

### Form C: Type Test Verification Report

Type Approval and **Manufacturer** declaration of compliance with the requirements of G98.  
 This form should be used when making a Type Test submission to the Energy Networks Association (ENA).  
 If the **Micro-generator** is **Fully Type Tested** and already registered with the ENA **Type Test Verification Report** Register, the **Installation Document** should include the **Manufacturer's** Reference Number (the Product ID), and this form does not need to be submitted.  
 Where the **Micro-generator** is not registered with the ENA **Type Test Verification Report** Register this form needs to be completed and provided to the DNO, to confirm that the **Micro-generator** has been tested to satisfy the requirements of this EREC G98.


Manufacturer's reference number	GT1-1K6S1; GT1-2K2S1; GT1-3KS1; GT1-3K3S1; GT1-3K6D1
Micro-generator Technology	Grid-Tied PV Inverter
Manufacturer	Hangzhou Livoltek Power Co., Ltd.
Address	1418-35 Moganshan Road, Shangcheng Industrial Zone,310011 Hangzhou, Zhejiang Province, P.R. China

Maximum Rated Capacity	Connection Option	
	1.6	kW Single Phase
	2.2	kW Single Phase
	3.0	kW Single Phase
	3.3	kW Single Phase
	3.6	kW Single Phase

Tel	+86-571-28330320	Fax	/
E-mail	info@livoltek.com	Web site	www.livoltek.com

Manufacturer Type Test declaration. - I certify that all products supplied by the company with the above Type Tested 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 G98.

Note that testing can be done by the Manufacturer of an individual component or by an external test house. 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.

Signed:  	On behalf of  Hangzhou Livoltek Power Co., Ltd.
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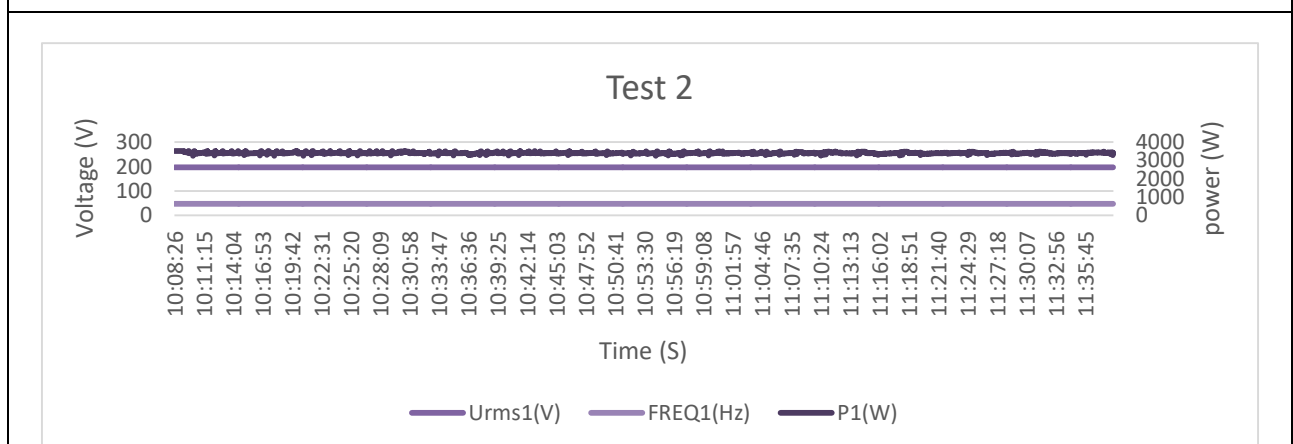
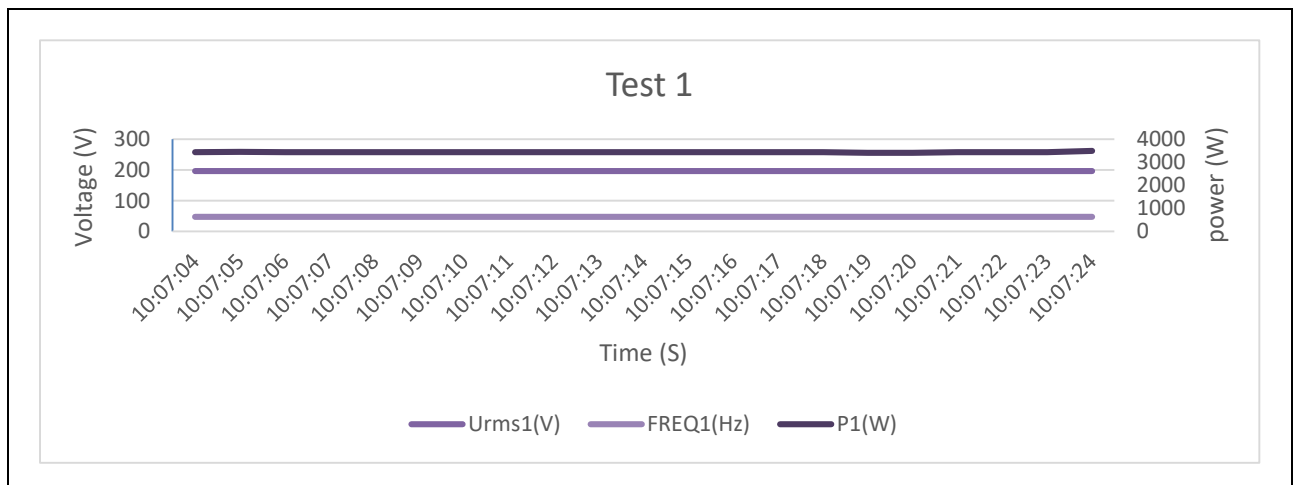
**Form C: Type Test Verification Report**

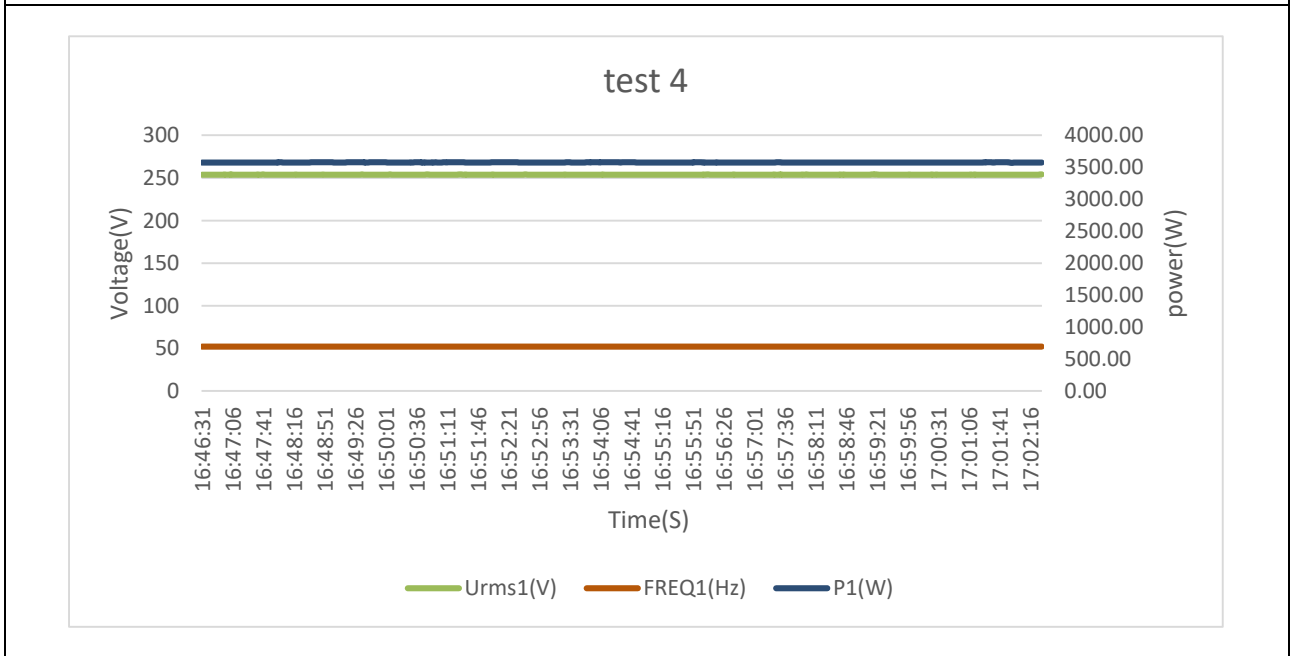
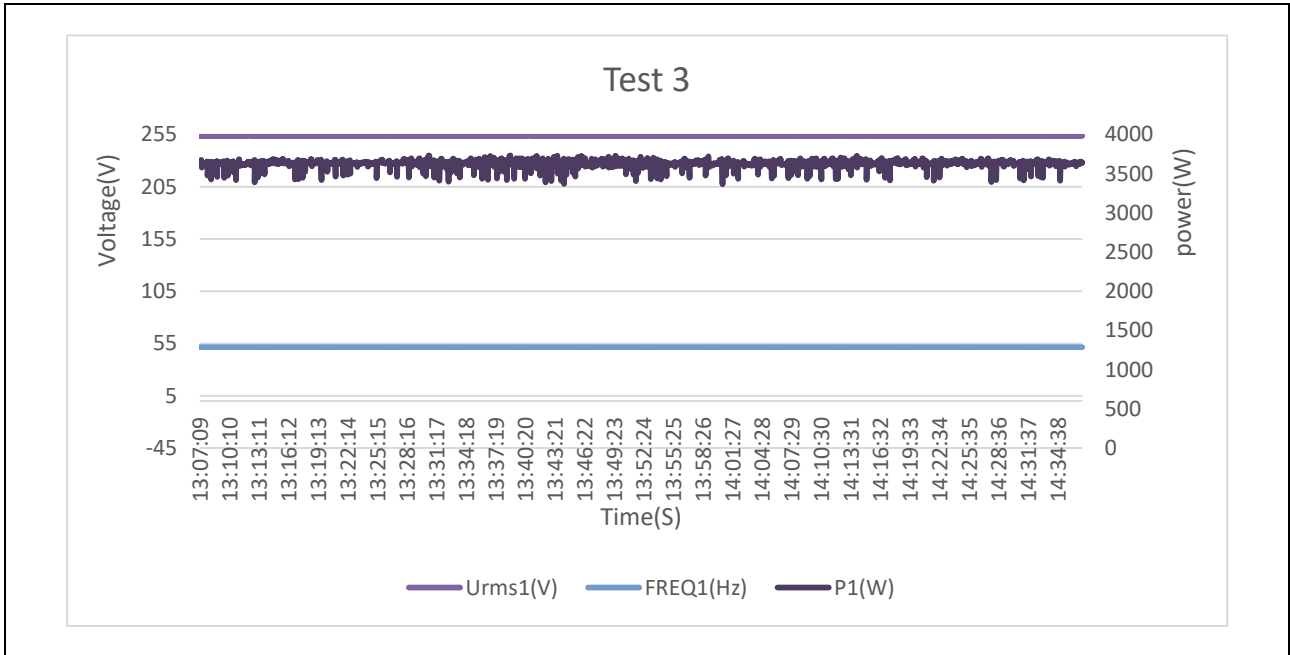
**Test record**

