Certificate of compliance

Applicant:

Fronius International GmbH
Günter Fronius Straße 1
4600 Wels-Thalheim
Austria

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

Model:

Primo 4.0-1
Primo 4.6-1
Primo 5.0-1
Primo 6.0-1
Primo 8.2-1

Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with Engineering Recommendation G99/NI 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, which can be accessed the distribution network provider at any time.

Applied rules and standards:

Engineering Recommendation G99/NI-1:2019
Requirements for the connection of generation equipment in parallel with public distribution networks in Northern Ireland

DIN V VDE V 0126-1-1:2006-02 (4.1 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:	**16TH0391-G99/NI_0**	**Certification program:**	**NSOP-0032-DEU-ZE-V01**
Certificate number:	**U20-0469**	**Date of issue:**	**2020-06-18**

Certification body

Thomas Lammel

Certification body Bureau Veritas Consumer Products Services Germany GmbH accredited according to DIN EN ISO/IEC 17065
A partial representation of the certificate requires the written approval of Bureau Veritas Consumer Products Services Germany GmbH

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules	
Extract from test report according to the Engineering Recommendation G99/NI	**Nr. 16TH0391-G99/NI_0**

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G99/NI.			
PGM Technology:	Photovoltaic Inverter		
Manufacturer / applicant:	Fronius International GmbH		
Address:	Günter Fronius Straße 1 4600 Wels-Thalheim Austria		
Tel	+43 7242 241-2330	**Fax:**	+43 7242 241-952330
Email:	feichtinger.josef@fronius.com	**Website:**	www.fronius.com

Rated values	**Primo 4.0-1**	**Primo 4.6-1**	**Primo 5.0-1**	**Primo 6.0-1**
MPP DC voltage range [V]	210 – 800	240 – 800	240 – 800	240 – 800
Input DC voltage range [V]	1000	1000	1000	1000
Input DC current [A]	12	12	12	18
Output AC voltage [V]	230;N;PE	230;N;PE	230;N;PE	230;N;PE
Output AC current [A]	17,4	20,0	21,7	26,1
Output power [VA]	4000	4600	5000	6000

Rated values	**Primo 8.2-1**			
MPP DC voltage range [V]	270 – 800			
Input DC voltage range [V]	1000			
Input DC current [A]	18			
Output AC voltage [V]	230;N;PE			
Output AC current [A]	35,7			
Output power [VA]	8200			

Firmware version	Beginning with V1.1.5.0
Measurement period:	2020-05-19 to 2020-05-20

Description of the structure of the power generation unit:

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 in series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.

The above stated Generating Units are tested according the requirements in the Engineering Recommendation G99/NI. 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 G99/NI.

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Operating Range.	
Test 1	Voltage = 85% of nominal (195,5 V) Frequency = 47,5 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 2	Voltage = 110% of nominal (253 V) Frequency = 51,5 Hz Power Factor = 1 Period of test 90 minutes
Connection:	Always connected
Limit:	Always connected
Test 3	Voltage = 110% of nominal (253 V) Frequency = 52,0 Hz Power Factor = 1 Period of test 15 minutes
Connection:	Always connected
Limit:	Always connected

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Protection. Voltage tests.

Phase 1

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V stage 1	195,5	3,0	195,2	3,044	199,5V / 5s	No trip
U/V stage 2	138,0	2,0	137,7	2,043	142,0 / 2,5s	No trip
					134V / 1,98s	No trip
O/V stage 1	262,2	0,5	253,1	0,551	249V 5,0s	No trip
					257V 0,45s	No trip

Note. For Voltage tests the Voltage required to trip is the setting ±3,45V. 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 ±4V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Frequency tests.

Function	Setting		Trip test		No trip test	
	Frequency [Hz]	Time delay [s]	Frequency [Hz]	Time delay [s]	Frequency / time	Confirm no trip
U/F stage 1	48,0	0,5	48,00	0,557	48,2Hz / 25s	No trip
					47,8Hz / 0,45s	No trip
O/F stage 1	52	1,0	52,01	1,063	51,8Hz / 120s	No trip
					52,2Hz / 0,98s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting ±0,1Hz. 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 ±0,2Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99/NI **Nr. 16TH0391-G99/NI_0**

Protection. Loss of Mains.						
Inverters tested according to BS EN 62116.						
Balancing load on islanded network	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
Trip time. Ph1 fuse removed [s]	0,145	0,118	0,199	0,187	0,132	0,189
Note. Trip time limit is 0,5s.						

