



**BUREAU
VERITAS**

Verklaring van geen bezwaar

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

Product: Fotovoltaïsche Omvormers

Model: RPI H5A_12X*
RPI H5A_02X*
RPI H4A_12X*
RPI H4A_02X*
RPI H3A_12X*
RPI H3A_02X*
*Noot: "X" = 0~9 , A~Z of leeg)

Reglementair voorgeschreven gebruik:

Automatisch schakelstation met enkelfasige netwerkbewaking conform DIN V VDE V 0126-1-1:2006-02 (afwijkende grenswaarden voor Nederland op basis van EN 50438:2013, NEN-EN 50438:2013, Annex A*) voor fotovoltaïsche installaties met een enkelfasige parallelvoeding door middel van gelijkstroom-wisselstroommutator in het net van de openbare voorziening. Het automatische schakelstation vormt een integraal bestanddeel van de hoger vermelde transformatorloze gelijkstroom-wisselstroommutator. Deze dient als vervangmiddel voor een te allen tijde voor de distributienetexploitant ("VNB") toegankelijk schakelstation met scheidingsfunctie.

Controlebasis:

EN 50438:2013, NEN-EN 50438:2013

Eisen voor het aansluiten van microgeneratoren op het openbare laagspanningsnet

DIN V VDE V 0126-1-1:2006-02 (Single fouttolerantie van de bescherming-interface systeem)

Automatisch schakelstation tussen een netparallele zelfopwekinstallatie en het openbare laagspanningsnet

Een representatief testpatroon van het hoger vermelde product voldoet aan de op het moment van de uitreiking van dit attest geldende veiligheidstechnische eisen van de vermelde controlegrondbeginselen voor een reglementair voorgeschreven gebruik.

Rapportnummer: PVNL140529C19-EN50438

Certificaatnummer: U14-0549

Datum: 2014-10-27

Certificatie-instelling

Dieter Zitzmann

Órgão de certificação da Bureau Veritas Consumer Products Services Germany GmbH
Acreditado nos termos da norma EN 45011 - ISO/IEC Guia 65

Appendix E Type Verification Test Report

Extract from test report according to EN 50438

Nr. PVNL140529C19

Type Approval and declaration of compliance with the requirements of EN 50438.

Manufacturer / applicant:	RPI H5A_12X* RPI H5A_02X* RPI H4A_12X* RPI H4A_02X* RPI H3A_12X* RPI H3A_02X*		
	*Noot: "X" = 0~9 , A~Z of leeg)		
Micro-generator Type	Grid-tied photovoltaic inverter		
Rated values	RPI H3A_12X RPI H3A_02X	RPI H4A_12X RPI H4A_02X	RPI H5A_12X RPI H5A_02X
Maximum rated capacity	3,00 kW	4,00 kW	5,00 kW
Rated voltage	230V	230V	230V
Firmware version	Comm: V2.03, DSP: V2.01, RED: V2.00		
Measurement period:	2014-08-08 to 2014-10-08		

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 no galvanic isolation between DC input and AC output. Output switch-off is performed with single-fault tolerance based on two series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.

