Certificate of compliance

Applicant:	**NingBo Deye Inverter Technology Co., Ltd.** No. 26 South YongJiang Road, Daqi, Beilun, NingBo **China**
Product:	**Photovoltaic inverter**
Model:	**SUN-18K-G04** **SUN-20K-G04** **SUN-25K-G04** **SUN-30K-G04** **SUN-33K-G04** **SUN-35K-G04** **SUN-36K-G04** **SUN-18K-G04P3-EU-CM2** **SUN-20K-G04P3-EU-CM2** **SUN-25K-G04P3-EU-CM2** **SUN-30K-G04P3-EU-CM2** **SUN-33K-G04P3-EU-CM2** **SUN-35K-G04P3-EU-CM2** **SUN-36K-G04P3-EU-CM2**

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with Engineering Recommendation G99/1 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, which can be accessed by the distribution network provider at any time.

Applied rules and standards:

Engineering Recommendation G99/1:2024
Requirements for the connection of generation equipment in parallel with public distribution networks

DIN V VDE V 0126-1-1:2006 (4.1 Functional safety)
Automatic disconnection device between a generator and the public low-voltage grid

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: **CWXK-ESH-P25080818**
Certification Program: **NSOP-0032-DEU-ZE-V10**
Certificate number: **U25-0795**
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Certification body

Georg LORITZ
Lab Supervisor Energy Systems

Accreditation

DAkkS Deutsche Akkreditierungsstelle D-ZE-12024-01-00

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules				
Extract from test report according to the Engineering Recommendation G99/1				
Type Approval and declaration of compliance with the requirements of Engineering Recommendation G99/1.				
PGM Technology	Photovoltaic inverter			
Manufacturer	NingBo Deye Inverter Technology Co., Ltd.			
Address	No. 26 South YongJiang Road, Daqi, Beilun, NingBo, China			
Tel	--	**Fax**	--	
Email	--	**Website**	--	
PGM Model	SUN-18K-G04	SUN-20K-G04	SUN-25K-G04	SUN-30K-G04
Input (DC photovoltaic)				
MPP voltage range [V]	200-1000	200-1000	200-1000	200-1000
Max. input voltage [V]	1100	1100	1100	1100
Max. input current per MPPT [A]	32+32	32+32	32+32	40+40
Output (AC)				
Rated AC voltage [V]	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz
Rated output current [A]	26,1	29,0	36,2	43,5
Max. output current [A]	28,7	31,9	39,9	47,8
Nom. converter output (P_{NINV}) [kW]	18,0	20,0	25,0	30,0
Max. apparent power [kVA]	19,8	22,0	27,5	33,0
PGM Model	SUN-33K-G04	SUN-35K-G04	SUN-36K-G04	--
Input (DC photovoltaic)				
MPP voltage range [V]	200-1000	200-1000	200-1000	--
Max. input voltage [V]	1100	1100	1100	--
Max. input current per MPPT [A]	40+40	40+40	40+40	--
Output (AC)				
Rated AC voltage [V]	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz	--
Rated output current [A]	47,8	50,7	52,2	--
Max. output current [A]	52,6	55,8	57,4	--
Nom. converter output (P_{NINV}) [kW]	33,0	35,0	36,0	--
Max. apparent power [kVA]	36,3	38,5	39,6	--

PGM Model	SUN-18K-G04P3-EU-CM2	SUN-20K-G04P3-EU-CM2	SUN-25K-G04P3-EU-CM2	SUN-30K-G04P3-EU-CM2
Input (DC photovoltaic)				
MPP voltage range [V]	200-1000	200-1000	200-1000	200-1000
Max. input voltage [V]	1100	1100	1100	1100
Max. input current per MPPT [A]	32+32	32+32	32+32	40+40
Output (AC)				
Rated AC voltage [V]	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz
Rated output current [A]	26,1	29,0	36,3	43,5
Max. output current [A]	28,7	31,9	39,9	47,9
Nom. converter output (P_{NINV}) [kW]	18,0	20,0	25,0	30,0
Max. apparent power [kVA]	19,8	22,0	27,5	33,0
PGM Model	SUN-33K-G04P3-EU-CM2	SUN-35K-G04P3-EU-CM2	SUN-36K-G04P3-EU-CM2	--
Input (DC photovoltaic)				
MPP voltage range [V]	200-1000	200-1000	200-1000	--
Max. input voltage [V]	1100	1100	1100	--
Max. input current per MPPT [A]	40+40	40+40	40+40	--
Output (AC)				
Rated AC voltage [V]	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz	3L/N/PE, 230/400, 50Hz	--
Rated output current [A]	47,9	50,8	52,2	--
Max. output current [A]	52,7	55,8	57,4	--
Nom. converter output (P_{NINV}) [kW]	33,0	35,0	36,0	--
Max. apparent power [kVA]	36,3	38,5	39,6	--

Interface protection system and interface switch (Network and system protection "NS-protection")	
Type of protection	integrated NS-protection
Assigned to generation unit type	SUN-18K-G04 SUN-20K-G04 SUN-25K-G04 SUN-30K-G04 SUN-33K-G04 SUN-35K-G04 SUN-36K-G04 SUN-18K-G04P3-EU-CM2 SUN-20K-G04P3-EU-CM2 SUN-25K-G04P3-EU-CM2 SUN-30K-G04P3-EU-CM2 SUN-33K-G04P3-EU-CM2 SUN-35K-G04P3-EU-CM2 SUN-36K-G04P3-EU-CM2
Integrated interface switch	Type of switching equipment 1: Relay (Model 117L_1AH1-F-C) Type of switching equipment 2: Relay (Model 117L_1AH1-F-C)
	Note: The output is switched off by the inverter bridge and two relay in series in each line and neutral.
Firmware version	5412-0324
The above stated Generating Units are tested according the requirements in the Engineering Recommendation G99/1. 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 G99/1.	

Operating Range.	
Test 1	Voltage = 85% of nominal (195,5V) Frequency = 47Hz Power Factor = 1 Period of test 20 s
Connection	Always connected
Limit	No disconnection allowed
Test 2	Voltage = 85% of nominal (195,5V) Frequency = 47,5Hz Power Factor = 1 Period of test 90 minutes
Connection	Always connected
Limit	No disconnection allowed
Test 3	Voltage = 110% of nominal (253V) Frequency = 51,5Hz Power Factor = 1 Period of test 90 minutes
Connection	Always connected
Limit	No disconnection allowed
Test 4	Voltage = 110% of nominal (253V) Frequency = 52,0Hz Power Factor = 1 Period of test 15 minutes
Connection	Always connected
Limit	No disconnection allowed
Test 5	Voltage = 100% of nominal (230 V) Frequency = 50,0 Hz Power Factor = 1 Period of test 90 minutes
Connection	Always connected
Limit	No disconnection allowed
Test 6	Confirm that the Power Generating Module is capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs-1 as measured over a period of 500ms. Note that this is not expected to be demonstrated on site.
Connection	Always connected
Limit	No disconnection allowed

Protection. Voltage tests.						
Phase 1						
Function	**Setting**		**Trip test**		**No trip test**	
	Voltage [V]	**Time delay [s]**	**Voltage [V]**	**Time delay [s]**	**Voltage / time**	**Confirm no trip**
U/V	184	2,5	182,86	2,583	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	262,11	1,018	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	275,00	0,572	269,7V 0,95s	No trip
					277,7V 0,45s	No trip

Protection. Voltage tests.						
Phase 2						
Function	**Setting**		**Trip test**		**No trip test**	
	Voltage [V]	**Time delay [s]**	**Voltage [V]**	**Time delay [s]**	**Voltage / time**	**Confirm no trip**
U/V	184	2,5	184,08	2,597	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	263,14	1,032	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	275,00	0,568	269,7V 0,95s	No trip
					277,7V 0,45s	No trip

Protection. Voltage tests.						
Phase 3						
Function	**Setting**		**Trip test**		**No trip test**	
	Voltage [V]	**Time delay [s]**	**Voltage [V]**	**Time delay [s]**	**Voltage / time**	**Confirm no trip**
U/V	184	2,5	184,24	2,599	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	263,28	1,038	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	275,30	0,576	269,7V 0,95s	No trip
					277,7V 0,45s	No trip
Note. For Voltage tests the Voltage required to trip is the setting ±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 ±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 [Hz]	**Time delay [s]**	**Frequency [Hz]**	**Time delay [s]**	**Frequency / time**	**Confirm no trip**
U/F stage 1	47,5	20	47,50	20,087	47,7Hz / 30s	No trip
U/F stage 2	47	0,5	47,00	0,529	47,2Hz / 19,5s	No trip
					46,8Hz / 0,45s	No trip
O/F stage 2	52	0,5	52,00	0,534	51,8Hz / 120s	No trip
					52,2Hz / 0,45s	No trip
Note. For Frequency Trip tests the Frequency required to trip is the setting ±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 ±0,2Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

Protection. Loss of Mains.						
Inverters tested according to BS EN 62116.						
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 [s]	0,154	0,286	0,484	0,163	0,273	0,334
Note. Trip time limit is 0,5s.						