Protection. Re-connection timer.	
Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.1.	
Over Voltage	
Time delay setting	**Measured delay**
60s	82s
Under Voltage	
Time delay setting	**Measured delay**
60s	100s
Over Frequency	
Time delay setting	**Measured delay**
60s	108s
Under Frequency	
Time delay setting	**Measured delay**
60s	108s

	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 257,0V	At 191,5V	At 47,9Hz	At 52,1Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Protection. Frequency change, Stability test.				
	Start Frequency [Hz]	**Change**	**Test Duration**	**Confirm no trip**
Positive Vector Shift	49,5	+50 degrees		No trip
Negative Vector Shift	50,5	-50 degrees		No trip
Positive Frequency drift	49,0 to 51,0	+0,95Hz/sec	2,1s	No trip
Negative Frequency drift	51,0 to 49,0	-0,95Hz/sec	2,1s	No trip

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Limited Frequency Sensitive Mode – Over Frequency							
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% Pn							
Frequency [Hz]:	50,00	50,25	50,71	51,14	50,69	50,25	50,00
$P_{expected}$ [kW]:	N/A	7,97	6,10	4,33	6,15	7,98	N/A
$P_{measured}$ [kW]:	8,17	7,99	6,12	4,35	6,17	7,99	8,17
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% Pn							
Frequency [Hz]:	50,00	50,25	50,70	51,15	50,70	50,25	50,00
$P_{expected}$ [kW]:	N/A	4,04	3,10	2,18	3,10	4,04	N/A
$P_{measured}$ [kW]:	4,14	4,05	3,11	2,19	3,11	4,05	4,53

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99/NI **Nr. 16TH0391-G99/NI_0**

Power Quality. Harmonics.

Primo 4.0-1

Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 2,04kW		100% of rated output 4,00kW			
Harmonic	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Limit in BS EN61000-3-12 in %**	
					1 phase	**3 phase**
2nd	0,080	0,460	0,088	0,505	8%	8%
3rd	0,383	2,188	0,586	3,349	21,6%	N/A
4th	0,086	0,494	0,091	0,522	4%	4%
5th	0,192	1,094	0,402	2,294	10,7%	10,7%
6th	0,018	0,102	0,020	0,114	2,67%	2,67%
7th	0,070	0,400	0,169	0,963	7,2%	7,2%
8th	0,024	0,138	0,028	0,160	2%	2%
9th	0,166	0,945	0,177	1,008	3,8%	N/A
10th	0,020	0,113	0,022	0,124	1,6%	1,6%
11th	0,068	0,388	0,051	0,291	3,1%	3,1%
12th	0,030	0,170	0,033	0,190	1,33%	1,33%
13th	0,105	0,600	0,107	0,611	2%	2%
14th	0,012	0,069	0,012	0,068	N/A	N/A
15th	0,029	0,168	0,047	0,267	N/A	N/A
16th	0,013	0,073	0,013	0,072	N/A	N/A
17th	0,072	0,412	0,090	0,515	N/A	N/A
18th	0,011	0,063	0,011	0,063	N/A	N/A
19th	0,025	0,140	0,038	0,218	N/A	N/A
20th	0,010	0,060	0,012	0,067	N/A	N/A
21th	0,048	0,273	0,060	0,344	N/A	N/A
22th	0,010	0,058	0,012	0,067	N/A	N/A
23th	0,018	0,105	0,026	0,146	N/A	N/A
24th	0,010	0,056	0,010	0,056	N/A	N/A
25th	0,030	0,172	0,037	0,209	N/A	N/A
26th	0,013	0,077	0,013	0,077	N/A	N/A
27th	0,018	0,103	0,024	0,137	N/A	N/A
28th	0,009	0,054	0,011	0,060	N/A	N/A
29th	0,012	0,066	0,017	0,100	N/A	N/A
30th	0,010	0,057	0,012	0,070	N/A	N/A
31th	0,017	0,095	0,023	0,133	N/A	N/A
32th	0,009	0,051	0,009	0,053	N/A	N/A
33th	0,015	0,085	0,022	0,124	N/A	N/A
34th	0,011	0,061	0,011	0,060	N/A	N/A
35th	0,014	0,081	0,017	0,097	N/A	N/A
36th	0,009	0,051	0,010	0,055	N/A	N/A
37th	0,012	0,070	0,009	0,052	N/A	N/A
38th	0,009	0,054	0,009	0,052	N/A	N/A
39th	0,016	0,094	0,024	0,138	N/A	N/A
40th	0,011	0,060	0,012	0,066	N/A	N/A
THD_{40} [%]	5,81		4,50		23%	13%
PWHD [%]	0,032		0,013		23%	22%

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99/NI **Nr. 16TH0391-G99/NI_0**

Power Quality. Harmonics.

