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

## Certificate of compliance

**Applicant:** **Delta Energy Systems Germany) GmbH**  
Tscheulinstraße 21  
79331 Teningen  
**Germany**

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

**Model:** SOL2.0-1TR1-G4, SOL2.5-1TR1-G4,  
SOL3.0-1TR1-G4, SOL3.3-1TR1-G4,  
SOL3.6-1TR1-G4, Solivia 2.0 EUG4 TR,  
Solivia 2.5 EUG4 TR, Solivia 3.0 EUG4 TR,  
Solivia 3.3 EUG4 TR, Solivia 3.6 EUG4 TR

### Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G83/2 for photovoltaic systems with a single-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 G83/2:2012

Recommendations for the Connection of Type Tested Small-scale Embedded Generators (Up to 16A per Phase) in Parallel with Low-Voltage Distribution Systems

#### DIN V VDE V 0126-1-1:2006-02 (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:** 11TH0316-G83/2  
**Certificate number:** U14-0037  
**Date of issue:** 2014-01-27    **Valid until:** 2017-01-26

### Certification body

Dieter Zitzmann



Deutsche  
Akkreditierungsstelle  
D-ZE-12024-01-01



QUALITY



HEALTH



SAFETY



ENVIRONMENT



SOCIAL  
ACCOUNTABILITY

**Appendix 4 Type Verification Test Report**  
 Extract from test report according the Engineering Recommendation G83/2 Nr. 11TH0316

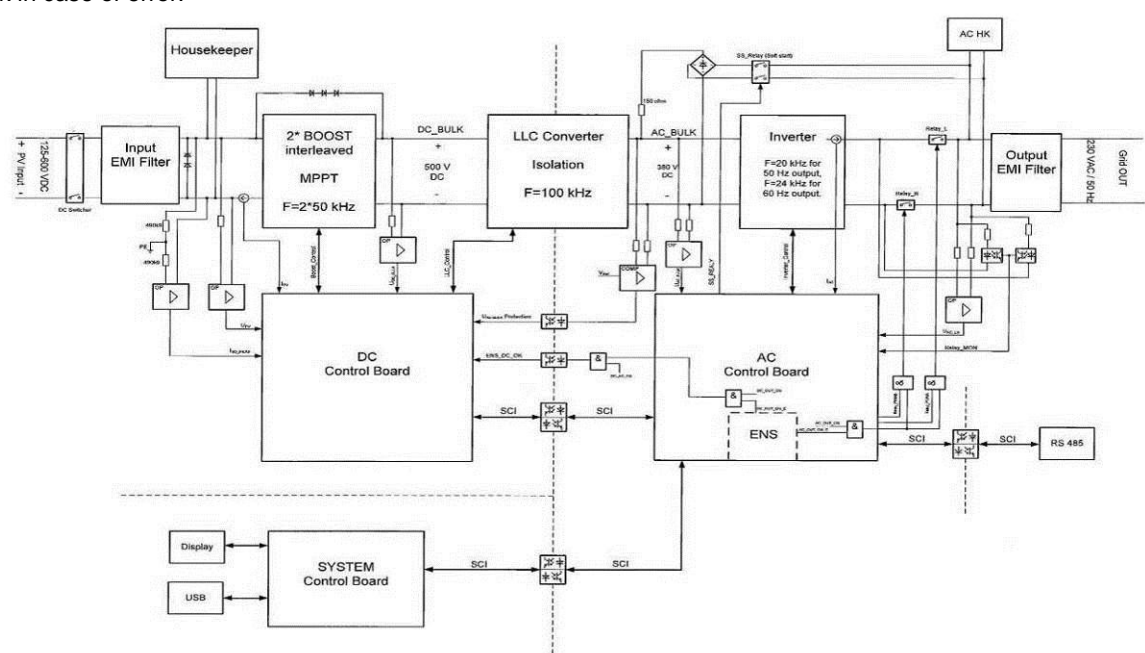
Type Approval and declaration of compliance with the requirements of Engineering Recommendation G83/2.					
<b>Manufacturer / applicant:</b>	<b>Delta Electronics (Thailand) Public Co., Ltd.</b> 909 Soi 9, Moo 4, Bangpoo Industrial Estate (E. P. Z), Pattana 1 Rd., Tambol Phraksa, Amphur Muang, Samutprakarn 10280 Thailand				
<b>SSEG Type</b>	<b>Grid-tied photovoltaic inverter</b>				
<b>Rated values</b>	SOL2.0-1TR1-G4	SOL2.5-1TR1-G4	SOL3.0-1TR1-G4	SOL3.3-1TR1-G4	SOL3.6-1TR1-G4
<b>Maximum rated capacity</b>	2000 VA	2500 VA	3000 VA	3300 VA	3600 VA
<b>Rated voltage</b>	230 Vac / 50 Hz L/N/PE				
<b>Rated values</b>	Solivia 2.0 EUG4TR	Solivia 2.5 EUG4TR	Solivia 3.0 EUG4TR	Solivia 3.3 EUG4TR	Solivia 3.6 EUG4TR
<b>Maximum rated capacity</b>	2000 VA	2500 VA	3000 VA	3300 VA	3600 VA
<b>Rated voltage</b>	230 Vac / 50 Hz L/N/PE				
<b>Firmware version</b>	AC: 00.35.63 DC: 00.35.63 SYS: 01.02.36 ENS: 00.35.63*				

