

## Auszug aus dem Prüfbericht / Extract from the test report

Teil 1: Netzverträglichkeit / Part 1: Power Quality

### Bestimmung der Elektrischen Eigenschaften des BHKW

HBG70

Determination of the electrical properties – power quality (EMC) of the CHP

Auszug Nr. / Extract No : DEWI-UL-NR18-12447812.A45.01

Seite/Page 1/5

„Technische Richtlinie Teil 3“ Revision 25. FGW

Anlagentyp / Installation type :	HBG70	Herstellerangaben / Manufacturer's specifications :	
Anlagenhersteller Manufacturer :	Sommer energy Unterer Koppenhagen 52 37355 Niederorschel OT Deuna Deutschland	Anlagenart Generic type of installation:	Blockheizkraftwerk combined heat and power
Prüfbericht Test report:	UL-GER-NR18-12447812.03.02	Nennleistung Rated power :	$P_n$ 70 kW
		Messzeitraum Period of measurement :	02.03.2019 - 29.03.2019

### Nennndaten / Rated data :

Nennscheinleistung Rated apparent power	$S_n$	70 kVA	Nennstrom Rated current	$I_n$	101 A
Nennfrequenz Rated frequency	$f_n$	50 Hz	Nennspannung Nominal Voltage	$U_n$	400 V

### Wirkleistungsspitzen / Power peaks

Wirkleistungsspitzen [kW] Power peaks [kW]		Wirkleistungsspitzen in p.u. Power peaks in p.u.		Anzahl 10-Minuten Datensätze Number of 10-minute data set	
$P_{0.2} = P_{\text{momentan}}$	70.6	$P_{0.2} = P_{0.2}/P_n$	1.01	$P_{0.2} / P_{0.2}$	3
$P_{60} = P_{1 \text{ min}}$	70.1	$p_{60} = P_{60}/P_n$	1.00	$P_{60} / P_{60}$	
$P_{600} = P_{10 \text{ min}}$	70.0	$P_{600} = P_{600}/P_n$	1.00	$P_{600} / P_{600}$	

### Schalthandlungen / Switching operations :

	Einschalten bei $P_{\text{verfügbar}} < 10\% P_n$ / Start-up at $P_{\text{available}} < 10\% P_n$			
Max Anz. Schalthandlungen / Max. no. of switching operations $N_{10}$	-			
Max Anz. Schalthandlungen / Max. no. of switching operations $N_{120}$	-			
Netzimpedanzwinkel / Grid impedance angle	30°	50°	70°	85°
Flickerformfaktor / Flicker step factor $k_f(\psi_k)$	-	-	-	-
Spannungsänderungsfaktor / Voltage change factor $k_U(\psi_k)$	-	-	-	-

Schaltvorgang / Case of switching operation	Ungünstigster Fall beim Umschalten der Generatorstufen / Worst case of switching between generators			
Max Anz. Schalthandlungen / Max. no. of switching operations $N_{10}$	-			
Max Anz. Schalthandlungen / Max. no. of switching operations $N_{120}$	-			
Netzimpedanzwinkel / Grid impedance angle	30°	50°	70°	85°
Flickerformfaktor / Flicker step factor $k_f(\psi_k)$	-	-	-	-
Spannungsänderungsfaktor / Voltage change factor $k_U(\psi_k)$	-	-	-	-

Schaltvorgang / Case of switching operation	Einschalten bei $P_{\text{verfügbar}} = P_n$ / Start-up at $P_{\text{available}} = P_n$			
Max Anz. Schalthandlungen / Max. no. of switching operations $N_{10}$	2			
Max Anz. Schalthandlungen / Max. no. of switching operations $N_{120}$	5			
Netzimpedanzwinkel / Grid impedance angle	30°	50°	70°	85°
Flickerformfaktor / Flicker step factor $k_f(\psi_k)$	0.49	0.36	0.22	0.14
Spannungsänderungsfaktor / Voltage change factor $k_U(\psi_k)$	1.02	0.77	0.45	0.21

Schaltvorgang / Case of switching operation	Serviceabschaltung bei Nennleistung / Service shutdown at rated active power			
Max Anz. Schalthandlungen / Max. no. of switching operations $N_{10}$	2			
Max Anz. Schalthandlungen / Max. no. of switching operations $N_{120}$	5			
Netzimpedanzwinkel / Grid impedance angle	30°	50°	70°	85°
Flickerformfaktor / Flicker step factor $k_f(\psi_k)$	0.27	0.22	0.15	0.09
Spannungsänderungsfaktor / Voltage change factor $k_U(\psi_k)$	0.92	0.71	0.42	0.17

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Seite/Page 2/5

„Technische Richtlinie Teil 3“ Revision 25. FGW

### Unsymmetrie / Unbalance

$P_{bin}$ [%]	0	10	20	30	40	50	60	70	80	90	100	Max
$u_i$ [%]	-	-	-	-	-	0.88	0.58	0.71	0.55	0.57	0.51	1.24

