	0,003	0,011	3,1%	3,1%
12th	0,003	0,014	0,002	0,008	1,33%	1,33%
13th	0,019	0,077	0,003	0,011	2%	2%
14th	0,003	0,014	0,003	0,011	N/A	N/A
15th	0,017	0,070	0,003	0,011	N/A	N/A
16th	0,003	0,013	0,002	0,009	N/A	N/A
17th	0,017	0,068	0,004	0,017	N/A	N/A
18th	0,003	0,012	0,003	0,010	N/A	N/A
19th	0,016	0,065	0,003	0,013	N/A	N/A
20th	0,003	0,012	0,002	0,010	N/A	N/A
21th	0,013	0,052	0,004	0,018	N/A	N/A
22th	0,003	0,011	0,002	0,010	N/A	N/A
23th	0,014	0,056	0,006	0,026	N/A	N/A
24th	0,002	0,010	0,002	0,010	N/A	N/A
25th	0,012	0,047	0,005	0,022	N/A	N/A
26th	0,002	0,009	0,002	0,009	N/A	N/A
27th	0,010	0,042	0,006	0,024	N/A	N/A
28th	0,002	0,008	0,002	0,008	N/A	N/A
29th	0,010	0,040	0,008	0,031	N/A	N/A
30th	0,002	0,007	0,002	0,008	N/A	N/A
31th	0,009	0,038	0,007	0,029	N/A	N/A
32th	0,002	0,007	0,002	0,008	N/A	N/A
33th	0,008	0,031	0,006	0,026	N/A	N/A
34th	0,002	0,006	0,002	0,007	N/A	N/A
35th	0,008	0,031	0,007	0,027	N/A	N/A
36th	0,001	0,006	0,002	0,007	N/A	N/A
37th	0,007	0,030	0,006	0,026	N/A	N/A
38th	0,001	0,006	0,002	0,007	N/A	N/A
39th	0,006	0,026	0,006	0,024	N/A	N/A
40th	0,001	0,005	0,002	0,006	N/A	N/A
THD <sub>40</sub>	0,59%		0,32%		23%	13%
PWHD	0,001%		0,001%		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0086

Power Quality. Harmonics.						
867R017 Phase 2						
SSEG rating per phase (rpp)						
	At 45-55% of rated output 8,5kW		100% of rated output 17kW			
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	0,014	0,056	0,020	0,080	8%	8%
3rd	0,047	0,190	0,073	0,297	21,6%	N/A
4th	0,006	0,026	0,004	0,015	4%	4%
5th	0,017	0,069	0,030	0,122	10,7%	10,7%
6th	0,005	0,020	0,004	0,018	2,67%	2,67%
7th	0,020	0,080	0,005	0,022	7,2%	7,2%
8th	0,006	0,024	0,002	0,008	2%	2%
9th	0,020	0,082	0,005	0,020	3,8%	N/A
10th	0,005	0,022	0,002	0,009	1,6%	1,6%
11th	0,018	0,074	0,004	0,016	3,1%	3,1%
12th	0,005	0,021	0,002	0,009	1,33%	1,33%
13th	0,019	0,075	0,003	0,012	2%	2%
14th	0,005	0,021	0,002	0,009	N/A	N/A
15th	0,016	0,065	0,003	0,013	N/A	N/A
16th	0,005	0,019	0,002	0,009	N/A	N/A
17th	0,016	0,065	0,003	0,011	N/A	N/A
18th	0,004	0,017	0,002	0,009	N/A	N/A
19th	0,015	0,062	0,004	0,016	N/A	N/A
20th	0,004	0,016	0,002	0,009	N/A	N/A
21th	0,012	0,049	0,003	0,014	N/A	N/A
22th	0,004	0,015	0,002	0,009	N/A	N/A
23th	0,012	0,050	0,005	0,020	N/A	N/A
24th	0,003	0,013	0,002	0,009	N/A	N/A
25th	0,011	0,047	0,006	0,026	N/A	N/A
26th	0,003	0,013	0,002	0,008	N/A	N/A
27th	0,009	0,039	0,005	0,021	N/A	N/A
28th	0,003	0,011	0,002	0,008	N/A	N/A
29th	0,009	0,038	0,007	0,026	N/A	N/A
30th	0,002	0,010	0,002	0,008	N/A	N/A
31th	0,009	0,037	0,007	0,029	N/A	N/A
32th	0,002	0,009	0,002	0,007	N/A	N/A
33th	0,008	0,031	0,006	0,026	N/A	N/A
34th	0,002	0,009	0,002	0,007	N/A	N/A
35th	0,008	0,032	0,007	0,027	N/A	N/A
36th	0,002	0,008	0,002	0,007	N/A	N/A
37th	0,007	0,030	0,007	0,028	N/A	N/A
38th	0,002	0,007	0,002	0,006	N/A	N/A
39th	0,007	0,027	0,006	0,023	N/A	N/A
40th	0,002	0,007	0,002	0,006	N/A	N/A
THD <sub>40</sub>	0,64%	0,35%	0,64%	0,35%	23%	13%
PWHD	0,001%	0,002%	0,001%	0,002%	23%	22%



