

C E R T I F I C A T E
of Conformity



Registration No.: AK 60104858 0001

Report No.: 28108201 001

Holder: Fronius International GmbH
Guenter Fronius-Str. 1
4600 Wels - Thalheim
Austria

Product: PV-Inverter
Solar grid tied inverter

Identification: Trademark: FRONIUS
Models: Fronius Galvo 3.1-1
Fronius Galvo 3.0-1
Fronius Galvo 2.5-1
Fronius Galvo 2.0-1
Fronius Galvo 1.5-1

Attachment: Annex to Certificate

Tested acc. to: EN 50438:2013

The certificate of conformity refers to the above mentioned product. This is to certify that the specimen is in conformity with the assessment requirement mentioned above. This certificate does not imply assessment of the production of the product and does not permit the use of a TÜV Rheinland mark of conformity.

Date 30.09.2015

Certification Body

Marco Piva


TÜV Rheinland LGA Products GmbH - Tillystraße 2 - 90431 Nürnberg

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E.1 General Details

E.1.1 Micro-generator details

Models of the same family:

Fronius GALVO 3.1-1;
Fronius GALVO 1.5-1;
Fronius GALVO 2.0-1;
Fronius GALVO 2.5-1;
Fronius GALVO 3.0-1.

FRONIUS International GmbH
Guenter Fronius-Str.1
A-4600 Wels-Thalheim _ Austria

E.1.2 Test house details

Name and address of test house	TÜV Rheinland Italia S.r.l. Via Mattei. 3 - 20010 Pogliano Milanese (MI) - Italy
Telephone number	Tel: +39.02.939 687
Facsimile number	Fax: +39.02.939 687 23
E-mail address	info@it.tuv.com

E.1.3 Test details

Date of test	See First Page
Name of test Engineer	Alessandro Luciani
Signature of test Engineer	See First Page
Test location (if different from above)	See above

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E.2 Type testing of the interface protection

E.2.1 General

If the interface protection is considered as a dedicated device external to the micro-generator, only the operate time of the interface protection can be evaluated. In this case, the opening time of the interface switch shall be taken into account when evaluating the compliance with this European Standard.

E.2.2 Over / Under frequency

	Under frequency		Over frequency	
Parameter	Frequency [Hz]	Time[s]	Frequency [Hz]	Time[s]
Protection Limit	47.00	0.5	51.00	0.5
Trip Value	46.94	0.47	51.05	0.47
Supplementary information: none				

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E.2.3 Over / Under voltage

Parameter	Under Voltage		Over Voltage	
	Voltage [V]	Time [s]	Voltage [V]	Time [s]
Protection Limit	195.5 (230 V -15%)	0.2	264.5 (230 V +15%)	0.2
Trip Value	193.8	0.194	263.1	0.180

Supplementary information: none

Parameter	Over Voltage		Remarks
	Voltage [V]	Time [s]	
Protection Limit	255.3 (230 V +11%)	60	--
Trip Value	255.3	46.5	--

Supplementary information: none

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E.2.4 Loss of main (LoM)

Balanced load								
Test A			Test B			Test C		
M (%)	N(%)	Trip Time [ms]	M (%)	N(%)	Trip Time [ms]	M (%)	N(%)	Trip Time [ms]
-10	10	308	0	-9	170	0	-5	262
-10	5	280	0	-6	334	0	-4	166
-10	0	254	0	-5	256	0	-3	268
-10	-5	246	0	-4	280	0	-2	174
-10	-10	286	0	-3	360	0	-1	292
-5	10	174	0	-2	138	0	0	426
-5	5	431	0	-1	416	0	1	462
-5	0	218	0	0	358	0	2	154
-5	-5	135	0	1	157	0	3	210
-5	-10	254	0	2	317	0	4	220
0	10	398	0	3	283	0	5	298
0	5	136	0	4	289			
0	0	460	0	5	288			
0	-5	352	0	6	91			
0	-10	566						
5	10	166						
5	5	246						
5	0	136						
5	-5	291						
5	-10	132						
10	10	160						
10	5	288						
10	0	424						
10	-5	196						
10	-10	274						

Test A is at full power.

