

Certificate G59/3

Engineering Recommendation

The results of the G59/3 test are summarized in this certificate. Delta Energy Systems (Germany) GmbH declares that devices shipped to the UK comply with the requirements defined in engineering recommendation G59/3 :2013.

Hereby tests Delta Energy Systems internal test results for Solivia three phase and Grid Tied Inverters.

	Max. apparent power (VA)	Rated AC power (VA)
SOLIVIA 15 EU G4 TL EOE48010362	15750	15000
SOLIVIA 20 EU G4 TL EOE48010364	21000	20000
SOLIVIA 30 EU T4 TL EOE48030458	30000*	30000

Note that all tests were carried out on the largest inverter of the family under tests. The results for the other inverters of the family are equivalent.

These settings are available when inverter runs at least with following FW components, or upper:

RED \geq 1.50 / DSP \geq 2.16 / COMM \geq 2.20

Delta Energy Systems (Germany) GmbH can only certify performances related to inverters (not for requirements related to the solar plant system).

Teningen, December 2nd, 2014



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Product Management LOB SPE



ppa. Andreas Hoischen
Head of LOB SPE

**max possible power can be set to 31.5KVA by setting tunings*

DELTA ENERGY SYSTEMS (GERMANY) GMBH
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Reg.-Nr.: 00023

1.1. Harmonics

Harmonics as per BS EN 61000-3-12							
Order	Freq. (Hz)	P/Pn(%)				Limit I/In (%) / Results	
		50%		100%			
		Measured (A) / (%)		Measured (A) / (%)			
2	100	0,06	0,14%	0,048	0,11%	8,0%	Ok
3	150	0,011	0,03%	0,037	0,09%	N/A	-
4	200	0,043	0,10%	0,039	0,09%	4,0%	Ok
5	250	0,184	0,43%	0,106	0,25%	10,7%	Ok
6	300	0,06	0,14%	0,055	0,13%	2,7%	Ok
7	350	0,146	0,34%	0,084	0,20%	7,2%	Ok
8	400	0,042	0,10%	0,035	0,08%	2,0%	Ok
9	450	0,017	0,04%	0,016	0,04%	N/A	-
10	500	0,012	0,03%	0,018	0,04%	1,6%	Ok
11	550	0,04	0,09%	0,105	0,24%	3,1%	Ok
12	600	0,007	0,02%	0,011	0,03%	1,3%	Ok
13	650	0,215	0,50%	0,124	0,29%	2,0%	Ok
14	700	0,01	0,02%	0,009	0,02%	-	-
15	750	0,011	0,03%	0,02	0,05%	-	-
16	800	0,021	0,05%	0,017	0,04%	-	-
17	850	0,1	0,23%	0,057	0,13%	-	-
18	900	0,02	0,05%	0,018	0,04%	-	-
19	950	0,118	0,27%	0,136	0,32%	-	-
20	1000	0,021	0,05%	0,015	0,03%	-	-
21	1050	0,006	0,01%	0,013	0,03%	-	-
22	1100	0,007	0,02%	0,011	0,03%	-	-
23	1150	0,075	0,17%	0,07	0,16%	-	-
24	1200	0,002	0,00%	0,006	0,01%	-	-
25	1250	0,031	0,07%	0,044	0,10%	-	-
26	1300	0,003	0,01%	0,004	0,01%	-	-
27	1350	0,006	0,01%	0,01	0,02%	-	-
28	1400	0,005	0,01%	0,005	0,01%	-	-
29	1450	0,047	0,11%	0,042	0,10%	-	-
30	1500	0,004	0,01%	0,006	0,01%	-	-
31	1550	0,023	0,05%	0,036	0,08%	-	-
32	1600	0,006	0,01%	0,005	0,01%	-	-
33	1650	0,001	0,00%	0,006	0,01%	-	-
34	1700	0,004	0,01%	0,007	0,02%	-	-
35	1750	0,024	0,06%	0,028	0,07%	-	-
36	1800	0,001	0,00%	0,003	0,01%	-	-
37	1850	0,021	0,05%	0,028	0,07%	-	-
38	1900	0,001	0,00%	0,005	0,01%	-	-
39	1950	0,001	0,00%	0,009	0,02%	-	-
40	2000	0,003	0,01%	0,005	0,01%	-	-
THD	-	1.77%	-	0,71%	-	-	-
PWHD	-	3.94%	-	2.07%	-	-	-

