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Certificate G83/2

Engineering Recommendation

Manufacturer	PowerFlow Energy Ltd
Address	Netherwood Road, Rotherwas Industrial Est, Hereford, Herefordshire, HR2 6JU, (UK)

Type Tested Reference Number	G83/2 01 20731-140244
Generating Unit Technology	Single Phase Inverter
Test House Details	Euro Test Laboratories
Test Date	12/11/2014

Type Tested Reference Number	G83/2 01 20731-140244
Generating Unit Technology	Single Phase Inverter
Test House Details	Euro Test Laboratories
Test Period	Start: 03/10/2014 until: 13/01/2015

Product Type Reference	**Max. Apparent AC Power (VA)**	**Rated AC Power (W)**	**Firmware Version**
Sundial M SDM-1.5/500	580	520	FM2.87
Sundial S SDS-1.5/500	580	520	FM2.87
Sundial S SDS-0.75/250	290	260	FM2.87

The results of the G83/2 testing program are summarised in this certificate. PowerFlow Energy Ltd declares that all units shipped in the UK, with the firmware version specified, are within the specifications and parameters set by G83/2 engineering recommendation. These settings cannot be changed by an installer, user or any other person other than PowerFlow Energy Ltd.

Up to 7 Sundial devices of 500W output can be connected together (total of 3500W) per phase under G83/2.

Test Results

Power Quality: Harmonic

Power Quality. Harmonics					
SSEG rating per phase (rpp)			0.25	kW	NV=MV*3.68/rpp
Harmonic	At 50% of rated output		100% of rated output		
	Measured Value (MV) (A)	Normalised Value (MV) (A)	Measured Value (MV) (A)	Normalised Value (NV) (A)	Limit in CEI EN 61000-3-2 (A)
1	0.539	7.928	1.116	16.428	-
2	0.002	0.033	0.004	00.57	1.080
3	0.017	0.249	0.030	0.444	2.300
4	0.008	0.117	0.007	0.102	0.430
5	0.001	0.018	0.004	0.052	1.140
6	0.003	0.038	0.003	0.047	0.300
7	0.004	0.052	0.006	0.082	0.770
8	0.001	0.017	0.003	0.050	0.230
9	0.003	0.044	0.004	0.052	0.400
10	0.002	0.023	0.002	0.034	0.184
11	0.002	0.036	0.004	0.059	0.230
12	0.002	0.027	0.002	0.034	0.153
13	0.002	0.034	0.003	0.045	0.210
14	0.002	0.027	0.002	0.036	0.131
15	0.002	0.031	0.003	0.047	0.150
16	0.002	0.030	0.003	0.049	0.115
17	0.002	0.024	0.003	0.045	0.132
18	0.002	0.030	0.003	0.050	0.102
19	0.002	0.024	0.003	0.038	0.118
20	0.002	0.030	0.004	0.056	0.092
21	0.001	0.021	0.003	0.041	0.107
22	0.002	0.029	0.004	0.052	0.084

Test Results

Power Quality

Harmonic	Measured Value (MV) (A)	Normalised Value (MV) (A)	Measured Value (MV) (A)	Normalised Value (NV) (A)	Limit in CEI EN 61000-3-2 (A)
23	0.001	0.019	0.002	0.030	0.098
24	0.002	0.033	0.003	0.049	0.077
25	0.001	0.022	0.002	0.027	0.090
26	0.002	0.032	0.004	0.053	0.071
27	0.001	0.018	0.003	0.038	0.083
28	0.002	0.028	0.003	0.050	0.066
29	0.001	0.018	0.002	0.034	0.078
30	0.002	0.027	0.003	0.045	0.061
31	0.001	0.018	0.002	0.034	0.073
32	0.002	0.025	0.003	0.040	0.058
33	0.001	0.017	0.002	0.031	0.068
34	0.002	0.024	0.003	0.040	0.054
35	0.001	0.018	0.003	0.038	0.064
36	0.002	0.022	0.003	0.045	0.051
37	0.001	0.016	0.002	0.035	0.061
38	0.001	0.021	0.002	0.036	0.048
39	0.001	0.017	0.002	0.030	0.058
40	0.001	0.020	0.003	0.043	0.046

