

FORM A2-3 Compliance Verification Report for Type A Inverter Connected Power Generating Modules

This form should be used by the **Manufacturer** to demonstrate and declare compliance with the requirements of EREC G99. The form can be used in a variety of ways as detailed below:

1. To obtain **Fully Type Tested** status ($\leq 50\text{kW}$)

The **Manufacturer** can use this form to obtain **Fully Type Tested** status for a **Power Generating Module** by registering this completed form with the Energy Networks Association (ENA) Type Test Verification Report Register. Tests 1 – 15 must all be completed and compliant for the **Power Generating Module** to be classified as **Fully Type Tested**.

2. To obtain **Type Tested** status for a product

This form can be used by the **Manufacturer** to obtain **Type Tested** status for a product which is used in a **Power Generating Module** by registering this form with the relevant parts completed with the Energy Networks Association (ENA) Type Test Verification Report Register.

Where the **Manufacturer** is seeking to obtain **Type Tested** status for an **Interface Protection** device the appropriate section of Form A2-4 should be used.

3. One-off Installation

This form can be used by the **Manufacturer** or **Installer** to confirm that the **Power Generating Module** has been tested to satisfy all or part of the requirements of this EREC G99. This form shall be submitted to the **DNO** as part of the application.

A combination of (2) and (3) can be used as required, together with Form A2-4 where compliance of the **Interface Protection** is to be demonstrated on site.

Note:

Within this Form A2-3 the term Power Park Module will be used but its meaning can be interpreted within Form A2-3 to mean Power Park Module, Generating Unit or Inverter as appropriate for the context. However, note that compliance must be demonstrated at the Power Park Module level.

If the Power Generating Module is Fully Type Tested and registered with the Energy Networks Association (ENA) Type Test Verification Report Register, the Installation Document (Form A3) should include the Manufacturer's reference number (the Product ID), and this form does not need to be submitted.

Where the Power Generating Module is not registered with the ENA Type Test Verification Report Register or is not Fully Type Tested this form (all or in parts as applicable) needs to be completed and provided to the DNO, to confirm that the Power Generating Module has been tested to satisfy all or part of the requirements of this EREC G99.

Manufacturer's reference number		Primo GEN24 10.0 (see family approach page 12)	
PGM technology		IGBT power modules, transformerless	
Manufacturer name		Fronius International GmbH	
Address		Guenter Fronius Str.1 4600 Wels-Thalheim, Austria	
Tel	+43-7242-241-0	Web site	www.fronius.com





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E:mail	pv@fronius.com		
Registered Capacity	10,0 kW		
Energy storage device	kWh		
Manufacturer compliance declaration. - I certify that all products supplied by the company with the above Type Tested Manufacturer's reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site Modifications are required to ensure that the product meets all the requirements of EREC G99.			
Signed	  FRONIUS INTERNATIONAL GMBH Günter Fronius Str. 2 34100 Weisbaden Tel: +43 / (0) 72 42 / 341-0, Fax: 47 8 25	On behalf of	Fronius International GmbH
<p>Note that testing can be done by the Manufacturer of an individual component or by an external test house.</p> <p>Where parts of the testing are carried out by persons or organisations other than the Manufacturer then that person or organisation shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.</p>			

A2-3 Compliance Verification Report – Tests for Type A Inverter Connected Power Generating Modules – test record

1. Operating Range: Tests should be carried with the **Power Generating Module** operating at **Registered Capacity** and connected to a suitable test supply or grid simulation set. The power supplied by the primary source shall be kept stable within $\pm 5\%$ of the apparent power value set for the entire duration of each test sequence.

Frequency, voltage and **Active Power** measurements at the output terminals of the **Power Generating Module** shall be recorded every second. The tests will verify that the **Power Generating Module** can operate within the required ranges for the specified period of time. The **Interface Protection** shall be disabled during the tests.

In case of a PV **Power Park Module** the PV primary source may be replaced by a DC source.

In case of a full converter **Power Park Module** (eg wind) the primary source and the prime mover **Inverter/rectifier** may be replaced by a DC source.

Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement “Pass”, “No disconnection occurs”, etc. Graphical evidence is preferred.

Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47.0 Hz, Power factor = 1, Period of test 20 s	No disconnection occurs
Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, Power factor = 1, Period of test 90 minutes	No disconnection occurs
Test 3 Voltage = 110% of nominal (253 V), Frequency = 51.5 Hz, Power factor = 1, Period of test 90 minutes	No disconnection occurs
Test 4 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, Power factor = 1, Period of test 15 minutes	No disconnection occurs
Test 5 Voltage = 100% of nominal (230 V), Frequency = 50.0 Hz, Power factor = 1, Period of test 90 minutes	No disconnection occurs



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<p>Test 6 RoCoF withstand</p> <p>Confirm that the Power Generating Module is capable of staying connected to the Distribution Network and operate at rates of change of frequency up to 1 Hzs^{-1} as measured over a period of 500 ms. Note that this is not expected to be demonstrated on site.</p>	<p>No disconnection occurs</p>
<p><u>Remark:</u> During the tests 1, 2, 3, 4,5 and 6 the unit does not disconnect, tests have been passed.</p>	

2. Power Quality – Harmonics:

For **Power Generating Modules of Registered Capacity** of less than 75 A per phase (ie 50 kW) the test requirements are specified in Annex A.7.1.5. These tests should be carried out as specified in BS EN 61000-3-12, and measurements for the 2nd – 13th harmonics should be provided. The results need to comply with the limits of Table 2 of BS EN 61000-3-12 for single phase equipment and Table 3 of BS EN 61000-3-12 for three phase equipment. For three phase **Power Generating Modules**, measurements for all phases should be provided.

For **Power Generating Modules of Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC G5.

The rating of the **Power Generating Module** (per phase) should be provided below, and the Total Harmonic Distortion (THD) and Partial Weighted Harmonic Distortion (PWhD) should be provided at the bottom of this section.

Power Generating Module tested to BS EN 61000-3-12

Power Generating Module rating per phase (rpp)	10.0			kVA			Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
Single or three phase measurements (for single phase measurements, only complete L1 columns below)								
Harmonic	At 45-55% of Registered Capacity						Limit in BS EN 61000-3-12	
	Measured Value MV in Amps			Measured Value MV in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.018			0.041			8%	8%
3	0.010			0.022			21.6%	Not stated
4	0.011			0.025			4%	4%
5	0.012			0.027			10.7%	10.7%
6	0.005			0.013			2.67%	2.67%
7	0.005			0.011			7.2%	7.2%
8	0.005			0.011			2%	2%
9	0.032			0.075			3.8%	Not stated
10	0.005			0.012			1.6%	1.6%
11	0.030			0.070			3.1%	3.1%
12	0.004			0.010			1.33%	1.33%
13	0.025			0.057			2%	2%
THD ²⁷	0.100			0.230			23%	13%



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PWHD ²⁸	0.410			0.97.			23%	22%
Harmonic	At 100% of Registered Capacity						Limit in BS EN 61000-3-12	
	Measured Value MV in Amps			Measured Value MV in %				
	L1	L2	L3	L1	L2	L3	1 phase	3 phase
2	0.021			0.049			8%	8%
3	0.013			0.029			21.6%	Not stated
4	0.009			0.021			4%	4%
5	0.014			0.032			10.7%	10.7%
6	0.009			0.021			2.67%	2.67%
7	0.007			0.016			7.2%	7.2%
8	0.006			0.015			2%	2%
9	0.045			0.104			3.8%	Not stated
10	0.005			0.012			1.6%	1.6%
11	0.035			0.080			3.1%	3.1%
12	0.006			0.014			1.33%	1.33%
13	0.031			0.072			2%	2%
THD ²⁹	0.120			0.280			23%	13%
PWHD ³⁰	0.460			1.090			23%	22%

²⁷ THD = Total Harmonic Distortion

²⁸ PWHD = Partial Weighted Harmonic Distortion

²⁹ THD = Total Harmonic Distortion

³⁰ PWHD = Partial Weighted Harmonic Distortion

3. Power Quality – Voltage fluctuations and Flicker:

For **Power Generating Modules of Registered Capacity** of less than 75 A per phase (ie 50 kW) these tests should be undertaken in accordance with Annex A.7.1.4.3. Results should be normalised to a standard source impedance, or if this results in figures above the limits set in BS EN 61000-3-11 to a suitable Maximum Impedance.

For **Power Generating Modules of Registered Capacity** of greater than 75 A per phase (ie 50 kW) the installation shall be designed in accordance with EREC P28.

The standard test impedance is 0.4 Ω for a single phase **Power Generating Module** (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase **Power Generating Module** (and for a two phase unit in a split phase system). Please ensure that both test and standard impedance are completed on this form. If the test impedance (or the measured impedance) is different to the standard impedance, it must be normalised to the standard impedance as follows (where the **Power Factor** of the generation output is 0.98 or above):

d_{\max} normalised value = (Standard impedance / Measured impedance) x Measured value.

Where the **Power Factor** of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the standard impedance.

The stopping test should be a trip from full load operation.