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1.2. Power Quality

Voltage fluctuations and flicker as per BS EN 61000-3-11								
	Starting			Stopping			Running	
	dmax	Dc	d(t) in ms	dmax	dc	d(t) in ms	Pst	Plt (2h)
Limits under BS EN 61000 3-11	4%	3.3%	3.3% / 500ms	4%	3.3%	3.3% / 500ms	1.0	0.65
Measured	0.244%	0.031%	0	0.258%	0.031%	0	0.198	0.126
Verification	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok
Test Impedance	0.133+0.0833j			0.133+0.0833j				

Dc Injection			
	P/Pn (%)		
	10 %	55 %	100%
Limit	0.25%In	0.25%In	0.25%In
measured	11.6mA	-52mA	-67mA
%Inom	0.026%	0.119%	0.154%
Verification	Ok	Ok	Ok

Power factor			
	Voltage (V)		
	216.4V	230V	253V
Limit	0.95	0.95	0.95
measured	0.996	0.996	0.996
Verification	Ok	Ok	Ok

1.3. Protection – Grid monitoring and reconnection time

Trip Tests	G59/3		Settings		Measures Values		Verification
	Magnitude	Time	Magnitude	Time	Magnitude	Time	
UnderVoltage stage1	200.1V	2.5s	200.1V	2.5s	200.1	2.5s	Ok
UnderVoltage stage2	184V	0.5s	184V	0.5s	183.9	0.5s	Ok
OverVoltage stage1	262.2V	1s	262.2V	1s	262.8V	1.0s	Ok
OverVoltage stage2	273.7V	0.5s	273.7V	0.5s	274.2V	0.5s	Ok
UnderFrequency stage1	47.5Hz	20s	47.5Hz	20s	47.5Hz	20s	Ok
UnderFrequency stage2	47Hz	0.5s	47Hz	0.5s	47Hz	0.5s	Ok
OverFrequency stage1	51.5Hz	90s	51.5Hz	90s	51.5Hz	91s	Ok
OverFrequency stage2	52Hz	0.5s	52Hz	0.5s	52Hz	0.5s	Ok

No Trip test	G59/3		Verification
	Magnitude	Time	
UnderVoltage 1	204.1V	3.5s	Ok
UnderVoltage 2	188V	2.48s	Ok
UnderVoltage 3	180V	0.48s	Ok
OverVoltage 1	258.2V	2s	Ok
OverVoltage 2	269.7V	0.98s	Ok
OverVoltage 3	277.7V	0.48s	Ok

No Trip test	G59/3		Verification
	Magnitude	Time	
UnderFreq 1	47.7Hz	25s	Ok
UnderFreq 2	47.2Hz	19.98s	Ok
UnderFreq 3	46.8Hz	0.48s	Ok
OverFreq 1	51.3Hz	95s	Ok
OverFreq 2	51.8Hz	89.98s	Ok
OverFreq 3	52.2Hz	0.48s	Ok

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Reconnection time (Voltage)			
Limit	Settings	Measured	Verification
20s	20s	29.36s	Ok

No reconnection			
266.2V	196.1V	47.4Hz	51.6Hz
Ok	Ok	Ok	Ok

Reconnection time (Frequency)			
Limit	Settings	Measured	Verification
20s	20s	29.59s	Ok

1.4. Protection – Loss of main

Test Power	25%	50%	100%	25%	50%	100%
Balancing load on island	95% of generating unit output			105% of generating unit output		
Trip time limit :0.5s	174ms	100.6ms	195ms	151.4ms	99.6ms	177.6ms
Phase1 removed	Phase2 removed		Phase3 removed			
Trip confirmed	Trip confirmed		Trip confirmed			

Protection Frequency change, stability test	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49.5Hz	+9 degrees	na	No Trip
Negative Vector Shift	50.5Hz	-9 degrees	na	No Trip
Positive Frequency Shift	49.5Hz	+0.19Hz/sec	51.5Hz	No Trip
Negative Frequency Shift	50.5Hz	-0.19Hz/sec	47.5Hz	No Trip

Fault Level contribution	Volts	Amps r.m.s
Tine after Fault		
20ms	27,04V	28,05
100ms	27,06V	N/A
250ms	27,06V	N/A
500ms	27,06V	N/A
Time to trip (s)	0.074	

Self-Monitoring – Solid state switching
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 0.5seconds.
Note: Units 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