Primo 8.2-1

Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 4,04kW		100% of rated output 8,18kW			
Harmonic	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Measured Value (MV) in [A]**	**Measured Value (MV) in [%]**	**Limit in BS EN61000-3-12 in %**	
					1 phase	**3 phase**
2nd	0,088	0,250	0,080	0,229	8%	8%
3rd	0,586	1,672	0,651	1,859	21,6%	N/A
4th	0,091	0,259	0,097	0,277	4%	4%
5th	0,401	1,146	0,484	1,383	10,7%	10,7%
6th	0,019	0,055	0,019	0,055	2,67%	2,67%
7th	0,168	0,479	0,244	0,698	7,2%	7,2%
8th	0,028	0,080	0,030	0,086	2%	2%
9th	0,176	0,503	0,258	0,735	3,8%	N/A
10th	0,022	0,063	0,026	0,073	1,6%	1,6%
11th	0,051	0,146	0,116	0,331	3,1%	3,1%
12th	0,033	0,093	0,036	0,103	1,33%	1,33%
13th	0,107	0,305	0,164	0,469	2%	2%
14th	0,012	0,034	0,014	0,040	N/A	N/A
15th	0,046	0,132	0,087	0,249	N/A	N/A
16th	0,013	0,037	0,011	0,032	N/A	N/A
17th	0,090	0,258	0,120	0,343	N/A	N/A
18th	0,011	0,030	0,012	0,034	N/A	N/A
19th	0,038	0,110	0,065	0,187	N/A	N/A
20th	0,012	0,034	0,012	0,034	N/A	N/A
21th	0,060	0,170	0,084	0,240	N/A	N/A
22th	0,012	0,033	0,013	0,037	N/A	N/A
23th	0,025	0,073	0,048	0,137	N/A	N/A
24th	0,010	0,027	0,011	0,032	N/A	N/A
25th	0,036	0,104	0,059	0,168	N/A	N/A
26th	0,014	0,039	0,024	0,069	N/A	N/A
27th	0,024	0,069	0,058	0,164	N/A	N/A
28th	0,011	0,031	0,041	0,117	N/A	N/A
29th	0,017	0,050	0,041	0,117	N/A	N/A
30th	0,012	0,034	0,020	0,056	N/A	N/A
31th	0,023	0,067	0,045	0,128	N/A	N/A
32th	0,009	0,027	0,016	0,045	N/A	N/A
33th	0,022	0,062	0,032	0,093	N/A	N/A
34th	0,010	0,030	0,012	0,035	N/A	N/A
35th	0,017	0,048	0,025	0,071	N/A	N/A
36th	0,010	0,028	0,012	0,034	N/A	N/A
37th	0,009	0,026	0,020	0,058	N/A	N/A
38th	0,009	0,027	0,010	0,030	N/A	N/A
39th	0,024	0,068	0,036	0,102	N/A	N/A
40th	0,011	0,032	0,012	0,033	N/A	N/A
THD_{40} [%]	4,50		2,71		23%	13%
PWHD [%]	0,013		0,007		23%	22%

Appendix A2-3 Compliance Verification Report for Inverter Connected Power Generating Modules

Extract from test report according to the Engineering Recommendation G99/NI **Nr. 16TH0391-G99/NI_0**

Power Quality. Power factor.				
Output power	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within ±1,5% of the stated level during the test.
100%	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	

Power Quality. Voltage fluctuation and Flicker.								
	Starting			**Stopping**			**Running**	
	dmax	**dc**	**d(t)**	**dmax**	**dc**	**d(t)**	**Pst**	**Plt 2 hours**
Measured values at test impedance	5,130	5,000	4,060	5,130	5,000	4,060	1,101	1,088
Measured values at standard impedance	5,130	5,000	4,060	5,130	5,000	4,060	1,101	1,088
Values for maximum impedance	3,065	2,987	0,000	3,065	2,987	0,000	0,658	0,650
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65

Test impedance	R	0,4	Ω	Xl	0,25	Ω
	Z	0,472	Ω			
Standard impedance	R	0,4	Ω	Xl	0,25	Ω
	Z	0,472	Ω			
Maximum impedance	R	0,239	Ω	Xl	0,149	Ω
	Zmax	0,282	Ω			

Power Quality. DC injection.			
Primo 4.0-1			
Test level power [%]	10	55	100
Recorded value [mA]	42	40	39
Recorded value [%]	0,24	0,23	0,22
Limit [%]	0,25	0,25	0,25
Primo 8.2-1			
Test level power [%]	10	55	100
Recorded value [mA]	52,9	54,8	26,5
Recorded value [%]	0,15	0,15	0,07
Limit [%]	0,25	0,25	0,25
Note. DC-injection is tested at each phase of the inverter and a limit of 0,25% per phase was used as pass criteria.			

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Fault level Contribution.					
For a directly coupled SSEG			**For a Inverter SSEG**		
Parameter	**Symbol**	**Value**	**Time after fault**	**Volts [V]**	**Amps [A]**
Peak Short Circuit current	I_p	N/A	20ms	92,9	19,08
Initial Value of aperiodic current	A	N/A	100ms	18,47	0,34
Initial symmetrical short-circuit current*	I_k	N/A	250ms	18,47	0,32
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	18,47	0,32
Reactance/Resistance Ratio of source*	X/R	N/A	**Time to Trip [s]**	2,548	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.					

Self Monitoring – Solid state switching.	**N/A**
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 seconds.	N/A
Note. Unit do not provide solid state switching relays. In case the semiconductor bridge is switched off, then the voltage on the output drops to 0. In this case the relays on the output will also open (Functional safety of the internal automatic disconnection device according to VDE 0126-1-1).	

Logic Interface (input port)	**P**
Confirm that an input port is provided and can be used to shut down the module.	Yes