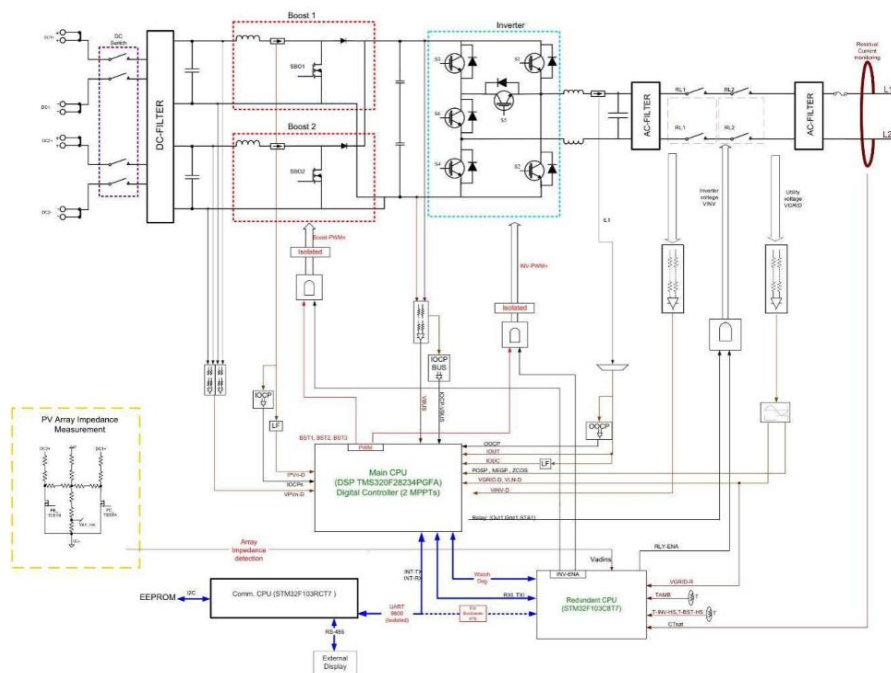


Figure 1 – Schematic structure of the power generation unit

Differences between Micro-generator units:

Difference between models RPI H3A_12X, RPI H4A_12X, RPI H5A_12X and models RPI H3A_02X, RPI H4A_02X, RPI H5A_02X is a DC-switch, which is included in models RPI H3A_12X, RPI H4A_12X, RPI H5A_12X and not in models RPI H3A_02X, RPI H4A_02X, RPI H5A_02X.

The above stated micro-generators are tested according to the requirements in the EN 50438. 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 EN 50438.

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Type testing of the interface protection

Over-/under-voltage tests						
Deviations for Netherlands						
Parameter	Protection limit		Actual setting		Trip value (test result)	
	Voltage [V]	Disconnection time [s]	Voltage [V]	Disconnection time [s]	Voltage [V]	Disconnection time [s]
Over-voltage	253,0	2,00	253,0	2,00	251,0	1,94
Under-voltage	184,0	2,00	184,0	2,00	185,0	1,94

Over-/under-frequency tests						
Deviations for Netherlands						
Parameter	Protection limit		Actual setting		Trip value (test result)	
	Frequency [Hz]	Disconnection time [s]	Frequency [Hz]	Disconnection time [s]	Frequency [Hz]	Disconnection time [s]
Over-frequency	51,00	2,00	51,0	2,00	51,01	1,84
Under-frequency	48,00	2,00	48,0	2,00	47,98	1,88

LoM test						
Standard EN 50438						
Method used	EN 62116					
Balancing load on islanded network	33% of -5% Q	66% of -5% Q	100% of -5% P	33% of +5% Q	66% of +5% Q	100% of +5% P
Trip time. Phase 1 fuse removed	68ms	82ms	128ms	86ms	97ms	129ms
Indicate additional shut down time included in above results. (Integrated interface switch)				Type of switching equipment 1: Song Chuan 841-P-2A-F-C-H with 30ms Type of switching equipment 2: Song Chuan 841-P-2A-F-C-H with 30ms		

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Type testing of a micro-generator

Operating range				
Standard EN 50438				
Test 1: U = 195,5 V; f = 47,5 Hz; P = 1,00 Sn; cosφ = 1				
Test 2: U = 253,0 V; f = 51,5 Hz; P = 1,00 Sn; cosφ = 1				
Test sequence	Voltage [V]	Frequency [Hz]	Output power [W]	Cos φ [1]
1	195,59	47,50	4512	0,9987
2	253,02	51,50	4975	0,9986
Note: During the tests the interface protection was disabled.				

Active power at under-frequency			
Standard EN 50438			
5-min mean value (each)	a) 50 ± 0,01 [Hz]	b) - 0,4 to - 0,5 [Hz]	c) - 2,4 to - 2,5 [Hz]
Frequency [Hz]:	50,00	49,50	47,50
Active power [kW]:	4,972	4,963	4,968
ΔP/PM [%] per 1 Hz:			0,07%

Power response to over-frequency							
Standard EN 50438							
1-min mean value [Hz]:	a) 50,00	b) 50,25	c) 50,70	d) 51,15	e) 50,70	f) 50,25	g) 50,00
1. Measurement a) to g): Active power output > 80% P _n							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
PM [kW]:	N/A	4,502	3,675	2,848	3,675	4,502	N/A
PE60 [kW]:	4,594	4,430	3,624	2,801	3,624	4,430	4,596
ΔPE60/PM [%]:	N/A	-1,58	-1,12	-1,03	-1,10	-1,56	N/A
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P _n							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
PM [kW]:	N/A	2,252	1,838	1,424	1,838	2,252	N/A
PE60 [kW]:	2,297	2,223	1,817	1,392	1,818	2,224	2,296
ΔPE60/PM [%]:	N/A	-0,61	-0,46	-0,71	-0,44	-0,61	N/A
Limit ΔP/P _{1min} :	+ 10 % of P _M						