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 10.1.				
Over Voltage (258,2 V)				
Time delay setting [s]	**Measured delay [s]**			
20	68,4			
Under Voltage (188,0V)				
Time delay setting [s]	**Measured delay [s]**			
20	69,2			
Over Frequency (51,9 Hz)				
Time delay setting [s]	**Measured delay [s]**			
20	66,6			
Under Frequency (47,6 Hz)				
Time delay setting [s]	**Measured delay [s]**			
20	70,2			
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 180,0V	At 47,4Hz	At 52,1Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Protection. Frequency change, Stability test.				
	Start Frequency [Hz]	**Change**	**Test Duration**	**Confirm no trip**
Positive Vector Shift	49,5	+50 degrees		No trip
Negative Vector Shift	50,5	-50 degrees		No trip
Positive Frequency drift	49,0 to 51,0	+0,95Hz/sec	2,1s	No trip
Negative Frequency drift	51,0 to 49,0	-0,95Hz/sec	2,1s	No trip

Limited Frequency Sensitive Mode – Over Frequency							
1-min mean value [Hz]:	**a) 50,00**	**b) 50,45**	**c) 50,70**	**d) 51,15**	**e) 50,70**	**f) 50,45**	**g) 50,00**
1. Measurement a) to g): Active power output > 80% Pn							
Frequency [Hz]	36,00	35,64	33,84	30,60	33,84	35,64	36,00
$P_{expected}$ [kW]	36,03	35,63	33,87	30,62	33,86	35,63	36,05
$P_{measured}$ [kW]	N/A	-0,02	0,08	0,06	0,06	-0,03	N/A
2. Measurement a) to g): Active power output 40% and 60% Pn							
Frequency [Hz]	18,00	17,64	15,84	12,60	15,84	17,64	36,00
$P_{expected}$ [kW]	17,97	17,58	15,82	12,55	15,82	17,57	36,03
$P_{measured}$ [kW]	N/A	-0,18	-0,07	-0,14	-0,06	-0,19	N/A

Output Power with falling Frequency						
Frequency setpoint [Hz]	50,00	49,50	49,00	48,00	47,60	47,10
Frequency [Hz]	50,00	49,50	49,00	48,00	47,60	47,10
Active power [kW]	36,01	36,03	36,03	36,06	36,06	36,06
ΔP/Pmax [%]		0,08	0,08	0,17	0,17	0,17

Note.
No Power reduction for electronic inverter.

Power Quality. Harmonics.

SUN-36K-G04

Generating Unit rating per phase (rpp)

At 100% of rated output
36,00 kW

Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	51,815	52,051	52,281	-	-	-	--	--
2nd	0,095	0,134	0,102	0,182	0,257	0,195	8%	8%
3rd	0,092	0,058	0,032	0,177	0,110	0,062	21,6%	N/A
4th	0,048	0,029	0,028	0,092	0,055	0,054	4%	4%
5th	0,198	0,146	0,147	0,380	0,280	0,282	10,7%	10,7%
6th	0,046	0,033	0,033	0,088	0,063	0,064	2,67%	2,67%
7th	0,064	0,055	0,097	0,122	0,105	0,186	7,2%	7,2%
8th	0,031	0,042	0,049	0,059	0,080	0,094	2%	2%
9th	0,031	0,017	0,039	0,059	0,032	0,075	3,8%	N/A
10th	0,054	0,030	0,045	0,104	0,058	0,087	1,6%	1,6%
11th	0,338	0,322	0,370	0,648	0,616	0,709	3,1%	3,1%
12th	0,035	0,018	0,043	0,067	0,035	0,083	1,33%	1,33%
13th	0,271	0,236	0,275	0,519	0,453	0,528	2%	2%
14th	0,029	0,024	0,035	0,055	0,046	0,067	N/A	N/A
15th	0,031	0,013	0,028	0,060	0,025	0,054	N/A	N/A
16th	0,017	0,030	0,030	0,032	0,057	0,058	N/A	N/A
17th	0,097	0,121	0,105	0,186	0,232	0,201	N/A	N/A
18th	0,030	0,013	0,041	0,058	0,025	0,079	N/A	N/A
19th	0,116	0,122	0,098	0,222	0,234	0,187	N/A	N/A
20th	0,050	0,018	0,045	0,095	0,035	0,085	N/A	N/A
21th	0,036	0,009	0,033	0,070	0,018	0,063	N/A	N/A
22th	0,031	0,015	0,040	0,059	0,028	0,077	N/A	N/A
23th	0,104	0,070	0,076	0,198	0,134	0,146	N/A	N/A
24th	0,026	0,006	0,023	0,051	0,011	0,045	N/A	N/A
25th	0,085	0,089	0,116	0,164	0,170	0,222	N/A	N/A
26th	0,013	0,011	0,022	0,025	0,021	0,043	N/A	N/A
27th	0,020	0,015	0,033	0,039	0,029	0,062	N/A	N/A
28th	0,020	0,007	0,015	0,039	0,014	0,028	N/A	N/A
29th	0,056	0,054	0,071	0,106	0,104	0,135	N/A	N/A
30th	0,026	0,005	0,029	0,050	0,010	0,055	N/A	N/A
31th	0,066	0,052	0,067	0,126	0,099	0,128	N/A	N/A
32th	0,030	0,007	0,025	0,057	0,013	0,047	N/A	N/A
33th	0,030	0,011	0,022	0,057	0,020	0,042	N/A	N/A
34th	0,023	0,005	0,026	0,044	0,009	0,049	N/A	N/A
35th	0,036	0,040	0,013	0,069	0,077	0,024	N/A	N/A
36th	0,022	0,006	0,026	0,043	0,012	0,049	N/A	N/A
37th	0,008	0,030	0,027	0,016	0,057	0,051	N/A	N/A
38th	0,019	0,005	0,022	0,037	0,009	0,042	N/A	N/A
39th	0,021	0,006	0,026	0,040	0,012	0,050	N/A	N/A
40th	0,019	0,007	0,015	0,036	0,013	0,029	N/A	N/A
THD_{40}	-	-	-	1,089	0,985	1,103	23%	13%
PWHD	-	-	-	2,318	2,070	2,381	23%	22%

Power Quality. Harmonics.

SUN-36K-G04

Generating Unit rating per phase (rpp)

At 45 - 55% of rated output
18,00 kW

Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	25,835	25,961	26,060	-	-	-	--	--
2nd	0,145	0,099	0,145	0,278	0,190	0,278	8%	8%
3rd	0,047	0,017	0,020	0,089	0,033	0,039	21,6%	N/A
4th	0,032	0,012	0,036	0,061	0,024	0,070	4%	4%
5th	0,110	0,090	0,066	0,211	0,172	0,126	10,7%	10,7%
6th	0,025	0,015	0,029	0,047	0,029	0,056	2,67%	2,67%
7th	0,021	0,029	0,044	0,040	0,055	0,084	7,2%	7,2%
8th	0,028	0,024	0,039	0,053	0,047	0,075	2%	2%
9th	0,015	0,012	0,021	0,028	0,023	0,040	3,8%	N/A
10th	0,051	0,018	0,038	0,098	0,034	0,073	1,6%	1,6%
11th	0,129	0,097	0,134	0,247	0,187	0,256	3,1%	3,1%
12th	0,024	0,012	0,028	0,046	0,024	0,053	1,33%	1,33%
13th	0,105	0,082	0,113	0,202	0,156	0,217	2%	2%
14th	0,013	0,016	0,027	0,025	0,031	0,051	N/A	N/A
15th	0,015	0,010	0,016	0,028	0,019	0,030	N/A	N/A
16th	0,015	0,012	0,009	0,029	0,023	0,018	N/A	N/A
17th	0,034	0,047	0,047	0,066	0,090	0,090	N/A	N/A
18th	0,026	0,010	0,033	0,049	0,018	0,063	N/A	N/A
19th	0,048	0,038	0,025	0,091	0,072	0,047	N/A	N/A
20th	0,035	0,004	0,035	0,067	0,008	0,068	N/A	N/A
21th	0,029	0,006	0,022	0,055	0,011	0,043	N/A	N/A
22th	0,023	0,009	0,028	0,044	0,018	0,053	N/A	N/A
23th	0,036	0,012	0,037	0,069	0,023	0,070	N/A	N/A
24th	0,018	0,007	0,022	0,035	0,013	0,042	N/A	N/A
25th	0,032	0,024	0,044	0,062	0,046	0,083	N/A	N/A
26th	0,022	0,004	0,020	0,043	0,007	0,038	N/A	N/A
27th	0,018	0,006	0,022	0,034	0,012	0,042	N/A	N/A
28th	0,021	0,004	0,022	0,040	0,007	0,042	N/A	N/A
29th	0,014	0,032	0,028	0,027	0,062	0,054	N/A	N/A
30th	0,020	0,004	0,022	0,039	0,007	0,041	N/A	N/A
31th	0,036	0,027	0,028	0,068	0,052	0,054	N/A	N/A
32th	0,019	0,004	0,018	0,036	0,008	0,034	N/A	N/A
33th	0,020	0,006	0,019	0,038	0,012	0,037	N/A	N/A
34th	0,018	0,004	0,019	0,034	0,008	0,036	N/A	N/A
35th	0,050	0,036	0,026	0,095	0,070	0,051	N/A	N/A
36th	0,019	0,004	0,017	0,036	0,007	0,032	N/A	N/A
37th	0,019	0,034	0,046	0,037	0,065	0,089	N/A	N/A
38th	0,013	0,006	0,018	0,025	0,011	0,034	N/A	N/A
39th	0,022	0,008	0,022	0,041	0,016	0,043	N/A	N/A
40th	0,017	0,005	0,013	0,033	0,010	0,025	N/A	N/A
THD_{40}	-	-	-	0,567	0,413	0,557	23%	13%
PWHD	-	-	-	1,321	0,952	1,372	23%	22%

Power Quality. Harmonics.