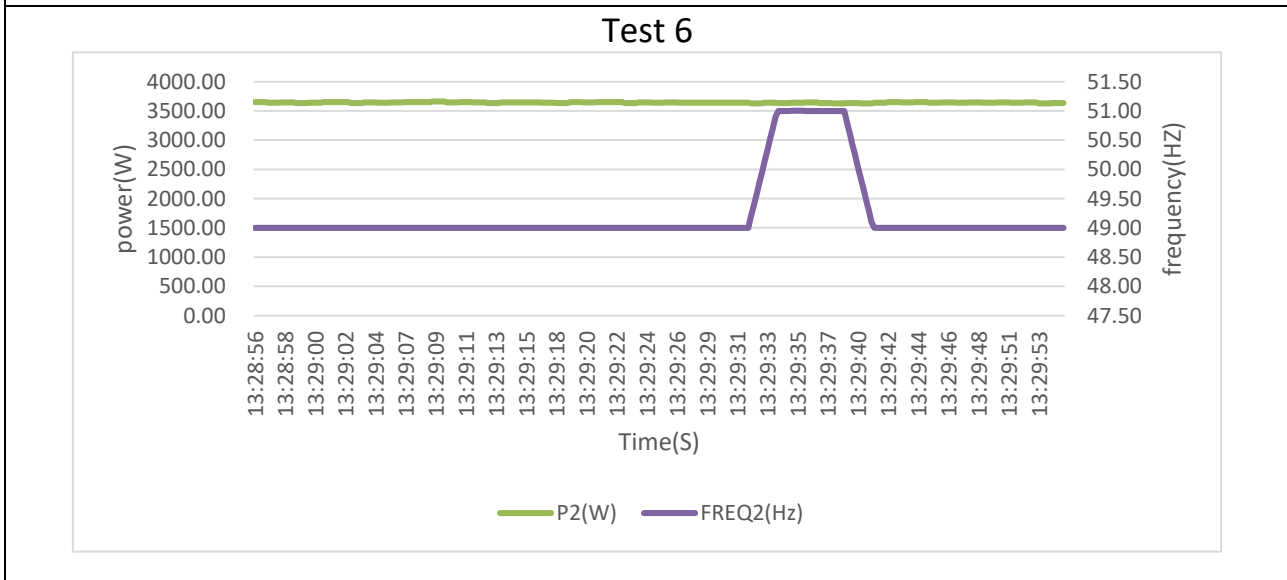
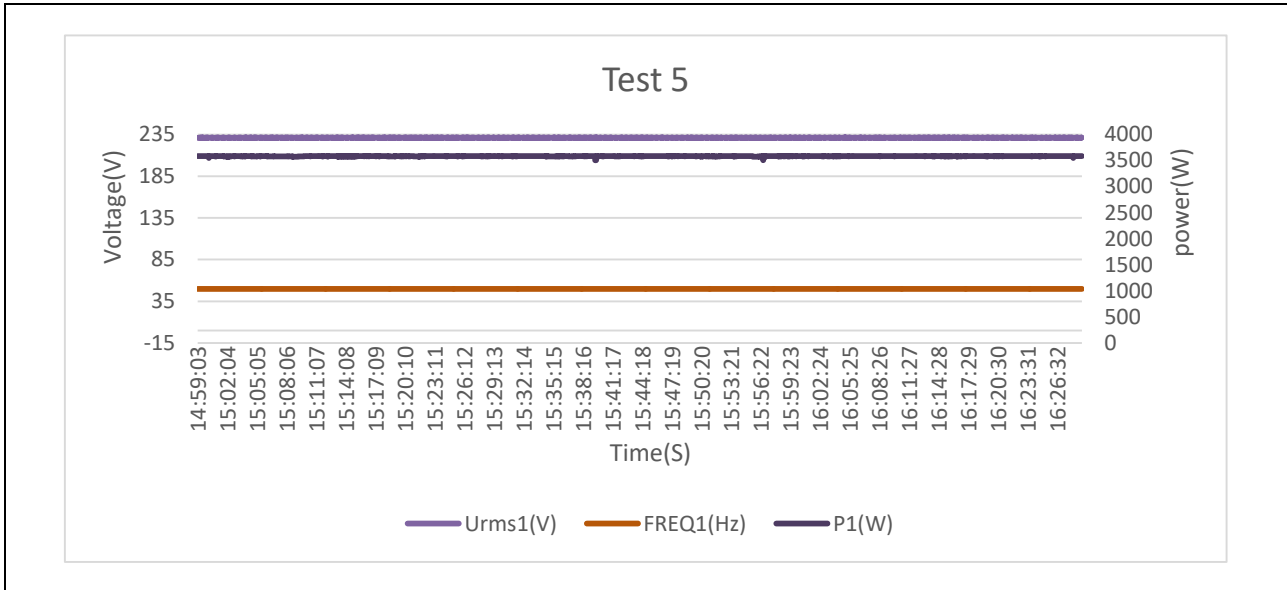
<b>1. Operating Range:</b>		<b>P</b>
This test should be carried out as specified in A.1.2.10. Pass or failure of the test should be indicated in the fields below (right hand side), for example with the statement "Pass", "No disconnection occurs", etc. Graphical evidence is preferred.		
Test 1 Voltage = 85% of nominal (195.5 V), Frequency = 47.0 Hz, Power Factor = 1, Period of test 20 s	Test chart to confirm operation	
Test 2 Voltage = 85% of nominal (195.5 V), Frequency = 47.5 Hz, Power Factor = 1, Period of test 90 minutes	Test chart to confirm operation	
Test 3 Voltage = 110% of nominal (253 V), Frequency = 51.5 Hz, Power Factor = 1, Period of test 90 minutes	Test chart to confirm operation	
Test 4 Voltage = 110% of nominal (253 V), Frequency = 52.0 Hz, Power Factor = 1, Period of test 15 minutes	Test chart to confirm operation	
Test 5 Voltage = 100% of nominal (230 V), Frequency = 50.0 Hz, Power Factor = 1, Period of test = 90 minutes	Test chart to confirm operation	
Test 6 RoCoF withstand Confirm that the <b>Micro-Generating Plant</b> is capable of staying connected to the <b>Distribution Network</b> and operate at rates of change of frequency up to 1 Hzs <sup>-1</sup> as measured over a period of 500 ms.	Test chart to confirm operation	

Model: GT1-3K6D1				
<b>Test 1:</b>				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (seconds)
196.81	47.00	3444.04	0.9998	20
<b>Test 2:</b>				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)

196.80	47.50	3406.18	0.9969	90
<b>Test 3:</b>				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
253.82	51.5	3636.67	0.9951	90
<b>Test 4:</b>				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
253.68	52	3542.77	0.9915	15
<b>Test 5:</b>				
Measured Voltage (V)	Measured Frequency (Hz)	Measured Power (W)	Measured Power factor	Test Time (Minutes)
231.14	50	3583.53	0.9970	90
<b>Test 6:</b>				
-	Ramp range	Test frequency ramp	Test Duration	Confirm no trip
-	49.0 Hz to 51.0 Hz	+0.95 Hzs <sup>-1</sup>	2.1s	no trip
-	51.0 Hz to 49.0 Hz	-0.95 Hzs <sup>-1</sup>	2.1s	no trip







2. Power Quality – Harmonics:		P
These tests should be carried out as specified in BS EN 61000-3-2. The chosen test should be undertaken with a fixed source of energy at two power levels a) between 45 and 55% and b) at 100% of <b>Registered Capacity</b> . The test requirements are specified in Annex A1 A.1.3.1 ( <b>Inverter</b> connected) or Annex A2 A.2.3.1 (Synchronous).		
Model: GT1-3K6D1		
Micro-generator tested to BS EN 61000-3-2		
Micro-generator rating per phase (rpp)	3.6	kW
For 3-phase Micro-generators, tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please	Single phase PV inverter	

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replicate this section with the results for each phase.						
Harmonic	At 45-55% of Registered Capacity		100% of Registered Capacity		NV=MV*3.68/rpp	
	Measured Value MV in Amps	Normalised Value (NV) in Amps	Measured Value MV in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.02	-	0.02	-	1.080	
3	0.15	-	0.22	-	2.300	
4	0.01	-	0.02	-	0.430	
5	0.03	-	0.07	-	1.140	
6	0.01	-	0.01	-	0.300	
7	0.01	-	0.04	-	0.770	
8	0.01	-	0.01	-	0.230	
9	0.03	-	0.02	-	0.400	
10	0.01	-	0.01	-	0.184	
11	0.04	-	0.01	-	0.330	
12	0.00	-	0.01	-	0.153	
13	0.04	-	0.03	-	0.210	
14	0.00	-	0.01	-	0.131	
15	0.03	-	0.04	-	0.150	
16	0.00	-	0.01	-	0.115	
17	0.03	-	0.03	-	0.132	
18	0.00	-	0.01	-	0.102	
19	0.02	-	0.02	-	0.118	
20	0.00	-	0.01	-	0.092	
21	0.01	-	0.02	-	0.107	0.160
22	0.00	-	0.01	-	0.084	
23	0.01	-	0.01	-	0.098	0.147
24	0.01	-	0.01	-	0.077	
25	0.01	-	0.01	-	0.090	0.135
26	0.01	-	0.01	-	0.071	
27	0.01	-	0.01	-	0.083	0.124
28	0.01	-	0.01	-	0.066	
29	0.01	-	0.01	-	0.078	0.117
30	0.01	-	0.01	-	0.061	
31	0.01	-	0.01	-	0.073	0.109
32	0.01	-	0.01	-	0.058	

33	0.01	-	0.01	-	0.068	0.102
34	0.01	-	0.01	-	0.054	
35	0.02	-	0.01	-	0.064	0.096
36	0.01	-	0.01	-	0.051	
37	0.01	-	0.01	-	0.061	0.091
38	0.01	-	0.01	-	0.048	
39	0.01	-	0.02	-	0.058	0.087
40	0.01	-	0.01	-	0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

<b>2. Power Quality – Harmonics:</b>						<b>P</b>
These tests should be carried out as specified in BS EN 61000-3-2. The chosen test should be undertaken with a fixed source of energy at two power levels a) between 45 and 55% and b) at 100% of <b>Registered Capacity</b> . The test requirements are specified in Annex A1 A.1.3.1 ( <b>Inverter</b> connected) or Annex A2 A.2.3.1 (Synchronous).						
Model: GT1-1K6S1						
<b>Micro-generator</b> tested to BS EN 61000-3-2						
<b>Micro-generator</b> rating per phase (rpp)				1.6	kW	
For 3-phase Micro-generators, tick this box if harmonic measurements are identical for all three phases. If the harmonics are not identical for each phase, please replicate this section with the results for each phase.				Single phase PV inverter		
Harmonic	At 45-55% of Registered Capacity		100% of Registered Capacity		NV=MV*3.68/rpp	
	Measured Value MV in Amps	Normalised Value (NV) in Amps	Measured Value MV in Amps	Normalised Value (NV) in Amps	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.25	-	0.04	-	1.080	
3	0.19	-	0.15	-	2.300	
4	0.21	-	0.02	-	0.430	
5	0.09	-	0.06	-	1.140	
6	0.13	-	0.01	-	0.300	
7	0.09	-	0.04	-	0.770	
8	0.14	-	0.01	-	0.230	
9	0.08	-	0.02	-	0.400	
10	0.12	-	0.01	-	0.184	
11	0.10	-	0.01	-	0.330	

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12	0.11	-	0.01	-	0.153	
13	0.16	-	0.01	-	0.210	
14	0.10	-	0.01	-	0.131	
15	0.10	-	0.01	-	0.150	
16	0.10	-	0.01	-	0.115	
17	0.07	-	0.01	-	0.132	
18	0.09	-	0.01	-	0.102	
19	0.07	-	0.01	-	0.118	
20	0.02	-	0.01	-	0.092	
21	0.07	-	0.01	-	0.107	0.160
22	0.06	-	0.01	-	0.084	
23	0.06	-	0.01	-	0.098	0.147
24	0.06	-	0.01	-	0.077	
25	0.06	-	0.01	-	0.090	0.135
26	0.02	-	0.01	-	0.071	
27	0.02	-	0.01	-	0.083	0.124
28	0.02	-	0.01	-	0.066	
29	0.02	-	0.01	-	0.078	0.117
30	0.02	-	0.01	-	0.061	
31	0.02	-	0.01	-	0.073	0.109
32	0.02	-	0.01	-	0.058	
33	0.02	-	0.01	-	0.068	0.102
34	0.02	-	0.01	-	0.054	
35	0.05	-	0.01	-	0.064	0.096
36	0.03	-	0.01	-	0.051	
37	0.03	-	0.01	-	0.061	0.091
38	0.02	-	0.01	-	0.048	
39	0.05	-	0.01	-	0.058	0.087
40	0.03	-	0.01	-	0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.



3. Power Quality – Voltage fluctuations and Flicker:								P
<p>These tests should be undertaken in accordance with EREC G98 Annex A1 A.1.3.3 (Inverter connected) or Annex A2 A.2.3.3 (Synchronous).</p> <p>The standard test impedance is 0.4 Ω for a single phase Micro-generating Plant (and for a two phase unit in a three phase system) and 0.24 Ω for a three phase Micro-generating Plant (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):</p> <p><math>d \text{ max normalised value} = (\text{Standard impedance} / \text{Measured impedance}) \times \text{Measured value}.</math></p> <p>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.</p> <p>The stopping test should be a trip from full load operation.</p> <p>The duration of these tests needs to comply with the particular requirements set out in the testing notes for the technology under test.</p> <p>The test date and location must be declared.</p>								
Model:	GT1-3K6D1							
Test start date	28,July,2022			Test end date	28,July,2022			
Test location	Hangzhou Livoltek Power Co., Ltd.							
	Starting			Stopping			Running	
	d(max) %	d(c) %	d(t) %	d(max) %	d(c) %	d(t) %	P <sub>st</sub>	P <sub>It</sub> 2 hours
Measured Values at test impedance	0.142%	0.110%	0%	0.719%	0.517%	0%	0.015	0.054
Normalised to standard impedance	0.142%	0.110%	0%	0.719%	0.517%	0%	0.015	0.054
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 61000-3-3	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 Micro-generators. Delete as appropriate.								
^ Applies to single phase Micro-generators and Micro-generators using two phases on a three phase								

system. Delete as appropriate.

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\*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 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 need to conform to the particular requirements set out in the testing notes for the technology under test. Dates and location of the test need to be noted below.

Diagram of test

Update: 7524      Runtime: 8:00:17      46% 10% x2      2023-01-31 17:41:00

**4. Power quality – DC injection:**

P

This test should be carried out in accordance with A 1.3.4 as applicable.

