TESTING FOR THE VERIFICATION OF COMPLIANCE OF PV INVERTER WITH :

AS / NZS 4777.2:2015 GRID CONNECTION OF ENERGY SYSTEMS VIA INVERTERS

(PART 2: INVERTER REQUIREMENTS)

Procedure: PE.T-LE-62

Test Report Number ....:	**2219 / 0253 / E1 – M1**
Trademark ....:	SUN SYNK
Tested Model ....:	**SUNSYNK-5K-SG03LP1**
Variant Models ....:	**SUNSYNK-3.6K-SG03LP1**

APPLICANT

Name..:	SunSynk Ltd.
Address ....:	Flat A,3/F Wai Yip Industrial Building,171 Wai Yip Street, Kwun Tong,Hong Kong

TESTING LABORATORY

Name..:	SGS Tecnos, S.A. (Electrical Testing Laboratory)
Address ....:	C/ Trespaderne, 29 - Edificio Barajas 1 28042 MADRID (Spain)
Conducted (tested) by...................................:	Roger Hu (Project Engineer)
Approved by ....:	Jacobo Tevar (Technical Reviewer)
Date of issue ....:	25/09/2019
Number of pages ....:	151

SGS Tecnos, S.A.
Laboratorio de Ensayos E&E

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Test Report Historical Revision:

Test Report Version	Date	Resume
2219 / 0253 / E1 – M1	20/09/2019	First issuance based on reports 2219 / 0253 / E1 - M1 issued on 16/08/2019 to issue co-report. Editorial changes have been included to change the applicant, model no. and trademark references.

INDEX

1 SCOPE

SGS Tecnos, S.A. (Electrical Testing Laboratory) has been contract by SunSynk Ltd., in order to issue a co-report based on report number 2219/0253/E1-M1 according to AS/NZS 4777.2: 2015: Grid connection of energy systems via inverters. Part 2: Inverter requirements. For the purpose of this test report, it has only been considered deviations for Australia.

2 GENERAL INFORMATION

2.1 Testing Period and Climatic conditions

The necessary testing has been performed along between the 6th of May and the 23rd of July of 2019.

All the tests and checks have been performed at 25 ± 5ºC, 96 kPa ± 10 kPa and 40% RH ± 10% RH.

SITE TEST

Name...: Shenzhen BALUN Technology Co., Ltd

Address..: Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China

2.2 Equipment under Testing

Apparatus type .... : Hybrid Inverter

Installation .... : Fixed (permanent connection)

Manufacturer .... : NingBo Deye Inverter Technology Co.,Ltd

Trade mark.. : SUN SYNK

Model / Type reference .... : SUNSYNK-5K-SG03LP1

Serial Number .... : **1907044001 (See point 5 of this report)**

Software Version....................................... : HMI: Verc308
MAIN: Ver0108

Rated Characteristics................................. : PV side: 100-500Vdc, MPPT Input Voltage: 125-425Vdc, 6000W max
Battery side: 48Vdc (40-60Vdc), 125Ad.c.Max
AC output: 230Vac, 50Hz, 21.7Aa.c.(Rated), 25Aa.c.(Max), Rated 5000W, Maximum 5500W.
AC back-up: 230Vac, 50Hz, 21.7Aa.c.(Rated), 25Aa.c.(Max), 5500W.

Date of manufacturing: 2019

Test item particulars

Input .... : PV, AC and Batteries

Output .... AC

Class of protection against electric shock... : Class I

Degree of protection against moisture .... : IP 65

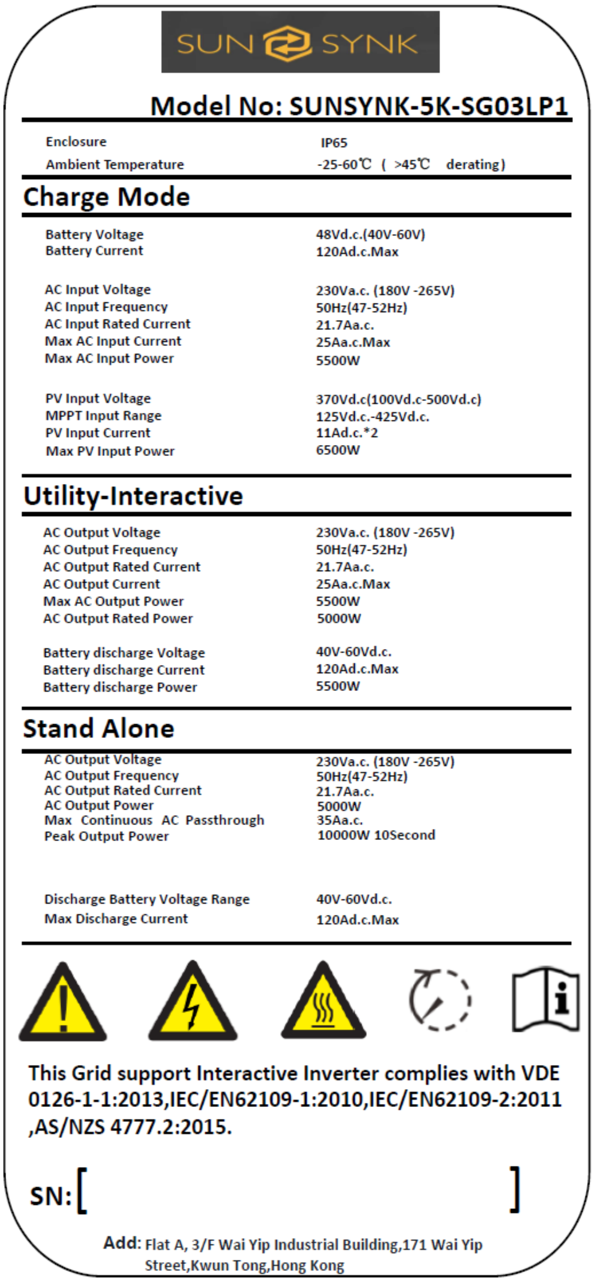
Type of connection to the main supply .... : Single phase – Fixed installation

Cooling group.. : FAN

Modular .... : No

Internal Transformer .... : No

Copy of rating plate (representative):



SUN SYNK

Model No: SUNSYNK-5K-SG03LP1

Enclosure	IP65
Ambient Temperature	-25-60℃ (>45℃ derating)

Charge Mode

Battery Voltage	48Vd.c.(40V-60V)
Battery Current	120Ad.c.Max
AC Input Voltage	230Va.c. (180V -265V)
AC Input Frequency	50Hz(47-52Hz)
AC Input Rated Current	21.7Aa.c.
Max AC Input Current	25Aa.c.Max
Max AC Input Power	5500W
PV Input Voltage	370Vd.c(100Vd.c-500Vd.c)
MPPT Input Range	125Vd.c.-425Vd.c.
PV Input Current	11Ad.c.*2
Max PV Input Power	6500W

Utility-Interactive

AC Output Voltage	230Va.c. (180V -265V)
AC Output Frequency	50Hz(47-52Hz)
AC Output Rated Current	21.7Aa.c.
AC Output Current	25Aa.c.Max
Max AC Output Power	5500W
AC Output Rated Power	5000W
Battery discharge Voltage	40V-60Vd.c.
Battery discharge Current	120Ad.c.Max
Battery discharge Power	5500W

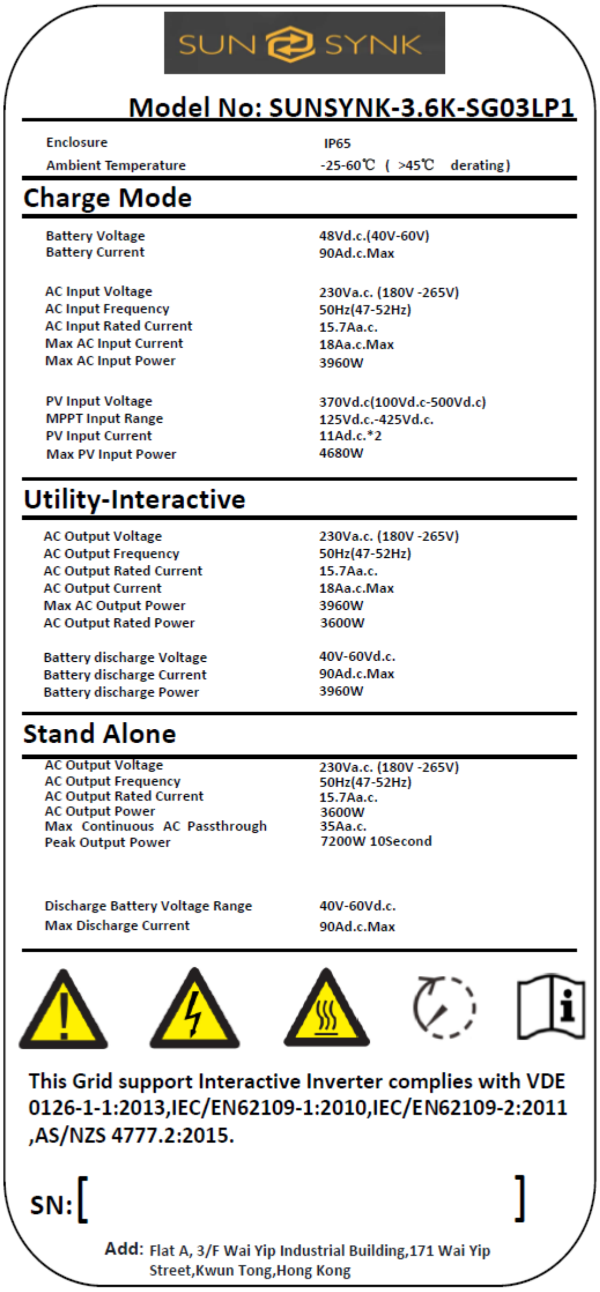
Stand Alone

AC Output Voltage	230Va.c. (180V -265V)
AC Output Frequency	50Hz(47-52Hz)
AC Output Rated Current	21.7Aa.c.
AC Output Power	5000W
Max Continuous AC Passthrough	35Aa.c.
Peak Output Power	10000W 10Second
Discharge Battery Voltage Range	40V-60Vd.c.
Max Discharge Current	120Ad.c.Max

This Grid support Interactive Inverter complies with VDE 0126-1-1:2013,IEC/EN62109-1:2010,IEC/EN62109-2:2011 ,AS/NZS 4777.2:2015.

SN:[ ]

Add: Flat A, 3/F Wai Yip Industrial Building,171 Wai Yip Street,Kwun Tong,Hong Kong



SUN SYNK

Model No: SUNSYNK-3.6K-SG03LP1

Enclosure	IP65
Ambient Temperature	-25-60℃ (>45℃ derating)

Charge Mode

Battery Voltage	48Vd.c.(40V-60V)
Battery Current	90Ad.c.Max
AC Input Voltage	230Va.c. (180V -265V)
AC Input Frequency	50Hz(47-52Hz)
AC Input Rated Current	15.7Aa.c.
Max AC Input Current	18Aa.c.Max
Max AC Input Power	3960W
PV Input Voltage	370Vd.c(100Vd.c-500Vd.c)
MPPT Input Range	125Vd.c.-425Vd.c.
PV Input Current	11Ad.c.*2
Max PV Input Power	4680W

Utility-Interactive

AC Output Voltage	230Va.c. (180V -265V)
AC Output Frequency	50Hz(47-52Hz)
AC Output Rated Current	15.7Aa.c.
AC Output Current	18Aa.c.Max
Max AC Output Power	3960W
AC Output Rated Power	3600W
Battery discharge Voltage	40V-60Vd.c.
Battery discharge Current	90Ad.c.Max
Battery discharge Power	3960W

Stand Alone

AC Output Voltage	230Va.c. (180V -265V)
AC Output Frequency	50Hz(47-52Hz)
AC Output Rated Current	15.7Aa.c.
AC Output Power	3600W
Max Continuous AC Passthrough	35Aa.c.
Peak Output Power	7200W 10Second
Discharge Battery Voltage Range	40V-60Vd.c.
Max Discharge Current	90Ad.c.Max

This Grid support Interactive Inverter complies with VDE 0126-1-1:2013,IEC/EN62109-1:2010,IEC/EN62109-2:2011 ,AS/NZS 4777.2:2015.

SN:[ ]

Add: Flat A, 3/F Wai Yip Industrial Building,171 Wai Yip Street,Kwun Tong,Hong Kong

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.

Equipment under testing:

- **SUNSYNK-5K-SG03LP1**

The variants models are:

- **SUNSYNK-3.6K-SG03LP1**

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 2.5 and 2/3 of the EUT or Modular inverters.
- Same Firmware Version.

The results obtained apply only to the particular sample tested that is the subject of the present test report. The most unfavorable result values of the verifications and tests performed are contained herein.

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

2.3 Manufacturer and Factory information

Manufacturer Name ....:	NingBo Deye Inverter Technology Co.,Ltd
Manufacturer Address...................................:	No.26 South YongJiang Road, Daqi, Beilun, NingBo,Zhejiang, China.
Factory Name...:	NingBo Deye Inverter Technology Co.,Ltd
Factory Address ....:	No.26 South YongJiang Road, Daqi, Beilun, NingBo,Zhejiang, China.

2.4 Test equipment list

	No.	Equipment Name	MARK/Model No.	Equipment No.	Equipment calibration due date
Balun	1	Digital oscilloscope	Tektronix / MS04054B	BZ-EP-L016	2020/02/25
	2	Current clamp	HIOKI / CT6863-05	BZ-EP-L006	2020/02/27
	3	Current clamp	HIOKI / CT6863-05	BZ-EP-L007	2020/02/27
	4	Current clamp	HIOKI / CT6863-05	BZ-EP-L008	2020/02/27
	5	Current clamp	HIOKI / CT6863-05	BZ-EP-L009	2020/02/27
	6	Differential probe	CYBERTEK / DP6130	BZ-SFT-L079	2019/11/04
	7	Power analyzer	HIOKI / PW6001-16	BZ-EP-L005	2020/02/26
	8	Power analyzer	ZLG / PA6006H	BZ-EP-L051	2019/11/04
	9	Temperature & Humidity meter	SMART SENSOR / AR827	01769263	2019/11/04
SGS	10	True RMS Multimeter	Fluke / 289C	SHES100602 (15100038)	2020/01/06

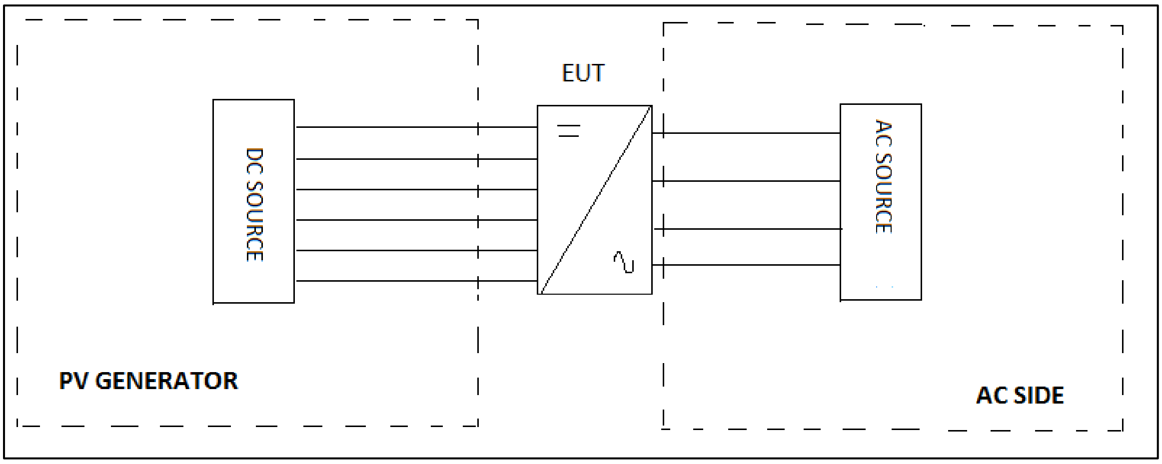
2.5 Measurement uncertainty

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	±1º
Temperature	±3º C
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 solicitant. 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.



Different equipment has been used to take measures as it shows in chapter 2.3. Current and voltage 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.

<u>The test bench used includes:</u>

EQUIPMENT	MARK / MODEL	RATED CHARACTERISTICS	OWNER / ID.CODE
AC source	Kewell / KACM-75-33	Voltage: 0-600 V 75kVA	Balun/BZ-EP-L001
PV source	Kewell / IVS-60KW	Voltage: 0 - 1000 V 60kW	Balun/BZ-EP-L002
Programmable ac load	QUNLING / ACLT-3820	Voltage: 0-600 V 60kVA	Balun/BZ-EP-L003
DRED Testing fixture	--	AS/NZS 4777.2:2015 I1	Interterk / ST127-14

2.7 Definitions

EUT	Equipment Under Testing	Hz	Hertz
A	Ampere	V	Volt
VAr	Volt-Ampere reactive	W	Watt
Un	Nominal Voltage	In	Nominal current
Pn	Nominal Active Power	Sn	Nominal Apparent Power
Qn	Nominal Reactive Power	p.u	Per unit
V1+	Voltage Positive Sequence	I1+	Current Positive Sequence
V1-	Voltage Negative Sequence	I1-	Current Negative Sequence
Uv	Voltage Imbalance	Ui	Current Imbalance
DRM	Demand Response Mode	THD	Total Harmonic Distortion
I_h	Harmonic Current	U_h	Harmonic Voltage
PST	Severity of Flicker Short-Term	PLT	Severity of Flicker Long-Term
dc	Maximum Variation of Voltage	d(t)	Variation of Voltage
DRED	Demand Response Enabling Device	d max	Maximum Absolute Value of Voltage Variation

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

STANDARD SECTION	STANDARD REQUIREMENTS AS/NZS 4777.2:2015	RESULT
A.5	**Reference network impedance**	**P**
	Network impedance	P
5	**General Requirements**	**P**
5.1	Electrical safety	P
5.2	Provision for External Connections	P
5.3	PV Array earth fault/earth leakage detection	P
5.4	Compatibility with electrical installation	P
5.5	Power Factor	P
5.6	Harmonics	--
--	Harmonics Current	P
--	Harmonics Voltage	P
5.7	Flickers	P
5.8	Transient voltage limits	P
5.9	DC Current Injection	P
5.10	Current Balance for Three-phase inverters	N/A
6	**Operational modes and Multiple mode inverters**	**P**
6.2	Inverter Demand Response Modes (DRMs)	P
6.2.1	General	P
6.2.2	Interaction with Demand Response Enabling Device (DRED)	P
6.3	Inverter Power quality response modes	P
6.3.2	Volt response modes	P
6.3.2.2	Volt-Watt response mode	P
6.3.2.3	Volt-Var response mode	P
6.3.2.4	Voltage balanced modes	P
6.3.3	Fixed power factor mode and reactive power mode	P
6.3.4	Characteristics power factor curve for cos ϕ (P) (Power response)	P
6.3.5	Power rate limit	P
6.3.5.3.3	Changes in a.c. operation and control	N/A
6.3.5.3.4	Changes in energy source operation	N/A
6.4	Multiple mode inverter operation	N/A
6.4.2	Sinusoidal output in stand-alone mode (Harmonics voltage)	P
6.4.3	Volt-Watt response mode for charging of energy storage	P
6.5	Security	P
7	**Protective functions for connection to electrical installations and the grid**	**P**
7.2	Automatic disconnection device	P
7.3	Active Anti-Islanding protection	P
7.4	Voltage and frequency limits (passive anti-islanding protection)	P
7.5	Limits for sustained operation.	P
7.5.2	Sustained operation for voltage variations	P
7.5.3	Sustained operation for frequency variations	P
7.5.3.1	Response to an increase in frequency	P
--	Response to a decrease in frequency	P
7.5.3.2	Response to a decrease in grid frequency with energy storage	P

STANDARD SECTION	STANDARD REQUIREMENTS AS/NZS 4777.2:2015	RESULT
7.6	Disconnection on external signal	P
7.7	Connection and reconnection procedure	P
7.8	Security of protection settings	P
8	**Multiple inverter combination**	**N/A**
8.2	Inverter current balance across multiple phases	N/A
8.3	Grid Disconnection	N/A
8.4	Grid Connection and Reconnection	N/A
8.5.1	Single-phase combinations	N/A
8.5.2	Single-phase inverters used in three-phase combinations	N/A
8.5.3	Required Tests for Multiple Inverter Combination	N/A
8.5.4	Multiple Inverters with one Automatic Disconnection Device	N/A
9	**Inverter marking and documentation**	**P**

Note: The declaration of conformity has been evaluated taking into account the IEC Guide 115.

4 TEST RESULTS

4.1 REFERENCE NETWORK IMPEDANCE

The network reference impedance used during the tests has been of:

R_A = 0.24 Ohms; X_A = j 0.15 Ohms at 50 Hz;
R_N = 0.16 Ohms; X_N = j 0.10 Ohms at 50 Hz.

4.2 ELECTRICAL SAFETY

As required per the Clause 5.1 of the standard, inverters for use in energy systems with photovoltaic (PV) arrays, the inverters shall comply with the appropriate electrical safety requirements. The compliances with these requirements are stated in the following test reports:

- IEC 62109-1 and IEC 62109-2: test report nº BL-SZ1998124-B01 on 2019/04/22 issued by Shenzhen BALUN Technology Co., Ltd.

4.3 PROVISION FOR EXTERNAL CONNECTIONS

The inverter complies with the requirements according to Clause 5.2 of the standard.

4.4 PV ARRAY EARTH FAULT / EARTH LEAKAGE DETECTION

The compliances with these requirements are stated in the following test reports:

- IEC 62109-1 and IEC 62109-2: test report nº BL-SZ1998124-B01 on 2019/04/22 issued by Shenzhen BALUN Technology Co., Ltd.

4.5 COMPATIBILITY WITH ELECTRICAL INSTALLATION

According to the requirements stated in the clause 5.4 of the standard, it has been verified that the inverter is able to operate with AC voltage and frequency limits specified in AS 60038 (for Australia).

The inverter shall stay connected providing the maximum of its available active power working in abnormal voltage and/or frequency conditions.

The following tables show the results of the tests performed:

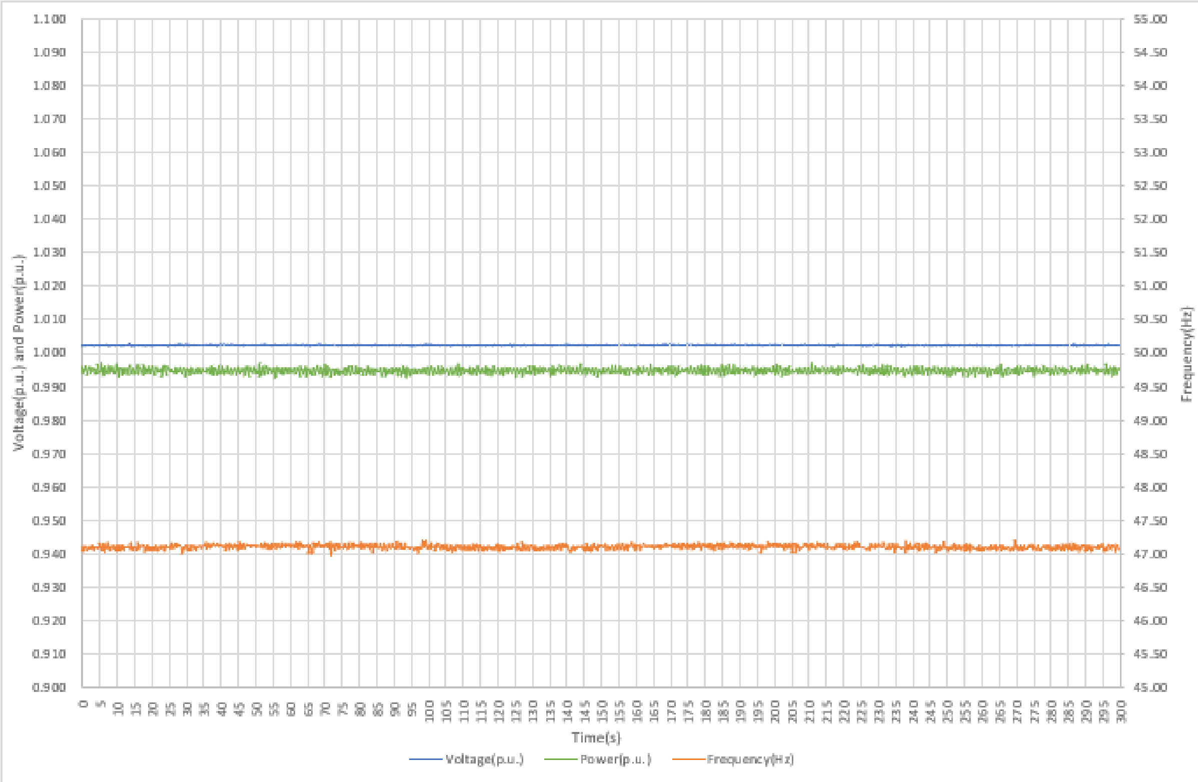
Test 1		Under Frequency		
Voltage	**Frequency**	**Active Power measured**	**Minimum Operation Time**	**Time measured**
100%Un	**47.1Hz**	99.5%Pn	Continuous Operation	> 5 min
Disconnection		☒ NO ☐ YES		

Test 2		Under Voltage		
Voltage	**Frequency**	**Active Power measured**	**Minimum Operation Time**	**Time measured**
94%Un	**50.0Hz**	99.4%Pn	Continuous Operation	> 5 min
Disconnection		☒ NO ☐ YES		

Test 3		Over Voltage + Over Frequency		
Voltage	**Frequency**	**Active Power measured**	**Minimum Operation Time**	**Time measured**
110%Un	**50.25Hz**	99.5%Pn	Continuous Operation	> 5 min
Disconnection		☒ NO ☐ YES		

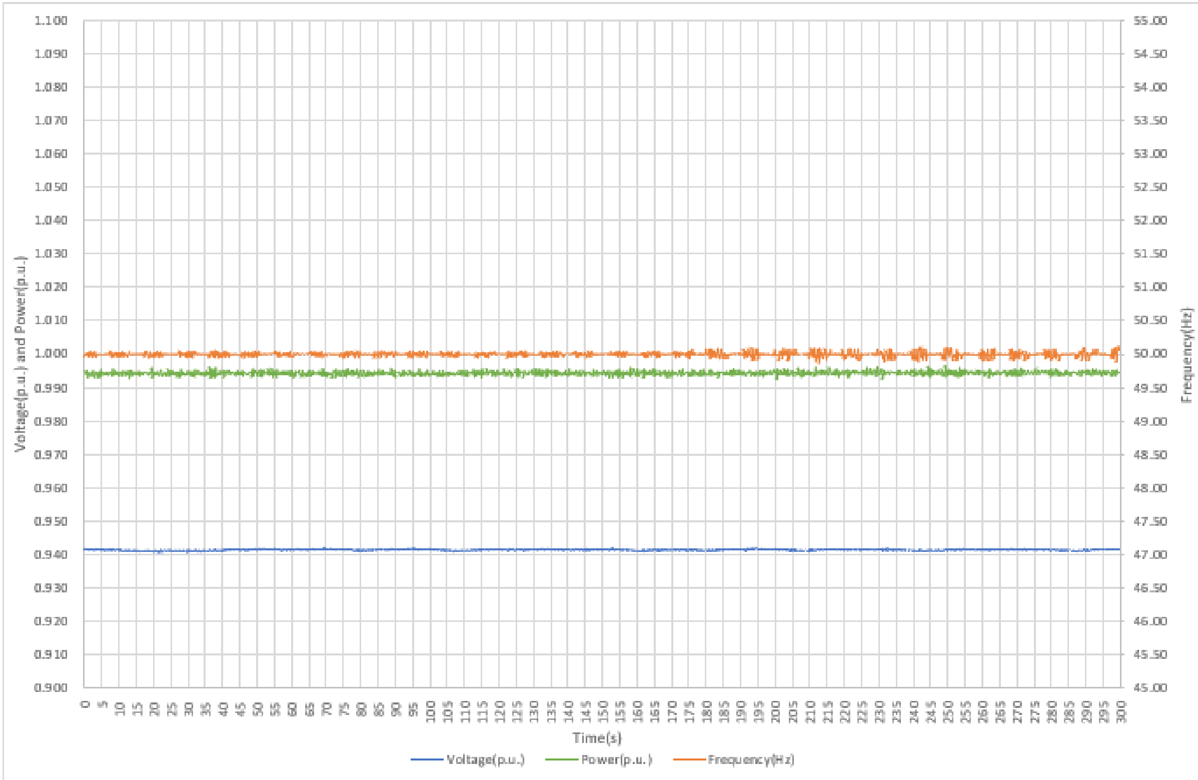
(*) The measured value of active power is calculated as the average of the samples taken each 200 ms during the corresponding measured time.

Test 1 (V = 100%Un and F = 47.0 Hz)

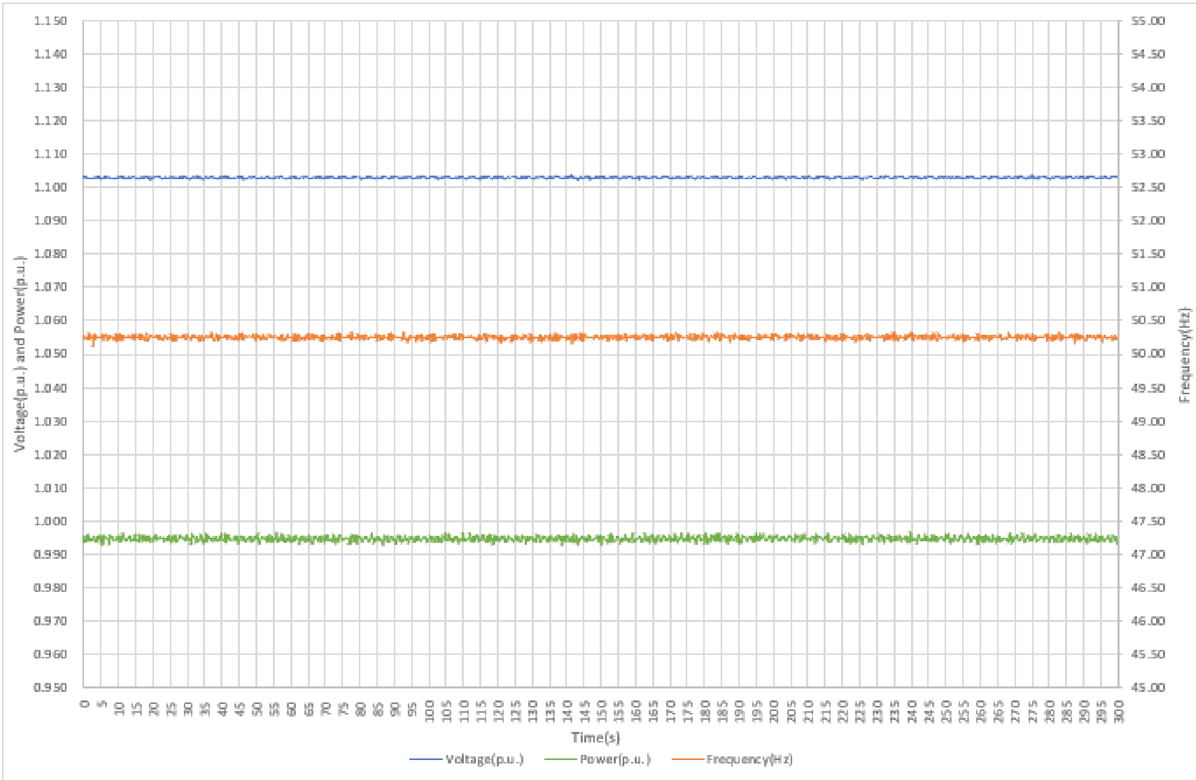


	Time measured: 5 min
Voltage average measured: 99.5 %Un	Frequency measured: 47.10 Hz

Test 2 (V = 94%Un and F = 50.0 Hz)



	Time measured: 5 min
Voltage average measured: 99.4 %Un	Frequency measured: 50.00 Hz

Test 3 (V = 110%Un and F = 50.25 Hz)	
	
	Time measured: 5 min
Voltage average measured: 110.3 %Un	Frequency measured: 50.25 Hz

4.6 POWER FACTOR

The power factor has been measured according to Clause 5.5 and the annex B of the standard, with an initial power factor at unity.

As the inverter is capable of different power factor settings, the test has been repeated varying the power factor within the range 0.8 leading to 0.8(*) lagging.

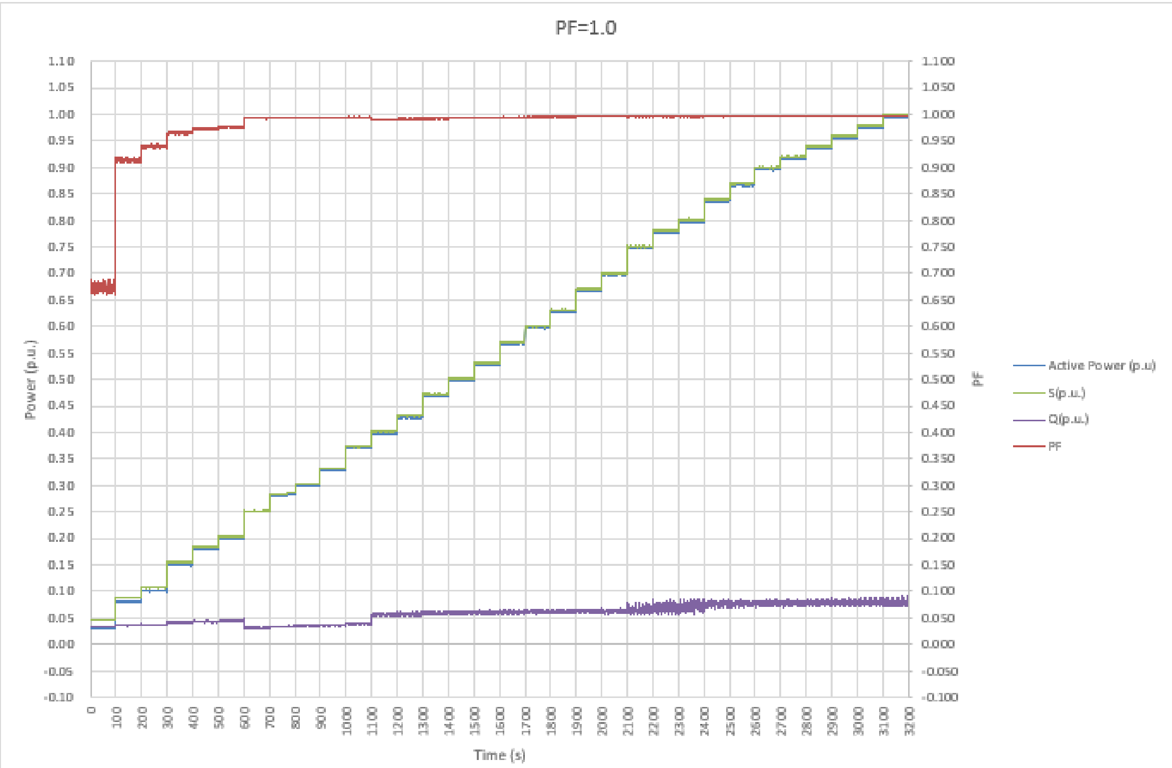
(*)0.8 leading to 0.8 lagging is more restrictive than 0.95 as the standard required.

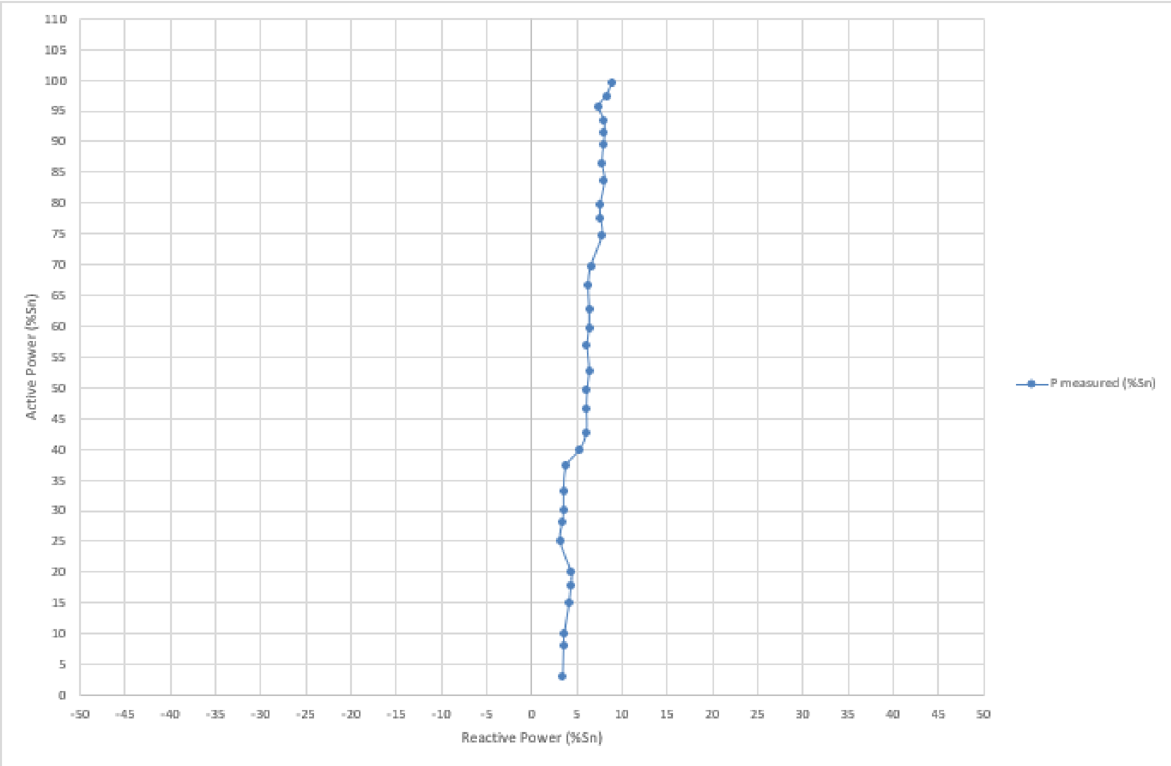
The maximum tolerance allowed for the measured Power Factor is ± 0.01, for measurements from 25%Sn.