SUN-35K-G04

Generating Unit rating per phase (rpp)

At 100% of rated output
35,00 kW

Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	50,325	50,538	50,772	--	--	--	--	--
2nd	0,087	0,114	0,083	0,171	0,225	0,163	8%	8%
3rd	0,086	0,059	0,030	0,169	0,116	0,059	21,6%	N/A
4th	0,045	0,028	0,030	0,089	0,054	0,058	4%	4%
5th	0,191	0,143	0,141	0,376	0,281	0,279	10,7%	10,7%
6th	0,047	0,031	0,039	0,094	0,061	0,077	2,67%	2,67%
7th	0,063	0,051	0,094	0,125	0,101	0,186	7,2%	7,2%
8th	0,035	0,042	0,048	0,069	0,082	0,094	2%	2%
9th	0,035	0,015	0,042	0,068	0,030	0,082	3,8%	N/A
10th	0,053	0,023	0,045	0,104	0,046	0,088	1,6%	1,6%
11th	0,326	0,315	0,356	0,643	0,621	0,703	3,1%	3,1%
12th	0,035	0,014	0,040	0,070	0,028	0,079	1,33%	1,33%
13th	0,259	0,227	0,262	0,511	0,448	0,517	2%	2%
14th	0,026	0,020	0,032	0,051	0,040	0,064	N/A	N/A
15th	0,033	0,013	0,029	0,065	0,026	0,058	N/A	N/A
16th	0,013	0,028	0,028	0,026	0,054	0,056	N/A	N/A
17th	0,091	0,115	0,100	0,180	0,227	0,197	N/A	N/A
18th	0,028	0,011	0,036	0,056	0,022	0,072	N/A	N/A
19th	0,117	0,120	0,097	0,230	0,237	0,192	N/A	N/A
20th	0,047	0,018	0,046	0,093	0,035	0,090	N/A	N/A
21th	0,036	0,009	0,031	0,070	0,018	0,061	N/A	N/A
22th	0,032	0,013	0,040	0,063	0,025	0,079	N/A	N/A
23th	0,101	0,069	0,074	0,199	0,137	0,145	N/A	N/A
24th	0,026	0,006	0,027	0,050	0,011	0,054	N/A	N/A
25th	0,082	0,085	0,113	0,162	0,168	0,222	N/A	N/A
26th	0,015	0,011	0,024	0,030	0,022	0,047	N/A	N/A
27th	0,018	0,015	0,031	0,036	0,030	0,061	N/A	N/A
28th	0,019	0,006	0,015	0,037	0,012	0,029	N/A	N/A
29th	0,051	0,050	0,067	0,101	0,098	0,132	N/A	N/A
30th	0,025	0,005	0,026	0,050	0,010	0,051	N/A	N/A
31th	0,065	0,050	0,066	0,128	0,098	0,130	N/A	N/A
32th	0,028	0,006	0,023	0,055	0,012	0,045	N/A	N/A
33th	0,030	0,011	0,022	0,058	0,021	0,043	N/A	N/A
34th	0,021	0,005	0,024	0,042	0,010	0,048	N/A	N/A
35th	0,034	0,037	0,011	0,067	0,073	0,021	N/A	N/A
36th	0,023	0,005	0,025	0,045	0,010	0,049	N/A	N/A
37th	0,005	0,026	0,025	0,010	0,052	0,049	N/A	N/A
38th	0,020	0,007	0,026	0,039	0,014	0,051	N/A	N/A
39th	0,021	0,006	0,025	0,042	0,011	0,050	N/A	N/A
40th	0,018	0,004	0,018	0,036	0,008	0,035	N/A	N/A
THD_{40}	-	-	-	1,079	0,974	1,089	23%	13%
PWHD	-	-	-	2,317	2,039	2,388	23%	22%

Power Quality. Harmonics.

SUN-35K-G04

Generating Unit rating per phase (rpp)								
	At 45 - 55% of rated output 17,50 kW							
Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	25,133	25,258	25,364	--	--	--	--	--
2nd	0,154	0,114	0,158	0,303	0,224	0,312	8%	8%
3rd	0,046	0,017	0,021	0,091	0,034	0,041	21,6%	N/A
4th	0,033	0,012	0,038	0,064	0,023	0,074	4%	4%
5th	0,110	0,091	0,064	0,217	0,179	0,126	10,7%	10,7%
6th	0,024	0,016	0,030	0,047	0,031	0,059	2,67%	2,67%
7th	0,020	0,028	0,043	0,039	0,055	0,084	7,2%	7,2%
8th	0,027	0,025	0,040	0,053	0,050	0,079	2%	2%
9th	0,015	0,011	0,020	0,029	0,021	0,040	3,8%	N/A
10th	0,052	0,017	0,040	0,102	0,033	0,079	1,6%	1,6%
11th	0,123	0,092	0,127	0,242	0,181	0,251	3,1%	3,1%
12th	0,023	0,012	0,027	0,046	0,024	0,052	1,33%	1,33%
13th	0,096	0,074	0,104	0,190	0,145	0,206	2%	2%
14th	0,012	0,017	0,027	0,024	0,033	0,053	N/A	N/A
15th	0,014	0,010	0,016	0,027	0,020	0,031	N/A	N/A
16th	0,014	0,011	0,008	0,028	0,022	0,016	N/A	N/A
17th	0,031	0,042	0,044	0,061	0,083	0,086	N/A	N/A
18th	0,025	0,008	0,031	0,050	0,017	0,060	N/A	N/A
19th	0,043	0,033	0,020	0,085	0,065	0,039	N/A	N/A
20th	0,033	0,004	0,034	0,066	0,008	0,066	N/A	N/A
21th	0,028	0,005	0,023	0,056	0,011	0,045	N/A	N/A
22th	0,022	0,009	0,026	0,043	0,017	0,051	N/A	N/A
23th	0,036	0,015	0,038	0,071	0,030	0,075	N/A	N/A
24th	0,018	0,006	0,021	0,035	0,012	0,041	N/A	N/A
25th	0,034	0,026	0,045	0,067	0,051	0,089	N/A	N/A
26th	0,024	0,004	0,022	0,048	0,007	0,044	N/A	N/A
27th	0,019	0,006	0,023	0,038	0,011	0,046	N/A	N/A
28th	0,022	0,004	0,023	0,044	0,007	0,046	N/A	N/A
29th	0,016	0,035	0,030	0,032	0,070	0,060	N/A	N/A
30th	0,021	0,004	0,021	0,041	0,007	0,042	N/A	N/A
31th	0,037	0,029	0,030	0,074	0,058	0,060	N/A	N/A
32th	0,019	0,003	0,019	0,037	0,007	0,038	N/A	N/A
33th	0,021	0,007	0,020	0,041	0,014	0,039	N/A	N/A
34th	0,019	0,004	0,020	0,038	0,008	0,040	N/A	N/A
35th	0,050	0,037	0,025	0,098	0,073	0,049	N/A	N/A
36th	0,017	0,004	0,017	0,034	0,007	0,034	N/A	N/A
37th	0,018	0,035	0,046	0,036	0,069	0,091	N/A	N/A
38th	0,012	0,005	0,017	0,024	0,011	0,033	N/A	N/A
39th	0,023	0,008	0,023	0,044	0,015	0,046	N/A	N/A
40th	0,017	0,005	0,015	0,034	0,009	0,030	N/A	N/A
THD_{40}	-	-	-	0,579	0,428	0,574	23%	13%
PWHD	-	-	-	1,357	0,987	1,418	23%	22%

Power Quality. Harmonics.

SUN-33K-G04

Generating Unit rating per phase (rpp)

At 100% of rated output
33,00 kW

Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	47,405	47,448	47,772	--	--	--	--	--
2nd	0,046	0,030	0,057	0,096	0,064	0,120	8%	8%
3rd	0,673	0,658	0,668	1,408	1,375	1,397	21,6%	N/A
4th	0,110	0,141	0,156	0,230	0,295	0,326	4%	4%
5th	0,367	0,338	0,343	0,768	0,706	0,717	10,7%	10,7%
6th	0,026	0,046	0,077	0,055	0,095	0,161	2,67%	2,67%
7th	0,310	0,320	0,324	0,648	0,669	0,678	7,2%	7,2%
8th	0,055	0,032	0,068	0,115	0,068	0,141	2%	2%
9th	0,155	0,134	0,165	0,325	0,280	0,344	3,8%	N/A
10th	0,050	0,024	0,062	0,105	0,051	0,130	1,6%	1,6%
11th	0,294	0,288	0,306	0,615	0,603	0,640	3,1%	3,1%
12th	0,013	0,013	0,009	0,026	0,027	0,019	1,33%	1,33%
13th	0,279	0,269	0,271	0,583	0,563	0,566	2%	2%
14th	0,022	0,008	0,025	0,047	0,017	0,052	N/A	N/A
15th	0,143	0,144	0,140	0,299	0,301	0,293	N/A	N/A
16th	0,014	0,014	0,022	0,029	0,028	0,046	N/A	N/A
17th	0,232	0,219	0,233	0,484	0,457	0,488	N/A	N/A
18th	0,016	0,018	0,022	0,034	0,037	0,045	N/A	N/A
19th	0,216	0,199	0,200	0,451	0,415	0,419	N/A	N/A
20th	0,018	0,012	0,021	0,037	0,025	0,043	N/A	N/A
21th	0,122	0,141	0,123	0,254	0,294	0,256	N/A	N/A
22th	0,016	0,018	0,013	0,034	0,037	0,027	N/A	N/A
23th	0,141	0,127	0,127	0,294	0,265	0,265	N/A	N/A
24th	0,022	0,022	0,016	0,046	0,046	0,034	N/A	N/A
25th	0,117	0,109	0,115	0,246	0,228	0,241	N/A	N/A
26th	0,022	0,020	0,030	0,047	0,041	0,063	N/A	N/A
27th	0,157	0,163	0,145	0,328	0,341	0,302	N/A	N/A
28th	0,031	0,035	0,035	0,064	0,073	0,074	N/A	N/A
29th	0,096	0,076	0,117	0,200	0,158	0,244	N/A	N/A
30th	0,046	0,042	0,040	0,096	0,087	0,084	N/A	N/A
31th	0,092	0,063	0,073	0,193	0,131	0,153	N/A	N/A
32th	0,032	0,029	0,025	0,067	0,060	0,052	N/A	N/A
33th	0,079	0,084	0,077	0,165	0,176	0,160	N/A	N/A
34th	0,023	0,035	0,014	0,049	0,073	0,030	N/A	N/A
35th	0,070	0,073	0,053	0,146	0,153	0,111	N/A	N/A
36th	0,019	0,016	0,022	0,039	0,033	0,046	N/A	N/A
37th	0,049	0,060	0,046	0,102	0,125	0,096	N/A	N/A
38th	0,012	0,012	0,018	0,026	0,025	0,038	N/A	N/A
39th	0,058	0,060	0,059	0,121	0,125	0,123	N/A	N/A
40th	0,010	0,020	0,021	0,020	0,042	0,044	N/A	N/A
THD_{40}	-	-	-	2,222	2,159	2,219	23%	13%
PWHD	-	-	-	4,775	4,616	4,608	23%	22%

Power Quality. Harmonics.

