TESTING FOR THE VERIFICATION OF COMPLIANCE OF PV INVERTER WITH :

ENA ENGINEERING RECOMMENDATION G100 ISSUE 1 AMENDMENT 2 2018, TECHNICAL REQUIREMENTS FOR CUSTOMER EXPORT LIMITING SCHEMES

Test Report Number	:	**GZES230300372901**
Type	:	PowerStream Microinverter
Tested Model	:	EFWN511
Variant Models	:	EFWN511B

APPLICANT

Name	:	**EcoFlow Inc.**
Address	:	Plant A202, Founder Technology Industrial Park, Shiyan Subdistrict, Bao'an District Shenzhen, 518000 Guangdong China

TESTING LABORATORY

Name	:	SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch
Address	:	198 Kezhu Road, Science City, Economic & Technology Development Area, Guangzhou, Guangdong, China
Conducted (tested) by	:	Colin Chen (Project Engineer)
Approved by	:	Roger Hu (Technical Reviewer)
Date of issue	:	2023/06/27
Number of pages	:	49

Important Note:

- This document is issued by the Company under its General Conditions of service accessible at http://www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

- Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

- Unless otherwise stated the results shown in this test report refer only to the sample(s) tested as received. **Information of derived or extension models of the range as provided by the applicant, (if any), is included in this report only for informative purposes.** The Company SGS shall not be liable for any incorrect results arising from unclear, erroneous, incomplete, misleading or false information provided by Client. This document cannot be reproduced except in full, without prior approval of the Company.

Test Report Historical Revision:

Test Report Version	Date	Resume
GZES230300372901	2023/06/27	First issuance

INDEX

1 SCOPE 4
2 GENERAL INFORMATION 5
2.1 Testing Period and Climatic conditions 5
2.2 Equipment under Testing 5
2.3 Reference Values 9
2.4 Test equipment list 10
2.5 Measurement uncertainty 11
2.6 Test set up of the different standard 12
2.7 Factory Information 12
2.8 List of installation components 13
2.9 Definitions 13
3 RESUME OF TEST RESULTS 14
4 TEST RESULTS 15
4.1 Description of Operation 15
4.2 Power Quality Requirements 16
4.3 System Schematic 17
4.4 Component Interconnection/Fail Safe Operation 18
4.5 Accuracy and Response time 20
4.5.1 Accuracy test 20
4.5.2 Response time test 23
4.6 Excursions 42
4.7 Password Protection 42
5 PHOTOS 43
6 ELECTRICAL SCHEME 49

1 SCOPE

SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch has been contracted by **EcoFlow Inc.**, in order to perform the testing according the “Engineering Recommendation G100 Issue 1 Amendment 2 2018, Technical Requirements for Customer Export Limiting Schemes”

ENA Engineering Recommendation G100: Technical Guidance for Customer Export Limiting Schemes “defines the technical design requirements for Export Limitation Schemes which limit the net site export to below an agreed maximum and are installed on the Customer’s side of the Connection Point”.

2 GENERAL INFORMATION

2.1 TESTING PERIOD AND CLIMATIC CONDITIONS

The necessary testing has been performed between the 13th of April and the 27th of May of 2023.

All the tests and checks have been performed at climatic conditions:

Temperature	25 ± 10 ºC
Relative Humidity	50 ± 20 %
Pressure	90 ± 10 kPa

SITE TEST

Name .....: **Dongguan BALUN Testing Technology Co., Ltd.**

Address.....: Room 104, 204, 205, Building 1, No. 6, Industrial South Road, Songshan Lake District, Dongguan, Guangdong, China

2.2 EQUIPMENT UNDER TESTING

Apparatus type/ Installation .....: EcoFlow PowerStream Microinverter

Manufacturer/ Supplier/ Installer.....: **EcoFlow Inc.**

Address.....: Plant A202, Founder Technology Industrial Park, Shiyan Subdistrict, Bao'an District Shenzhen, 518000 Guangdong China

Trademark .....:

Model/ Type .....: EFWN511

Serial Number.....: HW51ZEH1RF330001

Firmware Version….....: V1.0

Control element for self-consumption….....: Internal (integrated in the Software of the inverter)

Nominal characteristics of the inverter.....: PV input: 11-55 V, Max. 2× 13 A
Battery charging: 30V-58V, Max.: 13A
Battery discharging: 11V-15V/ 40-59V, Max.: 13A
AC output: L/N/PE 230 V, 50 Hz, 3.7 A, 800 W

Date of manufacture: 2023

Particularities of the elements tested

Input ..... DC

Output ..... AC, L/N/PE

Electrical hazard protection class..... Class I

Degree of protection against moisture IP67

Type of connection to the main source ..... Single phase - Fixed installation

Cooling group ..... Natural Cooling

Internal Transformer..... Yes

Modular ..... No

Copy of marking plate:

Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation
3. Labels of other models are as the same with **EFWN511**'s except the parameters of rating.

Equipment Under Testing:

- EFWN511

The variants models:

- EFWN511B

The results obtained apply only to the particular sample tested that is the subject of the present test report.

The most unfavourable result values of the verifications and tests performed are contained herein.

Throughout this report a point (~~comma~~) is used as the decimal separator

The variants models have been included in this test report without tests because the following features don´t change regarding to the tested model:

- Same connection system and hardware topology
- Same control algorithm.
- Output power within 1/√10 and 2 times of the rated output power or the EUT or Modular inverters.
- Same Firmware Version.

Following table shows the full ratings of all the models referenced in this report, marked in **bold letters** are the ones subjected to testing:

Model	**EFWN511**	EFWN511B
PV Input		
Max. input voltage	55 Vdc	
MPPT operating voltage range	11-55 Vdc	
Max. input current	13 A/13 A	
Battery Input		
Battery charge voltage range	30V-58 Vdc	
Battery charge current	13 A	
Battery discharge voltage range	11V-15, 40-59 Vdc	
Battery discharge current	13 A	
AC Output		
Nominal grid voltage	L/N/PE, 230Vac	
Nominal grid frequency	50 Hz	
Rated AC power	800 W	600 W
Max. AC apparent power	800 VA	600 VA
Rated AC current	3.5 A	2.6A
Max. AC current	3.7 A	2.8A
Output power factor	1 default (adjustable+/-0.8)	
General Data		
Operating temperature range	-40 ºC ~ +50 ºC	
Protection degree	IP67	
Protective class	Class I	
Cooling method	Natural Cooling	
Topology	Isolated	

2.3 REFERENCE VALUES

The values presented in the following table have been used for calculation of referenced values (p.u.; %) through the report if not otherwise indicated.

Model: EFWN511	
Rated power, **Pn** in W	800
Maximum apparent power, **Smax** in VA	800
Rated wind speed (only WT), **vn** in m/s	N/A
Rated current, **In** in A	3.5
Rated output voltage, (phase to neutral) **Un** in Vac	230
Note: In this report p.u. values are calculated as follows: -For Active & Reactive Power p.u values are reference to **Pn** -For Currents p.u values, the reference is always **In** -For Voltages p.u values, the reference is always **Un=230V_{L-N}**	

2.4 TEST EQUIPMENT LIST

Owner	No.	EQUIPMENT	TRADEMARK/MODEL	S/N	CALIBRATION PERIOD
Balun	1	Power Analyzer	ZLG/ PA6000H	BZ-DGD- L059	2022/10/13 to 2023/10/12
	2	Current Probe	HIOKI/ CT6863-05	BZ-DGD- L026-5	2023/02/20 to 2024/02/19
	3	Current Probe	HIOKI/ CT6863-05	BZ-DGD- L026-1	2023/02/20 to 2024/02/19
	4	Current Probe	HIOKI/ CT6863-05	BZ-DGD- L026-2	2023/02/20 to 2024/02/19
	5	Current Probe	HIOKI/ CT6863-05	BZ-DGD- L026-3	2023/02/20 to 2024/02/19
	6	Voltage Probe	CYBERTEK/ P1300	EC-7B-6-HVP-20211220-097	2022/07/31 to 2023/07/30
	7	Temperature & Humidity meter	CEM/ DT-322	BZ-DGD-L270	2022/10/25 to 2023/10/24
	8	Digital Oscilloscope	ZLG/ ZDS3024 PLUS	EC-7B-7-OS-20220112-072	2022/07/31 to 2023/07/30
	9	Power Analyzer	DEWETRON / TRIONet	BZ-DGD-L305	2022/08/18 to 2023/08/17
SGS	10	True RMS Multimeter	Fluke/187	GZE012-43	2022/11/11 to 2023/11/10

Note: Voltage direct measurement through power analyzer. All measurement equipment were used inside their corresponding calibration period. Copy of all calibration certificates are available at the laboratory for reference.

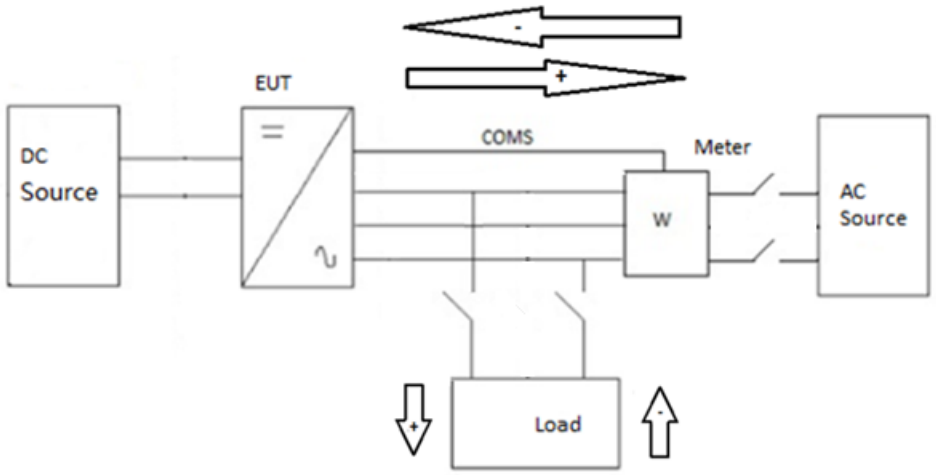
2.5 MEASUREMENT UNCERTAINTY

Associated uncertainties through measurements showed in this this report are the maximum allowable uncertainties.

Magnitude	Uncertainty
Voltage measurement	±1.5 %
Current measurement	±2.0 %
Frequency measurement	±0.2 %
Time measurement	±0.2 %
Power measurement	±2.5 %
Phase Angle	±1 º
Temperature	±3 ºC
Note1: Measurements uncertainties showed in this table are maximum allowable uncertainties. The measurement uncertainties associated with other parameters measured during the tests are in the laboratory at disposal of the petitioner. Note2: Where the standard requires lower uncertainties that those in this table. Most restrictive uncertainty has been considered.	

2.6 TEST SET UP OF THE DIFFERENT STANDARD

Below is the simplified construction of the test set up.



Deviations from the picture: the element of control is internal in the inverter, so it is part of the EUT on the scheme above. The EUT has been tested together with smart meter as which characteristics are shown on page 13.

Different equipment has been used to take measures as it shows in chapter 2.4. Current clamps have been connected to the inverter input / output for all the tests.

All the tests described in the following pages have used this specified test setup.

The test bench used includes:

EQUIPMENT	TRADEMARK / MODEL	RATED CHARACTERISTICS	OWNER / ID.CODE
AC source	KEWELL / KACM-75-33	60 kVA max. 45-65 Hz	BZ-DGD-L193
DC source	CHROMA / Chroma 6215011-1000s	15 kVA max.	BZ-DGD-L009
RLC load	QunLing / ACTL-3820	68 kW,68 kvar	BZ-DGD-L063

2.7 FACTORY INFORMATION

Factory Name .....: Dongguan Streamax Electronics Co., Ltd.

Factory Address.....: 101 Room, No.20 Building Leaguer Zijing Intelligent Manufacture Center, NO.105 Qingbin East Road, Qingxi Town, Dongguan City, Guangdong Province, China

2.8 LIST OF INSTALLATION COMPONENTS

Type of appliance/ Installation:	Smart socket
Manufacturer / Distributor / Installer:	EcoFlow Inc.
Brand:	
Model/ Type:	EFWN511-SCH
Nominal characteristics:	100 V- 230V ±10%, 0-2500W, 50/60 Hz Power accuracy: 0.1%

Note: According to the inverter user manual, the output voltage sampling accuracy error margin is determined by inverter itself, that is 1.5%, so the output power sampling accuracy error margin of inverter is 2%.

2.9 Definitions

EUT	Equipment Under Testing	Hz	Hertz
A	Ampere	V	Volt
Un	Nominal Voltage	p.u	Per unit
In	Nominal Current	Pn	Rated Active Power
Ia	Active Current	Qn	Rated Reactive Power
Ir	Reactive Current	Sn	Rated Apparent Power
fn	Nominal frequency	ms	Millisecond
RMS	Root Mean Square	s	Second
AC	Alternating Current	min	Minute
Pmax	Maximum active power	P	Active Power
P_A	Available active power	Q	Reactive Power
Meas.	Measured	PF	Power Factor
Des.	Desired	Nr.	Number
PGU	Power Generating Unit	POC	Point of Connection
Smax	Maximum apparent power	VA	Apparent Power(VA)
ELS	Export Limitation Scheme		

3 RESUME OF TEST RESULTS

INTERPRETATION KEYS

Test object does meet the requirement..... **P** Pass
Test object does not meet the requirement ..... **F** Fails
Test case does not apply to the test object..... **N/A** Not applicable
To make a reference to a table or an annex. ..... See additional sheet
To indicate that the test has not been realized ..... **N/R** Not realized

STANDAARD CLAUSE	STANDARD REQUIREMENTS		RESULT
	Engineering Recommendation G100 Issue 1 Amendment 2 2018		
	TEST	REMARKS	
5.4	Power Quality Requirements		P
Paragraph 5 of Annex C	Component Interconnection/Fail Safe Operation		P
5.5	Accuracy and Response Time		P
5.6	Excursions		P
Paragraph 7 of Annex C	Password Protection		P

4 TEST RESULTS

4.1 DESCRIPTION OF OPERATION

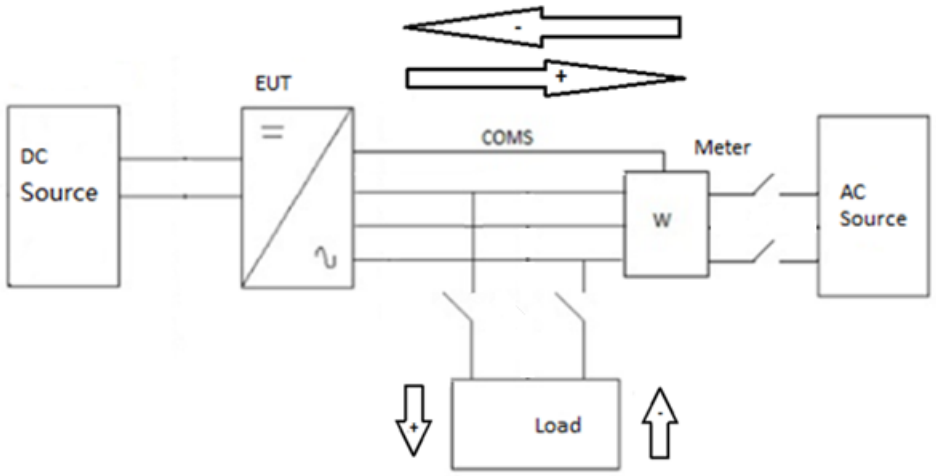
G100 Requirement:

A description of the scheme, its settings, and a single line diagram should be permanently displayed on site.

When installed in conjunction with a hybrid inverter under test , the EFWN511 operates in “Customer Export Limiting Mode”. The following text can be used to describe this operational mode

Maximum power injected during the registration time, in Watts. Negative values indicate that the inverter and load system consume, i.e. there is no power injection into the network, in those cases, the consumption values closest to the power injection have been taken.

Sign Criterion for Data Interpretation:



In the results tables are positive the power injection values from the inverter to loads, and negative the values consumed by the loads. Values from network to loads are also negative, so if injection from the inverter to the net would occur this would look like positive values.

4.2 POWER QUALITY REQUIREMENTS

The tests have been carried out in accordance with paragraph 5.4 of the standard. The test according to BSEN 61000-3-12

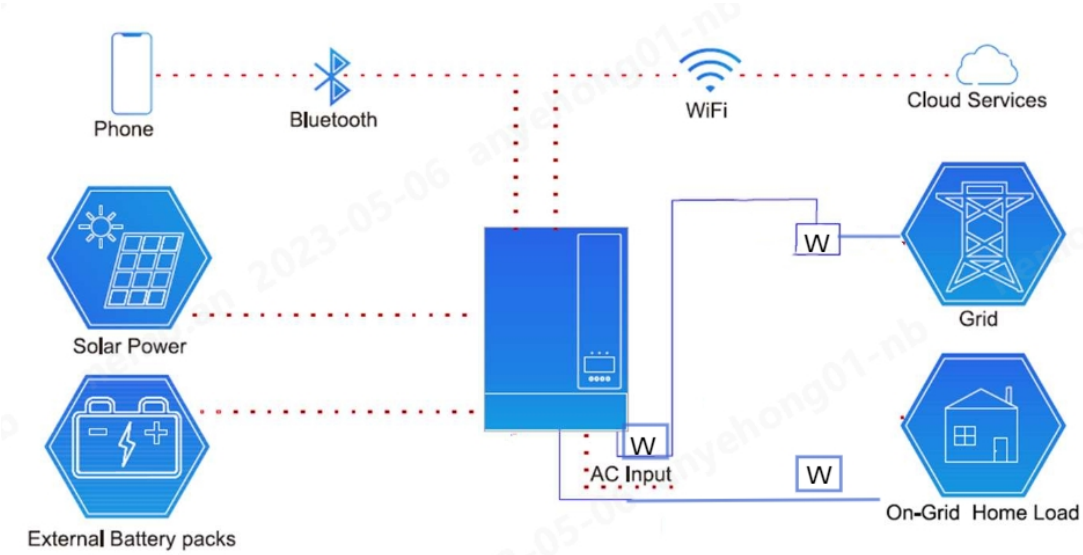
The results obtained are shown below:

Power Generating Module rating per phase (rpp)			0.8	kVA	Harmonic % = Measured Value (A) x 23/rating per phase (kVA)	
Phase A						
Harmonic	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	0.014	0.400	0.010	0.291	8%	8%
3	0.050	1.437	0.056	1.599	21.6%	Not stated
4	0.003	0.095	0.002	0.050	4%	4%
5	0.021	0.597	0.051	1.454	10.7%	10.7%
6	0.002	0.066	0.002	0.069	2.67%	2.67%
7	0.007	0.193	0.032	0.910	7.2%	7.2%
8	0.003	0.090	0.002	0.064	2%	2%
9	0.004	0.112	0.018	0.516	3.8%	Not stated
10	0.002	0.064	0.002	0.062	1.6%	1.6%
11	0.006	0.177	0.009	0.270	3.1%	3.1%
12	0.002	0.056	0.002	0.057	1.33%	1.33%
13	0.005	0.133	0.004	0.104	2%	2%
THD	--	1.949	--	2.596	23%	13%
PWHD	--	5.644	--	4.701	23%	22%