**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0086

Power Quality. Harmonics.						
867R017 Phase 3						
SSEG rating per phase (rpp)						
	At 45-55% of rated output 8,5kW		100% of rated output 17kW			
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	0,011	0,046	0,013	0,053	8%	8%
3rd	0,120	0,482	0,114	0,459	21,6%	N/A
4th	0,009	0,035	0,005	0,018	4%	4%
5th	0,029	0,118	0,052	0,210	10,7%	10,7%
6th	0,007	0,028	0,008	0,033	2,67%	2,67%
7th	0,016	0,064	0,018	0,071	7,2%	7,2%
8th	0,007	0,028	0,004	0,016	2%	2%
9th	0,017	0,070	0,024	0,098	3,8%	N/A
10th	0,007	0,028	0,006	0,026	1,6%	1,6%
11th	0,016	0,066	0,012	0,047	3,1%	3,1%
12th	0,006	0,024	0,005	0,020	1,33%	1,33%
13th	0,016	0,065	0,010	0,039	2%	2%
14th	0,005	0,022	0,004	0,016	N/A	N/A
15th	0,013	0,053	0,011	0,044	N/A	N/A
16th	0,005	0,021	0,004	0,014	N/A	N/A
17th	0,015	0,059	0,010	0,041	N/A	N/A
18th	0,005	0,019	0,004	0,017	N/A	N/A
19th	0,013	0,053	0,010	0,039	N/A	N/A
20th	0,005	0,018	0,003	0,013	N/A	N/A
21th	0,012	0,047	0,010	0,041	N/A	N/A
22th	0,004	0,017	0,004	0,014	N/A	N/A
23th	0,012	0,048	0,009	0,038	N/A	N/A
24th	0,004	0,016	0,003	0,014	N/A	N/A
25th	0,011	0,044	0,010	0,041	N/A	N/A
26th	0,004	0,015	0,003	0,014	N/A	N/A
27th	0,010	0,039	0,011	0,046	N/A	N/A
28th	0,003	0,013	0,003	0,012	N/A	N/A
29th	0,010	0,039	0,009	0,038	N/A	N/A
30th	0,003	0,012	0,003	0,012	N/A	N/A
31th	0,009	0,038	0,010	0,038	N/A	N/A
32th	0,003	0,012	0,003	0,011	N/A	N/A
33th	0,008	0,032	0,011	0,045	N/A	N/A
34th	0,003	0,011	0,003	0,010	N/A	N/A
35th	0,009	0,034	0,009	0,037	N/A	N/A
36th	0,002	0,010	0,003	0,010	N/A	N/A
37th	0,008	0,032	0,008	0,033	N/A	N/A
38th	0,003	0,010	0,002	0,010	N/A	N/A
39th	0,007	0,028	0,009	0,035	N/A	N/A
40th	0,002	0,009	0,002	0,009	N/A	N/A
THD <sub>40</sub>	1,11%		0,55%		23%	13%
PWHD	0,001%		0,001%		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0086

