



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

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

Model:	MultiPlus-II 48/3000/35-32 MultiPlus-II 48/3000/35-32 GX MultiPlus-II 24/3000/70-32, MultiPlus-II 24/3000/70-32 GX	MultiPlus-II 48/5000/70-50 MultiPlus-II 48/5000/70-50 GX
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 inverter with automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G98 Issue 1 – Amendment 3 with a single 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 G98 Issue 1 – Amendment 3 March 2019

Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks on or after 27 April 2019

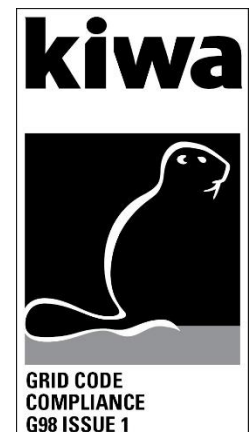
The safety concept of an aforementioned representative product corresponds at the time of issue of this certificate to the valid safety specifications for the specified use in accordance with regulations.

The units are only compliant with type A Power Generating Module requirements

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CERTIFICATE

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Power Quality: Continuous voltage operation range					
Continuous frequency operation range					
Generating Unit tested to EN 50438:2013					
	U [V]	f [Hz]	Cos ϕ	P [kW]	Limit [%Sn]:
Test 1*	85%Un	47,50Hz	1,00	100%Sn	P \geq 85%Sn
Measured 90min avg	195,7	47,50	-1,000	-2,10	-85,0
Test 2*	110%Un	51,50Hz	1,00	100%Sn	-
Measured 90min avg	253,5	51,50	-0,999	-2,42	-98,0
Test 3*	110%Un	52,00Hz	1,00	100%Sn	-
Measured 15min avg	253,5	51,90	-1,000	-2,42	-98,0



Power Quality: Harmonics				
Micro-Generator tested to BS EN 61000-3-2				
Micro-Generator rating per phase (rpp)		2,47	kW	
Harmonic	At 45-55% of Registered capacity	100% of Registered capacity		
	Measured Value (MV) in Amps	Measured Value (MV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0,067	0,044	1,080	
3	0,076	0,077	2,300	
4	0,058	0,040	0,430	
5	0,154	0,083	1,140	
6	0,039	0,027	0,300	
7	0,112	0,054	0,770	
8	0,024	0,016	0,230	
9	0,063	0,043	0,400	
10	0,014	0,010	0,184	
11	0,054	0,026	0,330	
12	0,009	0,005	0,153	
13	0,036	0,014	0,210	
14	0,003	0,002	0,131	
15	0,021	0,012	0,150	
16	0,002	0,001	0,115	
17	0,026	0,015	0,132	
18	0,001	0,001	0,102	
19	0,025	0,013	0,118	
20	0,001	0,001	0,092	
21	0,018	0,005	0,107	0,160
22	0,002	0,001	0,084	
23	0,021	0,004	0,098	0,147
24	0,001	0,001	0,077	
25	0,014	0,010	0,090	0,135
26	0,001	0,001	0,071	
27	0,022	0,006	0,083	0,124
28	0,001	0,001	0,066	
29	0,013	0,010	0,078	0,117
30	0,001	0,001	0,061	
31	0,016	0,009	0,073	0,109
32	0,001	0,001	0,058	
33	0,024	0,010	0,068	0,102
34	0,002	0,001	0,054	
35	0,026	0,011	0,064	0,096
36	0,002	0,001	0,051	
37	0,022	0,011	0,061	0,091
38	0,003	0,001	0,048	
39	0,021	0,011	0,058	0,087
40	0,007	0,002	0,046	



Power Quality: Voltage fluctuations and flicker								
	Starting			Stopping			Running	
	d_{\max}	d_c	$d_{(t)}$	d_{\max}	d_c	$d_{(t)}$	P_{st}	P_{lt} 2 hours
Measured Values at test impedance	0,313	0,313	0,0	0,388	0,274	0,0	0,021	0,021
Normalised to standard impedance	0,313	0,313	0,0	0,388	0,274	0,0	0,021	0,021
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	0,4	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		
Power Quality: DC injection.								
Test power level	20%		50%		75%		100%	
Recorded value in Amps	-0,008		-0,007		-0,007		-0,005	
As % of rated AC current	-0,23%		-0,20%		-0,19%		-0,16%	
Limit	0,25%		0,25%		0,25%		0,25%	



