

ATTESTATION OF CONFORMITY

Issued to: Soltaro Pty. Ltd. ATF Soltaro Unit Trust
Level 9/440 Collins Street, Melbourne VIC, 3000, Australia

For the product: Hybrid inverter

Trade name: SOLTARO

Type/Model: AIO2-INS-4600, AIO2-INS-5000

Ratings: See Annex

Manufactured by: Soltaro Pty. Ltd. ATF Soltaro Unit Trust
Level 9/440 Collins Street, Melbourne VIC, 3000, Australia

Requirements: Engineering Recommendation G99
Issue 1 Amendment 6 2020

This Attestation is granted on account of an examination by DEKRA, the results of which are laid down in a confidential file no. 6092940.51

The examination has been carried out on one single specimen or several specimens of the product, submitted by the manufacturer. The Attestation does not include an assessment of the manufacturer's production. Conformity of his production with the specimen tested by DEKRA is not the responsibility of DEKRA.

Arnhem, 25 February 2021

Number: 6092940.02AOC

DEKRA Testing and Certification (Shanghai) Ltd.



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Page 1 of 9

Operating temperature range: - 10°C to + 60°C

Protective class: I

Ingress protection rating: IP65

Power factor range (adjustable): 0.8 leading...0.8 lagging

AIO2-INS-4600:

PV input: Max. 600 Vdc, MPPT voltage range: 125-500 Vdc, max 2x12 A, Isc PV: 2x15 A

Battery: Type: Lithium battery, voltage range: 40-60 Vdc, rated voltage: 48 Vdc, max charge/discharge current: 100 A

Output: 230 Vac, 50 Hz, 4600 VA, max 20 A

AIO2-INS-5000:

PV input: Max. 600 Vdc, MPPT voltage range: 125-500 Vdc, max 2x12 A, Isc PV: 2x15 A

Battery: Type: Lithium battery, voltage range: 40-60 Vdc, rated voltage: 48 Vdc, max charge/discharge current: 100 A

Output: 230 Vac, 50 Hz, 5000 VA, max 21.7 A

G99/1-6 Form A2-3 Compliance Verification Report-Test for Type A Inverter

Extract form test report number.:

6092940.51

1. Operating Range: Four 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.

Test 1

Voltage = 85% of nominal (195.5 V),
Frequency = 47 Hz,
Power Factor = 1,
Period of test 20 s

Test 2

Voltage = 85% of nominal (195.5 V),
Frequency = 47.5 Hz,
Power Factor = 1,
Period of test 90 minutes

Test 3

Voltage = 110% of nominal (253 V),
Frequency = 51.5 Hz,
Power Factor = 1,
Period of test 90 minutes

Test 4

Voltage = 110% of nominal (253 V),
Frequency = 52.0 Hz,
Power Factor = 1,
Period of test 15 minutes

Test 5 RoCoF withstand

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.

Model: AIO2-INS-5000

Test 1

P

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (seconds)
195.91	47.00	4326.06	0.998	20

Test 2

P

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
195.93	47.50	4356.01	0.998	90

Test 3

P

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
253.11	51.50	4978.03	0.999	90

Test 4

P

Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
253.12	52.00	4976.55	0.999	15
Test 5				P
Measured Voltage (V)	Ramp range	Test frequency ramp	Test Duration	Confirm no trip
195.5	47.0 Hz to 52.0 Hz	+1 Hzs ⁻¹	5.0 s	No trip
253.0	52.0 Hz to 49.0 Hz	-1 Hzs ⁻¹	3.0 s	No trip

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 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.

Power Generating Modules with emissions close to the limits laid down in BS EN 61000-3-12 may require the installation of a transformer between 2 and 4 times the rating of the **Power Generating Module** in order to accept the connection to a **Distribution Network**.

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.