4.3 SYSTEM SCHEMATIC

Main elements:
- Hybrid inverter(EFWN511)
- Smart socket (EFWN511-SCH)

System Schematic as following:

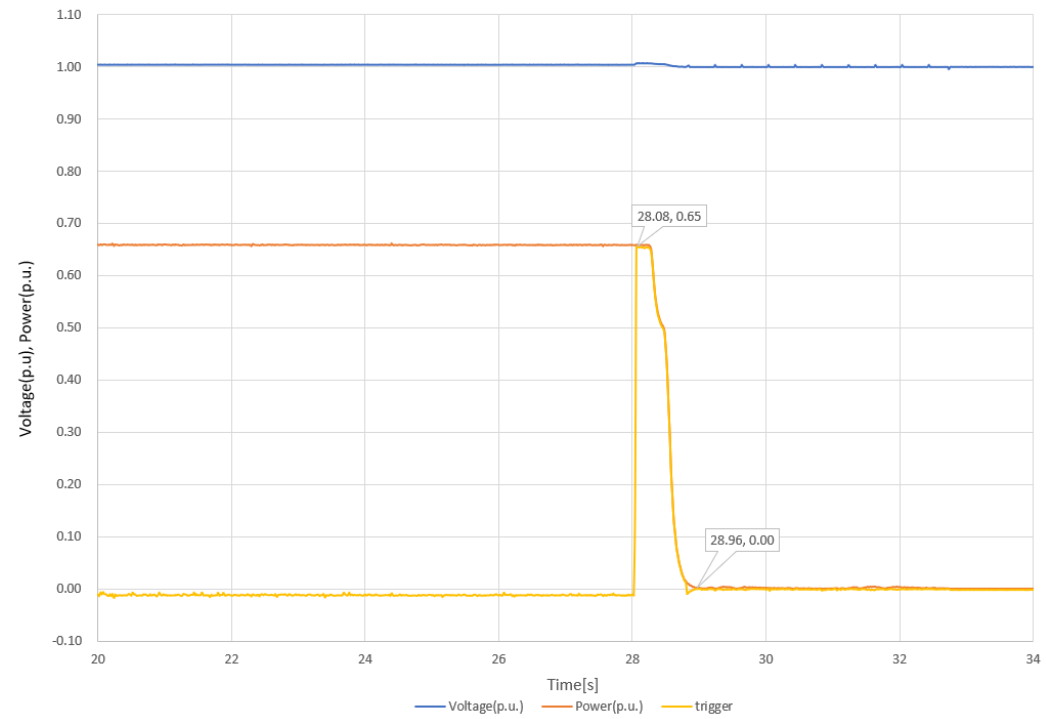
System Schematic


4.4 COMPONENT INTERCONNECTION/FAIL SAFE OPERATION

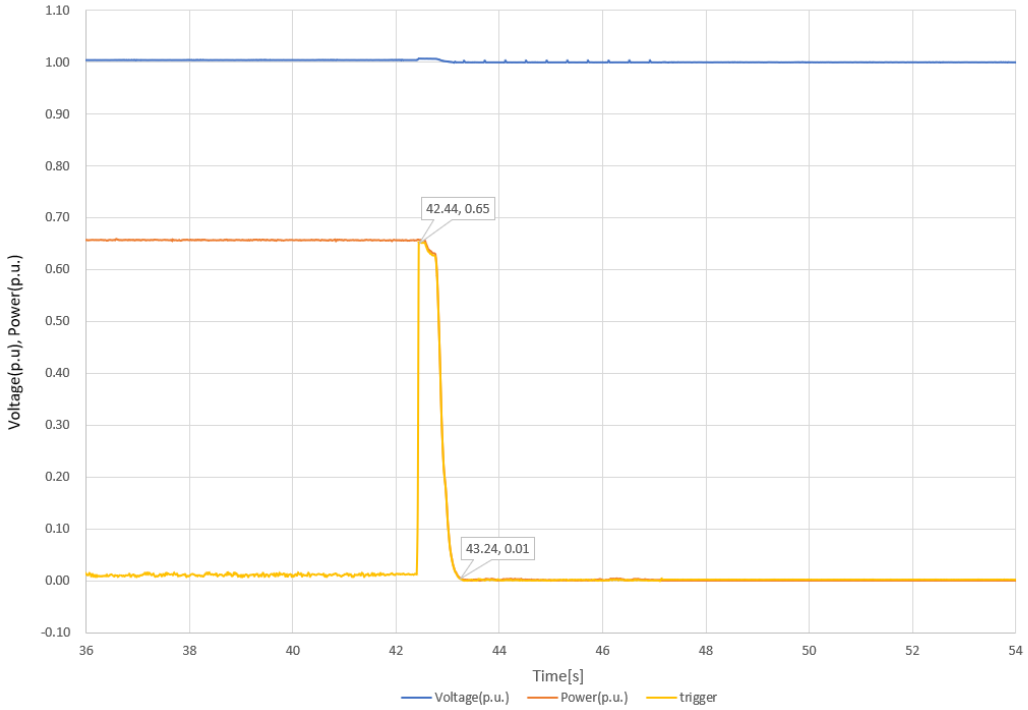
The tests have been carried out in accordance with paragraph 5 of Annex C of the standard. The tests preform for loss of communications between Hybrid inverter (EFWN511) and Smart socket (EFWN511-SCH)

Test model: EFWN511							
Test No.	Required Load (% Pn)	Measurement Load (% Pn)	Final Power Required (% Pn)	Final Power Measure (% Pn)	Stabilization time(s)	Time limit(s)	Disconnect Yes or No
1	60-70	66.0	0.0	0.00	0.88	2.00	Yes
2	60-70	65.8	0.0	0.00	0.80		Yes
3	60-70	65.5	0.0	0.00	0.88		Yes

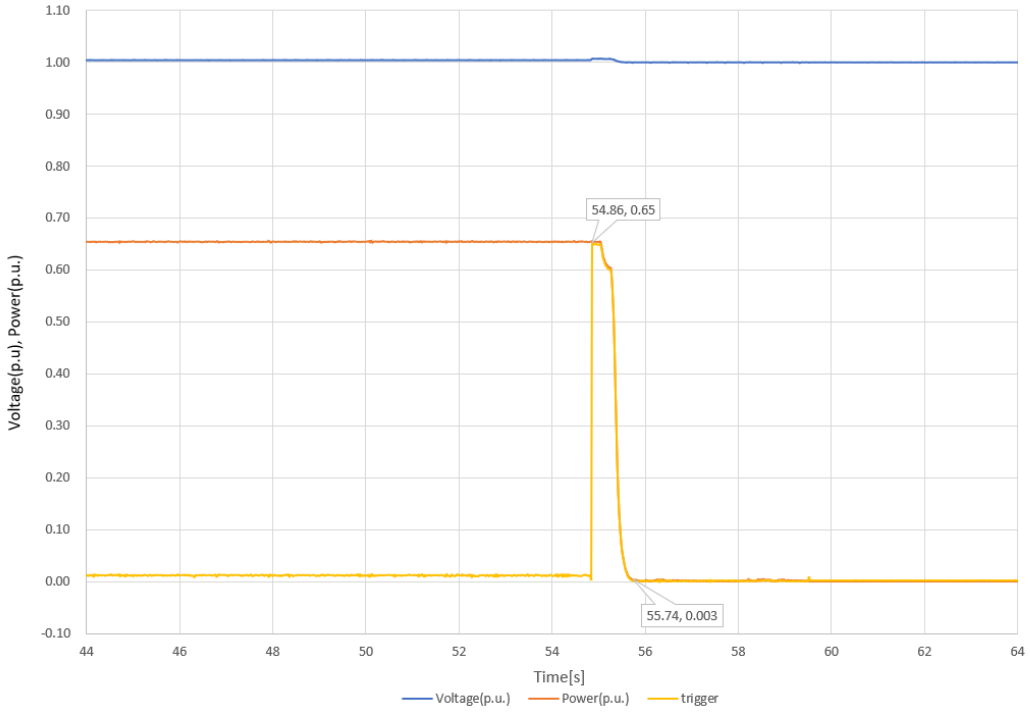
Test 1



Test 2


1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
Voltage(p.u), Power(p.u.)
42.44, 0.65
43.24, 0.01
36
38
40
42
44
46
48
50
52
54
Time[s]
Voltage(p.u.)
Power(p.u.)
trigger

Test 3


1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
Voltage(p.u), Power(p.u.)
54.86, 0.65
55.74, 0.003
44
46
48
50
52
54
56
58
60
62
64
Time[s]
Voltage(p.u.)
Power(p.u.)
trigger

4.5 ACCURACY AND RESPONSE TIME

The tests have been carried out in accordance with paragraph 5.5 of the standard.

As the agreement with the manufactory, the ELS is requirement to limit the export to 0W and it has overall tolerance of -2%Pn, and detect an excursion and reduce the export to agreed export capacity or less within 5 seconds.

4.5.1 Accuracy test

Test model: SUNT-5KW-H					
Test No.	Load (%Pn)		Test time (min)	Injected power (W) (1)	Injected power limit (W) (2)
	Desired	Measured			
1	90-100	91.5	1.58	-10.7	-16
2	60-70	65.6	1.33	-9.0	
3	10-20	13.1	1.67	-9.0	
4	0	2.0	2.00	-11.6	

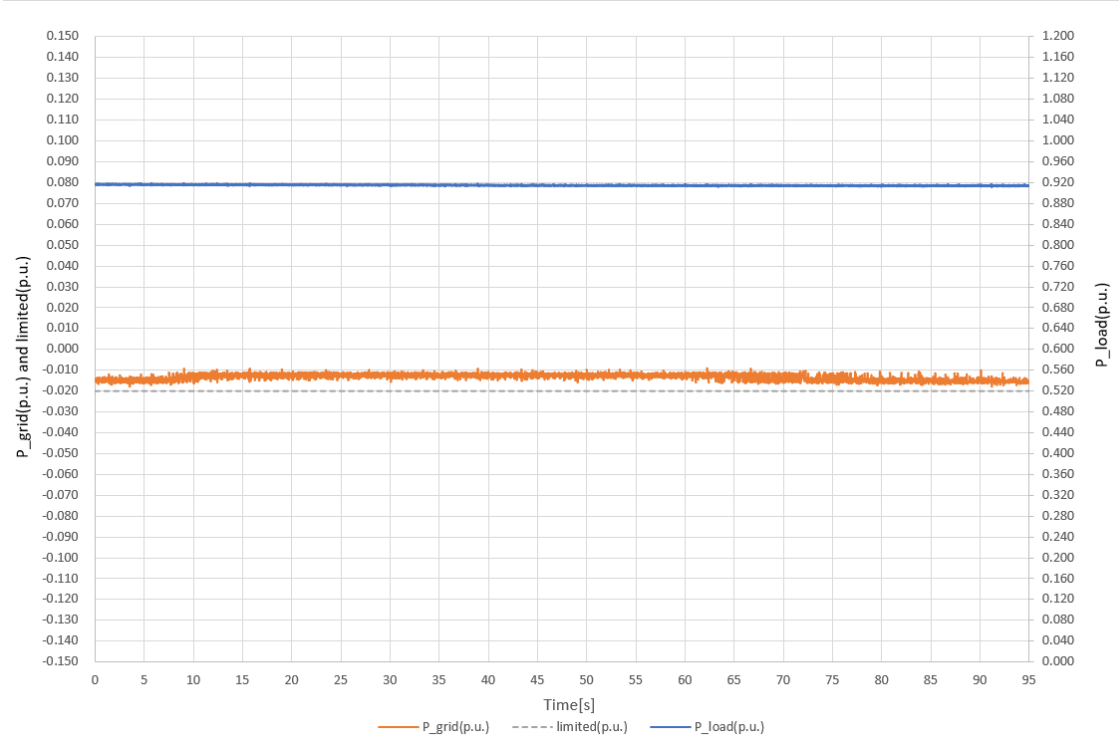
Additional information:

(1) Maximum power injected during the test time.

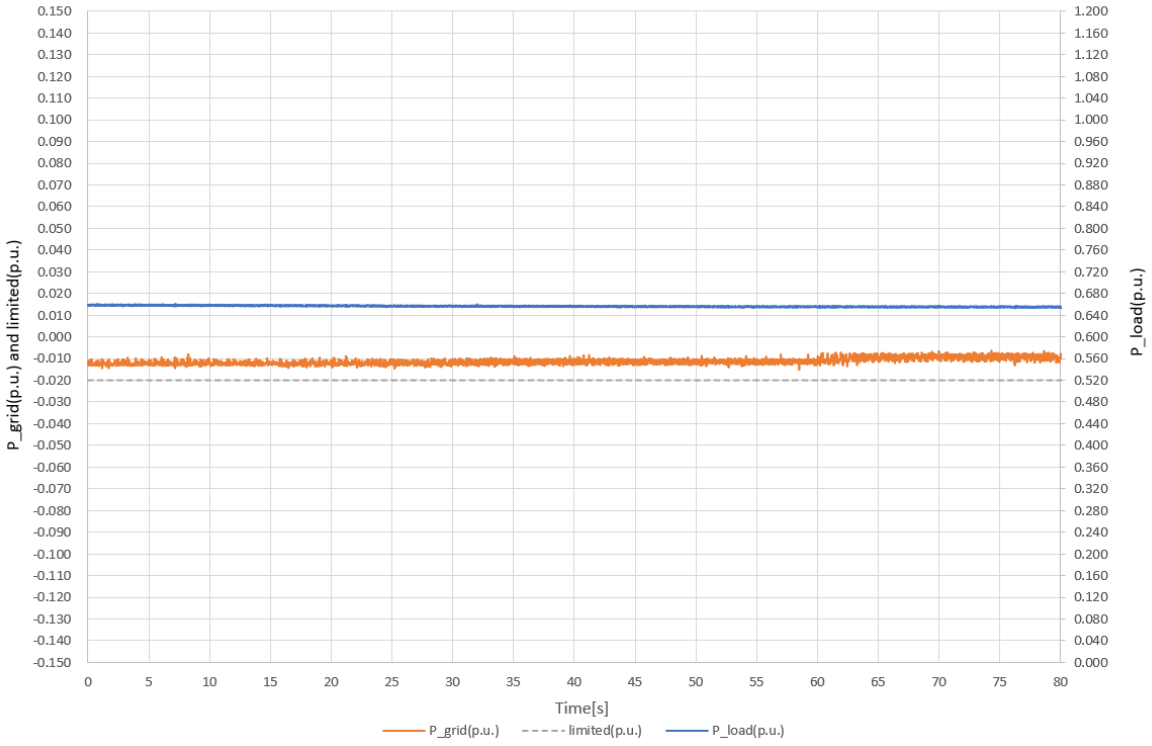
(2) The power limit injected is -2%Pn.

Test results are represented at diagrams below.

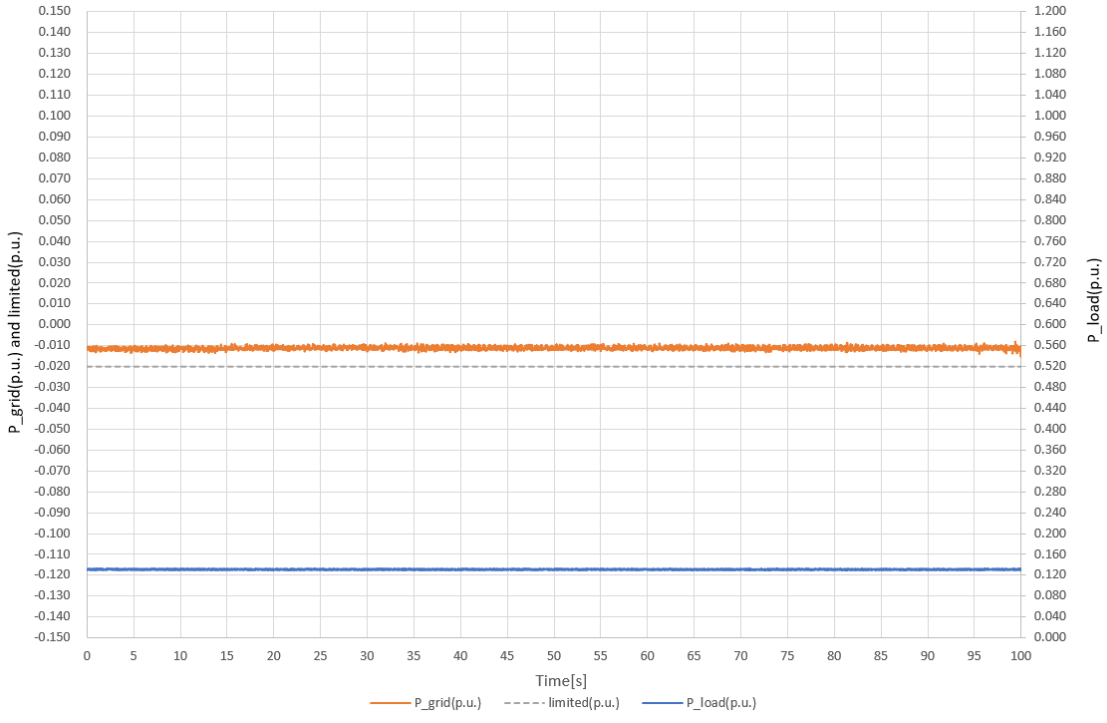
Test 1



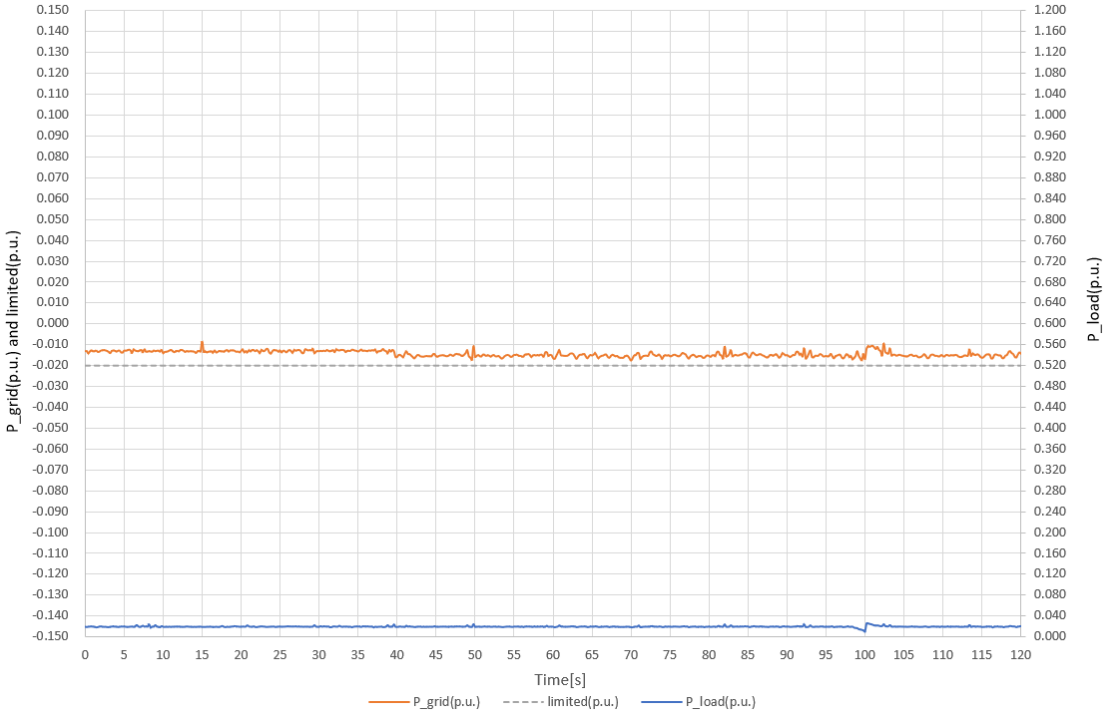
Test 2


P_grid(p.u.) and limited(p.u.)
P_load(p.u.)
Time[s]
P_grid(p.u.)
limited(p.u.)
P_load(p.u.)