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Reactive power			
Standard EN 50438			
Uncontrollable reactive power			
Test Voltage	211,6V	230V	248,4V
Output power			
25% PN	0,9974	0,9973	0,9970
50% PN	0,9990	0,9991	0,9991
75% PN	0,9992	0,9993	0,9993
100% PN	0,9993	0,9993	0,9993
Limit	>0,95	>0,95	>0,95

Controllable reactive power				
Standard EN 50438				
Inductive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	246	201	0,78	229
10% - 20%	503	249	0,90	229
20% - 30%	1010	493	0,90	229
30% - 40%	1516	727	0,90	230
40% - 50%	2019	958	0,90	230
50% - 60%	2522	1204	0,90	230
60% - 70%	3023	1440	0,90	230
70% - 80%	3523	1675	0,90	230
80% - 90%	4020	1909	0,90	230
90% - 100%	4471	2124	0,90	230
Capacitive (supply reactive power)				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	246	-61	0,87	229
10% - 20%	978	-484	0,90	229
20% - 30%	1478	-726	0,90	229
30% - 40%	1982	-980	0,90	230
40% - 50%	2475	-1192	0,90	230
50% - 60%	2966	-1435	0,90	230
60% - 70%	3456	-1679	0,90	230
70% - 80%	3945	-1924	0,90	230
80% - 90%	4434	-2170	0,90	230
90% - 100%	4498	-2186	0,90	230

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Reactive power supply with set point Q=0				
Power-BIN	Active power [W]	Reactive power [Var]	Power factor (cos φ)	DC power [W]
0% - 10%	255	79	0,95	229
10% - 20%	504	95	0,98	229
20% - 30%	1005	90	1,00	229
30% - 40%	1510	80	1,00	230
40% - 50%	2012	89	1,00	230
50% - 60%	2512	87	1,00	230
60% - 70%	3013	106	1,00	230
70% - 80%	3512	118	1,00	230
80% - 90%	4010	129	1,00	230
90% - 100%	4508	147	1,00	230

Q adjustment				
Standard EN 50438				
	Reactive power set point Q [Var]	Measured reactive power Q [Var]	Measured cos φ	Deviation compared to setpoint ΔQ / PN [%]
- Qmin	-48,43	-2186,54	0,75	0,16%
0	0	20,54	1,00	-0,46%
+ Qmax	+48,43	2156,41	0,76	0,51%

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Extract from test report according to EN 50438

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Connection and starting to generate electrical power		
Standard EN 50438		
Voltage conditions		
a) Start up for voltage range	<84% Un for twice of observation time	>111% Un for twice of observation time
Connection:	No connection	No connection
Limit:	No connection allowed	
b) In voltage range at start-up	≥84% Un within twice setting observation time	≤111% Un within twice setting observation time
Reconnection time [s]	76,8	77,2
Limit:	Connected after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
c) In voltage range after voltage failure	≥84% Un for twice of setting observation time	≤111% Un for twice of setting observation time
Reconnection time [s]	75,4	77
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
Frequency conditions		
d) Start up for frequency range	<47,45 Hz for twice of setting observation time	>50,15 Hz for twice of setting observation time
Connection:	No connection	No connection
Limit:	No connection allowed	
e) In frequency range at start-up	≥47,45 Hz within twice of setting observation time	≤51,15 Hz within twice of setting observation time
Reconnection time [s]	73,2	74
Limit:	Connected after setting delay time(≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	
f) In frequency range after frequency failure	≥47,45 Hz for twice of setting observation time	≤51,15 Hz for twice of setting observation time
Reconnection time [s]	73,8	73,4
Limit:	Reconnection after setting observation time (≥60s)	
Gradient:	For adjustable micro generators the maximum occurring active power gradient after connection respectively start generating electrical power is less than the configured maximum active power per minute Max gradient: 10%Pn/min. For recorded gradient see diagram below.	