SUN-33K-G04

Generating Unit rating per phase (rpp)								
	At 45 - 55% of rated output 16,50 kW							
Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	23,700	23,723	23,880	--	--	--	--	--
2nd	0,023	0,015	0,028	0,048	0,032	0,058	8%	8%
3rd	0,336	0,329	0,335	0,703	0,687	0,701	21,6%	N/A
4th	0,056	0,071	0,078	0,117	0,149	0,164	4%	4%
5th	0,184	0,169	0,172	0,385	0,354	0,360	10,7%	10,7%
6th	0,013	0,023	0,039	0,027	0,049	0,082	2,67%	2,67%
7th	0,154	0,160	0,162	0,322	0,335	0,339	7,2%	7,2%
8th	0,028	0,017	0,034	0,059	0,037	0,072	2%	2%
9th	0,078	0,068	0,082	0,163	0,142	0,171	3,8%	N/A
10th	0,026	0,013	0,031	0,055	0,027	0,066	1,6%	1,6%
11th	0,147	0,144	0,153	0,308	0,302	0,320	3,1%	3,1%
12th	0,006	0,007	0,004	0,014	0,015	0,009	1,33%	1,33%
13th	0,139	0,135	0,135	0,290	0,281	0,283	2%	2%
14th	0,012	0,004	0,012	0,024	0,009	0,026	N/A	N/A
15th	0,072	0,072	0,070	0,150	0,151	0,146	N/A	N/A
16th	0,007	0,007	0,011	0,016	0,014	0,023	N/A	N/A
17th	0,115	0,109	0,116	0,241	0,228	0,243	N/A	N/A
18th	0,009	0,009	0,012	0,018	0,018	0,024	N/A	N/A
19th	0,107	0,099	0,100	0,225	0,208	0,209	N/A	N/A
20th	0,009	0,006	0,010	0,018	0,012	0,022	N/A	N/A
21th	0,060	0,070	0,061	0,126	0,146	0,128	N/A	N/A
22th	0,008	0,009	0,007	0,017	0,020	0,014	N/A	N/A
23th	0,070	0,064	0,064	0,147	0,133	0,133	N/A	N/A
24th	0,011	0,011	0,008	0,023	0,024	0,017	N/A	N/A
25th	0,058	0,055	0,057	0,122	0,115	0,119	N/A	N/A
26th	0,011	0,010	0,015	0,023	0,020	0,031	N/A	N/A
27th	0,078	0,081	0,072	0,162	0,169	0,150	N/A	N/A
28th	0,016	0,018	0,017	0,033	0,038	0,036	N/A	N/A
29th	0,047	0,039	0,058	0,099	0,081	0,121	N/A	N/A
30th	0,023	0,021	0,020	0,049	0,044	0,042	N/A	N/A
31th	0,047	0,031	0,037	0,097	0,064	0,077	N/A	N/A
32th	0,016	0,014	0,012	0,033	0,030	0,025	N/A	N/A
33th	0,039	0,043	0,039	0,082	0,089	0,081	N/A	N/A
34th	0,011	0,018	0,007	0,024	0,038	0,015	N/A	N/A
35th	0,034	0,036	0,027	0,072	0,075	0,056	N/A	N/A
36th	0,009	0,008	0,011	0,018	0,016	0,023	N/A	N/A
37th	0,024	0,030	0,023	0,049	0,062	0,049	N/A	N/A
38th	0,006	0,006	0,010	0,013	0,013	0,021	N/A	N/A
39th	0,030	0,029	0,029	0,062	0,062	0,061	N/A	N/A
40th	0,004	0,010	0,009	0,009	0,021	0,018	N/A	N/A
THD_{40}	-	-	-	1,110	1,080	1,111	23%	13%
PWHD	-	-	-	2,377	2,307	2,297	23%	22%

Power Quality. Harmonics.

SUN-30K-G04

Generating Unit rating per phase (rpp)								
	At 100% of rated output 30,00 kW							
Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	43,168	43,337	43,521	--	--	--	--	--
2nd	0,109	0,115	0,096	0,251	0,264	0,222	8%	8%
3rd	0,067	0,036	0,024	0,154	0,082	0,056	21,6%	N/A
4th	0,050	0,022	0,033	0,116	0,051	0,075	4%	4%
5th	0,170	0,129	0,125	0,392	0,297	0,287	10,7%	10,7%
6th	0,030	0,021	0,032	0,069	0,048	0,074	2,67%	2,67%
7th	0,050	0,043	0,081	0,114	0,098	0,185	7,2%	7,2%
8th	0,034	0,033	0,037	0,078	0,077	0,085	2%	2%
9th	0,024	0,015	0,032	0,056	0,034	0,072	3,8%	N/A
10th	0,052	0,026	0,038	0,120	0,059	0,087	1,6%	1,6%
11th	0,288	0,277	0,319	0,663	0,637	0,733	3,1%	3,1%
12th	0,034	0,010	0,036	0,077	0,022	0,083	1,33%	1,33%
13th	0,205	0,177	0,209	0,472	0,407	0,482	2%	2%
14th	0,025	0,020	0,023	0,057	0,047	0,052	N/A	N/A
15th	0,026	0,010	0,025	0,060	0,023	0,057	N/A	N/A
16th	0,014	0,022	0,025	0,033	0,050	0,058	N/A	N/A
17th	0,080	0,098	0,087	0,184	0,225	0,199	N/A	N/A
18th	0,032	0,009	0,039	0,074	0,021	0,089	N/A	N/A
19th	0,103	0,105	0,087	0,237	0,241	0,199	N/A	N/A
20th	0,044	0,010	0,043	0,101	0,024	0,100	N/A	N/A
21th	0,034	0,009	0,029	0,078	0,020	0,067	N/A	N/A
22th	0,029	0,018	0,037	0,066	0,040	0,084	N/A	N/A
23th	0,091	0,064	0,065	0,208	0,147	0,150	N/A	N/A
24th	0,018	0,006	0,022	0,042	0,014	0,050	N/A	N/A
25th	0,059	0,061	0,087	0,136	0,139	0,199	N/A	N/A
26th	0,014	0,008	0,019	0,032	0,018	0,044	N/A	N/A
27th	0,017	0,011	0,026	0,040	0,024	0,060	N/A	N/A
28th	0,023	0,006	0,018	0,052	0,015	0,042	N/A	N/A
29th	0,046	0,037	0,055	0,106	0,084	0,126	N/A	N/A
30th	0,028	0,005	0,027	0,065	0,010	0,063	N/A	N/A
31th	0,052	0,034	0,049	0,119	0,079	0,114	N/A	N/A
32th	0,027	0,005	0,023	0,061	0,012	0,052	N/A	N/A
33th	0,026	0,008	0,020	0,060	0,019	0,046	N/A	N/A
34th	0,021	0,005	0,025	0,049	0,012	0,057	N/A	N/A
35th	0,025	0,020	0,007	0,059	0,046	0,017	N/A	N/A
36th	0,021	0,006	0,025	0,048	0,013	0,057	N/A	N/A
37th	0,009	0,016	0,023	0,022	0,036	0,052	N/A	N/A
38th	0,021	0,004	0,024	0,048	0,009	0,055	N/A	N/A
39th	0,022	0,004	0,024	0,050	0,010	0,055	N/A	N/A
40th	0,019	0,006	0,014	0,043	0,013	0,033	N/A	N/A
THD_{40}	-	-	-	1,099	0,969	1,105	23%	13%
PWHD	-	-	-	2,374	1,921	2,384	23%	22%

Power Quality. Harmonics.

SUN-30K-G04

Generating Unit rating per phase (rpp)								
	At 45 - 55% of rated output 15,00 kW							
Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	21,562	21,675	21,760	--	--	--	--	--
2nd	0,169	0,126	0,175	0,389	0,290	0,403	8%	8%
3rd	0,043	0,014	0,022	0,099	0,033	0,050	21,6%	N/A
4th	0,021	0,015	0,030	0,048	0,035	0,069	4%	4%
5th	0,097	0,083	0,054	0,224	0,191	0,124	10,7%	10,7%
6th	0,020	0,019	0,030	0,045	0,043	0,069	2,67%	2,67%
7th	0,011	0,024	0,030	0,025	0,056	0,068	7,2%	7,2%
8th	0,029	0,020	0,047	0,067	0,045	0,108	2%	2%
9th	0,015	0,010	0,020	0,034	0,023	0,046	3,8%	N/A
10th	0,056	0,012	0,046	0,129	0,028	0,106	1,6%	1,6%
11th	0,085	0,050	0,083	0,195	0,115	0,192	3,1%	3,1%
12th	0,015	0,011	0,018	0,034	0,024	0,043	1,33%	1,33%
13th	0,052	0,029	0,055	0,119	0,067	0,127	2%	2%
14th	0,009	0,020	0,022	0,021	0,046	0,050	N/A	N/A
15th	0,012	0,011	0,017	0,027	0,025	0,040	N/A	N/A
16th	0,019	0,012	0,010	0,043	0,027	0,023	N/A	N/A
17th	0,006	0,018	0,020	0,013	0,041	0,045	N/A	N/A
18th	0,024	0,012	0,032	0,056	0,027	0,074	N/A	N/A
19th	0,021	0,035	0,018	0,049	0,082	0,042	N/A	N/A
20th	0,025	0,005	0,027	0,058	0,011	0,063	N/A	N/A
21th	0,024	0,006	0,021	0,056	0,014	0,048	N/A	N/A
22th	0,017	0,005	0,016	0,040	0,010	0,036	N/A	N/A
23th	0,056	0,041	0,055	0,130	0,095	0,126	N/A	N/A
24th	0,019	0,005	0,022	0,044	0,011	0,052	N/A	N/A
25th	0,053	0,043	0,066	0,123	0,099	0,152	N/A	N/A
26th	0,028	0,003	0,027	0,064	0,008	0,063	N/A	N/A
27th	0,023	0,005	0,024	0,053	0,011	0,054	N/A	N/A
28th	0,021	0,008	0,027	0,049	0,017	0,062	N/A	N/A
29th	0,034	0,055	0,050	0,079	0,127	0,116	N/A	N/A
30th	0,024	0,006	0,027	0,055	0,014	0,063	N/A	N/A
31th	0,049	0,039	0,046	0,112	0,089	0,106	N/A	N/A
32th	0,026	0,004	0,028	0,059	0,009	0,064	N/A	N/A
33th	0,025	0,007	0,025	0,059	0,017	0,057	N/A	N/A
34th	0,022	0,009	0,028	0,050	0,021	0,065	N/A	N/A
35th	0,034	0,035	0,007	0,077	0,080	0,016	N/A	N/A
36th	0,018	0,007	0,021	0,042	0,016	0,049	N/A	N/A
37th	0,006	0,029	0,026	0,013	0,067	0,060	N/A	N/A
38th	0,016	0,003	0,015	0,036	0,008	0,034	N/A	N/A
39th	0,021	0,007	0,022	0,048	0,016	0,052	N/A	N/A
40th	0,014	0,004	0,013	0,032	0,008	0,029	N/A	N/A
THD_{40}	-	-	-	0,629	0,467	0,632	23%	13%
PWHD	-	-	-	1,674	1,362	1,825	23%	22%