### Flicker:

$P_{bin}$ [%]	0	10	20	30	40	50	60	70	80	90	100	Max
Netzimpedanzwinkel / Network impedance phase angle, $\psi_k$	Flickerkoeffizient / Flicker coefficient, $c(\psi_k, P_{bin})$											
30°	-	-	-	-	-	5.68	6.80	7.54	8.60	9.49	11.00	11.00
50°	-	-	-	-	-	4.60	5.54	6.29	7.20	7.83	9.28	9.28
70°	-	-	-	-	-	3.23	3.88	4.65	5.28	5.48	6.56	6.56
85°	-	-	-	-	-	2.41	2.78	3.58	3.94	3.70	4.52	4.52

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Seite/Page 3/5

„Technische Richtlinie Teil 3“ Revision 25. FGW

### Ganzzahlige Oberschwingungsströme / Integer harmonic current components

P <sub>bin</sub> (%)	0	10	20	30	40	50	60	70	80	90	100	Max.
Ordnung / Order	I <sub>n</sub> /I <sub>n</sub> (%)											
2	-	-	-	-	-	0.10	0.08	0.15	0.14	0.13	0.11	0.15
3	-	-	-	-	-	0.93	0.83	0.86	0.78	0.79	0.81	0.93
4	-	-	-	-	-	0.06	0.06	0.07	0.07	0.08	0.08	0.08
5	-	-	-	-	-	4.11	3.66	3.65	3.49	3.86	3.96	4.11
6	-	-	-	-	-	0.05	0.05	0.06	0.05	0.05	0.04	0.06
7	-	-	-	-	-	0.48	0.23	0.54	1.08	1.40	1.76	1.76
8	-	-	-	-	-	0.02	0.03	0.04	0.04	0.03	0.03	0.04
9	-	-	-	-	-	0.18	0.16	0.15	0.14	0.15	0.15	0.18
10	-	-	-	-	-	0.02	0.01	0.02	0.02	0.02	0.02	0.02
11	-	-	-	-	-	0.55	0.63	0.76	0.83	0.89	0.98	0.98
12	-	-	-	-	-	0.01	0.01	0.02	0.02	0.01	0.01	0.02
13	-	-	-	-	-	0.18	0.17	0.19	0.18	0.17	0.19	0.19
14	-	-	-	-	-	0.04	0.04	0.05	0.05	0.05	0.05	0.05
15	-	-	-	-	-	0.05	0.05	0.06	0.06	0.06	0.06	0.06
16	-	-	-	-	-	0.04	0.05	0.05	0.05	0.06	0.06	0.06
17	-	-	-	-	-	0.20	0.24	0.28	0.32	0.37	0.39	0.39
18	-	-	-	-	-	0.00	0.01	0.01	0.01	0.01	0.01	0.01
19	-	-	-	-	-	0.12	0.11	0.12	0.13	0.14	0.16	0.16
20	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
21	-	-	-	-	-	0.02	0.03	0.03	0.03	0.03	0.03	0.03
22	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
23	-	-	-	-	-	0.11	0.15	0.19	0.21	0.24	0.26	0.26
24	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
25	-	-	-	-	-	0.14	0.16	0.17	0.18	0.19	0.20	0.20
26	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.01	0.01
27	-	-	-	-	-	0.01	0.01	0.01	0.02	0.02	0.02	0.02
28	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
29	-	-	-	-	-	0.03	0.03	0.03	0.04	0.04	0.03	0.04
30	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
31	-	-	-	-	-	0.02	0.02	0.03	0.03	0.03	0.04	0.04
32	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
33	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
34	-	-	-	-	-	0.00	0.00	0.01	0.01	0.00	0.00	0.01
35	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
36	-	-	-	-	-	0.00	0.00	0.01	0.01	0.00	0.00	0.01
37	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.01	0.01
38	-	-	-	-	-	0.00	0.00	0.01	0.00	0.00	0.00	0.01
39	-	-	-	-	-	0.00	0.00	0.01	0.01	0.00	0.00	0.01
40	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
41	-	-	-	-	-	0.02	0.01	0.01	0.01	0.01	0.01	0.02
42	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	-	-	-	-	-	0.02	0.02	0.02	0.01	0.01	0.01	0.02
44	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
45	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.01	0.01
46	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
47	-	-	-	-	-	0.07	0.07	0.07	0.07	0.07	0.08	0.08
48	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	-	-	-	-	-	0.05	0.06	0.06	0.06	0.06	0.06	0.06
50	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
THC (%)	-	-	-	-	-	4.27	3.82	3.87	3.81	4.24	4.44	4.44

