

# Certificate

**Applicant:** Delta Electronics, Inc  
39 Sec.2 Huandong Road  
Shanhua Dist., Tainan City 74144  
Taiwan

**Product:** Photovoltaic Inverter with integrated automatic disconnection device between a generator and the public low-voltage grid

<b>Model:</b>	<b>RPI-M20A</b>	<b>RPI-M15A</b>
<b>Rating:</b>	<b>20,0kW</b>	<b>15,0kW</b>

## Intended use:

An automatic disconnection device with three-phase mains surveillance in accordance with Engineering Recommendation G59/3 for photovoltaic systems with a three-phase parallel coupling via an inverter to the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter.

## Applied standards and guidelines:

**Engineering Recommendation G59/3-1  
Issue 3 Amendment 1 August 2014**

Recommendations for the connection of generating plant to the distribution systems of licensed distribution network operators

The safety concept of an aforementioned representative product corresponds at the time of issue of this certificate to the valid safety specifications for the specified use in accordance with regulations.

**Report No:** 13KFS043-09

**Certificate No:** 14-175-01

**Date of issue:** 2015-01-15



**Andreas Aufmuth**  
Certification Department



**Annex to certificate 14-175-01:**

<b>Power Quality. Harmonics.</b>								
Generating Unit tested to BS EN 61000-3-12								
Generating Unit rating per phase (rpp)			6,67	kVA	Harmonics % = Measured Value (Amps) x 23/rating per phase (kVA)			
Harmonics	At 45-55% of rated output		100% of rated output		Limit in BS EN 61000-3-12			
	Measured Value (MV) in Amps*	%	Measured Value (MV) in Amps*	%	1 phase	3 phase		
2	0,15	0,52	0,17	0,57	8%	8%		
3	0,07	0,24	0,08	0,26	21,6%	Not stated		
4	0,13	0,46	0,14	0,48	4%	4%		
5	0,21	0,73	0,18	0,61	10,7%	10,7%		
6	0,10	0,36	0,10	0,36	2,67%	2,67%		
7	0,14	0,49	0,13	0,45	7,2%	7,2%		
8	0,08	0,29	0,08	0,29	2%	2%		
9	0,03	0,11	0,03	0,11	3,8%	Not stated		
10	0,06	0,20	0,05	0,18	1,6%	1,6%		
11	0,37	1,29	0,42	1,44	3,1%	3,1%		
12	0,04	0,15	0,04	0,13	1,33%	1,33%		
13	0,36	1,25	0,58	1,99	2%	2%		
THD	-	4,82	-	3,04	23%	13%		
PWHD	-	4,97	-	3,69	23%	22%		
<b>Power Quality. Voltage fluctuations and flicker</b>								
	Starting			Stopping from full load			Running	
	d <sub>max</sub>	d <sub>c</sub>	d <sub>(t)</sub>	d <sub>max</sub>	d <sub>c</sub>	d <sub>(t)</sub>	P <sub>st</sub>	P <sub>lt</sub> 2 hours
Measured Values at test impedance	-0,49%	-0,30%	0%	0,5%	0,42%	0%	0,08	0,08
Normalised to standard impedance	-0,49%	-0,30%	0%	0,5%	0,42%	0%	0,08	0,08
Normalised to required maximum impedance	N/A							
Limits set under BS EN 61000-3-11	4%	3,3%	3,3%	4%	3,3%	3,3%	1,0	0,65
Test impedance	R	0,24	Ω	XI	0,15	Ω		
Standard impedance	R	0,24* 0,4^	Ω	XI	0,15* 0,25^	Ω		
Maximum impedance	R	N/A	Ω	XI	N/A	Ω		
<b>Power Quality. DC injection.</b>								
Test power level	10%			55%			100%	
Recorded value in Amps	-9,0 mA			-21,1 mA			-25,3 mA	
As % of rated AC current	-0,03%			-0,07%			-0,09%	
Limit	0,25%			0,25%			0,25%	

Power Quality. Power factor.				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within + or – 1,5% of the stated level during test.
Measured Value	0,997	0,997	0,997	
Limit	>0,95	>0,95	>0,95	

Protection. Frequency tests						
Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20,0s	47,53	20,11	47,7Hz 25s	No trip
U/F stage 2	47,0Hz	0,5s	47,01	0,429	47,2Hz 19,98s	No trip
					46,8Hz 0,48s	No trip
O/F stage 1	51,5Hz	90,0s	51,50	90,0	51,3Hz 95s	No trip
O/F stage 2	52,0Hz	0,5s	52,00	0,497	51,8Hz 89,98s	No trip
					52,2Hz 0,48s	No trip

Protection. Voltage tests						
Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	200,2	2512	204,1V 3,5s	No trip
U/V stage 2	184,0V	0,5s	184,2	521	188,0V 2,48s	No trip
					180,0V 0,48s	No trip
O/V stage 1	262,2V	1.0s	262,5	1009	258,2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	274,3	531	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

### a) Protection. Loss of Mains test and single phase test

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.

Test power and imbalance	33% -5% Q Tests 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time. Limit is 0.5s	275ms	245ms	50ms	270ms	325ms	406ms

Single phase test for multi phase **Generating Units**. Confirm that when generating in parallel with a network operating at around 50Hz with no network disturbance, that the removal of a single phase connection to the **Generating Unit**, with the remaining phases connected causes a disconnection of the generating unit within a maximum of 1s.

Ph 1 removed	Confirm trip Unit trip	Ph 2 removed	Confirm trip Unit trip	Ph 3 removed	Confirm trip Unit trip
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### b) Protection. Frequency change, Stability test.

	Start frequency	Change	End frequency	Confirm no trip
Positive vector shift	49,5Hz	+9 degrees		No trip
Negative vector shift	50,5Hz	-9 degrees		No trip
Positive frequency drift	49,5Hz	+0,19Hz/sec	51,5Hz	No trip
Negative frequency drift	50,5Hz	-0,19Hz/sec	47,5Hz	No trip

### c) Protection. Re-connection timer.

Time delay settings (s)	Measured delay (s)	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 10.5.7.1			
180	180	At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
Confirmation that the <b>Generating Unit</b> does not re-connect		No reconnection	No reconnection	No reconnection	No reconnection

<b>d) Faul Level contribution.</b>					
For machines with electro-magnetic output			For inverter output		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$i_p$		20ms	32,34	0,27
Initial Value of aperiodic current	A		100ms	24,71	0,09
Initial symmetrical short-circuit current	$I_k$		250ms	24,93	0,09
Decaying (aperiodic) component of short-circuit current	$i_{DC}$		500ms	24,71	0,11
Reactance/Resistance Ratio of source	X/R		Time to trip	0,02	In seconds
<b>E) Self Monitoring solid state switching.</b>					
It has been verified that in the event of the solid state switching device failing to disconnect the Generating Plant, the voltage on the output side of the switching device is reduced to a value below 50 volt within 0,5s.					NA