P

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

Model: AIO2-INS-4600

Power Generating Module rating per phase (rpp)			4.6	kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
Harm onic	At 45-55% of Registered Capacity		100% of Registered Capacity		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase
2	0.015	0.153	0.018	0.090	8%	8%
3	0.223	2.196	0.366	1.829	21.6%	Not stated
4	0.006	0.057	0.004	0.020	4%	4%
5	0.053	0.520	0.069	0.347	10.7%	10.7%
6	0.004	0.036	0.003	0.015	2.67%	2.67%
7	0.061	0.602	0.071	0.354	7.2%	7.2%
8	0.006	0.063	0.003	0.013	2%	2%
9	0.055	0.541	0.062	0.308	3.8%	Not stated
10	0.006	0.057	0.005	0.023	1.6%	1.6%
11	0.048	0.471	0.057	0.283	3.1%	3.1%
12	0.005	0.049	0.003	0.015	1.33%	1.33%
13	0.041	0.404	0.050	0.248	2%	2%
THD	--	2.602	---	2.032	23%	13%
PWHD	--	2.982	---	2.207	23%	22%

Model: AIO2-INS-5000

Power Generating Module rating per phase (rpp)			5.0	kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
Harm onic	At 45-55% of Registered Capacity		100% of Registered Capacity		Limit in BS EN 61000-3-12	
	Measured Value MV in Amps	%	Measured Value MV in Amps	%	1 phase	3 phase

2	0.009	0.082	0.016	0.075	8%	8%
3	0.225	2.063	0.387	1.810	21.6%	Not stated
4	0.003	0.025	0.004	0.021	4%	4%
5	0.055	0.509	0.075	0.350	10.7%	10.7%
6	0.002	0.019	0.003	0.016	2.67%	2.67%
7	0.062	0.574	0.071	0.333	7.2%	7.2%
8	0.002	0.020	0.003	0.014	2%	2%
9	0.055	0.506	0.063	0.296	3.8%	Not stated
10	0.003	0.025	0.004	0.017	1.6%	1.6%
11	0.049	0.452	0.056	0.263	3.1%	3.1%
12	0.003	0.025	0.003	0.014	1.33%	1.33%
13	0.042	0.384	0.051	0.240	2%	2%
THD	--	2.467	---	1.999	23%	13%
PWHD	--	2.884	---	1.881	23%	22%

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.

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Model: AIO2-INS-5000

	Starting			Stopping			Running	
	d max	d c	d(t)	d max	d c	d(t)	Pst	Plt 2 hours
Measured Values at test impedance	0.56%	0.27%	0	1.43%	0.16%	0	0.22	0.19
Normalised to standard impedance	0.56%	0.27%	0	1.43%	0.16%	0	0.22	0.19
Normalised to required maximum impedance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	XI	0.25	Ω		
Standard Impedance	R	0.24 * 0.4 ^	Ω	XI	0.15 * 0.25 ^	Ω		
Maximum Impedance	R	N/A #	Ω	XI	N/A #	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

For voltage change and flicker measurements the following formula is to be used to convert the measured values to the normalised values where the **Power Factor** of the generation output is 0.98 or above.

Normalised value = Measured value x reference source resistance/measured source resistance at test point

Single phase units reference source resistance is 0.4 Ω
 Two phase units in a three phase system reference source resistance is 0.4 Ω
 Two phase units in a split phase system reference source resistance is 0.24 Ω
 Three phase units reference source resistance is 0.24 Ω
 Where the **Power Factor** of the output is under 0.98 then the XI 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 need to comply with the particular requirements set out in the testing notes for the technology under test.

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.

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Model: AIO2-INS-4600

Test power level	10%	55%	100%
Recorded value in Amps	0.020	0.009	0.046
as % of rated AC current	0.10%	0.05%	0.23%
Limit	0.25%	0.25%	0.25%

Model: AIO2-INS-5000

Test power level	10%	55%	100%
Recorded value in Amps	0.025	0.012	0.051
as % of rated AC current	0.11%	0.06%	0.23%
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**. 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.

P

Model: AIO2-INS-4600

Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.998	0.999	0.998
Power Factor Limit	>0.95	>0.95	>0.95

Model: AIO2-INS-5000

Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)
Measured value	0.999	0.999	0.999
Power Factor Limit	>0.95	>0.95	>0.95