The following table and graphs show test results for measurements of power factor set to unity (PF=1):

Unity Power Factor (PF=1.0)					
P Desired (%Sn)	**P measured (%Sn)**	**Q measured (%Sn)**	**Power Factor desired (cos φ)**	**Power Factor measured (cos φ)**	**Power Factor Deviation (cos φ)**
3%	3.0	3.4	1.000	0.670	-0.330
8%	8.1	3.5	1.000	0.916	-0.084
10%	10.1	3.6	1.000	0.942	-0.058
15%	15.0	4.1	1.000	0.964	-0.036
18%	18.0	4.3	1.000	0.972	-0.028
20%	20.0	4.3	1.000	0.978	-0.022
25%	25.0	3.1	1.000	0.993	-0.007
28%	28.3	3.4	1.000	0.993	-0.007
30%	30.2	3.5	1.000	0.993	-0.007
33%	33.2	3.5	1.000	0.995	-0.005
37%	37.3	3.8	1.000	0.995	-0.005
40%	39.9	5.3	1.000	0.991	-0.009
43%	42.8	6.0	1.000	0.990	-0.010
47%	46.7	6.0	1.000	0.992	-0.008
50%	49.8	6.1	1.000	0.993	-0.007
53%	52.8	6.3	1.000	0.993	-0.007
57%	56.8	6.1	1.000	0.994	-0.006
60%	59.7	6.3	1.000	0.995	-0.005
63%	62.7	6.3	1.000	0.995	-0.005
67%	66.6	6.2	1.000	0.996	-0.004
70%	69.8	6.5	1.000	0.996	-0.004
75%	74.7	7.7	1.000	0.995	-0.005
78%	77.7	7.5	1.000	0.995	-0.005
80%	79.7	7.5	1.000	0.996	-0.004
84%	83.6	8.0	1.000	0.995	-0.005
87%	86.6	7.7	1.000	0.996	-0.004
90%	89.6	7.9	1.000	0.996	-0.004
92%	91.6	8.0	1.000	0.996	-0.004
94%	93.6	7.9	1.000	0.996	-0.004
96%	95.6	7.3	1.000	0.997	-0.003
98%	97.5	8.2	1.000	0.996	-0.004
100%	99.5	8.8	1.000	0.996	-0.004

Unity Power Factor (PF=1.0)





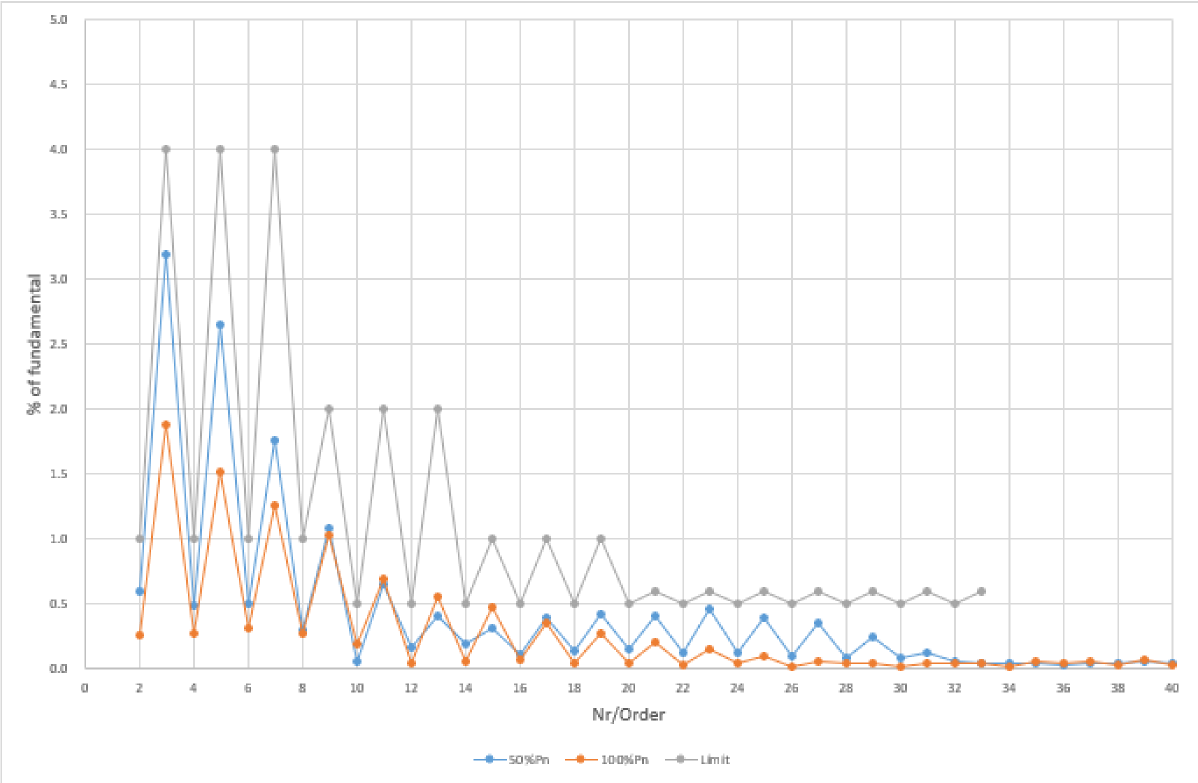
4.7 VOLTAGE QUALITY MEASUREMENTS

4.7.1 Current harmonics

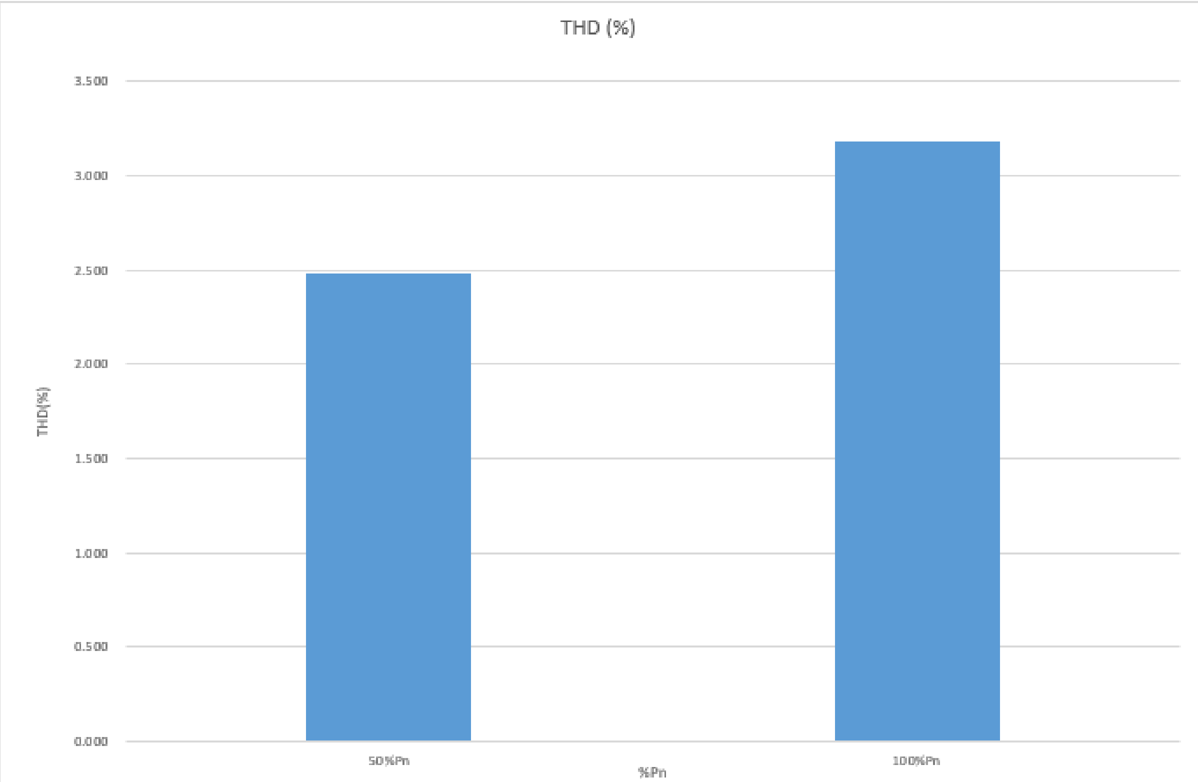
The current harmonics have been measured according to the Clause 5.6 of the standard, at the required power values.

	Limit	50% of rated current	100% of rated current
Eliminate order	% of fundamental	% of fundamental	% of fundamental
2	1.0%	0.60%	0.26%
3	4.0%	3.19%	1.88%
4	1.0%	0.49%	0.27%
5	4.0%	2.65%	1.51%
6	1.0%	0.51%	0.31%
7	4.0%	1.76%	1.26%
8	1.0%	0.30%	0.27%
9	2.0%	1.08%	1.03%
10	0.5%	0.06%	0.19%
11	2.0%	0.65%	0.69%
12	0.5%	0.17%	0.04%
13	2.0%	0.41%	0.56%
14	0.5%	0.19%	0.06%
15	1.0%	0.32%	0.48%
16	0.5%	0.11%	0.07%
17	1.0%	0.40%	0.36%
18	0.5%	0.14%	0.05%
19	1.0%	0.43%	0.28%
20	0.5%	0.16%	0.04%
21	0.6%	0.41%	0.21%
22	0.5%	0.13%	0.03%
23	0.6%	0.47%	0.16%
24	0.5%	0.13%	0.05%
25	0.6%	0.40%	0.10%
26	0.5%	0.10%	0.02%
27	0.6%	0.36%	0.06%
28	0.5%	0.09%	0.04%
29	0.6%	0.25%	0.05%
30	0.5%	0.08%	0.02%
31	0.6%	0.13%	0.05%
32	0.5%	0.06%	0.05%
33	0.6%	0.05%	0.05%
34	--	0.05%	0.02%
35	--	0.04%	0.06%
36	--	0.03%	0.04%
37	--	0.05%	0.06%
38	--	0.04%	0.03%
39	--	0.06%	0.07%
40	--	0.04%	0.03%
THD		2.481%	3.178%

Current Harmonics



THD



4.7.2 Voltage harmonics

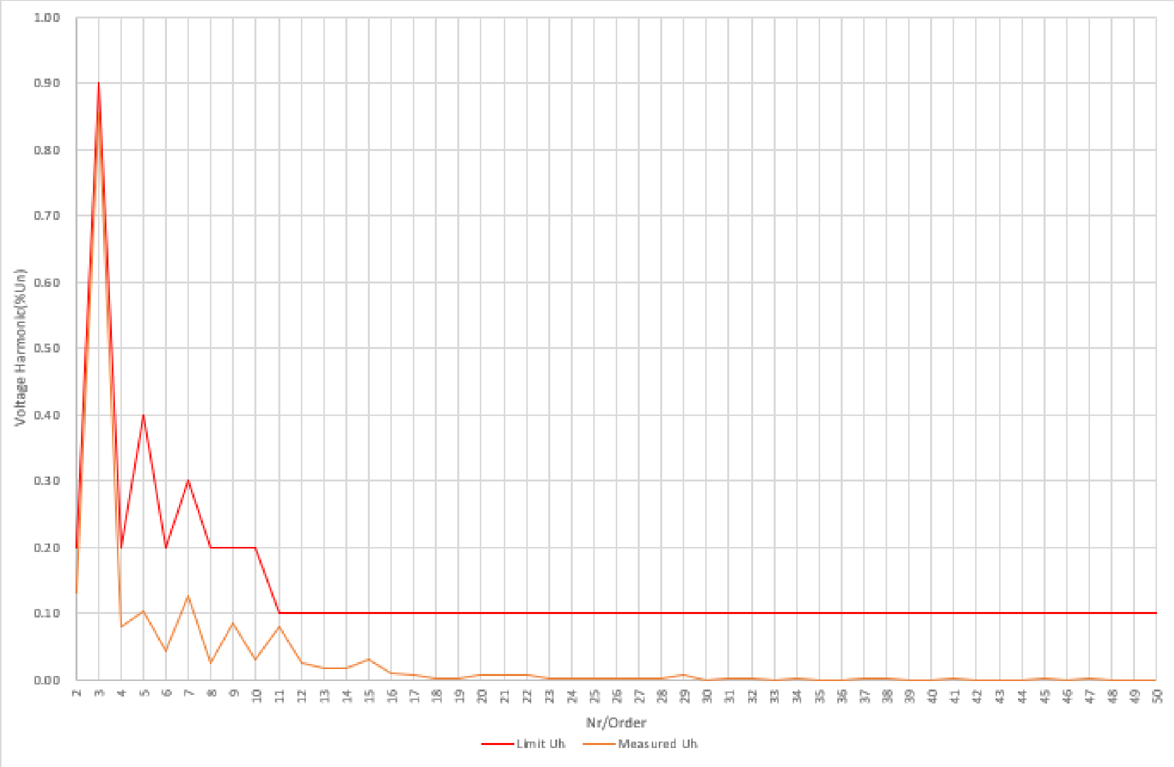
The background voltage harmonics have been verified according to the Clause 5.6 (Appendix C) of the standard, into AC terminals of the grid source.

The test results are shown in the graphic and the table below.

Voltage Source Harmonics		
Nr/Order	**Limit U_h (%fundamental)**	**Measured U_h (%fundamental)**
2	0.20	0.132
3	0.90	0.857
4	0.20	0.080
5	0.40	0.104
6	0.20	0.045
7	0.30	0.127
8	0.20	0.027
9	0.20	0.086
10	0.20	0.032
11	0.10	0.080
12	0.10	0.025
13	0.10	0.018
14	0.10	0.017
15	0.10	0.032
16	0.10	0.010
17	0.10	0.007
18	0.10	0.003
19	0.10	0.003
20	0.10	0.007
21	0.10	0.008
22	0.10	0.007
23	0.10	0.003
24	0.10	0.003
25	0.10	0.003
26	0.10	0.002
27	0.10	0.002
28	0.10	0.003
29	0.10	0.007
30	0.10	0.001
31	0.10	0.002

Voltage Source Harmonics		
Nr/Order	Limit U_h (%fundamental)	Measured U_h (%fundamental)
32	0.10	0.002
33	0.10	0.001
34	0.10	0.003
35	0.10	0.001
36	0.10	0.000
37	0.10	0.002
38	0.10	0.002
39	0.10	0.001
40	0.10	0.001
41	0.10	0.002
42	0.10	0.001
43	0.10	0.000
44	0.10	0.000
45	0.10	0.002
46	0.10	0.001
47	0.10	0.002
48	0.10	0.001
49	0.10	0.001
50	0.10	0.001
THD((%fundamental)	5.00	0.897

Voltage Source Harmonics



Voltage THD

4.8 FLICKERS IN CONTINUOUS OPERATION

Measurements of voltage fluctuations in continuous operation have been measured according to the Clause 5.7 of the standard.

Limits considered are: 1.0 for Pst, 0.65 for Plt, 3.3% for dc and 4% for dmax measurements, according to the standard IEC 61000-3-11: 2017.

Test done at 100%Pn				
Pn(%)	Limit	33 %	66 %	100 %
PST	≤ 1.0	0.675	0.349	0.688
PLT	≤ 0.65	0.508	0.232	0.569
dc [%]	≤ 3.30	0.737	0.096	0.185
dmax [%]	4	3.565	3.006	3.991

As it can be seen in the next screenshots, this test has 12 steps. The values took of Pst, Plt, dc and dmax are the most unfavorable of the 12 steps.

Running operation 33% Pn

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.099	Pass	3.565	Pass	0.0	Pass	0.675	Pass		
2	0.056	Pass	2.750	Pass	0.0	Pass	0.491	Pass		
3	0.041	Pass	2.874	Pass	0.0	Pass	0.493	Pass		
4	0.033	Pass	2.748	Pass	0.0	Pass	0.498	Pass		
5	0.737	Pass	2.756	Pass	0.0	Pass	0.487	Pass		
6	0.037	Pass	2.772	Pass	0.0	Pass	0.499	Pass		
7	0.043	Pass	3.200	Pass	0.0	Pass	0.501	Pass		
8	0.060	Pass	2.565	Pass	0.0	Pass	0.533	Pass		
9	0.048	Pass	3.199	Pass	0.0	Pass	0.499	Pass		
10	0.063	Pass	2.726	Pass	0.0	Pass	0.428	Pass		
11	0.029	Pass	2.770	Pass	0.0	Pass	0.504	Pass		
12	0.065	Pass	2.228	Pass	0.0	Pass	0.508	Pass		
Result		Pass		Pass		Pass		Pass	0.508	Pass

Running operation 66% Pn

Flicker Mode Flicker | Range Over U1 U2 U3 U4 U5 U6 U7 I1 I2 I3 I4 I5 I6 I7 | Spd Scaling Line Filter Trq AVG Freq Filter | Integral : Reset | CH: 1 2 3 4 5 6 7

Count 12/12 Complete
Interval 00:00s/10:00s
Element 2
Volt Range 600 V/50Hz
Un (Set) 230.000V
Freq (U2) 50.012Hz

Element2 Judgement Pass
Total Judgement Pass
(Element2)

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.060	Pass	2.191	Pass	0.0	Pass	0.349	Pass		
2	0.062	Pass	2.179	Pass	0.0	Pass	0.289	Pass		
3	0.096	Pass	2.263	Pass	0.0	Pass	0.274	Pass		
4	0.062	Pass	2.242	Pass	0.0	Pass	0.301	Pass		
5	0.054	Pass	1.899	Pass	0.0	Pass	0.289	Pass		
6	0.052	Pass	3.006	Pass	0.0	Pass	0.263	Pass		
7	0.074	Pass	2.474	Pass	0.0	Pass	0.242	Pass		
8	0.096	Pass	2.114	Pass	0.0	Pass	0.195	Pass		
9	0.069	Pass	1.989	Pass	0.0	Pass	0.260	Pass		
10	0.078	Pass	2.018	Pass	0.0	Pass	0.178	Pass		
11	0.067	Pass	2.770	Pass	0.0	Pass	0.267	Pass		
12	0.079	Pass	2.008	Pass	0.0	Pass	0.180	Pass		
Result		Pass		Pass		Pass		Pass	0.232	Pass

COMP EXT
Element 1 U1 600 Vrms I1 50 Arms
Element 2 U2 600 Vrms I2 50 Arms
Element 3 U3 600 Vrms I3 50 Arms
Element 4 U4 600 Vrms I4 50 Arms
Element 5 U5 600 Vrms I5 50 Arms
Element 6 U6 600 Vrms I6 50 Arms
Element 7 U7 600 Vrms I7 50 Arms
Integral : Reset Time —:—:— Timer 0 : 00 : 30

Update: 0 Runtime: 5:04:57 2019-05-17 14:21:42

Running operation 100% Pn

Flicker Mode Flicker | Range Over U1 U2 U3 U4 U5 U6 U7 I1 I2 I3 I4 I5 I6 I7 | Spd Scaling Line Filter Trq AVG Freq Filter | Integral : Reset | CH: 1 2 3 4 5 6 7

Count 12/12 Complete
Interval 00:00s/10:00s
Element 1
Volt Range 600 V/50Hz
Un (Set) 230.000V
Freq (U1) 50.015Hz

Element1 Judgement Pass
Total Judgement Pass
(Element1)

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.072	Pass	2.791	Pass	0.0	Pass	0.507	Pass		
2	0.090	Pass	2.896	Pass	0.0	Pass	0.581	Pass		
3	0.094	Pass	3.884	Pass	0.0	Pass	0.584	Pass		
4	0.094	Pass	3.852	Pass	0.0	Pass	0.504	Pass		
5	0.089	Pass	2.776	Pass	0.0	Pass	0.582	Pass		
6	0.062	Pass	3.941	Pass	0.0	Pass	0.601	Pass		
7	0.068	Pass	2.275	Pass	0.0	Pass	0.688	Pass		
8	0.185	Pass	2.246	Pass	0.0	Pass	0.586	Pass		
9	0.085	Pass	3.909	Pass	0.0	Pass	0.683	Pass		
10	0.108	Pass	2.781	Pass	0.0	Pass	0.583	Pass		
11	0.101	Pass	3.701	Pass	0.0	Pass	0.586	Pass		
12	0.092	Pass	3.991	Pass	0.0	Pass	0.608	Pass		
Result		Pass		Pass		Pass		Pass	0.569	Pass

COMP EXT
Element 1 U1 600 Vrms I1 50 Arms
Element 2 U2 600 Vrms I2 50 Arms
Element 3 U3 600 Vrms I3 50 Arms
Element 4 U4 600 Vrms I4 50 Arms
Element 5 U5 600 Vrms I5 50 Arms
Element 6 U6 600 Vrms I6 50 Arms
Element 7 U7 600 Vrms I7 50 Arms
Integral : Reset Time —:—:— Timer 0 : 00 : 30

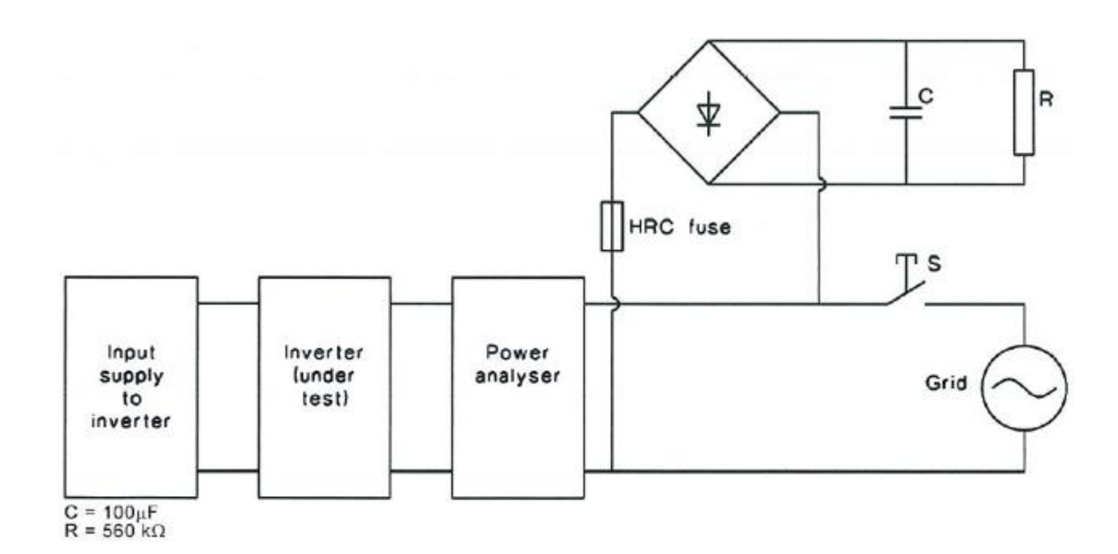
Update: 0 Runtime: 7:03:34 2019-05-17 21:23:19

4.9 TRANSIENT VOLTAGE LIMITS

The purpose of this test is to verify that the inverter complies with the transient voltage limits specified below when the grid is disconnected from the inverter.

The transient voltage limits have been measured according to the Clause 5.8 of the standard and it has been used the following circuit:

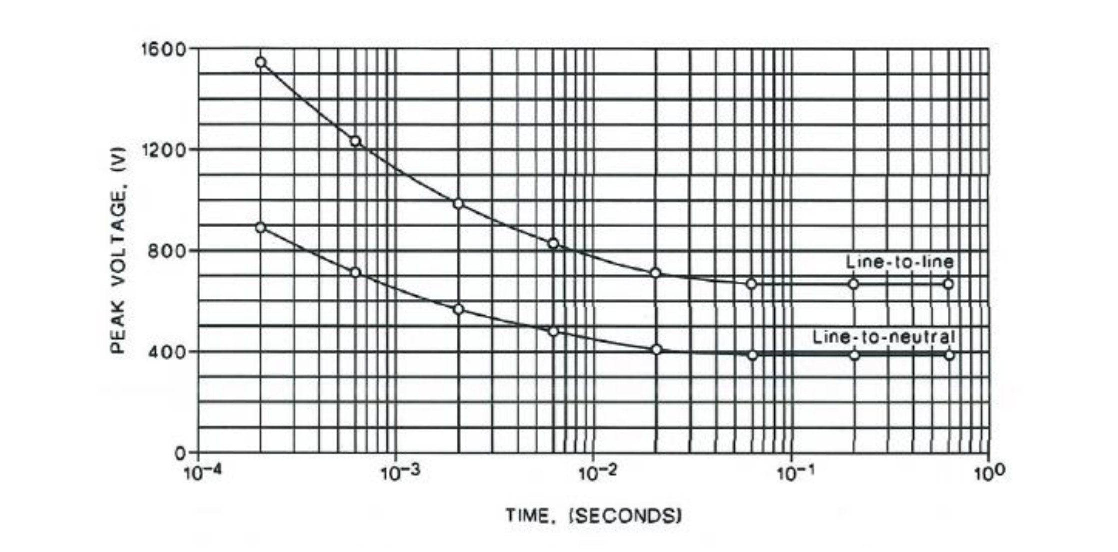
Transient Voltage Limits diagram



The resistor value per phase (R) has been calculated according to standard AS/NZS 4777.2:2015:

- The resistor is equivalent to 0.1% of the rated apparent power of the inverter.

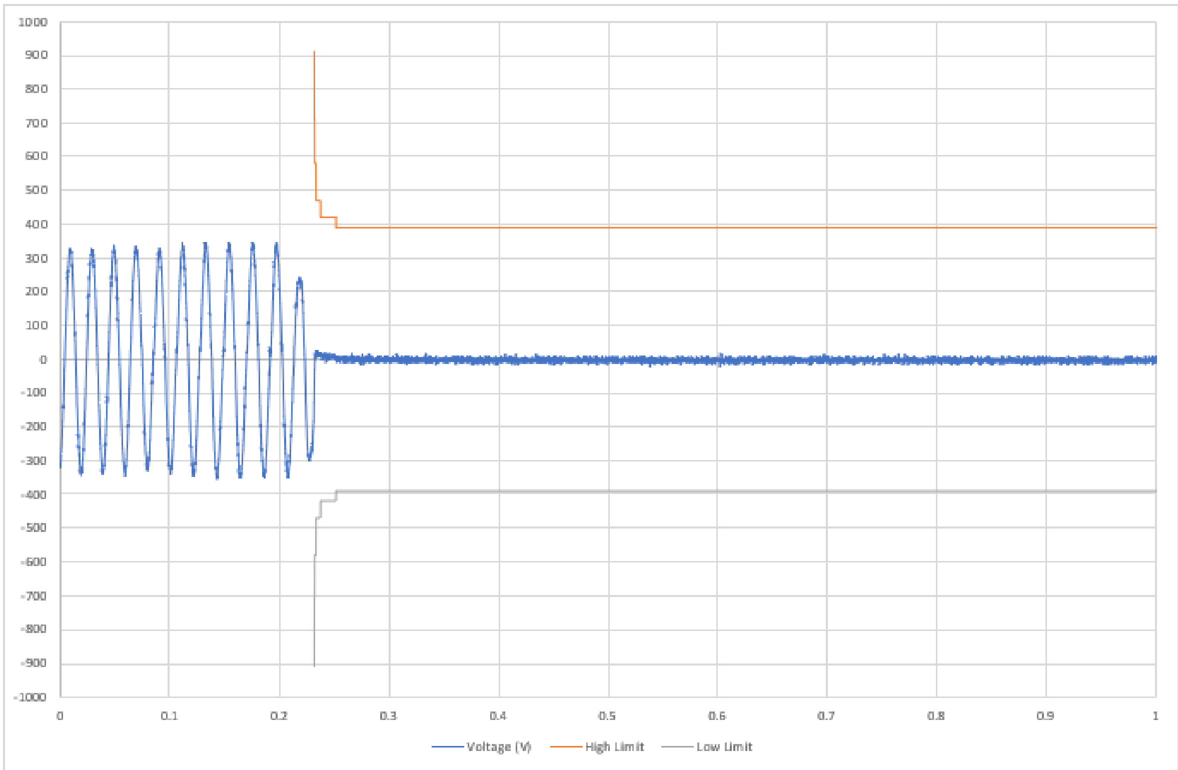
Voltage-duration Curve of transient voltage limits



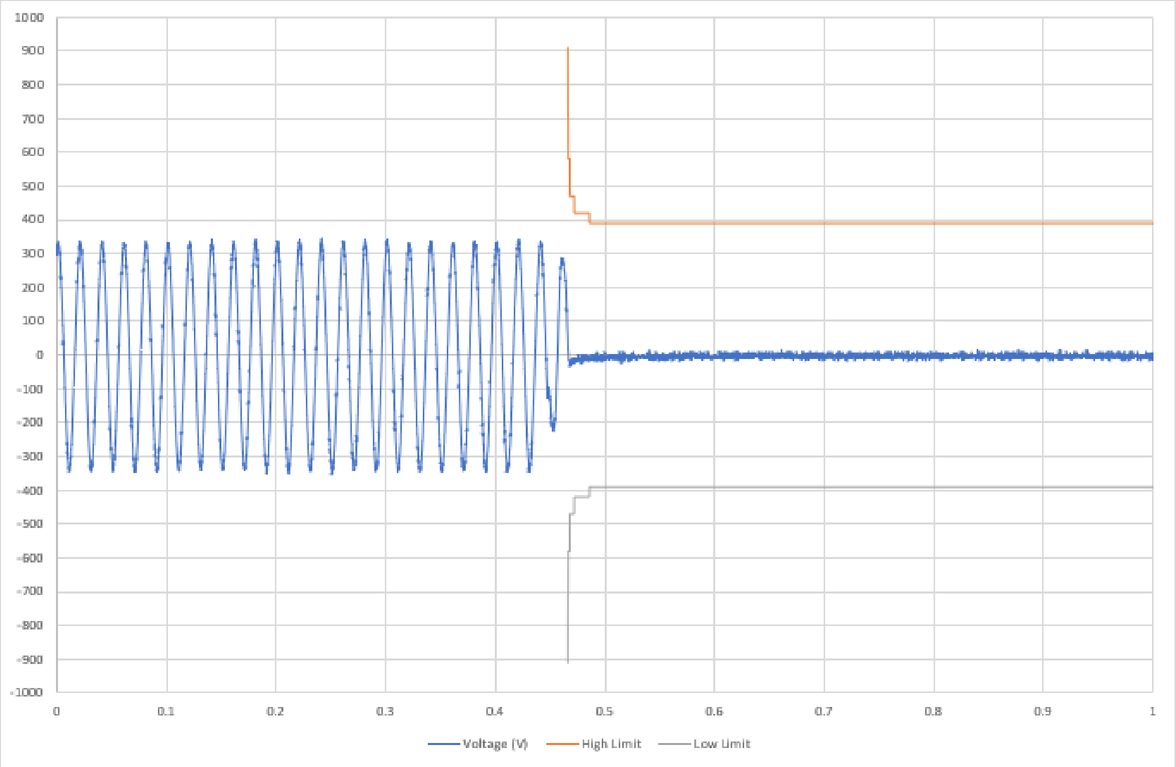
Measurements have been verified at three different active power levels, 10%Pn, 50%Pn and 100%Pn. Test results are offered in following pages.

Overvoltage value measured (V)					
Duration (s)	Instantaneous Voltage				RESULT
	100% Pn	50% Pn	10% Pn	Limit	
0.0002	-88	48	64	±910	**P**
0.0006	-32	16	32	±710	**P**
0.002	16	-24	-8	±580	**P**
0.006	8	-24	0	±470	**P**
0.02	8	-16	-8	±420	**P**
0.06	8	-8	-8	±390	**P**
0.2	-8	-8	-8	±390	**P**
0.6	0	0	0	±390	**P**

100% Pn

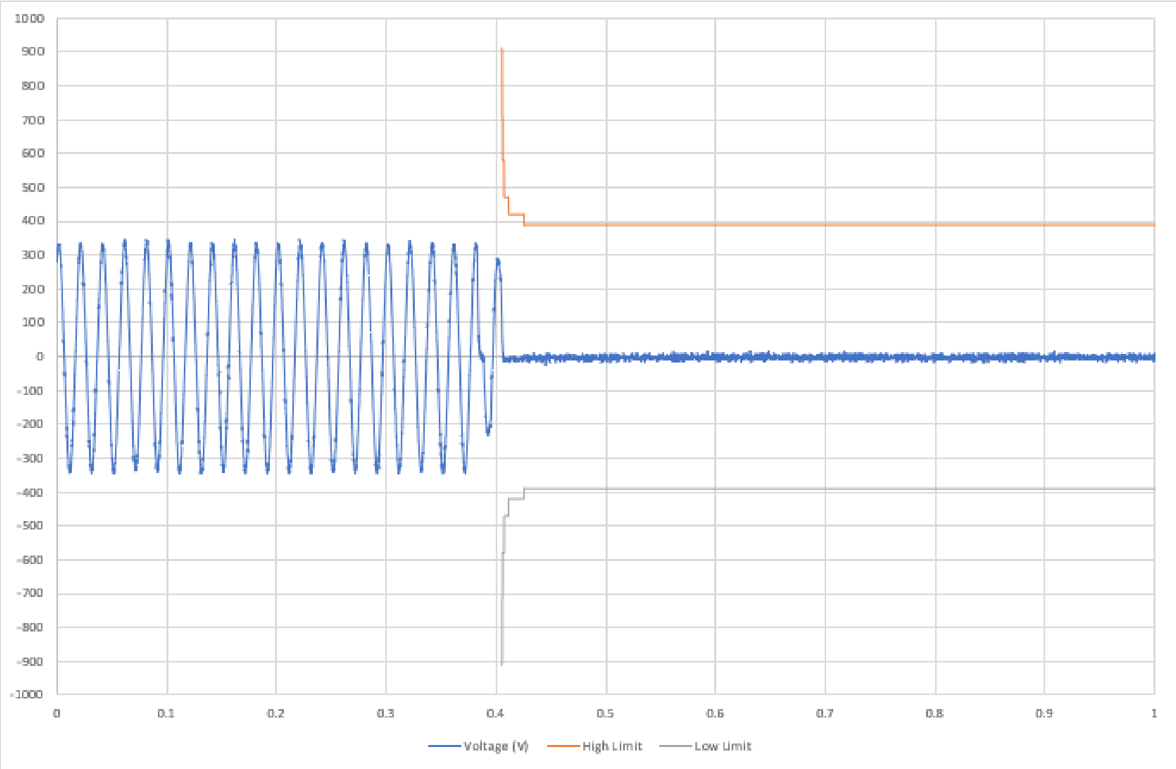


50% Pn



1000
900
800
700
600
500
400
300
200
100
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Voltage (V)
High Limit
Low Limit

10% Pn



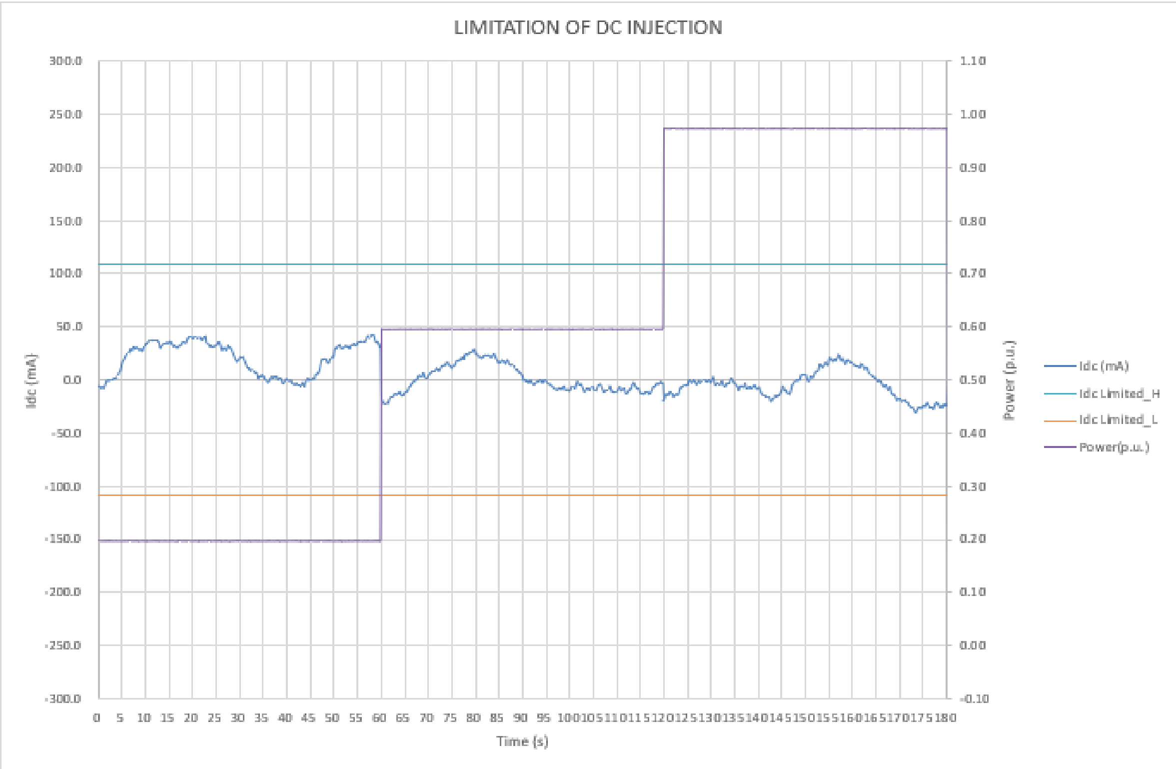
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Voltage (V)
High Limit
Low Limit

4.10 D.C. CURRENT INJECTION

The verification of DC component emission is required according to the clause 5.9 of the standard, at the specified active power levels.

	Min ~ 20%Pn	Medium ~ 60%Pn	Max ~ 100%Pn
Inverter Current （A）	4.459	13.066	21.085
Max. Test value (mA)	-7	29	-30
Limited (mA)	109	109	109

DC Current Injection



4.11 CURRENT BALANCE FOR THREE – PHASE INVERTERS

The verification of Current Balance test has been measured according to the clause 5.10 of the standard.

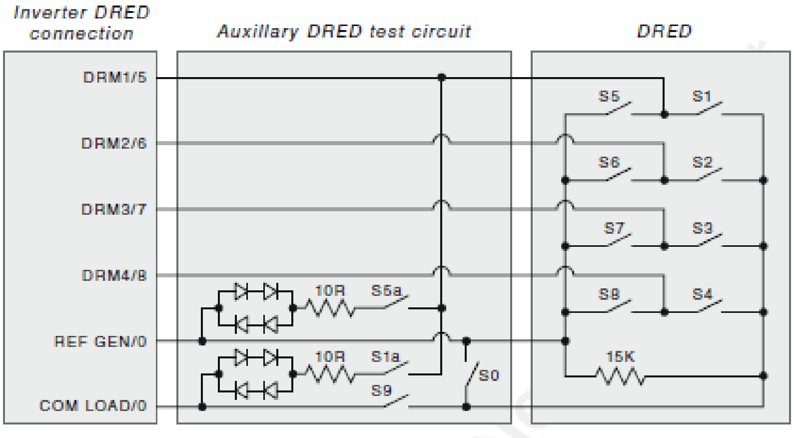
It is not applicable due to the inverter is single phase.

4.12 OPERATIONAL MODES AND MULTIPLE MODE INVERTERS

4.12.1 Inverter Demand Response Modes (DRMs)

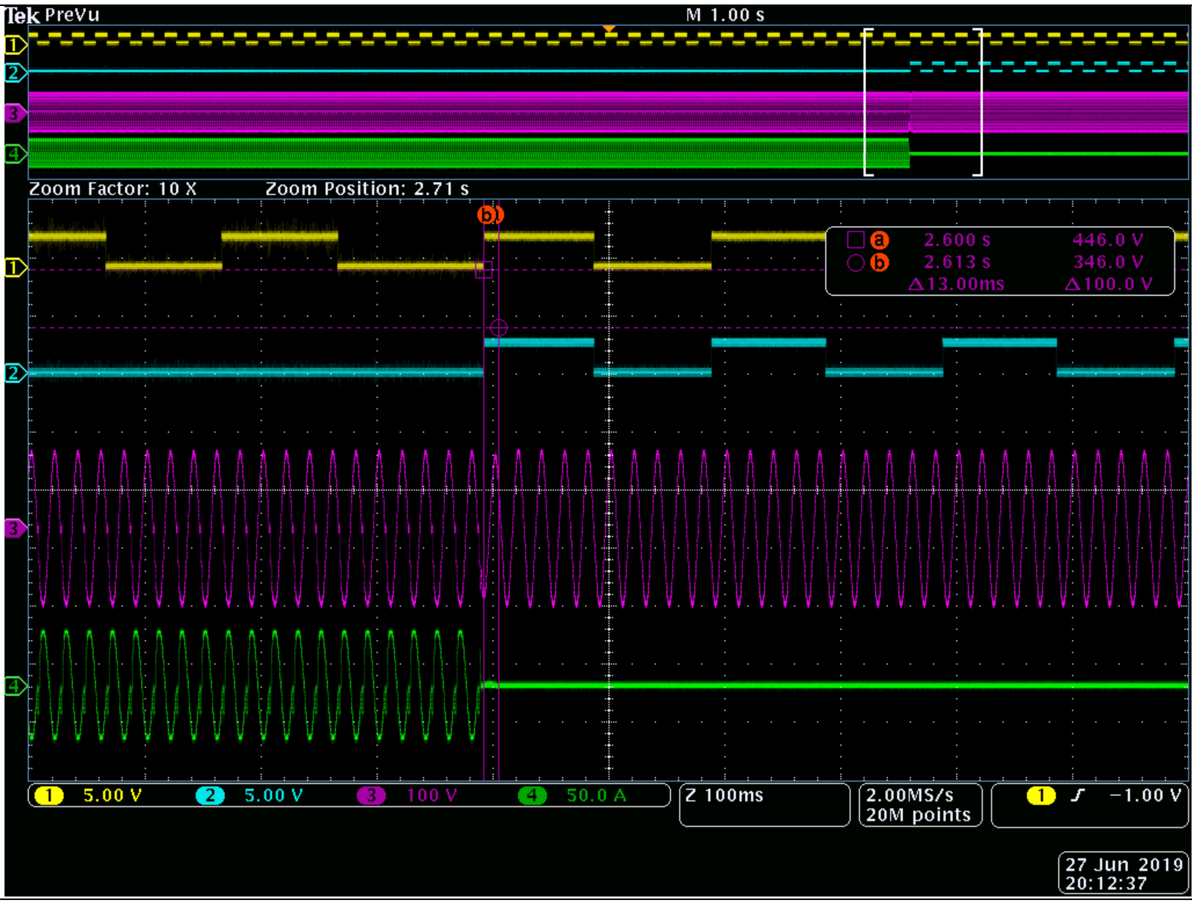
The inverter demand response mode DRM 0 has been tested according to Clause 6.2.1 of the standard. The inverter shall detect and initiate a response to the demand response commands within 2 s.