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

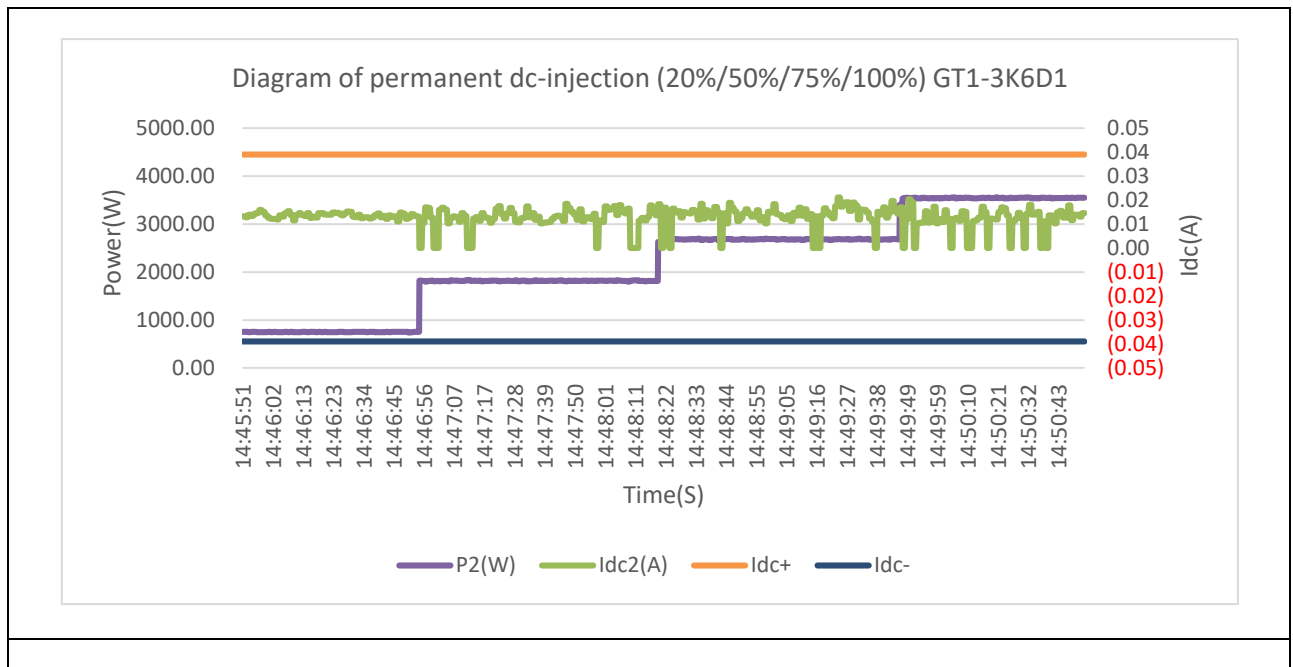
% DC injection = Recorded DC value in Amps / base current

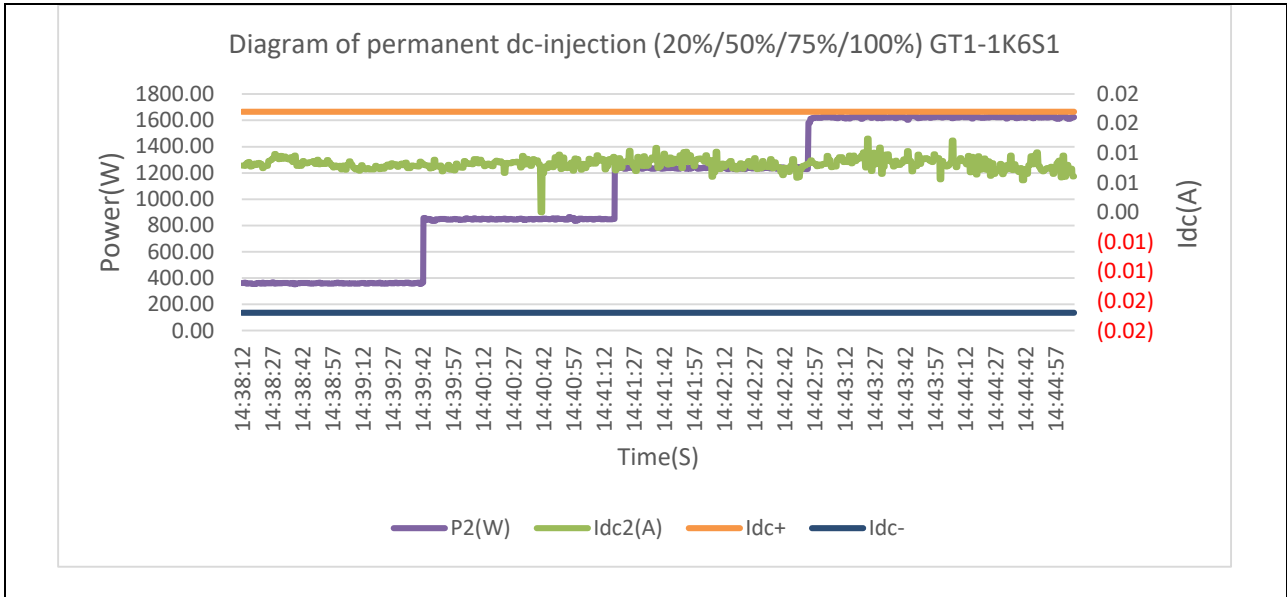
where the base current is the **Registered Capacity** (W) / 230 V. The % DC injection should not be greater than 0.25%.

Model: GT1-3K6D1				
Test power level	20%	50%	75%	100%
Recorded DC injection value in Amps	0.01	0.01	0.01	0.01
as % of rated AC current	0.06%	0.06%	0.06%	0.06%
Limit	0.25%	0.25%	0.25%	0.25%

Model: GT1-1K6S1				
Test power level	20%	50%	75%	100%
Recorded DC injection value in Amps	0.01	0.01	0.01	0.01
as % of rated AC current	0.14%	0.14%	0.14%	0.14%
Limit	0.25%	0.25%	0.25%	0.25%





5. Power Factor:				P
This test shall be carried out in accordance with A.1.3.2 and A.2.3.2 at three voltage levels and at <b>Registered Capacity</b> and the measured <b>Power Factor</b> must be greater than 0.95 to pass. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.				
Model: GT1-3K6D1				
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)	
Measured value	0.999	0.999	0.999	
<b>Power Factor Limit</b>	>0.95	>0.95	>0.95	
Model: GT1-1K6S1				
Voltage	0.94 pu (216.2 V)	1 pu (230 V)	1.1 pu (253 V)	
Measured value	0.985	0.993	0.994	
<b>Power Factor Limit</b>	>0.95	>0.95	>0.95	