Test Results

Power Quality: Voltage Fluctuations and Flicker

Power Quality. Voltage Fluctuations and Flicker								
	Starting			Stopping			Running	
	d_{max}	d_c	$D_{(t)}$	d_{max}	d_c	$D_{(t)}$	P_{st}	P_{it} 2 hours
Measured Values	0.239	0.185	0	0.117	0.04	0	0.028	0.017
Normalised to standard impedance and 3.68kW for multiple units.	0.203	0.157	0	0.099	0.034	0	0.024	0.014
Limits set under EN 61000-3-2	4%	3.30%	3.30% 500ms	4%	3.30%	3.30% 500ms	1	0.65

Power Quality. DC injection			
Test Power Level	**10%**	**55%**	**100%**
Recorded Value	0.0004	0.0009	0.0004
As % of rated AC Current	0.04	0.08	0.04
Limit	0.25%	0.25%	0.25%

Power Quality. Power Factor			
Voltage	**230**	**216.2**	**253**
Recorded Value	0.999991	0.999998	0.999968
Limit	>0.95	>0.95	>0.95

Test Results

Protection: Grid monitoring and reconnection time

Protection: Frequency and Voltage Tests						
Function	**Setting**		**Trip Test**		**No Trip Tests**	
	Frequency	**Time Delay**	**Frequency**	**Time Delay**	**Frequency / Time**	**Confirm No Trip**
Under Frequency Stage 1	47.5Hz	20s	47.5Hz	20.24s	47.7Hz 25s	No Trip
Under Frequency Stage 2	47Hz	0.5s	46.99Hz	0.532s	47.2Hz 19.98s	No Trip
Under Frequency Stage 3					46.8Hz 0.48s	No Trip
Over Frequency Stage 1	51.5Hz	90s	51.51Hz	90s	51.3Hz 95s	No Trip
Over Frequency Stage 2	52Hz	0.5s	52.01Hz	0.532s	51.8Hz 89.98s	No Trip
Over Frequency Stage 3					52.2Hz 0.48s	No Trip
Function	**Setting**		**Trip Test**		**No Trip Tests**	
	Voltage	**Time Delay**	**Voltage**	**Time Delay**	**Voltage / Time**	**Confirm No Trip**
Under Voltage Stage 1	200.1V	2.5s	199.3V	2.55s	204.1V 3.5s	No Trip
Under Voltage Stage 2	184V	0.5s	183.79V	0.532s	188V 2.48s	No Trip
Under Voltage Stage 3					180V 0.48s	No Trip
Over Voltage Stage 1	262.2V	1.0s	261.6V	1.03s	258.2V 2.0s	No Trip
Over Voltage Stage 2	273.7V	0.5s	273.71V	0.531s	269.7V 0.98s	No Trip
Over Voltage Stage 3					277.7V 0.48s	No Trip

Test Results

Protection: Grid monitoring and reconnection time

Protection. Re-connection Timer					
Time Delay Setting	**Measured Delay**	**Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits.**			
20s	31.95s	At 266.2V	At 196.1V	At 47.4Hz	At 51.6Hz
Confirmation that the SSEG does not re-connect.		No Reconnection	No Reconnection	No Reconnection	No Reconnection

Protection. Loss of Mains Test						
Test Power and Imbalance	**33% -5%Q**	**66% -5%Q**	**100% -5%P**	**33% +5%Q**	**66% +5%Q**	**100% +5%P**
Trip Time	413.4ms	412.2ms	413.2ms	414.4ms	412.4ms	415.2ms

Protection. Frequency Change, Stability Test				
	Start Frequency	**Change**	**End Frequency**	**Confirm No Trip**
Positive Vector Shirt	49.5Hz	+9 Degrees	-	No Trip
Negative Vector Shift	50.5Hz	-9 Degrees	-	No Trip
Positive Vector Shirt	49.5Hz	+0.19Hz/sec	51.5Hz	No Trip
Negative Vector Shift	50.5Hz	-0.19Hz/sec	47.5Hz	No Trip

Protection. Fault Level Contribution					
For a Directly Coupled SSEG			**For an Inverter SSEG**		
Parameter	**Symbol**	**Value**	**Time After Fault**	**Volts**	**Amps**
Peak Short Circuit Current	Ip	7.15A	20ms	0.4	0.106
Initial Value of Aperiodic Current	A	-	100ms	0	0
Initial Symmetrical Short-Circuit Current	Ik	7.15A	250ms	0	0
Decaying (aperiodic) Component of Short Circuit Current	iDC	-	500ms	0	0
Reactance/Resistance Ration of Source	X/R	2.5	Time to Trip	0.122	In seconds