Test B is at 65%Pn

Test C is at 33% Pn

Tested in accordance with IEC62116. Table from SGS Report No.: 2213/0351-IEC

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E.3 Type testing of a micro-generator

E.3.1 Operating range

Test sequence	Voltage [V]	Frequency [Hz]	Output power [W]	Primary power Source [W]
Test 1	195.5	47.5	2680	3500
Test 2	253	51.5	3020	3500

E.3.2 Active power feed-in at under-frequency

Test sequence	Output Power [W]	Frequency [Hz]	Primary power Source [W]
Test a)	3100	50.00	3500
Test b)	3070	49.65	3500
Test c)	3080	47.55	3500

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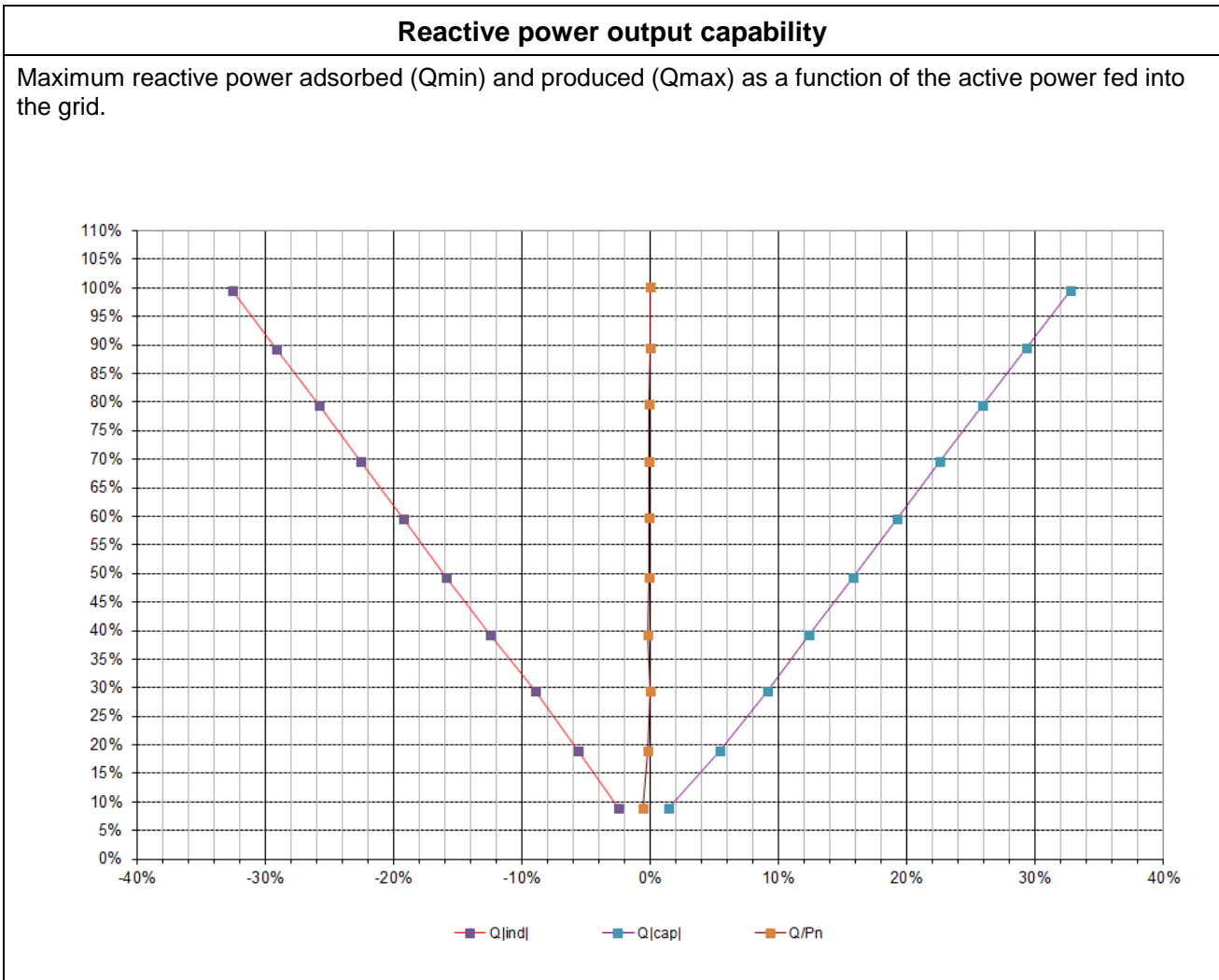
E.3.3 Power response to over-frequency