\* The tests were performed with Firmwareversion AC: 00.35.63 DC: 00.35.63 SYS: 01.02.36 ENS: 00.35.63. Changes in the Firmwareversion on position 00.00.xx has no effect on the required electrical properties.  
 x = could be any number or sign

**Measurement period:** 2014-01-08 until 2014-01-17

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

The power generation unit is equipped with a PV and line-side EMC filter. The power generation unit has galvanic isolation between DC input and AC output (HF transformer). Output switch-off is performed with single-fault tolerance based on series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.



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

The above stated Small Scale Embedded Generators (SSEGs) are tested according the requirements in the Engineering Recommendation G83/2. 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 G83/2.

**Appendix 4 Type Verification Test Report**

Extract from test report according the Engineering Recommendation G83/2

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<b>Protection. Voltage tests.</b>						
The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
<b>U/V stage 1</b>	200,1V	2,5s	198,8 V	2,593 s	204,1V / 3,5s	No trip
<b>U/V stage 2</b>	184V	0,5s	183,2 V	0,599 s	188V / 2,48s	No trip
					180V / 0,48s	No trip
<b>O/V stage 1</b>	262,2V	1,0s	260,5 V	1,097 s	258.2V 2,0s	No trip
<b>O/V stage 2</b>	273,7V	0,5s	271,9 V	0,595 s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip
<p>Note for Voltage tests the Voltage required to trip is the setting <math>\pm 3,45V</math>. 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 <math>\pm 4V</math> and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p>						

<b>Protection. Frequency tests.</b>						
The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.3						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
<b>U/F stage 1</b>	47,5Hz	20s	47,50 Hz	20,10 s	47,7Hz / 25s	No trip
<b>U/F stage 2</b>	47Hz	0,5s	47,00 Hz	0,532 s	47,2Hz / 19,98s	No trip
					46.8Hz / 0,48s	No trip
<b>O/F stage 1</b>	51,5Hz	90s	51,59 Hz	90,08 s	51,3Hz / 95s	No trip
<b>O/F stage 2</b>	52Hz	0,5s	52,00 Hz	0,584 s	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip
<p>Note for Frequency Trip tests the Frequency required to trip is the setting <math>\pm 0,1Hz</math>. 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 <math>\pm 0,2Hz</math> and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p>						



Annex to the G83/2 certificate of compliance No. U14-0037

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**Protection. Loss of Mains.**

The requirement is specified in section 5.3.2, test procedure in Annex A or B 1.3.4

Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.

<b>Balancing load on islanded network</b>	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% Q Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% Q Test 10
<b>Trip time. Ph1 fuse removed</b>	734 ms	90 ms	416 ms	62 ms	68 ms	55 ms

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:  
Panasonic ALFG1PF12 with 10ms

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<b>Protection. Re-connection timer.</b>					
<b>The requirement is specified in section 5.3.4 Automatic Reconnection, test procedure in Annex A or B 1.3.5</b>					
Test should prove that the reconnection sequence starts after a minimum delay of 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 1.					
<b>Voltage</b>					
<b>Time delay setting</b>		<b>Measured delay</b>			
20s		194,86 s			
<b>Frequency</b>					
<b>Time delay setting</b>		<b>Measured delay</b>			
20s		180,95 s			
		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 SSEG does not re-connect.</b>	No reconnection	No reconnection	No reconnection	No reconnection	

<b>Protection. Frequency change, Stability test.</b>				
<b>The requirement is specified in section 5.3.3, test procedure in Annex A or B 1.3.6</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

