CERTIFICATE

Applicant: **Victron Energy B.V.**
De Paal 35
1351 JG Almere
The Netherlands

Product: **Battery Storage System with PV input**

Model:	Easysolar-II 48/3000/35-32 MPPT 250/70GX	Easysolar-II 24/3000/70-32 MPPT 250/70GX	Easysolar-II 48/5000/70-50 MPPT 250/100GX
Rating:			
Output power (feed in On Grid)	2,5kVA / 2,47kW		4,5kVA / 4,4kW
Output power (Off-Grid)	3,0kVA / 2,4kW		5,0kVA / 4,0kW

Intended use:

Battery Storage system with an automatic disconnection device with single phase mains surveillance in accordance with Engineering Recommendation G99-1 for photovoltaic systems with a single 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:

SOP-9-1_14 GCC Certification Program, 11/20
Based on:
Engineering Recommendation G99 Issue 1 – Amendment 6, 09 March 2020
Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019

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: 20PP183-08_0

Certificate No: 21-124-00

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GRID CODE COMPLIANCE G99 ISSUE 1

DAkkS Deutsche Akkreditierungsstelle D-ZE-12089-01-00

Power Quality – Continuous voltage operation range Continuous frequency operation range					
	U [V]	f [Hz]	Cos ϕ	P [kW]	Limit [%Sn]:
Test 1	85%Un 195,5V	47,00Hz	1,00	100%Sn	-
Measured 20s avg	196,5	47,00	-1,000	86,0%	-
Test 2	85%Un 195,5V	47,50Hz	1,00	100%Sn	-
Measured 90min avg	195,7	47,50	-1,000	85,0%	-
Test 3	110%Un 253V	51,50Hz	1,00	100%Sn	-
Measured 90min avg	253,5	51,50	-0,999	98,0%	-
Test 4	110%Un 253V	52,00Hz	1,00	100%Sn	-
Measured 15min avg	253,5	51,90	-1,000	98,0%	-

Test 5	Start frequency	Change	End frequency	Confirm no trip
Positive frequency drift	49,5Hz	+1,0Hz/sec	50,0Hz	No trip
Negative frequency drift	50,5Hz	-1,0Hz/sec	50,0Hz	No trip

Power Quality – Harmonics Easysolar-II 48/3000/35-32 MPPT 250/70GX and Easysolar-II 24/3000/70-32 MPPT 250/70GX						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)			2,47	kVA	Harmonics % =Measured Value (Amps) x 23/rating per phase (kVA)	
Harmonic	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	0,067	0,628	0,044	0,409	8%	8%
3	0,076	0,707	0,077	0,717	21,6%	Not stated
4	0,058	0,538	0,040	0,369	4%	4%
5	0,154	1,435	0,083	0,777	10,7%	10,7%
6	0,039	0,359	0,027	0,249	2,67%	2,67%
7	0,112	1,046	0,054	0,498	7,2%	7,2%
8	0,024	0,219	0,016	0,149	2%	2%
9	0,063	0,588	0,043	0,399	3,8%	Not stated
10	0,014	0,130	0,010	0,090	1,6%	1,6%
11	0,054	0,498	0,026	0,239	3,1%	3,1%
12	0,009	0,080	0,005	0,050	1,33%	1,33%
13	0,036	0,339	0,014	0,130	2%	2%
THD	-	2,408	-	1,459	23%	13%
PWHD	-	3,735	-	1,744	23%	22%