Power Quality. Harmonics.

SUN-25K-G04

Generating Unit rating per phase (rpp)

At 100% of rated output
25,00 kW

Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	35,975	36,127	36,287	--	--	--	--	--
2nd	0,122	0,106	0,109	0,337	0,293	0,300	8%	8%
3rd	0,057	0,029	0,022	0,157	0,081	0,060	21,6%	N/A
4th	0,046	0,018	0,036	0,128	0,050	0,100	4%	4%
5th	0,146	0,109	0,104	0,404	0,300	0,286	10,7%	10,7%
6th	0,028	0,015	0,029	0,076	0,042	0,080	2,67%	2,67%
7th	0,036	0,035	0,065	0,099	0,097	0,180	7,2%	7,2%
8th	0,031	0,031	0,037	0,087	0,087	0,101	2%	2%
9th	0,020	0,016	0,031	0,055	0,045	0,085	3,8%	N/A
10th	0,050	0,031	0,027	0,139	0,085	0,074	1,6%	1,6%
11th	0,236	0,220	0,263	0,651	0,606	0,726	3,1%	3,1%
12th	0,033	0,009	0,031	0,090	0,026	0,086	1,33%	1,33%
13th	0,171	0,149	0,182	0,473	0,410	0,502	2%	2%
14th	0,024	0,016	0,023	0,065	0,045	0,063	N/A	N/A
15th	0,020	0,011	0,020	0,056	0,031	0,056	N/A	N/A
16th	0,016	0,015	0,017	0,044	0,043	0,047	N/A	N/A
17th	0,080	0,098	0,089	0,222	0,270	0,245	N/A	N/A
18th	0,027	0,008	0,033	0,076	0,021	0,092	N/A	N/A
19th	0,078	0,077	0,063	0,216	0,213	0,175	N/A	N/A
20th	0,038	0,009	0,034	0,106	0,026	0,095	N/A	N/A
21th	0,033	0,010	0,026	0,090	0,027	0,072	N/A	N/A
22th	0,025	0,011	0,031	0,069	0,030	0,085	N/A	N/A
23th	0,061	0,035	0,041	0,167	0,097	0,114	N/A	N/A
24th	0,021	0,006	0,024	0,058	0,017	0,068	N/A	N/A
25th	0,045	0,045	0,068	0,123	0,125	0,187	N/A	N/A
26th	0,016	0,006	0,021	0,043	0,017	0,058	N/A	N/A
27th	0,014	0,013	0,026	0,040	0,036	0,071	N/A	N/A
28th	0,019	0,004	0,020	0,053	0,012	0,054	N/A	N/A
29th	0,028	0,028	0,041	0,077	0,078	0,112	N/A	N/A
30th	0,027	0,004	0,026	0,074	0,011	0,071	N/A	N/A
31th	0,039	0,019	0,036	0,109	0,053	0,101	N/A	N/A
32th	0,024	0,003	0,024	0,066	0,009	0,066	N/A	N/A
33th	0,023	0,004	0,024	0,064	0,012	0,066	N/A	N/A
34th	0,021	0,005	0,023	0,058	0,013	0,063	N/A	N/A
35th	0,027	0,011	0,017	0,075	0,029	0,048	N/A	N/A
36th	0,020	0,006	0,024	0,055	0,016	0,065	N/A	N/A
37th	0,017	0,013	0,029	0,046	0,035	0,080	N/A	N/A
38th	0,017	0,006	0,022	0,047	0,017	0,062	N/A	N/A
39th	0,023	0,005	0,022	0,064	0,015	0,060	N/A	N/A
40th	0,019	0,004	0,016	0,054	0,012	0,044	N/A	N/A
THD_{40}	-	-	-	1,123	0,956	1,136	23%	13%
PWHD	-	-	-	2,361	1,809	2,448	23%	22%

Power Quality. Harmonics.

SUN-25K-G04

Generating Unit rating per phase (rpp)								
	At 45 - 55% of rated output 12,50 kW							
Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	17,960	18,083	18,152	--	--	--	--	--
2nd	0,112	0,076	0,135	0,308	0,210	0,374	8%	8%
3rd	0,045	0,014	0,022	0,124	0,039	0,062	21,6%	N/A
4th	0,013	0,012	0,018	0,037	0,034	0,050	4%	4%
5th	0,085	0,078	0,045	0,235	0,216	0,123	10,7%	10,7%
6th	0,022	0,008	0,024	0,061	0,021	0,066	2,67%	2,67%
7th	0,015	0,022	0,016	0,042	0,060	0,045	7,2%	7,2%
8th	0,048	0,017	0,046	0,131	0,046	0,127	2%	2%
9th	0,018	0,009	0,019	0,050	0,024	0,053	3,8%	N/A
10th	0,048	0,027	0,063	0,133	0,075	0,173	1,6%	1,6%
11th	0,048	0,016	0,054	0,131	0,045	0,150	3,1%	3,1%
12th	0,017	0,013	0,008	0,047	0,035	0,022	1,33%	1,33%
13th	0,037	0,023	0,025	0,102	0,064	0,069	2%	2%
14th	0,007	0,030	0,030	0,020	0,082	0,081	N/A	N/A
15th	0,012	0,009	0,018	0,034	0,025	0,049	N/A	N/A
16th	0,024	0,009	0,022	0,066	0,024	0,060	N/A	N/A
17th	0,026	0,042	0,026	0,070	0,116	0,071	N/A	N/A
18th	0,028	0,006	0,025	0,077	0,017	0,068	N/A	N/A
19th	0,042	0,057	0,047	0,117	0,158	0,129	N/A	N/A
20th	0,011	0,016	0,025	0,030	0,043	0,068	N/A	N/A
21th	0,019	0,006	0,022	0,053	0,016	0,060	N/A	N/A
22th	0,015	0,012	0,011	0,041	0,033	0,030	N/A	N/A
23th	0,074	0,058	0,057	0,205	0,160	0,158	N/A	N/A
24th	0,021	0,005	0,024	0,058	0,013	0,068	N/A	N/A
25th	0,055	0,051	0,074	0,151	0,140	0,206	N/A	N/A
26th	0,018	0,008	0,022	0,050	0,021	0,060	N/A	N/A
27th	0,019	0,007	0,020	0,052	0,020	0,055	N/A	N/A
28th	0,019	0,007	0,013	0,053	0,019	0,037	N/A	N/A
29th	0,039	0,045	0,053	0,108	0,125	0,146	N/A	N/A
30th	0,016	0,008	0,022	0,045	0,022	0,060	N/A	N/A
31th	0,041	0,028	0,042	0,114	0,077	0,116	N/A	N/A
32th	0,023	0,007	0,019	0,065	0,018	0,052	N/A	N/A
33th	0,022	0,006	0,017	0,061	0,017	0,048	N/A	N/A
34th	0,019	0,008	0,019	0,052	0,022	0,053	N/A	N/A
35th	0,013	0,014	0,007	0,035	0,038	0,018	N/A	N/A
36th	0,016	0,005	0,018	0,043	0,015	0,051	N/A	N/A
37th	0,009	0,017	0,019	0,024	0,047	0,051	N/A	N/A
38th	0,023	0,008	0,018	0,064	0,022	0,049	N/A	N/A
39th	0,026	0,006	0,022	0,073	0,016	0,062	N/A	N/A
40th	0,019	0,006	0,017	0,052	0,016	0,046	N/A	N/A
THD_{40}	-	-	-	0,637	0,487	0,658	23%	13%
PWHD	-	-	-	2,062	1,692	2,177	23%	22%

Power Quality. Harmonics.