The DRED (Demand Response Enabling Device) connection circuit used for this test is:



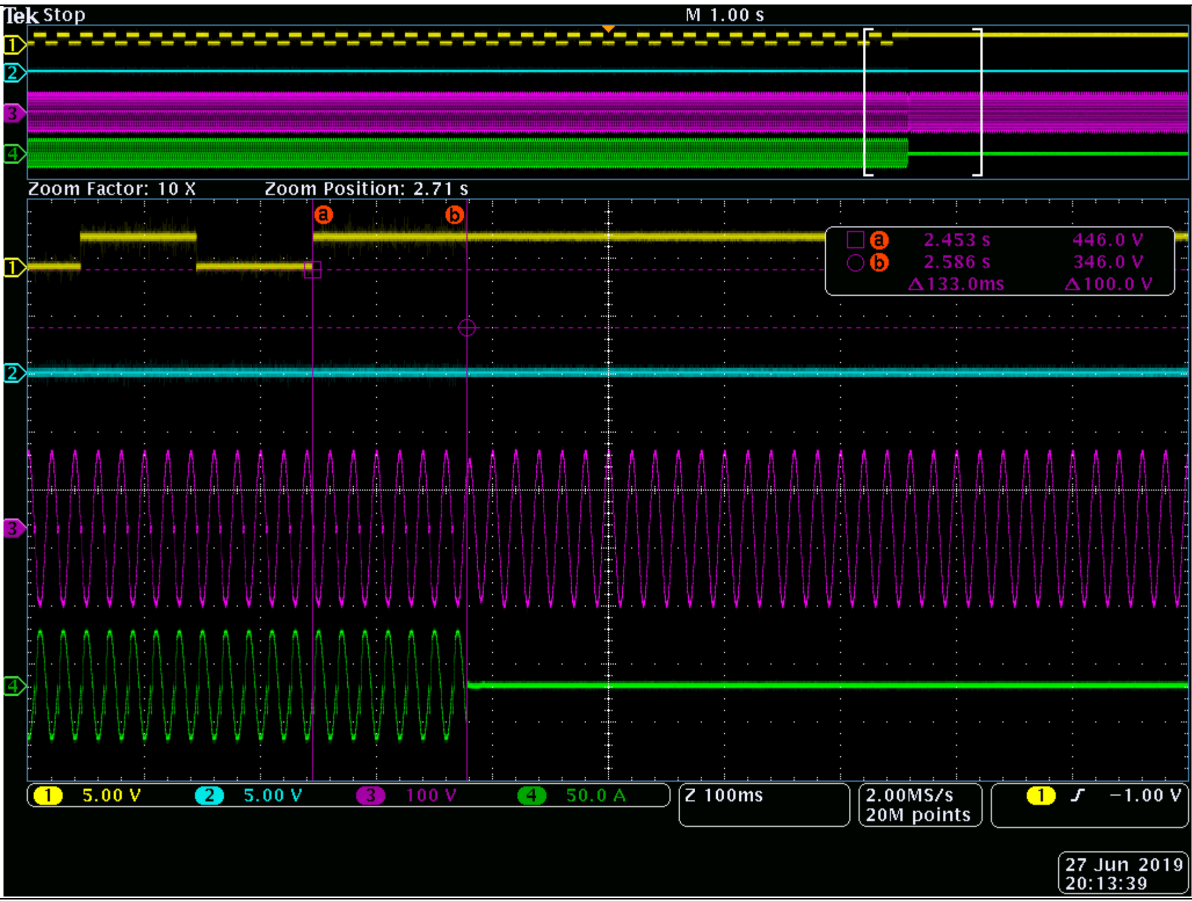
The test procedure followed has been the same as specified in the point I.2 of the standard and it is described in the following points together with test results:

a) With S9 switched closed and the inverter operating at 100% ± 5% of its rated current output, if the DRED switch S0 is asserted the unit shall disconnect.



The inverter disconnects in 13 ms

b) Opening the switch S9 again the inverter shall disconnect.



The inverter disconnects in 133 ms

4.12.2 Interaction with demand response enabling device (DRED)

The inverter shall have a means of connecting to a DRED. This means of connection shall include a terminal block or RJ45 socket. The terminal block or RJ45 socket shall comply with the minimum electrical specifications in Table 6. The terminal block or RJ45 socket may be physically mounted in the inverter or in a separate device that remotely communicates with the inverter.

RJ45 provided. No tests needed.

4.13 Inverter Power Quality Response Modes

The inverter power quality response modes tests have been measured according to Clause 6.3 of the standard.

The different operating modes available in the inverter and evaluated are the following:

-Volt response modes.

-Fixed power factor or reactive power mode.

-Power response mode.

-Power rate limit.

4.13.1 Volt Response Modes

Volt response modes tests have been measured according to Clause 6.3.2 of the standard.
The voltage values applied for the tests of the Clauses 6.3.2.2, 6.3.2.3 and 6.3.2.4 are the following:

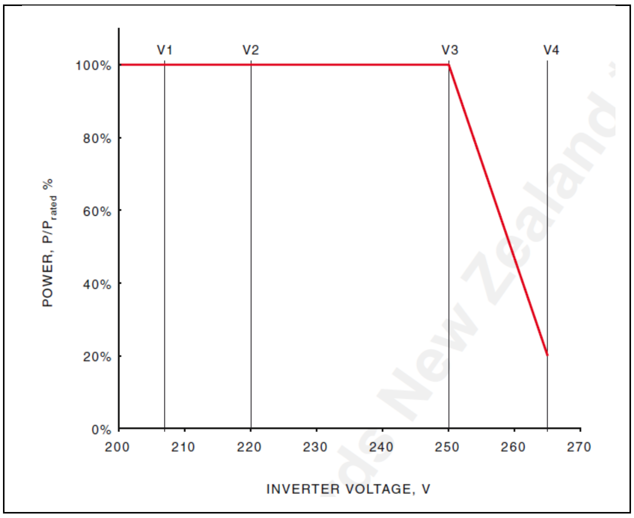
Reference	Australia. default value (% Un)	Range (% Un)
V1	90.0%	Not applicable
V2	95.6%	93.9%Un to 100.0%Un
V3	108.7%	102.1%Un to 110.9%Un
V4	115.2%	106.1%Un to 115.2%Un

4.13.1.1 Volt – Watt Response Mode

Volt – Watt Response Mode has been measured according to Clauses 6.3.2.2 (PV Systems) at the required voltage and power points of operation.

The volt-watt response mode varies the output power of the inverter in response to the abnormal voltage at its terminal.

The curve required for volt-watt response mode for PV systems is defined by the picture below according to point 6.3.2.2 of the standard.



Two different tests have been performed to verify that the inverter volt-watt response is in accordance with the standard. These two curves tested prove also that volt-watt control function is configurable to different curves:

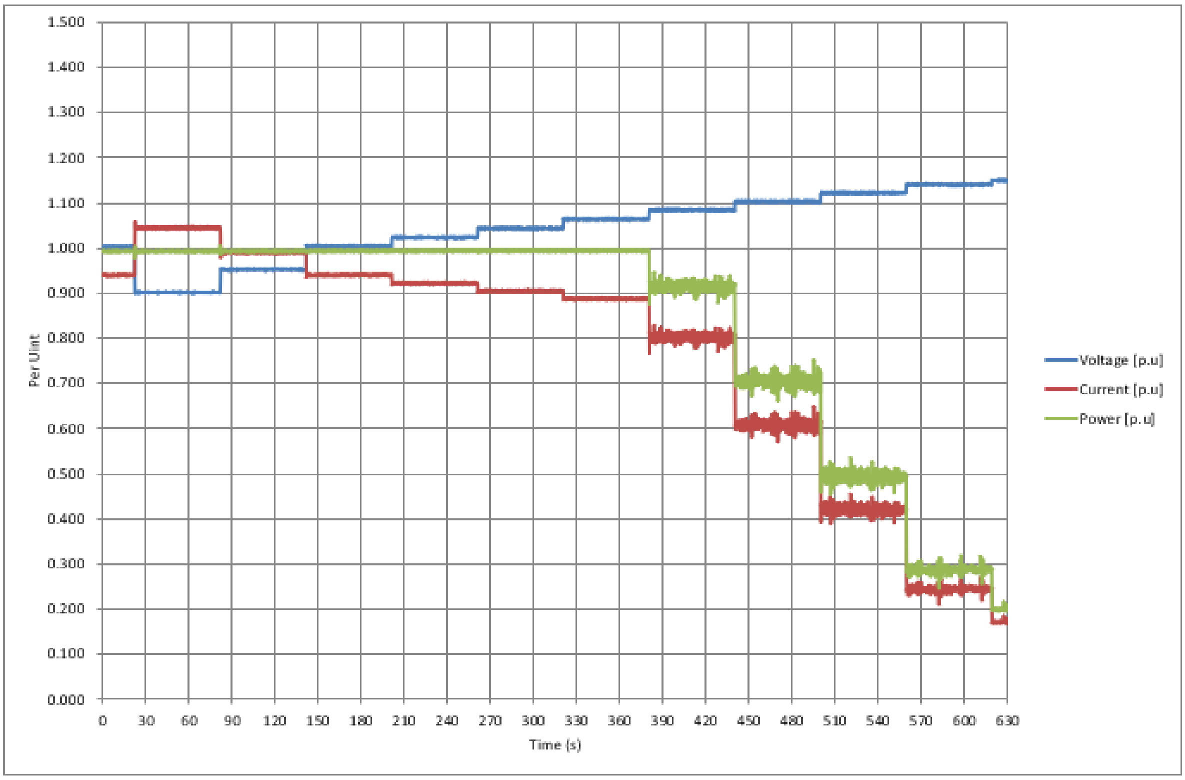
The setting values for voltage and power in the inverter have been the following:

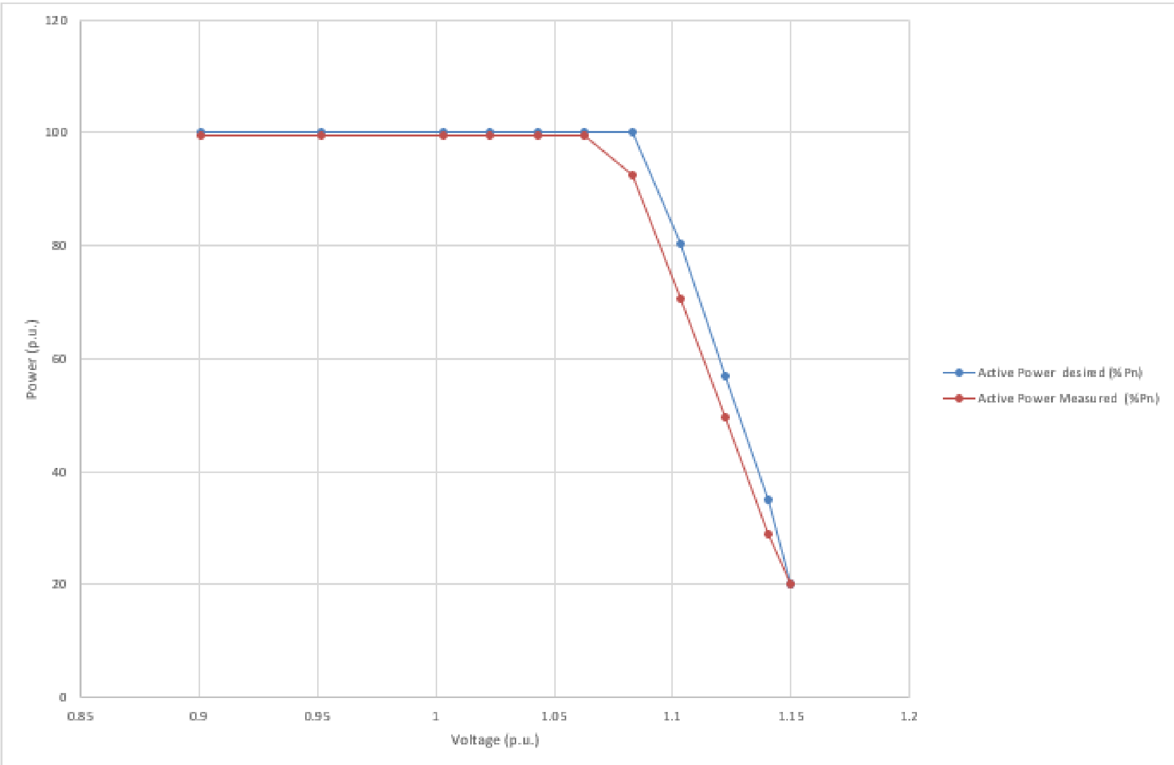
Reference	Test 1 (for Australia setting)		Test 2 (for New Zealand setting)	
	Volt. (V)	Power (%Pn)	Volt. (V)	Power (%Pn)
V1	207	100%	207	100%
V2	220	100%	220	100%
V3	250	100%	244	100%
V4	265	20%	255	20%

4.13.1.1.1 Test 1 (for Australia setting)

Voltage desired (%Un)	Voltage Measured (%Un)	Active Power desired (%Pn)	Active Power Measured (%Pn)	Active Power Deviation (%Pn)
90.0	90.1	100.0	99.4	-0.6
95.0	95.2	100.0	99.4	-0.6
100.0	100.3	100.0	99.4	-0.6
102.0	102.3	100.0	99.4	-0.6
104.0	104.3	100.0	99.4	-0.6
106.0	106.3	100.0	99.4	-0.6
108.0	108.3	100.0	92.5	-7.5
110.0	110.3	80.3	70.6	-9.7
112.0	112.2	57.0	49.6	-7.4
114.0	114.0	35.0	28.9	-6.1
115.0	115.0	20.0	20.1	0.1

Volt – Watt (Test 1)



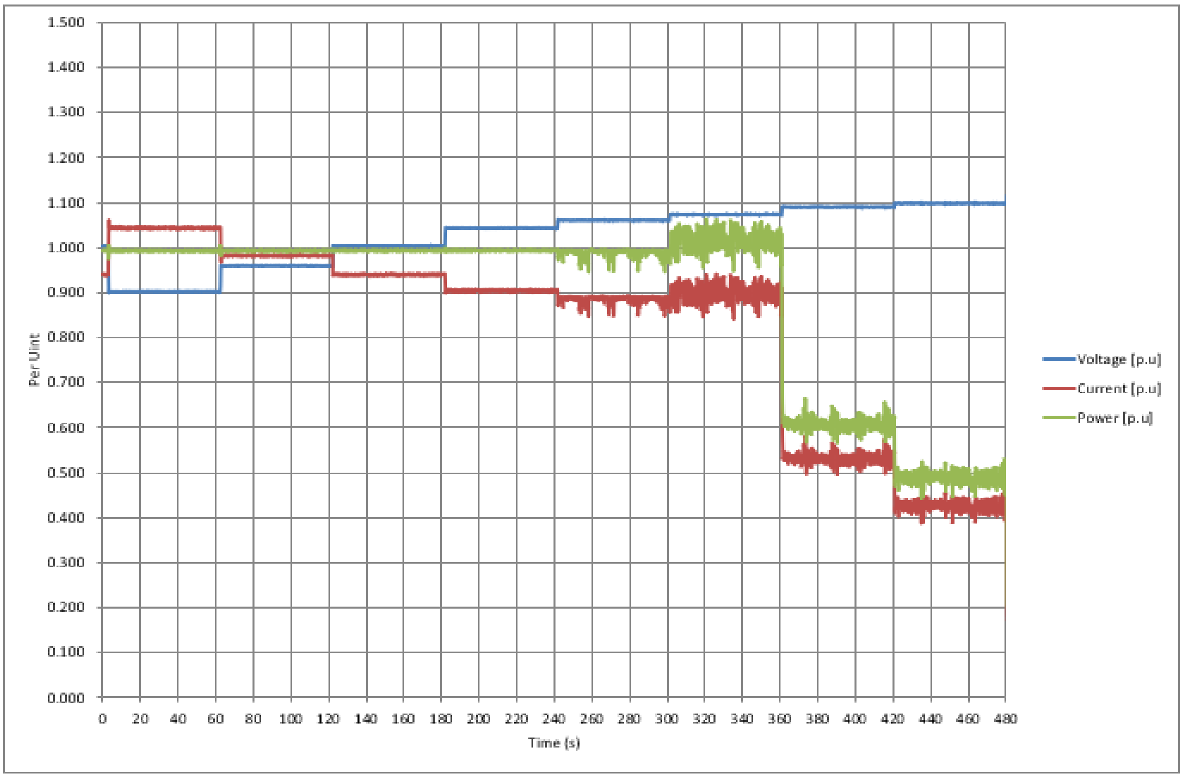


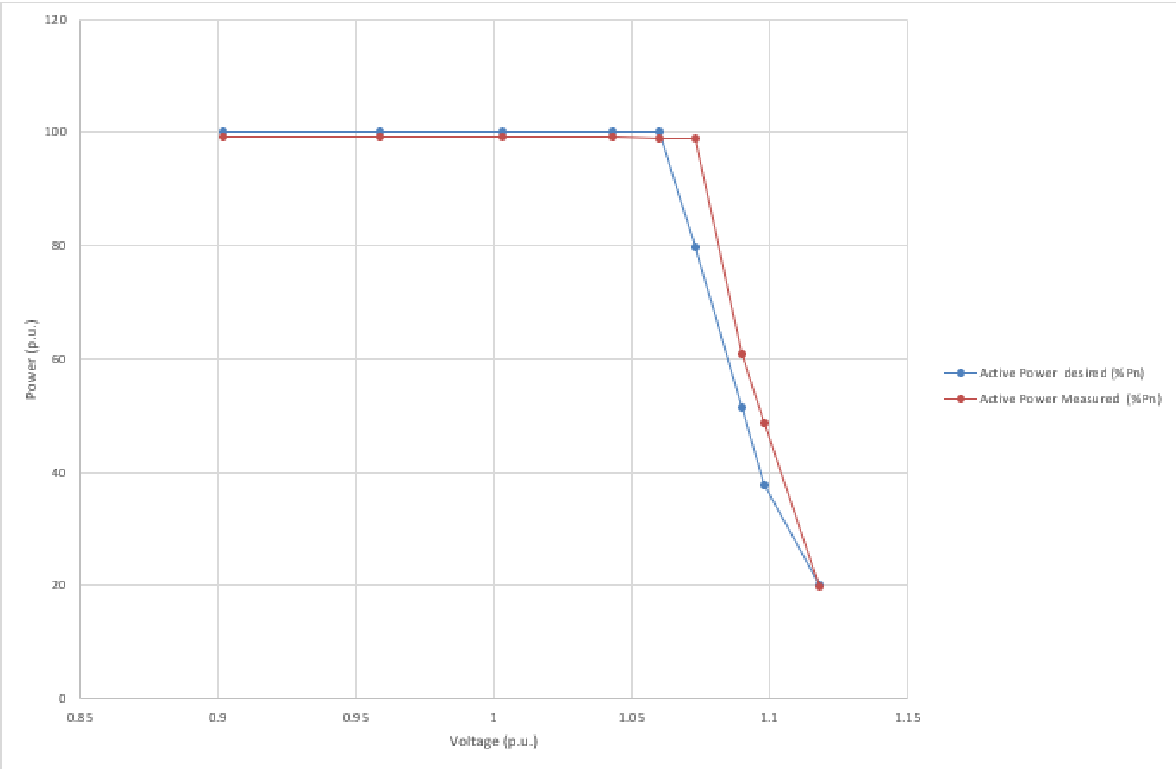
4.13.1.1.2 Test 2 (for New Zealand setting)

Voltage desired (%Un)	Voltage Measured (%Un)	Active Power desired (%Pn)	Active Power Measured (%Pn)	Active Power Deviation (%Pn)
90	90.2	100	99.2	-0.8
96	95.9	100	99.3	-0.7
100	100.3	100	99.3	-0.7
104	104.3	100	99.3	-0.7
106	106.0	100	99.0	-1.0
108	107.3	79.7	99.0	19.3
109	109.0	51.3	60.9	9.6
110	109.8	37.9	48.6	10.7

(*) The desired value of active power has not been reached due to limitations in the maximum current of the inverter.

Volt – Watt (Test 2)





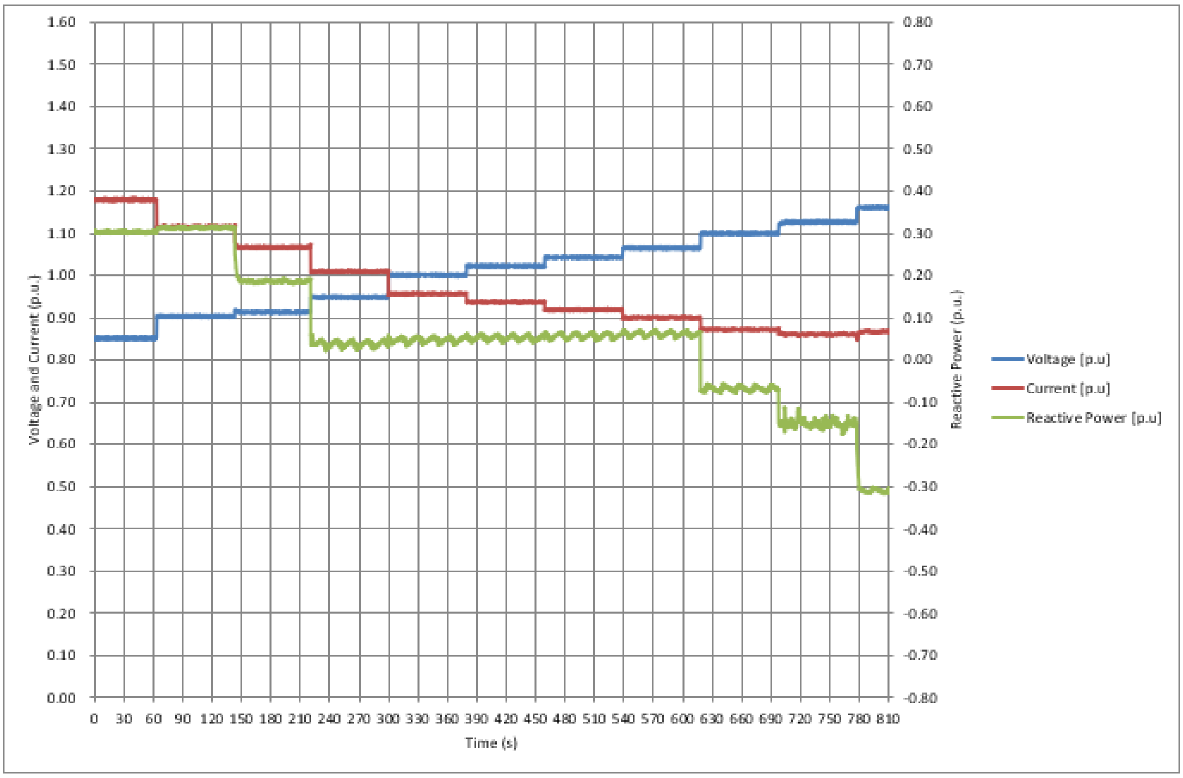
4.13.1.2 Volt –Var Response Mode

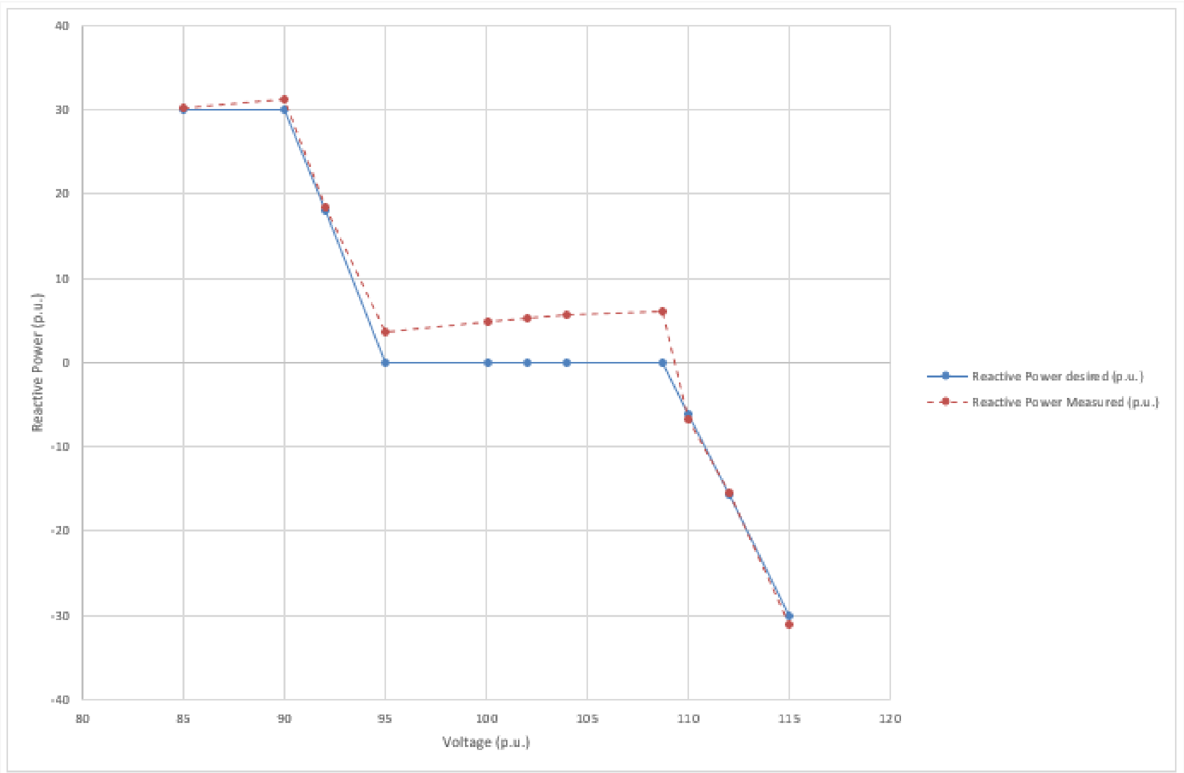
Volt – Var Response Mode has been measured according to Clause 6.3.2.3 of the standard, at the required voltage and VAr points of operation.

The default VAr level (30% lagging/leading) has been tested as following:

Q = 30 % Sn				
Voltage Desired (%Un)	**Voltage Measured (%Un)**	**Reactive Power desired (%Sn)**	**Reactive Power Measured (%Sn)**	**Reactive Power Deviation (%Sn)**
85	85.2	30.0	30.3	0.3
90	90.3	30.0	31.3	1.3
92	91.3	18.0	18.5	0.5
95	94.8	0.0	3.7	3.7
100	100.1	0.0	4.9	4.9
102	102.2	0.0	5.2	5.2
104	104.3	0.0	5.7	5.7
108	106.5	0.0	6.1	6.1
110	110.0	-6.2	-6.8	-0.6
112	112.7	-15.7	-15.5	0.2
115	116.0	-30.0	-31.0	-1.0

Volt – Var 30 % Sn (Test 1)





4.13.1.3 Voltage Balance Modes

The requirement of Voltage Balance Modes test has to be verified according to the clause 6.3.2.4 of the standard.

It is not applicable due to the inverter is single phase.

4.13.2 Fixed Power Factor Mode and Reactive Power Mode

The verification of reactive power supply capability test has been measured according to the clause 6.3.3 of the standard.

Three different tests have been done:

- Test 1: Rectangular Curve Q fixed (Q=±30% Sn)
- Test 2: Triangular Curve PF fixed (PF=±0.8)
- Test 3: Semicircular Curve S fixed (S=100% Sn)

4.13.2.1 Test 1: Rectangular Curve (Q =±30%Sn)

This test verifies the capability of the inverter to provide a fixed value of reactive power. In addition, it is verified the Q control mode.

At high active power levels the reactive power provided by the inverter is automatically limited by the inverter in order to protect against over current.

Allowed tolerance to be considered is 5%Sn when possible.

The following table shows the test results:

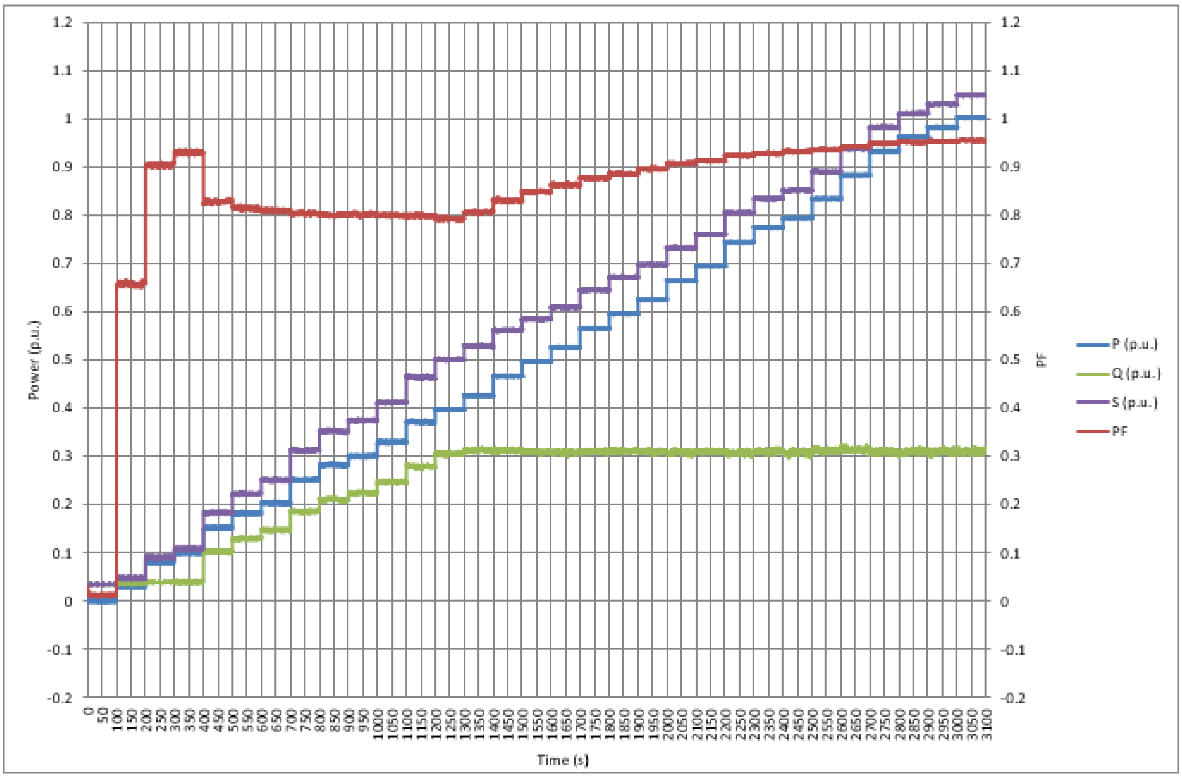
Rectangular Curve (Q=30.0%Sn / Inductive)					
P Desired (%Sn)	P measured (%Sn)	Q desired (%Sn)	Q measured (%Sn)	Q Deviation (%Sn)	Power Factor (cos φ)
0%	0.1	30.0(*)	3.4	--	0.022
3%	3.1	30.0(*)	3.6	--	0.654
8%	8.2	30.0(*)	3.9	--	0.904
10%	10.1	30.0(*)	3.9	--	0.931
15%	15.1	30.0(*)	10.3	--	0.826
18%	18.0	30.0(*)	12.8	--	0.816
20%	20.4	30.0(*)	14.8	--	0.809
25%	25.2	30.0(*)	18.6	-11.4	0.805
28%	28.2	30.0(*)	21.1	-8.9	0.801
30%	30.0	30.0(*)	22.3	-7.7	0.803
33%	33.1	30.0(*)	24.6	-5.4	0.803
37%	37.1	30.0	28.2	-1.8	0.796
40%	39.7	30.0	30.7	0.7	0.791
43%	42.7	30.0	31.4	1.4	0.806
47%	46.6	30.0	31.0	1	0.833
50%	49.6	30.0	30.9	0.9	0.848
53%	52.6	30.0	31.1	1.1	0.861
57%	56.6	30.0	31.0	1	0.877
60%	59.6	30.0	30.6	0.6	0.889
63%	62.6	30.0	31.4	1.4	0.894
67%	66.5	30.0	30.7	0.7	0.908
70%	69.5	30.0	30.9	0.9	0.914
75%	74.4	30.0	30.8	0.8	0.924
78%	77.4	30.0	30.8	0.8	0.929
80%	79.4	30.0	30.6	0.6	0.933
84%	83.4	30.0	31.4	1.4	0.936
89%	88.3	30.0	32.6	2.6	0.938
94%	93.3	30.0	31.1	1.1	0.949
97%	96.3	30.0	30.4	0.4	0.954
100%	100.2	30.0	31.7	1.7	0.953

Rectangular Curve (Q=30.0%Sn / Capacitive)					
P Desired (%Sn)	**P measured (%Sn)**	**Q desired (%Sn)**	**Q measured (%Sn)**	**Q Deviation (%Sn)**	**Power Factor (cos φ)**
0%	0.0	-30.0(*)	3.5	--	0.014
3%	3.1	-30.0(*)	3.6	--	0.652
8%	8.1	-30.0(*)	3.9	--	0.901
10%	10.2	-30.0(*)	3.9	--	0.933
15%	15.1	-30.0(*)	-6.0	--	0.930
18%	18.2	-30.0(*)	-8.2	--	0.911
20%	20.5	-30.0(*)	-10.0	--	0.898
25%	25.2	-30.0(*)	-18.6	11.4	0.804
28%	28.2	-30.0(*)	-21.1	8.9	0.802
30%	30.4	-30.0(*)	-22.3	7.7	0.807
33%	33.4	-30.0(*)	-24.6	5.4	0.805
37%	37.4	-30.0	-27.4	2.6	0.807
40%	40.7	-30.0	-30.4	-0.4	0.801
43%	43.2	-30.0	-32.3	-2.3	0.800
47%	46.9	-30.0	-30.5	-0.5	0.838
50%	49.8	-30.0	-31.4	-1.4	0.846
53%	52.8	-30.0	-31.2	-1.2	0.861
57%	56.7	-30.0	-31.0	-1.0	0.877
60%	59.7	-30.0	-31.1	-1.1	0.887
63%	62.6	-30.0	-31.6	-1.6	0.893
67%	66.6	-30.0	-30.9	-0.9	0.907
70%	69.5	-30.0	-31.0	-1.0	0.913
75%	74.6	-30.0	-31.0	-1.0	0.924
78%	77.6	-30.0	-31.0	-1.0	0.928
80%	79.5	-30.0	-31.0	-1.0	0.932
84%	83.5	-30.0	-31.1	-1.1	0.937
89%	88.5	-30.0	-31.5	-1.5	0.942
94%	93.4	-30.0	-30.8	-0.8	0.950
97%	96.3	-30	-31.3	-1.3	0.951
100%	99.4	-30	-31.1	-1.1	0.954

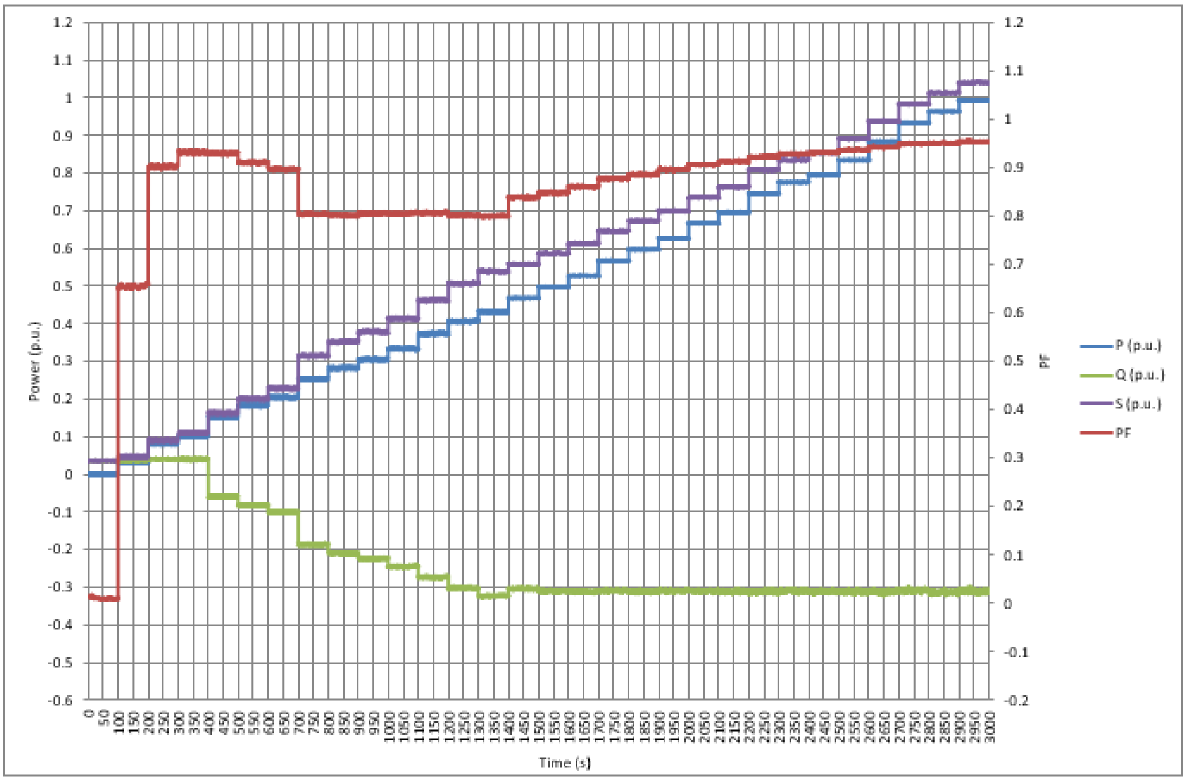
(*) When operating in this mode for all inverter current outputs below 33% of rated current, it is acceptable for the displacement power factor to be controlled such that the vars supplied or drawn are limited.

Test results are represented at diagrams below.

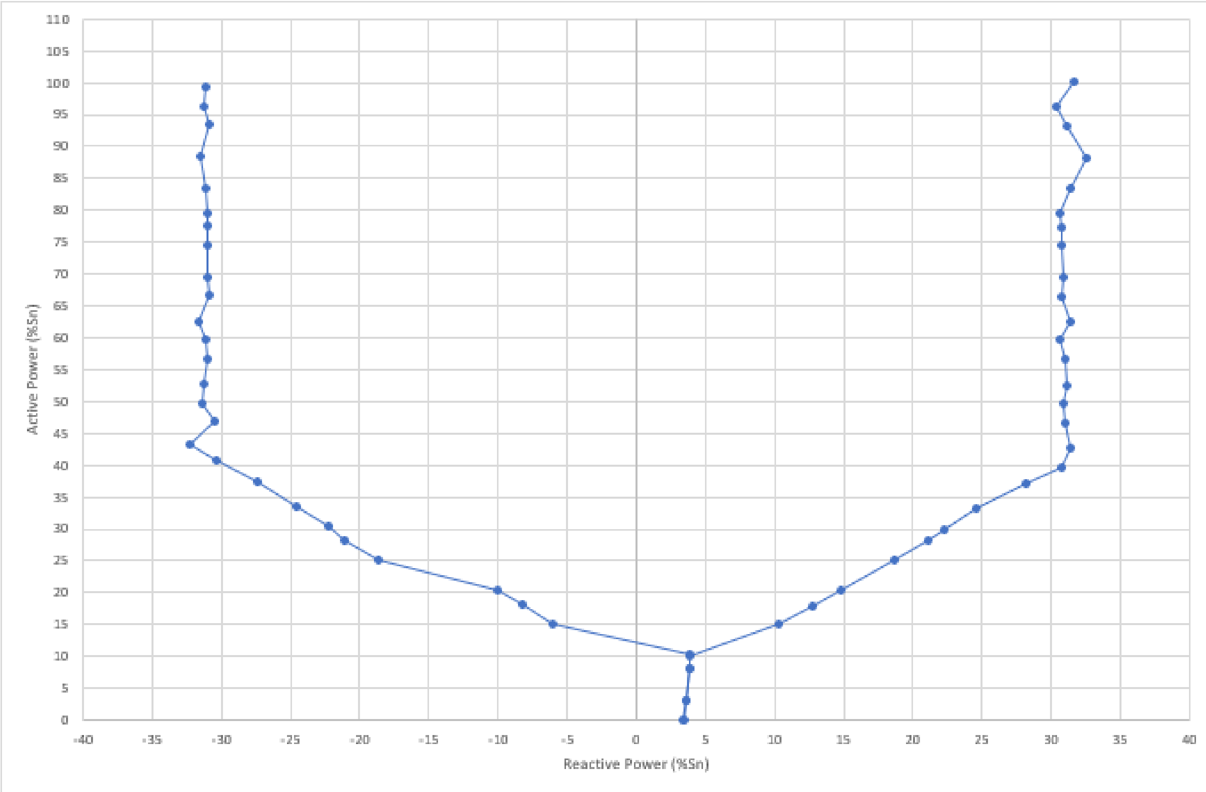
Rectangular Curve (Q=30.0%Sn / Inductive)



Rectangular Curve (Q=30.0%S_n / Capacitive)



Rectangular Curve (Capacitive vs Inductive)



4.13.2.2 Test 2: Triangular Curve (PF=±0.8)

This test verifies the capability of the inverter to provide a fixed value of power factor. In addition it is verified the PF control mode.

At high active power levels the reactive power provided by the inverter is automatically limited by the inverter in order to protect against over current.

The maximum tolerance allowed for the measured Power Factor is ± 0.01, for measurements from 25%Sn.