Test sequence at power level >80%	Output Power [W]	Frequency [Hz]	Primary Power Source [W]	Power Gradient [W/Hz]
Test a)	3100	50.00	3500	-
Test b)	3000	50.25	3500	-
Test c)	2400	50.70	3500	-
Test d)	550	51.15	3500	-
Test e)	550	50.70	3500	-
Test f)	550	50.25	3500	-
Test g)	3100	50.00	3500	9.6% P _n min ⁻¹

Test sequence at power level 40%-60%	Output Power [W]	Frequency [Hz]	Primary Power Source [W]	Power Gradient [W/Hz]
Test a)	1520	50.00	1600	-
Test b)	1500	50.25	1600	-
Test c)	650	50.70	1600	-
Test d)	430	51.15	1600	-
Test e)	430	50.70	1600	-
Test f)	430	50.25	1600	-
Test g)	1530	50.00	1600	9.6% P _n min ⁻¹

E.3.4 Reactive power capability

E.3.4.2 Reactive power output capability



Adsorption of inductive reactive power

Power-Bin		Active power [W]	Reactive Power [VAr]	Power Factor (cosφ)	DC Power [W]
0 % - 10 %	no, 1	260,07	-72,05	0,947	289,59
	no, 2	261,05	-70,83	0,947	289,81
	no, 3	260,64	-72,25	0,947	290,00
10 % - 20 %	no, 1	556,71	-163,48	0,948	596,58
	no, 2	557,14	-163,35	0,948	596,60
	no, 3	557,26	-164,57	0,947	596,53
20 % - 30 %	no, 1	864,14	-262,40	0,948	917,58
	no, 2	864,42	-264,55	0,948	917,66
	no, 3	863,59	-263,47	0,948	917,42
30 % - 40 %	no, 1	1154,68	-363,28	0,948	1223,74
	no, 2	1156,26	-368,31	0,949	1223,84
	no, 3	1154,52	-367,25	0,947	1223,92
40 % - 50 %	no, 1	1450,34	-466,76	0,948	1536,58
	no, 2	1451,90	-466,76	0,948	1537,14
	no, 3	1451,42	-466,26	0,947	1537,15
50 % - 60 %	no, 1	1754,49	-566,38	0,948	1857,39
	no, 2	1755,38	-566,56	0,948	1857,91
	no, 3	1754,39	-566,13	0,948	1857,51
60 % - 70 %	no, 1	2047,77	-664,00	0,948	2169,97
	no, 2	2048,06	-662,74	0,949	2170,02
	no, 3	2047,76	-663,42	0,949	2170,37
70 % - 80 %	no, 1	2337,86	-760,48	0,949	2481,73
	no, 2	2338,16	-758,53	0,949	2481,94
	no, 3	2338,61	-759,58	0,949	2482,06
80 % - 90 %	no, 1	2631,27	-858,56	0,949	2800,05
	no, 2	2633,11	-858,42	0,949	2801,28
	no, 3	2632,29	-857,84	0,949	2801,40
90 % - 100 %	no, 1	2930,44	-958,57	0,949	3127,01
	no, 2	2931,47	-955,83	0,949	3127,97
	no, 3	2930,14	-956,35	0,949	3126,49