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Seite/Page 4/5

„Technische Richtlinie Teil 3“ Revision 25. FGW

### Zwischenharmonische Oberschwingungsströme / Interharmonic current components

$P_{bin}$ (%)	0	10	20	30	40	50	60	70	80	90	100	Max.
f (Hz)	$I_h/I_n$ (%)											
75	-	-	-	-	-	0.97	1.15	1.30	1.45	1.63	1.83	<b>1.83</b>
125	-	-	-	-	-	0.13	0.12	0.18	0.17	0.15	0.14	0.18
175	-	-	-	-	-	0.05	0.06	0.11	0.10	0.09	0.07	0.11
225	-	-	-	-	-	0.05	0.06	0.08	0.10	0.10	0.11	0.11
275	-	-	-	-	-	0.04	0.05	0.07	0.07	0.08	0.08	0.08
325	-	-	-	-	-	0.06	0.07	0.09	0.10	0.11	0.12	0.12
375	-	-	-	-	-	0.08	0.09	0.11	0.13	0.15	0.16	0.16
425	-	-	-	-	-	0.02	0.02	0.04	0.04	0.04	0.03	0.04
475	-	-	-	-	-	0.01	0.01	0.03	0.04	0.04	0.03	0.04
525	-	-	-	-	-	0.02	0.02	0.04	0.04	0.04	0.03	0.04
575	-	-	-	-	-	0.02	0.02	0.03	0.04	0.04	0.04	0.04
625	-	-	-	-	-	0.01	0.02	0.03	0.03	0.03	0.03	0.03
675	-	-	-	-	-	0.01	0.01	0.03	0.02	0.02	0.03	0.03
725	-	-	-	-	-	0.01	0.01	0.02	0.02	0.02	0.01	0.02
775	-	-	-	-	-	0.01	0.01	0.02	0.02	0.02	0.01	0.02
825	-	-	-	-	-	0.01	0.01	0.02	0.02	0.02	0.02	0.02
875	-	-	-	-	-	0.01	0.02	0.02	0.03	0.03	0.03	0.03
925	-	-	-	-	-	0.01	0.01	0.02	0.02	0.02	0.01	0.02
975	-	-	-	-	-	0.01	0.01	0.02	0.02	0.02	0.02	0.02
1025	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.01	0.01
1075	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.01	0.01
1125	-	-	-	-	-	0.01	0.01	0.02	0.02	0.02	0.02	0.02
1175	-	-	-	-	-	0.01	0.01	0.02	0.02	0.02	0.02	0.02
1225	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1275	-	-	-	-	-	0.01	0.01	0.02	0.02	0.02	0.02	0.02
1325	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1375	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1425	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.01	0.01
1475	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1525	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1575	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1625	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1675	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1725	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1775	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1825	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1875	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1925	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01
1975	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.00	0.01

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Seite/Page 5/5

„Technische Richtlinie Teil 3“ Revision 25. FGW

### Höherfrequente Oberschwingungsströme / Higher frequency current components

P <sub>bin</sub> (%)	0	10	20	30	40	50	60	70	80	90	100	Max.
f (kHz)	I <sub>n</sub> /I <sub>n</sub> (%)											
2.1	-	-	-	-	-	0.02	0.02	0.02	0.02	0.02	0.02	0.02
2.3	-	-	-	-	-	0.07	0.07	0.08	0.07	0.08	0.08	0.08
2.5	-	-	-	-	-	0.06	0.06	0.06	0.06	0.06	0.06	0.06
2.7	-	-	-	-	-	0.01	0.01	0.01	0.02	0.01	0.02	0.02
2.9	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
3.1	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
3.3	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
3.5	-	-	-	-	-	0.02	0.02	0.02	0.02	0.02	0.02	0.02
3.7	-	-	-	-	-	0.02	0.02	0.02	0.02	0.02	0.02	0.02
3.9	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4.1	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.01	0.01
4.3	-	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.01	0.01
4.5	-	-	-	-	-	0.00	0.01	0.01	0.01	0.01	0.01	0.01
4.7	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4.9	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
5.1	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.01	0.01
5.3	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.01	0.01
5.5	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
5.7	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.01	0.01
5.9	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
6.1	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.01	0.01
6.3	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.01	0.01
6.5	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
6.7	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.01	0.01
6.9	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01
7.1	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.01	0.01
7.3	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.5	-	-	-	-	-	0.01	0.01	0.01	0.01	0.01	0.00	0.01
7.7	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.9	-	-	-	-	-	0.01	0.01	0.01	0.01	0.00	0.01	0.01
8.1	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.01	0.01
8.3	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.5	-	-	-	-	-	0.01	0.01	0.00	0.00	0.00	0.01	0.01
8.7	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.9	-	-	-	-	-	0.00	0.00	0.00	0.01	0.01	0.01	0.01

Dieser Auszug aus dem Prüfbericht fasst die Ergebnisse des Prüfberichtes Nr. UL-GER-NR18-12447812.03.02 zusammen.

This extract from the test report summarizes the results of the test report No. UL-GER-NR18-12447812.03.02.

Gemessen durch: **UL International GmbH, DEWI**  
 measured by: Ebertstraße 96  
 26382 Wilhelmshaven, Germany  
 Datum / Date : 16.12.2020

  
 Dipl. Ing. J. Herbrandt  
 Expert in Charge

  
 Dipl. Ing. F. Santjer  
 Head of Electrical Characteristics