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Extract from test report according to EN 50438

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Short-circuit current contribution					
Standard EN 50438					
Short-circuit current parameters					
For a directly coupled micro-generator			For a Inverter micro-generator		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	I_p	N/A	20ms	57	0
Initial Value of aperiodic current	A	N/A	100ms	57	0
Initial symmetrical short-circuit current*	I_k	N/A	250ms	57	0
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	57	0
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,0014	In seconds

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Power Quality. Harmonic current emission				
Standard EN 50438				
micro-generator		RPI H3A_12X		
Harmonic order n	Current Magnitude [A] at 100% rated output power	% of Fundamental	Phase	Harmonic current limit EN 61000-3-2, Class A [A]
1st	13,073	--	Phase 1	-
2nd	0,046	0,35	Phase 1	1,080
3rd	0,123	0,94	Phase 1	2,300
4th	0,013	0,10	Phase 1	0,430
5th	0,085	0,65	Phase 1	1,140
6th	0,001	0,01	Phase 1	0,300
7th	0,051	0,39	Phase 1	0,770
8th	0,002	0,02	Phase 1	0,230
9th	0,042	0,32	Phase 1	0,400
10th	0,004	0,03	Phase 1	0,184
11th	0,030	0,23	Phase 1	0,330
12th	0,001	0,01	Phase 1	0,153
13th	0,032	0,25	Phase 1	0,210
14th	0,004	0,03	Phase 1	0,131
15th	0,028	0,21	Phase 1	0,150
16th	0,002	0,02	Phase 1	0,115
17th	0,028	0,21	Phase 1	0,132
18th	0,002	0,02	Phase 1	0,102
19th	0,029	0,22	Phase 1	0,118
20th	0,004	0,03	Phase 1	0,092
21th	0,033	0,25	Phase 1	0,107
22th	0,002	0,02	Phase 1	0,084
23th	0,035	0,27	Phase 1	0,098
24th	0,002	0,02	Phase 1	0,077
25th	0,040	0,31	Phase 1	0,090
26th	0,001	0,01	Phase 1	0,071
27th	0,039	0,30	Phase 1	0,083
28th	0,002	0,02	Phase 1	0,066
29th	0,042	0,32	Phase 1	0,078
30th	0,002	0,02	Phase 1	0,061
31th	0,040	0,31	Phase 1	0,073
32th	0,001	0,01	Phase 1	0,058
33th	0,042	0,32	Phase 1	0,068
34th	0,001	0,01	Phase 1	0,054
35th	0,040	0,31	Phase 1	0,064
36th	0,001	0,01	Phase 1	0,051
37th	0,036	0,28	Phase 1	0,061
38th	0,003	0,02	Phase 1	0,048
39th	0,034	0,26	Phase 1	0,058
40th	0,001	0,01	Phase 1	0,046

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Extract from test report according to EN 50438

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Power Quality. Harmonic current emission				
micro-generator		RPI H4A_12X		
Harmonic order n	Current Magnitude [A] at 100% rated output power	% of Fundamental	Phase	Harmonic current limit EN 61000-3-2, Class A [A]
1st	17,436	--	Phase 1	-
2nd	0,057	0,33	Phase 1	1,080
3rd	0,134	0,77	Phase 1	2,300
4th	0,013	0,07	Phase 1	0,430
5th	0,095	0,55	Phase 1	1,140
6th	0,005	0,03	Phase 1	0,300
7th	0,056	0,32	Phase 1	0,770
8th	0,002	0,01	Phase 1	0,230
9th	0,045	0,26	Phase 1	0,400
10th	0,001	0,01	Phase 1	0,184
11th	0,040	0,23	Phase 1	0,330
12th	0,005	0,03	Phase 1	0,153
13th	0,033	0,19	Phase 1	0,210
14th	0,006	0,03	Phase 1	0,131
15th	0,029	0,17	Phase 1	0,150
16th	0,006	0,03	Phase 1	0,115
17th	0,034	0,20	Phase 1	0,132
18th	0,006	0,03	Phase 1	0,102
19th	0,029	0,17	Phase 1	0,118
20th	0,003	0,02	Phase 1	0,092
21th	0,035	0,20	Phase 1	0,107
22th	0,004	0,02	Phase 1	0,084
23th	0,034	0,20	Phase 1	0,098
24th	0,002	0,01	Phase 1	0,077
25th	0,040	0,23	Phase 1	0,090
26th	0,003	0,02	Phase 1	0,071
27th	0,040	0,23	Phase 1	0,083
28th	0,002	0,01	Phase 1	0,066
29th	0,042	0,24	Phase 1	0,078
30th	0,002	0,01	Phase 1	0,061
31th	0,042	0,24	Phase 1	0,073
32th	0,003	0,02	Phase 1	0,058
33th	0,041	0,24	Phase 1	0,068
34th	0,002	0,01	Phase 1	0,054
35th	0,039	0,22	Phase 1	0,064
36th	0,001	0,01	Phase 1	0,051
37th	0,035	0,20	Phase 1	0,061
38th	0,003	0,02	Phase 1	0,048
39th	0,034	0,20	Phase 1	0,058
40th	0,003	0,02	Phase 1	0,046