Power Quality. Harmonics.						
867R020 Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 10kW		100% of rated output 20kW			
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	0,019	0,066	0,042	0,145	8%	8%
3rd	0,059	0,205	0,121	0,420	21,6%	N/A
4th	0,005	0,018	0,008	0,027	4%	4%
5th	0,034	0,118	0,060	0,209	10,7%	10,7%
6th	0,001	0,004	0,003	0,010	2,67%	2,67%
7th	0,029	0,102	0,052	0,179	7,2%	7,2%
8th	0,002	0,006	0,003	0,010	2%	2%
9th	0,028	0,096	0,045	0,156	3,8%	N/A
10th	0,001	0,004	0,003	0,010	1,6%	1,6%
11th	0,027	0,094	0,046	0,158	3,1%	3,1%
12th	0,001	0,004	0,003	0,009	1,33%	1,33%
13th	0,029	0,099	0,048	0,166	2%	2%
14th	0,001	0,004	0,003	0,009	N/A	N/A
15th	0,027	0,094	0,047	0,163	N/A	N/A
16th	0,001	0,005	0,002	0,009	N/A	N/A
17th	0,028	0,097	0,048	0,167	N/A	N/A
18th	0,001	0,004	0,002	0,008	N/A	N/A
19th	0,028	0,098	0,050	0,172	N/A	N/A
20th	0,002	0,005	0,002	0,008	N/A	N/A
21th	0,026	0,092	0,048	0,169	N/A	N/A
22th	0,002	0,006	0,002	0,008	N/A	N/A
23th	0,029	0,101	0,052	0,180	N/A	N/A
24th	0,002	0,006	0,002	0,008	N/A	N/A
25th	0,028	0,097	0,053	0,185	N/A	N/A
26th	0,002	0,005	0,002	0,007	N/A	N/A
27th	0,025	0,087	0,048	0,167	N/A	N/A
28th	0,001	0,004	0,002	0,007	N/A	N/A
29th	0,027	0,093	0,051	0,178	N/A	N/A
30th	0,002	0,006	0,002	0,008	N/A	N/A
31th	0,024	0,083	0,048	0,168	N/A	N/A
32th	0,001	0,004	0,002	0,006	N/A	N/A
33th	0,021	0,073	0,040	0,141	N/A	N/A
34th	0,001	0,004	0,002	0,007	N/A	N/A
35th	0,019	0,066	0,039	0,137	N/A	N/A
36th	0,001	0,004	0,002	0,006	N/A	N/A
37th	0,017	0,059	0,035	0,121	N/A	N/A
38th	0,001	0,004	0,002	0,006	N/A	N/A
39th	0,014	0,050	0,028	0,098	N/A	N/A
40th	0,001	0,004	0,002	0,006	N/A	N/A
THD <sub>40</sub>	0,87%		0,83%		23%	13%
PWHD	0,005%		0,005%		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**  
 Extract from test report according the Engineering Recommendation G59/3 Nr. 14TH0086