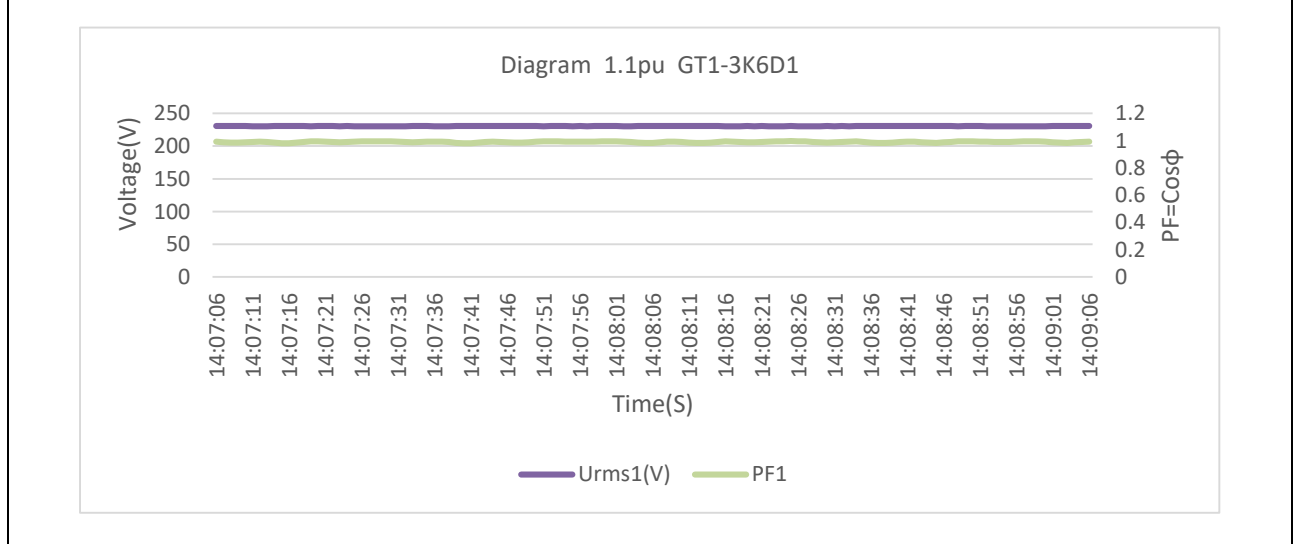
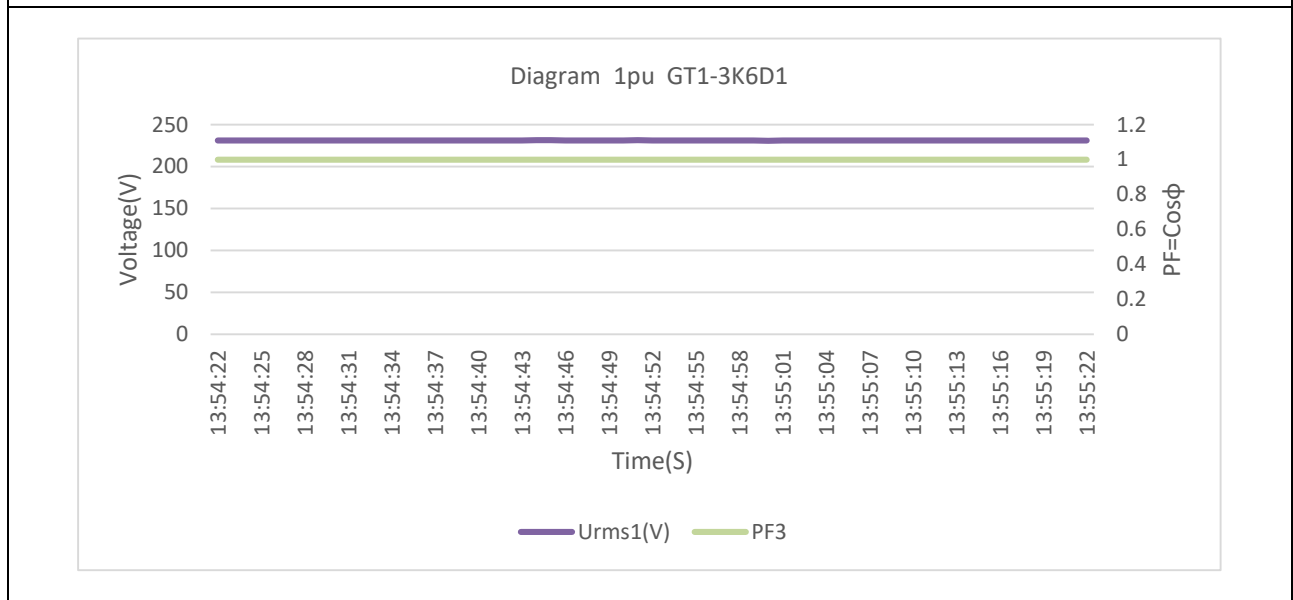
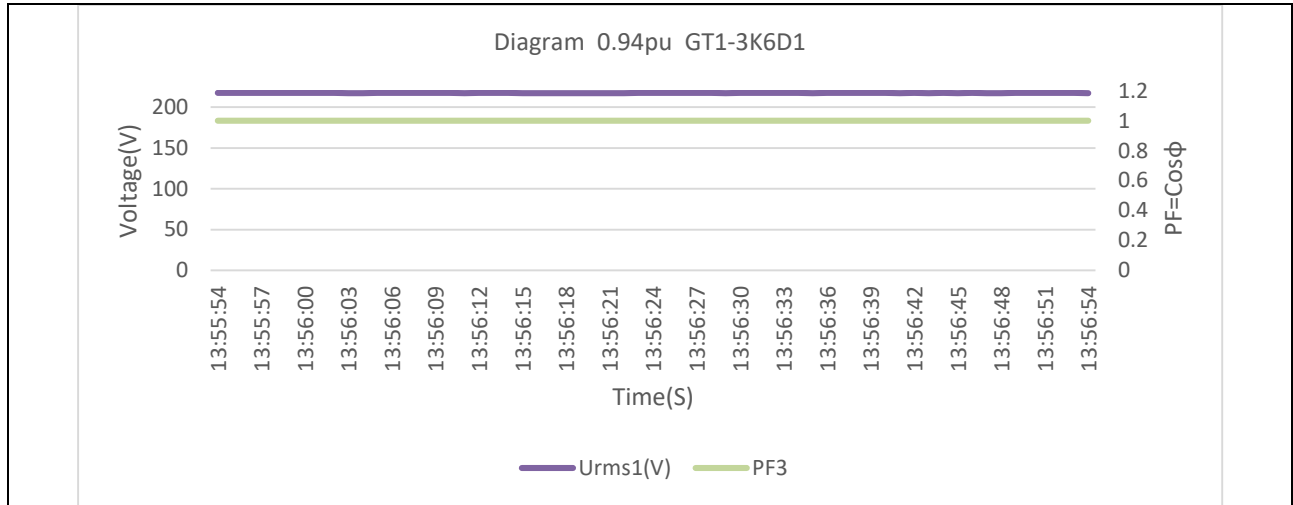
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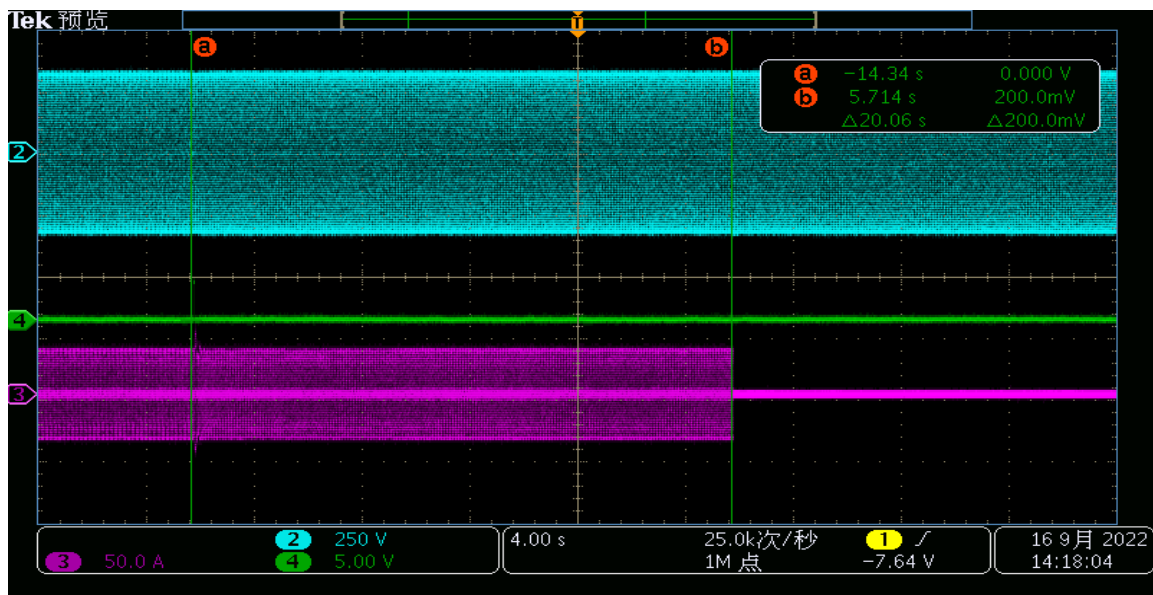
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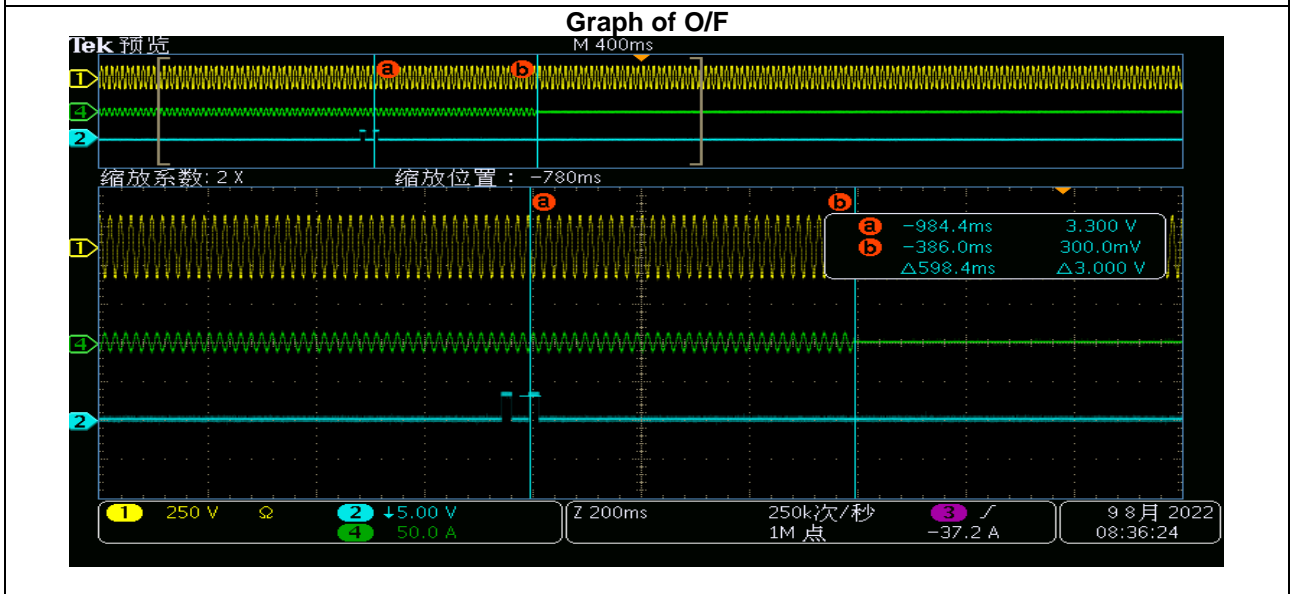
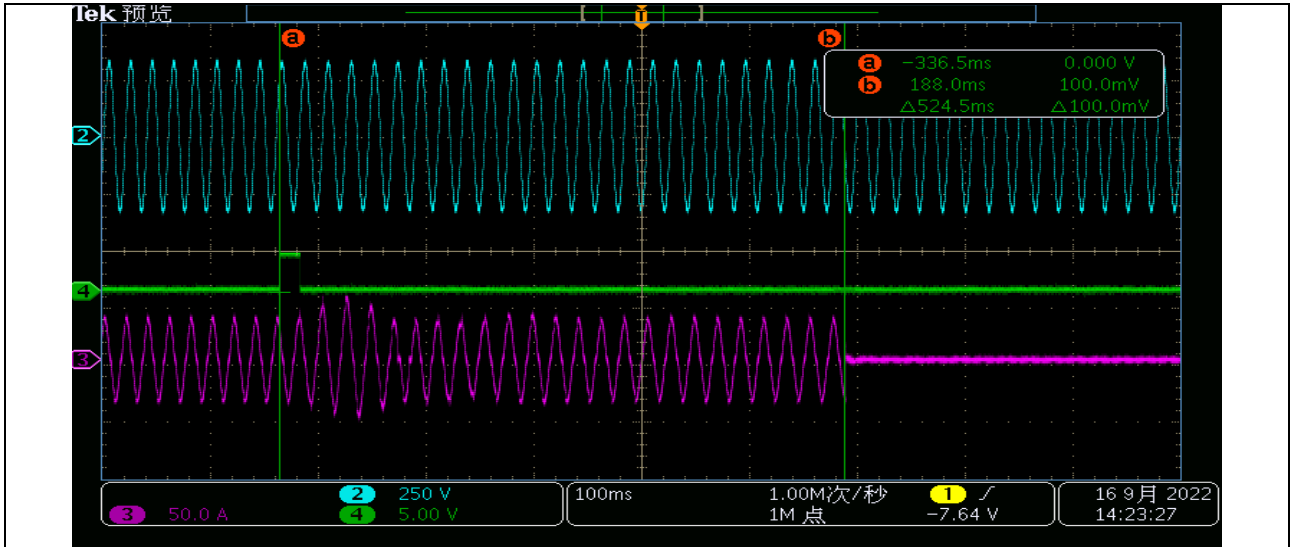


6. Protection – Frequency tests:						P
These tests should be carried out in accordance with Annex A1 A.1.2.3 ( <b>Inverter</b> connected) or Annex A2 A.2.2.3 (Synchronous). For trip tests, frequency and time delay should be stated. For “no trip tests”, “no trip” can be stated.						
Model: GT1-3K6D1						
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	47.45Hz	20.06s	47.7 Hz 30 s	No trip
U/F stage 2	47.0 Hz	0.5 s	46.95 Hz	0.52s	47.2 Hz 19.5 s	No trip
					46.8 Hz 0.45 s	No trip
O/F	52.0 Hz	0.5 s	52.05 Hz	0.59s	51.8 Hz 120.0 s	No trip
					52.2 Hz 0.45 s	No trip
Note: For frequency trip tests the frequency required to trip is the setting $\pm 0.1$ 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 $\pm 0.2$ Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.						

Graph of U/F stage 1



Graph of U/F stage 2

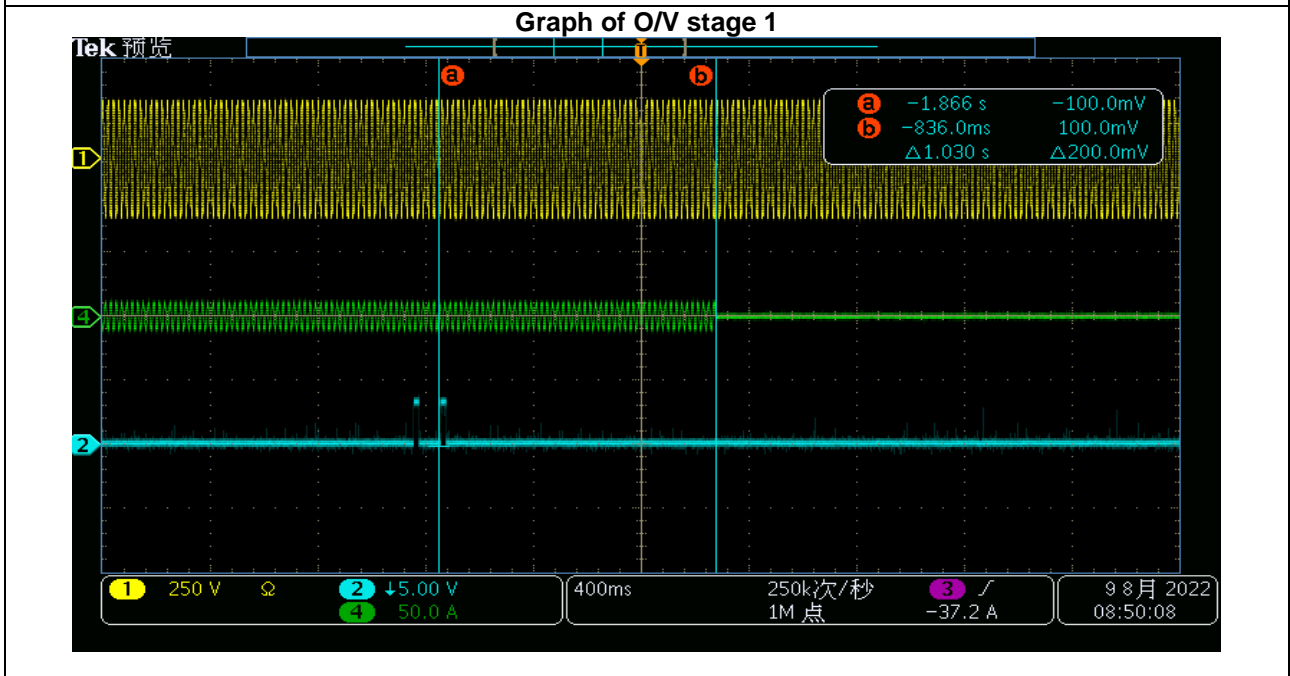
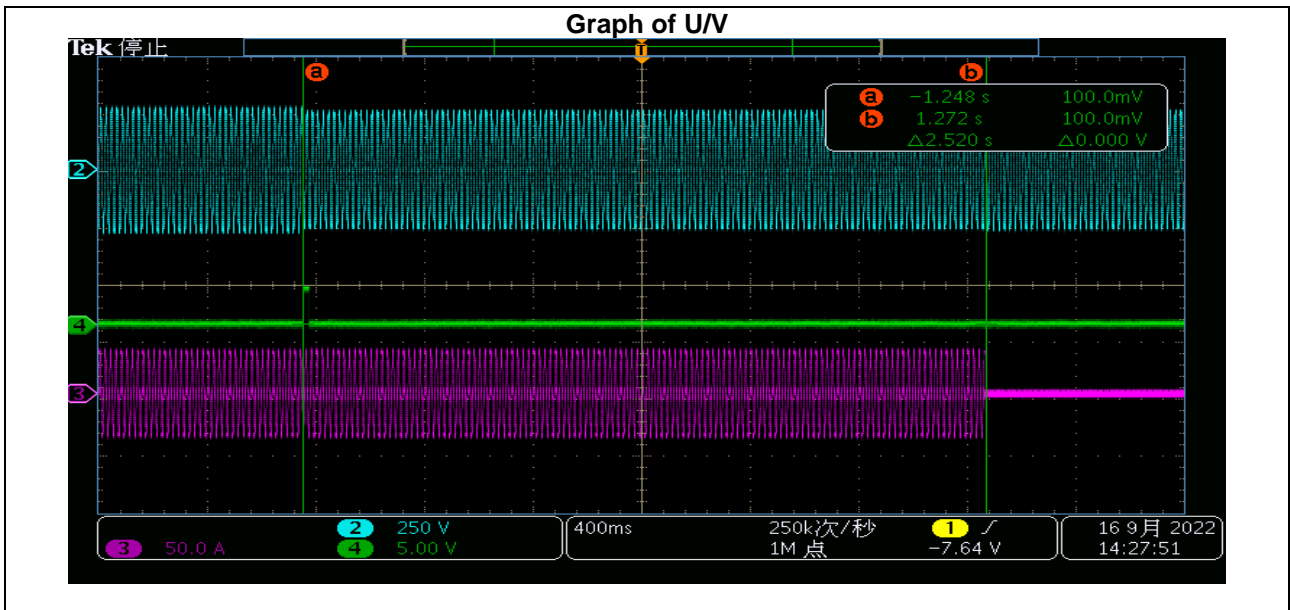