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Power Quality. Harmonic current emission					
micro-generator		RPI H5A_12X			
Harmonic order n	Current Magnitude [A] at 100% rated output power	% of Fundamental	Phase	Harmonic current limit EN61000-3-12 [%]	
				1 phase	3 phase
1st	21,297	--	Phase 1	-	-
2nd	0,049	0,23	Phase 1	8	8
3rd	0,120	0,55	Phase 1	21,6	N/A
4th	0,010	0,05	Phase 1	4	4
5th	0,084	0,39	Phase 1	10,7	10,7
6th	0,002	0,01	Phase 1	2,67	2,67
7th	0,058	0,27	Phase 1	7,2	7,2
8th	0,002	0,01	Phase 1	2	2
9th	0,051	0,23	Phase 1	3,8	N/A
10th	0,005	0,02	Phase 1	1,6	1,6
11th	0,037	0,17	Phase 1	3,1	3,1
12th	0,003	0,01	Phase 1	1,33	1,33
13th	0,045	0,21	Phase 1	2	2
14th	0,003	0,01	Phase 1	N/A	N/A
15th	0,040	0,18	Phase 1	N/A	N/A
16th	0,007	0,03	Phase 1	N/A	N/A
17th	0,044	0,20	Phase 1	N/A	N/A
18th	0,004	0,02	Phase 1	N/A	N/A
19th	0,041	0,19	Phase 1	N/A	N/A
20th	0,005	0,02	Phase 1	N/A	N/A
21th	0,049	0,23	Phase 1	N/A	N/A
22th	0,006	0,03	Phase 1	N/A	N/A
23th	0,046	0,21	Phase 1	N/A	N/A
24th	0,003	0,01	Phase 1	N/A	N/A
25th	0,046	0,21	Phase 1	N/A	N/A
26th	0,005	0,02	Phase 1	N/A	N/A
27th	0,048	0,22	Phase 1	N/A	N/A
28th	0,003	0,01	Phase 1	N/A	N/A
29th	0,053	0,24	Phase 1	N/A	N/A
30th	0,004	0,02	Phase 1	N/A	N/A
31th	0,049	0,23	Phase 1	N/A	N/A
32th	0,005	0,02	Phase 1	N/A	N/A
33th	0,050	0,23	Phase 1	N/A	N/A
34th	0,002	0,01	Phase 1	N/A	N/A
35th	0,047	0,22	Phase 1	N/A	N/A
36th	0,007	0,03	Phase 1	N/A	N/A
37th	0,047	0,22	Phase 1	N/A	N/A
38th	0,002	0,01	Phase 1	N/A	N/A
39th	0,044	0,20	Phase 1	N/A	N/A
40th	0,001	0,01	Phase 1	N/A	N/A
THD ₄₀	--	1,168	Phase 1	13	13
PWHD	--	4,070	Phase 1	22	22

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Voltage fluctuation and Flicker.					
Standard EN 50438					
RPI H3A_12X					
	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-3				
Value	Pst	Plt 2 hours	d(t) _{500ms}	dc	dmax
Limit	1,0	0,65	3,3%	3,3%	4%
Test value	0,908	0,184	1,460	1,090	0,001
RPI H5A_12X					
	Maximum permissible flicker and voltage fluctuation as per EN 61000-3-11				
Value	Pst	Plt 2 hours	d(t) _{500ms}	dc	dmax
Limit	1,0	0,65	3,3%	3,3%	4%
Test value	0,322	0,22	-0,810	0,250	0,011

DC-Injection.				
Standard EN 50438				
RPI H3A_12X				
Protection limit	Tested at four power levels limit 0,5% of IAC _{nom}			
Output power	~20%	~50%	75%	~100%
Max. test value (phase 1) [mA]	3	-4	-5	-6
RPI H5A_12X				
Protection limit	Tested at four power levels limit 0,5% of IAC _{nom}			
Output power	~20%	~50%	75%	~100%
Max. test value (phase 1) [mA]	-5	-6	-7	-10

Comments
The inverters RPI H5A_12X, RPI H5A_02X, RPI H4A_12X, RPI H4A_02X, RPI H3A_12X and RPI H3A_02X are tested for the Automatic exchange of reactive power according to a characteristic curve $Q = f(V)$ based on the CEI 0-21 in point B.1.2.6.