Power Quality. Harmonics.						
867R020 Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated ouput 10kW		100% of rated output 20kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit inBS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,008	0,029	0,017	0,058	8%	8%
3rd	0,063	0,219	0,109	0,378	21,6%	N/A
4th	0,002	0,006	0,004	0,014	4%	4%
5th	0,032	0,112	0,057	0,199	10,7%	10,7%
6th	0,004	0,012	0,004	0,013	2,67%	2,67%
7th	0,029	0,102	0,051	0,178	7,2%	7,2%
8th	0,001	0,003	0,003	0,009	2%	2%
9th	0,027	0,093	0,044	0,153	3,8%	N/A
10th	0,003	0,010	0,003	0,011	1,6%	1,6%
11th	0,030	0,104	0,047	0,164	3,1%	3,1%
12th	0,002	0,006	0,003	0,010	1,33%	1,33%
13th	0,028	0,097	0,046	0,161	2%	2%
14th	0,001	0,005	0,003	0,009	N/A	N/A
15th	0,027	0,092	0,046	0,160	N/A	N/A
16th	0,001	0,005	0,002	0,008	N/A	N/A
17th	0,029	0,102	0,048	0,168	N/A	N/A
18th	0,002	0,007	0,003	0,009	N/A	N/A
19th	0,028	0,098	0,048	0,167	N/A	N/A
20th	0,002	0,007	0,002	0,008	N/A	N/A
21th	0,026	0,092	0,048	0,166	N/A	N/A
22th	0,002	0,006	0,003	0,009	N/A	N/A
23th	0,028	0,096	0,050	0,174	N/A	N/A
24th	0,002	0,008	0,003	0,011	N/A	N/A
25th	0,028	0,097	0,051	0,177	N/A	N/A
26th	0,002	0,006	0,002	0,008	N/A	N/A
27th	0,025	0,088	0,048	0,167	N/A	N/A
28th	0,001	0,005	0,002	0,008	N/A	N/A
29th	0,026	0,090	0,049	0,172	N/A	N/A
30th	0,002	0,005	0,002	0,007	N/A	N/A
31th	0,024	0,082	0,047	0,162	N/A	N/A
32th	0,001	0,004	0,002	0,008	N/A	N/A
33th	0,021	0,074	0,041	0,141	N/A	N/A
34th	0,001	0,004	0,002	0,007	N/A	N/A
35th	0,020	0,069	0,040	0,138	N/A	N/A
36th	0,002	0,005	0,002	0,007	N/A	N/A
37th	0,017	0,059	0,035	0,120	N/A	N/A
38th	0,001	0,004	0,002	0,007	N/A	N/A
39th	0,015	0,052	0,029	0,100	N/A	N/A
40th	0,001	0,003	0,002	0,005	N/A	N/A
THD <sub>40</sub>	0,88%		0,78%		23%	13%
PWHD	0,005%		0,005%		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0086

Power Quality. Harmonics.						
867R020 Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated ouput 10kW		100% of rated output 20kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit inBS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,007	0,023	0,009	0,032	8%	8%
3rd	0,074	0,257	0,115	0,397	21,6%	N/A
4th	0,003	0,010	0,005	0,017	4%	4%
5th	0,044	0,153	0,068	0,236	10,7%	10,7%
6th	0,004	0,013	0,004	0,014	2,67%	2,67%
7th	0,034	0,116	0,054	0,186	7,2%	7,2%
8th	0,002	0,006	0,009	0,033	2%	2%
9th	0,038	0,132	0,062	0,213	3,8%	N/A
10th	0,004	0,013	0,003	0,012	1,6%	1,6%
11th	0,037	0,127	0,055	0,190	3,1%	3,1%
12th	0,003	0,010	0,003	0,011	1,33%	1,33%
13th	0,037	0,129	0,056	0,194	2%	2%
14th	0,003	0,010	0,003	0,010	N/A	N/A
15th	0,036	0,123	0,057	0,196	N/A	N/A
16th	0,003	0,011	0,003	0,010	N/A	N/A
17th	0,037	0,128	0,057	0,198	N/A	N/A
18th	0,002	0,007	0,003	0,009	N/A	N/A
19th	0,036	0,125	0,057	0,199	N/A	N/A
20th	0,003	0,011	0,003	0,010	N/A	N/A
21th	0,035	0,120	0,057	0,195	N/A	N/A
22th	0,003	0,009	0,003	0,010	N/A	N/A
23th	0,035	0,120	0,058	0,202	N/A	N/A
24th	0,003	0,010	0,003	0,011	N/A	N/A
25th	0,034	0,118	0,060	0,207	N/A	N/A
26th	0,004	0,013	0,003	0,012	N/A	N/A
27th	0,030	0,104	0,056	0,195	N/A	N/A
28th	0,002	0,007	0,003	0,009	N/A	N/A
29th	0,030	0,103	0,056	0,192	N/A	N/A
30th	0,003	0,009	0,002	0,008	N/A	N/A
31th	0,028	0,095	0,056	0,192	N/A	N/A
32th	0,001	0,004	0,002	0,008	N/A	N/A
33th	0,022	0,076	0,046	0,159	N/A	N/A
34th	0,001	0,004	0,002	0,007	N/A	N/A
35th	0,021	0,071	0,044	0,154	N/A	N/A
36th	0,001	0,005	0,002	0,007	N/A	N/A
37th	0,019	0,065	0,041	0,141	N/A	N/A
38th	0,001	0,005	0,002	0,008	N/A	N/A
39th	0,014	0,047	0,033	0,113	N/A	N/A
40th	0,001	0,003	0,001	0,005	N/A	N/A
THD <sub>40</sub>	1,07%		0,90%		23%	13%
PWHD	0,008%		0,006%		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0086