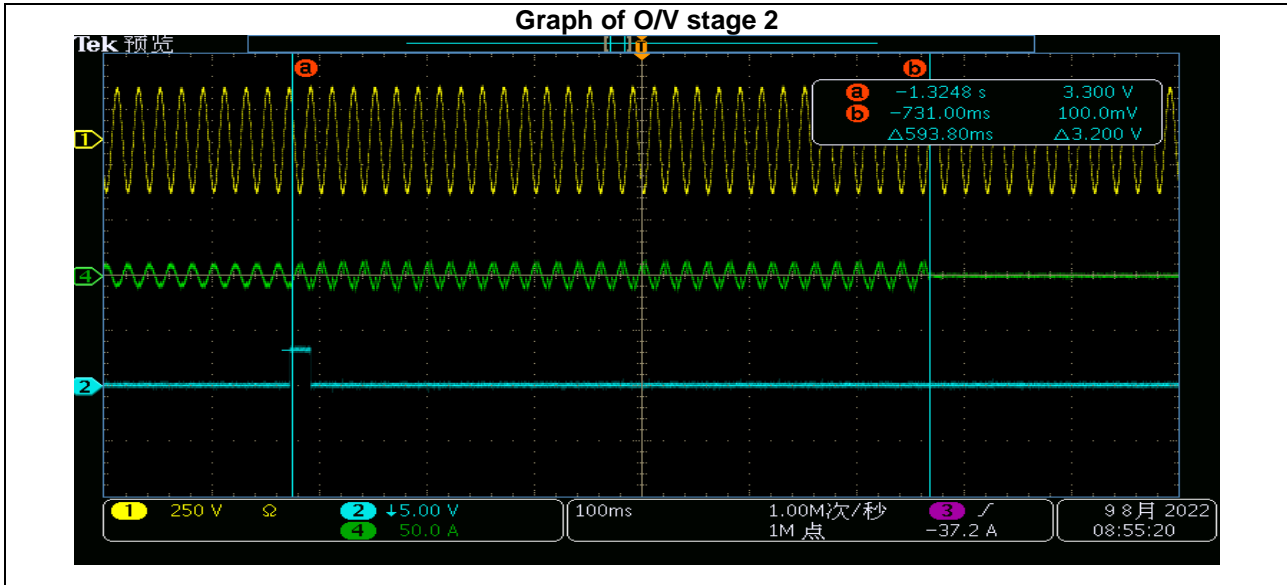
7. Protection – Voltage tests:						P
These tests should be carried out in accordance with Annex A1 A.1.2.2 ( <b>Inverter</b> connected) or Annex A2 A.2.2.2 (Synchronous). For trip tests, voltage and time delay should be stated. For “no trip tests”, “no trip” can be stated.						
Model: GT1-3K6D1						
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	184V	2.52s	188 V 5.0 s	no trip
					180 V 2.45 s	no trip



O/V stage 1	1.14 pu (262.2 V)	1.0 s	262.2V	1.03s	258.2 V 5.0 s	no trip
O/V stage 2	1.19 pu (273.7 V)	0.5 s	274V	0.59s	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  $\pm 3.45$  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  $\pm 4$  V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.





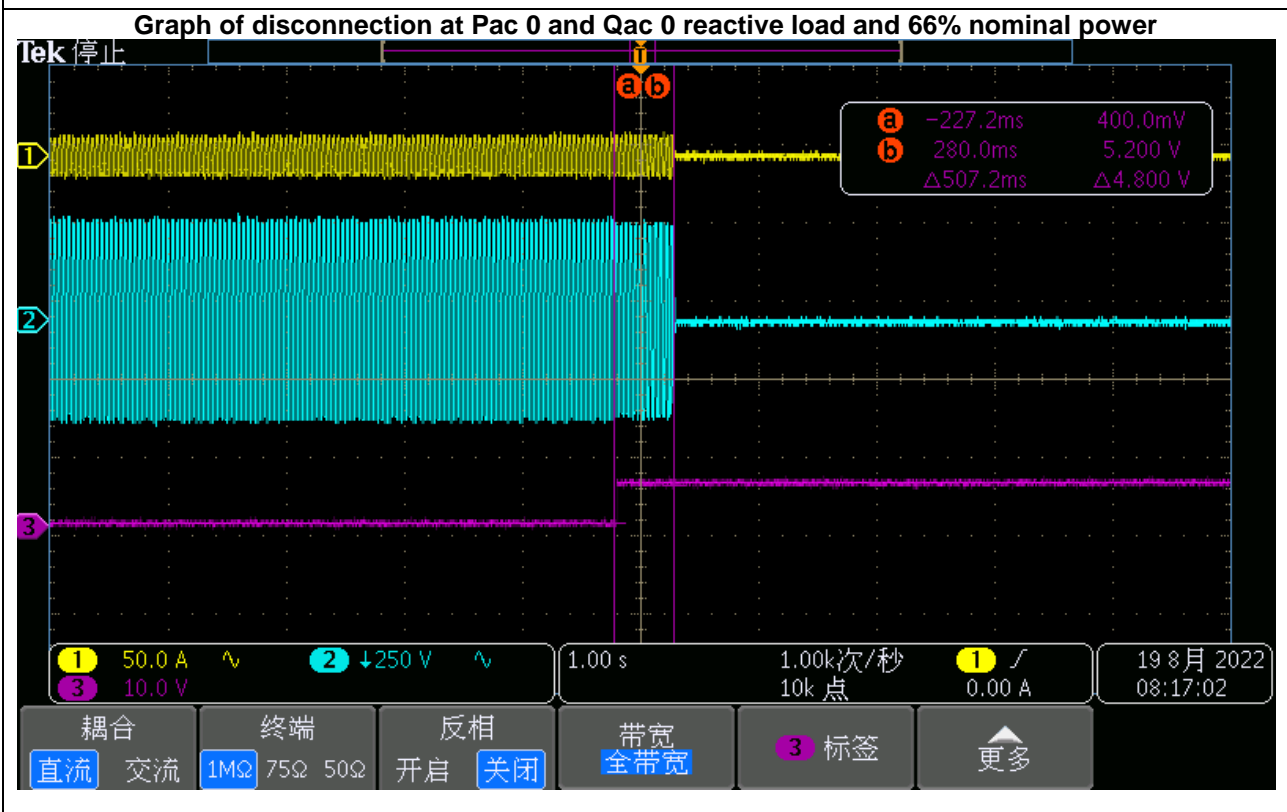
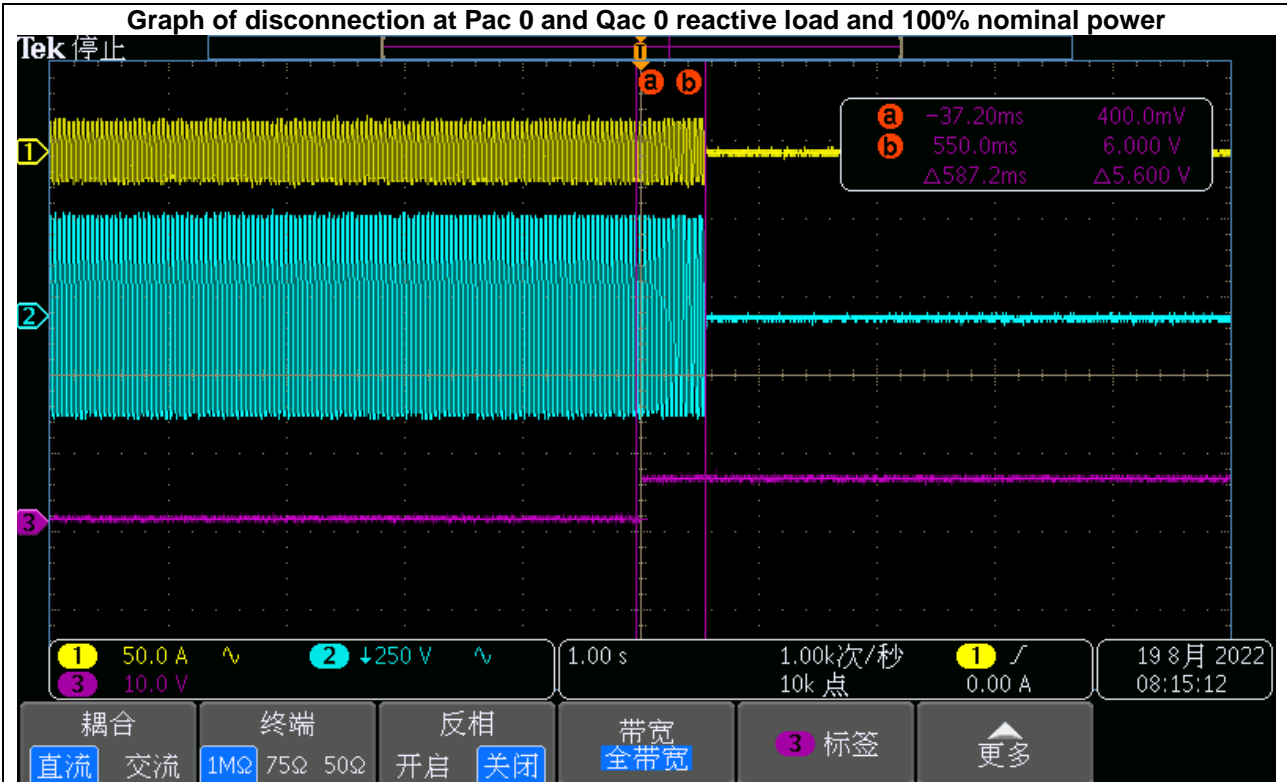
8. Protection – Loss of Mains test:									P
For PV <b>Inverters</b> shall be tested in accordance with BS EN 62116. Other <b>Micro-generators</b> should be tested in accordance with A.2.2.4 at 10%, 55% and 100% of rated power.									
For test condition A, EUT output = 100 % P <sub>n</sub> , test condition B, EUT output = 50 % to 66 % P <sub>n</sub> , and test condition C, EUT output = 25 % to 33 % P <sub>n</sub> .									
Model: GT1-3K6D1									
For <b>Inverters</b> tested to BS EN 62116 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. <b>Limit is 0.5s</b>	465ms	477ms	467ms	407ms	417ms	455ms			
No.	PEUT <sup>a)</sup> (% of EUT rating)	Reactive load (% of Q <sub>L</sub> )	P <sub>AC</sub> <sup>b)</sup> (% of nominal)	Q <sub>AC</sub> <sup>c)</sup> (% of nominal)	Run-on time (ms)	PEUT (W)	Actual Q <sub>f</sub>	V <sub>DC</sub> <sup>d)</sup>	Remarks <sup>e)</sup>
1	100	100	0	0	587	3600	1.00	426V	Test A at BL
2	66	66	0	0	507	2200	1.00	308V	Test B at BL
3	33	33	0	0	537	1100	1.00	189V	Test C at BL
4	100	100	-5	-5	507	3600	0.95	426V	Test A at IB
5	100	100	-5	0	467	3600	1.00	426V	Test A at IB
6	100	100	-5	+5	437	3600	1.05	426V	Test A at IB
7	100	100	0	-5	447	3600	0.95	426V	Test A at IB
8	100	100	0	+5	387	3600	1.05	426V	Test A at IB
9	100	100	+5	-5	467	3600	0.95	426V	Test A at IB