Test 3


P_grid(p.u.) and limited(p.u.)
P_load(p.u.)
Time[s]
P_grid(p.u.)
limited(p.u.)
P_load(p.u.)

Test 4

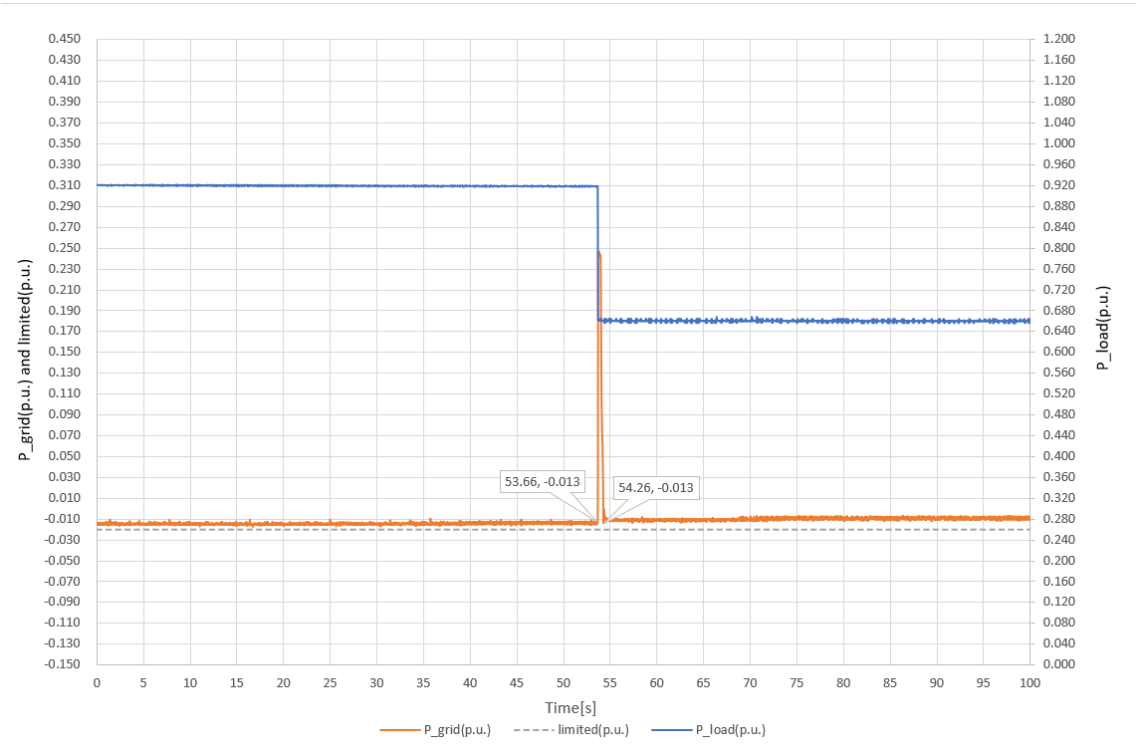
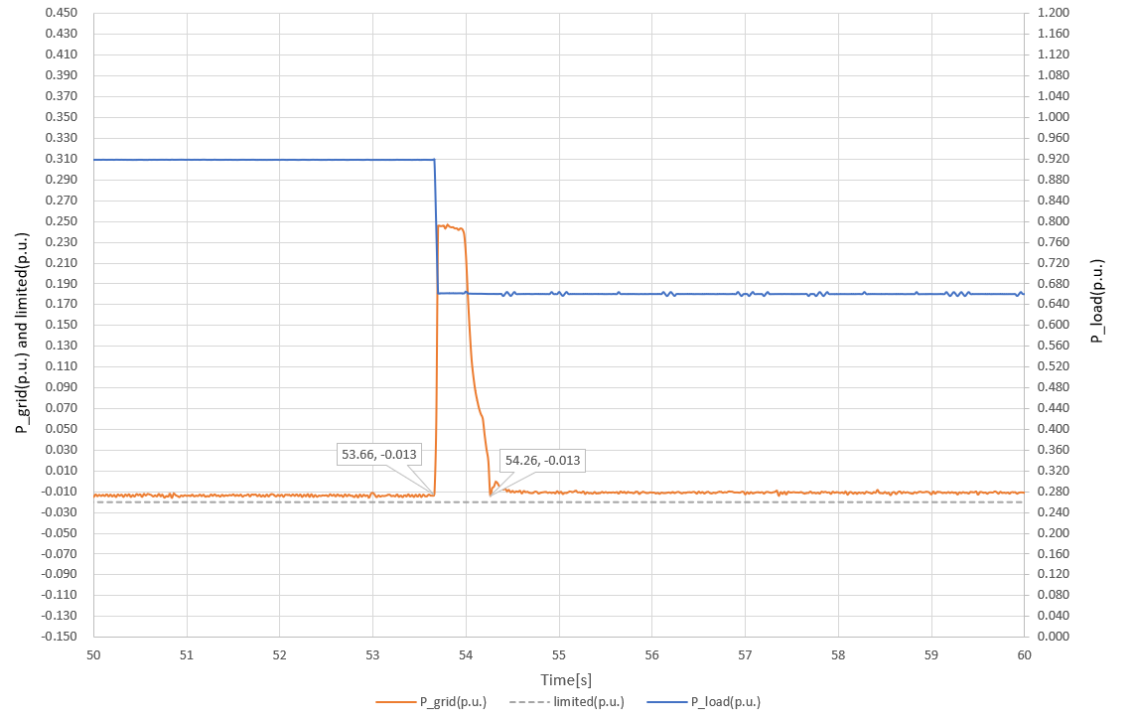

P_grid(p.u.) and limited(p.u.)
P_load(p.u.)
Time[s]
P_grid(p.u.)
limited(p.u.)
P_load(p.u.)

4.5.2 Response time test

Test No.	Initial load (% P_n)		Final load (% P_n)		Adjust time (s)	Time limit (s)
	Desired	Measured	Desired	Measured		
1.1	90-100	92.0	60-70	66.0	0.6	2.00
1.2	90-100	91.8	60-70	66.0	1.1	
1.3	90-100	91.9	60-70	65.9	0.76	
2.1	90-100	91.7	30-40	40.2	0.72	
2.2	90-100	92.2	30-40	40.2	0.82	
2.3	90-100	92.1	30-40	40.2	0.88	
3.1	90-100	92.0	0	0.0	0.86	
3.2	90-100	92.1	0	0.0	0.86	
3.3	90-100	92.1	0	0.0	0.86	
4.1	60-70	66.0	30-40	40.1	0.64	
4.2	60-70	66.0	30-40	40.1	0.70	
4.3	60-70	66.0	30-40	40.1	0.78	
5.1	60-70	66.3	0	0.0	0.80	
5.2	60-70	66.4	0	0.0	0.74	
5.3	60-70	66.3	0	0.0	0.78	
6.1	30-40	40.0	0	0.0	0.80	
6.2	30-40	40.0	0	0.0	0.76	
6.3	30-40	40.0	0	0.0	0.70	

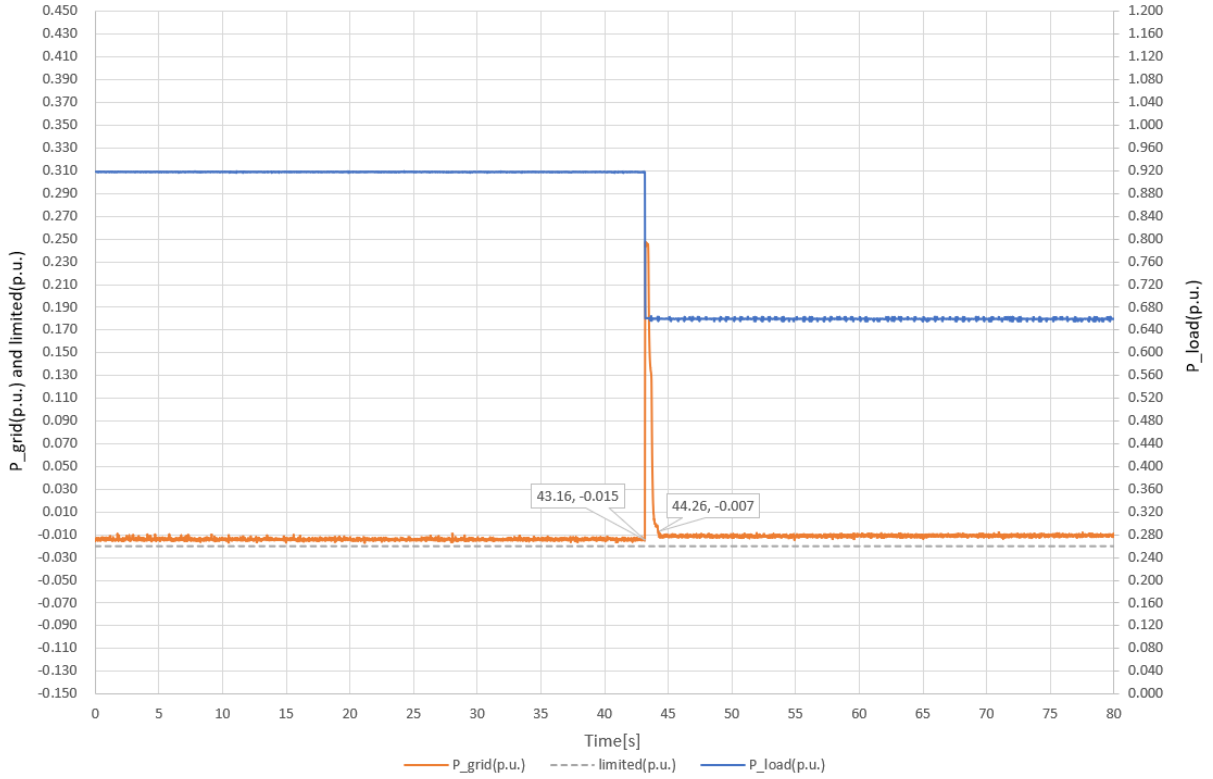
Additional information:
The power limit injected is -2%Pn.

Test results are represented at diagrams below.