Adsorption of capacitive reactive power

Power-Bin		Active power [W]	Reactive Power [VAr]	Power Factor (cosφ)	DC Power [W]
0 % - 10 %	no, 1	262,69	43,31	0,947	289,87
	no, 2	261,66	43,20	0,947	289,99
	no, 3	262,16	42,78	0,947	289,99
10 % - 20 %	no, 1	558,70	159,84	0,947	596,63
	no, 2	558,69	159,33	0,947	596,47
	no, 3	558,45	160,02	0,947	596,42
20 % - 30 %	no, 1	865,61	268,49	0,948	917,76
	no, 2	865,61	269,52	0,949	918,12
	no, 3	865,30	269,60	0,950	918,03
30 % - 40 %	no, 1	1157,53	364,07	0,949	1224,23
	no, 2	1157,65	364,62	0,949	1223,96
	no, 3	1157,35	363,67	0,948	1223,78
40 % - 50 %	no, 1	1453,14	464,32	0,949	1537,15
	no, 2	1454,06	465,13	0,949	1537,28
	no, 3	1454,09	464,95	0,949	1537,05
50 % - 60 %	no, 1	1756,51	566,58	0,949	1857,26
	no, 2	1757,53	566,47	0,949	1857,81
	no, 3	1757,30	567,00	0,949	1857,58
60 % - 70 %	no, 1	2051,31	665,26	0,949	2170,73
	no, 2	2050,94	665,65	0,949	2170,68
	no, 3	2050,92	665,63	0,949	2170,91
70 % - 80 %	no, 1	2342,31	763,36	0,949	2483,25
	no, 2	2343,17	762,43	0,949	2483,17
	no, 3	2341,89	763,31	0,949	2483,03
80 % - 90 %	no, 1	2636,97	861,87	0,949	2802,26
	no, 2	2636,08	861,00	0,949	2801,72
	no, 3	2636,33	863,29	0,949	2802,27
90 % - 100 %	no, 1	2934,63	963,38	0,949	3128,30
	no, 2	2934,91	963,74	0,949	3128,93
	no, 3	2934,10	963,58	0,949	3128,61

Reactive power production with set point Q = 0

Power-Bin		Active power [W]	Reactive Power [VAr]	Power Factor (cosφ)	DC Power [W]
0 % - 10 %	no, 1	261,13	-14,65	0,998	290,09
	no, 2	261,47	-15,44	0,998	290,18
	no, 3	261,59	-15,81	0,998	290,14
10 % - 20 %	no, 1	558,85	-5,86	1,000	596,85
	no, 2	559,32	-4,54	1,000	596,89
	no, 3	557,73	-4,77	1,000	596,82
20 % - 30 %	no, 1	865,56	0,61	1,000	918,04
	no, 2	866,68	0,12	1,000	918,06
	no, 3	868,81	-0,64	1,000	920,69
30 % - 40 %	no, 1	1157,24	-4,56	1,000	1223,80
	no, 2	1158,47	-4,14	1,000	1223,97
	no, 3	1158,00	-4,78	1,000	1223,88
40 % - 50 %	no, 1	1453,83	-2,47	1,000	1536,94
	no, 2	1454,76	-3,23	1,000	1536,92
	no, 3	1454,01	-2,76	1,000	1537,04
50 % - 60 %	no, 1	1757,57	-2,70	1,000	1857,59
	no, 2	1758,21	-2,07	1,000	1857,54
	no, 3	1758,96	-2,48	1,000	1857,63
60 % - 70 %	no, 1	2051,48	-2,14	1,000	2169,54
	no, 2	2051,43	-2,04	1,000	2169,69
	no, 3	2051,61	-2,26	1,000	2169,99
70 % - 80 %	no, 1	2343,20	-0,46	1,000	2482,36
	no, 2	2342,96	-1,62	1,000	2482,80
	no, 3	2342,30	-1,91	1,000	2482,22
80 % - 90 %	no, 1	2639,61	-0,80	1,000	2801,94
	no, 2	2637,88	0,08	1,000	2801,83
	no, 3	2637,41	-0,69	1,000	2801,39
90 % - 100 %	no, 1	2951,54	0,18	1,000	3142,76
	no, 2	2951,46	-0,08	1,000	3142,89
	no, 3	2950,78	-0,91	1,000	3142,92