The following table shows the test results:

Fixed Power Factor (PF=0.80 / Inductive)					
P Desired (%Sn)	**P measured (%Sn)**	**Q measured (%Sn)**	**Power Factor desired (cos φ)**	**Power Factor measured (cos φ)**	**Power Factor Deviation (cos φ)**
3%	3.1	3.7	0.800	0.639	-0.161
8%	8.1	3.7	0.800	0.908	0.108
10%	10.1	3.9	0.800	0.933	0.133
15%	15.0	10.3	0.800	0.823	0.023
18%	17.9	12.6	0.800	0.819	0.019
20%	19.9	14.3	0.800	0.813	0.013
25%	24.9	18.4	0.800	0.804	0.004
28%	27.8	20.6	0.800	0.803	0.003
30%	29.8	22.2	0.800	0.802	0.002
33%	32.8	24.5	0.800	0.801	0.001
37%	36.7	27.6	0.800	0.799	-0.001
40%	39.8	29.6	0.800	0.802	0.002
43%	42.7	32.3	0.800	0.798	-0.002
47%	46.7	34.8	0.800	0.801	0.001
50%	49.7	37.8	0.800	0.796	-0.004
53%	52.7	39.9	0.800	0.798	-0.002
57%	56.5	43.0	0.800	0.795	-0.005
60%	59.4	44.3	0.800	0.801	0.001
63%	62.5	47.9	0.800	0.794	-0.006
67%	66.4	50.6	0.800	0.795	-0.005
70%	69.4	53.1	0.800	0.794	-0.006
75%	74.1	56.6	0.800	0.795	-0.005
78%	77.0	58.4	0.800	0.797	-0.003
80%	79.3	61.3	0.800	0.791	-0.009
84%	83.4	56.4	0.800	0.829 (*)	0.029
87%	86.4	50.3	0.800	0.864 (*)	0.064
90%	89.8	46.1	0.800	0.889 (*)	0.089
92%	91.8	40.3	0.800	0.916 (*)	0.116
94%	93.9	35.3	0.800	0.936 (*)	0.136
96%	95.7	30.9	0.800	0.952 (*)	0.152
98%	97.6	20.8	0.800	0.978 (*)	0.178
100%	99.5	18.2	0.800	0.984 (*)	0.184

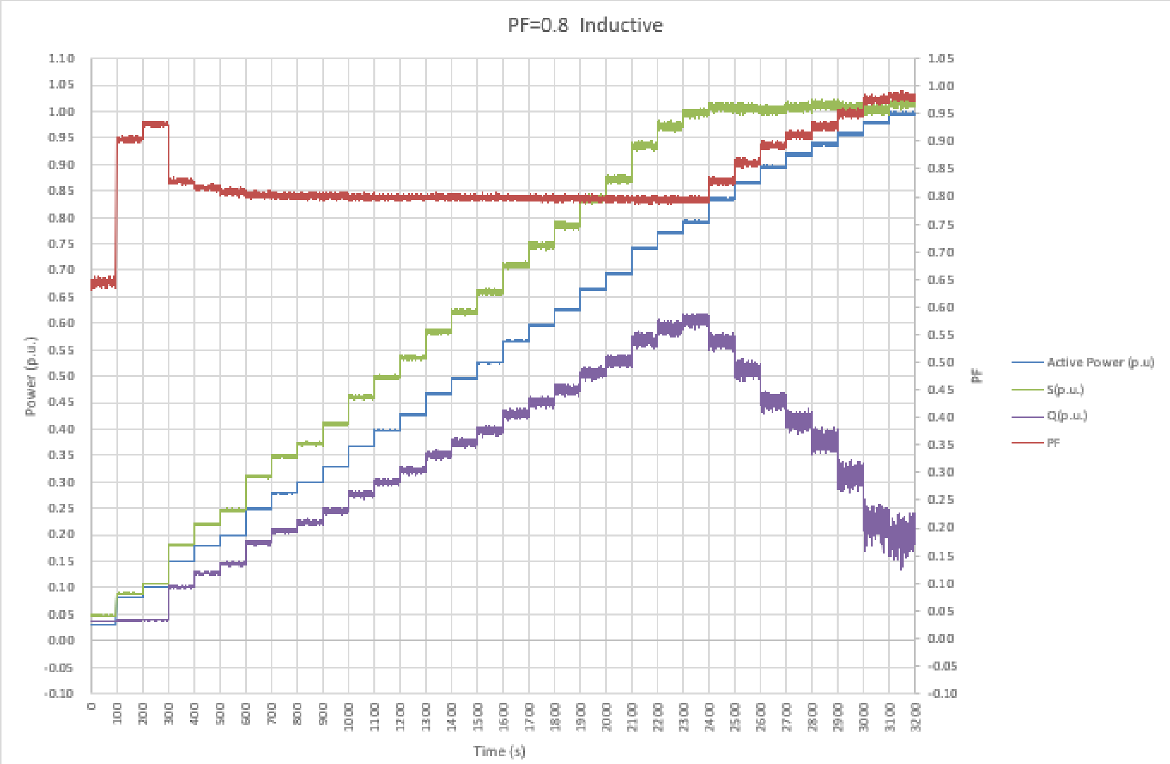
(*) The inverter does not reach the fixed power factor value of 0.8 due to the current limitation function.

The following table and graphs show test results for measurements of power factor set to 0.80 capacitive:

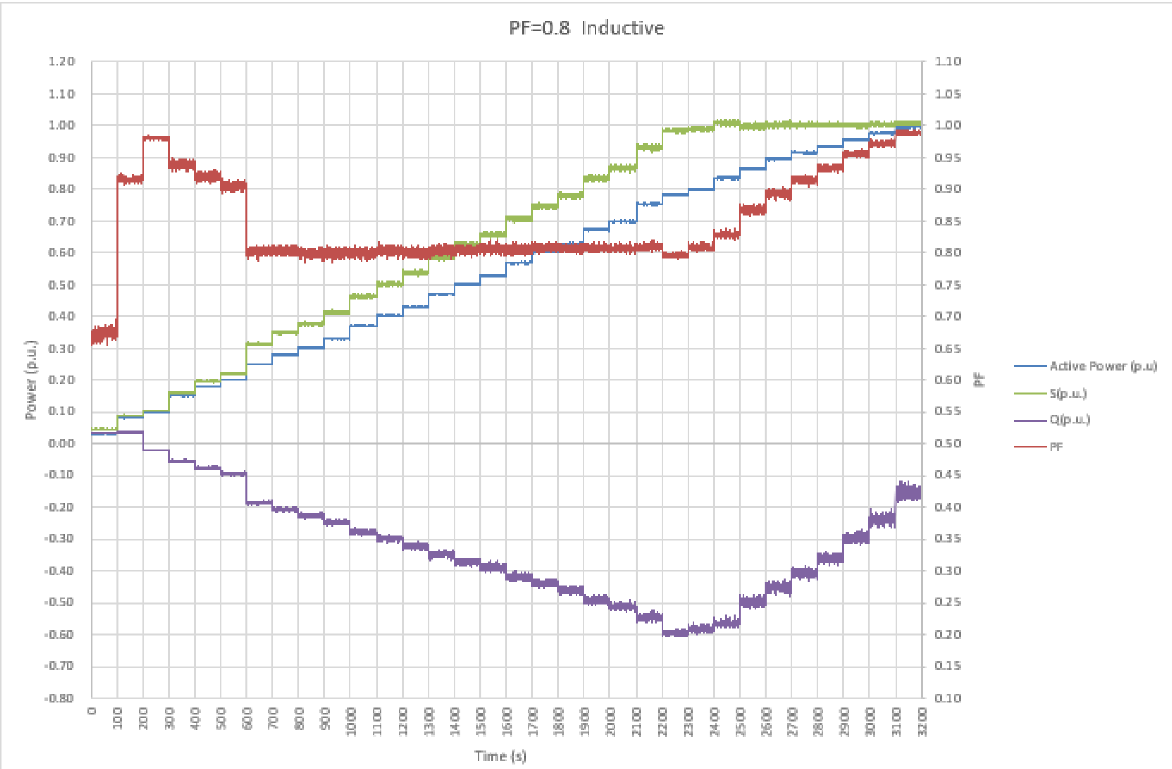
Fixed Power Factor (PF=0.80 / Capacitive)					
P Desired (%Sn)	**P measured (%Sn)**	**Q measured (%Sn)**	**Power Factor desired (cos φ)**	**Power Factor measured (cos φ)**	**Power Factor Deviation (cos φ)**
3%	3.0	3.4	0.800	0.661	-0.139
8%	8.1	3.6	0.800	0.913	0.113
10%	10.1	-1.9	0.800	0.982	0.182
15%	15.0	-5.4	0.800	0.941	0.141
18%	18.0	-7.8	0.800	0.918	0.118
20%	19.9	-9.4	0.800	0.903	0.103
25%	25.0	-18.8	0.800	0.799	-0.001
28%	28.1	-21.2	0.800	0.798	-0.002
30%	30.0	-22.3	0.800	0.803	0.003
33%	32.9	-24.7	0.800	0.799	-0.001
37%	37.0	-28.2	0.800	0.795	-0.005
40%	40.4	-30.0	0.800	0.803	0.003
43%	42.9	-32.4	0.800	0.798	-0.002
47%	46.7	-34.0	0.800	0.809	0.009
50%	50.2	-36.6	0.800	0.808	0.008
53%	52.8	-38.9	0.800	0.805	0.005
57%	56.6	-41.1	0.800	0.810	0.010
60%	60.4	-44.9	0.800	0.803	0.003
63%	62.6	-45.4	0.800	0.810	0.010
67%	67.5	-50.2	0.800	0.802	0.002
70%	69.7	-51.6	0.800	0.804	0.004
75%	75.0	-54.3	0.800	0.810	0.010
78%	78.1	-59.1	0.800	0.797	-0.003
80%	79.6	-58.9	0.800	0.804	0.004
84%	83.3	-56.0	0.800	0.830 (*)	0.030
87%	86.3	-50.0	0.800	0.865 (*)	0.065
90%	89.4	-46.4	0.800	0.888 (*)	0.088
92%	91.3	-39.8	0.800	0.917 (*)	0.117
94%	93.4	-35.9	0.800	0.934 (*)	0.134
96%	95.3	-29.0	0.800	0.957 (*)	0.157
98%	97.2	-24.1	0.800	0.971 (*)	0.171
100%	99.7	-15.6	0.800	0.988 (*)	0.188

(*) The inverter does not reach the fixed power factor value of 0.8 due to the current limitation function.

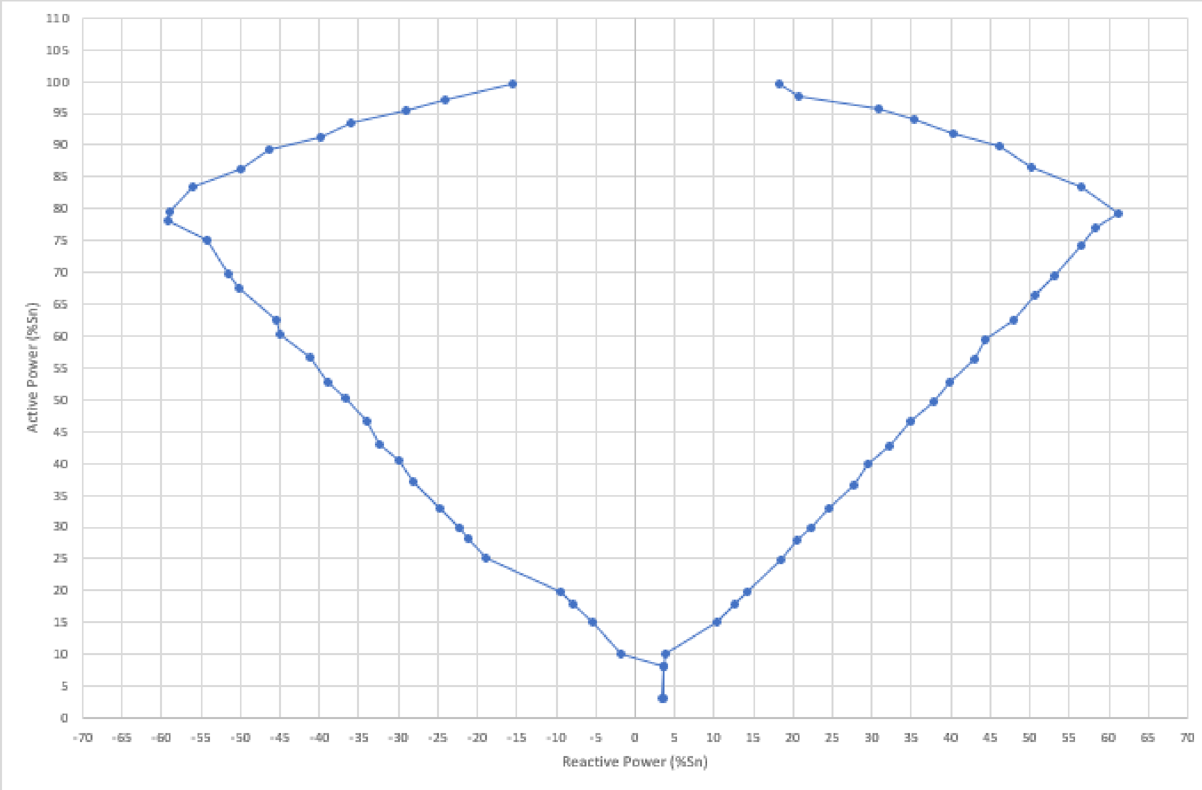
Triangular Curve (PF=0.80 / Inductive)



Triangular Curve (PF=0.8 / Capacitive)



Triangular Curve (Inductive vs Capacitive)



4.13.2.3 Test 3: Semicircular Curve (S=100%Sn)

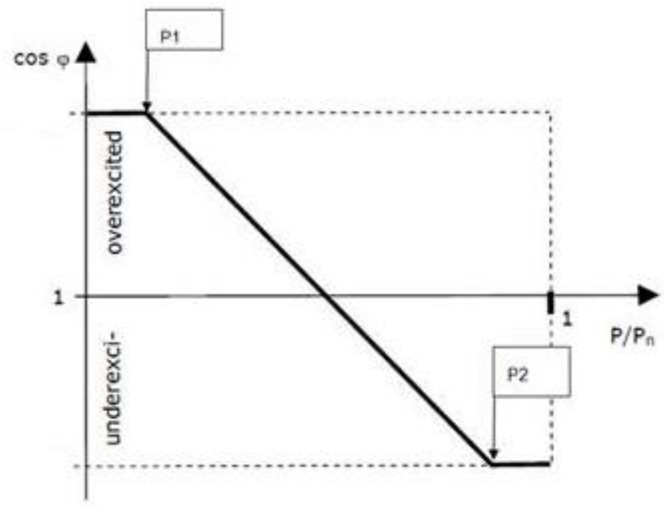
This test verifies the capability of the inverter to provide a fixed value of apparent power.

Allowed tolerance for reactive power measurements is to be considered inside ±5%Sn when active power more than 25%

The test is waived due to the manufacturer don't provided this operation mode.

4.13.3 Characteristics Power Factor Curve for Cos ϕ (Power Response)

The Characteristic Power Factor Curve for cos ϕ (Power response) has been measured according to the Clause 6.3.4 of the standard. Three tests have been done to verify an adjustable curve from PF inductive to PF capacitive.



These tests have been performed as detailed in following table:

Test Nº	Point P1		Point P2	
	Active Power (%Sn)	Power Factor	Active Power (%Sn)	Power Factor
1	20%	0.95	90%	-0.95
2	20%	0.90	90%	-0.90
3	20%	0.95	80%	-0.95

For all tests above detailed, the unity power factor is reached at 50%Pn.

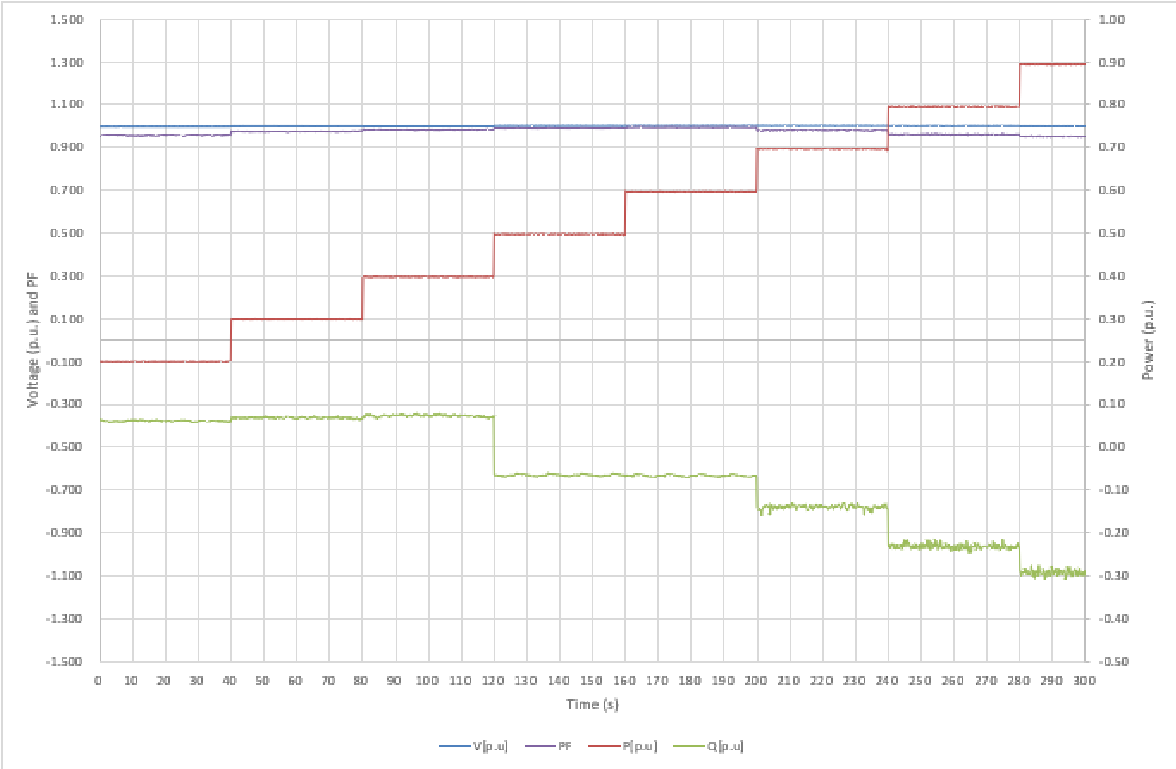
There is allowed a maximum tolerance for power factor measurement inside ±0.01.

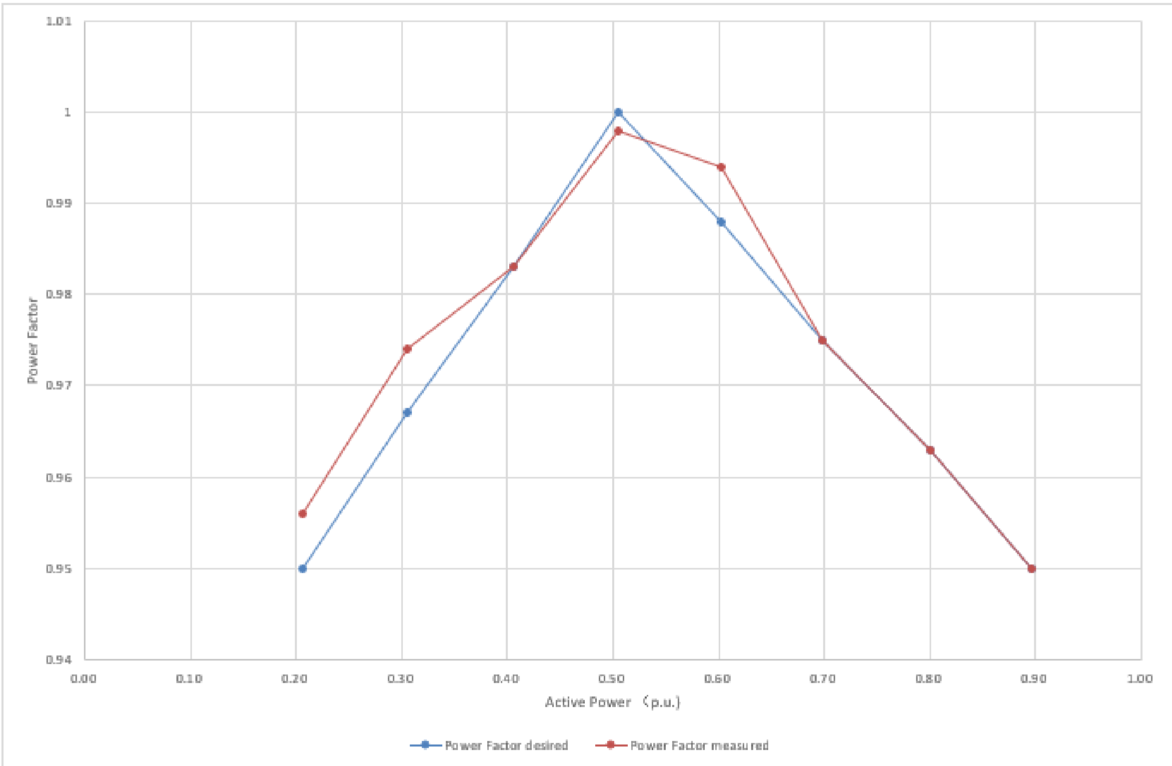
4.13.3.1 Test 1

In this test it is verified that the power factor vary linearly from PF = 0.95 (inductive) at 20%Pn, PF = 1 at 50%Pn, PF = 0.95 (capacitive) at 90%Pn. The following table shows the obtained test results:

P Desired (%Sn)	P measured (%Sn)	Q measured (%Sn)	Power Factor desired (cos φ)	Power Factor measured (cos φ)	Power Factor Deviation (cos φ)
20	20.0	6.0	0.950	0.956	0.006
30	29.9	6.9	0.967	0.974	0.007
40	39.8	7.4	0.983	0.983	0.000
50	49.8	-6.7	1.000	0.998	-0.002
60	59.7	-6.6	0.988	0.994	0.006
70	69.6	-13.8	0.975	0.975	0.000
80	79.5	-23.2	0.963	0.963	0.000
90	89.4	-29.3	0.950	0.950	0.000

Characteristic curve Cos φ (P) Test 1



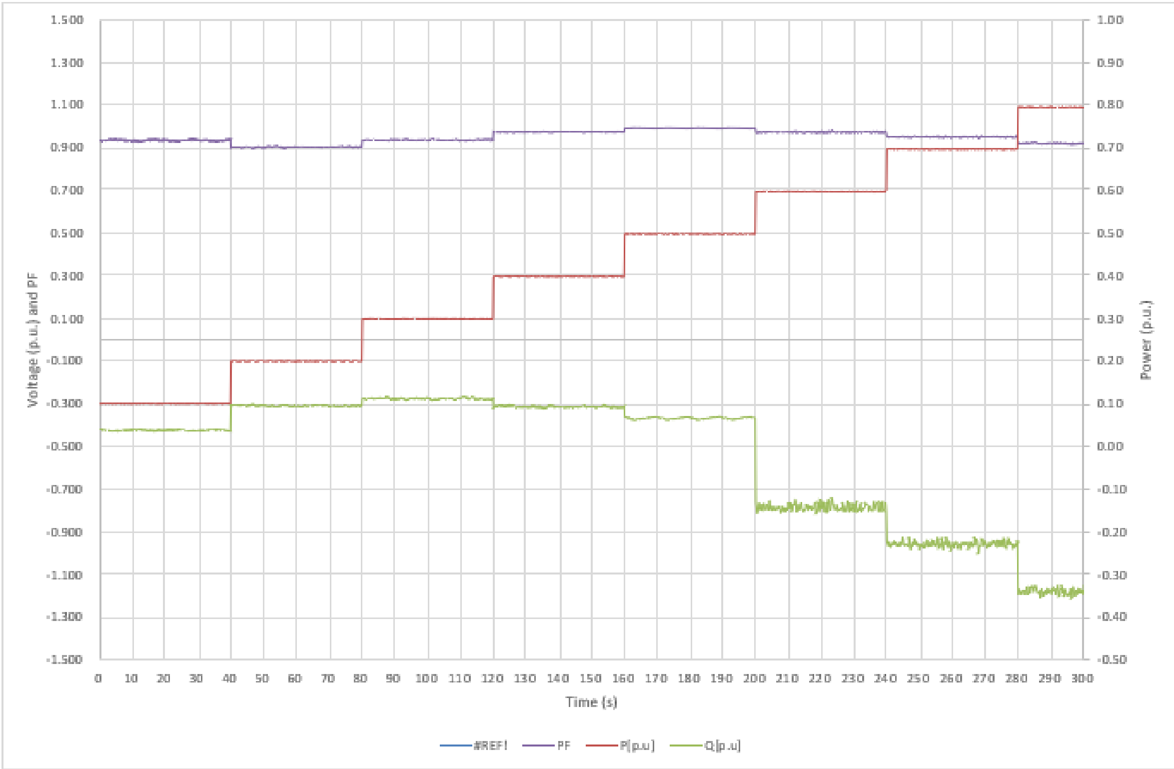


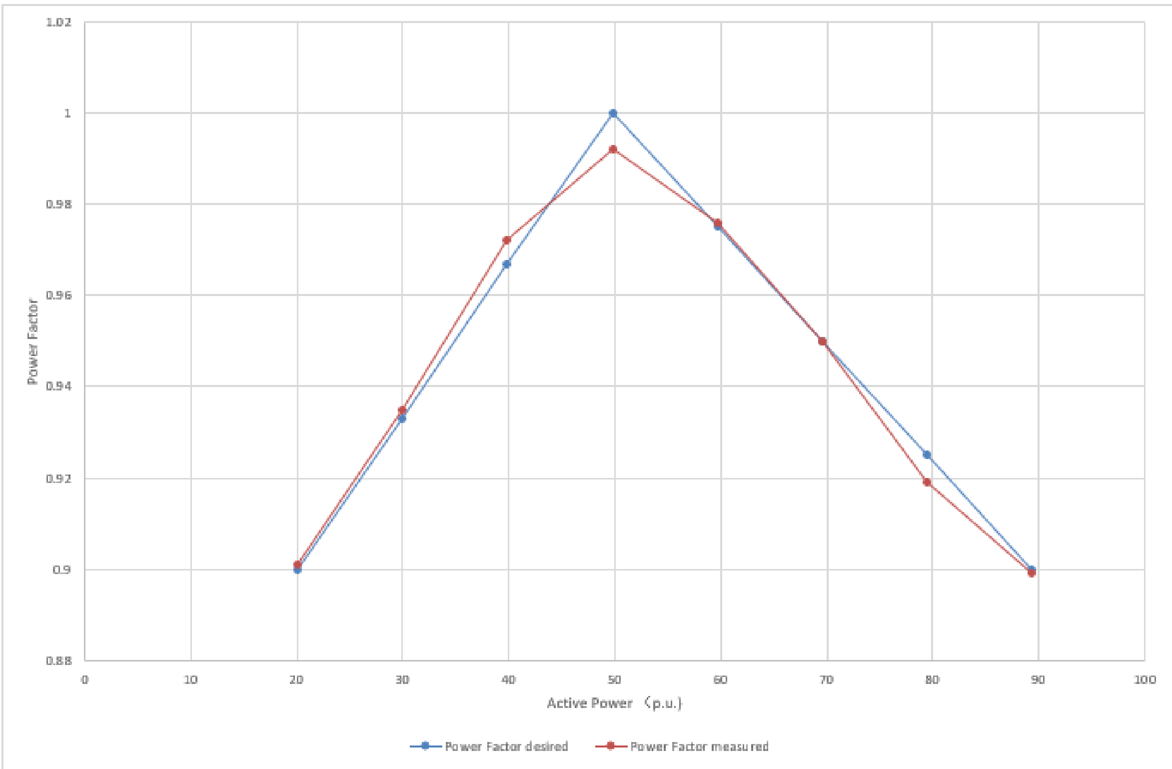
4.13.3.2 Test 2

In this test it is verified that the power factor vary linearly from PF = 0.90 (inductive) at 20%Pn, PF = 1 at 50%Pn, PF PF = 0.90 (capacitive) at 90%Pn. The following table shows the obtained test results:

P Desired (%Sn)	P measured (%Sn)	Q measured (%Sn)	Power Factor desired (cos φ)	Power Factor measured (cos φ)	Power Factor Deviation (cos φ)
20	20.0	9.6	0.900	0.901	0.001
30	29.9	11.3	0.933	0.935	0.002
40	39.8	9.6	0.967	0.972	0.005
50	49.8	6.5	1.000	0.992	-0.008
60	59.7	-14.4	0.975	0.976	0.001
70	69.6	-22.9	0.950	0.950	0.000
80	79.5	-34.2	0.925	0.919	-0.006
90	89.3	-43.5	0.900	0.899	-0.001

Characteristic curve Cos φ (P) Test 2



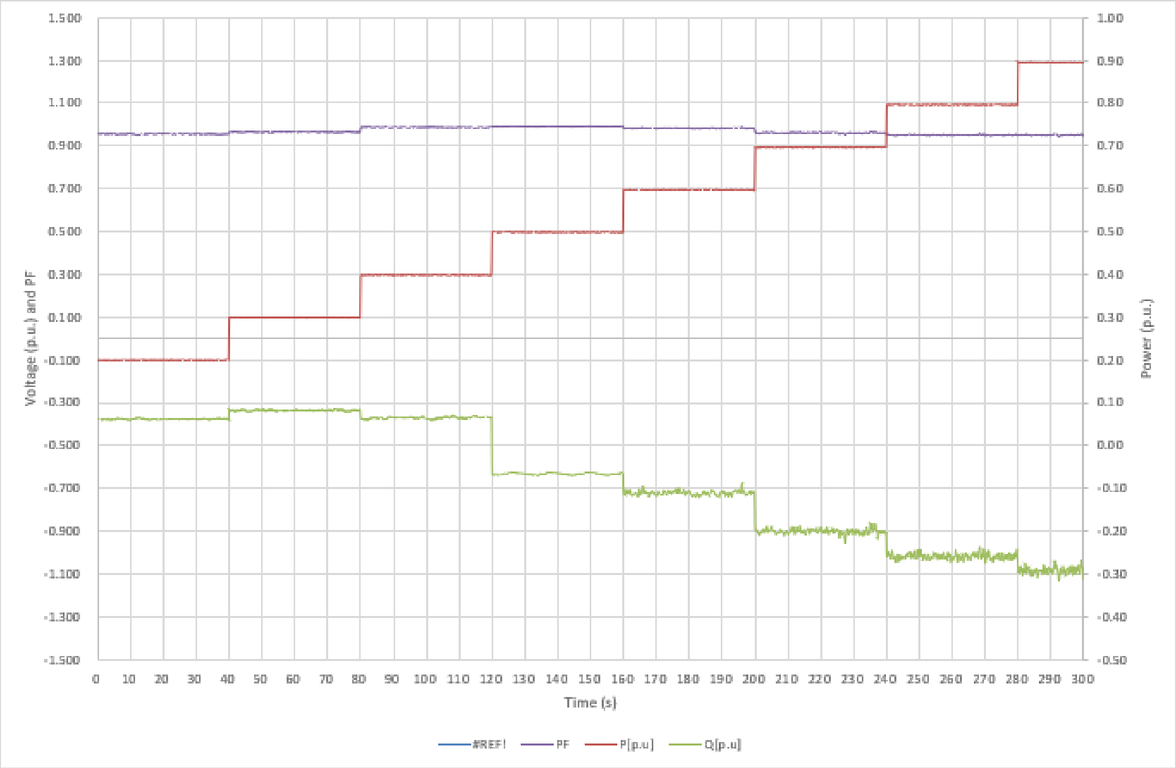


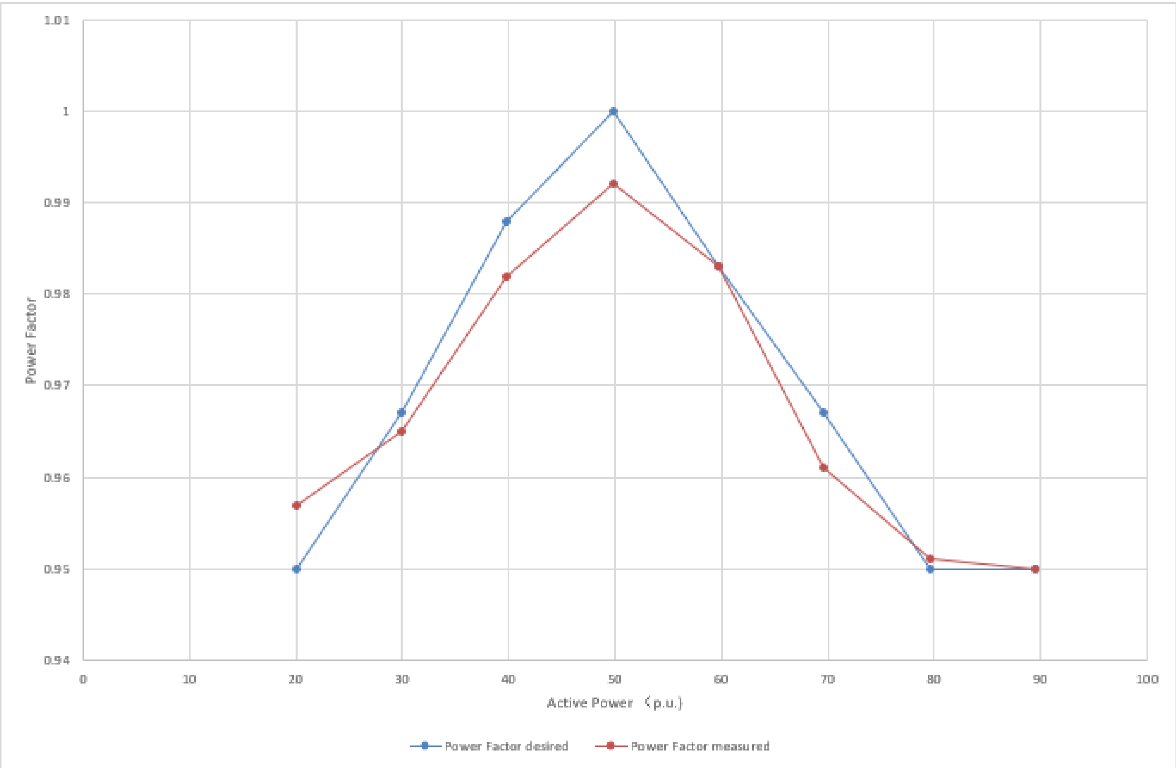
4.13.3.3 Test 3

In this test it is verified that the power factor vary linearly from PF = 0.95 (~~i~~inductive) at 20%Pn to PF = 0.95 (capacitive) at 80%Pn. The following table shows the obtained test results:

P Desired (%Sn)	P measured (%Sn)	Q measured (%Sn)	Power Factor desired (cos φ)	Power Factor measured (cos φ)	Power Factor Deviation (cos φ)
20	20.0	6.1	0.950	0.957	0.007
30	29.9	8.1	0.967	0.965	-0.002
40	39.8	6.4	0.988	0.982	-0.006
50	49.8	-6.5	1.000	0.992	-0.008
60	59.7	-11.1	0.983	0.983	0.000
70	69.6	-20.1	0.967	0.961	-0.006
80	79.6	-25.9	0.950	0.951	0.001
90	89.5	-29.4	0.950	0.950	0.000

Characteristic curve Cos φ (P) Test 3

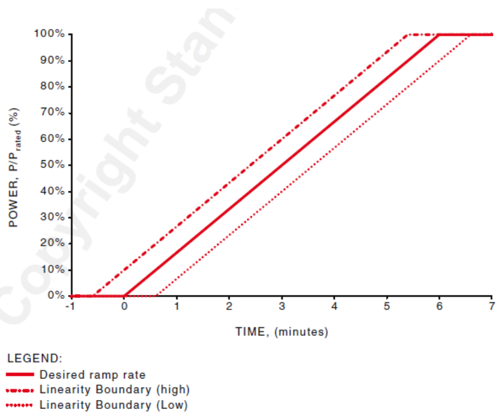




4.13.4 Power rate limit

According to the Clause 6.3.5 of the standard, the equipment shall have the capability to gradually increase its output power when requested.

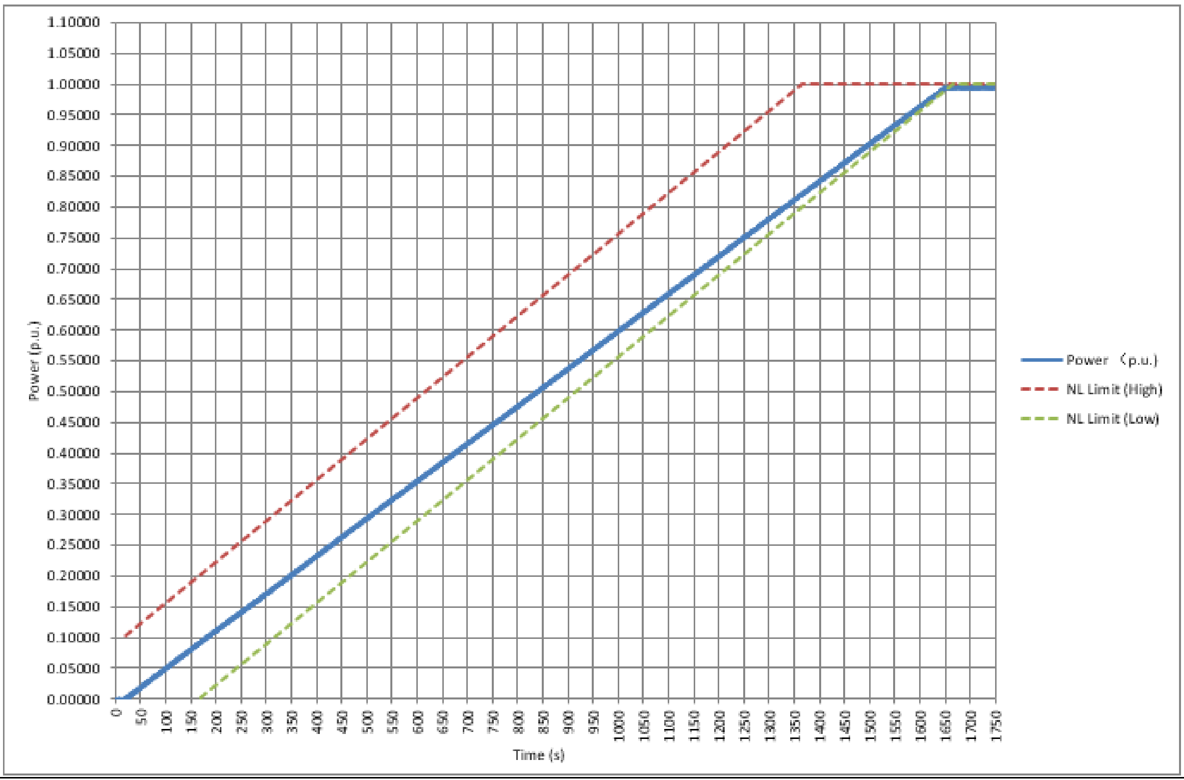
The maximum NL (Nonlinearity) shall be less 10% according to standard.