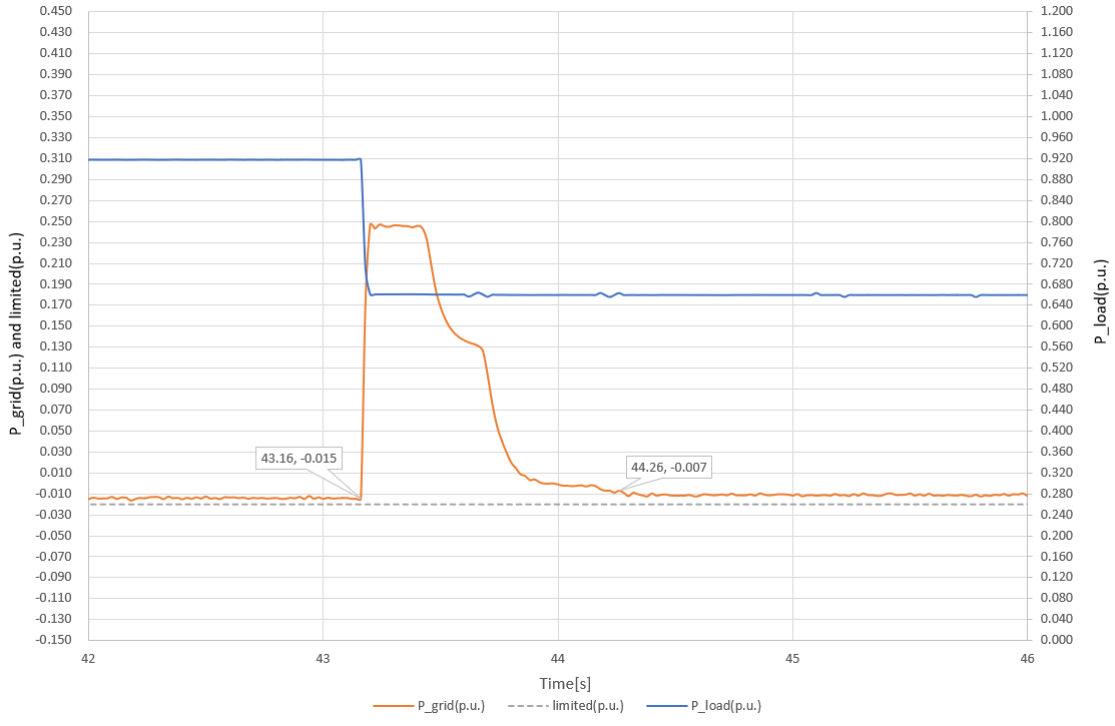
Test 1.1
Overview

Zoom in


Test 1.2

Overview

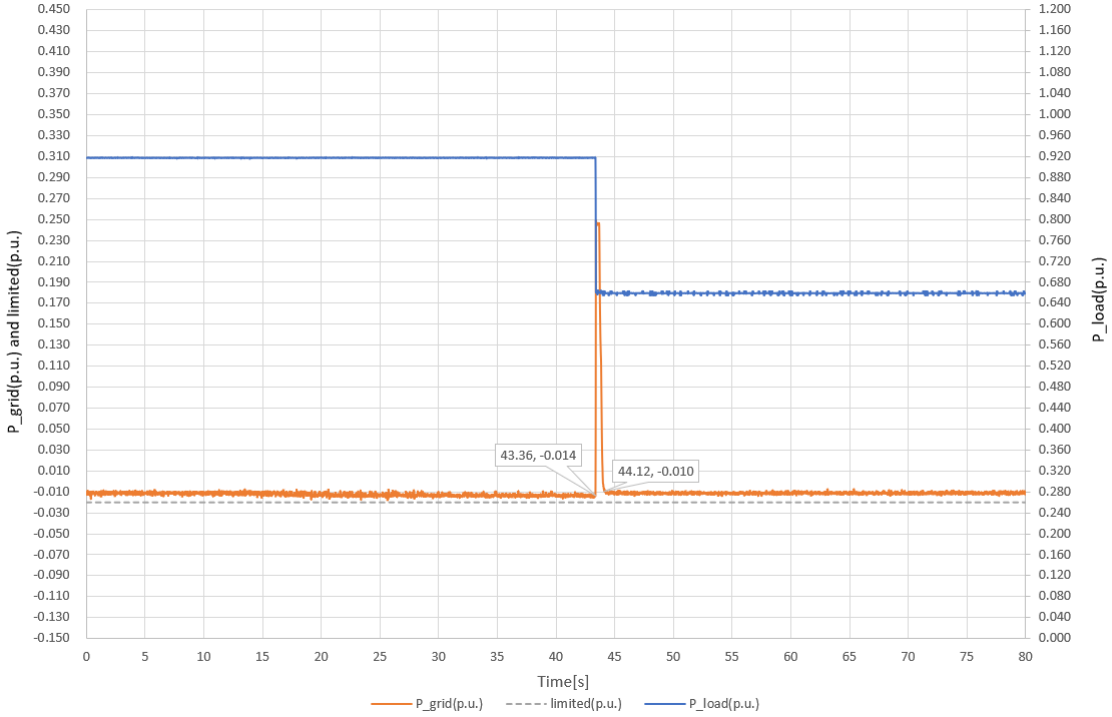


Zoom in

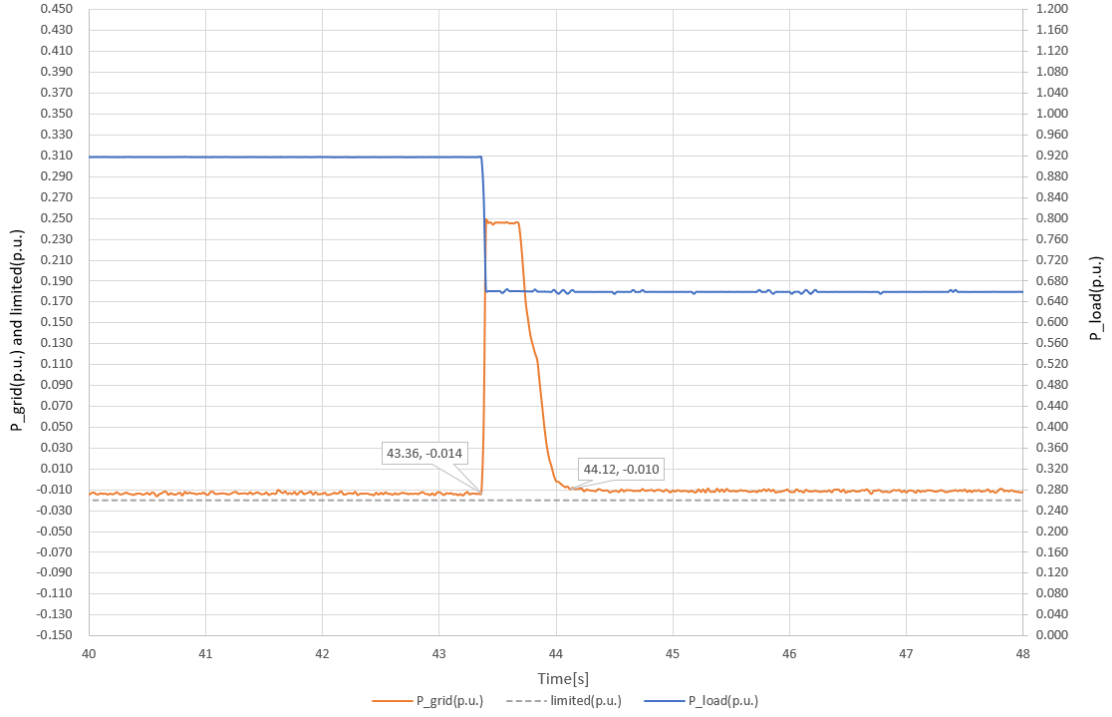


Test 1.3

Overview

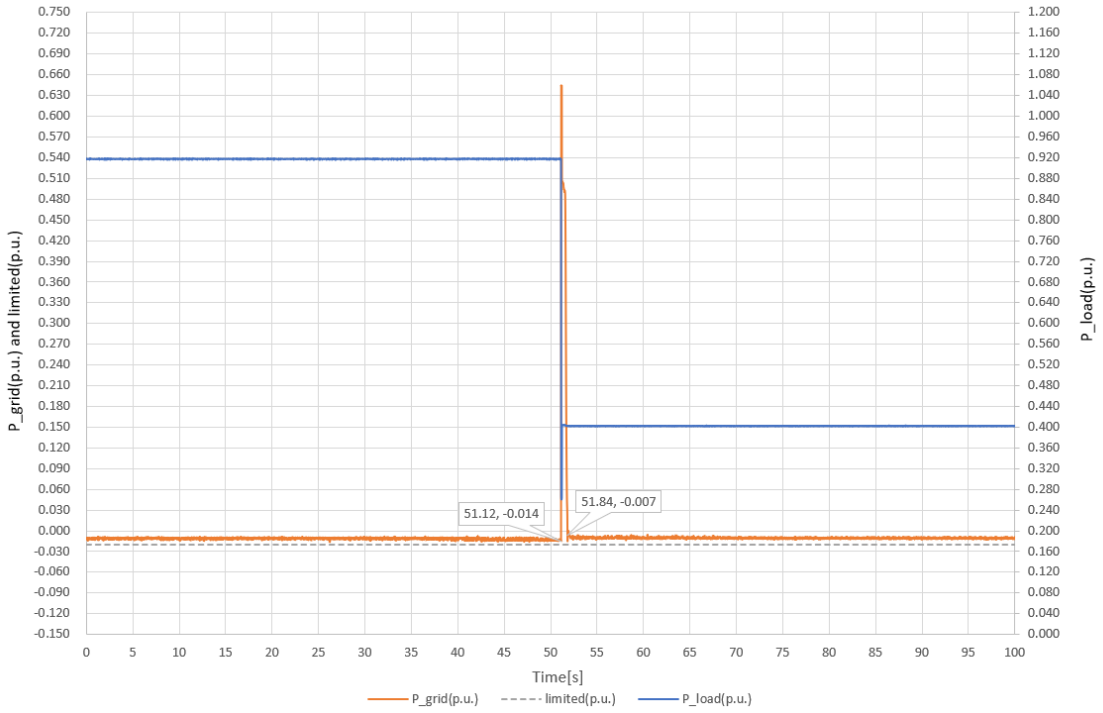


Zoom in

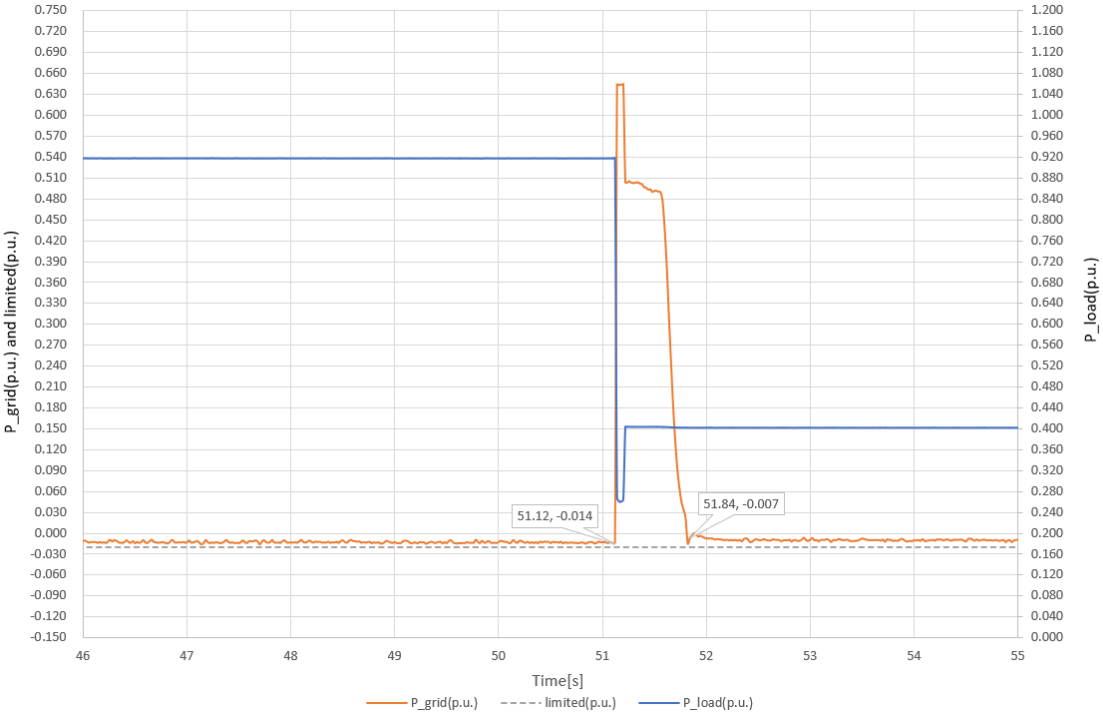


Test 2.1

Overview

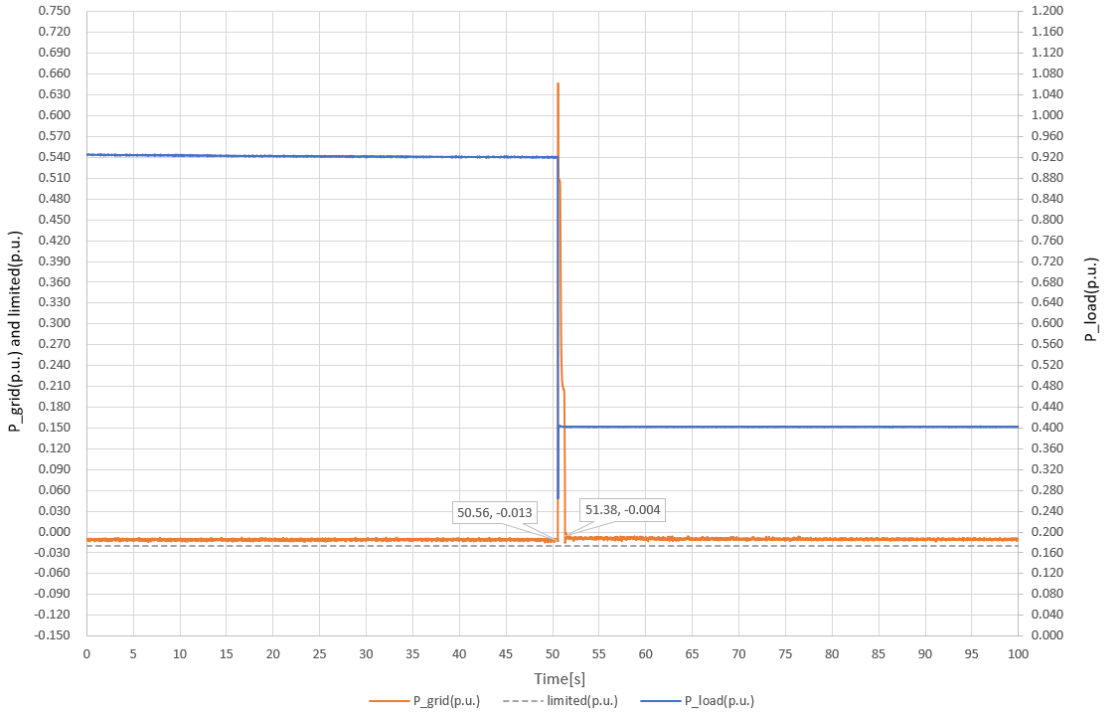


Zoom in

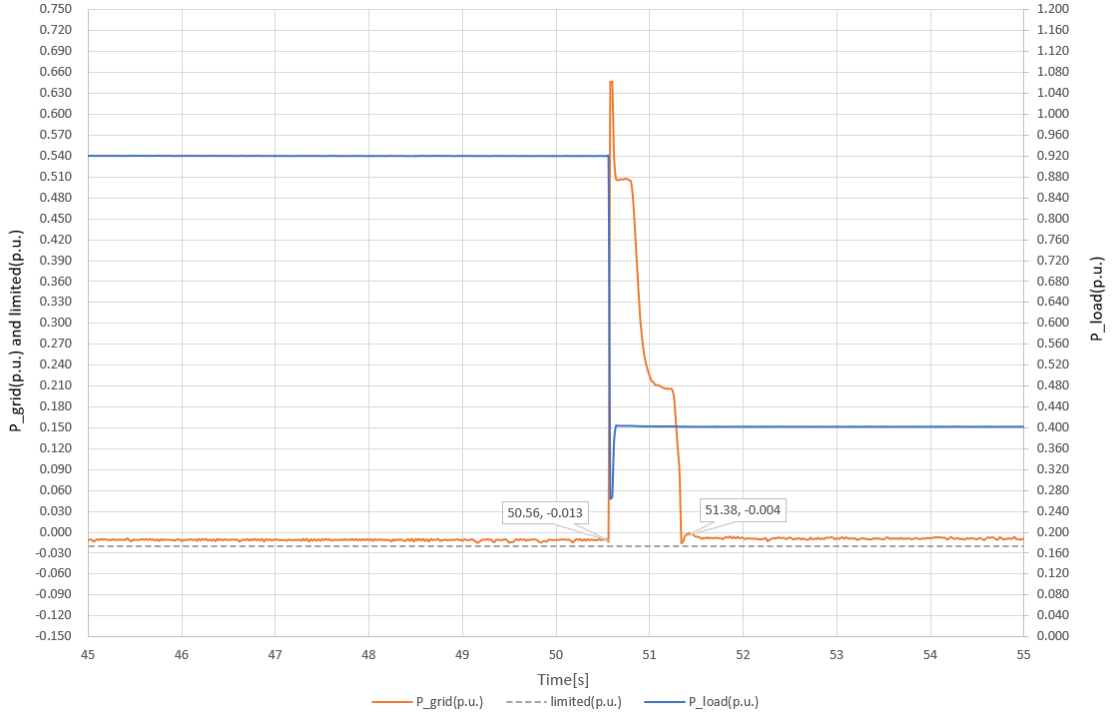


Test 2.2

Overview

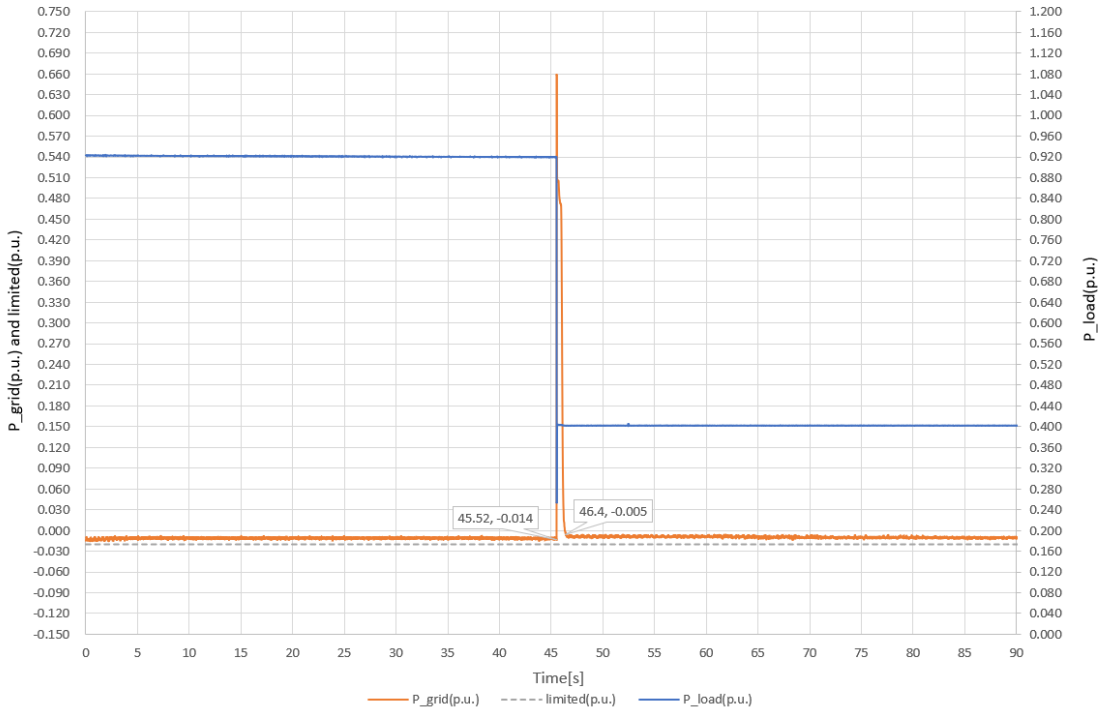


Zoom In

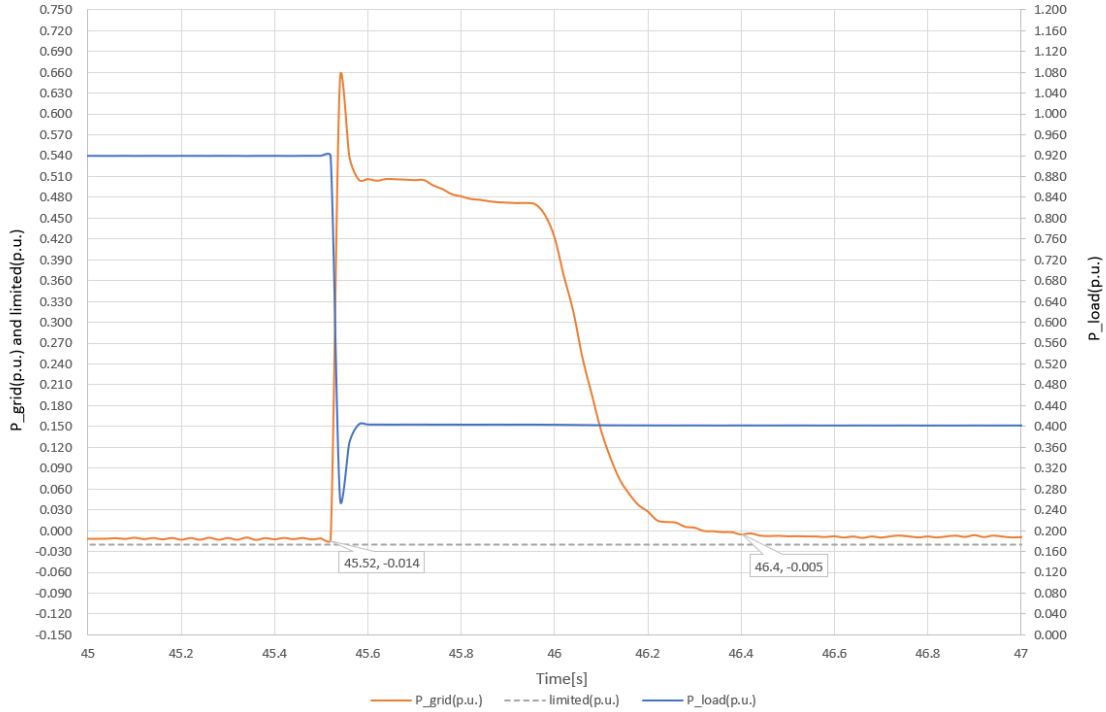