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E.3.5 Connection and starting to generate electrical power

Connection after trip of interface protection

Test sequence after trip	Connection	Connection allowed	Primary power source	Power gradient after connection
Step a)	No	No	-	-
Step b)	Yes	Yes	3100	9.6% $P_n \text{ min}^{-1}$
Step c)	No	No	-	-
Step d)	Yes	Yes	3100	9.6% $P_n \text{ min}^{-1}$
Step e)	No	No	-	-
Step f)	Yes	Yes	3100	9.6% $P_n \text{ min}^{-1}$
Step g)	No	No	-	-
Step h)	Yes	Yes	3100	9.6% $P_n \text{ min}^{-1}$

NOTE 1 It is sufficient to evaluate the power gradient after connection only at one test out of b). d). f). h).

Start of generating electrical power

Test sequence start of generation	Connection	Connection allowed	Primary power source	Power gradient after connection
Step a)	No	No	-	-
Step b)	Yes	Yes	3100	9.6% $P_n \text{ min}^{-1}$
Step c)	No	No	-	-
Step d)	Yes	Yes	3100	9.6% $P_n \text{ min}^{-1}$
Step e)	No	No	-	-
Step f)	Yes	Yes	3100	9.6% $P_n \text{ min}^{-1}$
Step g)	No	No	-	-
Step h)	Yes	Yes	3100	9.6% $P_n \text{ min}^{-1}$

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E.3.6 Short-circuit current contribution

E.3.6.1 Short circuit current at micro-generator terminals

Fault level contribution		
Time after fault [ms]	Voltage [V]	Current [A]
20	12.7	32.2
100	9.38	25.4
250	8.80	16.5
500	8.55	12.1

Note:
Trip Time: 66.1ms

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E.3.7 Power quality

Harmonic current emission

Average harmonic current results Phase R				
Hn	I _{eff} [A]	% of Limit	Limit [A]	Result
1	13,247			
2	8,146E-3	0,838	972,00E-3	PASS
3	248,623E-3	12,011	2,07	PASS
4	4,517E-3			PASS
5	187,957E-3	18,319	1,03	PASS
6	3,360E-3			PASS
7	98,625E-3	14,232	693,00E-3	PASS
8	2,931E-3			PASS
9	140,537E-3	39,038	360,00E-3	PASS
10	2,751E-3			PASS
11	53,007E-3	17,848	297,00E-3	PASS
12	2,707E-3			PASS
13	86,939E-3	46,000	189,00E-3	PASS
14	2,518E-3			PASS
15	32,998E-3	24,443	135,00E-3	PASS
16	2,538E-3			PASS
17	48,571E-3	40,777	119,11E-3	PASS
18	2,258E-3			PASS
19	19,293E-3	18,102	106,58E-3	PASS
20	3,016E-3			PASS
21	23,928E-3	24,815	96,43E-3	PASS
22	2,059E-3			PASS
23	14,252E-3	16,187	88,05E-3	PASS
24	2,070E-3			PASS
25	12,266E-3	15,143	81,00E-3	PASS
26	1,992E-3			PASS
27	11,793E-3	15,725	75,00E-3	PASS
28	1,902E-3			PASS
29	7,388E-3	10,580	69,83E-3	PASS
30	1,808E-3			PASS
31	9,243E-3	14,149	65,32E-3	PASS
32	1,702E-3			PASS
33	5,032E-3	8,201	61,36E-3	PASS
34	1,844E-3			PASS
35	6,183E-3	10,686	57,86E-3	PASS
36	1,875E-3			PASS
37	3,892E-3			PASS
38	2,131E-3			PASS
39	5,272E-3	10,153	51,92E-3	PASS
40	11,113E-3	26,842	41,40E-3	PASS