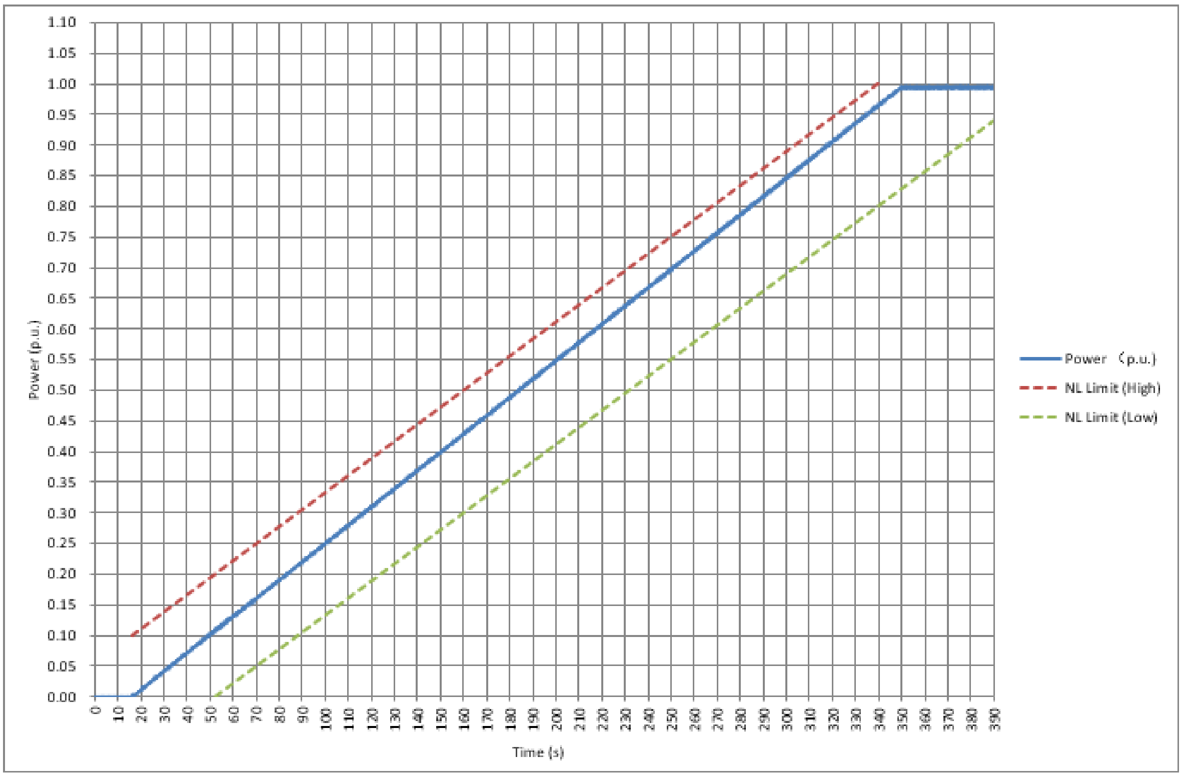
Gradients have ability to set from 4%Pn/min to 100%Pn/min by the control system of the inverter. Test results are offered in the table and pictures below:

Increase of Active Power			
Gradient (ΔP) desired (%P_n/min)	Nominal Ramp Time (s)	Gradient measured (%P_n/min)	Measured Ramp time (s)
4%	1500	3.7%	1626.4
16.7%	360	18.0%	332.8
100%	60	100.0%	60.0

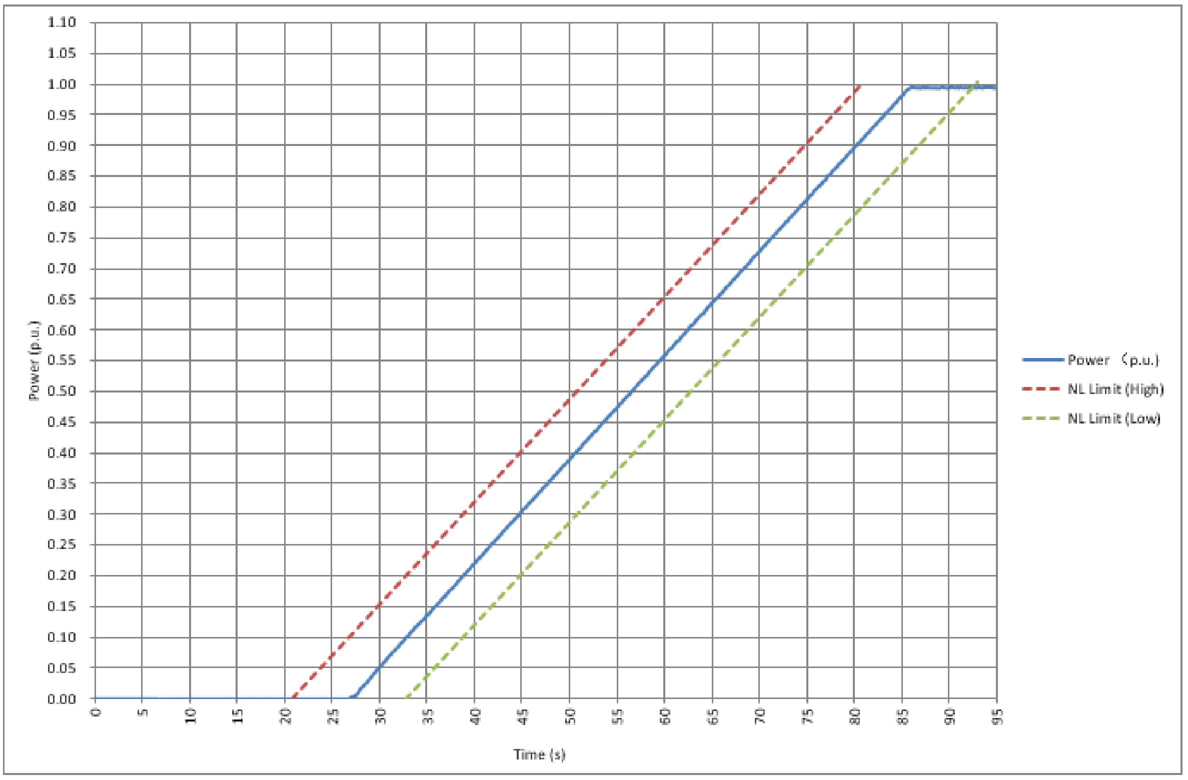
Increase of Active Power with 4%Pn/min



Increase of Active Power with 16.67%Pn/min



Increase of Active Power with 100%Pn/min



4.14 MULTIPLE MODE INVERTER OPERATION

The inverter power quality response modes tests have been measured according to Clause 6.4 of the standard.

The following operating modes are evaluated:

- Sinusoidal output in stand-alone mode
- Volt ‑ watt response mode for charging of energy storage

Test results are offered in the following pages:

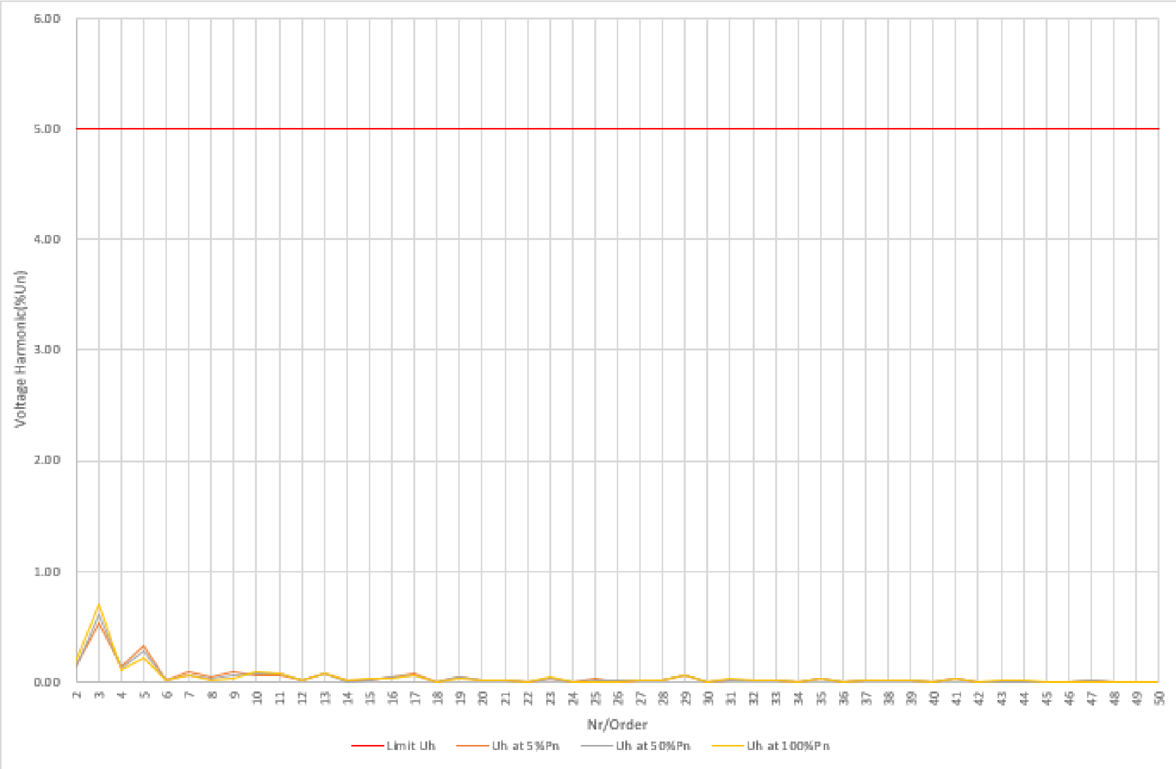
4.14.1 Sinusoidal output in stand-alone mode

Volt response modes tests have been measured according to Clause 6.4.2 of the standard.

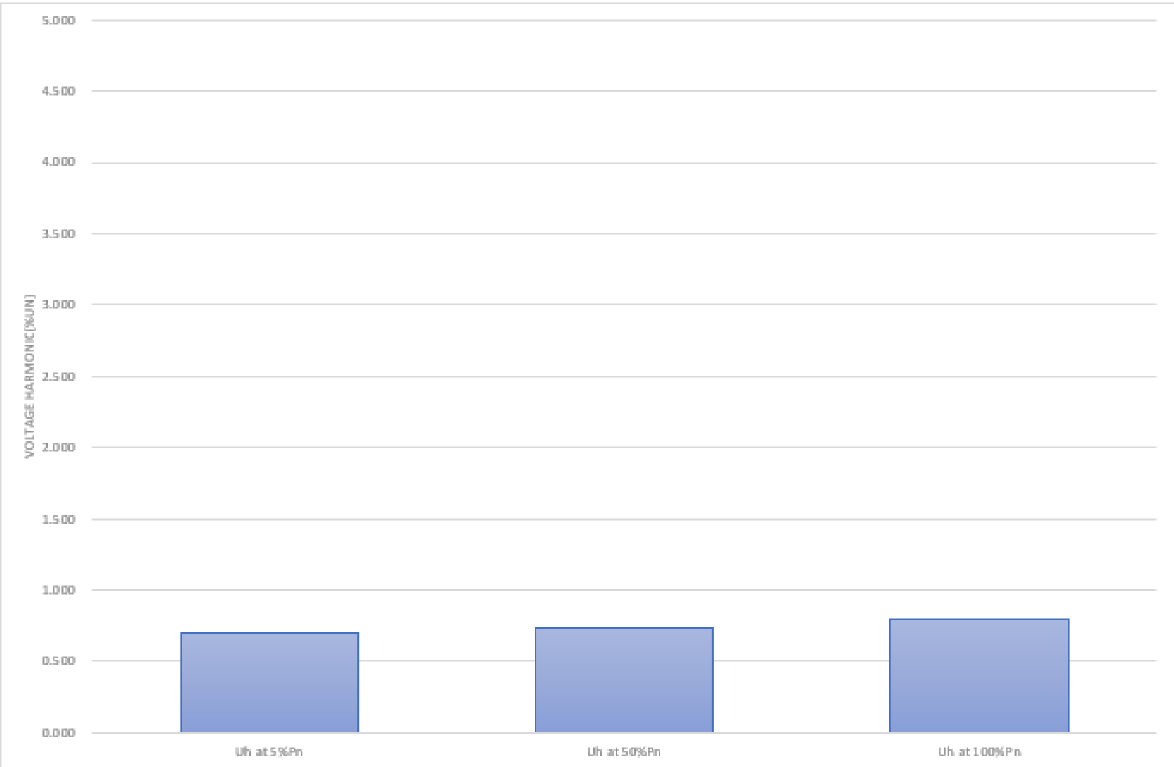
Voltage Harmonics				
Nr/Order	**Limit U_h (%fundamental)**	**U_h at 5%Pn (%fundamental)**	**U_h at 50%Pn (%fundamental)**	**U_h at 100%Pn (%fundamental)**
2	5.000	0.160	0.148	0.200
3	5.000	0.531	0.612	0.700
4	5.000	0.139	0.121	0.112
5	5.000	0.331	0.278	0.211
6	5.000	0.020	0.019	0.022
7	5.000	0.101	0.055	0.059
8	5.000	0.041	0.036	0.014
9	5.000	0.088	0.070	0.038
10	5.000	0.063	0.085	0.090
11	5.000	0.058	0.072	0.072
12	5.000	0.013	0.011	0.011
13	5.000	0.079	0.072	0.077
14	5.000	0.012	0.005	0.017
15	5.000	0.019	0.023	0.034
16	5.000	0.044	0.039	0.025
17	5.000	0.074	0.069	0.066
18	5.000	0.001	0.003	0.003
19	5.000	0.049	0.041	0.037
20	5.000	0.022	0.017	0.016
21	5.000	0.014	0.014	0.014
22	5.000	0.003	0.008	0.005
23	5.000	0.032	0.030	0.043
24	5.000	0.003	0.002	0.007
25	5.000	0.028	0.016	0.002

Voltage Harmonics				
Nr/Order	Limit U_h (%fundamental)	U_h at 5%Pn (%fundamental)	U_h at 50%Pn (%fundamental)	U_h at 100%Pn (%fundamental)
26	5.000	0.008	0.009	0.003
27	5.000	0.014	0.013	0.015
28	5.000	0.008	0.010	0.011
29	5.000	0.058	0.065	0.064
30	5.000	0.005	0.004	0.003
31	5.000	0.015	0.017	0.023
32	5.000	0.011	0.012	0.011
33	5.000	0.009	0.010	0.012
34	5.000	0.001	0.003	0.006
35	5.000	0.032	0.028	0.030
36	5.000	0.003	0.005	0.004
37	5.000	0.018	0.013	0.009
38	5.000	0.009	0.010	0.010
39	5.000	0.009	0.010	0.008
40	5.000	0.003	0.004	0.005
41	5.000	0.024	0.029	0.030
42	5.000	0.002	0.002	0.005
43	5.000	0.006	0.006	0.011
44	5.000	0.004	0.006	0.009
45	5.000	0.004	0.004	0.006
46	5.000	0.000	0.001	0.002
47	5.000	0.013	0.010	0.007
48	5.000	0.001	0.002	0.002
49	5.000	0.007	0.005	0.003
50	5.000	0.005	0.004	0.003
THD(%U_n)	5.000	0.700	0.730	0.794

Voltage Harmonics

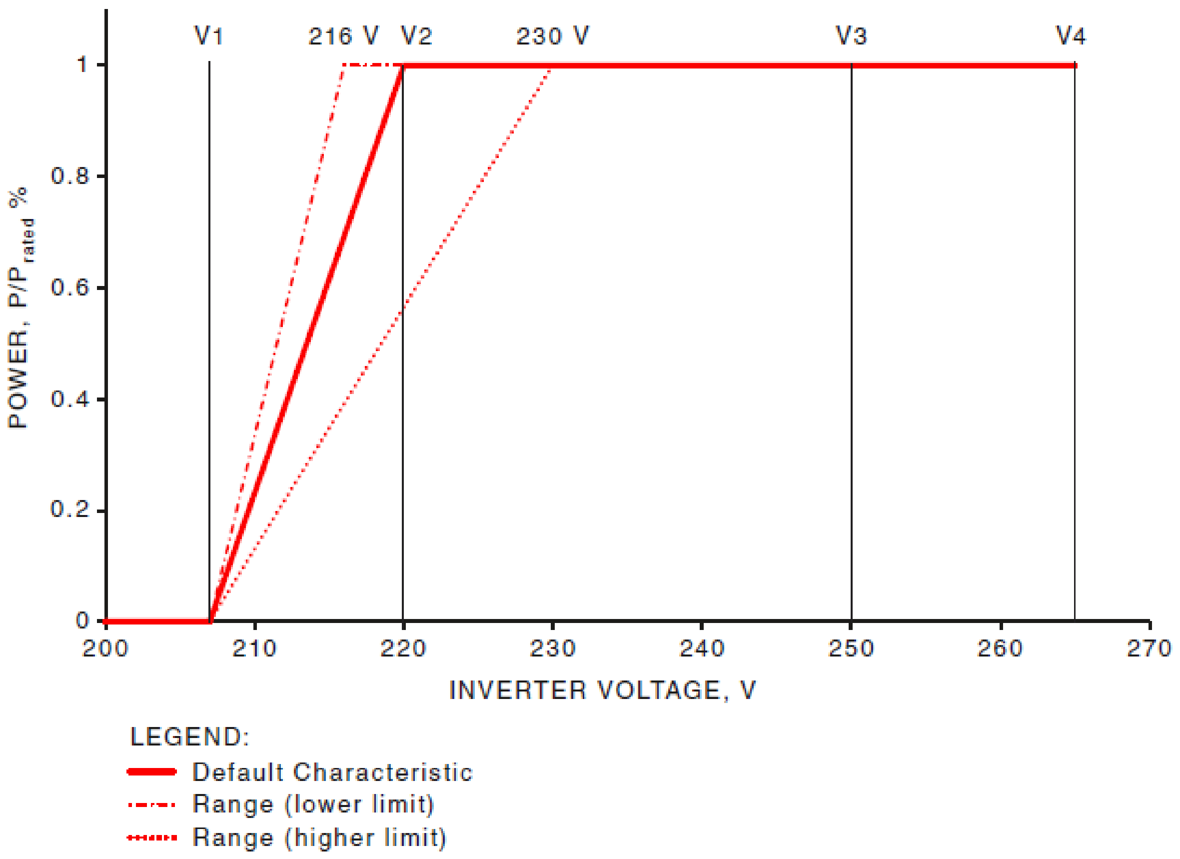


Voltage THD



4.14.2 Volt – watt response mode for charging of energy storage

Volt response modes tests have been measured according to Clause 6.4.3 of the standard.



Two different tests have been performed to verify that the inverter volt-watt response is in accordance with the standard. These two curves tested prove also that volt-watt control function is configurable to different curves:

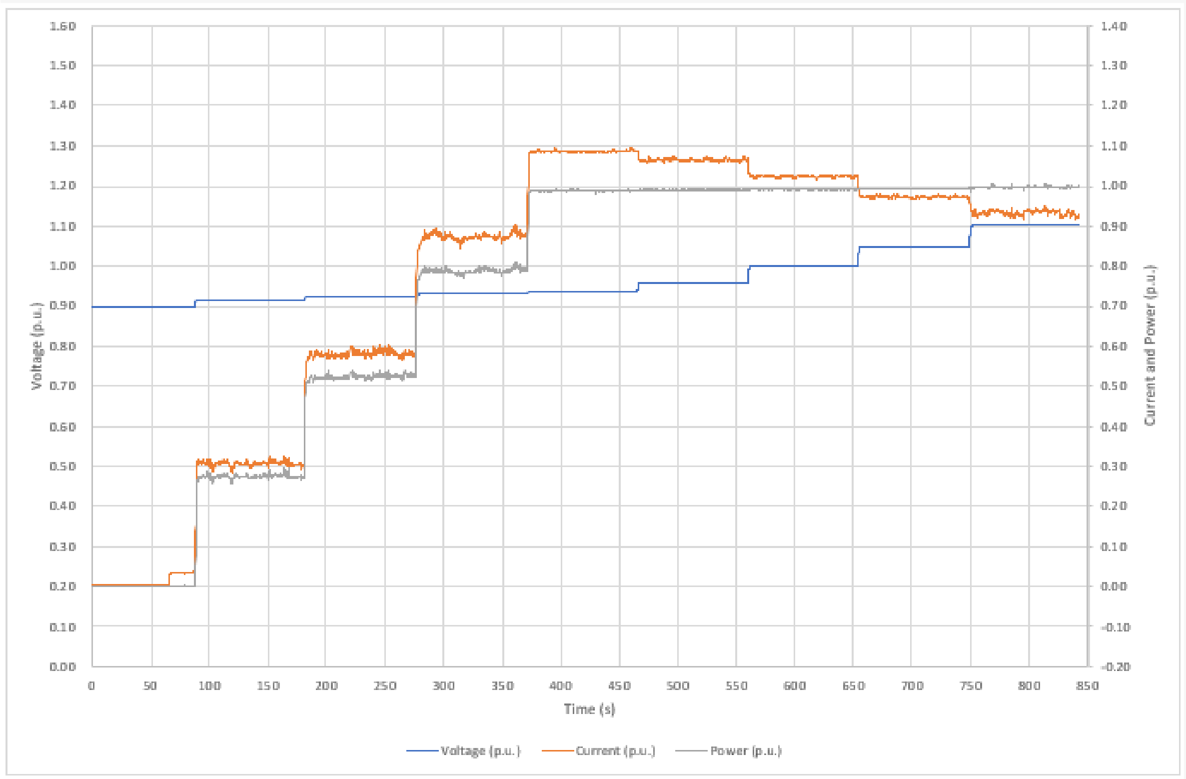
The setting values for voltage and power in the inverter have been the following:

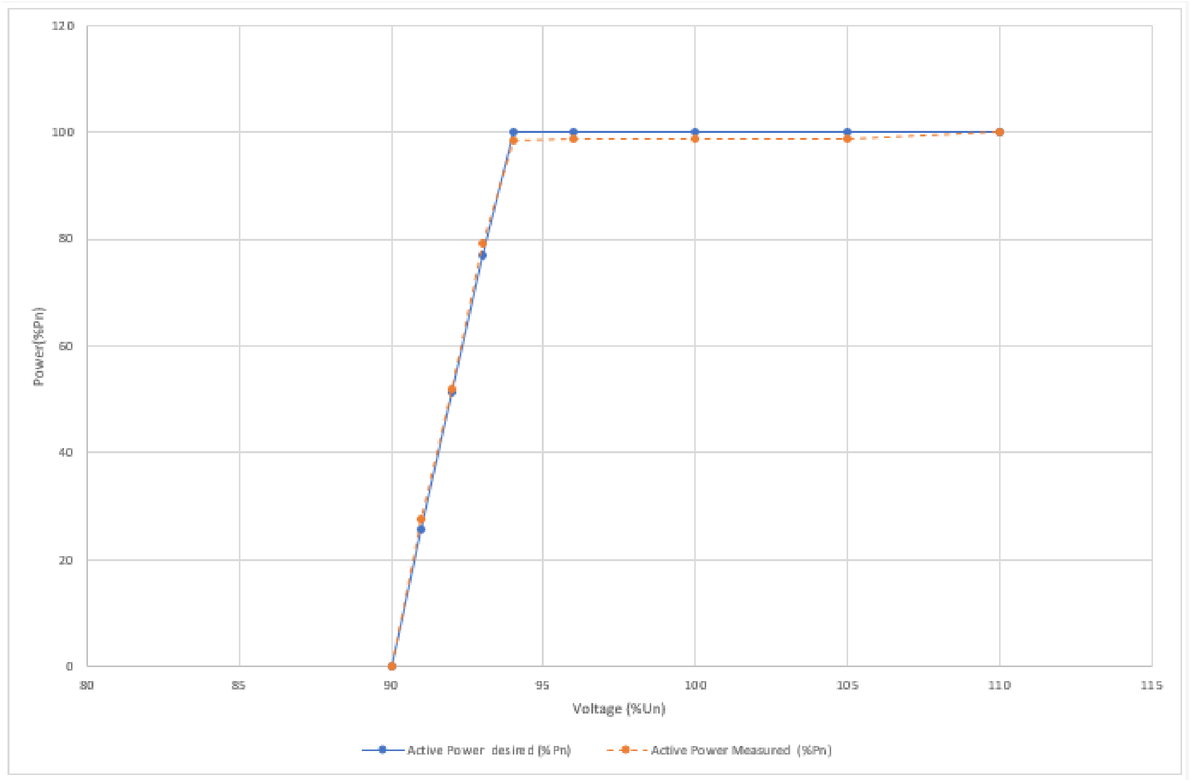
Reference	Test 1 Set points		Test 2 Set points	
	Volt. (%Un)	Power (%Pn)	Volt. (%Un)	Power (%Pn)
V1	90.0%	0%	90.0%	0%
V2	93.9%	100%	100.0%	100%
V3	108.7%	100%	108.7%	100%
V4	110.0%	100%	110.0%	100%

4.14.2.1 Test 1

Voltage desired (%Un)	Voltage Measured (%Un)	Active Power desired (%Pn)	Active Power Measured (%Pn)	Active Power Deviation (%Pn)
90.0	90.0	0	0	0
91.0	91.5	25.6	27.7	2.1
92.0	92.2	51.3	52.0	0.7
93.0	93.3	76.9	79.2	2.3
94.0	94.0	100.0	98.5	-1.5
96.0	96.0	100.0	98.8	-1.2
100.0	100.0	100.0	98.9	-1.1
105.0	105.0	100.0	98.9	-1.1
110.0	110.1	100.0	100.0	0

Volt – Watt (Test 1)

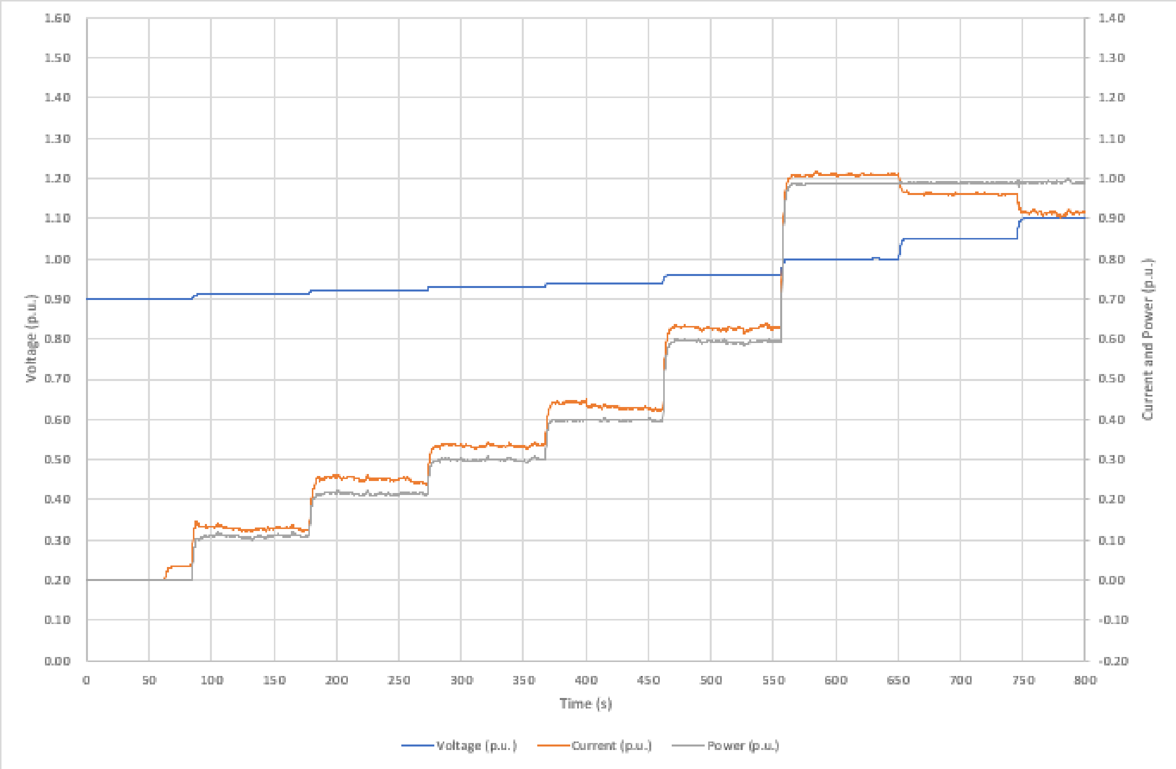


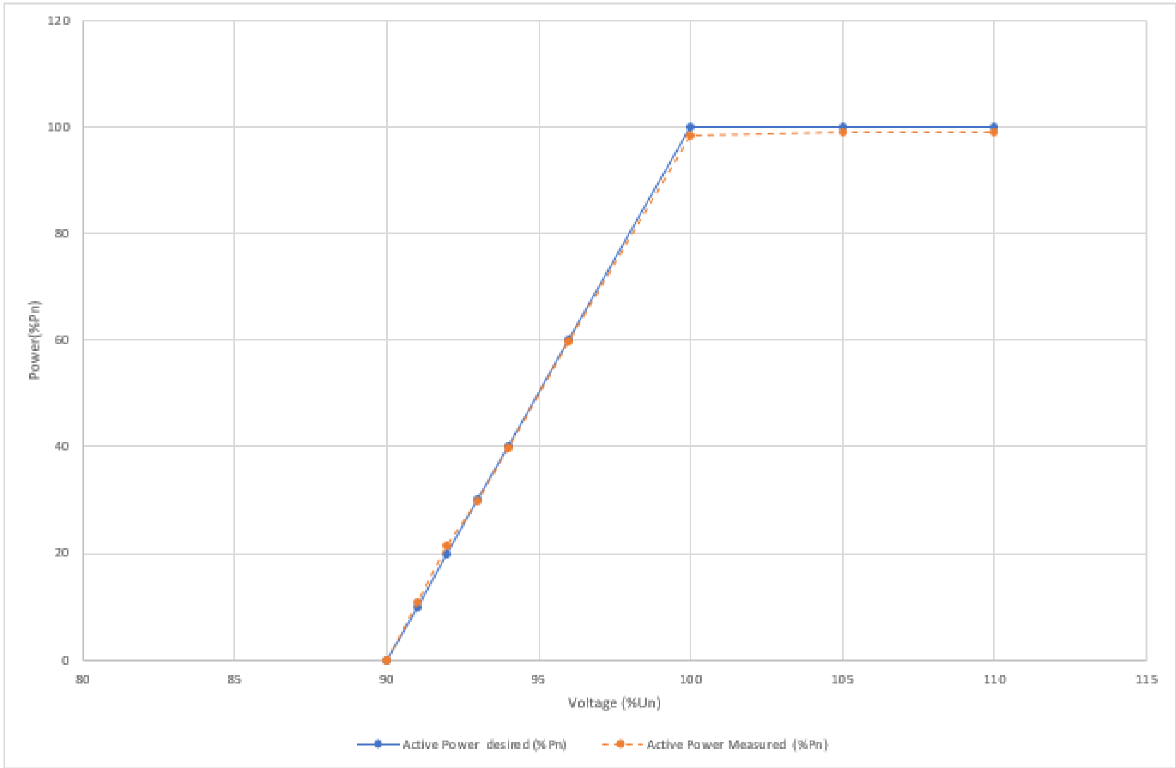


4.14.2.2 Test 2

Voltage desired (%Un)	Voltage Measured (%Un)	Active Power desired (%Pn)	Active Power Measured (%Pn)	Active Power Deviation (%Pn)
90.0	89.8	0.0	0	0
91.0	91.1	10.0	10.9	0.9
92.0	92.1	20.0	21.6	1.6
93.0	93.0	30.0	29.7	-0.3
94.0	94.0	40.0	39.7	-0.3
96.0	96.0	60.0	59.8	-0.2
100.0	100.0	100.0	98.5	-1.5
105.0	105.0	100.0	98.9	-1.1
110.0	110.0	100.0	99.0	-1.0

Volt – Watt (Test 2)





4.15 SECURITY OF OPERATIONAL SETTINGS

According to the Clause 6.5 of the standard, it has been verified by inspection that changes to the internal setting may require the use of a tool and special instructions not provided to unauthorized personnel.

4.16 AUTOMATIC DISCONNECTION DEVICE

It has been verified that the automatic disconnection device meets the requirements stated in the Clause 7.2 of the standard.

This automatic disconnection device is in compliance with the following points:

- Is capable to withstand an impulse voltage that could occur at the point of installation and has the appropriate contact gap.
- It doesn't indicate falsely that contacts are open.
- It is installed and designed to prevent unintentional closure that can be caused by events such as impacts or vibration.
- It has devices that disconnects on all live conductors (active and neutral) of the inverter from the grid.
- It is ensured that in case of single fault, there is simple separation.
- It is ensured that in case of single fault, power is prevented to entering the grid.
- It is capable of interrupting the rated current of the equipment.
- The settings of the automatic disconnection don't exceed the capability of the inverter.
- There are not used solid-state semiconductors for isolation purposes.

4.17 ACTIVE ANTI-ISLANDING PROTECTION

Test performed according to IEC 62116. The method used to provide active anti-islanding is frequency instability.

It has been done three different tests,

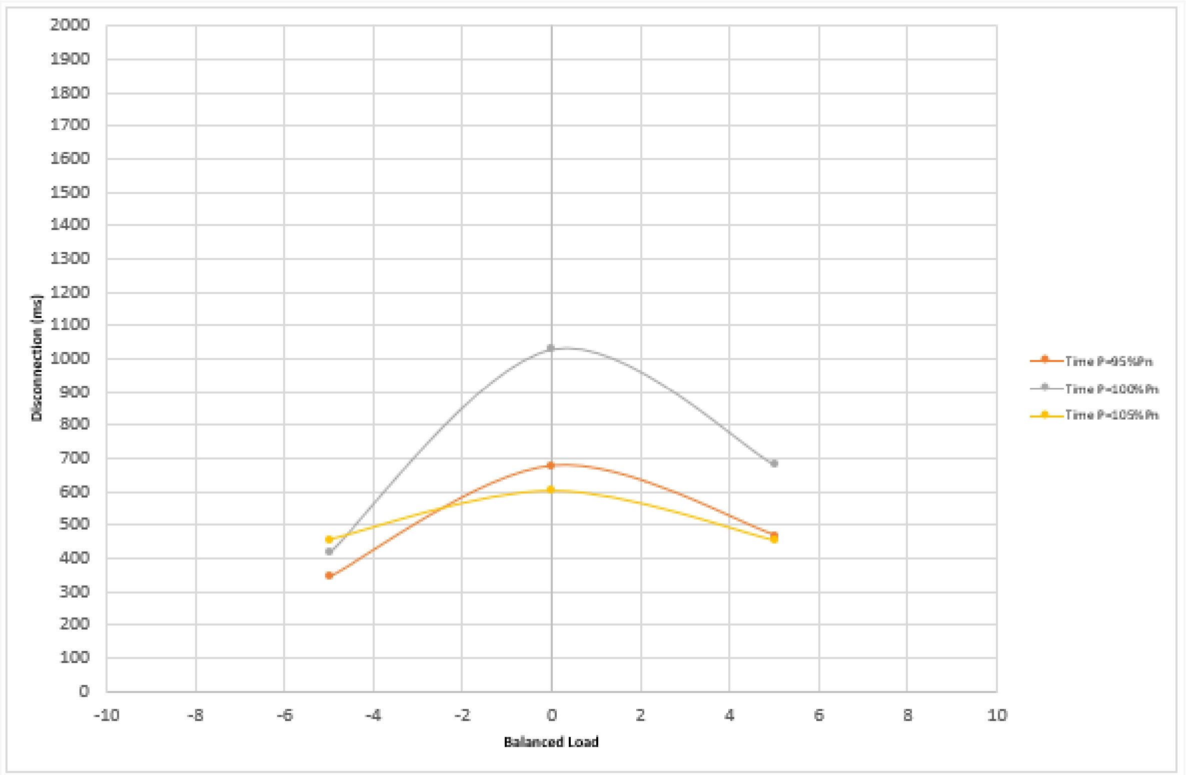
- Test A (Active Power >90% Pn and Input Voltage > 75% Vdc)
- Test B (Active Power 50-66% Pn and Input Voltage 50±10% Vdc)
- Test C (Active Power 25-33% Pn and Input Voltage < 20% Vdc)

The maximum trip time is 2 s.

Note: In the tables below, M(%) and N(%) are respectively referred to active and reactive power impedance variation as percentage.

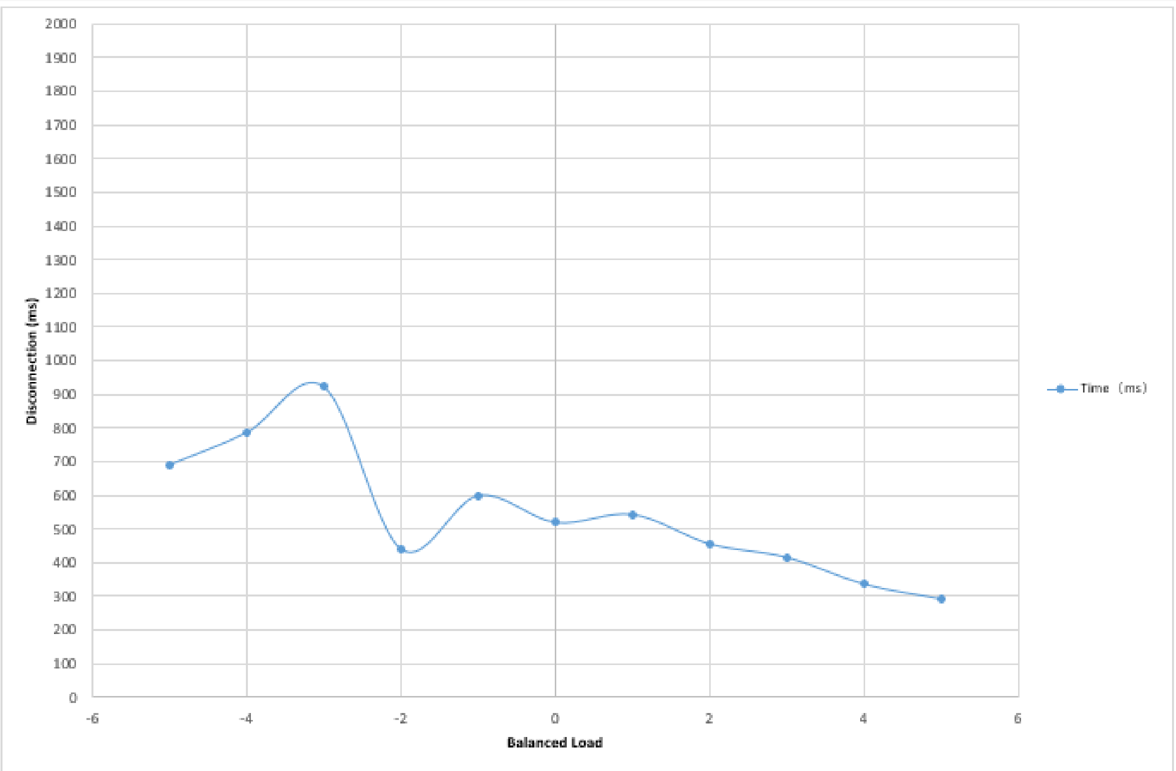
4.17.1 Test A

Balanced Load		
M (%)	N (%)	Disconnection (ms) (limit at t=2s)
-5	+5	468
-5	0	676
-5	-5	344
0	+5	680
0	0	1028
0	-5	420
+5	+5	452
+5	0	604
+5	-5	456



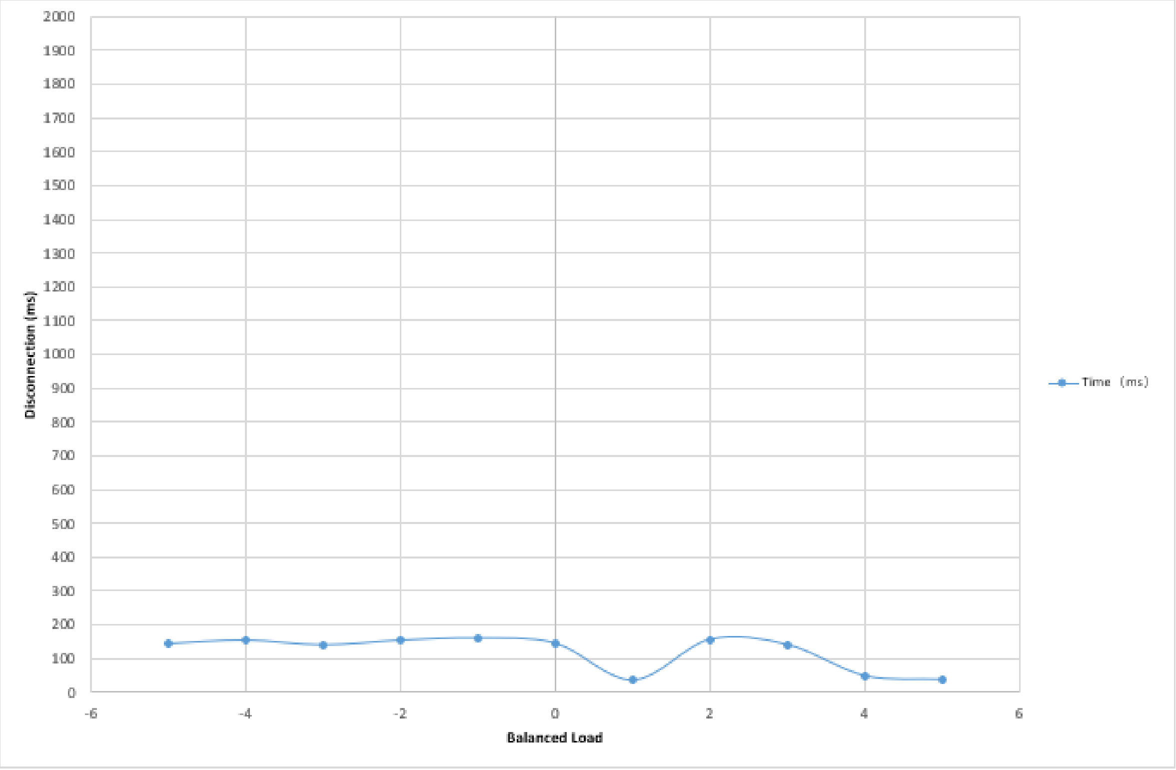
4.17.2 Test B

Balanced Load		
M (%)	N (%)	Disconnection (ms) (limit at t=2s)
0	-5	692
0	-4	788
0	-3	924
0	-2	440
0	-1	600
0	0	520
0	1	544
0	2	456
0	3	416
0	4	336
0	5	292



4.17.3 Test C

Balanced Load		
M (%)	N (%)	Disconnection (ms) (limit at t=2s)
0	-5	144
0	-4	154
0	-3	140
0	-2	154
0	-1	161
0	0	145
0	1	36
0	2	157
0	3	141
0	4	49
0	5	38



4.18 VOLTAGE AND FREQUENCY LIMITS (PASSIVE ANTI-ISLANDING PROTECTION)

Voltage and frequency limits (Passive Anti-islanding Protection) have been verified according to the Clause 7.4 of the standard.