The duration of these tests needs to comply with the particular requirements set out in the testing notes for the technology under test.

The test date and location must be declared.

Test start date	29.11.2023			Test end date	29.11.2023			
Test location	Bureau Veritas, Germany							
	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	2.65 %	2.63%	0	2.18 %	2.18%	0	0.225	0.202
Normalised to standard impedance	2.65 %	2.63%	0	2.18 %	2.18%	0	0.225	0.202
Normalised to required maximum impedance	2.65 %	2.63%	0	2.18 %	2.18%	0	0.225	0.202
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 *		Ω	X		0.15 *	Ω
		0.4^					0.25^	



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Maximum Impedance	R	0.4	Ω	X	0.25	Ω
<p>* Applies to three phase and split single phase Power Generating Modules. Delete as appropriate.</p> <p>^ Applies to single phase Power Generating Module and Power Generating Modules using two phases on a three phase system. Delete as appropriate.</p>						

4. Power quality – DC injection: The tests should be carried out on a single **Generating Unit**. Tests are to be carried out at three defined power levels $\pm 5\%$. At 230 V a 50 kW three phase **Inverter** has a current output of 217 A so DC limit is 543 mA. These tests should be undertaken in accordance with Annex A.7.1.4.4.

The % DC injection (“as % of rated AC current” below) is calculated as follows:

$$\% \text{ DC injection} = \text{Recorded DC value in Amps} / \text{Base current}$$

where the base current is the **Registered Capacity** (W) / Vphase. The % DC injection should not be greater than 0.25%.

Test power level	10%	55%	100%
Recorded value in Amps	0.0132	0.0065	0.0057
as % of rated AC current	0.030	0.014	0.013
Limit	0.25%	0.25%	0.25%

5. Power Factor: The tests should be carried out on a single **Power Generating Module**. Tests are to be carried out at three voltage levels and at **Registered Capacity** and the measured **Power Factor** must be greater than 0.95 to pass. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test. These tests should be undertaken in accordance with Annex A.7.1.4.2.

Note that the value of voltage stated in brackets assumes a **LV** connection. This should be adjusted for **HV** as required.

Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	1.000	1.000	1.000
Power Factor Limit	>0.95	>0.95	>0.95

6. Protection – Frequency tests: These tests should be carried out in accordance with Annex A.7.1.2.3. For trip tests, frequency and time delay should be stated. For “no trip tests”, “no trip” can be stated.

Function	Setting		Trip test		“No trip tests”	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.50Hz	20.044s	47.7 Hz 30 s	No trip occurred
U/F stage 2	47 Hz	0.5 s	46.99Hz	0.547s	47.2 Hz 19.5 s	No trip occurred
					46.8 Hz 0.45 s	No trip occurred
O/F stage 1	52 Hz	0.5 s	52.00Hz	0.542s	51.8 Hz 120.0 s	No trip occurred
					52.2Hz 0.45 s	No trip occurred

Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. 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 ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

7. Protection – Voltage tests: These tests should be carried out in accordance with Annex A.7.1.2.2. For trip tests, voltage and time delay should be stated. For “no trip tests”, “no trip” can be stated.

Note that the value of voltage stated below assumes a LV connection This should be adjusted for HV taking account of the VT ratio as required.

Function	Setting		Trip test		“No trip tests”	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	0.8 pu (184 V)	2.5 s	184.14V	2.555s	188 V 5.0 s	No trip occurred
					180 V 2.45 s	No trip occurred
O/V stage 1	1.14 (262.2 V)	1.0 s	261.97V	1.065s	258.2 V 5.0 s	No trip occurred
O/V stage 2	1.19 (273.7 V)	0.5 s	273.54V	0.554s	269.7 V 0.95 s	No trip occurred
					277.7 V 0.45 s	No trip occurred

Note for Voltage tests the Voltage required to trip is the setting ± 3.45 V. 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 ± 4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

8. Protection – Loss of Mains test: These tests should be carried out in accordance with BS EN 62116. Annex A.7.1.2.4.

The following sub set of tests should be recorded in the following table.

Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time Limit is 0.5s ³¹	0,325	0,254	0,217	0,168	0,175	0,192

³¹ If the device requires additional shut down time (beyond 0.5 s but less than 1 s) then this should be stated on this form.

Loss of Mains Protection, Vector Shift Stability test. This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip under positive / negative vector shift.

	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.5 Hz	+50 degrees	No trip occurred
Negative Vector Shift	50.5 Hz	-50 degrees	No trip occurred

Loss of Mains Protection, RoCoF Stability test: This test should be carried out in accordance with Annex A.7.1.2.6. Confirmation is required that the **Power Generating Module** does not trip for the duration of the ramp up and ramp down test.

Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0Hz	+0.95 Hzs ⁻¹	2.1 s	No trip occurred
51.0 Hz to 49.0Hz	-0.95 Hzs ⁻¹	2.1 s	No trip occurred

9. Limited Frequency Sensitive Mode – Over frequency test: The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%.

This test should be carried out in accordance with Annex A.7.1.3, which also contains the measurement tolerances.

Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.

N

Alternatively, test results should be noted below:

Test sequence at Registered Capacity >80%	Measured Active Power Output	Frequency	Primary Power Source	Active Power Gradient
Step a) 50.00 Hz ±0.01 Hz	10000W	50.00Hz	11,0 kW	20%/Hz
Step b) 50.45 Hz ±0.05 Hz	9890W	50.45Hz		
Step c) 50.70 Hz ±0.10 Hz	9390W	50.70Hz		
Step d) 51.15 Hz ±0.05 Hz	8490W	51.15Hz		
Step e) 50.70 Hz ±0.10 Hz	9390W	50.70Hz		
Step f) 50.45 Hz ±0.05 Hz	9890W	50.45Hz		
Step g) 50.00 Hz ±0.01 Hz	10000W	50.00Hz		

Test sequence at Registered Capacity 40% - 60%	Measured Active Power Output	Frequency	Primary Power Source	Active Power Gradient
Step a) 50.00 Hz ±0.01 Hz	5000W	50.00Hz	6,0 kW	20%/Hz
Step b) 50.45 Hz ±0.05 Hz	4900W	50.45Hz		
Step c) 50.70 Hz ±0.10 Hz	4400W	50.70Hz		
Step d) 51.15 Hz ±0.05 Hz	3500W	51.15Hz		
Step e) 50.70 Hz ±0.10 Hz	4400W	50.70Hz		
Step f) 50.45 Hz ±0.05 Hz	4900W	50.45Hz		
Step g) 50.00 Hz ±0.01 Hz	5000W	50.00Hz		

10. Protection - Re-connection timer.

Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 10.1. Both the time delay setting and the measured delay should be provided in this form; both should be greater than 20 s to pass. Confirmation should be provided that the **Power Generating Module** does not reconnect at the voltage and frequency settings below; a statement of “no reconnection” can be made.

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.			
20.0 s	61 s	At 1.16 pu (266.2 V LV connection, 127.6 V HV connection assuming 110 V ph-ph VT)	At 0.78 pu (180.0 V LV connection, 85.8 V HV connection assuming 110 V ph-ph VT)	At 47.4Hz	At 52.1Hz
Confirmation that the Power Generation Module does not re-connect.		No re-connect occurred	No re-connect occurred	No re-connect occurred	No re-connect occurred

11. Fault level contribution: These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5. Please complete each entry, even if the contribution to the fault level is zero.

For **inverter** output

Time after fault	Volts	Amps
20 ms	18,7	42
100 ms	8,4	19
250 ms	5,3	12
500 ms	3,7	8,5
Time to trip	0,16	In seconds

12. Self-Monitoring solid state switching: No specified test requirements. Refer to Annex A.7.1.6.

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

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).

13. Wiring functional tests: If required by para 15.2.1.

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

NA

14. Logic interface (input port)	
Confirm that an input port is provided and can be used to shut down the module.	YES
Provide high level description of logic interface, e.g. details in 11.1.3.1 such as AC or DC signal (the additional comments box below can be used) The GEN24 (Power Generating Module) has a WSD connector on the Pilot print which can be used for shutdown and as a logic interface to switch of the inverter. This WSD connector interrupts the inverter feeding energy into the grid.	YES

15. Cyber security	
Confirm that the Power Generating Module has been designed to comply with cyber security requirements, as detailed in 9.1.7.	YES

Additional comments
<p>6.3 Family approach to Type Testing 6.3.1 A family approach to type testing is acceptable, whereby Micro-generators that are the same model and produced by the same Manufacturer but vary in electrical output can be considered to be Fully Type Tested once one Micro-generator in the family has been shown to be compliant.</p> <p>Tested unit was Primo GEN24 10.0</p>

Ratings	Primo GEN24 8.0	Primo GEN24 10.0
Udc pv mpp	260 – 480V	260 – 480V
Udc pv min – max	65 – 600V	65 – 600V
Idc pv max 1 / 2	22A / 22A	22A / 22A
Uac nom	230V	230V
Iac nom	34.8A	43.5A
Smax	8000VA	10000VA