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Average harmonic current results Phase S				
Hn	I _{eff} [A]	% of Limit	Limit [A]	Result
1	9,020			
2	6,466E-3	0,665	972,00E-3	PASS
3	214,231E-3	10,349	2,07	PASS
4	4,349E-3			PASS
5	178,005E-3	17,349	1,03	PASS
6	3,327E-3			PASS
7	94,486E-3	13,634	693,00E-3	PASS
8	3,040E-3			PASS
9	123,273E-3	34,242	360,00E-3	PASS
10	3,146E-3			PASS
11	43,507E-3	14,649	297,00E-3	PASS
12	2,988E-3			PASS
13	71,004E-3	37,569	189,00E-3	PASS
14	2,556E-3			PASS
15	20,576E-3	15,242	135,00E-3	PASS
16	2,466E-3			PASS
17	35,154E-3	29,512	119,11E-3	PASS
18	2,347E-3			PASS
19	9,493E-3	8,907	106,58E-3	PASS
20	2,802E-3			PASS
21	12,816E-3	13,291	96,43E-3	PASS
22	1,976E-3			PASS
23	4,884E-3			PASS
24	1,891E-3			PASS
25	3,567E-3			PASS
26	1,839E-3			PASS
27	2,565E-3			PASS
28	1,732E-3			PASS
29	3,750E-3			PASS
30	1,612E-3			PASS
31	2,319E-3			PASS
32	1,585E-3			PASS
33	3,235E-3			PASS
34	1,571E-3			PASS
35	2,142E-3			PASS
36	1,604E-3			PASS
37	3,079E-3			PASS
38	1,869E-3			PASS
39	3,668E-3			PASS
40	10,438E-3	25,212	41,40E-3	PASS

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Average harmonic current results Phase T				
Hn	I _{eff} [A]	% of Limit	Limit [A]	Result
1	4.491			
2	6.046E-3	0.622	972.00E-3	PASS
3	226.202E-3	10.928	2.07	PASS
4	5.977E-3	1.545	387.00E-3	PASS
5	136.817E-3	13.335	1.03	PASS
6	4.083E-3			PASS
7	46.266E-3	6.676	693.00E-3	PASS
8	3.202E-3			PASS
9	68.815E-3	19.115	360.00E-3	PASS
10	2.205E-3			PASS
11	16.319E-3	5.495	297.00E-3	PASS
12	2.294E-3			PASS
13	46.323E-3	24.509	189.00E-3	PASS
14	2.179E-3			PASS
15	17.880E-3	13.244	135.00E-3	PASS
16	2.214E-3			PASS
17	21.567E-3	18.106	119.11E-3	PASS
18	2.052E-3			PASS
19	9.118E-3	8.555	106.58E-3	PASS
20	2.595E-3			PASS
21	3.903E-3			PASS
22	1.835E-3			PASS
23	7.003E-3	7.954	88.05E-3	PASS
24	1.751E-3			PASS
25	5.462E-3	6.743	81.00E-3	PASS
26	1.595E-3			PASS
27	2.745E-3			PASS
28	1.737E-3			PASS
29	4.748E-3			PASS
30	1.536E-3			PASS
31	3.243E-3			PASS
32	1.501E-3			PASS
33	4.101E-3			PASS
34	1.539E-3			PASS
35	2.433E-3			PASS
36	1.410E-3			PASS
37	4.459E-3			PASS
38	1.504E-3			PASS
39	3.037E-3			PASS
40	6.562E-3	15.849	41.40E-3	PASS

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Voltage fluctuations and flicker

	EUT values	Limit	Result
Pst	0,144	1,00	PASS
Plt	0,134	0,65	PASS
dc [%]	0,038	3,30	PASS
dmax [%]	0,177	4,00	PASS
dt [s]	0,000	0,50	PASS

End of the Annex