The inverter should remain in continuous and uninterrupted operation for voltage and frequency variations with duration shorter than the trip delay time specified in the next table:

Protective function	Protective function limit	Trip delay time	Maximum disconnection time
Undervoltage (V<)	180 V	1 s	2 s
Overvoltage 1 (V>)	260 V	1 s	2 s
Overvoltage 2 (V>>)	265 V	—	0.2 s
Under-frequency (F<)	47 Hz (Australia) 45 Hz (New Zealand)	1 s	2 s
Over-frequency (F>)	52 Hz	—	0.2 s

Voltage limits stated by the standard have been expressed as a percentage of 230V and applied to the rated values of the family of inverters contemplated in this report.

Each test should be repeated 3 times.

Following indications shall be taken into account to for test results offered in this point.

For trip tests evaluation it is considered the time from when the voltage or frequency, as proceed, is stabilized at the setting value to the instant when the inverter is effectively disconnected and with no current.

For frequency trip tests evaluation, in order to have a bigger accuracy it has been evaluated and represented the first period of the sine wave where the frequency surpasses the frequency limit and from that first period has been evaluated the tripping time.

For these cases, a second graph representing the “trip value” is offered. In them cursors are allocated among the beginning and the end of a period of the voltage sine wave, measuring the time that lasts the whole period and allowing calculating the frequency of the period.

4.18.1 Voltage trip tests

To asses that the protective function of the inverter against abnormal voltage is effective two different kinds of tests have been done:

- Trip value tests to evaluate if the inverter can trip with accuracy in accordance with a settling value of voltage.
- Trip time tests to evaluate if the inverter can trip into the limits of time stated by the standard in case of detecting voltage levels out of the limits stated.

The standard states that the tolerance limit for voltage trip values is ± 2 V, which is a 0.8% Un over 230 V, the reference voltage considered by the standard. So 0.8% Un is the allowed tolerance to be considered for voltage trip value tests.

4.18.1.1 Voltage trip value tests

The tests have been made as the following procedure:

- For undervoltage protection (U<): Starting from a voltage level 1% Un above the trip value of the protection function to be tested, the voltage is decreased 1V in steps of at least 5 seconds.
- For overvoltage protection (U>): Starting from a voltage level 1% Un below the trip value of the protection function to be tested, the voltage is increased 1V in steps of at least 5 seconds.
- For overvoltage protection (U>>): Starting from a voltage level 1% Un below the trip value of the protection function to be tested, the voltage is increased 1V in steps of at least 5 seconds. Disable overvoltage protection (U>) function during the test.

Test results are offered in the following table:

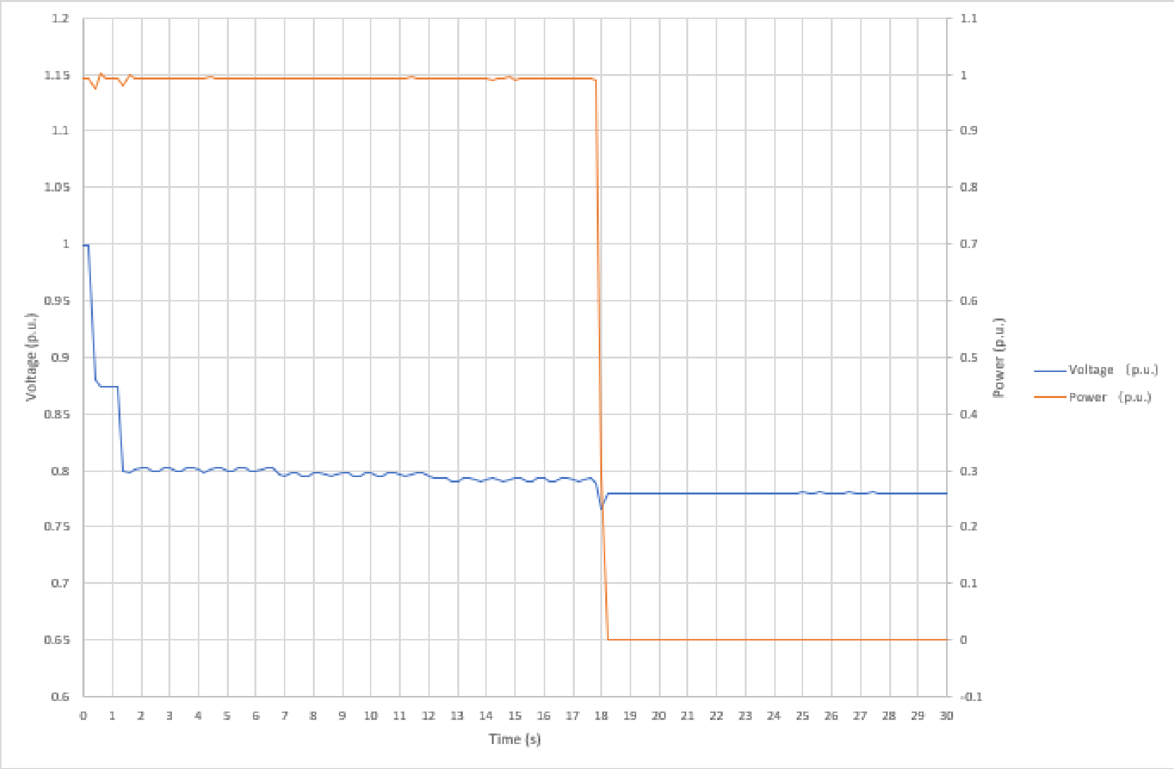
Protective Function Tested	No Trip Test			Trip Test		
	Start Voltage value (%Un)	Time measured per step (s)	Trip	Voltage Trip settling value (%Un)	Trip	Voltage trip value measured (%Un)
U < (Rep 1)	79.5%	>5.00	☒ NO ☐ YES	78.3%	☐ NO ☒ YES	77.9%
U < (Rep 2)	79.5%	>5.00	☒ NO ☐ YES	78.3%	☐ NO ☒ YES	78.1%
U < (Rep 3)	79.5%	>5.00	☒ NO ☐ YES	78.3%	☐ NO ☒ YES	78.1%
U > (Rep 1)	112.0%	>5.00	☒ NO ☐ YES	113.0%	☐ NO ☒ YES	113.2%
U > (Rep 1)	112.0%	>5.00	☒ NO ☐ YES	113.0%	☐ NO ☒ YES	113.3%
U > (Rep 3)	112.0%	>5.00	☒ NO ☐ YES	113.0%	☐ NO ☒ YES	113.3%
U > > (Rep 1) (*)	114.0%	>5.00	☒ NO ☐ YES	115.0%	☐ NO ☒ YES	115.7%
U > > (Rep 1) (*)	114.0%	>5.00	☒ NO ☐ YES	115.0%	☐ NO ☒ YES	115.7%
U > > (Rep 3) (*)	114.0%	>5.00	☒ NO ☐ YES	115.0%	☐ NO ☒ YES	115.6%

Maximum deviation allowed in voltage trip value is ± 0.8% Un.

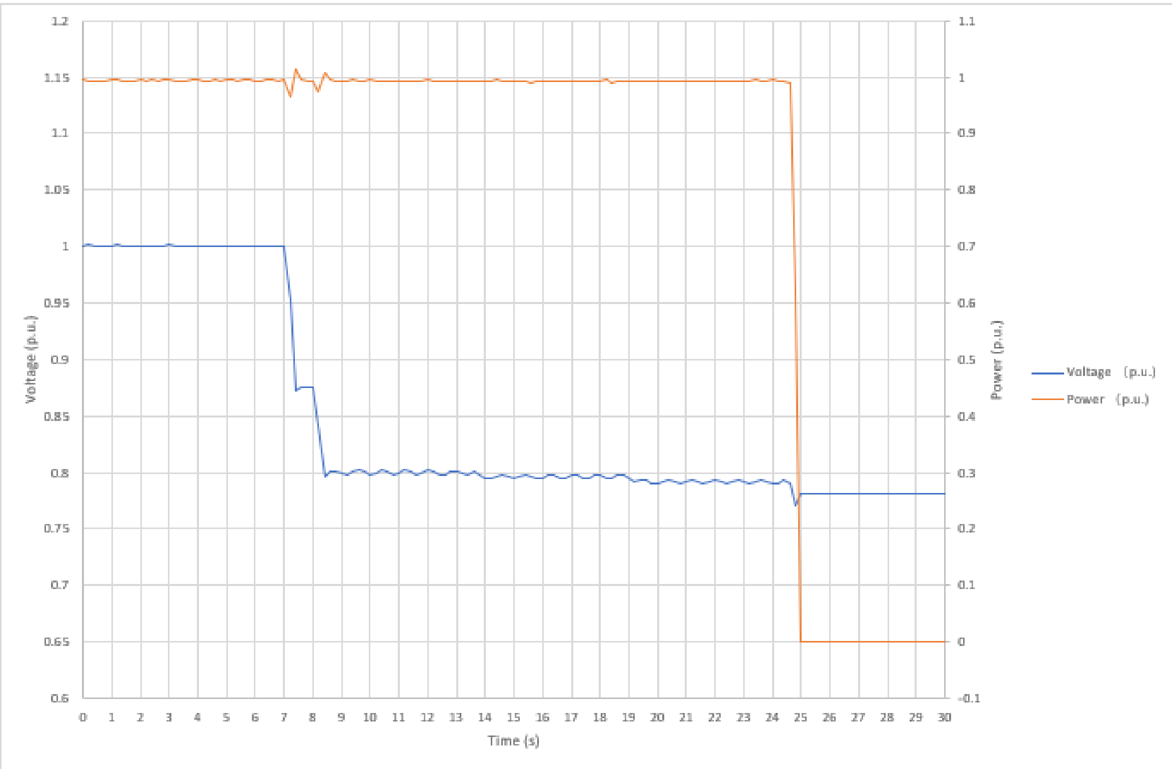
(*) Disable overvoltage protection (U>) function during the test.

Test results are graphically shown in following pages.

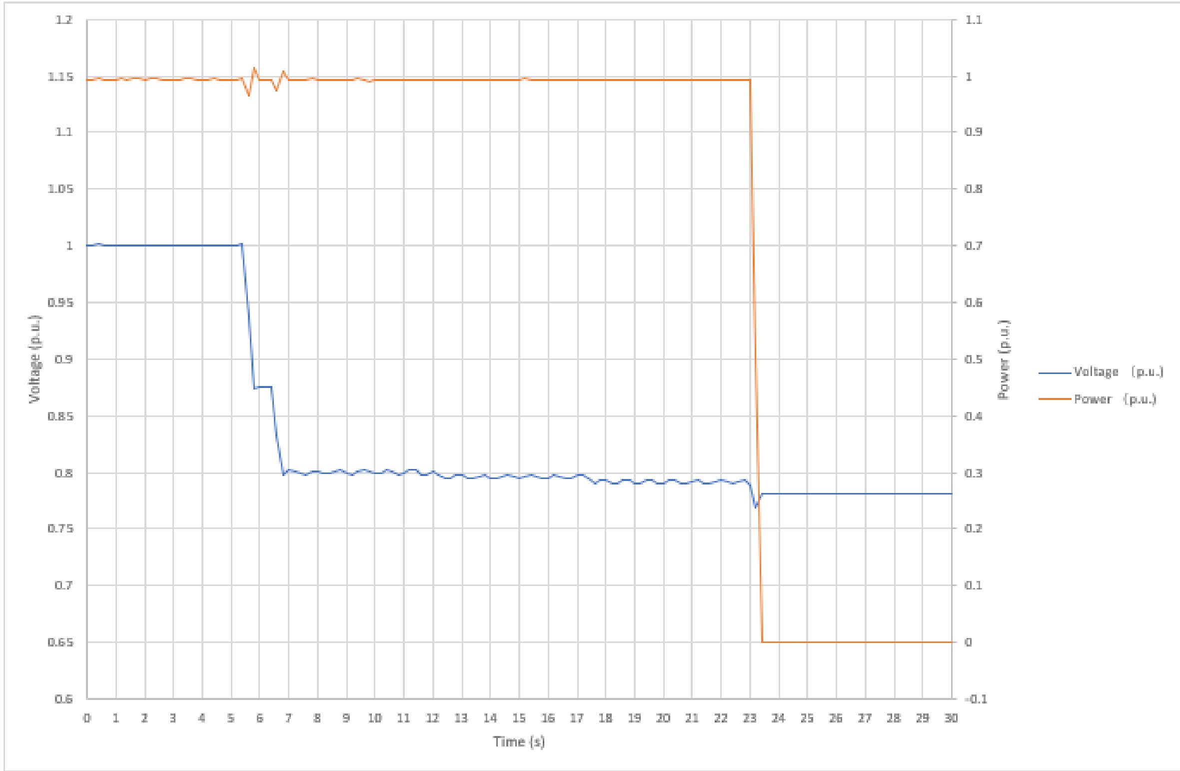
Undervoltage (U <) Rep 1



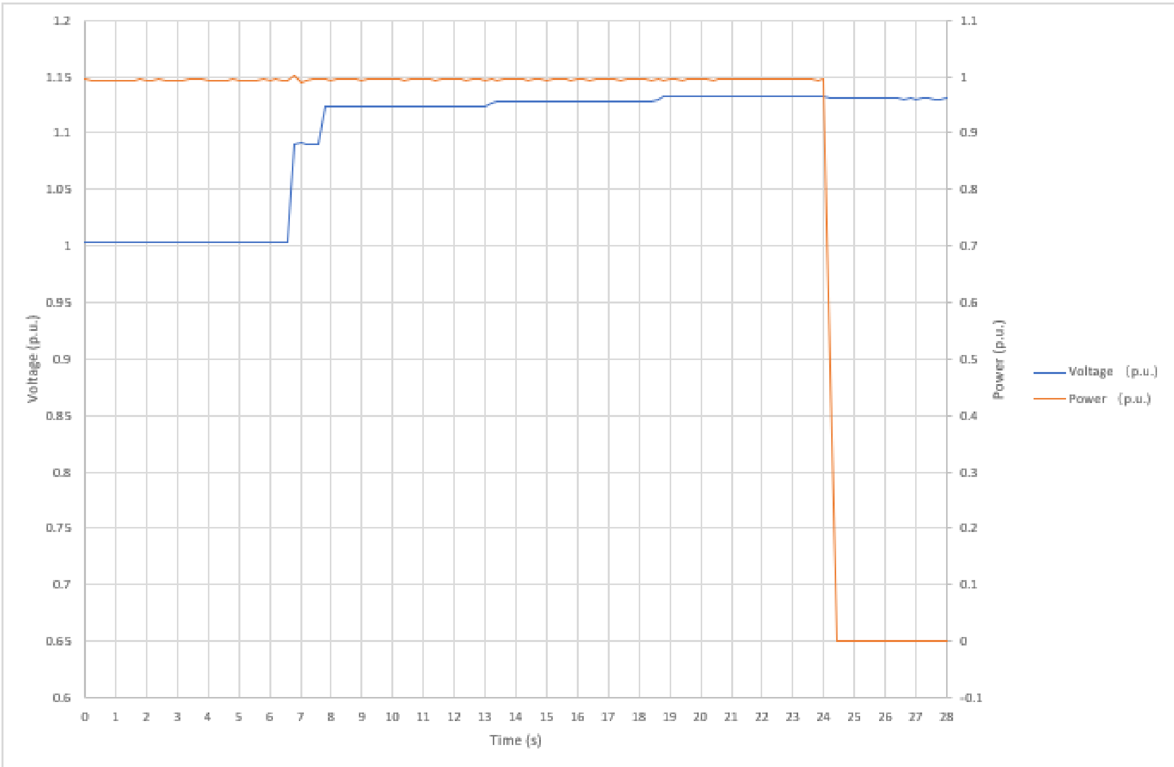
Undervoltage (U <) Rep 2



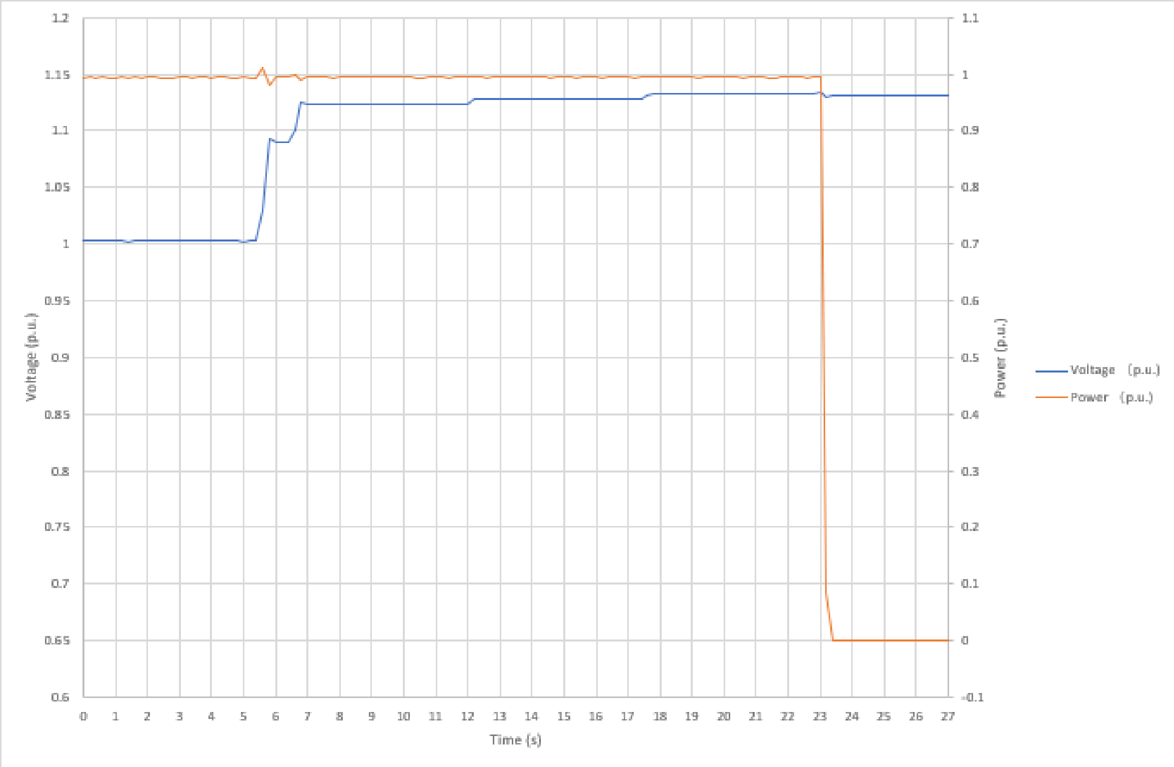
Undervoltage (U <) Rep 3



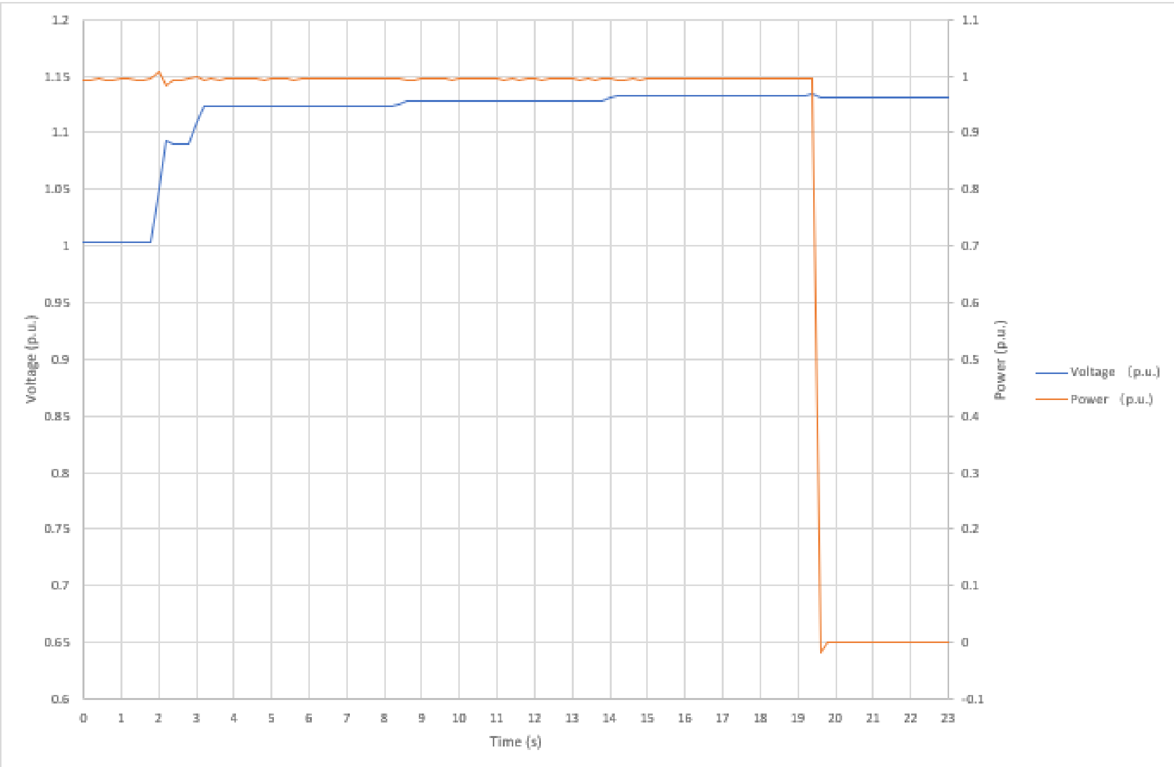
Overvoltage (U >) Rep 1



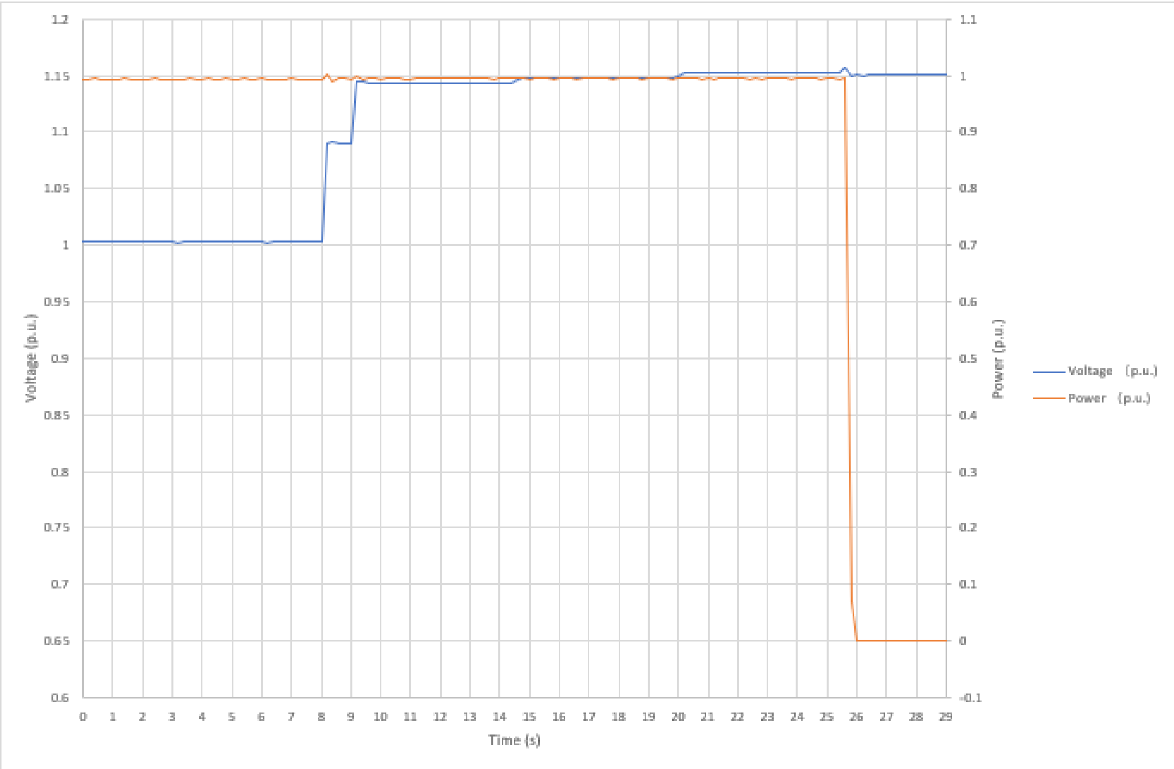
Overvoltage (U >) Rep 2



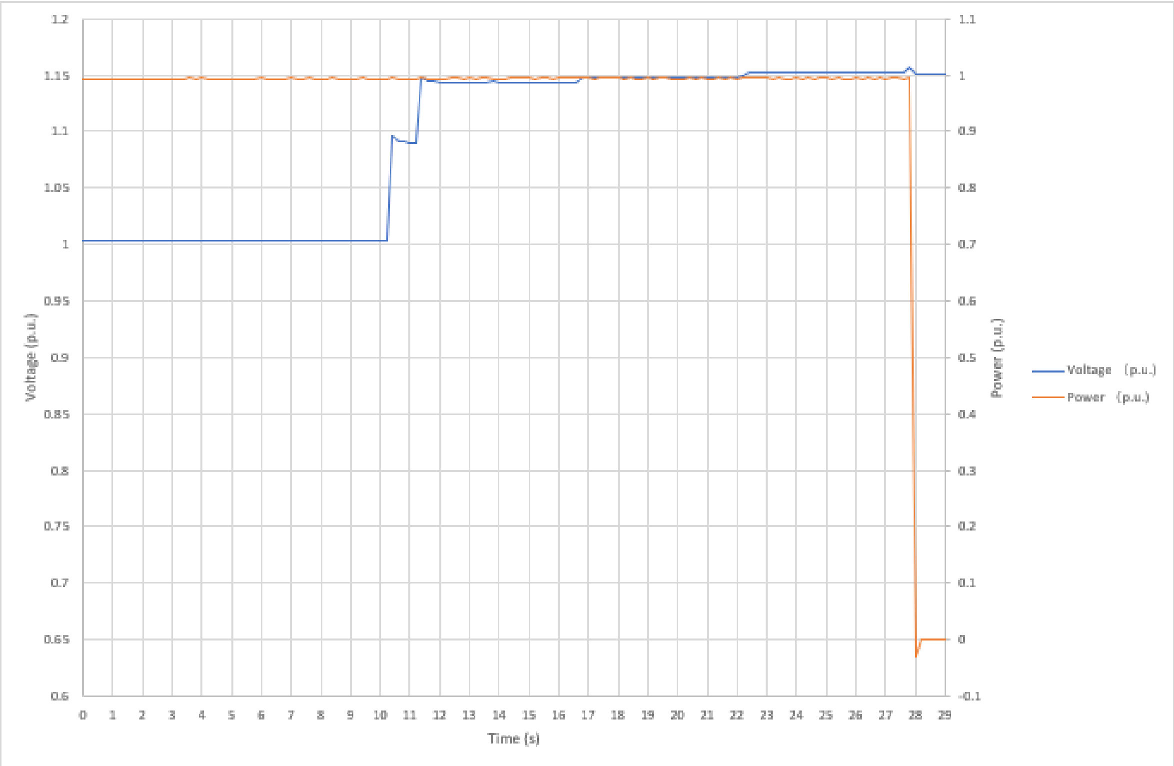
Overvoltage (U >) Rep 3



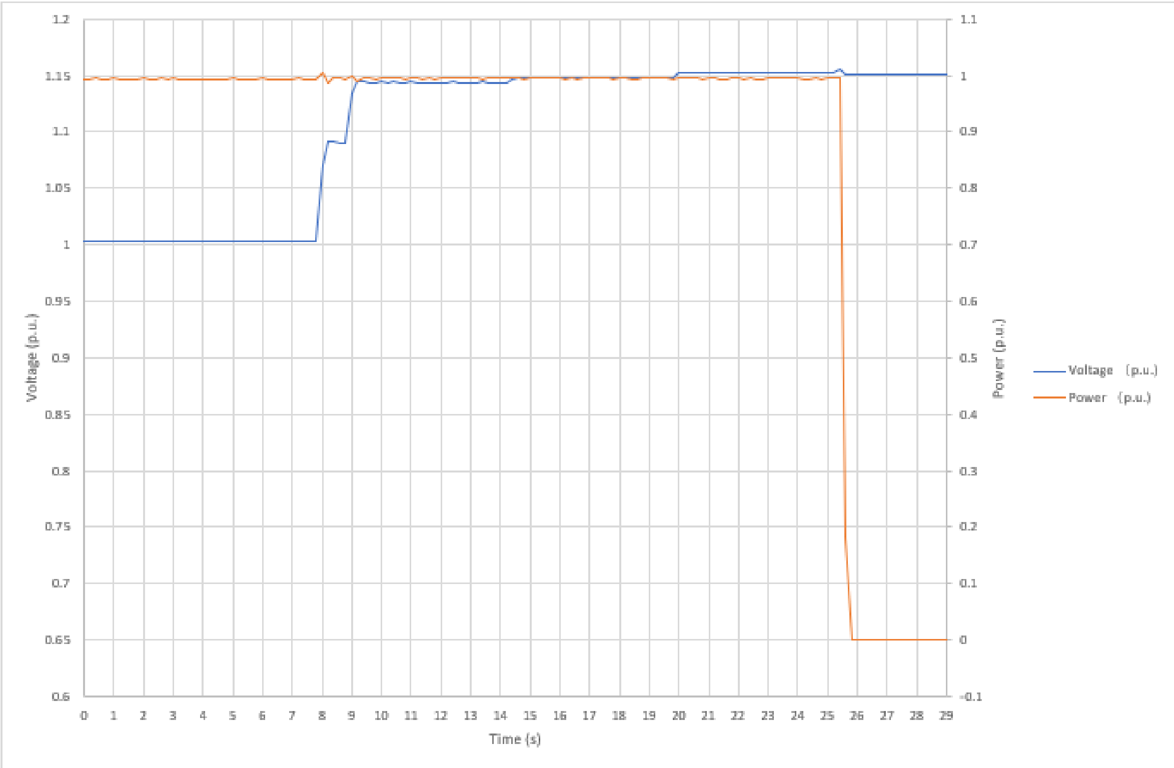
Overvoltage (U >>) Rep 1



Overvoltage (U >>) Rep 2



Overvoltage (U >>) Rep 3



4.18.1.2 Voltage trip time tests

The tests have been made as the following procedure:

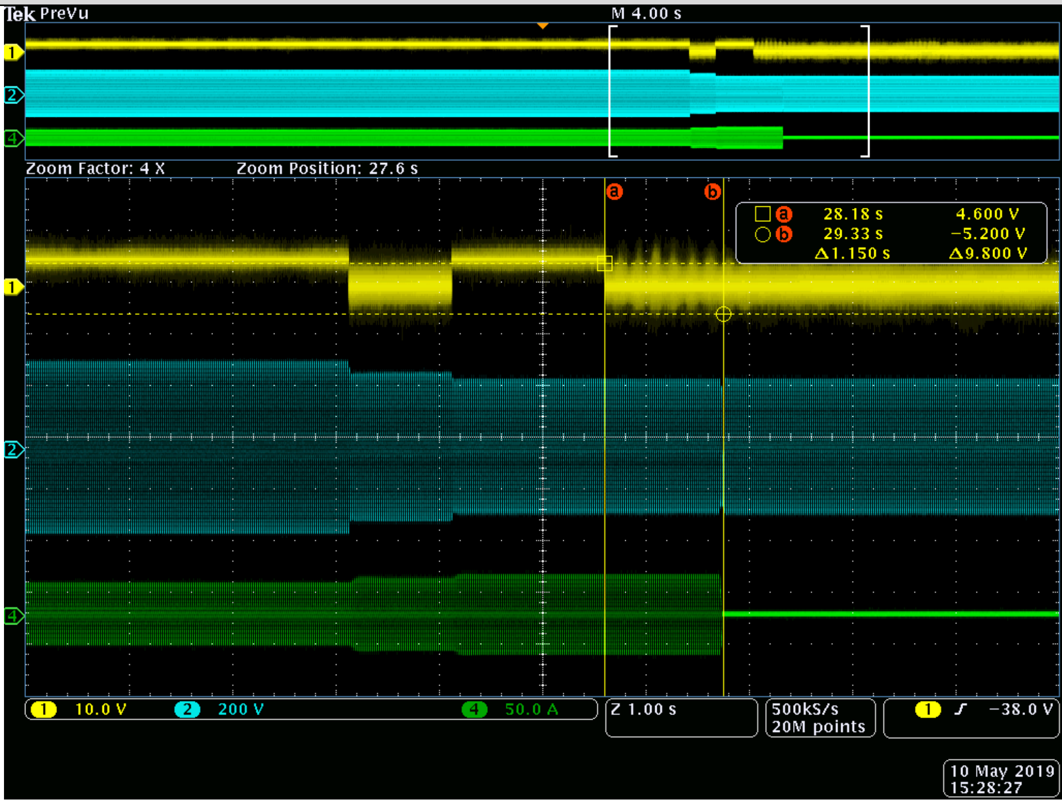
- For undervoltage protection (U<): Maintaining the voltage with a value 100%Un during at least 1.5 seconds and then change the frequency to 78.2%Un with a step. Trip time shall take place in less than 2 seconds and more than 1s.
- For overvoltage protection (U>): Maintaining the voltage with a value 112.5%Un during at least 1.5 seconds and then change the frequency to 113.0%Un with a step. Trip time shall take place in less than 2 seconds and more than 1s.
- For overvoltage protection (U>>): Maintaining the voltage with a value 114.5%Un during at least 0.5 seconds and then change the frequency to 115.0%Un with a step. Trip time shall take place in less than 0.2 seconds.

Test results are offered in the following table:

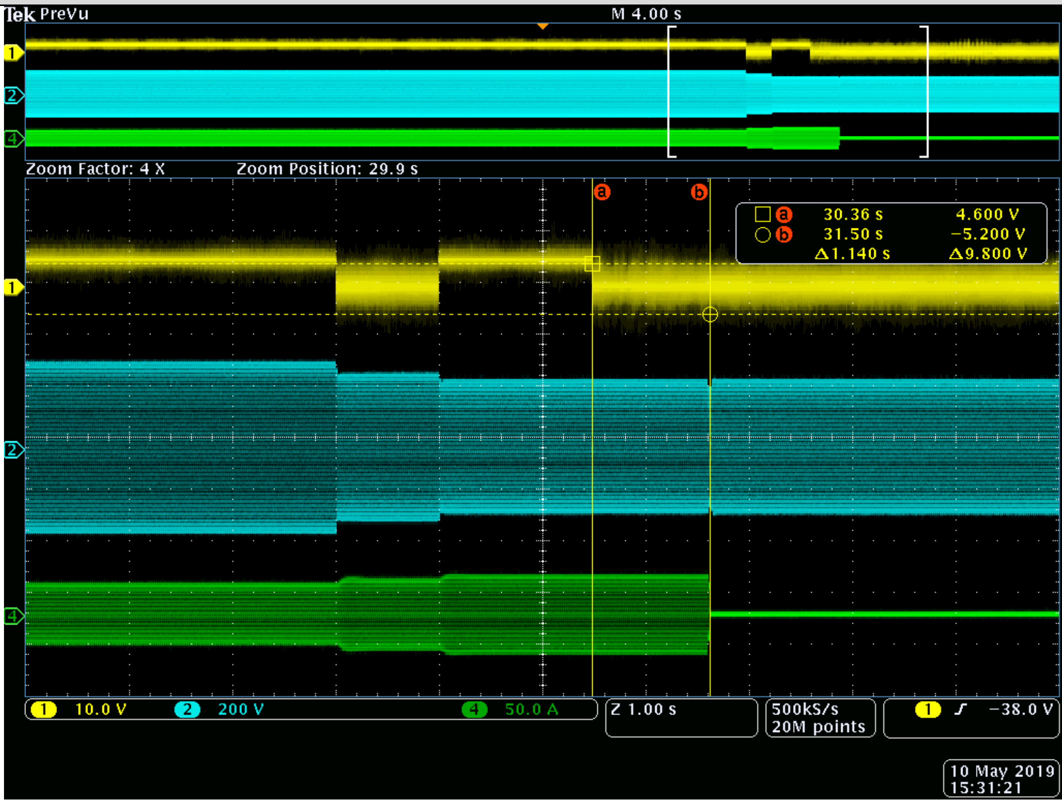
Protective Function Tested	No Trip Test			Trip Test		
	Voltage value (%Un)	Time measured (s)	Trip	Voltage settling value (%Un)	Trip	Trip time measured (ms)
U < (Rep 1)	78.5%	>1.5	☒ NO ☐ YES	78.2%	☐ NO ☒ YES	1150
U < (Rep 2)	78.5%	>1.5	☒ NO ☐ YES	78.2%	☐ NO ☒ YES	1140
U < (Rep 3)	78.5%	>1.5	☒ NO ☐ YES	78.2%	☐ NO ☒ YES	1090
U > (Rep 1)	112.5%	>1.5	☒ NO ☐ YES	113.0%	☐ NO ☒ YES	1040
U > (Rep 2)	112.5%	>1.5	☒ NO ☐ YES	113.0%	☐ NO ☒ YES	1012
U > (Rep 3)	112.5%	>1.5	☒ NO ☐ YES	113.0%	☐ NO ☒ YES	1016
U > > (Rep 1)	114.5%	> 0.5	☒ NO ☐ YES	115.0%	☐ NO ☒ YES	196
U > > (Rep 2)	114.5%	> 0.5	☒ NO ☐ YES	115.0%	☐ NO ☒ YES	180
U > > (Rep 3)	114.5%	> 0.5	☒ NO ☐ YES	115.0%	☐ NO ☒ YES	176

Test results are graphically shown in the graph below and in the following page.