Test 2.3

Overview

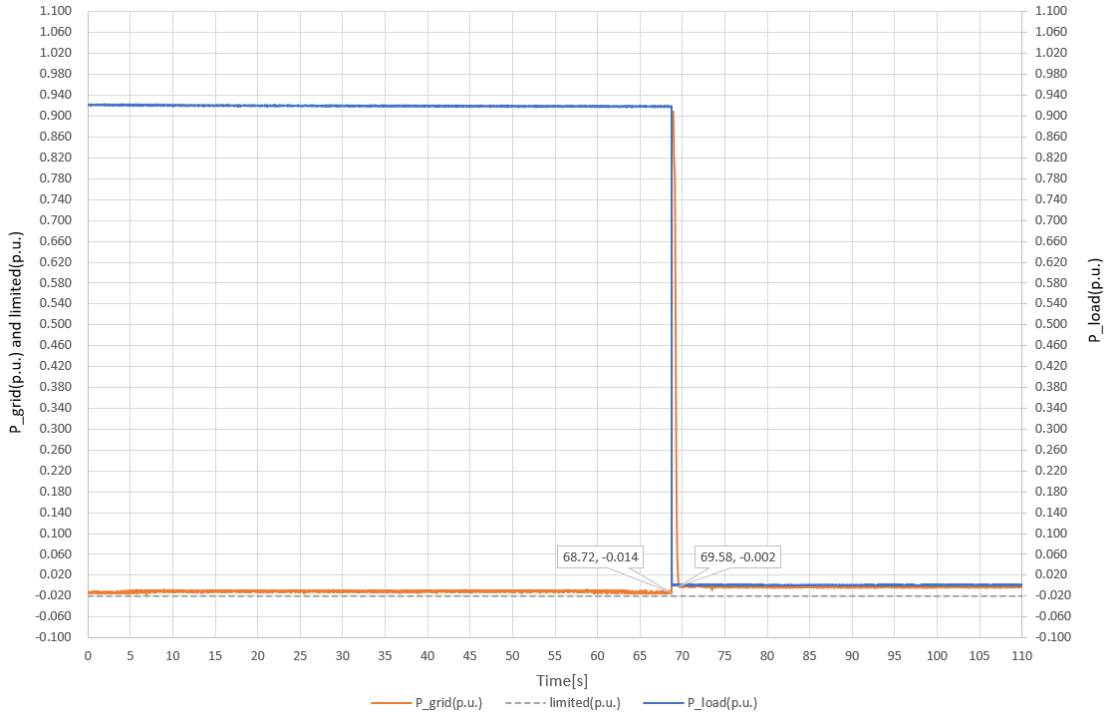


Zoom in

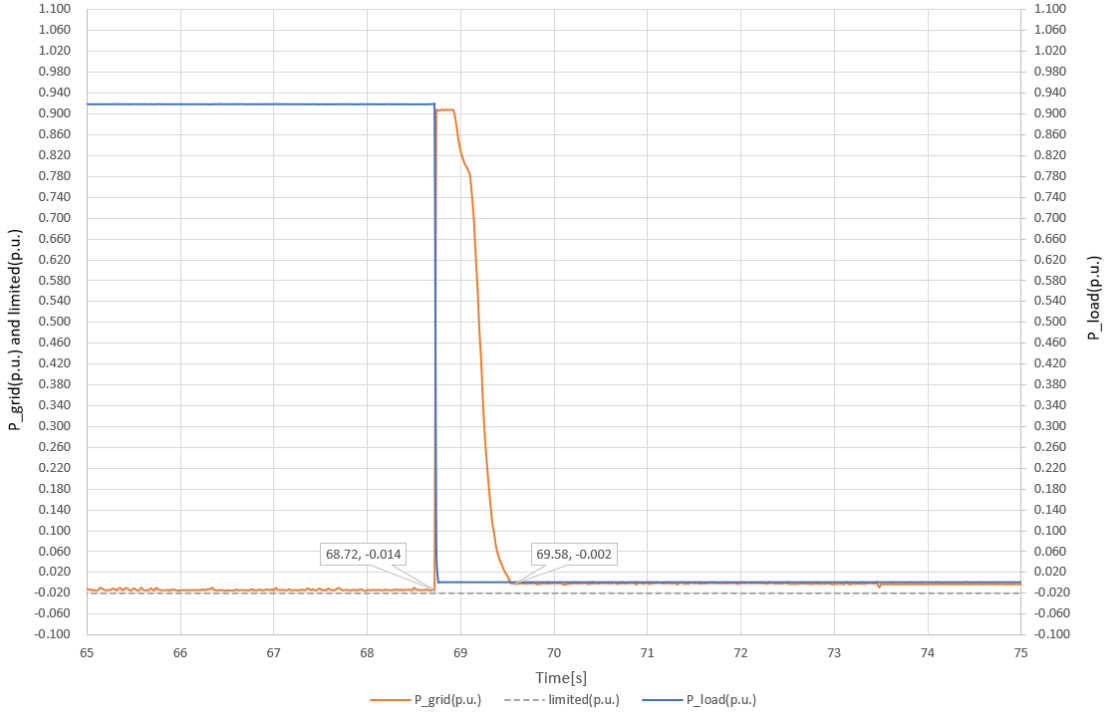


Test 3.1

Overview

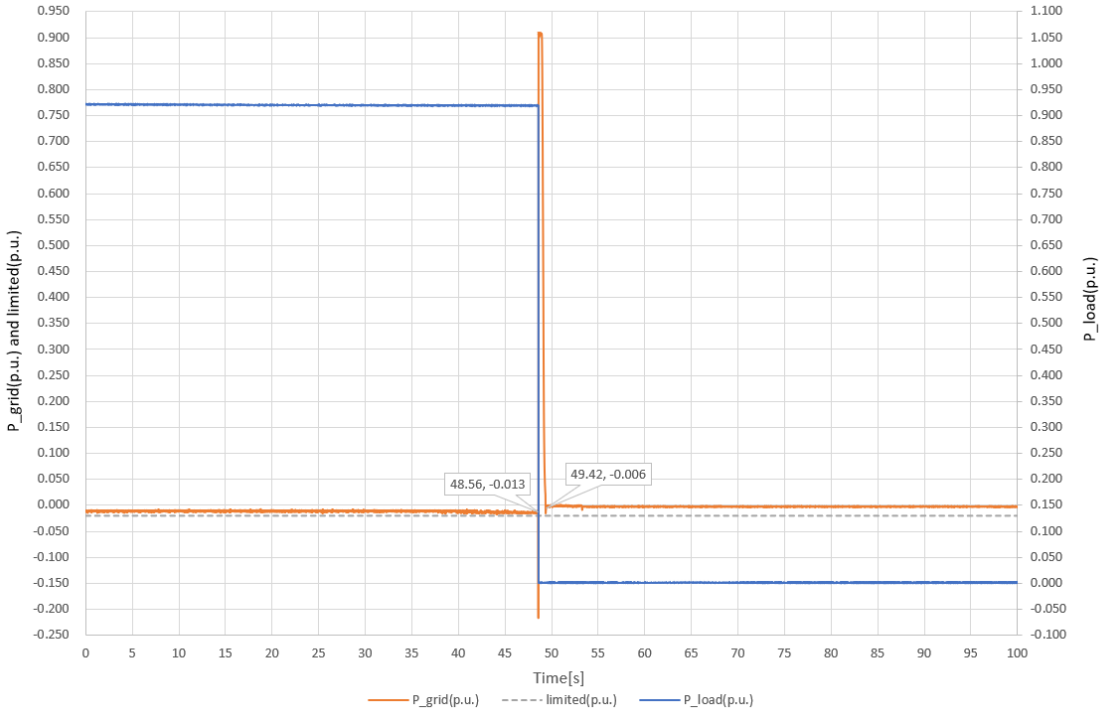


Zoom in

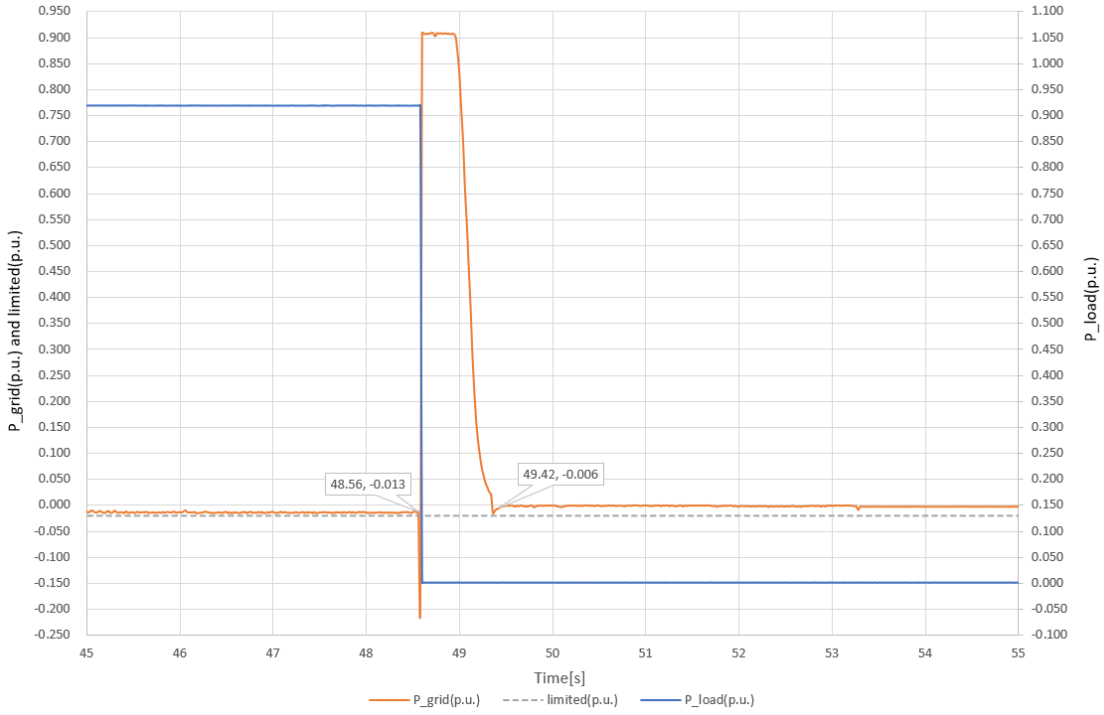


Test 3.2

Overview

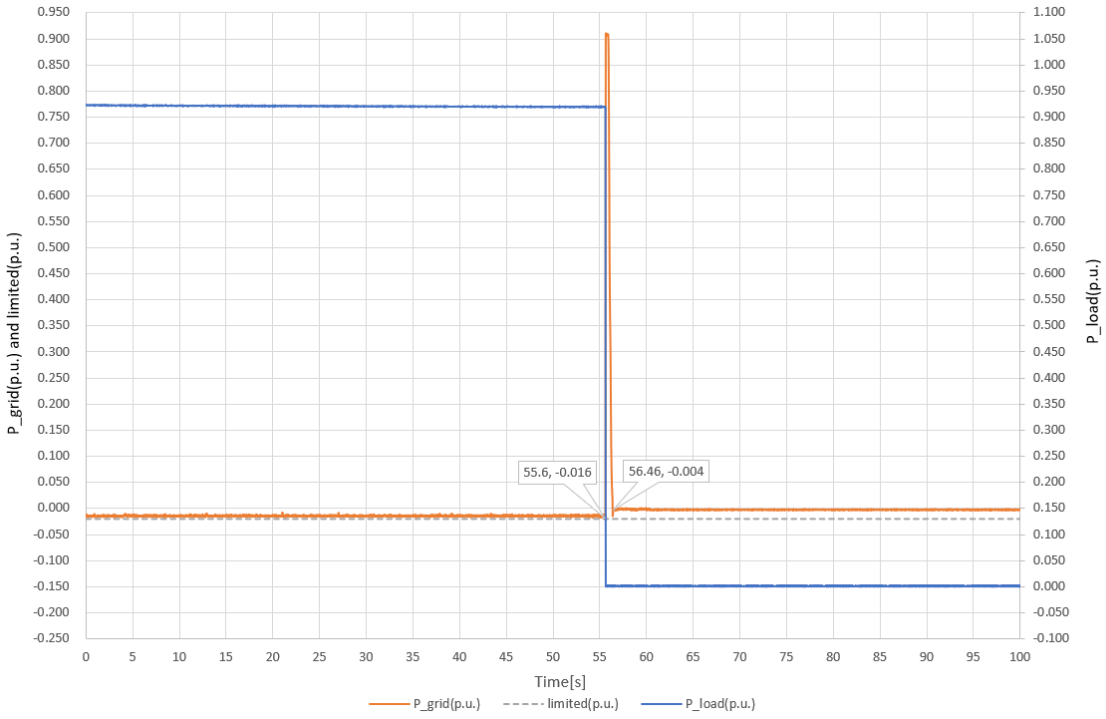


Zoom in

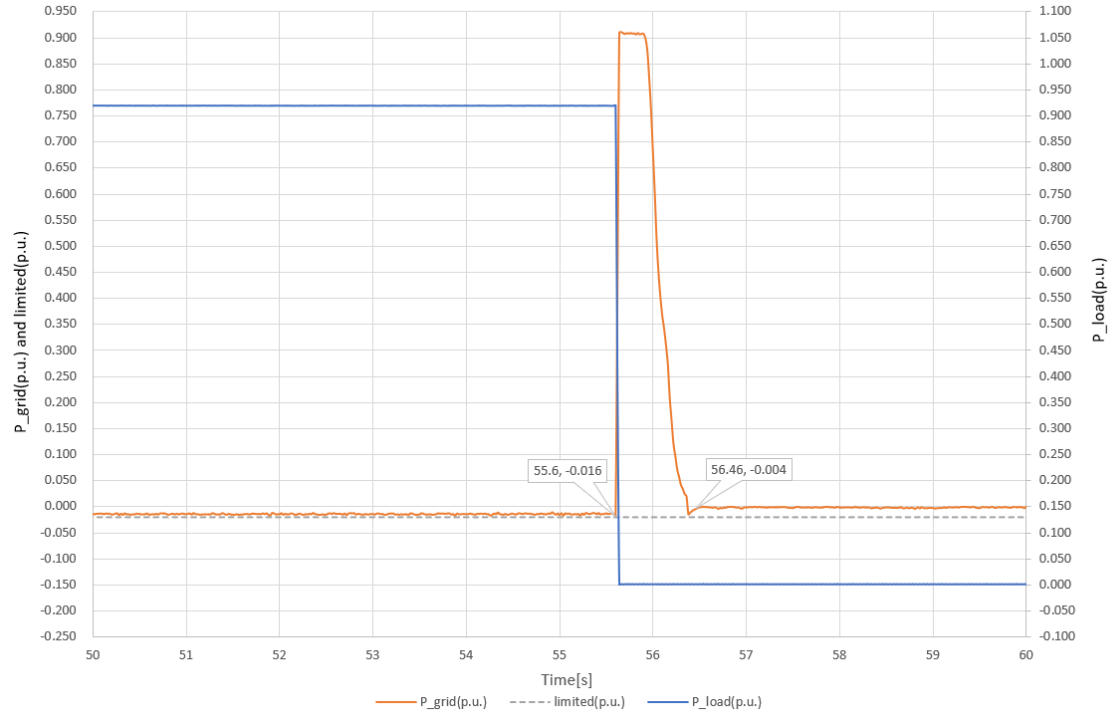


Test 3.3

Overview

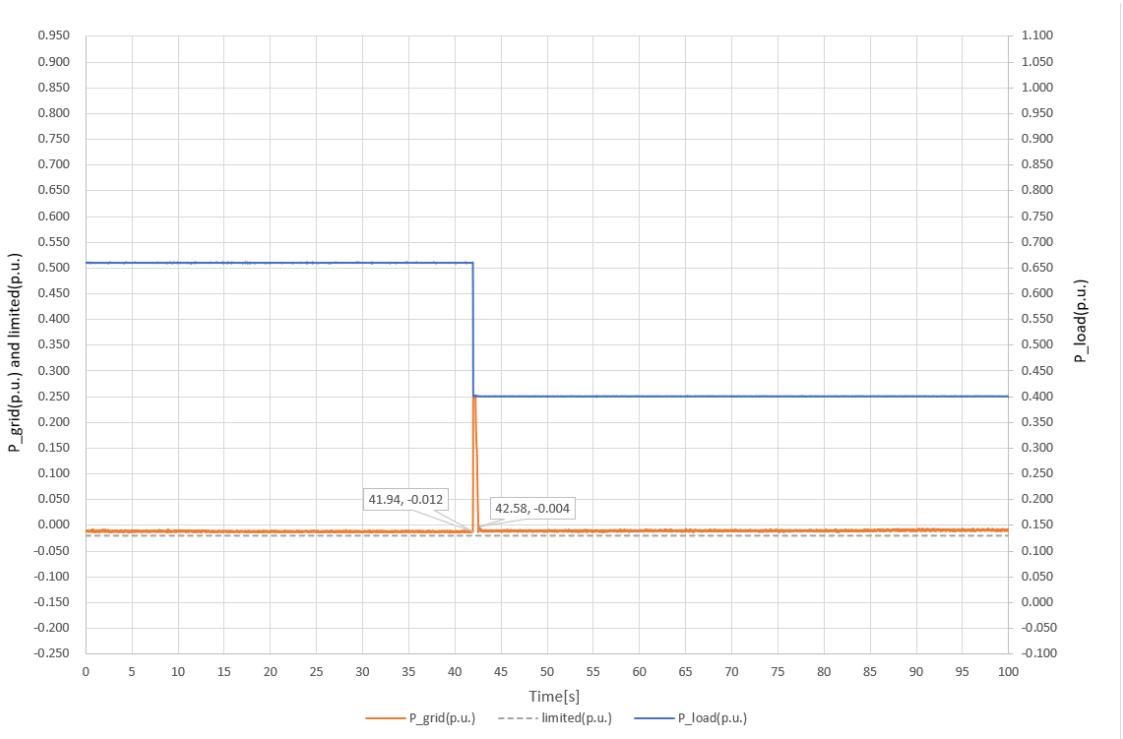


Zoom in

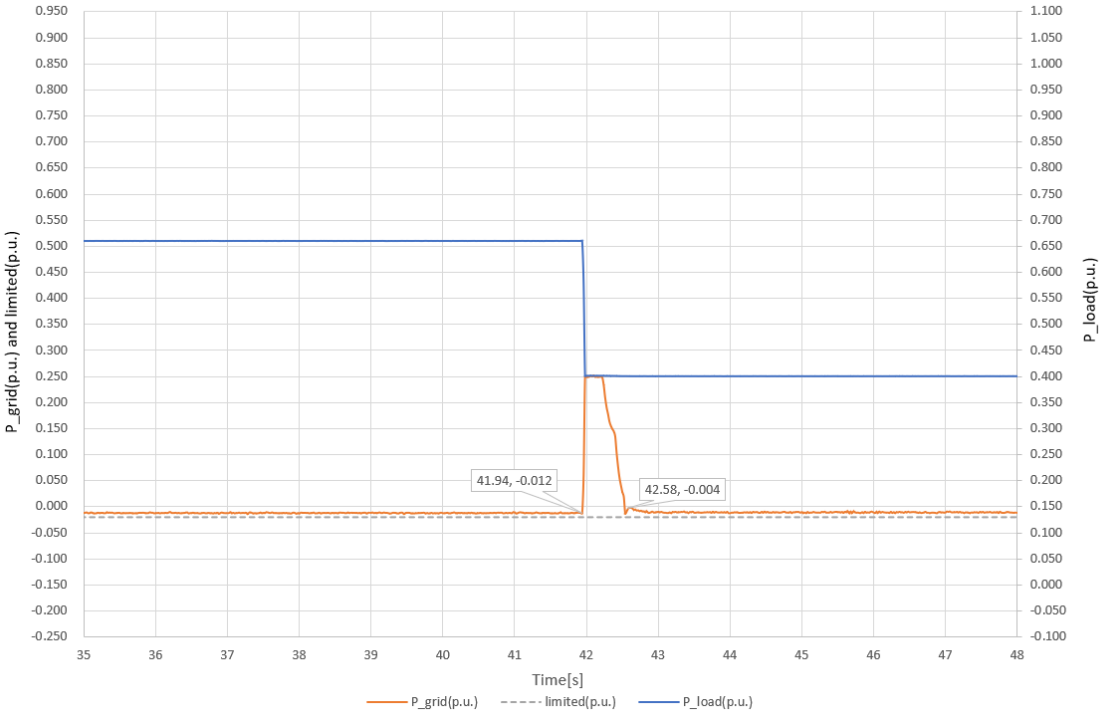


Test 4.1

Overview