6. Protection – Frequency tests: These tests should be carried out in accordance with the Annex A.7.1.2.3.						P
Model: AIO2-INS-5000						
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	47.48Hz	20.14s	47.7 Hz 30 s	No trip
U/F stage 2	47 Hz	0.5 s	46.98Hz	0.632s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F	52.0Hz	0.5s	52.02Hz	0.622s	51.8 Hz 120 s	No trip
					52.2 Hz 0.45 s	No trip
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.						P
Model: AIO2-INS-5000						
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)	2.5s	183.8V	2.620s	188 V 5.0 s	No trip
					180 V 2.45 s	No trip
O/V stage 1	1.14 pu (262.2 V)	1.0s	262.6V	1.120s	258.2 V 5.0 s	No trip
O/V stage 2	1.19 pu (273.7 V)	0.5s	276.7V	0.620s	269.7 V 0.95 s	No trip
					277.7 V 0.45 s	No trip
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.							P
The following sub set of tests should be recorded in the following table.							
Model: AIO2-INS-5000							
Test Power and imbalance	33% -5% Q	66% -5% Q	100% -5% P	33% +5% Q	66% +5% Q	100% +5% P	
Trip time. Limit is 0.5s	196.0 ms	256.8 ms	329.6 ms	215.6 ms	300.4 ms	348.0 ms	
Loss of Mains Protection, Vector Shift Stability test. This test should be carried out in accordance with Annex A.7.1.2.6.						P	
Model: AIO2-INS-5000							
Vector Shift	Start Frequency		Change		Confirm no trip		
Positive Vector Shift	49.0 Hz		+50 degrees		No trip		
Negative Vector Shift	50.0 Hz		- 50 degrees		No trip		
Loss of Mains Protection, RoCoF Stability test: This test should be carried out in accordance with Annex A.7.1.2.6.						P	
Model: Hyper-5000							
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		

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 less than 12.8% and greater than 8.5%. This test should be carried out in accordance with Annex A.7.1.3.						P
Active Power response to rising frequency/time plots are attached if frequency injection tests are undertaken in accordance with Annex A.7.2.4.						Y/N
Alternatively, simulation results should be noted below:						
Model: AIO2-INS-5000						
Test sequence at Registered Capacity >80%	Measured Active Power Output (W)	Frequency (Hz)	Calculate droop (%)	Primary Power Source	Active Power Gradient	
Step a) 50.00 Hz ±0.01 Hz	4944.20	50.00	-	Photovoltaic array simulator	-	
Step b) 50.45 Hz ±0.05 Hz	4754.49	50.45	-		-	
Step c) 50.70 Hz ±0.10 Hz	4542.83	50.70	11.81		-	
Step d) 51.15 Hz ±0.05 Hz	4190.62	51.15	12.41		-	
Step e) 50.70 Hz ±0.10 Hz	4543.83	50.70	11.86		-	
Step f) 50.45 Hz ±0.05 Hz	4750.17	50.45	-		-	
Step g) 50.00 Hz ±0.01 Hz	4942.50	50.00	-		10%	
Test sequence at Registered Capacity 40-60%	Measured Active Power Output (W)	Frequency (Hz)	Calculate droop (%)	Primary Power Source	Active Power Gradient	
Step a) 50.00 Hz ±0.01 Hz	2541.08	50.00	-	Photovoltaic	-	

Step b) 50.45 Hz \pm 0.05 Hz	2394.89	50.45	-	array simulator	-
Step c) 50.70 Hz \pm 0.10 Hz	2280.92	50.70	10.96		-
Step d) 51.15 Hz \pm 0.05 Hz	2103.93	51.15	12.02		-
Step e) 50.70 Hz \pm 0.10 Hz	2275.93	50.70	10.50		-
Step f) 50.45 Hz \pm 0.05 Hz	2389.33	50.45	-		-
Step g) 50.00 Hz \pm 0.01 Hz	2539.62	50.00	-		10%

10. Protection – Re-connection timer.					P
Model: AIO2-INS-5000					
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.					
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.			
60 s	61.02 s	At 1.16 pu (266.2 V)	At 0.78 pu (180.0 V)	At 47.4 Hz	At 52.1 Hz
Confirmation that the Micro-generator does not re-connect.		No reconnection	No reconnection	No reconnection	No reconnection

11. Fault level contribution: These tests shall be carried out in accordance with EREC G99 Annex A.7.1.5.			P
For Inverter output			
Model: AIO2-INS-5000			
Time after fault	Volts	Amps	
20ms	260V	22A	
100ms	240V	22A	
250ms	200V	20A	
500ms	150V	10A	
Time to trip	629.3ms	In seconds	

12. Self-Monitoring solid state switching: No specified test requirements. Refer to Annex A.7.1.7.	
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.	N/A
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)	N/A
14. Logic interface (input port).	
Confirm that an input port is provided and can be used to shut down the module.	Yes
Additional comments.	
No.	