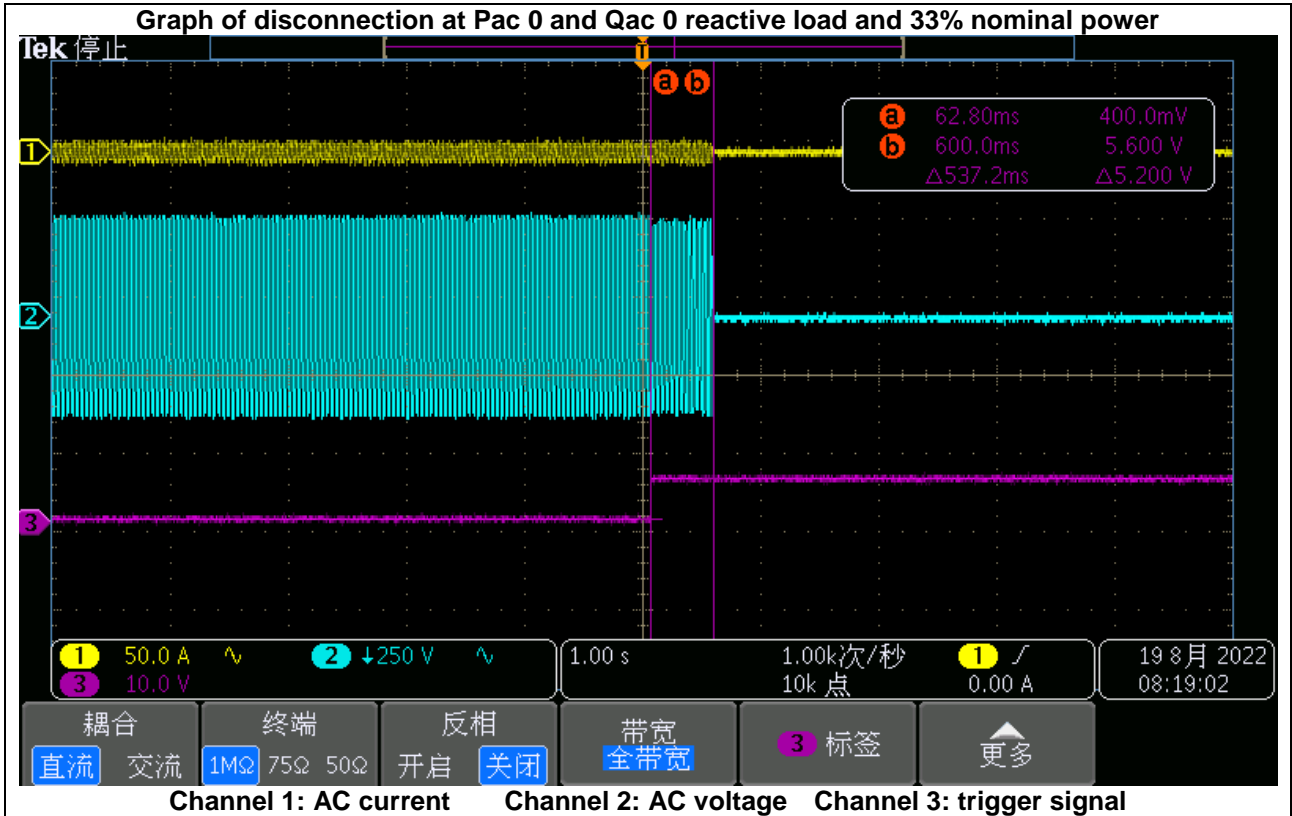
10	100	100	+5	0	455	3600	1.00	426V	Test A at IB
11	100	100	+5	+5	437	3600	1.05	426V	Test A at IB
12	66	66	0	-5	477	2200	0.95	308V	Test B at IB
13	66	66	0	-4	587	2200	0.96	308V	Test B at IB
14	66	66	0	-3	567	2200	0.97	308V	Test B at IB
15	66	66	0	-2	547	2200	0.98	308V	Test B at IB
16	66	66	0	-1	537	2200	0.99	308V	Test B at IB
17	66	66	0	+1	527	2200	1.01	308V	Test B at IB
18	66	66	0	+2	447	2200	1.02	308V	Test B at IB
19	66	66	0	+3	417	2200	1.03	308V	Test B at IB
20	66	66	0	+4	407	2200	1.04	308V	Test B at IB
21	66	66	0	+5	417	2200	1.05	308V	Test B at IB
22	33	33	0	-5	465	1100	0.95	189V	Test C at IB
23	33	33	0	-4	687	1100	0.96	189V	Test C at IB
24	33	33	0	-3	597	1100	0.97	189V	Test C at IB
25	33	33	0	-2	637	1100	0.98	189V	Test C at IB
26	33	33	0	-1	527	1100	0.99	189V	Test C at IB
27	33	33	0	+1	497	1100	1.01	189V	Test C at IB
28	33	33	0	+2	557	1100	1.02	189V	Test C at IB
29	33	33	0	+3	467	1100	1.03	189V	Test C at IB
30	33	33	0	+4	457	1100	1.04	189V	Test C at IB
31	33	33	0	+5	407	1100	1.05	189V	Test C at IB

**Note:**

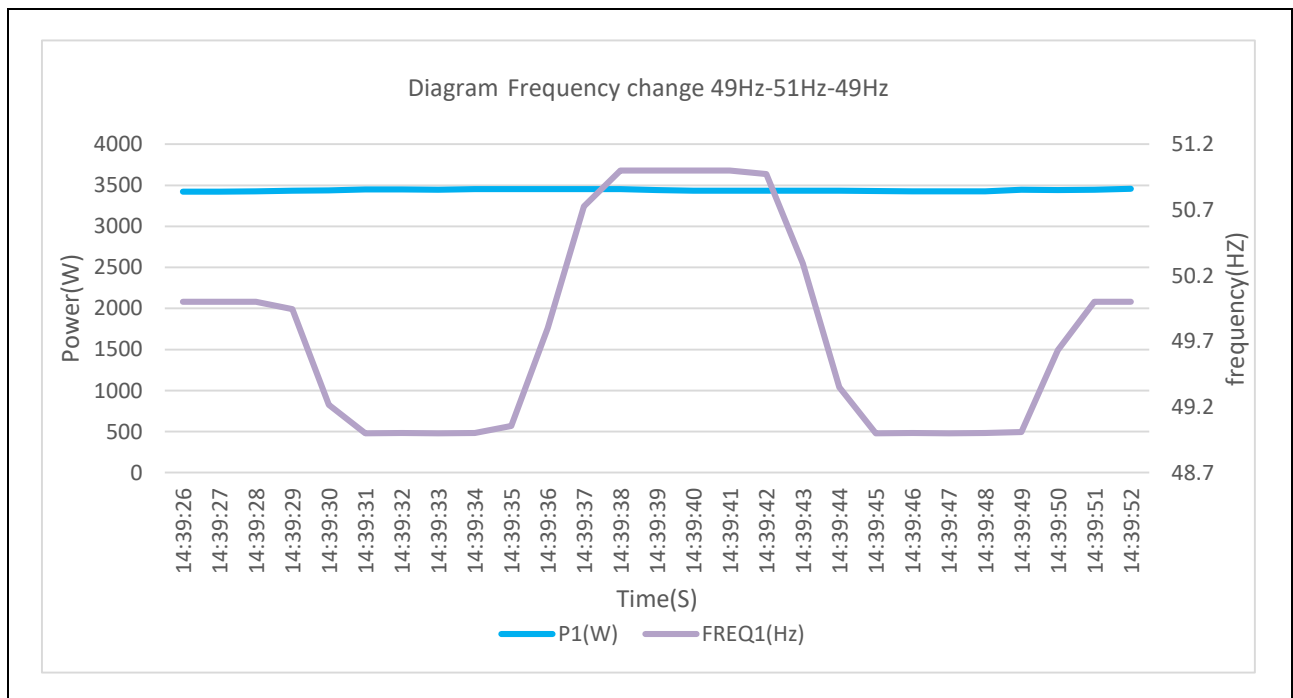
- a)  $P_{EUT}$ : EUT output power.
- b)  $P_{ac}$ : Active power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
- c)  $Q_{ac}$ : Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
- d) For test condition A, > 75 % of rated input voltage range used, for test condition B, 50 % of rated input voltage range,  $\pm 10$  % used, for test condition C, < 20 % of rated input voltage range used. Based on EUT rated input operating range. For example, if range is between X volts and Y volts, 75 % of range =  $X + 0,75 \times (Y - X)$ . Y shall not exceed  $0,8 \times$  EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.
- e) BL: Balance condition, IB: Imbalance condition.

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.





9. Protection – Frequency change, Vector Shift Stability test:				P
This test should be carried out in accordance with EREC G98 Annex A1 A.1.2.6 ( <b>Inverter</b> connected) or Annex A2 A.2.2.6 (Synchronous). Confirmation is required that the <b>Micro-generating Plant</b> does not trip under positive / negative vector shift.				
Model: GT1-3K6D1				
	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	
10. Protection – Frequency change, RoCoF Stability test:				P
The requirement is specified in section 11.3, test procedure in Annex A.1.2.6 ( <b>Inverter</b> connected) or Annex A2 A.2.2.6 (Synchronous). Confirmation is required that the <b>Micro-generating Plant</b> does not trip for the duration of the ramp up and ramp down test.				
Model: GT1-3K6D1				
Ramp range	Test frequency ramp:	Test Duration	Confirm no trip	
49.0 Hz to 51.0 Hz	+0.95 Hzs <sup>-1</sup>	2.1 s	no trip	
51.0 Hz to 49.0 Hz	-0.95 Hzs <sup>-1</sup>	2.1 s	no trip	



11. Limited Frequency Sensitive Mode – Over frequency test:					P
This test should be carried out in accordance with A.1.2.9. The test should be carried out using the specific threshold frequency of 50.4 Hz and <b>Droop</b> of 10%. The measurement tolerances are contained in A.1.2.9.					
Model: GT1-3K6D1					
Alternatively, simulation results should be noted below:					
Test sequence at <b>Registered Capacity</b> >80%	Measured <b>Active Power</b> Output (W)	Frequency (Hz)	Calculated droop (%)	Primary Power Source	<b>Active Power Gradient</b>
Step a) 50.00 Hz ±0.01 Hz	3593.3	50.00	-	Photovoltaic array simulator (100%Pn)	-
Step b) 50.45 Hz ±0.05 Hz	3560	50.45	10.8		-
Step c) 50.70 Hz ±0.10 Hz	3362	50.70	9.1		-
Step d) 51.15 Hz ±0.05 Hz	3095	51.15	12.1		-
Step e) 50.70 Hz ±0.10 Hz	3356	50.70	12.4		-
Step f) 50.45 Hz ±0.05 Hz	3561	50.45	8.8		-
Step g) 50.00 Hz ±0.01 Hz	3595	50.00	-		10%/Pn/min
Test sequence at <b>Registered Capacity</b> 40-60%	Measured <b>Active Power</b> Output (W)	Frequency (Hz)	Calculated droop (%)	Primary Power Source	<b>Active Power Gradient</b>
Step a) 50.00 Hz ±0.01 Hz	1800	50.00	-	Photovoltaic array simulator (50%Pn)	-
Step b) 50.45 Hz ±0.05 Hz	1760	50.45	9.0		-
Step c) 50.70 Hz ±0.10 Hz	1570.3	50.70	9.5		-
Step d) 51.15 Hz ±0.05 Hz	1266	51.15	10.6		-
Step e) 50.70 Hz ±0.10 Hz	1552	50.70	11.3		-
Step f) 50.45 Hz ±0.05 Hz	1756	50.45	8.8		-
Step g) 50.00 Hz ±0.01 Hz	3600	50.00	-		10%/Pn/min
The frequency at each step should be maintained for at least one minute and the Active Power reduction in the form of a gradient determined and assessed for compliance with paragraph 11.2.3. The Droop should be determined from the measurements between 50.4 Hz and 51.15 Hz. The allowed tolerance for the frequency measurement shall be ± 0.05 Hz. The allowed tolerance for Active Power output measurement shall be ±10% of the required change in Active Power.					
The resulting overall tolerance range for a nominal 10% Droop is +2.8% and – 1.5%, ie a Droop less than 12.8% and greater than 8.5%.					