SUN-20K-G04

Generating Unit rating per phase (rpp)

At 100% of rated output
20,00 kW

Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	28,728	28,864	29,001	--	--	--	--	--
2nd	0,130	0,080	0,129	0,448	0,276	0,446	8%	8%
3rd	0,052	0,020	0,022	0,180	0,068	0,075	21,6%	N/A
4th	0,034	0,014	0,039	0,116	0,050	0,135	4%	4%
5th	0,118	0,089	0,072	0,407	0,309	0,248	10,7%	10,7%
6th	0,032	0,014	0,029	0,110	0,048	0,101	2,67%	2,67%
7th	0,028	0,036	0,054	0,095	0,124	0,186	7,2%	7,2%
8th	0,026	0,029	0,037	0,091	0,101	0,127	2%	2%
9th	0,015	0,014	0,023	0,052	0,047	0,080	3,8%	N/A
10th	0,044	0,021	0,029	0,152	0,072	0,100	1,6%	1,6%
11th	0,156	0,127	0,168	0,538	0,439	0,579	3,1%	3,1%
12th	0,027	0,011	0,027	0,093	0,039	0,091	1,33%	1,33%
13th	0,131	0,108	0,138	0,451	0,372	0,477	2%	2%
14th	0,021	0,013	0,027	0,071	0,046	0,094	N/A	N/A
15th	0,017	0,010	0,017	0,058	0,034	0,059	N/A	N/A
16th	0,016	0,012	0,012	0,056	0,042	0,042	N/A	N/A
17th	0,050	0,065	0,059	0,173	0,223	0,204	N/A	N/A
18th	0,024	0,008	0,030	0,082	0,029	0,105	N/A	N/A
19th	0,059	0,048	0,041	0,203	0,167	0,141	N/A	N/A
20th	0,036	0,008	0,033	0,123	0,027	0,115	N/A	N/A
21th	0,031	0,006	0,025	0,106	0,019	0,086	N/A	N/A
22th	0,025	0,009	0,030	0,087	0,031	0,104	N/A	N/A
23th	0,041	0,014	0,032	0,140	0,047	0,112	N/A	N/A
24th	0,020	0,007	0,024	0,070	0,024	0,083	N/A	N/A
25th	0,031	0,023	0,044	0,107	0,080	0,153	N/A	N/A
26th	0,018	0,003	0,019	0,062	0,012	0,066	N/A	N/A
27th	0,014	0,008	0,021	0,047	0,029	0,072	N/A	N/A
28th	0,019	0,003	0,020	0,066	0,011	0,069	N/A	N/A
29th	0,010	0,025	0,028	0,035	0,085	0,098	N/A	N/A
30th	0,022	0,003	0,022	0,077	0,012	0,075	N/A	N/A
31th	0,031	0,020	0,021	0,107	0,068	0,073	N/A	N/A
32th	0,017	0,003	0,018	0,058	0,011	0,061	N/A	N/A
33th	0,019	0,005	0,020	0,066	0,016	0,068	N/A	N/A
34th	0,017	0,005	0,018	0,058	0,017	0,064	N/A	N/A
35th	0,045	0,031	0,025	0,154	0,106	0,085	N/A	N/A
36th	0,021	0,004	0,020	0,071	0,015	0,071	N/A	N/A
37th	0,022	0,029	0,045	0,075	0,100	0,157	N/A	N/A
38th	0,017	0,005	0,022	0,060	0,018	0,076	N/A	N/A
39th	0,024	0,007	0,020	0,082	0,024	0,070	N/A	N/A
40th	0,020	0,004	0,018	0,068	0,013	0,063	N/A	N/A
THD_{40}	-	-	-	1,104	0,823	1,092	23%	13%
PWHD	-	-	-	2,484	1,720	2,548	23%	22%

Power Quality. Harmonics.

SUN-20K-G04

Generating Unit rating per phase (rpp)								
	At 45 - 55% of rated output 10,00 kW							
Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	14,317	14,415	14,481	--	--	--	--	--
2nd	0,102	0,051	0,119	0,350	0,177	0,412	8%	8%
3rd	0,038	0,015	0,014	0,132	0,053	0,048	21,6%	N/A
4th	0,012	0,013	0,008	0,041	0,046	0,026	4%	4%
5th	0,067	0,065	0,032	0,231	0,225	0,109	10,7%	10,7%
6th	0,015	0,006	0,016	0,051	0,021	0,054	2,67%	2,67%
7th	0,031	0,020	0,014	0,106	0,068	0,048	7,2%	7,2%
8th	0,058	0,027	0,057	0,200	0,095	0,196	2%	2%
9th	0,022	0,006	0,016	0,075	0,020	0,056	3,8%	N/A
10th	0,049	0,029	0,064	0,167	0,101	0,222	1,6%	1,6%
11th	0,026	0,045	0,057	0,091	0,155	0,196	3,1%	3,1%
12th	0,007	0,006	0,009	0,023	0,022	0,030	1,33%	1,33%
13th	0,061	0,052	0,048	0,210	0,178	0,166	2%	2%
14th	0,017	0,008	0,023	0,058	0,026	0,080	N/A	N/A
15th	0,021	0,008	0,021	0,074	0,027	0,074	N/A	N/A
16th	0,028	0,012	0,039	0,097	0,040	0,135	N/A	N/A
17th	0,059	0,083	0,062	0,203	0,286	0,214	N/A	N/A
18th	0,024	0,005	0,022	0,085	0,019	0,076	N/A	N/A
19th	0,071	0,074	0,064	0,244	0,257	0,220	N/A	N/A
20th	0,013	0,014	0,025	0,046	0,049	0,085	N/A	N/A
21th	0,018	0,009	0,016	0,062	0,032	0,054	N/A	N/A
22th	0,021	0,004	0,018	0,071	0,015	0,063	N/A	N/A
23th	0,067	0,057	0,043	0,231	0,197	0,150	N/A	N/A
24th	0,027	0,010	0,022	0,093	0,033	0,076	N/A	N/A
25th	0,038	0,044	0,060	0,131	0,152	0,206	N/A	N/A
26th	0,009	0,015	0,023	0,031	0,052	0,081	N/A	N/A
27th	0,018	0,008	0,024	0,062	0,027	0,082	N/A	N/A
28th	0,021	0,008	0,014	0,074	0,026	0,050	N/A	N/A
29th	0,017	0,014	0,029	0,057	0,049	0,102	N/A	N/A
30th	0,019	0,009	0,025	0,065	0,031	0,087	N/A	N/A
31th	0,025	0,014	0,015	0,085	0,049	0,053	N/A	N/A
32th	0,015	0,004	0,017	0,050	0,014	0,059	N/A	N/A
33th	0,013	0,006	0,017	0,046	0,020	0,058	N/A	N/A
34th	0,019	0,003	0,019	0,067	0,011	0,066	N/A	N/A
35th	0,031	0,026	0,009	0,108	0,091	0,032	N/A	N/A
36th	0,021	0,007	0,023	0,073	0,026	0,079	N/A	N/A
37th	0,006	0,028	0,031	0,019	0,098	0,105	N/A	N/A
38th	0,019	0,006	0,016	0,064	0,021	0,057	N/A	N/A
39th	0,024	0,004	0,024	0,083	0,013	0,082	N/A	N/A
40th	0,018	0,006	0,019	0,062	0,021	0,065	N/A	N/A
THD_{40}	-	-	-	0,786	0,645	0,801	23%	13%
PWHD	-	-	-	2,562	2,297	2,628	23%	22%

Power Quality. Harmonics.

SUN-18K-G04

Generating Unit rating per phase (rpp)								
	At 100% of rated output 18,00 kW							
Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	25,859	25,980	26,089	--	--	--	--	--
2nd	0,150	0,100	0,015	0,573	0,385	0,058	8%	8%
3rd	0,049	0,018	0,002	0,188	0,067	0,008	21,6%	N/A
4th	0,030	0,013	0,004	0,115	0,050	0,014	4%	4%
5th	0,112	0,091	0,007	0,428	0,350	0,025	10,7%	10,7%
6th	0,024	0,016	0,003	0,093	0,063	0,012	2,67%	2,67%
7th	0,024	0,030	0,005	0,093	0,114	0,018	7,2%	7,2%
8th	0,026	0,027	0,004	0,099	0,103	0,016	2%	2%
9th	0,015	0,011	0,002	0,059	0,041	0,008	3,8%	N/A
10th	0,049	0,019	0,004	0,187	0,073	0,014	1,6%	1,6%
11th	0,131	0,100	0,014	0,502	0,383	0,052	3,1%	3,1%
12th	0,025	0,014	0,003	0,095	0,052	0,010	1,33%	1,33%
13th	0,105	0,080	0,011	0,402	0,308	0,043	2%	2%
14th	0,013	0,016	0,026	0,049	0,061	0,101	N/A	N/A
15th	0,014	0,010	0,016	0,054	0,039	0,061	N/A	N/A
16th	0,015	0,012	0,009	0,057	0,045	0,033	N/A	N/A
17th	0,035	0,047	0,047	0,133	0,179	0,182	N/A	N/A
18th	0,024	0,010	0,032	0,093	0,038	0,124	N/A	N/A
19th	0,048	0,037	0,025	0,183	0,141	0,095	N/A	N/A
20th	0,034	0,004	0,035	0,132	0,017	0,133	N/A	N/A
21th	0,029	0,006	0,023	0,110	0,022	0,087	N/A	N/A
22th	0,022	0,009	0,027	0,085	0,034	0,104	N/A	N/A
23th	0,036	0,012	0,037	0,137	0,047	0,141	N/A	N/A
24th	0,018	0,007	0,021	0,068	0,026	0,082	N/A	N/A
25th	0,033	0,024	0,044	0,126	0,092	0,169	N/A	N/A
26th	0,022	0,004	0,020	0,086	0,015	0,077	N/A	N/A
27th	0,018	0,006	0,022	0,069	0,022	0,082	N/A	N/A
28th	0,021	0,004	0,023	0,082	0,015	0,087	N/A	N/A
29th	0,015	0,033	0,030	0,056	0,127	0,115	N/A	N/A
30th	0,020	0,004	0,022	0,077	0,016	0,083	N/A	N/A
31th	0,037	0,028	0,028	0,140	0,106	0,109	N/A	N/A
32th	0,018	0,003	0,018	0,070	0,013	0,068	N/A	N/A
33th	0,021	0,006	0,020	0,079	0,024	0,077	N/A	N/A
34th	0,018	0,004	0,020	0,068	0,016	0,075	N/A	N/A
35th	0,050	0,037	0,025	0,190	0,142	0,094	N/A	N/A
36th	0,019	0,004	0,017	0,073	0,014	0,065	N/A	N/A
37th	0,018	0,035	0,046	0,071	0,132	0,177	N/A	N/A
38th	0,013	0,006	0,018	0,048	0,021	0,067	N/A	N/A
39th	0,021	0,008	0,021	0,082	0,032	0,082	N/A	N/A
40th	0,016	0,005	0,013	0,062	0,019	0,048	N/A	N/A
THD_{40}	-	-	-	1,147	0,837	0,547	23%	13%
PWHD	-	-	-	2,640	1,923	2,737	23%	22%

Power Quality. Harmonics.