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Power Quality. Harmonics.						
The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1						
SSEG rating per phase (rpp)				NV=MV*3,68/rpp		
	At 45-55% of rated output 1,80 kW		100% of rated output 3,60 kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit inBS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2nd	0,050	0,051	0,073	0,075	1,080	
3rd	0,190	0,194	0,188	0,192	2,300	
4th	0,029	0,030	0,090	0,092	0,430	
5th	0,035	0,036	0,071	0,073	1,140	
6th	0,005	0,005	0,005	0,005	0,300	
7th	0,024	0,025	0,066	0,067	0,770	
8th	0,018	0,018	0,008	0,008	0,230	
9th	0,061	0,062	0,130	0,133	0,400	
10th	0,008	0,008	0,003	0,003	0,184	
11th	0,044	0,045	0,097	0,099	0,330	
12th	0,005	0,005	0,004	0,004	0,153	
13th	0,041	0,042	0,065	0,066	0,210	
14th	0,004	0,004	0,002	0,002	0,131	
15th	0,033	0,034	0,041	0,042	0,150	
16th	0,003	0,003	0,002	0,002	0,115	
17th	0,028	0,029	0,037	0,038	0,132	
18th	0,004	0,004	0,002	0,002	0,102	
19th	0,002	0,002	0,019	0,019	0,118	
20th	0,004	0,004	0,003	0,003	0,092	
21th	0,022	0,022	0,018	0,018	0,107	0,160
22th	0,002	0,002	0,001	0,001	0,084	
23th	0,016	0,016	0,015	0,015	0,098	0,147
24th	0,003	0,003	0,002	0,002	0,077	
25th	0,011	0,011	0,018	0,018	0,090	0,135

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Power Quality. Harmonics.						
The requirement is specified in section 5.4.1, test procedure in Annex A or B 1.4.1						
SSEG rating per phase (rpp)				NV=MV*3,68/rpp		
	At 45-55% of rated output 1,80 kW		100% of rated output 3,60 kW			
Harmonic	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Measured Value (MV) in Amps	Normalised Value (NV) in Amps	Limit in BS EN61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
26th	0,031	0,032	0,001	0,001	0,071	
27th	0,019	0,019	0,008	0,008	0,083	0,124
28th	0,002	0,002	0,002	0,002	0,066	
29th	0,011	0,011	0,017	0,017	0,078	0,117
30th	0,002	0,002	0,002	0,002	0,061	
31th	0,007	0,007	0,017	0,017	0,073	0,109
32th	0,003	0,003	0,002	0,002	0,058	
33th	0,017	0,017	0,011	0,011	0,068	0,102
34th	0,002	0,002	0,001	0,001	0,054	
35th	0,014	0,014	0,004	0,004	0,064	0,096
36th	0,003	0,003	0,002	0,002	0,051	
37th	0,006	0,006	0,008	0,008	0,061	0,091
38th	0,003	0,003	0,001	0,001	0,048	
39th	0,008	0,008	0,002	0,002	0,058	0,087
40th	0,003	0,003	0,001	0,001	0,046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

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**Power Quality. Power factor.**

The requirement is specified in section 5.6, test procedure in Annex A or B 1.4.2

	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	0,996 c	0,996 c	0,995 c	
Limit	>0,95	>0,95	>0,95	

**Power Quality. Voltage fluctuation and Flicker.**

The requirement is specified in section 5.4.2, test procedure in Annex A or B 1.4.3

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured values	0,29%	3,20%	0%	0,29%	3,2%	0%	0,18	0,18
Normalised to standard impedance and 3.68kW for multiple units	0,30%	3,27%	0%	0,30%	3,27%	0%	0,18	0,18
Limits set under BS EN 61000-3-3	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

**Power Quality. DC injection.**

The requirement is specified in section 5.5, test procedure in Annex A or B 1.4.4

Test level power	10%	55%	100%
Recorded value	25,31 mA	13,73 mA	21,00 mA
As % of rated AC current	0,16 %	0,09 %	0,13 %
Limit	0,25%	0,25%	0,25%



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**Fault level Contribution.**

The requirement is specified in section 5.7, test procedure in Annex A or B 1.4.6

For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	77,83 V	23,05 A
Initial Value of aperiodic current	A	N/A	100ms	72,44 V	10,32 A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	71,63 V	6,54 A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	71,35 V	4,64 A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,020 s	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.