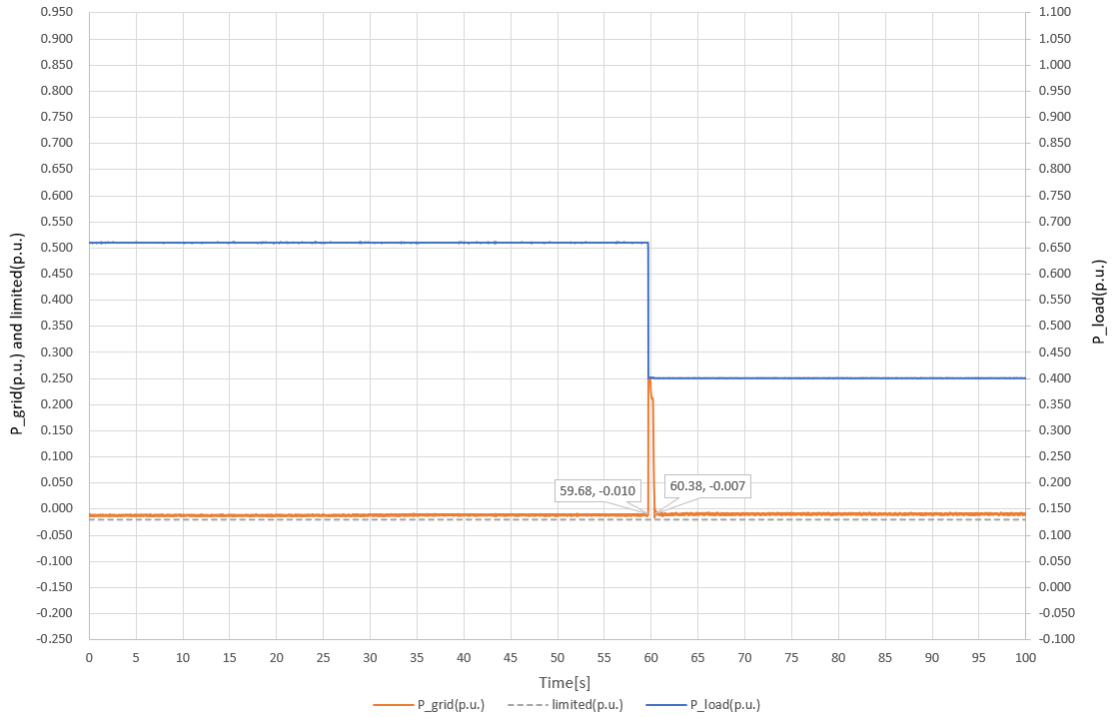


Zoom in

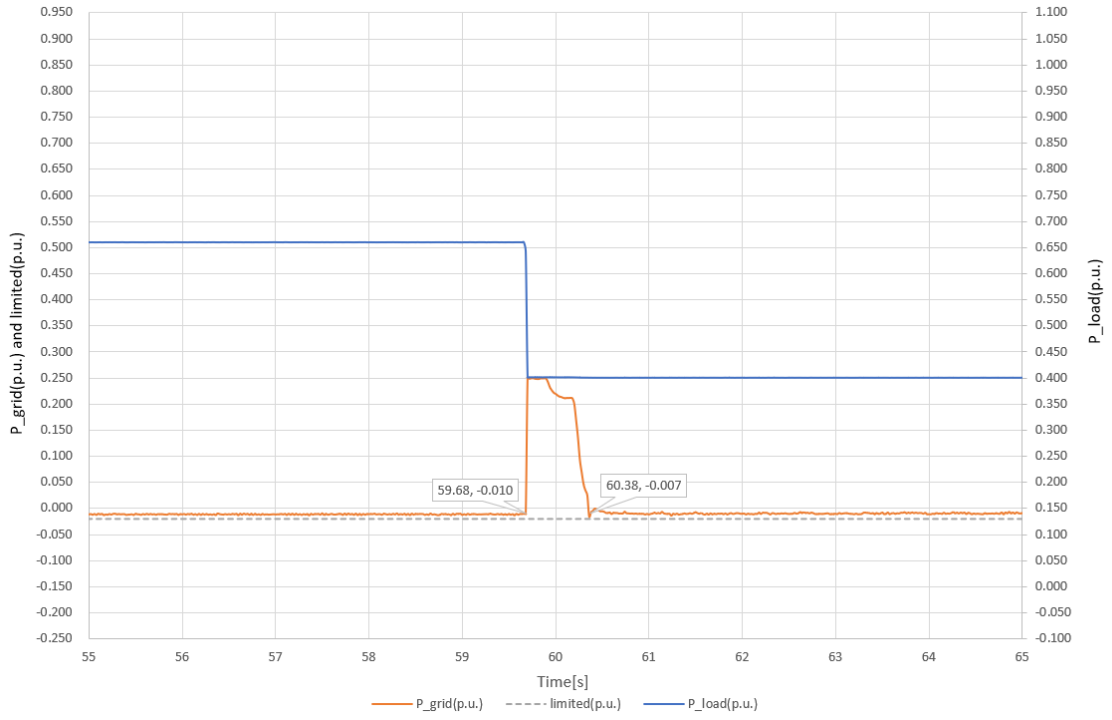


Test 4.2

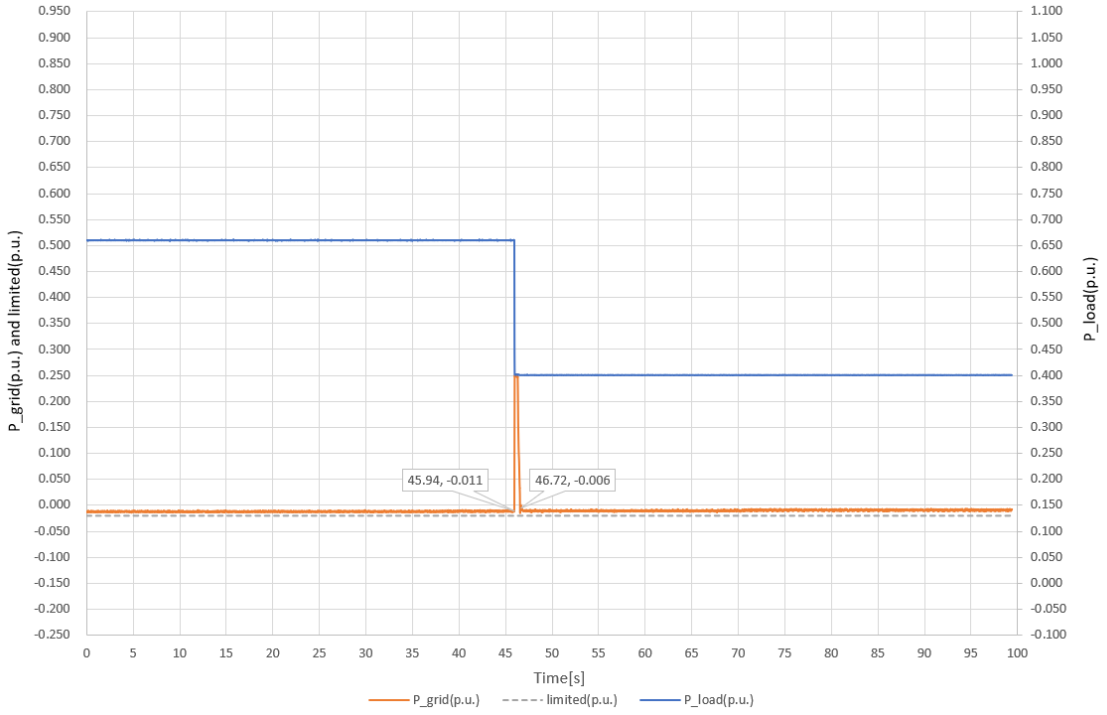
Overview



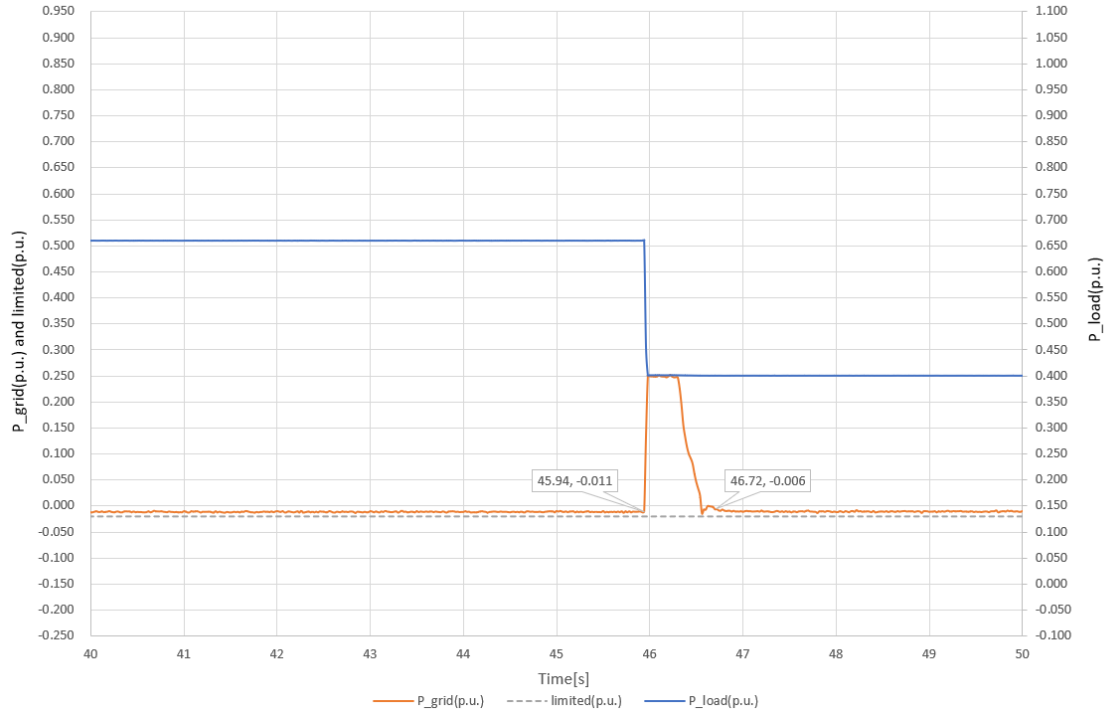
Zoom in



Test 4.3
Overview

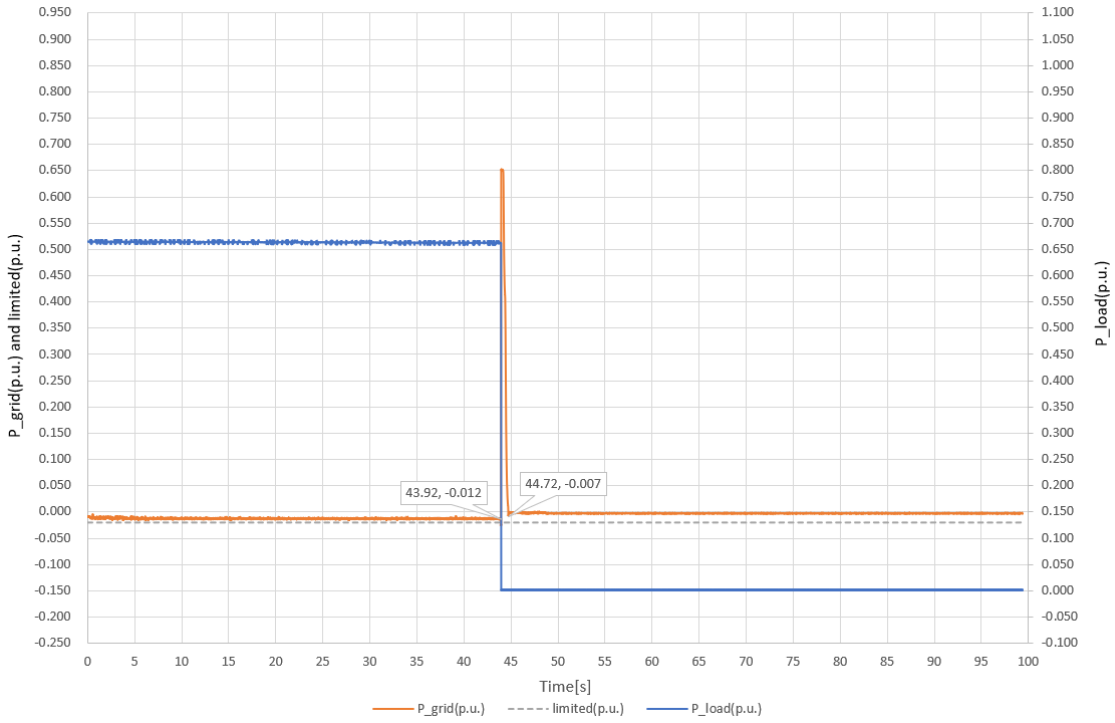


Zoom in

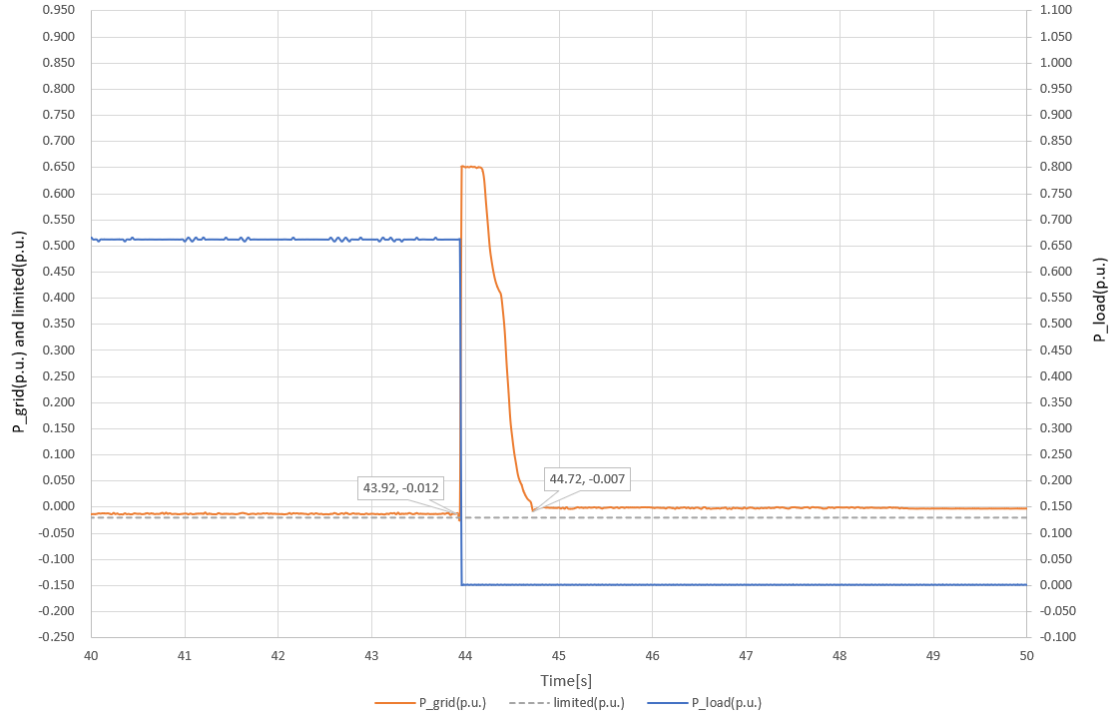


Test 5.1

Overview

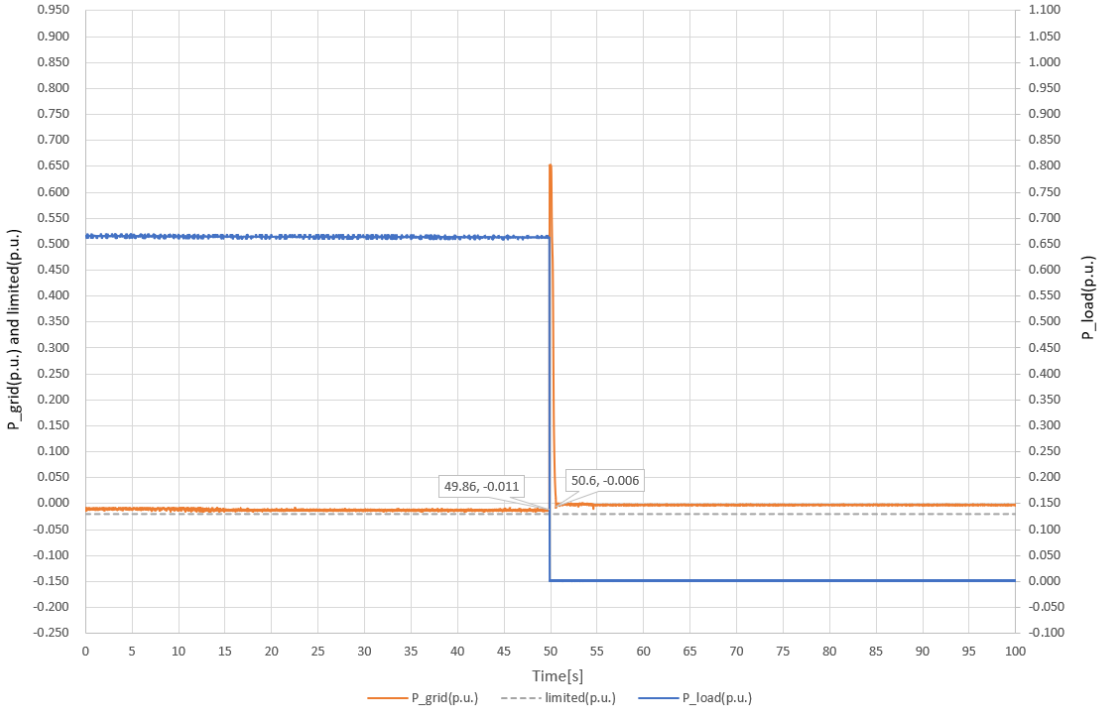


Zoom in

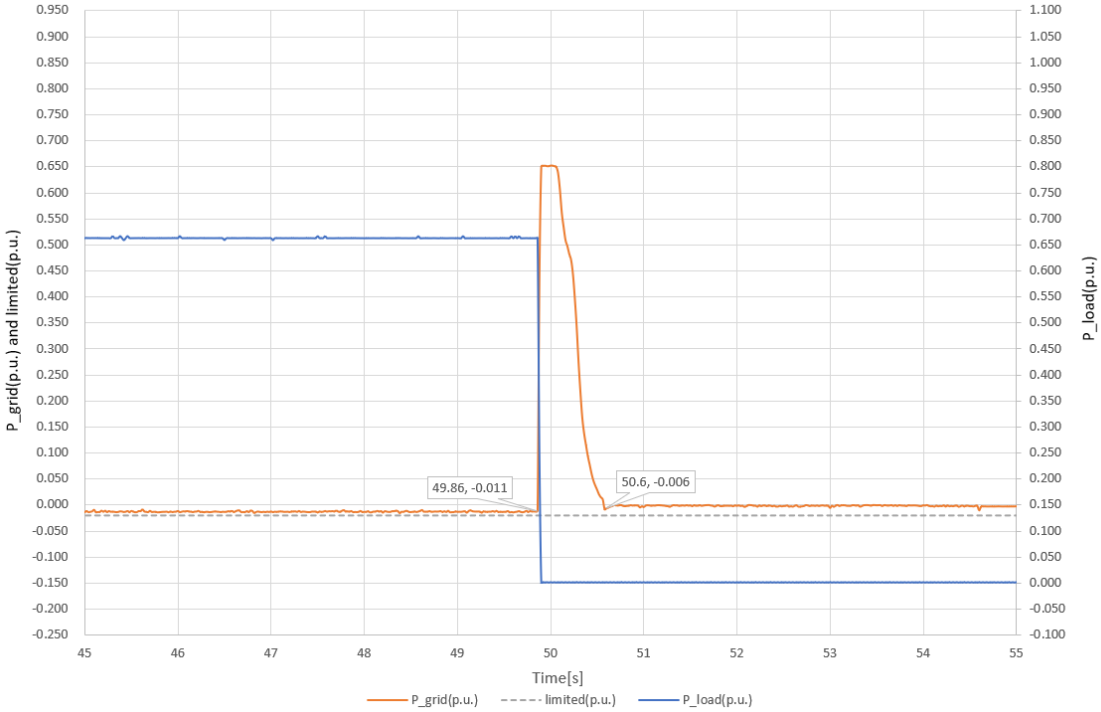


Test 5.2

Overview

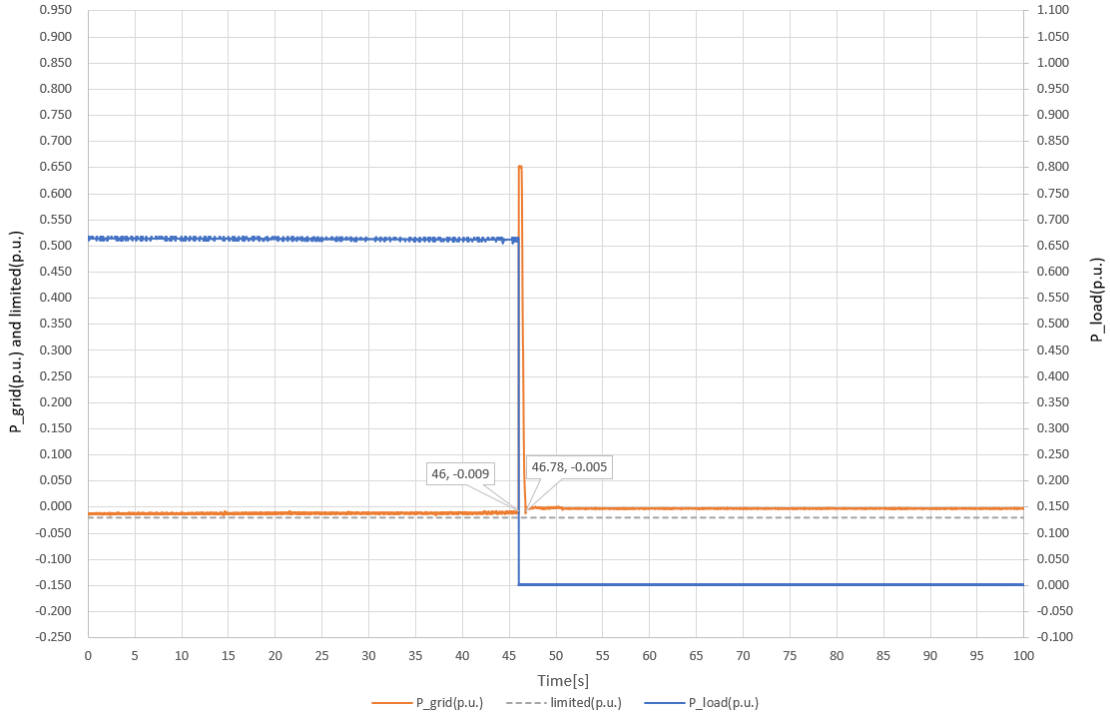


Zoom in