SUN-18K-G04

Generating Unit rating per phase (rpp)								
	At 45 - 55% of rated output 9,00 kW							
Harmonic	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in %	
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
1st	12,916	13,006	13,078	--	--	--	--	--
2nd	0,117	0,049	0,122	0,447	0,186	0,468	8%	8%
3rd	0,029	0,014	0,014	0,109	0,053	0,054	21,6%	N/A
4th	0,023	0,012	0,016	0,090	0,045	0,062	4%	4%
5th	0,054	0,052	0,018	0,207	0,201	0,069	10,7%	10,7%
6th	0,011	0,008	0,009	0,041	0,032	0,033	2,67%	2,67%
7th	0,036	0,021	0,026	0,138	0,079	0,100	7,2%	7,2%
8th	0,057	0,026	0,061	0,219	0,101	0,232	2%	2%
9th	0,015	0,007	0,009	0,058	0,028	0,034	3,8%	N/A
10th	0,037	0,030	0,059	0,144	0,116	0,226	1,6%	1,6%
11th	0,035	0,049	0,053	0,133	0,188	0,204	3,1%	3,1%
12th	0,011	0,007	0,013	0,044	0,029	0,049	1,33%	1,33%
13th	0,062	0,045	0,049	0,239	0,173	0,188	2%	2%
14th	0,027	0,011	0,025	0,105	0,042	0,094	N/A	N/A
15th	0,027	0,007	0,025	0,105	0,027	0,097	N/A	N/A
16th	0,032	0,015	0,041	0,123	0,058	0,156	N/A	N/A
17th	0,078	0,108	0,095	0,299	0,415	0,365	N/A	N/A
18th	0,022	0,004	0,023	0,085	0,017	0,087	N/A	N/A
19th	0,087	0,089	0,083	0,333	0,341	0,317	N/A	N/A
20th	0,015	0,010	0,024	0,057	0,037	0,091	N/A	N/A
21th	0,021	0,006	0,016	0,080	0,022	0,062	N/A	N/A
22th	0,013	0,004	0,014	0,050	0,014	0,054	N/A	N/A
23th	0,052	0,040	0,031	0,198	0,155	0,120	N/A	N/A
24th	0,023	0,008	0,017	0,089	0,032	0,064	N/A	N/A
25th	0,031	0,031	0,045	0,118	0,121	0,172	N/A	N/A
26th	0,012	0,018	0,029	0,047	0,069	0,113	N/A	N/A
27th	0,017	0,007	0,020	0,065	0,028	0,075	N/A	N/A
28th	0,027	0,009	0,018	0,103	0,035	0,069	N/A	N/A
29th	0,013	0,031	0,029	0,051	0,118	0,110	N/A	N/A
30th	0,021	0,008	0,025	0,080	0,029	0,095	N/A	N/A
31th	0,038	0,028	0,026	0,145	0,107	0,098	N/A	N/A
32th	0,014	0,006	0,019	0,052	0,024	0,071	N/A	N/A
33th	0,019	0,005	0,019	0,074	0,019	0,073	N/A	N/A
34th	0,020	0,005	0,018	0,076	0,020	0,070	N/A	N/A
35th	0,024	0,035	0,011	0,093	0,132	0,044	N/A	N/A
36th	0,019	0,007	0,025	0,072	0,026	0,095	N/A	N/A
37th	0,012	0,029	0,017	0,047	0,110	0,066	N/A	N/A
38th	0,020	0,003	0,020	0,077	0,013	0,076	N/A	N/A
39th	0,024	0,004	0,022	0,091	0,016	0,083	N/A	N/A
40th	0,021	0,005	0,018	0,079	0,019	0,068	N/A	N/A
THD_{40}	-	-	-	0,921	0,761	0,936	23%	13%
PWHD	-	-	-	3,039	2,887	3,118	23%	22%

Power Quality. Power factor.				
Output power	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within ±1,5% of the stated level during the test.
20%	0,9999	0,9998	0,9999	
50%	0,9999	0,9998	0,9999	
75%	0,9999	0,9998	0,9999	
100%	0,9999	0,9998	0,9999	
Limit	>0,95	>0,95	>0,95	

Power Quality. Voltage fluctuation and Flicker.								
	Starting			**Stopping**			**Running**	
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_{st}	P_{lt}
Measured values at test impedance	0,268	0,108	0,00	0,285	0,127	0,00	0,157	0,158
Measured values at standard impedance	0,268	0,108	0,00	0,285	0,127	0,00	0,157	0,158
Values at maximum impedance	0,268	0,108	0,00	0,285	0,127	0,00	0,157	0,158
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	Ω	X_l	0,15	Ω
	Z	0,28	Ω			
Standard impedance	R	0,24	Ω	X_l	0,15	Ω
	Z	0,28	Ω			
Maximum impedance	R	0,24	Ω	X_l	0,15*	Ω
	Z_{max}	0,28	Ω			

Power Quality. DC injection.			
SUN-36K-G04			
Phase 1			
Test level power [%]	10	55	100
Recorded value [mA]	81,91	73,25	92,55
As % of rated AC current [%]	0,16	0,14	0,18
Limit [%]	0,25	0,25	0,25
Phase 2			
Test level power [%]	10	55	100
Recorded value [mA]	85,67	117,96	107,31
As % of rated AC current [%]	0,16	0,23	0,21
Limit [%]	0,25	0,25	0,25
Phase 3			
Test level power [%]	10	55	100
Recorded value [mA]	120,21	101,02	120,60
As % of rated AC current [%]	0,23	0,19	0,23
Limit [%]	0,25	0,25	0,25
Note: Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.			
Sum of all Phases Tests are carried out at three defined power levels ±5%. At 230 V a 36,0 kW three phase Inverter has a current output of 156,52 A so DC limit is 391,30 mA. These tests is undertaken in accordance with Annex A.7.1.4.4. The % DC injection ("as % of rated AC current" below) is calculated as follows: % DC injection = Recorded DC value in Amps / Base current where the base current is the Registered Capacity (W) / V phase. The % DC injection should not be greater than 0,25%.			
Test level power [%]	10	55	100
Recorded value Sum [mA]	287,79	292,23	320.46
As % of rated AC current [%]	0,18	0,19	0,20
Limit [%]	0,25	0,25	0,25

Power Quality. DC injection.			
SUN-18K-G04			
Phase 1			
Test level power [%]	10	55	100
Recorded value [mA]	32,23	47,49	40,88
As % of rated AC current [%]	0,12	0,18	0,16
Limit [%]	0,25	0,25	0,25
Phase 2			
Test level power [%]	10	55	100
Recorded value [mA]	41,57	55,07	46,14
As % of rated AC current [%]	0,16	0,21	0,18
Limit [%]	0,25	0,25	0,25
Phase 3			
Test level power [%]	10	55	100
Recorded value [mA]	57,49	35,44	58,01
As % of rated AC current [%]	0,22	0,14	0,22
Limit [%]	0,25	0,25	0,25
Note: Informative measurement of DC-injection of each phase of the inverter and a limit of 0,25% per phase of the rated current per phase as pass criteria.			
Sum of all Phases Tests are carried out at three defined power levels ±5%. At 230 V a 18,0 kW three phase Inverter has a current output of 78,26 A so DC limit is 195,65 mA. These tests is undertaken in accordance with Annex A.7.1.4.4. The % DC injection ("as % of rated AC current" below) is calculated as follows: % DC injection = Recorded DC value in Amps / Base current where the base current is the Registered Capacity (W) / V phase. The % DC injection should not be greater than 0,25%.			
Test level power [%]	10	55	100
Recorded value Sum [mA]	131,29	138,00	145,03
As % of rated AC current [%]	0,17	0,18	0,19
Limit [%]	0,25	0,25	0,25

Fault level Contribution.					
For a directly coupled SSEG			**For a Inverter SSEG**		
Parameter	**Symbol**	**Value**	**Time after fault**	**Volts [V]**	**Amps [A]**
Peak Short Circuit current	i_p	N/A	20ms	86,19	2,639
Initial Value of aperiodic current	A	N/A	100ms	39,43	1,67
Initial symmetrical short-circuit current*	I_k	N/A	250ms	11,85	0,45
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	8,40	0,41
Reactance/Resistance Ratio of source*	X/R	N/A	**Time to Trip [s]**	0,142	
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 Power Park Module, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.	N/A
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 (Functional safety of the internal automatic disconnection device according to VDE 0126-1-1 / VDE 0124-100).	

Cyber security	**P**
Confirm that the Manufacturer or Installer of the Micro-generator has provided a statement describing how the Micro-generator has been designed to comply with cyber security requirements, as detailed in 9.7.	Yes
Note. Different levels of access, all are password protected, only certain parameters can be changed on maintenance level.	