Power Quality – Harmonics Easysolar-II 48/5000/70-50 MPPT 250/100GX						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)			2,47	kVA	Harmonics % =Measured Value (Amps) x 23/rating per phase (kVA)	
Harmonic	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	0,048	0,250	0,280	0,280	8%	8%
3	0,304	1,587	3,140	3,135	21,6%	Not stated
4	0,040	0,210	0,290	0,290	4%	4%
5	0,285	1,488	1,340	1,338	10,7%	10,7%
6	0,032	0,170	0,200	0,200	2,67%	2,67%
7	0,130	0,679	1,010	1,008	7,2%	7,2%
8	0,023	0,120	0,150	0,150	2%	2%
9	0,090	0,469	0,750	0,749	3,8%	Not stated
10	0,017	0,090	0,110	0,110	1,6%	1,6%
11	0,069	0,359	0,270	0,270	3,1%	3,1%
12	0,011	0,060	0,080	0,080	1,33%	1,33%
13	0,053	0,280	0,140	0,140	2%	2%
THD	-	2,425	-	3,699	23%	13%
PWHD	-	1,286	-	1,654	23%	22%

Power Quality – Voltage Fluctuations and Flicker

Easysolar-II 48/3000/35-32 MPPT 250/70GX and Easysolar-II 24/3000/70-32 MPPT 250/70GX

	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	0,313%	0,313%	0,0ms	0,388%	0,274%	0,0ms	0,021	0,021
Normalised to standard impedance	0,313%	0,313%	0,0ms	0,388%	0,274%	0,0ms	0,021	0,021
Normalised to required maximum impedance	-	-	-	-	-	-	-	-
Limit set under BS EN 61000-3-11	4%	3,3%	3,3%	4%	3,3%	3,3%	1,0	0,65
Limits	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Test Impedance	R	0,4	Ω	X	0,25	Ω
Standard Impedance	R	0,24 * 0,4 ^	Ω	X	0,15 * 0,25 ^	Ω
Maximum Impedance	R	-	Ω	X	-	Ω

* Applies to three phase and split single phase Power Generating Modules.

^ Applies to single phase Power Generating Module and Power Generating Modules using two phases on a three phase system.

Power Quality – Voltage Fluctuations and Flicker Easysolar-II 48/5000/70-50 MPPT 250/100GX								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Measured Values	3,344%	3,344%	150,0ms	3,469%	3,377%	0,0ms	0,027	0,027
Normalised to standard impedance	3,344%	3,344%	150,0ms	3,469%	3,377%	0,0ms	0,027	0,027
Normalised to required maximum impedance	3,268%	3,268%	0,0	3,390%	3,300%	0,0ms	0,026	0,026
Limit set under BS EN 61000-3-11	4,0%	3,3%	3,3%	4,0%	3,3%	3,3%	1,00	0,65
Limits	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Test Impedance	R	0,4	Ω	X	0,25	Ω
Standard Impedance	R	0,24 * 0,4 ^	Ω	X	0,15 * 0,25 ^	Ω
Maximum Impedance	R	0,39	Ω	X	0,24	Ω

* Applies to three phase and split single phase Power Generating Modules.

^ Applies to single phase Power Generating Module and Power Generating Modules using two phases on a three phase system.

Test start date	2019-08-01	Test end date	2019-08-01
Test Location	Kiwa Primara GmbH		

Power Quality – DC injection			
Test power level	10%	55%	100%
Recorded value in Amps	0,002	-0,002	-0,006
As % of rated AC current	0,07%	-0,06%	-0,16%
Limit	0,25%	0,25%	0,25%

Power Factor			
Voltage	0,94 pu (216.2 V)	1,0 pu (230 V)	1,1 pu (253 V)
Measured Value	1,000	1,000	1,000
Power Factor Limit	>0,95		

Protection – Frequency Tests						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency time	Confirm no trip
U/F stage 1	47,5 Hz	20 s	47,40 Hz	20,12 s	47,7Hz 30s	No trip
U/F stage 2	47,0 Hz	0,5 s	46,90 Hz	0,58 s	47,2 Hz 19,5s	No trip
					46,8 Hz 0,45 s	No trip
O/F	52,0 Hz	0,5 s	52,00 Hz	0,56 s	51,8 Hz 120 s	No trip
					52,2Hz 0,45s	No trip