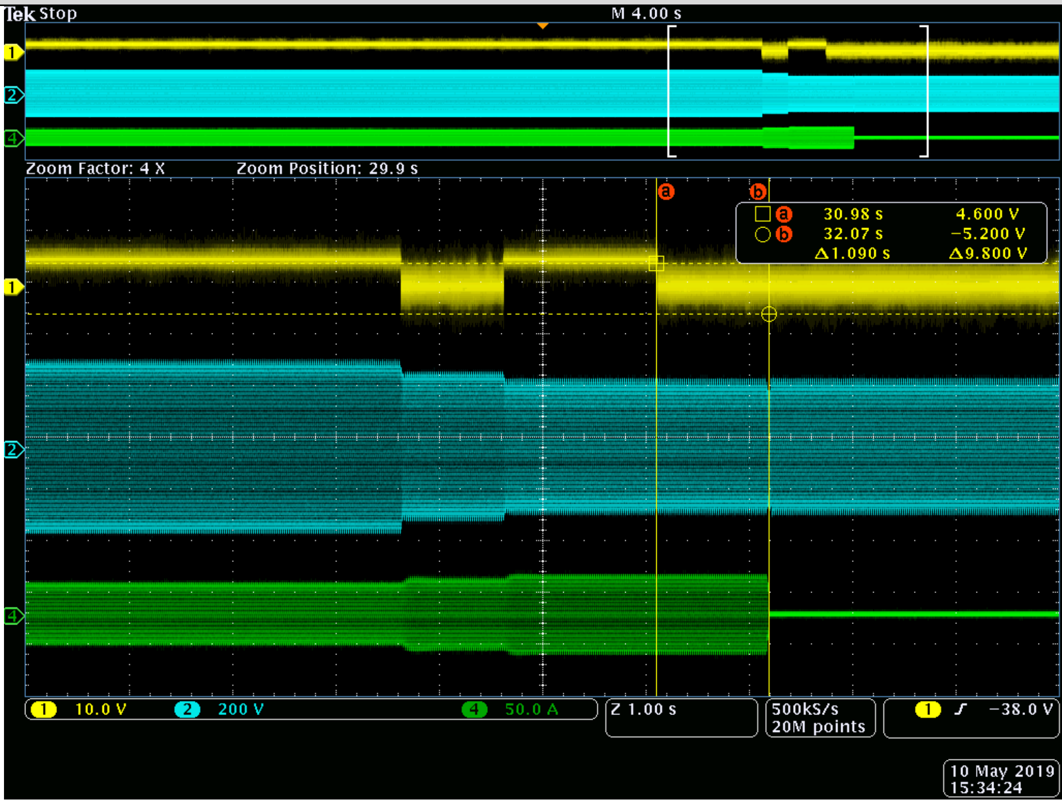
Undervoltage (U <) Rep 1



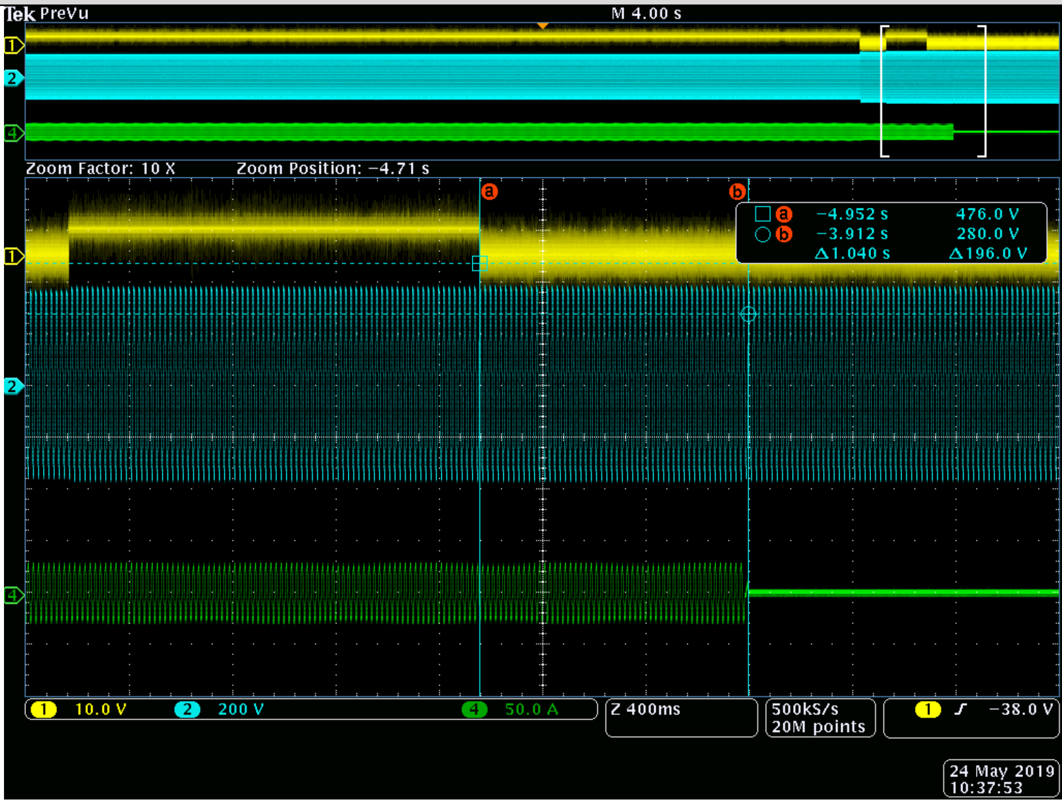
Undervoltage (U <) Rep 2



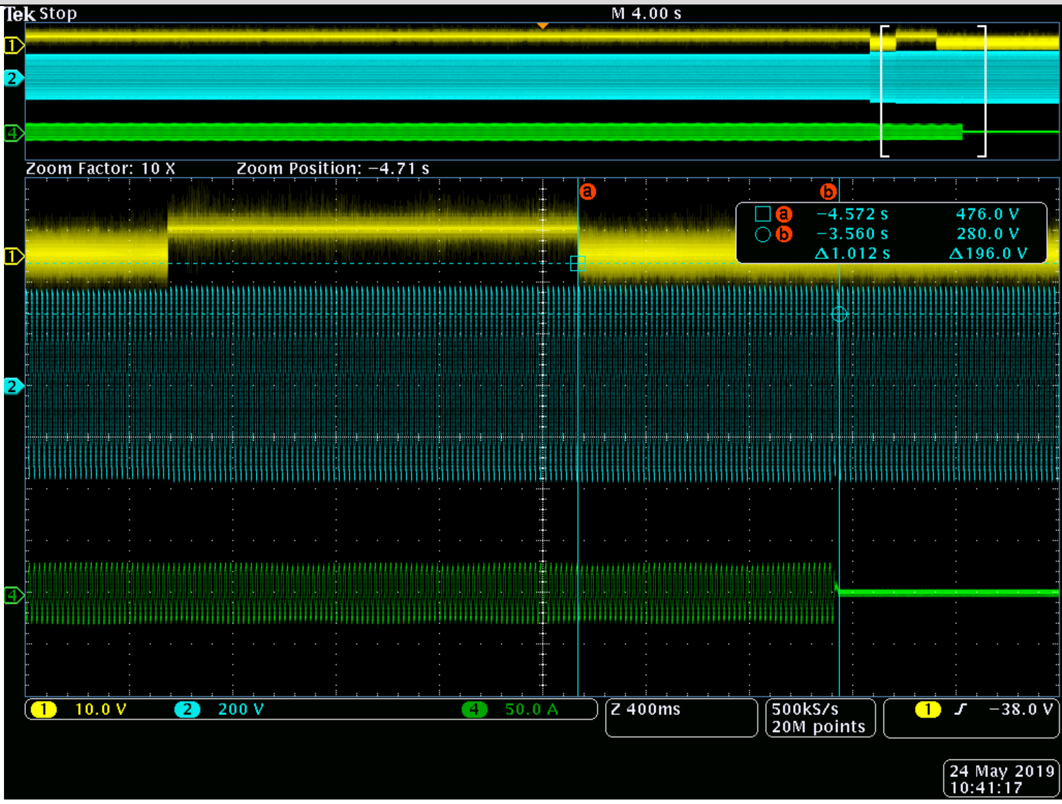
Undervoltage (U<) Rep 3



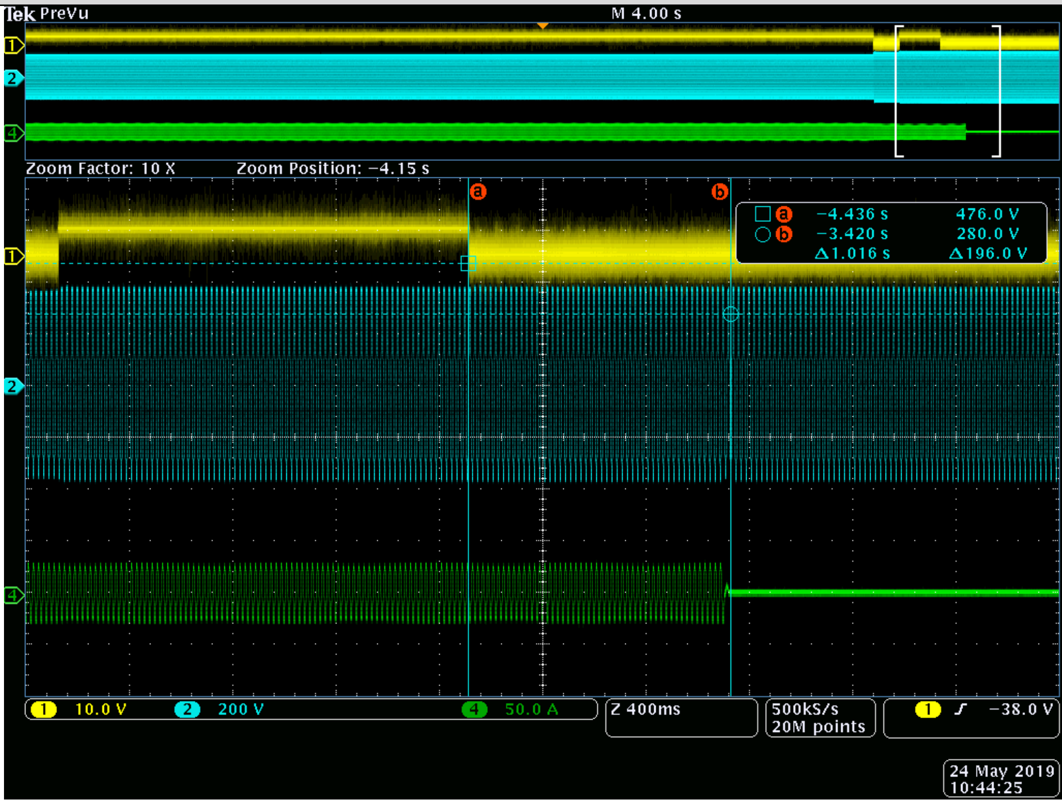
Overvoltage (U>) Rep 1



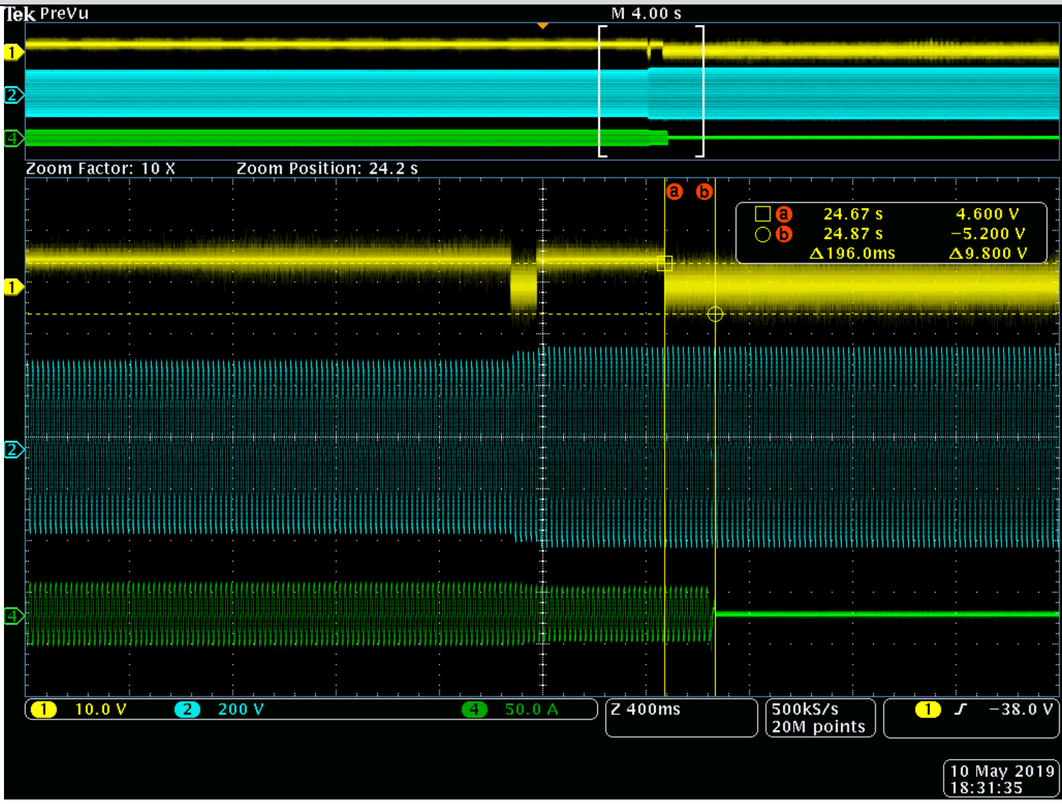
Overvoltage (U>) Rep 2



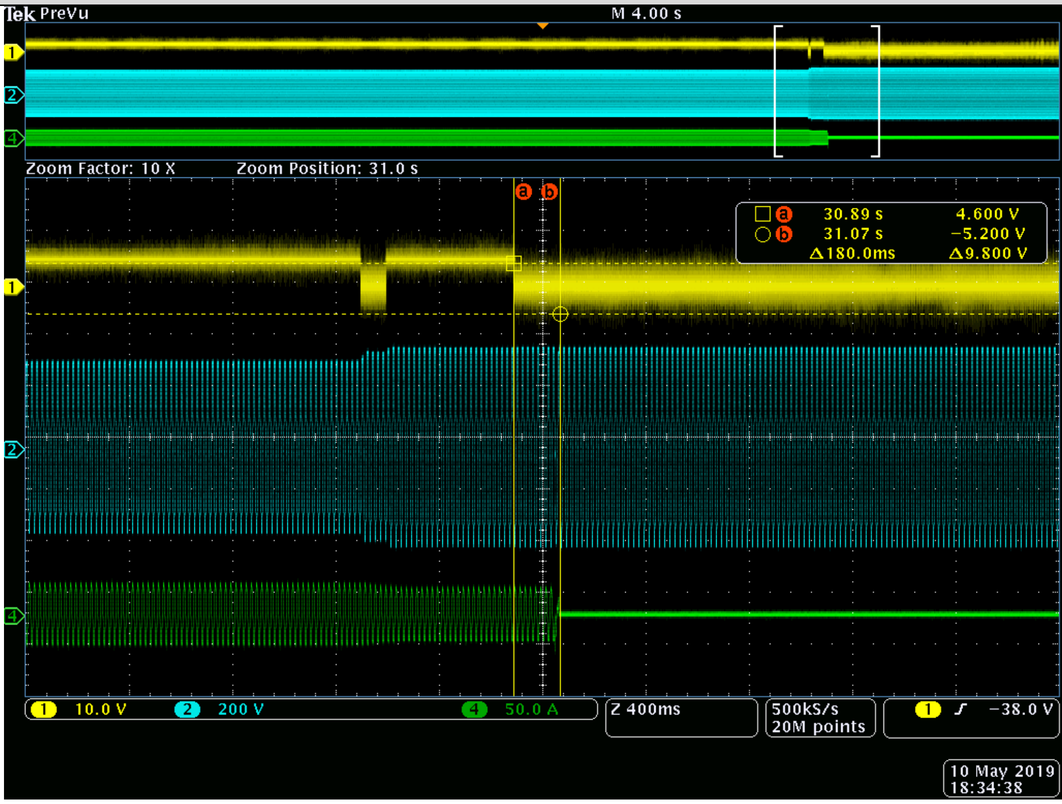
Overvoltage (U>) Rep 3



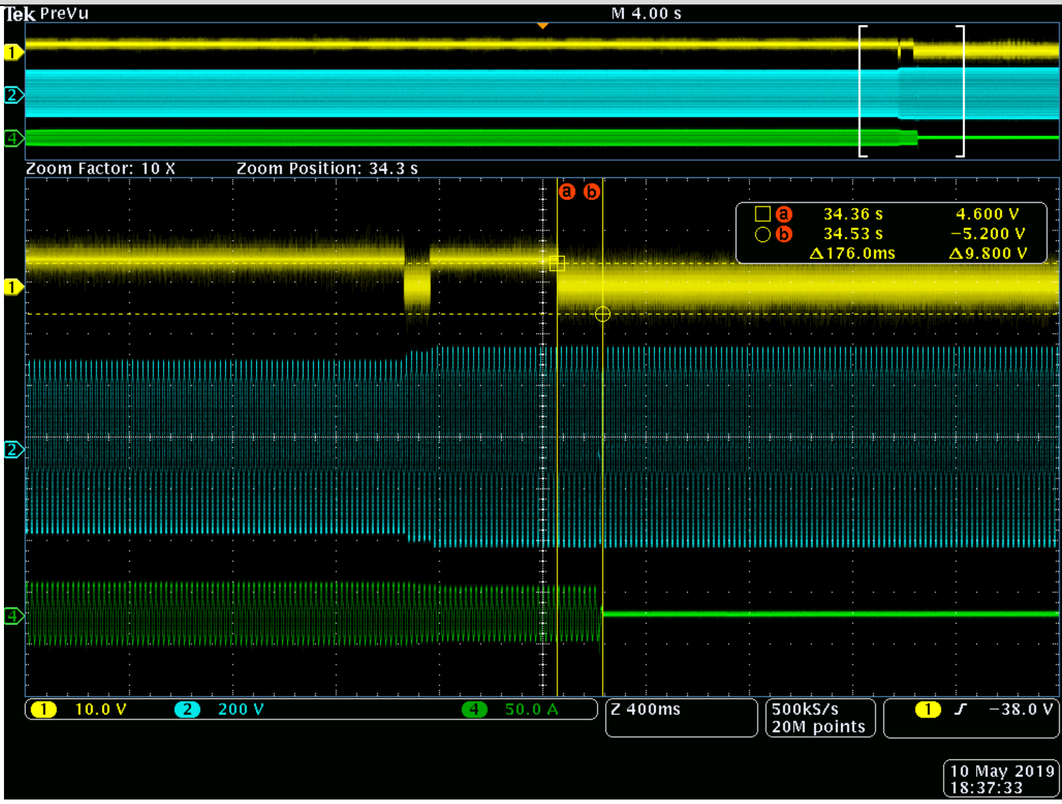
Overvoltage (U>>) Rep 1



Overvoltage (U>>) Rep 2



Overvoltage (U>>) Rep 3



4.18.2 Frequency trip tests

To asses that the protective function of the inverter against abnormal frequency is effective two different kinds of tests have been done:

- Trip value tests, to evaluate if the inverter can trip with accuracy in accordance with a settling value of frequency.
- Trip time tests, to evaluate if the inverter can trip into the limits of time stated by the standard in case of detecting frequency levels out of the limits stated by the standard.

4.18.2.1 Frequency trip value tests

The tests have been made as the following procedure:

- For underfrequency protection: Starting from a frequency level 0.2 Hz above the trip value of the protection function to be tested, the frequency is decreased 0.05 Hz in steps of at least 150% of the trip time delay stated in the protection function to be tested.
- For overfrequency protection: Starting from a frequency level 0.2 Hz below the trip value of the protection function to be tested, the frequency is increased 0.05 Hz in steps of at least 150% of the trip time delay stated in the protection function to be tested.

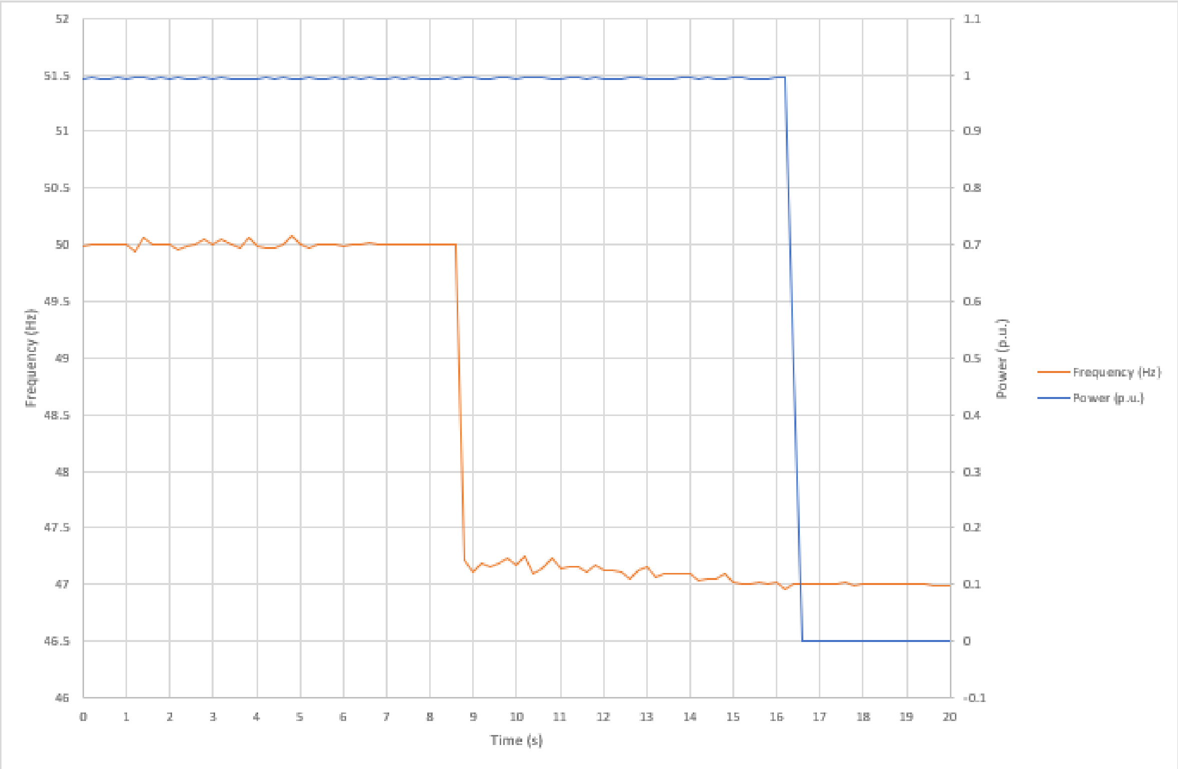
Test results are offered in the following tables:

Protective Function Tested	No Trip Test			Trip Test		
	Frequency value (Hz)	Time measured (s)	Trip	Frequency settling value (Hz)	Trip	Frequency trip value measured (Hz)
F< (Rep1)	47.20	> 1.5	☒ NO ☐ YES	47.00	☐ NO ☒ YES	47.00
F< (Rep2)	47.20	> 1.5	☒ NO ☐ YES	47.00	☐ NO ☒ YES	47.00
F< (Rep3)	47.20	> 1.5	☒ NO ☐ YES	47.00	☐ NO ☒ YES	47.00
F> (Rep1)	51.80	> 0.5	☒ NO ☐ YES	52.00	☐ NO ☒ YES	51.94
F> (Rep2)	51.80	> 0.5	☒ NO ☐ YES	52.00	☐ NO ☒ YES	52.04
F> (Rep3)	51.80	> 0.5	☒ NO ☐ YES	52.00	☐ NO ☒ YES	52.01

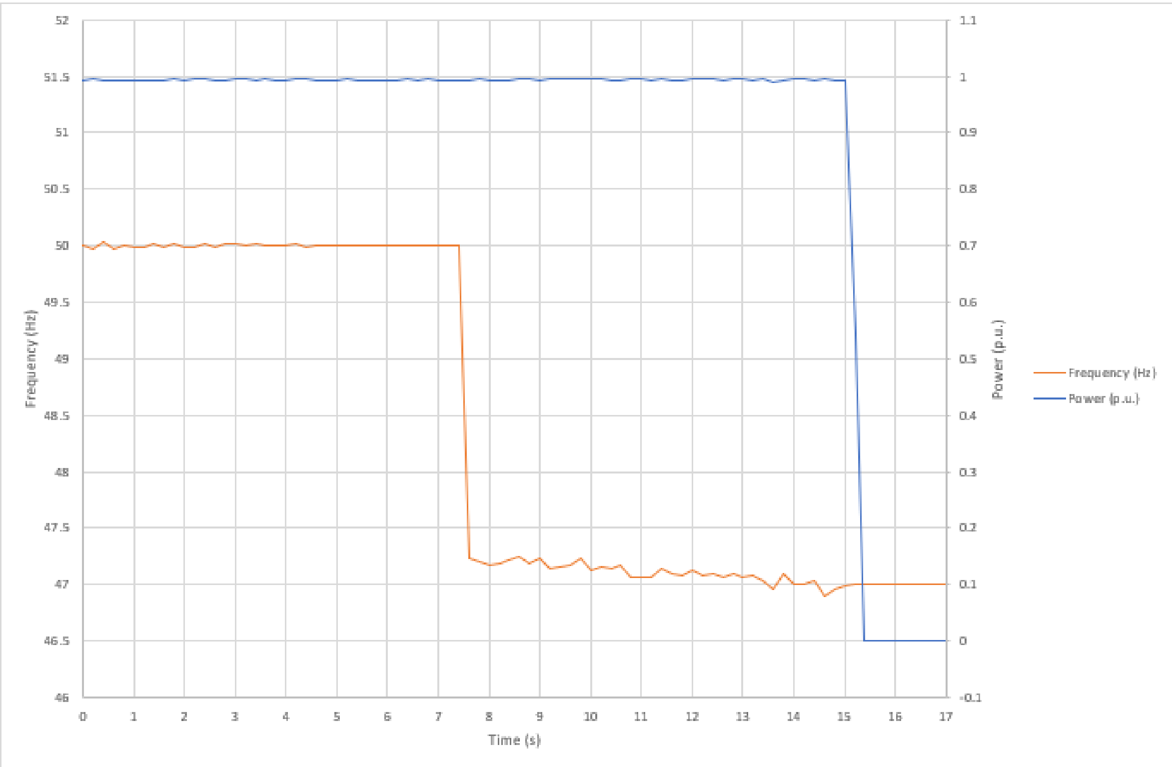
Maximum frequency deviation allowed is ±0.10 Hz.

Test results are graphically shown in following pages.

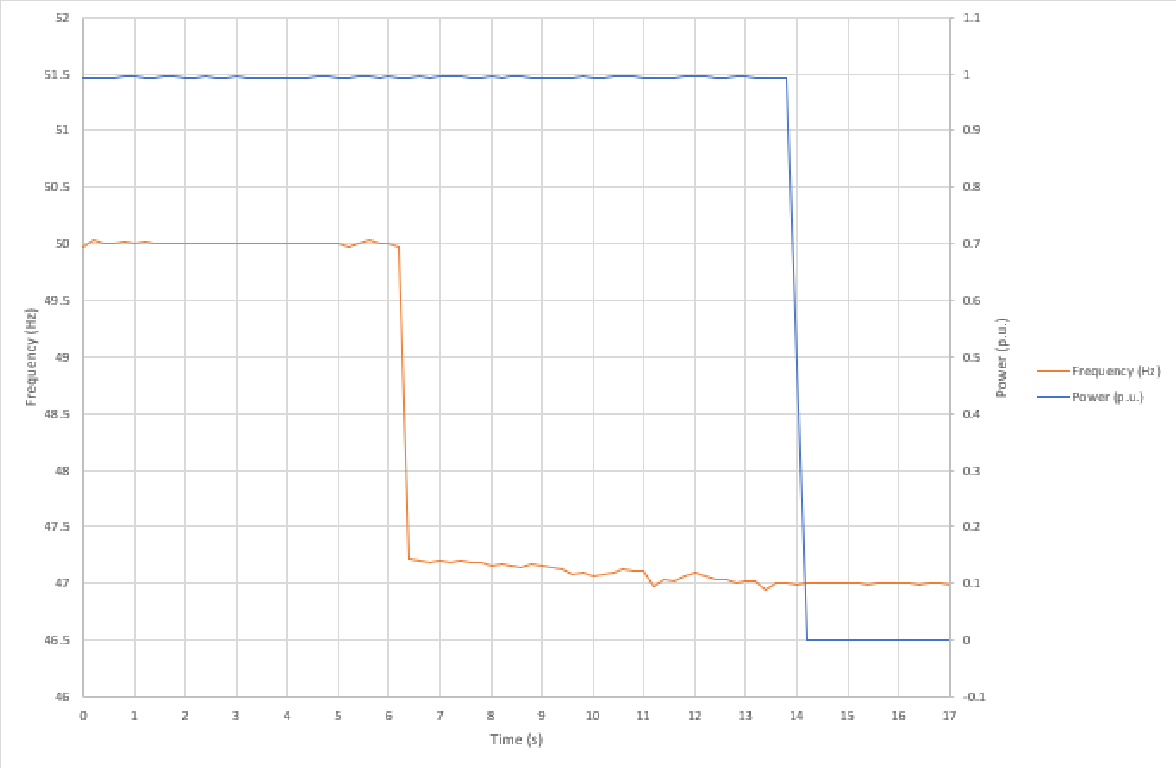
Underfrequency (F<) Rep 1



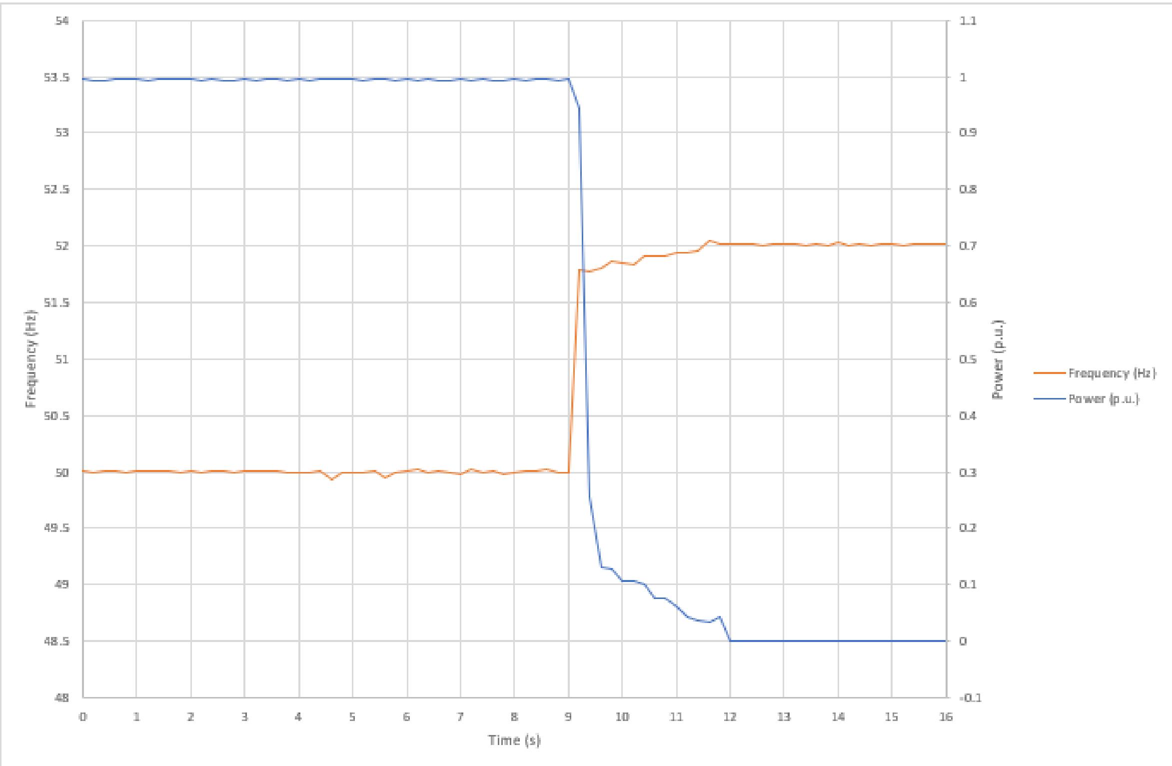
Underfrequency (F<) Rep 2



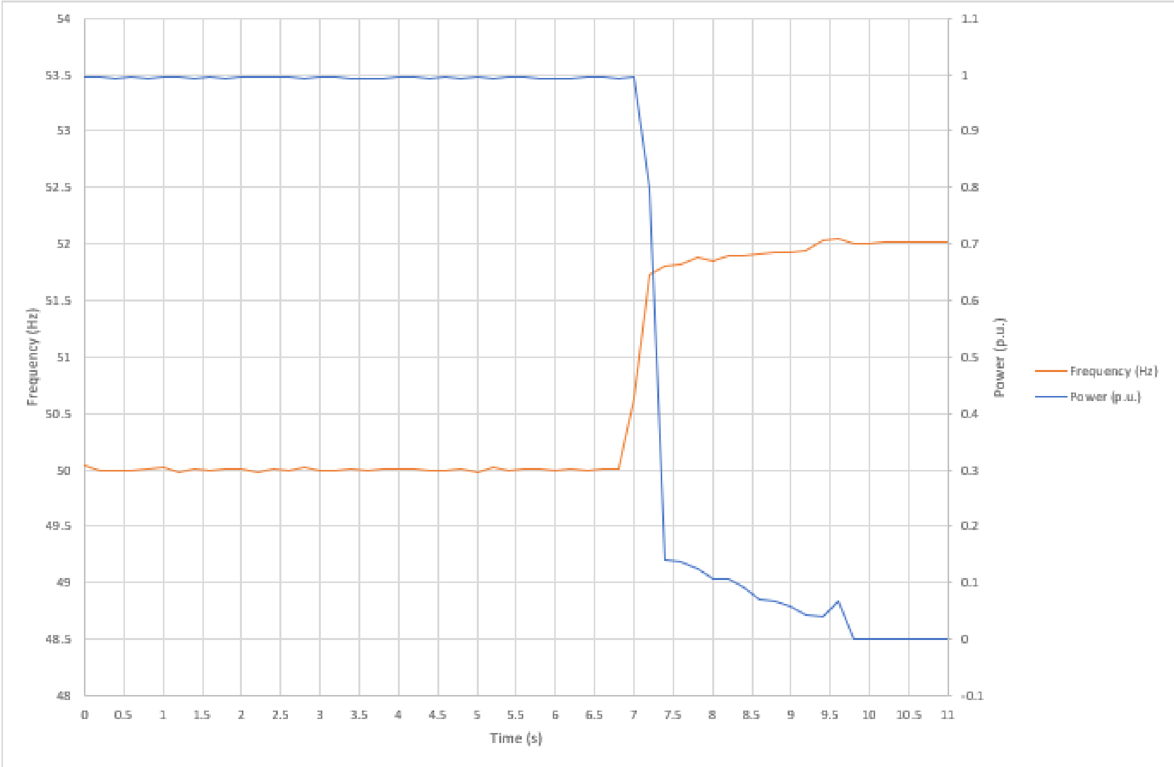
Underfrequency (F<) Rep 3



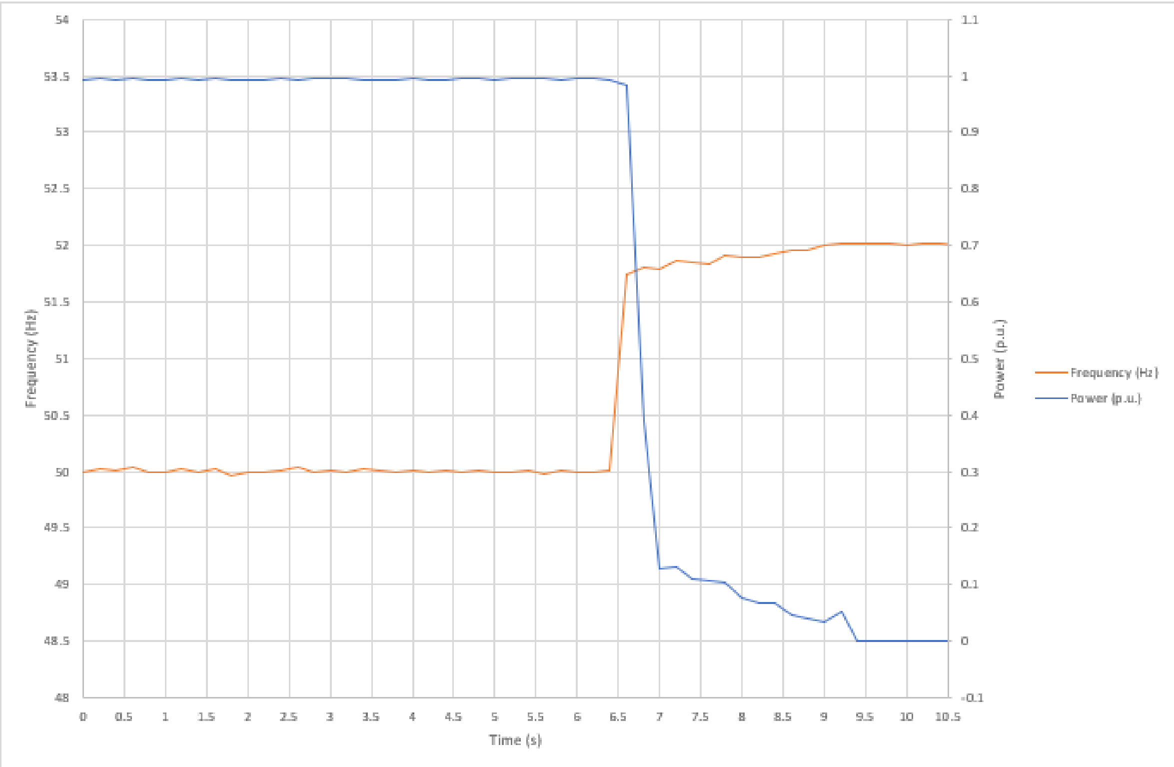
Overfrequency (F>) Rep 1



Overfrequency (F>) Rep 2



Overfrequency (F>) Rep 3



4.18.2.2 Frequency trip time tests

The tests have been made as the following procedure:

- For underfrequency protection: Maintaining the frequency with a value over the settling value during at least 1.5 seconds and then change the frequency to 46 Hz with a step.
- For overfrequency protection: Maintaining the frequency with a value below the settling value during at least 0.5 seconds and then change the frequency to 53 Hz with a step.

For underfrequency the standard states that the trip shall take place with a delay of at least 1 second and in less than 2 seconds, for overfrequency the condition stated by the standard is to trip in less than 0.2 seconds.

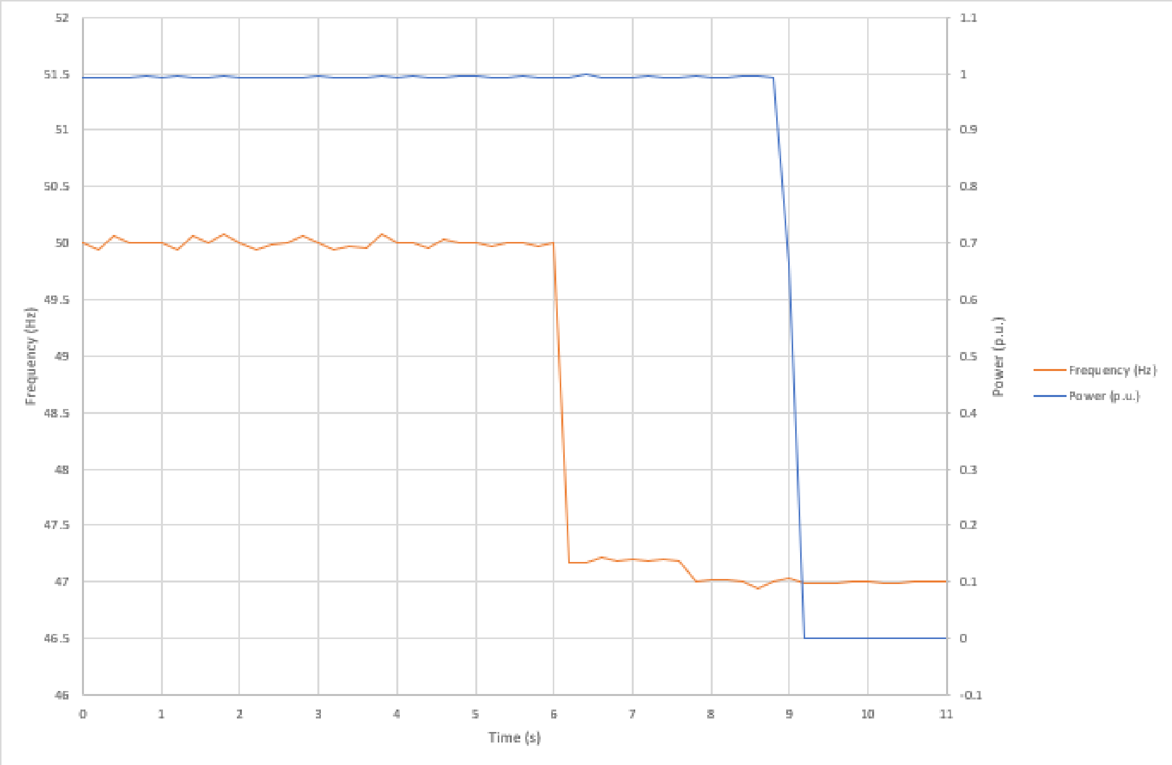
Test results are offered in the following tables:

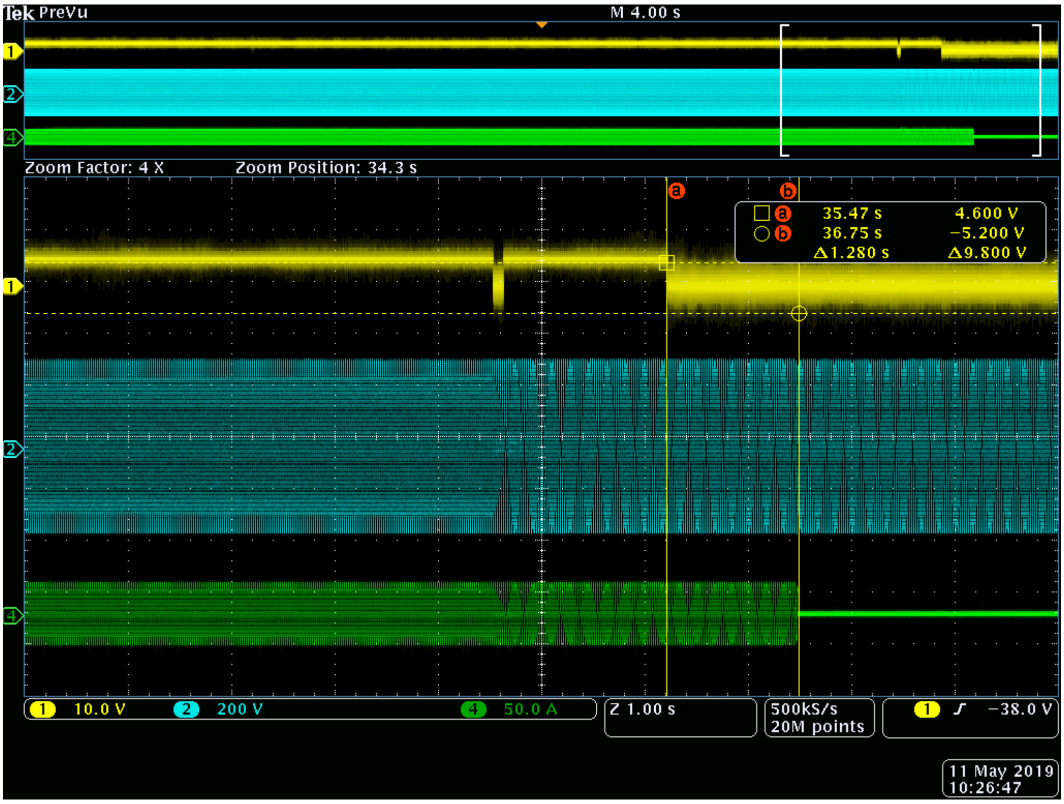
Protective Function Tested	No Trip Test			Trip Test		
	Frequency value (Hz)	Time measured (s)	Trip	Frequency settling value (Hz)	Trip	Trip Time measured (ms)
F< (Rep 1)	47.10	> 1.5	☒ NO ☐ YES	47.00	☐ NO ☒ YES	1280
F< (Rep 2)	47.10	> 1.5	☒ NO ☐ YES	47.00	☐ NO ☒ YES	1260
F< (Rep 3)	47.10	> 1.5	☒ NO ☐ YES	47.00	☐ NO ☒ YES	1270
F> (Rep 1)	51.90	> 0.5	☒ NO ☐ YES	52.00	☐ NO ☒ YES	126
F> (Rep 2)	51.90	> 0.5	☒ NO ☐ YES	52.00	☐ NO ☒ YES	130
F> (Rep 3)	51.90	> 0.5	☒ NO ☐ YES	52.00	☐ NO ☒ YES	52

Maximum frequency deviation allowed is ±0.10 Hz.