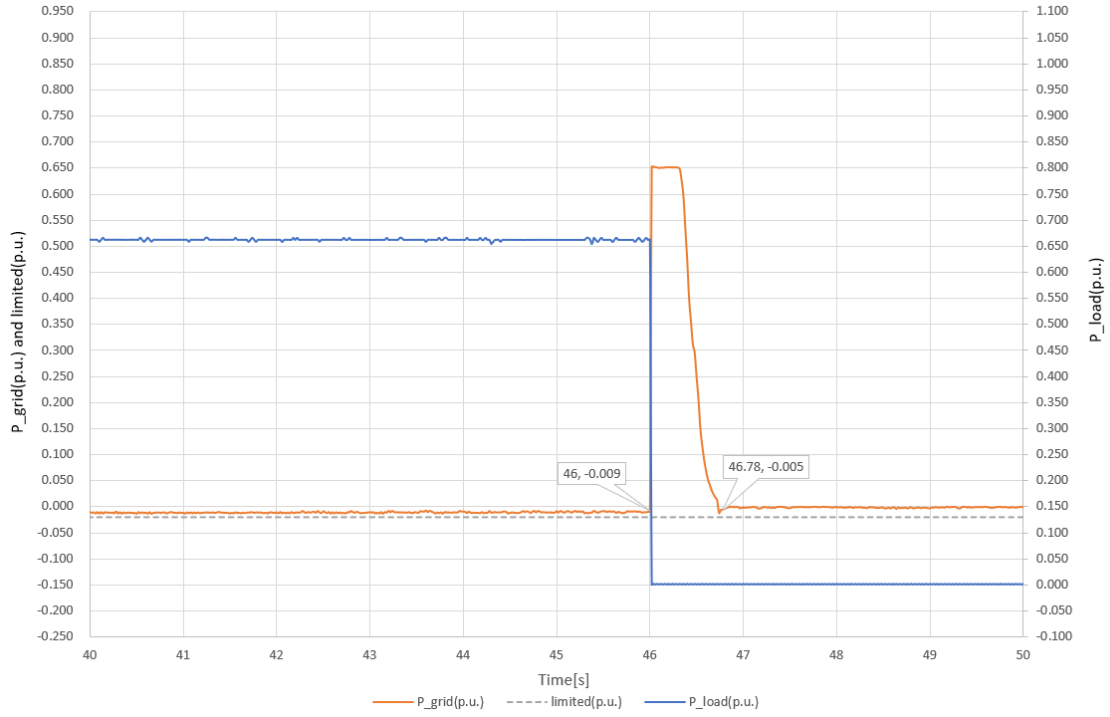


Test 5.3

Overview

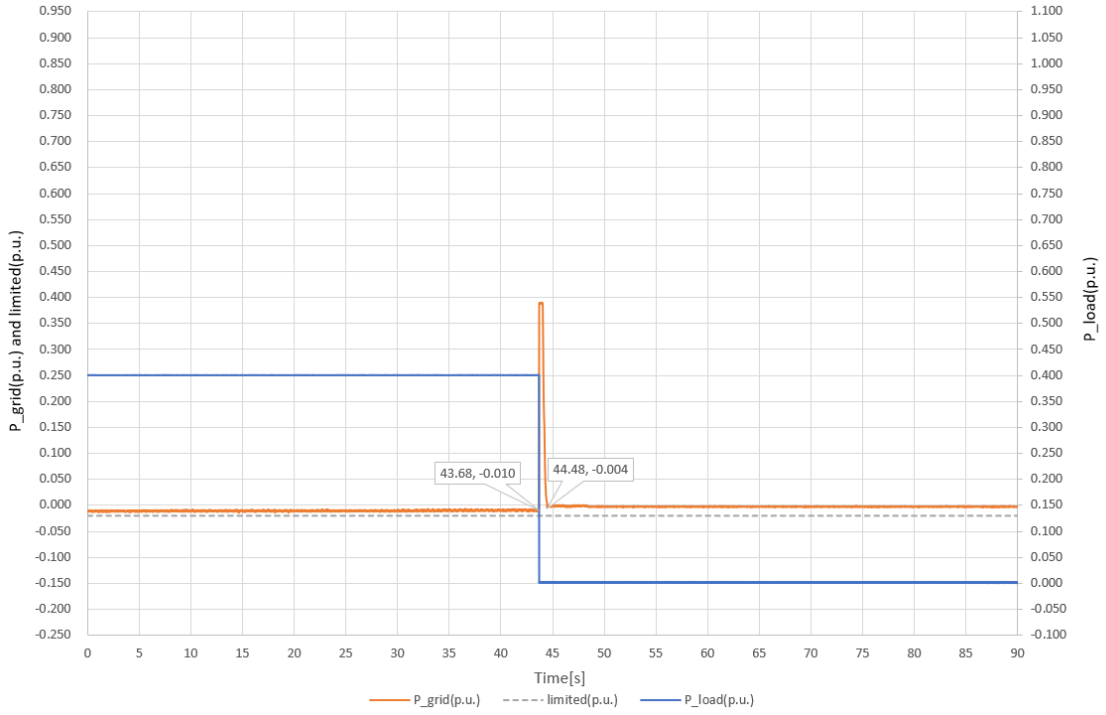


Zoom in

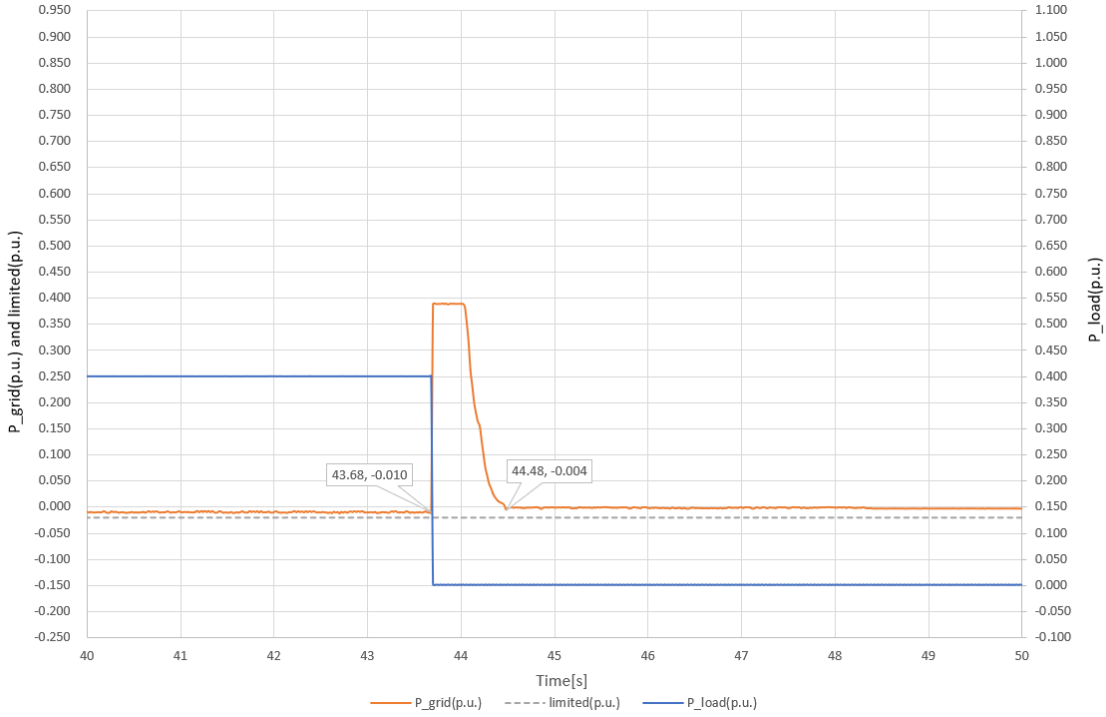


Test 6.1

Overview

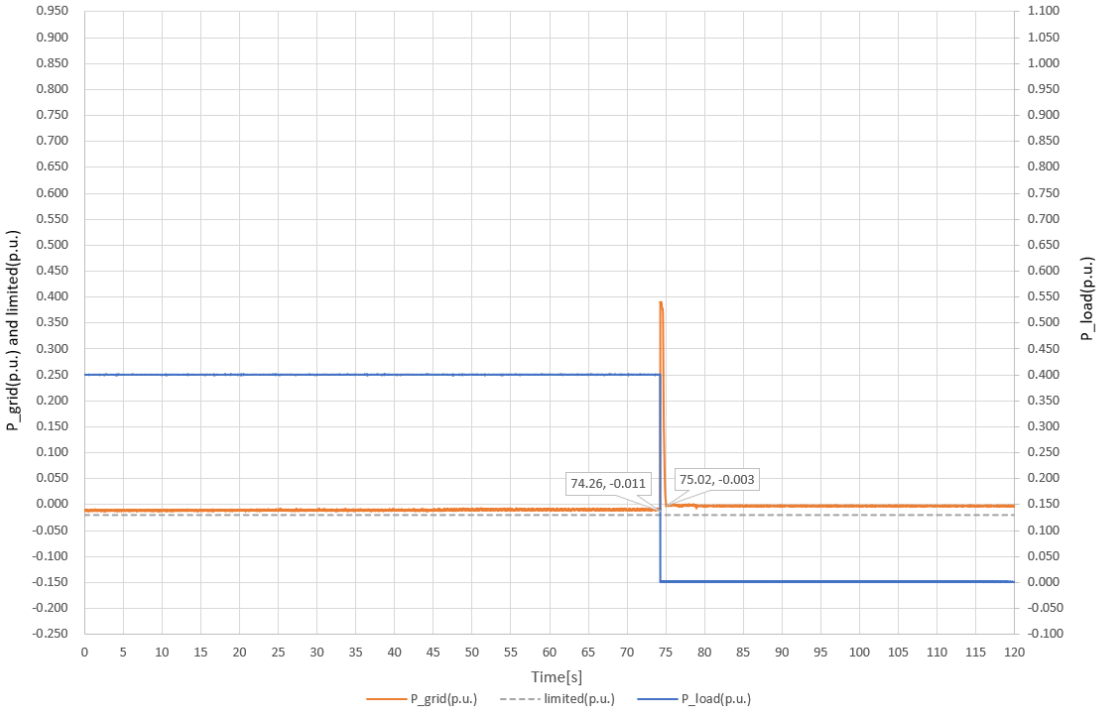


Zoom in

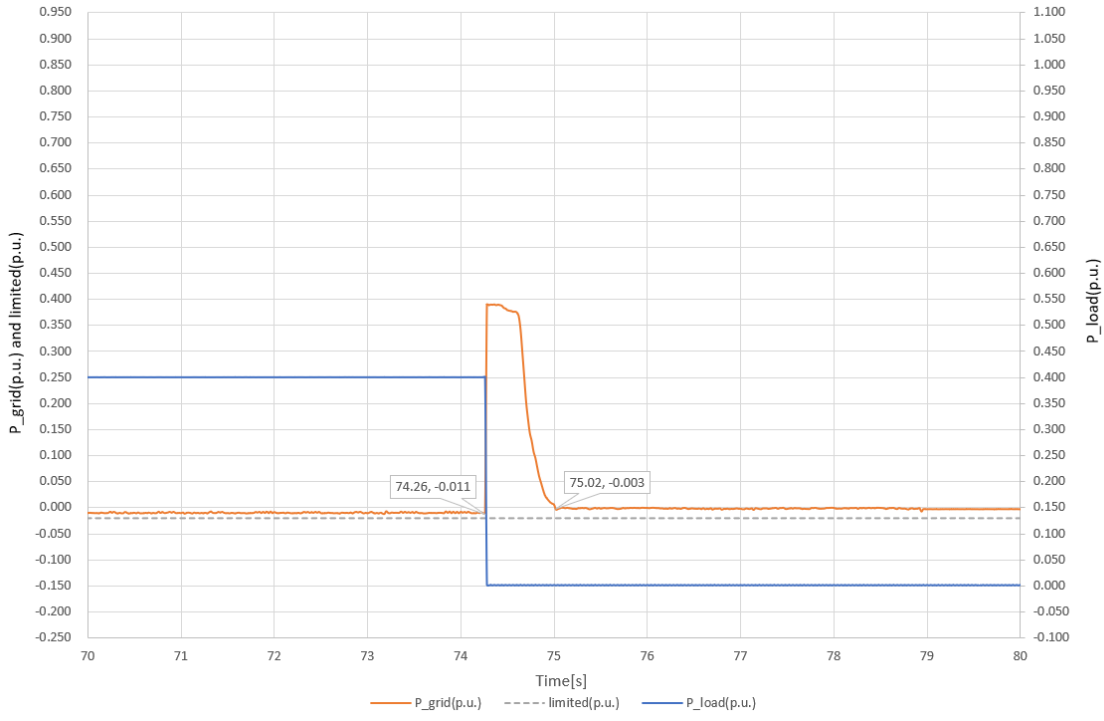


Test 6.2

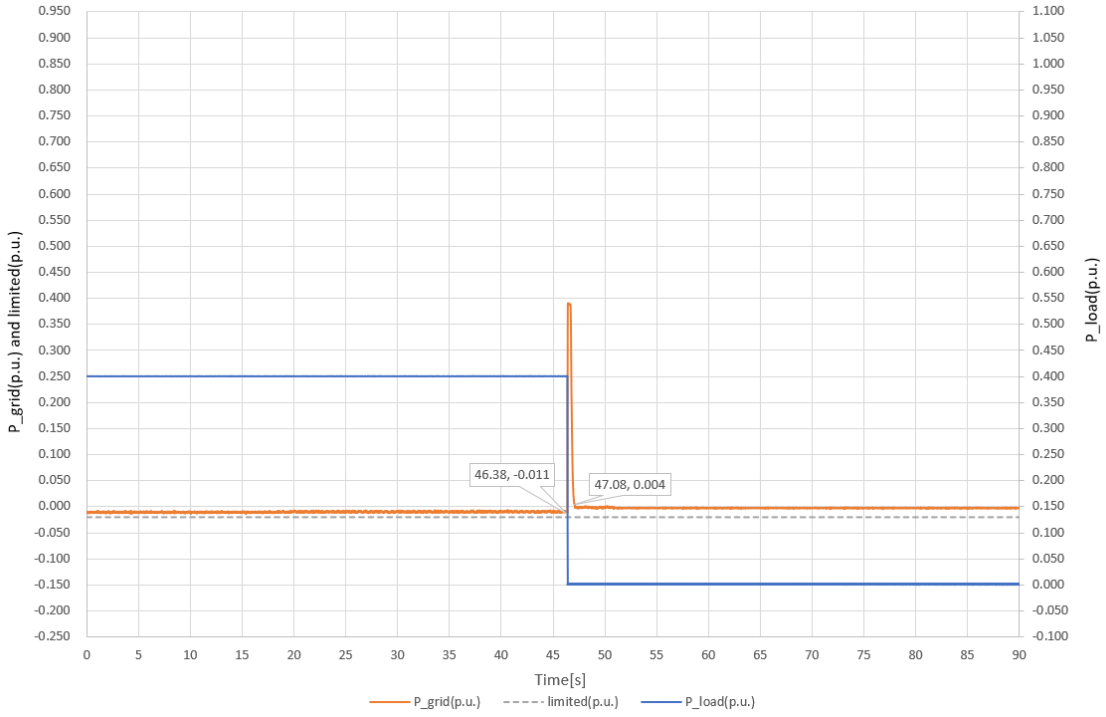
Overview



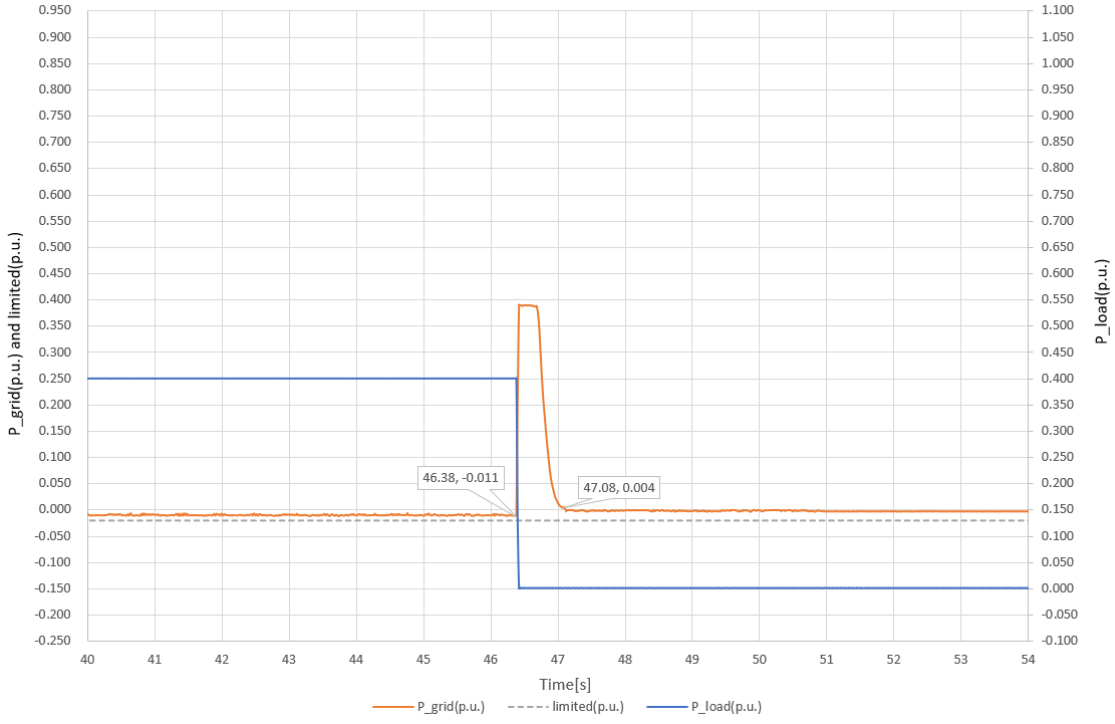
Zoom in



Test 6.3
Overview



Zoom in



4.6 EXCURSIONS

The requirements have been carried out in accordance with paragraph 5.6 of the standard.