Power Quality. Harmonics.						
867R023 Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 11,5kW		100% of rated output 23kW			
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	0,009	0,031	0,012	0,043	8%	8%
3rd	0,032	0,111	0,094	0,329	21,6%	N/A
4th	0,003	0,010	0,006	0,022	4%	4%
5th	0,020	0,069	0,035	0,122	10,7%	10,7%
6th	0,003	0,011	0,004	0,013	2,67%	2,67%
7th	0,019	0,067	0,005	0,018	7,2%	7,2%
8th	0,003	0,011	0,004	0,015	2%	2%
9th	0,021	0,075	0,012	0,041	3,8%	N/A
10th	0,003	0,010	0,004	0,014	1,6%	1,6%
11th	0,021	0,072	0,005	0,017	3,1%	3,1%
12th	0,003	0,010	0,004	0,012	1,33%	1,33%
13th	0,020	0,070	0,006	0,021	2%	2%
14th	0,003	0,010	0,004	0,013	N/A	N/A
15th	0,018	0,062	0,003	0,011	N/A	N/A
16th	0,003	0,010	0,003	0,012	N/A	N/A
17th	0,018	0,065	0,004	0,014	N/A	N/A
18th	0,003	0,009	0,003	0,012	N/A	N/A
19th	0,016	0,057	0,005	0,017	N/A	N/A
20th	0,003	0,009	0,003	0,011	N/A	N/A
21th	0,014	0,050	0,004	0,015	N/A	N/A
22th	0,002	0,008	0,003	0,011	N/A	N/A
23th	0,014	0,050	0,005	0,017	N/A	N/A
24th	0,002	0,008	0,003	0,011	N/A	N/A
25th	0,013	0,046	0,005	0,017	N/A	N/A
26th	0,002	0,008	0,003	0,010	N/A	N/A
27th	0,011	0,039	0,005	0,018	N/A	N/A
28th	0,002	0,007	0,003	0,010	N/A	N/A
29th	0,011	0,038	0,005	0,019	N/A	N/A
30th	0,002	0,007	0,003	0,009	N/A	N/A
31th	0,010	0,035	0,006	0,022	N/A	N/A
32th	0,002	0,007	0,002	0,008	N/A	N/A
33th	0,009	0,032	0,005	0,018	N/A	N/A
34th	0,002	0,006	0,002	0,008	N/A	N/A
35th	0,009	0,031	0,006	0,023	N/A	N/A
36th	0,002	0,006	0,002	0,008	N/A	N/A
37th	0,008	0,028	0,006	0,020	N/A	N/A
38th	0,002	0,006	0,002	0,007	N/A	N/A
39th	0,007	0,025	0,005	0,018	N/A	N/A
40th	0,001	0,005	0,002	0,007	N/A	N/A
THD <sub>40</sub>	0,51%		0,37%		23%	13%
PWHD	0,001%		0,001%		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0086