Protection – Voltage Tests.						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage time	Confirm no trip
U/V	0,8 pu (184V)	2,5s	182,5 V	2,54 s	188 V 5 s	No trip
					180V 2,45 s	No trip
O/V stage 1	1,14 pu (262,2V)	1,0s	261,2 V	1,07 s	258,2 V 5,0 s	No trip
O/V stage 2	1,19 pu (273,7V)	0,5s	273,0 V	0,59 s	269,7 V 0,95 s	No trip
					277,7 V 0,45 s	No trip

Protection – Loss of Mains Test according BS EN 62116 for Inverters.						
Test Power and imbal-ance	33% -5% Q	66% -5% Q	100% -5% Q	33% +5% Q	66% +5% Q	100% +5% Q
Trip time (ms)	202	209	182	169	166	203

Protection – Frequency change, Vector Shift Stability test.			
	Start frequnecy	Change	Confirm no trip
Positive vector shift	49,5Hz	+50 dregrees	No Trip
Negative vector shift	50,5Hz	- 50 dregrees	No Trip

Protection – Frequency Change, RoCoF Stability Test			
Ramp range	Test frequency ramp	Test duration	Confirm no Trip
49,0 Hz to 51,0 Hz	+0,95 Hzs^{-1}	2,1 s	No trip
51,0 Hz to 49,0 Hz	-0,95 Hzs^{-1}	2,1 s	No trip

Protection – Limited Frequency Sensitive Mode – Over frequency Test	
Active Power response to rising frequency/time plots are attached	N

Test sequence at **registered capacity** >80%	Measured **Active Power** output [kW]	Frequency [Hz]	Primary power source (if applicable	**Active Power** Gradient
Step a) 50,00Hz ± 0,01Hz	-2,38	50,00	—	—
Step b) 50,45Hz ± 0,05Hz	-2,34	50,45		—
Step c) 50,70Hz ± 0,10Hz	-2,22	50,70		—
Step d) 51,15Hz ± 0,05Hz	-2,00	51,15		—
Step e) 51,70Hz ± 0,10Hz	-2,22	50,70		—
Step f) 50,45Hz ± 0,05Hz	-2,34	50,45		—
Step g) 50,00Hz ± 0,01Hz	-2,38	50,00		≤10,0%P_n/min
Test sequence at **registered capacity** 40% - 60%	Measured **Active Power** output [kW]	Frequency [Hz]	Primary power source (if applicable	**Active Power** Gradient
Step a) 50,00Hz ± 0,01Hz	-1,22	50,00	—	—
Step b) 50,45Hz ± 0,05Hz	-1,17	50,45		—
Step c) 50,70Hz ± 0,10Hz	-1,11	50,70		—
Step d) 51,15Hz ± 0,05Hz	-1,00	51,15		—
Step e) 50,70Hz ± 0,01Hz	-1,11	50,70		—
Step f) 50,45 Hz ± 0,05Hz	-1,17	50,45		≤10,0%P_n/min
Step g) 50,00 Hz ± 0,01Hz	-2,35	50,00		≤10,0%P_n/min

Protection – Reconnection Timer					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of Table 10.1.			
20 s	25,2 s – 26,8 s	At 1,16 pu (266,2V)	At 0,78pu (180,0V)	At 47,4 Hz	At 52,1 Hz
Confirmation that the **Power Generating Module** does not re-connect.		No reconnection	No reconnection	No reconnection	No reconnection

Fault Level Contribution		
For Inverter Output		
Time after fault	Volts	Amps
20ms	85,1	19,27
100ms	-	-
250ms	-	-
500ms	-	-
Time to trip	0,03	In seconds
As SSEGs (small-scale embedded generators) for PV are inverter-connected the max. short circuit current is the max. AC current.		

Self-Monitoring Sold state switching	
It has been verified that in the event of the solid state switching device failing to disconnect the Power Park Module, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.	NA*
*there are no solid state switching devices in the unit, mechanical relays are provided	

Wiring functional Tests	
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)	NA

Logic interface (input port)	
Confirm that an input port is provided and can be used to shut down the module.	YES*
*An input port is available and can be used to shut down the module	

Additional Comments
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