The ELS must detect an excursion and reduce the export to the Agreed Export Capacity or less within 5 seconds.

- Under normal operating conditions, (enter product name) response time is less than 2s (test result see section 4.5.2 of this report).
- Under loss of communications, or loss of power to Meter/Gateway, response time is less than 2s (test result see section 4.4 of this report)

4.7 PASSWORD PROTECTION

Once installed and commissioned, the scheme settings should not be capable of being readily altered by the Customer and should only be changed with the written agreement of the DNO.

All functions settings are password protected and cannot be altered by the customer.

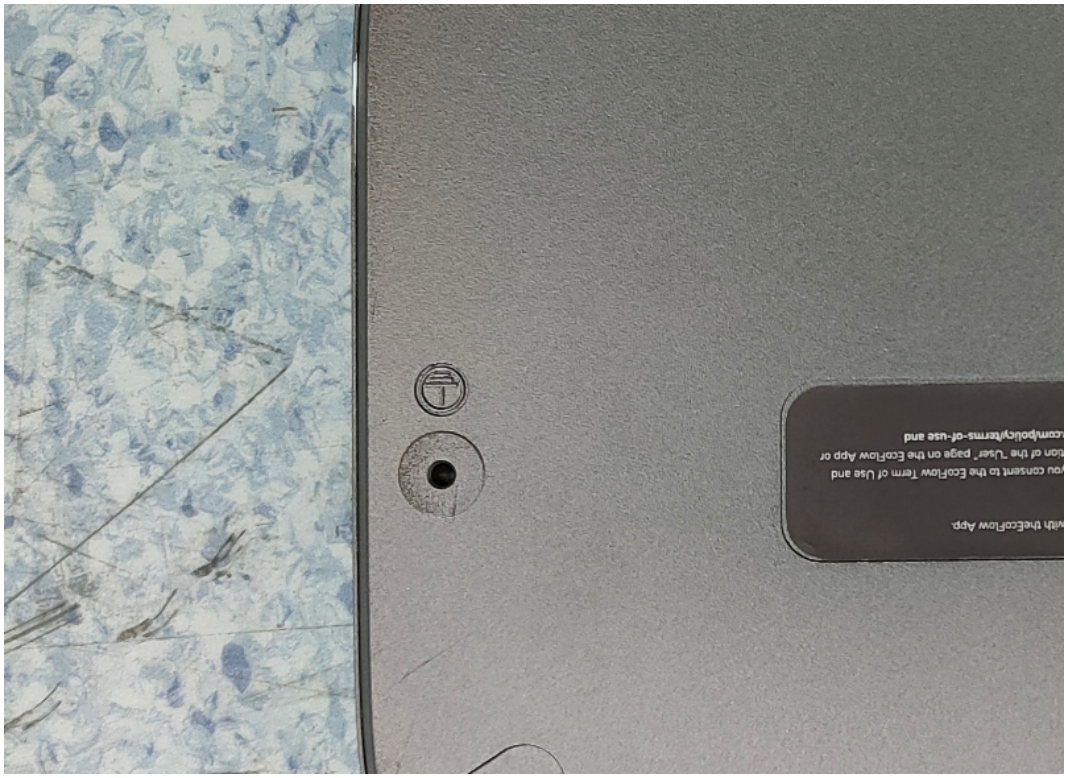
5 PHOTOS

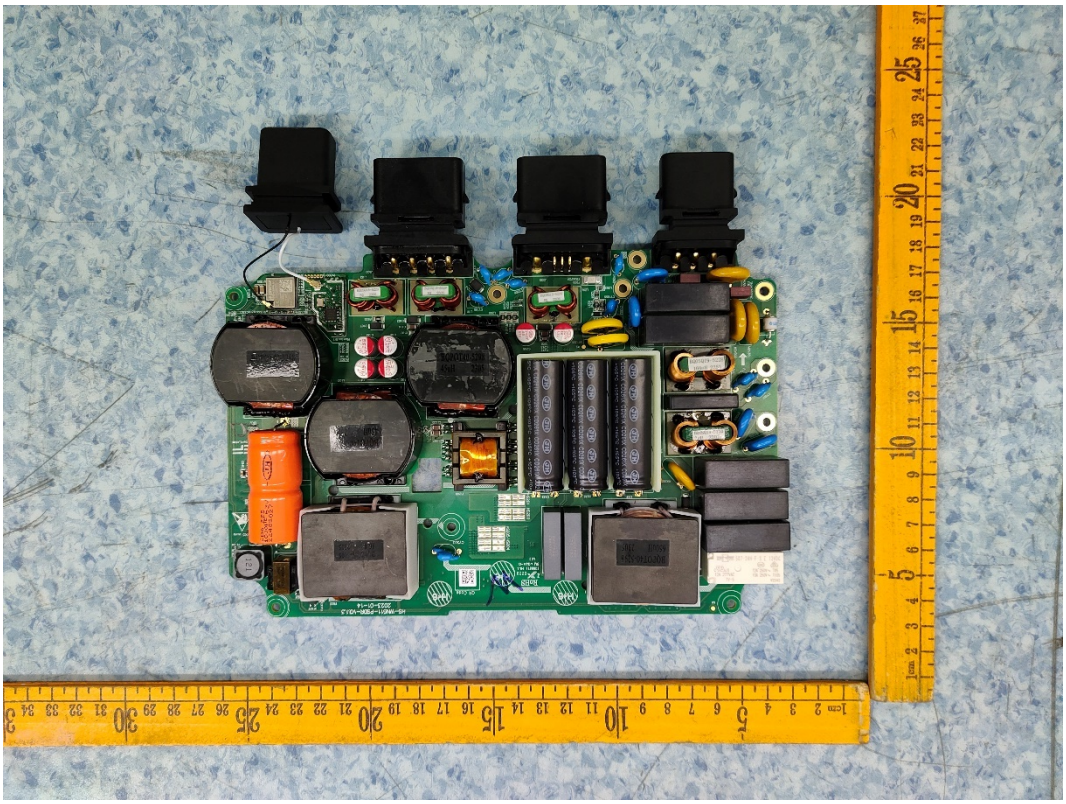
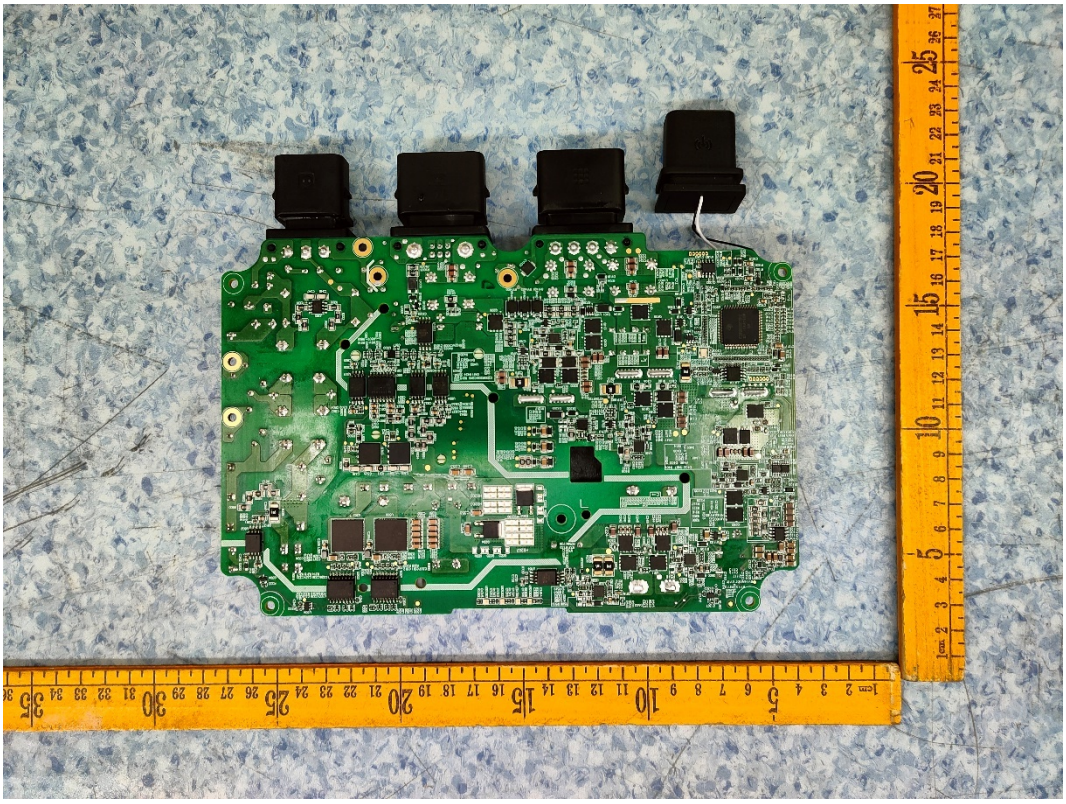
Front view

Back Side


Connection interface

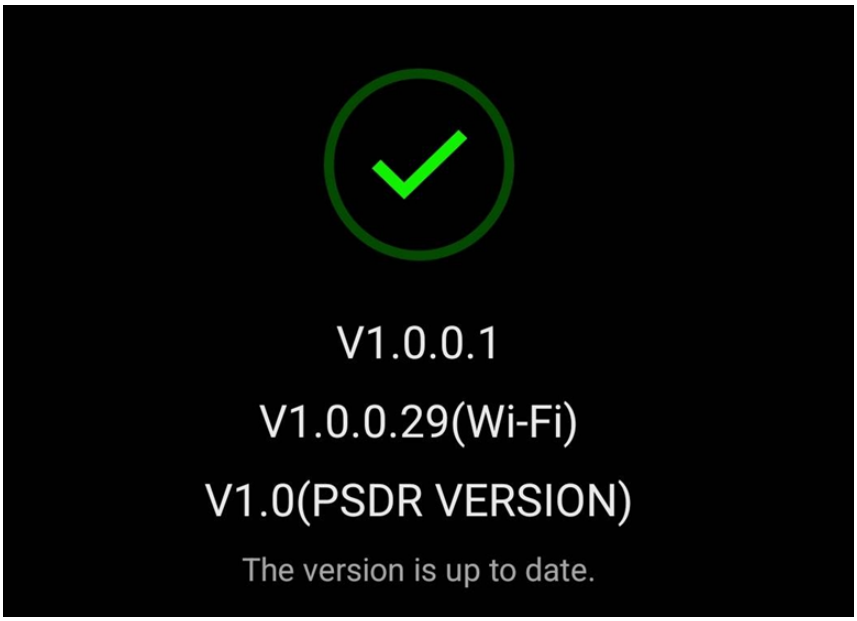
Top Side

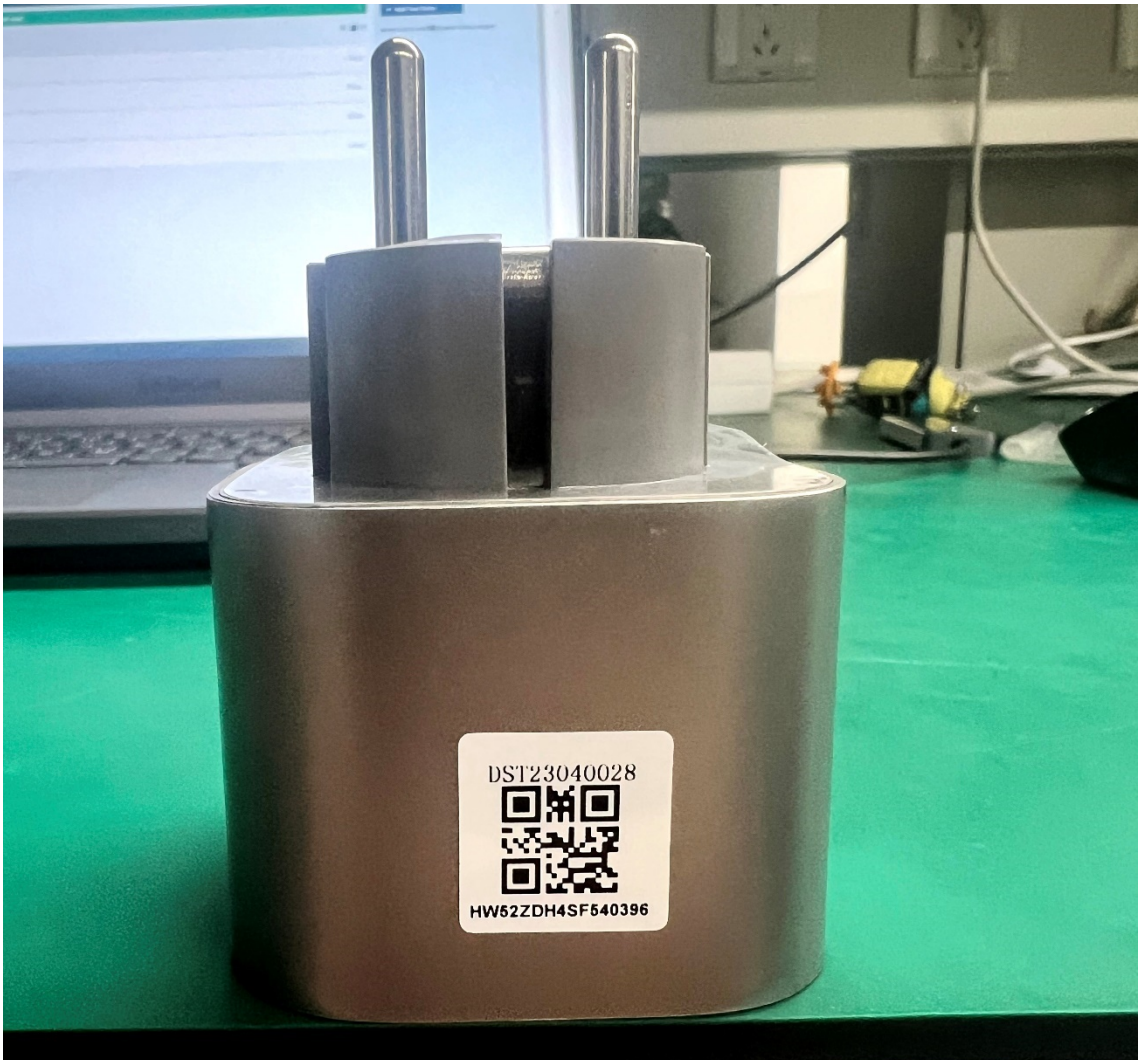

External grounding

General Internal view of inverter


Front of main power board

Back of main power board


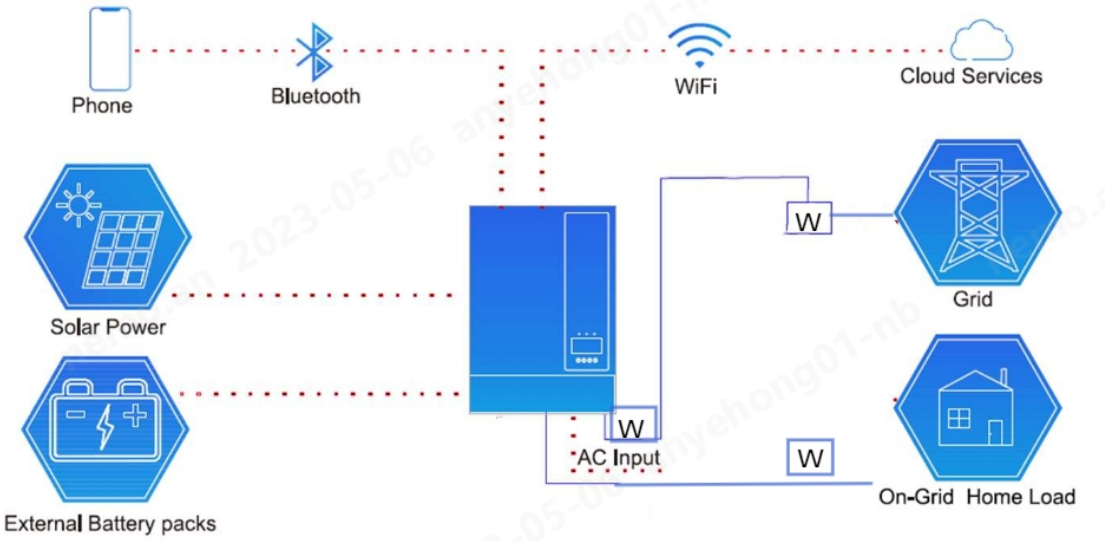
Serial Number and Software Version

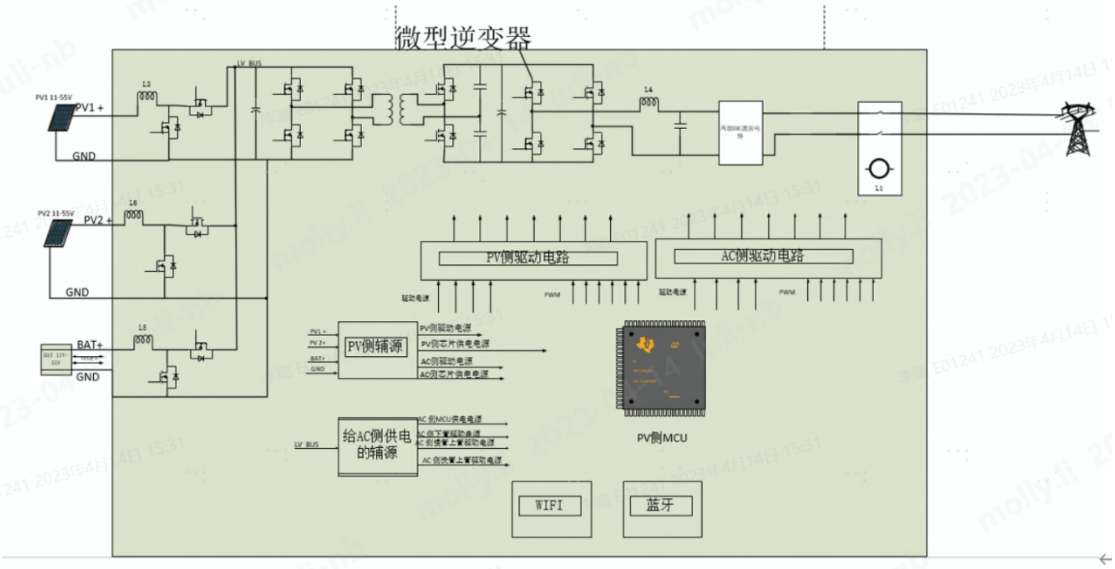
HW51ZEH1RF330001



Smart socket


6 ELECTRICAL SCHEME

Electrical scheme for system


Electrical scheme for PV inverter


----------END OF REPORT----------