Power Quality. Harmonics.						
867R023 Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 11,5kW		100% of rated output 23kW			
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	0,014	0,050	0,022	0,076	8%	8%
3rd	0,049	0,173	0,092	0,322	21,6%	N/A
4th	0,004	0,015	0,006	0,021	4%	4%
5th	0,017	0,059	0,036	0,127	10,7%	10,7%
6th	0,005	0,017	0,005	0,018	2,67%	2,67%
7th	0,020	0,069	0,003	0,012	7,2%	7,2%
8th	0,004	0,014	0,003	0,012	2%	2%
9th	0,023	0,079	0,012	0,043	3,8%	N/A
10th	0,004	0,014	0,004	0,014	1,6%	1,6%
11th	0,020	0,068	0,005	0,019	3,1%	3,1%
12th	0,004	0,014	0,003	0,011	1,33%	1,33%
13th	0,018	0,065	0,005	0,018	2%	2%
14th	0,004	0,013	0,003	0,012	N/A	N/A
15th	0,017	0,060	0,005	0,017	N/A	N/A
16th	0,004	0,013	0,003	0,010	N/A	N/A
17th	0,017	0,061	0,004	0,013	N/A	N/A
18th	0,003	0,012	0,003	0,012	N/A	N/A
19th	0,016	0,056	0,004	0,013	N/A	N/A
20th	0,003	0,010	0,003	0,010	N/A	N/A
21th	0,013	0,047	0,003	0,011	N/A	N/A
22th	0,003	0,010	0,003	0,010	N/A	N/A
23th	0,013	0,047	0,004	0,014	N/A	N/A
24th	0,002	0,008	0,003	0,009	N/A	N/A
25th	0,012	0,043	0,004	0,016	N/A	N/A
26th	0,002	0,008	0,003	0,009	N/A	N/A
27th	0,010	0,037	0,004	0,015	N/A	N/A
28th	0,002	0,007	0,002	0,008	N/A	N/A
29th	0,011	0,037	0,005	0,017	N/A	N/A
30th	0,002	0,006	0,002	0,008	N/A	N/A
31th	0,010	0,034	0,006	0,022	N/A	N/A
32th	0,002	0,006	0,002	0,007	N/A	N/A
33th	0,009	0,031	0,005	0,017	N/A	N/A
34th	0,001	0,005	0,002	0,006	N/A	N/A
35th	0,008	0,028	0,006	0,019	N/A	N/A
36th	0,001	0,004	0,002	0,006	N/A	N/A
37th	0,008	0,027	0,006	0,020	N/A	N/A
38th	0,001	0,004	0,002	0,005	N/A	N/A
39th	0,008	0,026	0,005	0,019	N/A	N/A
40th	0,001	0,004	0,001	0,005	N/A	N/A
THD <sub>40</sub>	0,57%		0,37%		23%	13%
PWHD	0,001%		0,001%		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0086