NINGBO DEYE INVERTER TECHNOLOGY CO.,LTD
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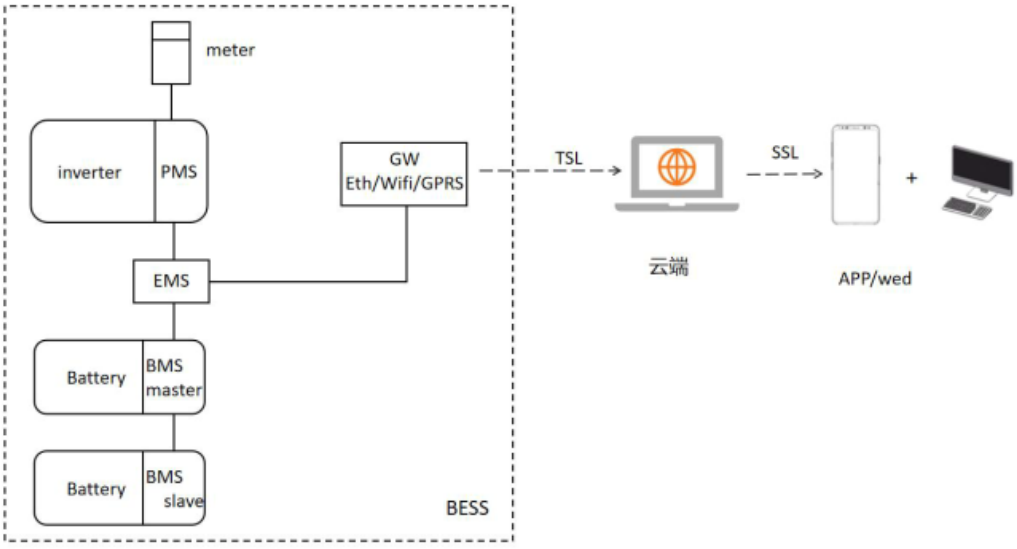
TEL:0086-574-86228957
FAX:0086-574-86228957

Manufacturer's declaration

NingBo Deye Inverter Technology Co.,Ltd.
No.26 South YongJiang Road, Daqi, Beilun, NingBo, China.
The undersigned Bard Dai as Certification Manager of the Company NingBo Deye Inverter Technology Co.,Ltd.On behalf of the same Company declares the following:

The inverter in accordance with the requirements of G98-Amd. 6 (2021-09) standard Sec.s 9.7.1, 9.7.2, and G99-Amd. 8 (2021-09) standard Sec.s 9.1.7, 9.1.8 regarding "Cyber Security"

The NingBo Deye Inverter Technology Co.,Ltd. Battery Energy Storage Systems (BESS) include a system of internal and external logic communications as summarized in the following scheme:



where the main components involved and their main functions are explained in the following table:

acronym/ name	*meaning*	*function*	*location*
PMS	Power Management System	monitoring and management of power fluxes through the inmverter, execution of EMS's commands or local logic functions depending on grid parameters values *Note: The PMS performs operational safety functions aimed at prevent physical damage/harm, typically by interrupting currents and/or opening contacts on some inverter ports when voltage, current or temperature limits are violated; no safety operation performed by PMS can be compromised/skypped by commands/signals originating outside the inverter.*	inverter
BMS	Battery Management System	monitoring of cells's status, execution of PMS's commands within safety conditions *Note: The BMS performs operational safety functions aimed at prevent physical damag/harm, typically by interrupting currents and/or opening contacts on some battery or BMS ports when voltage, current or temperature limits are violated; no safety operation performed by BMS can be compromised/skypped by commands/signals originating outside the BMS and batteries.*	battery
EMS	Energy Management System	monitoring of all field's measures, calculus of power and currents for every component of the system, reception of external commands, transmission of commands to PMS. *Note: No operational safety function aimed at preventing physical damage/harm is performed by the EMS; no operation performed by EMS can force the operational safety functions performed by BMS, PMS and electrical protections.*	Monitor Board
GW	Gate-Way	transmission of data to cloud server, reception of commands/settings from external stakeholder	Stick Logger
Meter	External Power Meter	meter at AC port of third party generator/inverter, for power measures	Meter

1) All communications between internal components of the BESS, and between EMS and supplied External Power Meter(s), take place via appropriate serial lines (RS485, CanBus) and are not directly connected to any device or system outside the BESS.

2) The only communication port between the BESS and the outside is constituted by the he Gate-Way layer (GW) on the machine; the communication between BESS and the outside world can take place via an Ethernet line, WiFi or GPRS router according to the customer's request.
The BESS is a not-constrained customer IoT device according to the definitions in ETSI EN 303 645 sec. 3.1.

3) The direct recipients/senders of communications with the BESS is the in-cloud server –the communication is made secure by the use of TSL (Transport Layer Security) techology on GW, and by the use of SSL (Secure Sockets Layer) technology on Final User's device side and web-tools side;

4) The cyber-security assessment of the BESS was performed according to the ETSI EN 303 645 standard, and it is reported according to the Table B.1 form of the same standard:

EN 303 645 v2.1.1 (2020-06) Table B.1: Implementation of provisions for consumer IoT security			
Clause number and title			
Reference	Status	Support	Detail
5.1 No universal default passwords			
Provision 5.1-1	M C (1)	N/A	Device don not permit final user's login
Provision 5.1-2	M C (2)	N/A	
Provision 5.1-3	M	N/A	
Provision 5.1-4	M C (8)	N/A	
Provision 5.1-5	M C (5)	N/A	
5.2 Implement a means to manage reports of vulnerabilities			
Provision 5.2-1	M	Y	
Provision 5.2-2	R	Y	
Provision 5.2-3	R	Y	
5.3 Keep software updated			
Provision 5.3-1	R	Y	
Provision 5.3-2	M C (5)	Y	
Provision 5.3-3	M C (12)	Y	
Provision 5.3-4	R C (12)	Y	The manufacturer manages the updates of the systems by means of remote automatisms, selectively by type of machine or by activating special functions at the request of the user
Provision 5.3-5	R C (12)	N	see note at 5.3-4
Provision 5.3-6	R C (9, 12)	N	see note at 5.3-4

EN 303 645 v2.1.1 (2020-06) Table B.1: Implementation of provisions for consumer IoT security			
Clause number and title			
Reference	Status	Support	Detail
Provision 5.3-7	M C (12)	Y	
Provision 5.3-8	M C (12)	N	see note at 5.3-4
Provision 5.3-9	R C (12)	N	
Provision 5.3-10	M (11, 12)	Y	
Provision 5.3-11	R C (12)	N	
Provision 5.3-12	R C (12)	N	
Provision 5.3-13	M	Y	
Provision 5.3-14	R C (3, 4)	N/A	not constrained device
Provision 5.3-15	R C (3, 4)	N/A	not constrained device
Provision 5.3-16	M	Y	
5.4 Securely store sensitive security parameters			
Provision 5.4-1	M	Y	
Provision 5.4-2	M C (10)	Y	
Provision 5.4-3	M	N/A	hard-coded identity not used in source code
Provision 5.4-4	M	Y	
5.5 Communicate securely			
Provision 5.5-1	M	Y	
Provision 5.5-2	R	Y	
Provision 5.5-3	R	Y	
Provision 5.5-4	R	N	
Provision 5.5-5	M	Y	
Provision 5.5-6	R	Y	
Provision 5.5-7	M	Y	
Provision 5.5-8	M	Y	
5.6 Minimize exposed attack surfaces			
Provision 5.6-1	M	Y	
Provision 5.6-2	M	Y	
Provision 5.6-3	R	Y	
Provision 5.6-4	M C (13)	N/A	no debug interface accessible
Provision 5.6-5	R	Y	
Provision 5.6-6	R	Y	
Provision 5.6-7	R	Y	
Provision 5.6-8	R	N	
Provision 5.6-9	R	Y	
5.7 Ensure software integrity			
Provision 5.7-1	R	N	
Provision 5.7-2	R	N	
5.8 Ensure that personal data is secure			
Provision 5.8-1	R	N/A	no personal data transit through BESS hw/sw
Provision 5.8-2	M	Y	applicable to server/cloud services and to the customer App for mobile devices
Provision 5.8-3	M	Y	
5.9 Make systems resilient to outages			
Provision 5.9-1	R	Y	
Provision 5.9-2	R	Y	
Provision 5.9-3	R	Y	
5.10 Examine system telemetry data			
Provision 5.10-1	R C (6)	N	

EN 303 645 v2.1.1 (2020-06) Table B.1: Implementation of provisions for consumer IoT security			
Clause number and title			
Reference	Status	Support	Detail
5.11 Make it easy for users to delete user data			
Provision 5.11-1	M	N/A	
Provision 5.11-2	R	N/A	
Provision 5.11-3	R	N/A	
Provision 5.11-4	R	N/A	
5.12 Make installation and maintenance of devices easy			
Provision 5.12-1	R	Y	
Provision 5.12-2	R	Y	
Provision 5.12-3	R	Y	
5.13 Validate input data			
Provision 5.13-1	M	Y	
6 Data protection provisions for consumer IoT			
Provision 6.1	M	N/A	no personal data transit through BESS hw/sw
Provision 6.2	M C (7)	N/A	
Provision 6.3	M	N/A	
Provision 6.4	R C (6)	N/A	
Provision 6.5	M C (6)	N/A	

Conditions:

1) passwords are used;
2) pre-installed passwords are used;
3) software components are not updateable;
4) the device is constrained;
5) the device is not constrained;
6) telemetry data being collected;
7) personal data is processed on the basis of consumers' consent;
8) the device allowing user authentication;
9) the device supports automatic updates and/or update notifications;
10) a hard-coded unique per device identity is used for security purposes;
11) updates are delivered over a network interface;
12) an update mechanism is implemented;
13) a debug interface is physically accessible.

Status' Column:

M	Mandatory provision
R	Recommended provision
M C	Mandatory and conditional provision
R C	Recommended and conditional provision

Support' Column:

Y	Implemented
N	Not implemented
N/A	Not applicable

宁波德业变频技术有限公司
NINGBO DEYE INVERTER TECHNOLOGY CO.,LTD.

Bard Dai
Senior Standard and Certification Engineer
On behalf of NingBo Deye Inverter Technology Co.,Ltd.
December 3,2021
Place: NingBo, China

Logic Interface (input port) Required by paragraph 11.1.3.1	**P**
Confirm that an input port is provided and can be used to reduce the Active Power output to zero	Yes
Note. Manufacturer information provided.	
Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal	Yes

The inverter has a DRM logical port,A 15K resistor needs to be connected to PIN 5 of the DRM port. The connection between PIN 1 and PIN 6 can be controlled by a switch, When the switch is closed, the inverter will reduce the active power to 0 within 5 seconds.