Power Quality: Power factor.						
	216,2V		230V		253V	
20% of Registered Capacity	1,000		1,000		0,998	
50% of Registered Capacity	1,000		1,000		0,999	
75% of Registered Capacity	1,000		1,000		0,999	
100% of Registered Capacity	1,000		1,000		1,000	
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	47,40	20,12s	47,7Hz 25s	No Trip
U/F stage 2	47,0Hz	0,5s	46,90	0,65s	47,2Hz 19,98s	No Trip
					46,8Hz 0,48s	No Trip
O/F stage 1	52,0Hz	0,5s	52,00	0,60s	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	184,0V	2,5s	182,5V	2,54s	188,0V 3,5s	No Trip
					180,0V 2,48s	No Trip
O/V stage 1	262,2V	1,0s	261,2V	1,07s	258,2V 2,0s	No Trip
O/V stage 2	273,7V	0,5s	273,0	0,59s	269,7V 0,98s	No Trip
					277,7V 0,48s	No Trip



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%	66%	100%	33%	66%	100%
	-5% Q	-5% Q	-5% P	+5% Q	+5% Q	+5% P
	Tests 22	Test 12	Test 5	Test 31	Test 21	Test 10
Trip time. Limit is 0.5s	202 ms	209 ms	182 ms	169 ms	166 ms	203 ms
Ph 1 removed	Confirm trip	Ph 2 removed	N/A	Ph 3 removed	N/A	
Protection: Frequency change, Vector Shift Stability test.						
	Start frequency	Change	Confirm no trip			
Positive vector shift	49,5Hz	+50 degrees	No trip			
Negative vector shift	50,5Hz	-50 degrees	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	+0,95Hz/s	2,1 s	No trip			
51,0 Hz to 49,0 Hz	-0,95Hz/s	2,1 s	No trip			



Protection: Limited Frequency Sensitive Mode – Overfrequency test					
Test sequence at Registered Capacity >80%	Measured Active Power Output	Frequency	Primary Power Source	Active Power Gradient	
Step a) 50,00 Hz± 0,01Hz	-2,38	50,00 Hz		—	
Step b) 50,45 Hz± 0,05Hz	-2,34	50,45 Hz		—	
Step c) 50,70 Hz± 0,10Hz	-2,22	50,70 Hz		—	
Step d) 51,15 Hz± 0,05Hz	-2,00	51,15 Hz		—	
Step e) 50,70 Hz± 0,10Hz	-2,22	50,70 Hz		—	
Step f) 50,45 Hz± 0,05Hz	-2,34	50,45 Hz		—	
Step g) 50,00 Hz± 0,01Hz	-2,38	50,00 Hz		≤10,0%P _n /min	
Test sequence at Registered Capacity 40% - 60%	Measured Active Power Output	Frequency	Primary Power Source	Active Power Gradient	
Step a) 50,00 Hz± 0,01Hz	-1,22	50,00 Hz		—	
Step b) 50,45 Hz± 0,05Hz	-1,17	50,45 Hz		—	
Step c) 50,70 Hz± 0,10Hz	-1,11	50,70 Hz		—	
Step d) 51,15 Hz± 0,05Hz	-1,00	51,15 Hz		—	
Step e) 50,70 Hz± 0,10Hz	-1,11	50,70 Hz		—	
Step f) 50,45 Hz± 0,05Hz	-1,17	50,45 Hz		—	
Step g) 50,00 Hz± 0,01Hz	-2,35	50,00 Hz		≤10,0%P _n /min	
Protection: Power output with falling frequency test					
Test sequence	Measured Active Power output	Frequency	Primary power source		
Test a) 50 Hz ± 0,01 Hz	2,40	50,00	N/A		
Test b) Point between 49,5 Hz and 49,6 Hz	2,40	49,75	N/A		
Test c) Point between 47,5 Hz and 47,6 Hz	2,40	47,55	N/A		
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			
20	25,2s – 27,3s	At 266,2V	At 180,0V	At 47,4Hz	At 52,1Hz
Confirmation that the Micro-generator does not re-connect		No reconnection	No reconnection	No reconnection	No reconnection



Fault Level contribution.					
For machines with electro-magnetic output			For inverter output		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	-	20ms	85,1	19,27
Initial Value of aperiodic current	A	-	100ms	0,0	0,0
Initial symmetrical short-circuit current	I_k	-	250ms	0,0	0,0
Decaying (aperiodic) component of short-circuit current	i_{DC}	-	500ms	0,0	0,0
Reactance/Resistance Ratio of source	X/R	-	Time to trip	0,03	In seconds
Logic Interface					Yes
Self Monitoring solid state switching					NA
It has been verified that in the event of the solid state switching device failing to disconnect the Micro-Generator, the voltage on the output side of the switching device is reduced to a value below 50 volt within 0,5s.					N/A*
*Redundant mechanical relays used as disconnection device.					