Power Quality. Harmonics.						
867R023 Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 11,5kW		100% of rated output 23kW			
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	0,009	0,033	0,022	0,077	8%	8%
3rd	0,125	0,436	0,129	0,448	21,6%	N/A
4th	0,005	0,016	0,006	0,019	4%	4%
5th	0,040	0,140	0,071	0,248	10,7%	10,7%
6th	0,005	0,018	0,005	0,016	2,67%	2,67%
7th	0,014	0,049	0,024	0,082	7,2%	7,2%
8th	0,004	0,015	0,005	0,017	2%	2%
9th	0,017	0,060	0,033	0,114	3,8%	N/A
10th	0,004	0,014	0,005	0,017	1,6%	1,6%
11th	0,017	0,059	0,020	0,069	3,1%	3,1%
12th	0,004	0,014	0,004	0,016	1,33%	1,33%
13th	0,016	0,055	0,018	0,062	2%	2%
14th	0,004	0,013	0,005	0,018	N/A	N/A
15th	0,013	0,046	0,015	0,053	N/A	N/A
16th	0,003	0,012	0,004	0,013	N/A	N/A
17th	0,014	0,050	0,016	0,054	N/A	N/A
18th	0,003	0,012	0,004	0,013	N/A	N/A
19th	0,014	0,047	0,015	0,051	N/A	N/A
20th	0,003	0,011	0,003	0,011	N/A	N/A
21th	0,012	0,042	0,014	0,049	N/A	N/A
22th	0,003	0,009	0,004	0,012	N/A	N/A
23th	0,012	0,043	0,014	0,050	N/A	N/A
24th	0,003	0,009	0,003	0,011	N/A	N/A
25th	0,012	0,040	0,012	0,042	N/A	N/A
26th	0,002	0,008	0,003	0,011	N/A	N/A
27th	0,009	0,033	0,013	0,046	N/A	N/A
28th	0,002	0,007	0,003	0,010	N/A	N/A
29th	0,011	0,037	0,012	0,041	N/A	N/A
30th	0,002	0,007	0,003	0,010	N/A	N/A
31th	0,010	0,033	0,011	0,038	N/A	N/A
32th	0,002	0,006	0,003	0,009	N/A	N/A
33th	0,008	0,029	0,012	0,043	N/A	N/A
34th	0,002	0,005	0,003	0,009	N/A	N/A
35th	0,009	0,030	0,010	0,036	N/A	N/A
36th	0,001	0,005	0,002	0,008	N/A	N/A
37th	0,008	0,029	0,009	0,032	N/A	N/A
38th	0,001	0,005	0,002	0,008	N/A	N/A
39th	0,007	0,024	0,011	0,037	N/A	N/A
40th	0,001	0,004	0,002	0,008	N/A	N/A
THD <sub>40</sub>	0,98%		0,57%		23%	13%
PWHD	0,001%		0,001%		23%	22%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 14TH0086

Power Quality. Power factor. 867R020				
	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	3,3%	3,3%	0,0%	3,3%	3,3%	0,0%	0,27	0,27
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Note. Method of evaluation: Current fluctuations due to power changes at the DC input where measured. It is assumed that the available DC input power changes by 10% of the maximum rated power every second (upwards or downwards). The solar inverter reacts with a current slope of 0,15 A/sec upwards and 136 A/sec downwards. Taking into account the form factors given in figure 5 of EN 61000-3-11 the resulting values are as given above.								

Power Quality. DC injection.			
Test level power	10%	55%	100%
Recorded value	17,44mA	31,12mA	44,23mA
As % of rated AC current	0,06%	0,11%	0,16%
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. 14TH0086

<b>Fault level Contribution.</b>					
<b>For a directly coupled SSEG</b>			<b>For a Inverter SSEG</b>		
<b>Parameter</b>	<b>Symbol</b>	<b>Value</b>	<b>Time after fault</b>	<b>Volts</b>	<b>Amps</b>
<b>Peak Short Circuit current</b>	$I_p$	N/A	20ms	55,0	0,81
<b>Initial Value of aperiodic current</b>	A	N/A	100ms	50,0	0,36
<b>Initial symmetrical short-circuit current*</b>	$I_k$	N/A	250ms	48,9	0,23
<b>Decaying (aperiodic) component of short circuit current*</b>	$i_{DC}$	N/A	500ms	48,4	0,17
<b>Reactance/Resistance Ratio of source*</b>	X/R	N/A	<b>Time to trip</b>	0,006	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.

<b>Self Monitoring – Solid state switching.</b>	<b>N/A</b>
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.	