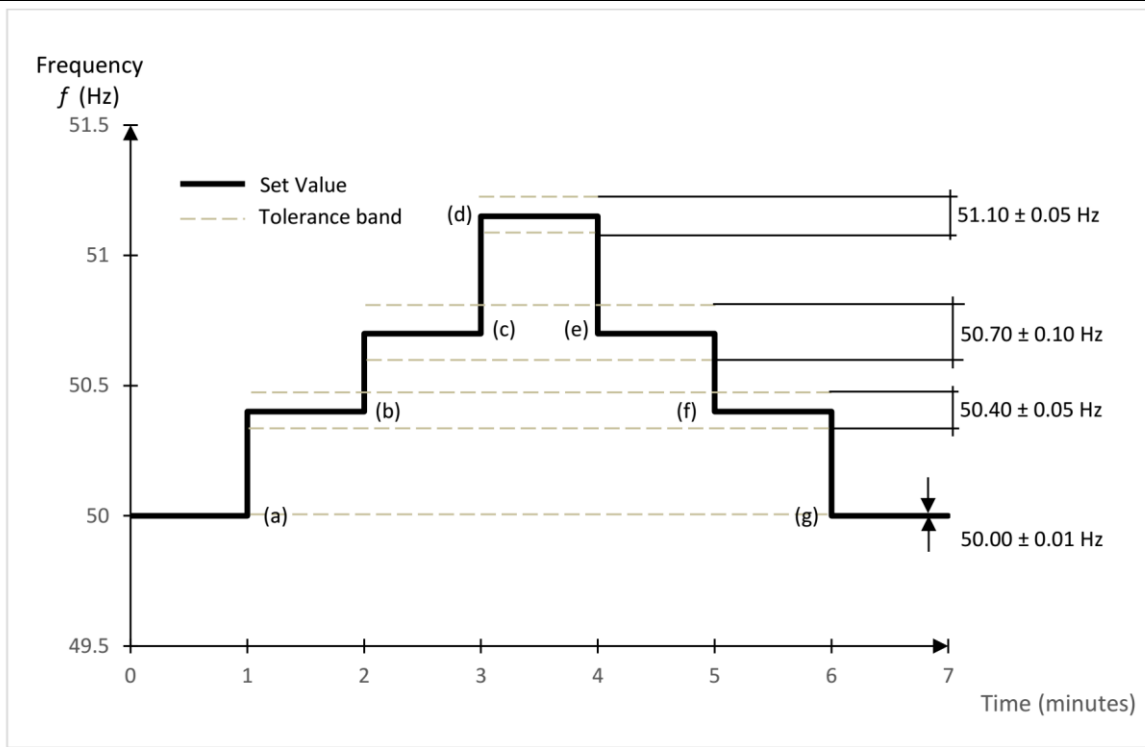
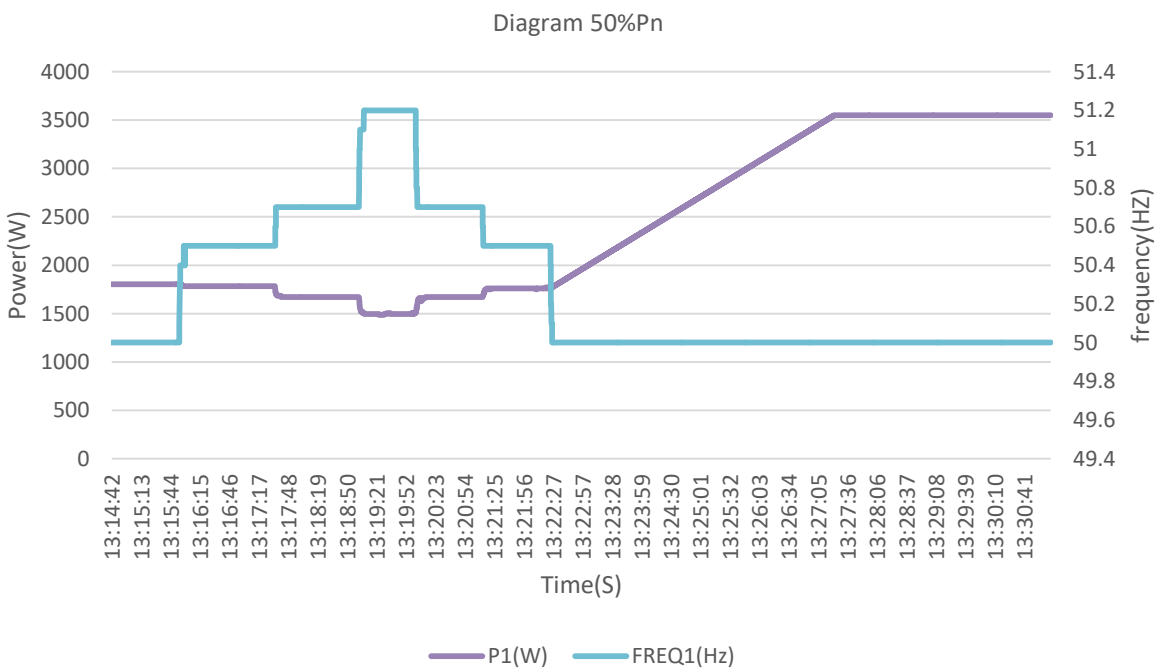
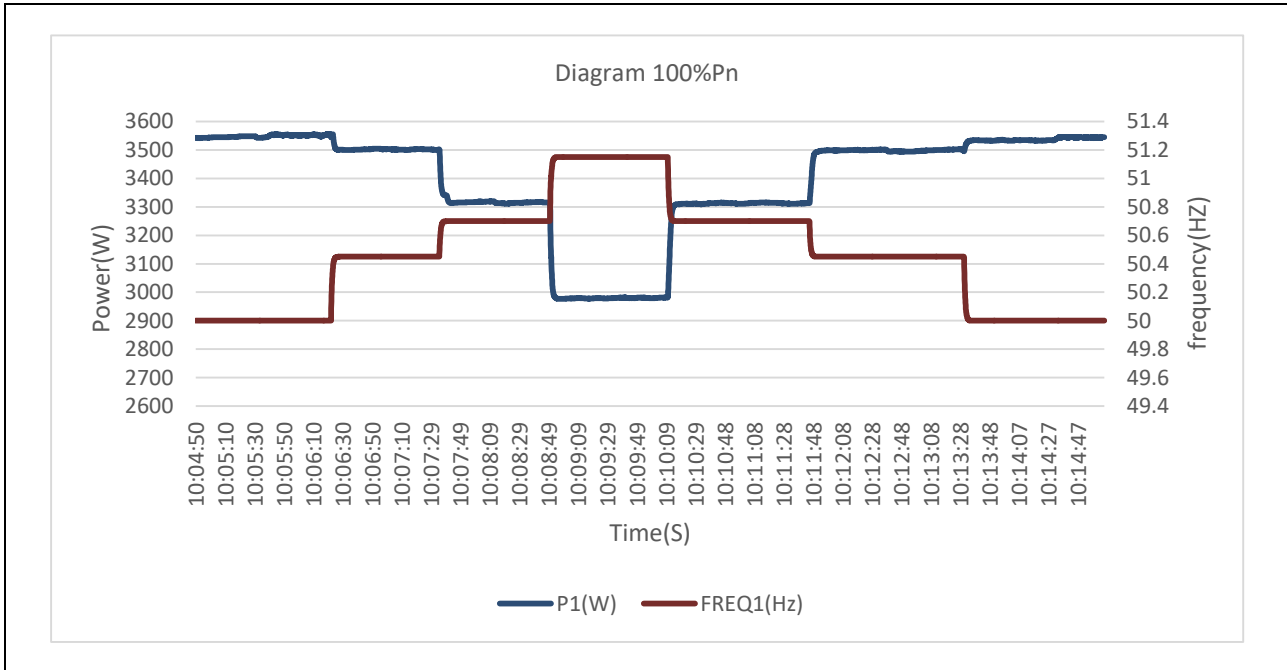


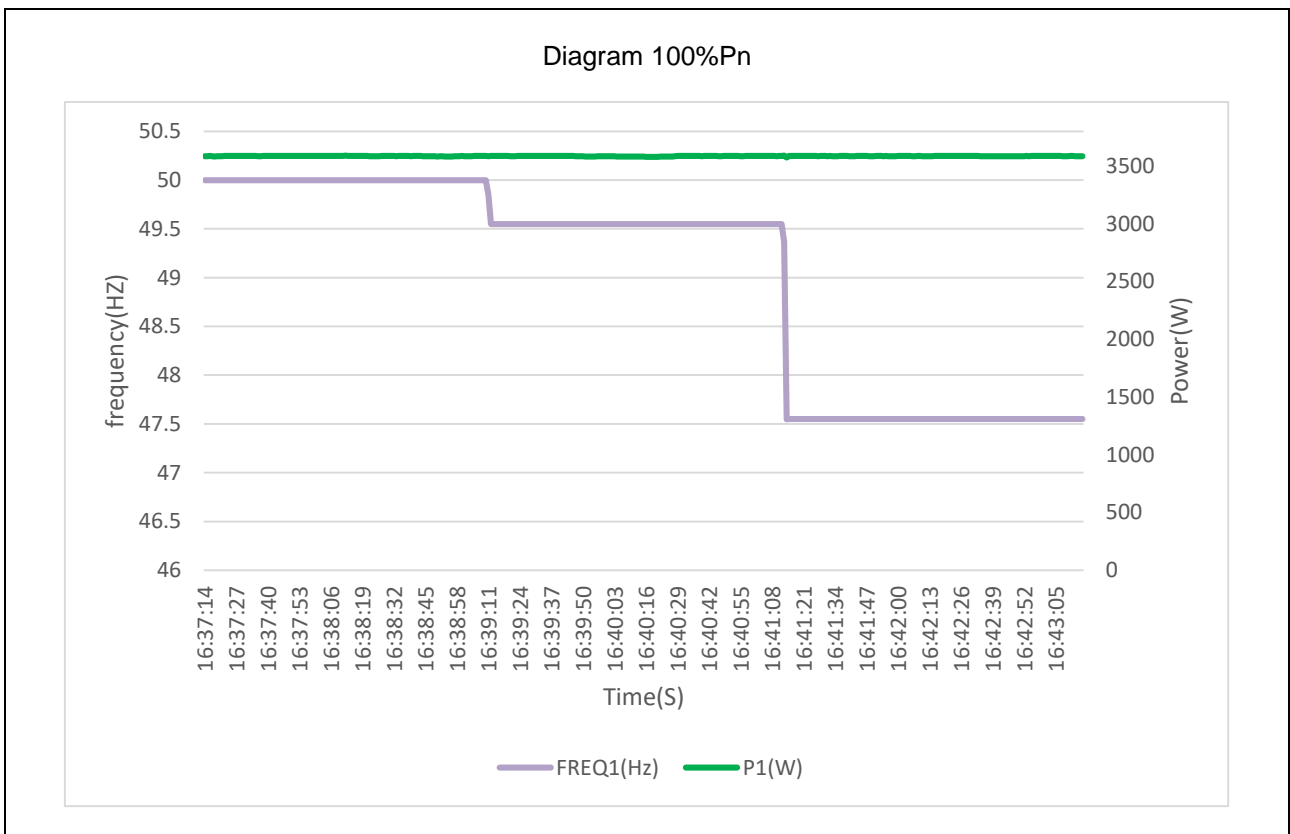
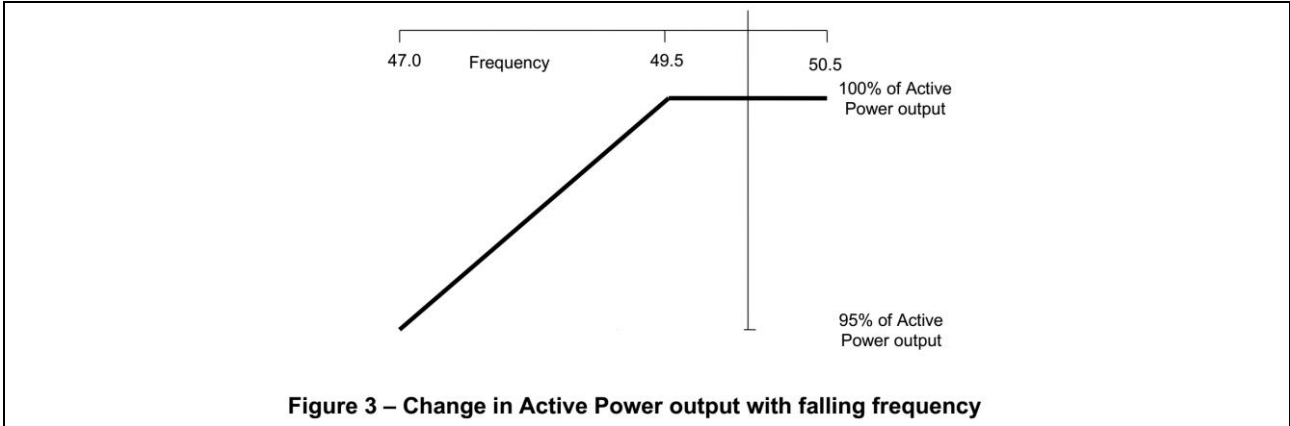
Figure A1.3 Testing the **Active Power** feed-in of the **Micro-generator** at over frequency.



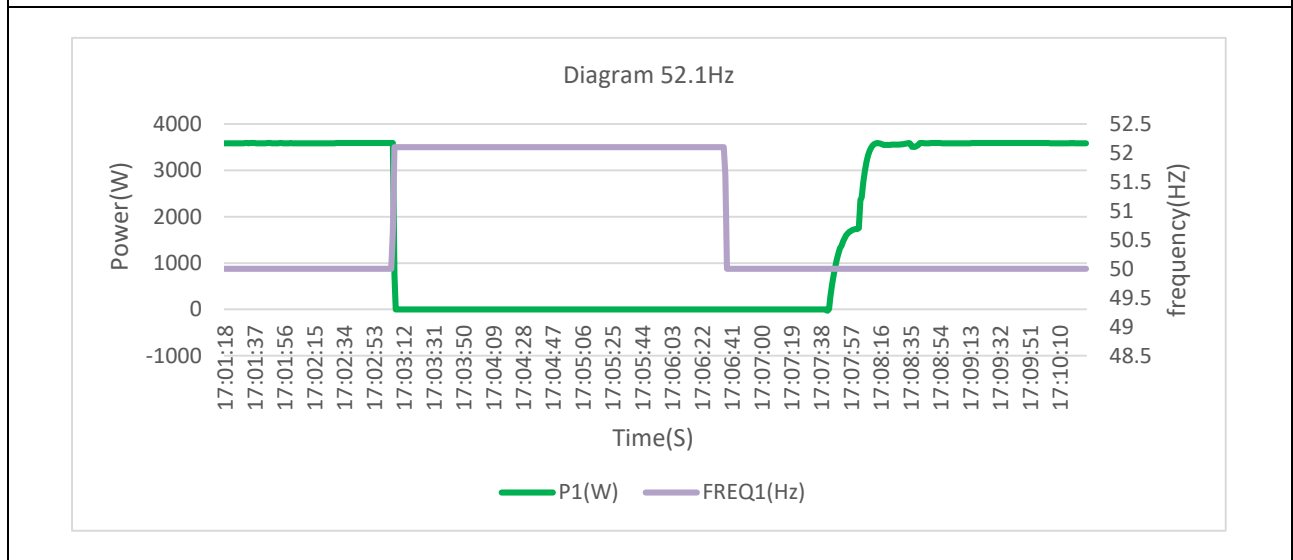
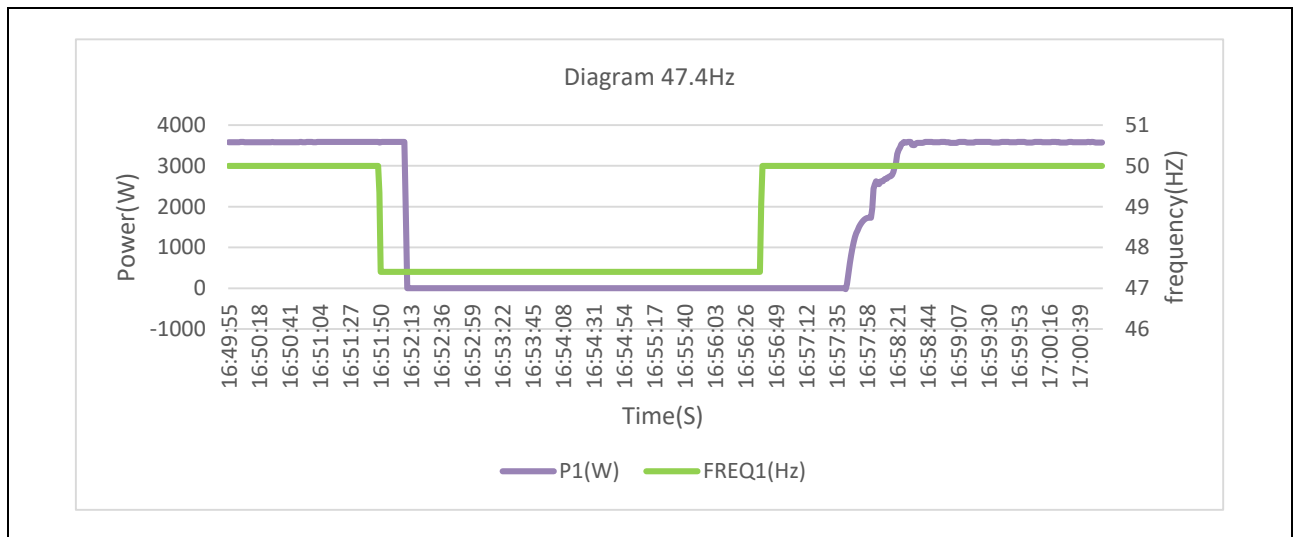




12. Power output with falling frequency test (For PV Inverter):			P
This test should be carried out in accordance with A.1.2.7.			
Model: GT1-3K6D1			
Test sequence	Measured Active Power Output (W)	Frequency (Hz)	Primary power source
Test a) 50 Hz $\pm$ 0.01 Hz	3585.6	50.00	Photovoltaic array simulator
Test b) Point between 49.5 Hz and 49.6 Hz	3587.2	49.55	Photovoltaic array simulator
Test c) Point between 47.5 Hz and 47.6 Hz	3586.3	47.55	Photovoltaic array simulator
<b>NOTE:</b> The operating point in Test (b) and (c) shall be maintained for at least 5 minutes			
<b>The test is regarded as passed if:</b>			
<ul style="list-style-type: none"> <li>the Micro-generator does not disconnect from the network at the operating points a) to c) when the network frequency is changed and</li> <li>the Micro-generator does not reduce output energy at point b) and</li> <li>the power reduction at point c) is less than or equal to the allowed power reduction according to paragraph 9.4.2 (Figure 3).</li> </ul>			
<b>The following data shall be documented:</b>			
<ul style="list-style-type: none"> <li>variation of the network frequency with time;</li> <li>the measured Active Power with time.</li> </ul>			



13. Re-connection timer				P	
Model: GT1-3K6D1					
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 2. 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 <b>Micro-generating Plant</b> 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.			
60 S	60 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 <b>Micro-generator</b> does not re-connect.		Yes	Yes	Yes	Yes

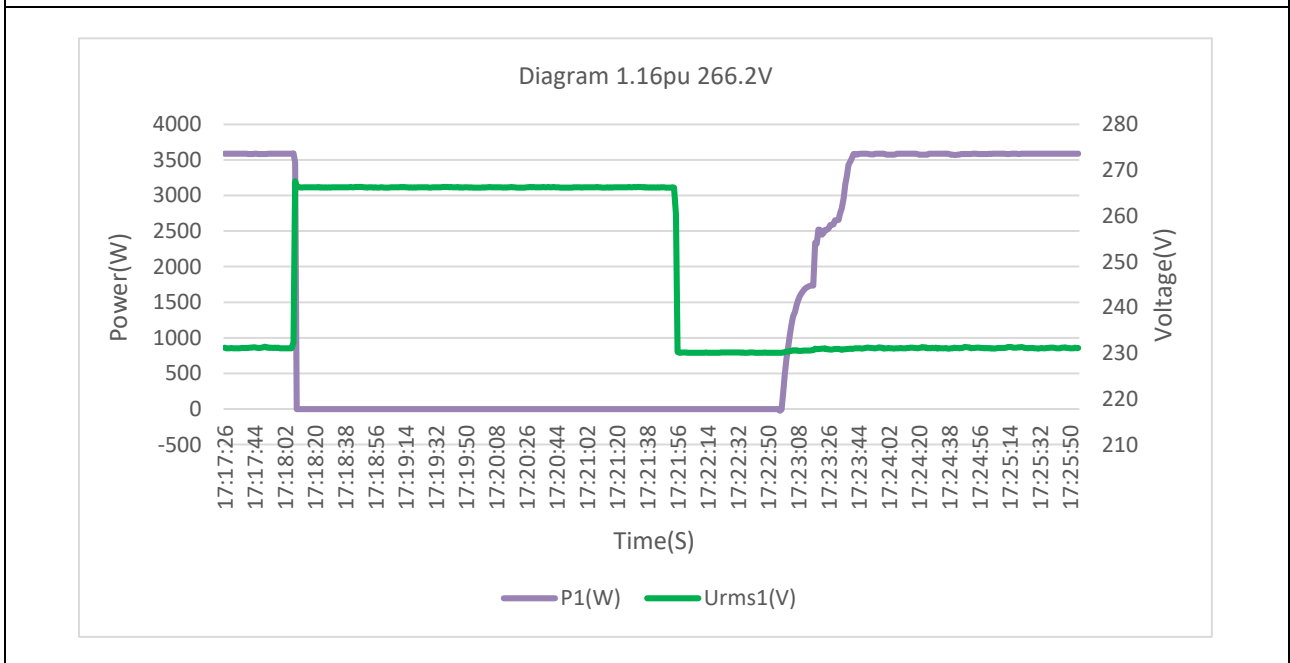
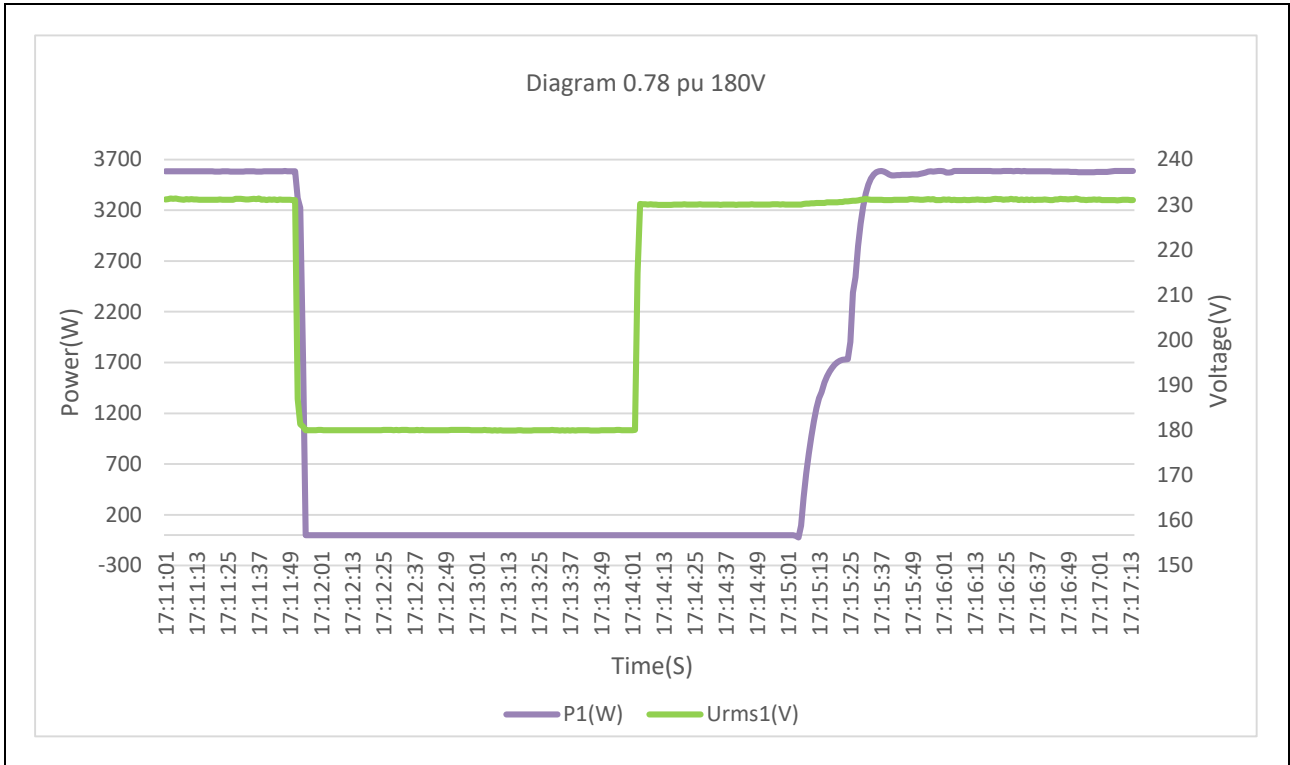


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14. Fault level contribution:					P
These tests shall be carried out in accordance with EREC G98 Annex A1 A.1.3.5 ( <b>Inverter</b> connected) and Annex A2 A.2.3.4 (Synchronous). Please complete each entry, even if the fault contribution is zero.					
Model:GT1-3K6D1					
For machines with electro-magnetic output			For <b>Inverter</b> output		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$i_p$	N/A	20ms	330V	20A
Initial Value of aperiodic current	$A$	N/A	100ms	50V	6A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	10V	4A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	-	-
Reactance/Resistance Ratio of source*	$X/R$	N/A	Time to trip	500ms	In seconds
For rotating machines and linear piston machines the test should produce a 0 s – 2 s plot of the short circuit current as seen at the <b>Micro-generator</b> terminals.					
* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.					

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<b>15. Logic interface (input port)</b>	
Confirm that an input port is provided and can be used to reduce the <b>Active Power</b> output to zero	Yes
This equipment is equipped with RJ45 terminal for logic interface that being received the signal from the DNO, the connection should be installed per installation manual, and the signal should be a simple binary output that captured by RJ45 terminal( PIN 5 and 1 for detecting the signal). Once the signal actived, the inverter will reduce its active power to zero within 5s.	
<b>16. Self-Monitoring solid state switching:</b> No specified test requirements. Refer to EREC G98 Annex A1 A.1.3.6 ( <b>Inverter</b> connected).	
It has been verified that in the event of the solid state switching device failing to disconnect the <b>Micro-generator</b> , the voltage on the output side of the switching device is reduced to a value below 50 V within 0.5 s.	N/A
<b>17. Cyber security</b>	
Confirm that the <b>Manufacturer</b> or <b>Installer</b> of the <b>Micro-generator</b> has provided a statement describing how the <b>Micro-generator</b> has been designed to comply with cyber security requirements, as detailed in 9.7.	Yes
Additional comments.	
The Manufacturer of the Micro-generator has provided a statement describing how the Microgenerator has been designed to comply with cyber security requirements in 9.1.7.	

**Signed**

Hangzhou Livoltek Power Co., Ltd.