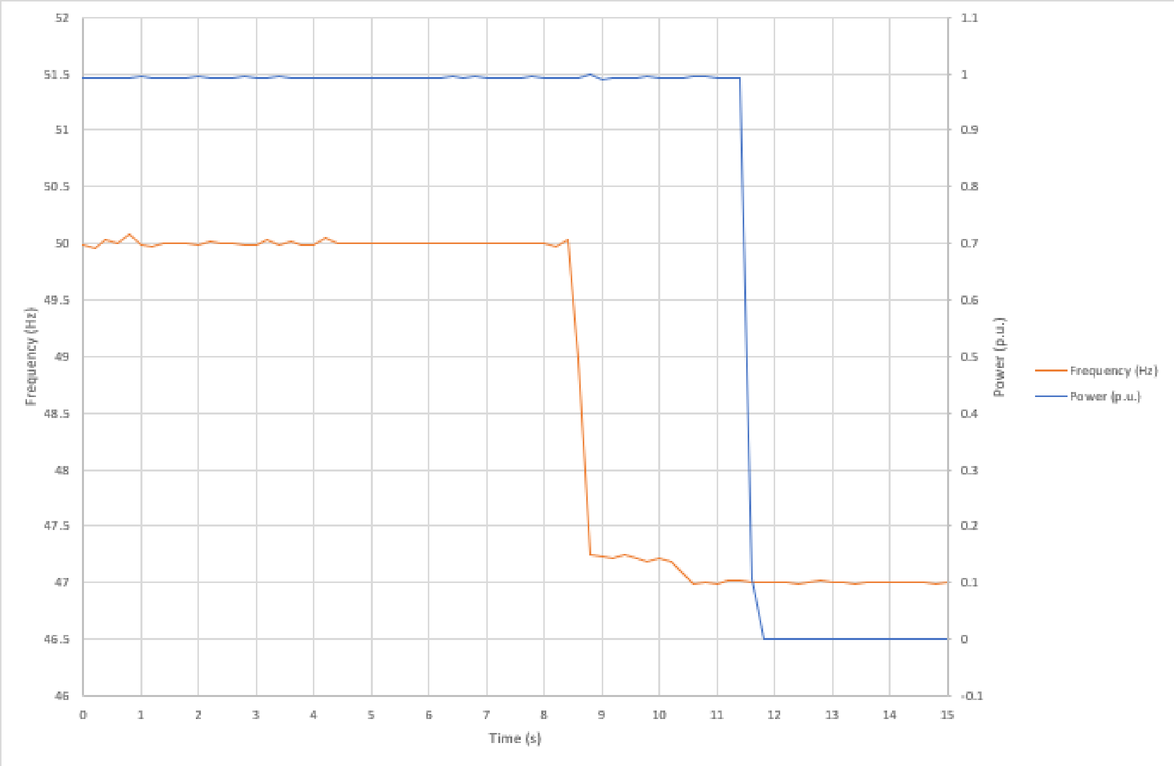
Test results are graphically shown in following pages.

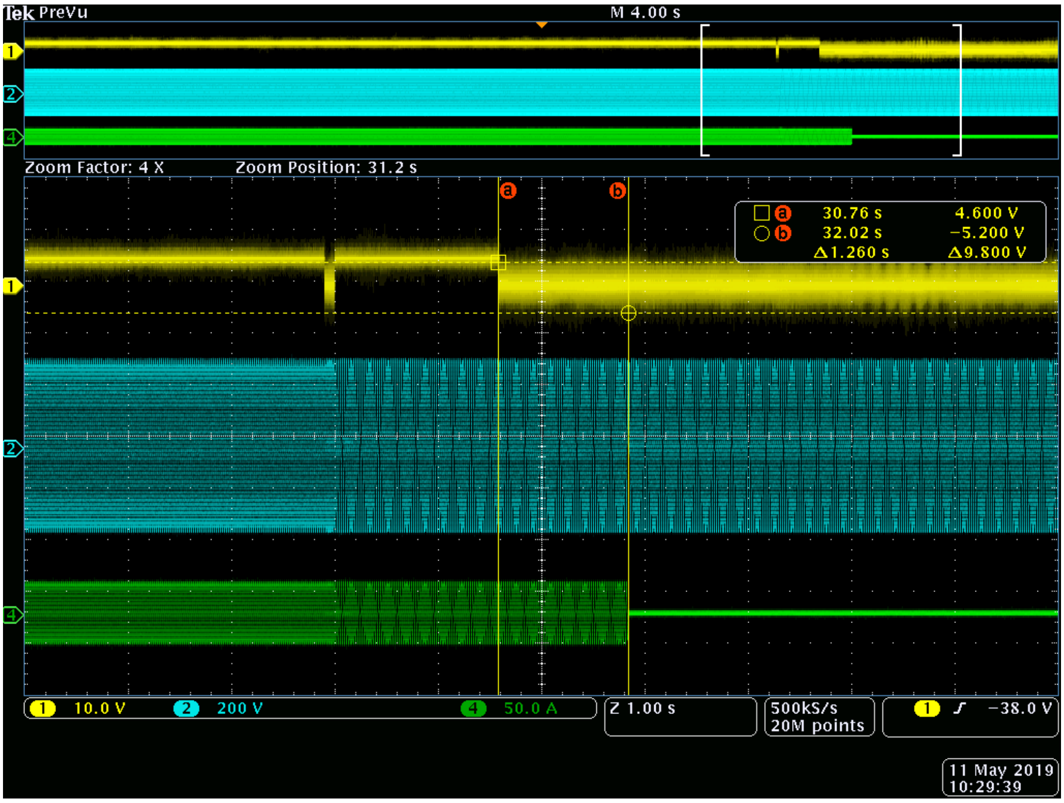
Underfrequency (F<) Rep 1



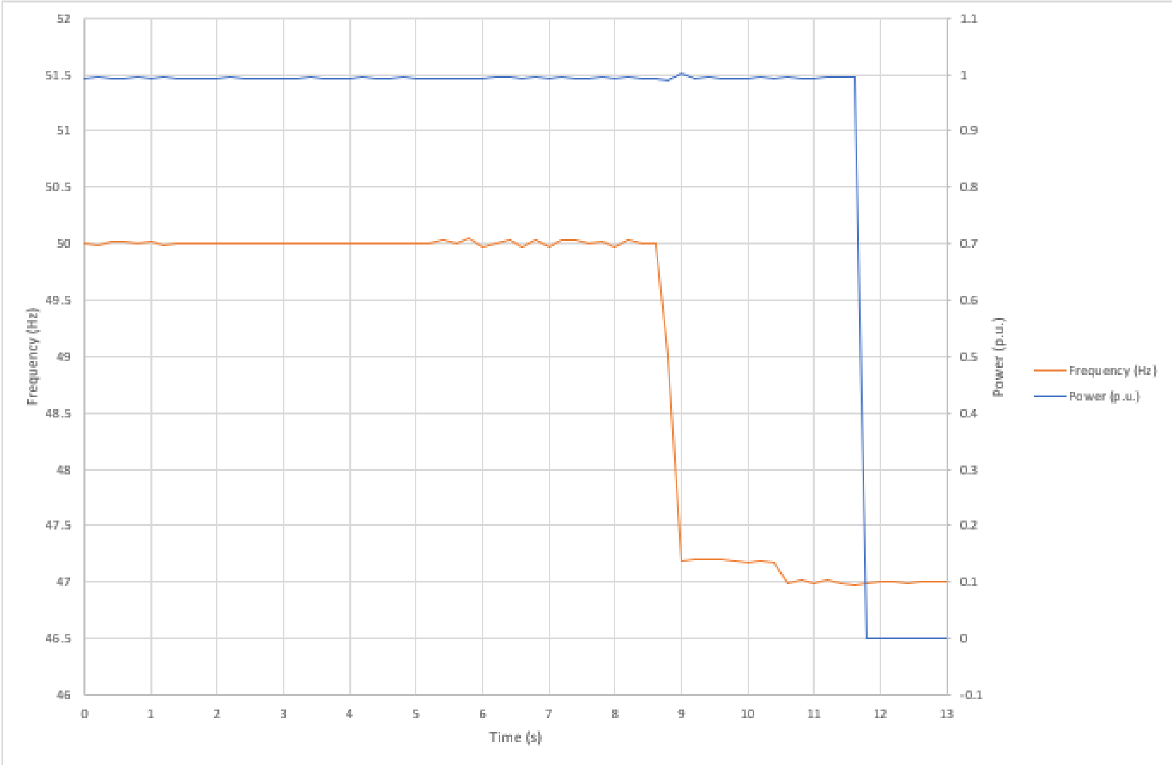


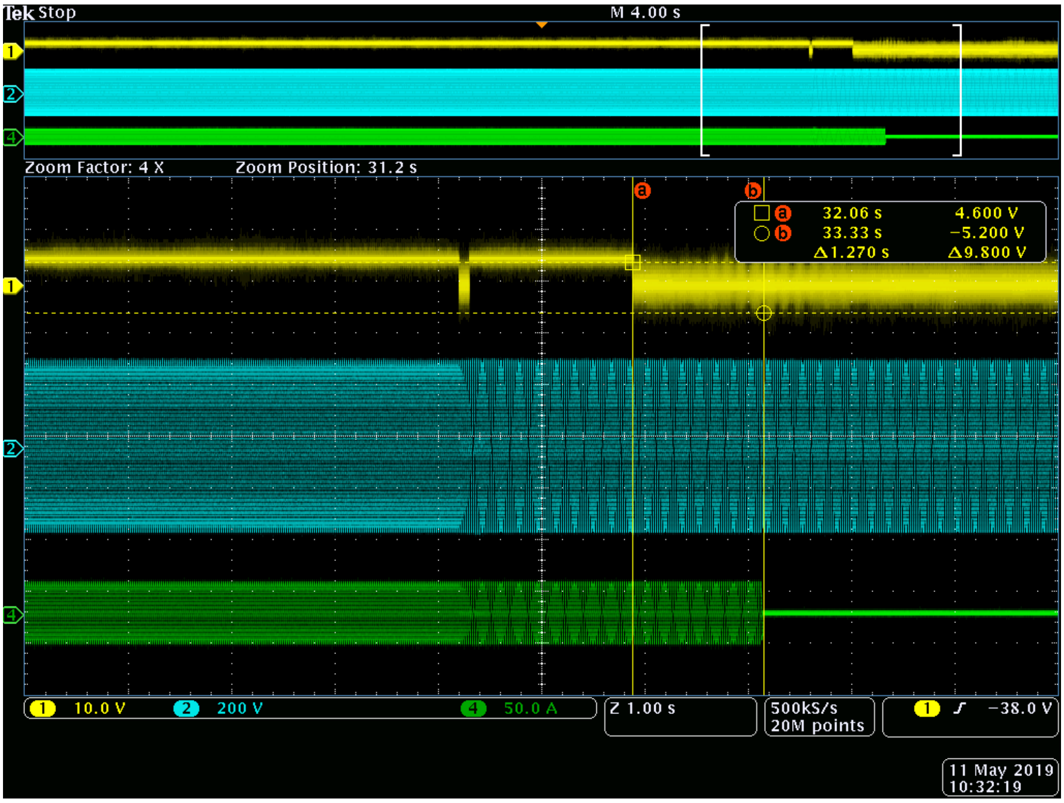
Underfrequency (F<) Rep 2



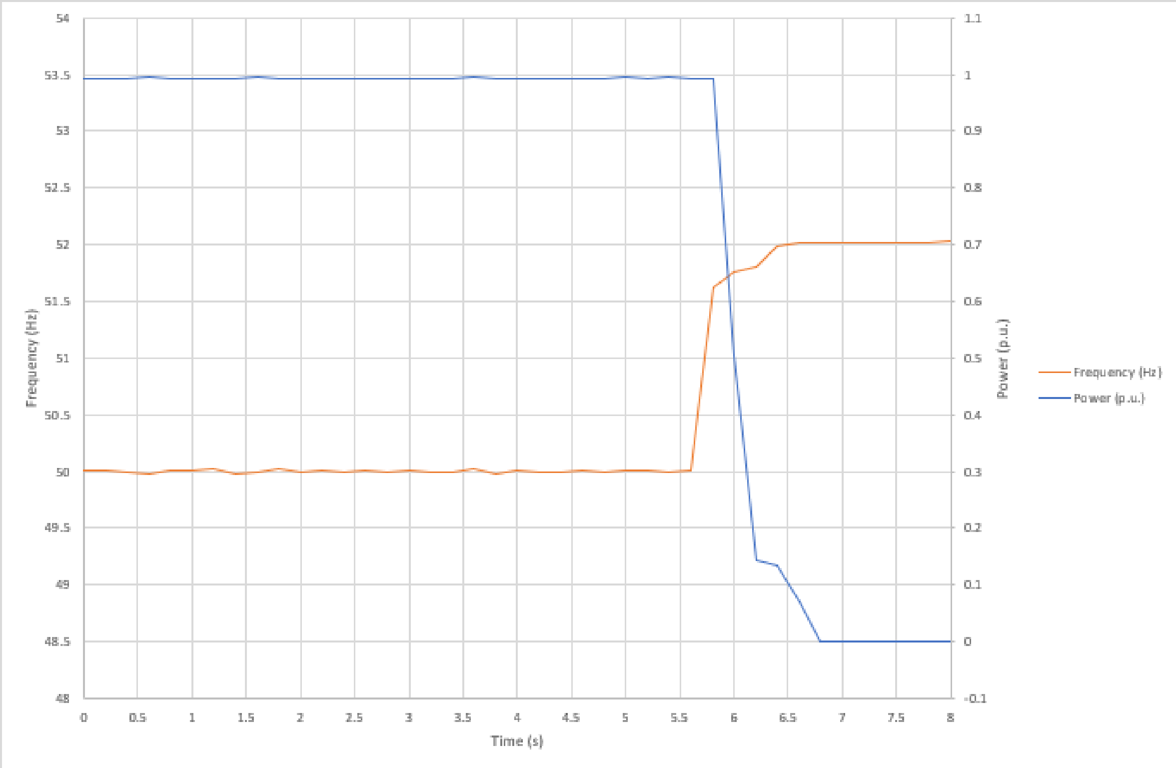


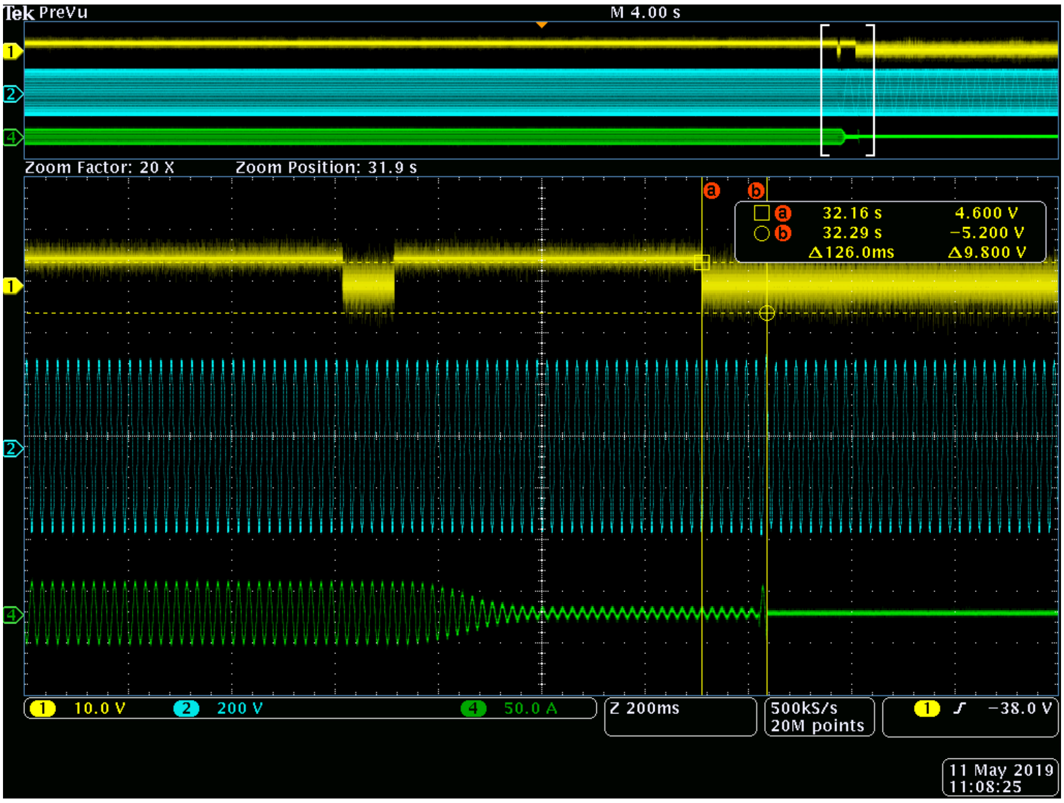
Underfrequency (F<) Rep 3



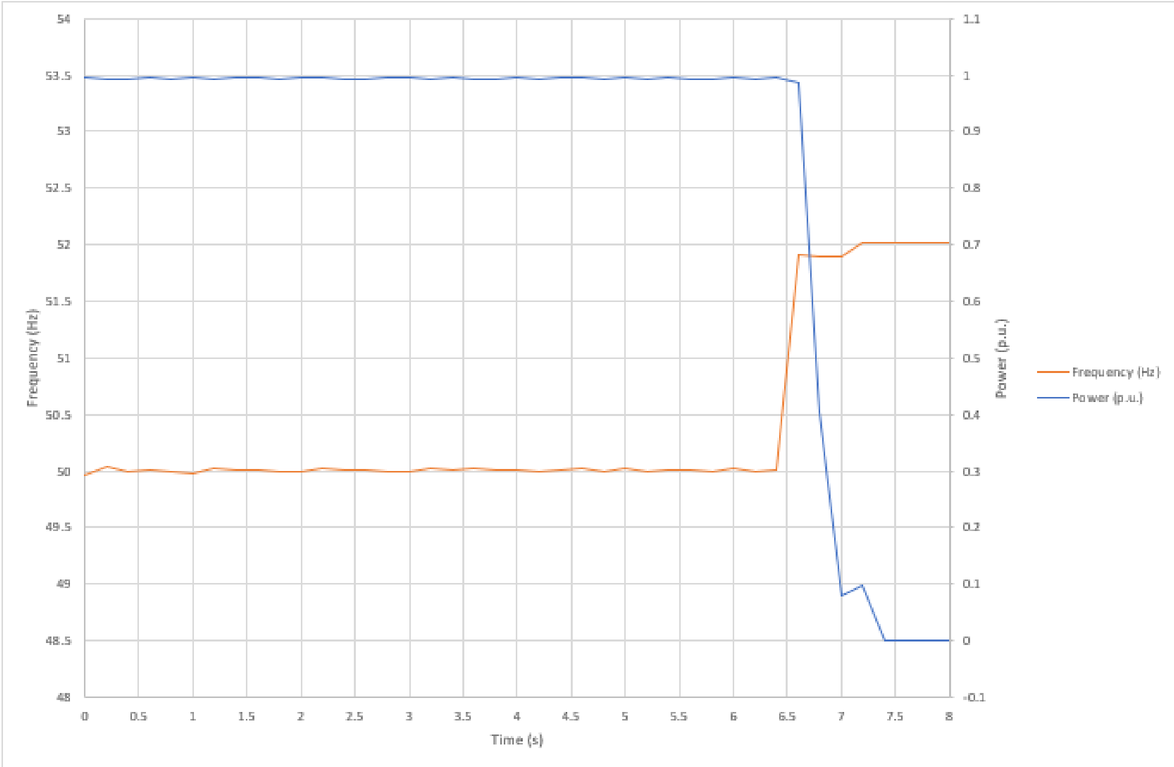


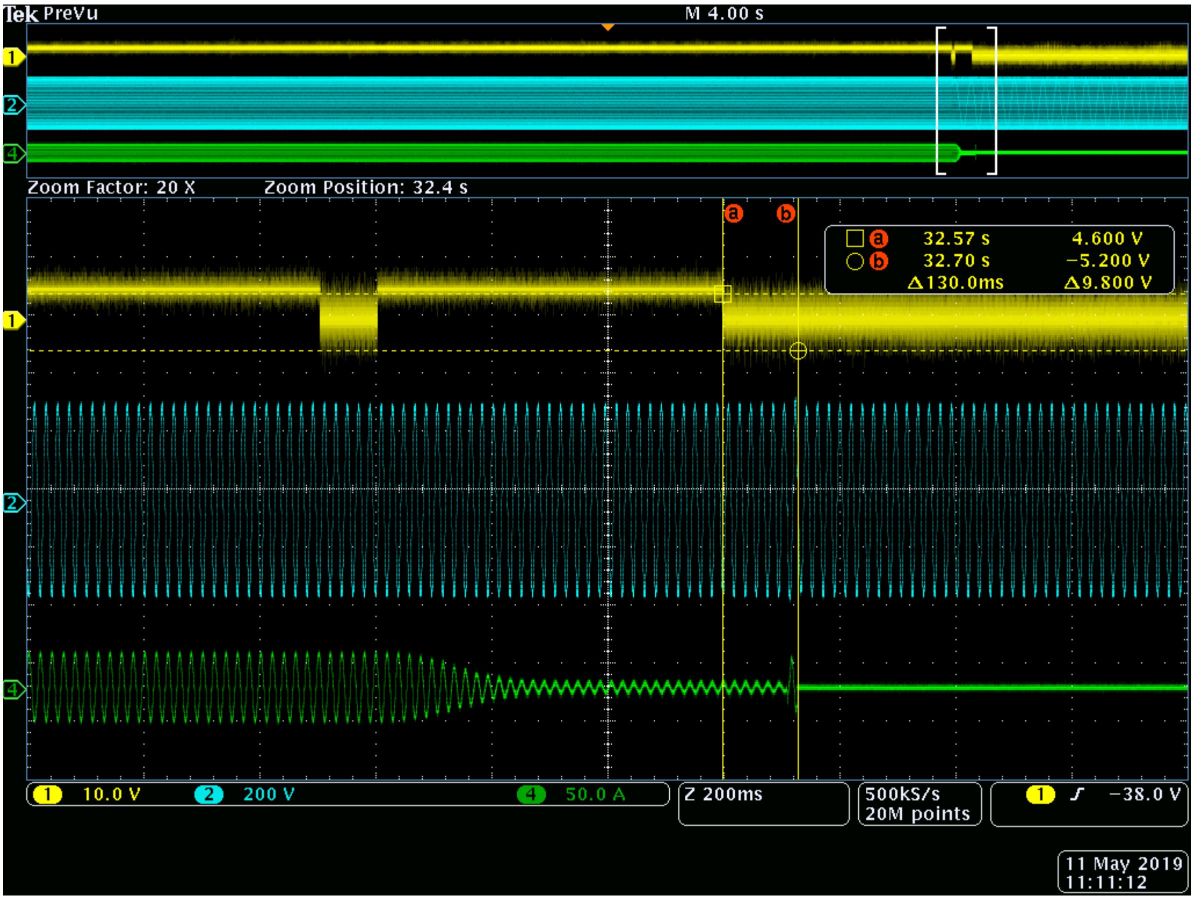
Overfrequency (F>) Rep 1



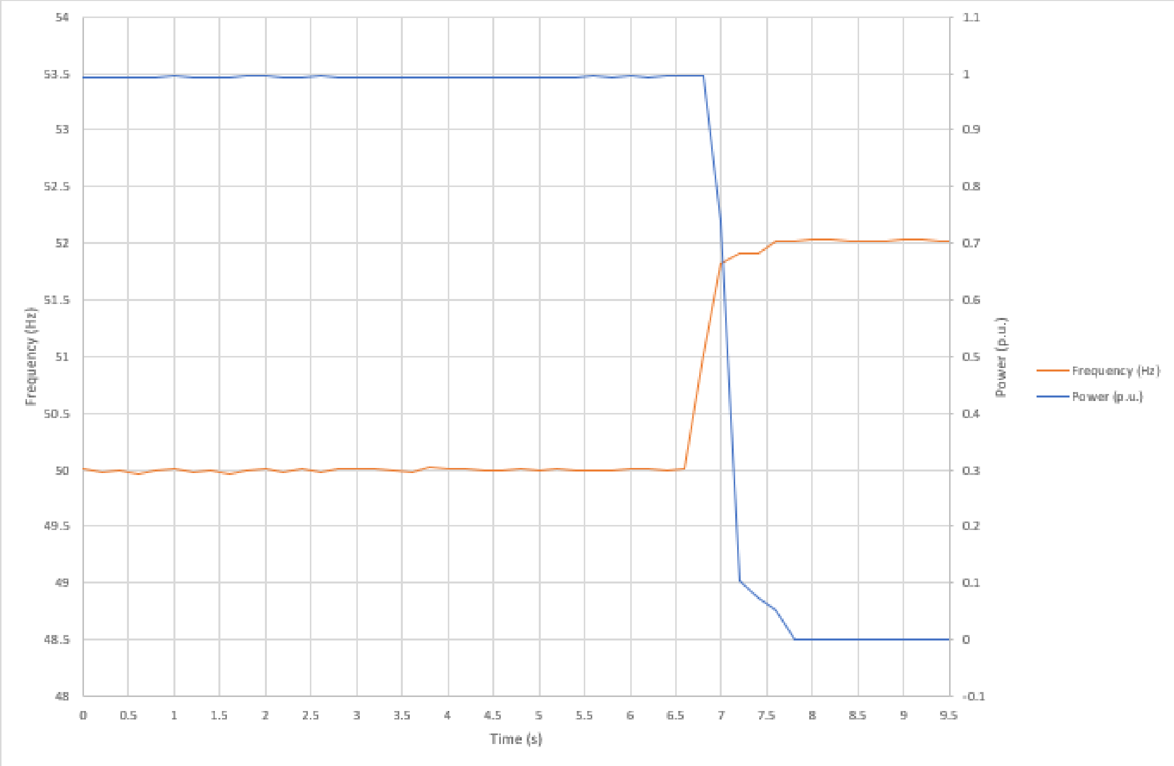


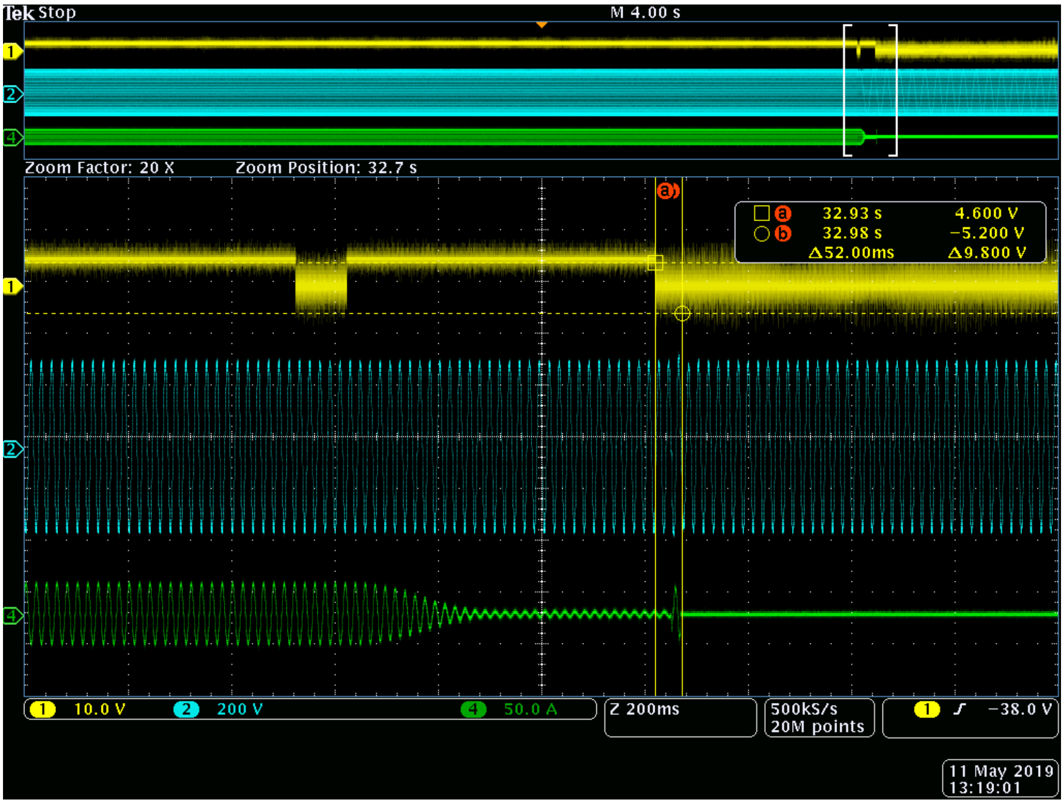
Overfrequency (F>) Rep 2





Overfrequency (F>) Rep 3





4.19 SUSTAINED OPERATION FOR VOLTAGE VARIATIONS

Tests for verifying the limits sustained operation for voltage variations have been carried out according to the Clause 7.5.2 of the standard.

The inverter shall operate the automatic disconnection device within 3 seconds when the average voltage for a 10 min period exceeds the V_{nom_max}. The voltage value applied for V_{nom_max} is 255V for Australia and 246V for New Zealand.

For the test performed, it has been verified that the inverter trips when any of the calculated voltage averages for total of the three phase system is above Vnom_max.

The test has been repeated 3 times for verifying the accuracy of the voltage trip value and 1 additional time to verify the trip time.

The admissible tolerance between setting value and trip value of the voltage is at maximum ±1V.

4.19.1 Voltage trip value tests

Starting from a voltage level equal to Un, this voltage is maintained a considerable time verifying that voltage averages calculated in each line are close to Un.

Then, the output voltage is increased up to a voltage equal to the Vnom_max setting less 1V. This level is maintained for 5 minutes.

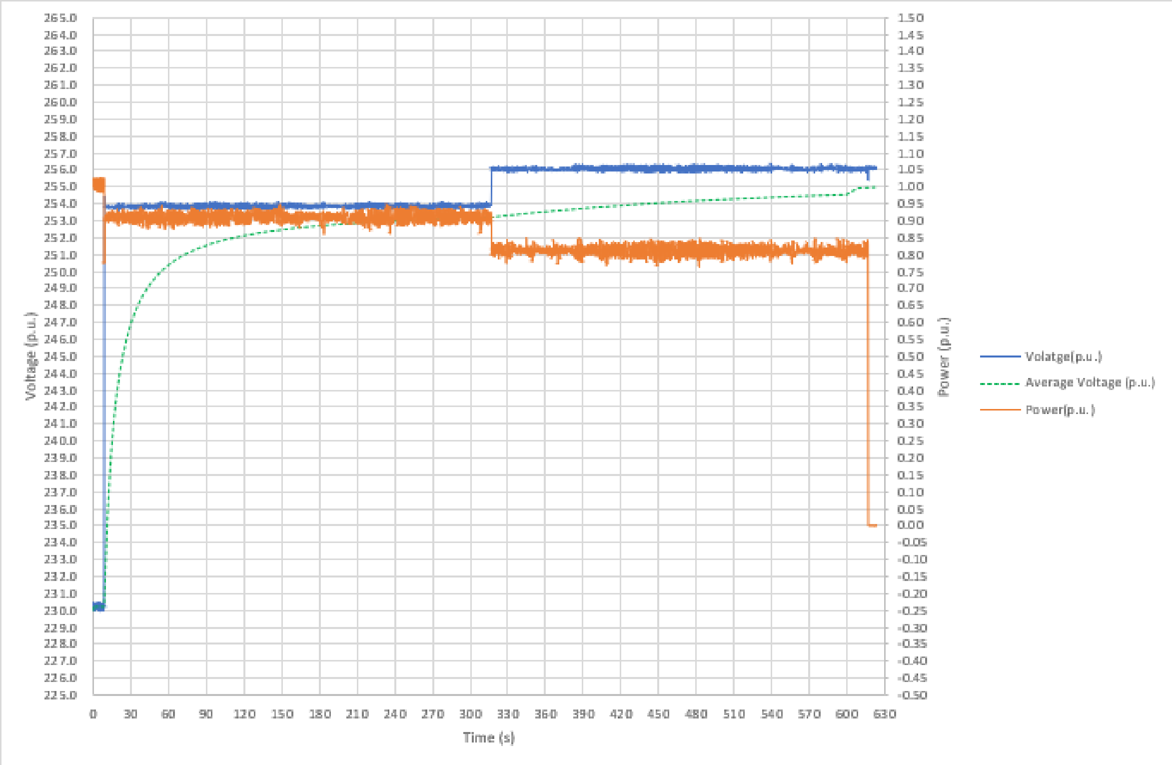
After this, the output voltage is increased up to a voltage equal to the Vnom_max setting plus 1V. This level is maintained up to the inverter trips and the voltage average value is recorded.

The table below offers test results obtained. Where the test procedure above mentioned has been applied.

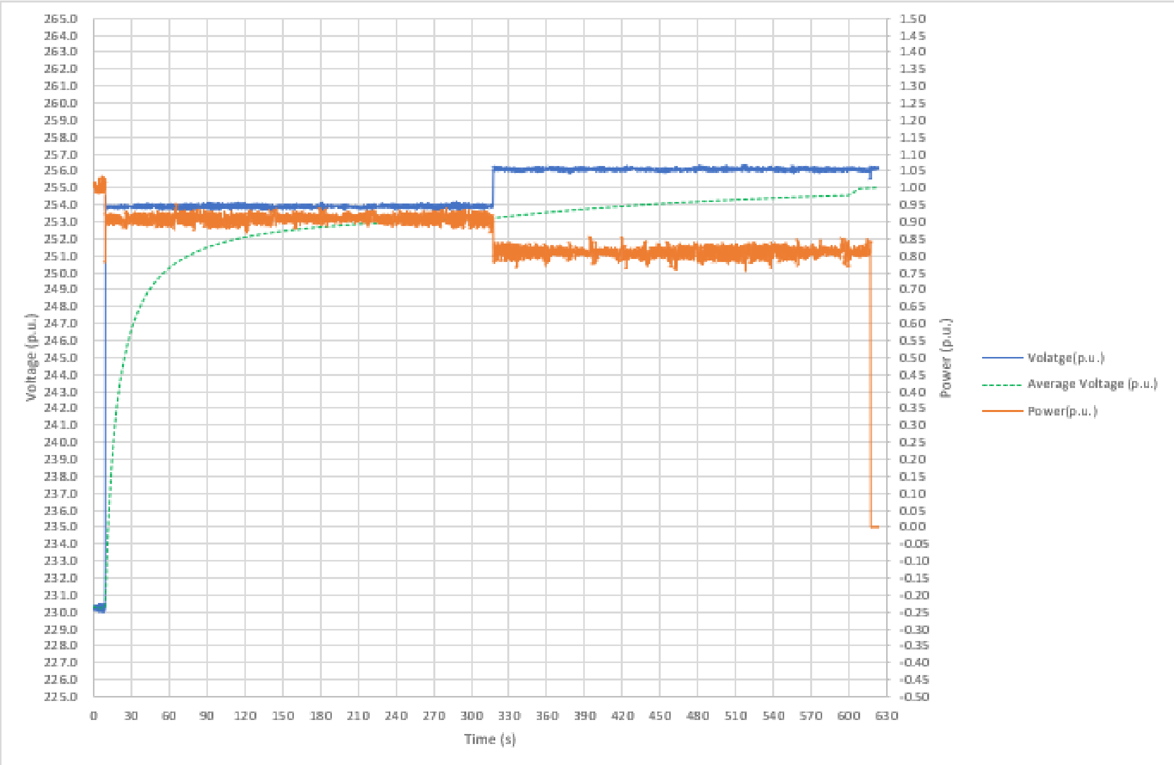
Test number	Threshold Value (V)	No Trip Test			Trip Test		
		Voltage value (V)	Time measured (s)	Trip	Voltage settling value (V)	Trip	Trip voltage average value (V)
Setting according to AS 60038 for Australia							
1	255.0	254.0	> 300	☒ NO ☐ YES	256.0	☐ NO ☒ YES	255.0
2	255.0	254.0	> 300	☒ NO ☐ YES	256.0	☐ NO ☒ YES	255.0
3	255.0	254.0	> 300	☒ NO ☐ YES	256.0	☐ NO ☒ YES	255.0
Setting according to IEC 60038 for New Zealand							
1	246.0	245.0	> 300	☒ NO ☐ YES	247.0	☐ NO ☒ YES	245.9
2	246.0	245.0	> 300	☒ NO ☐ YES	247.0	☐ NO ☒ YES	245.9
3	246.0	245.0	> 300	☒ NO ☐ YES	247.0	☐ NO ☒ YES	245.9

After these test results, it is considered the most restrictive trip voltage average value for verifying the trip time. With this,
The Vnom_max is set to 255V in the following test:

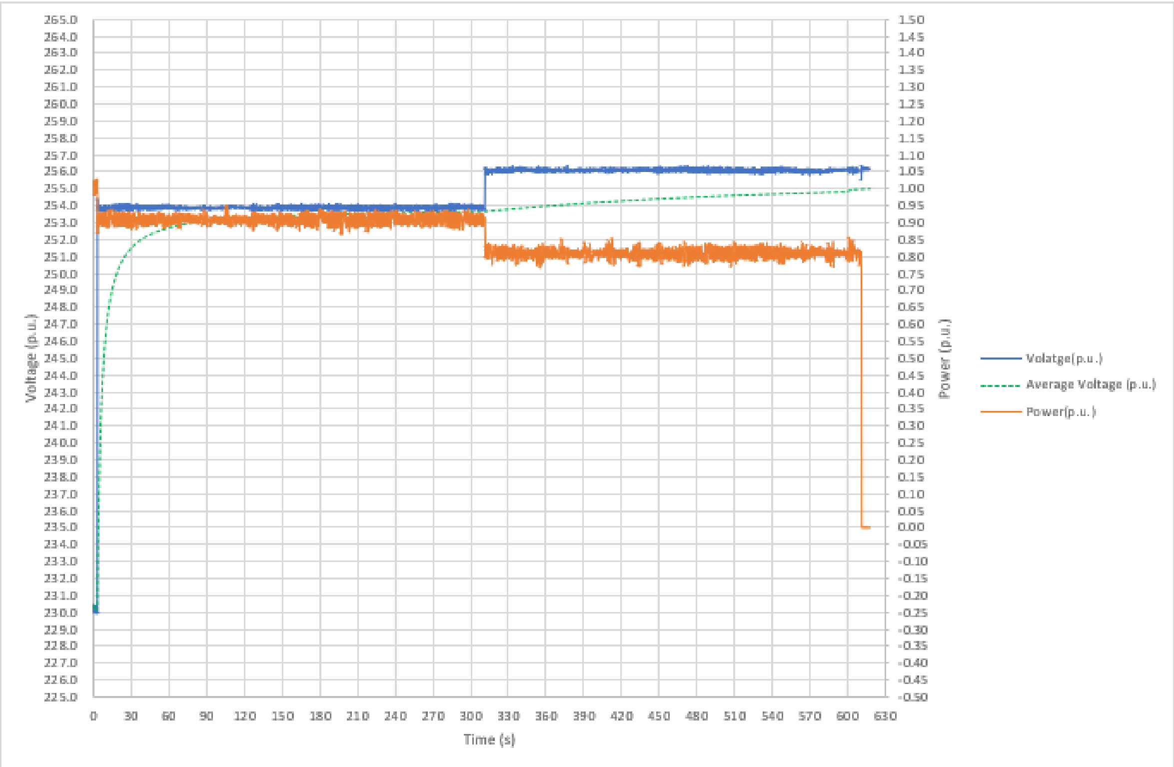
Sustained operation for Voltage Variations setting at 255V
(Test 1: voltage average trip value test)



Sustained operation for Voltage Variations setting at 255V
(Test 2: voltage average trip value test)

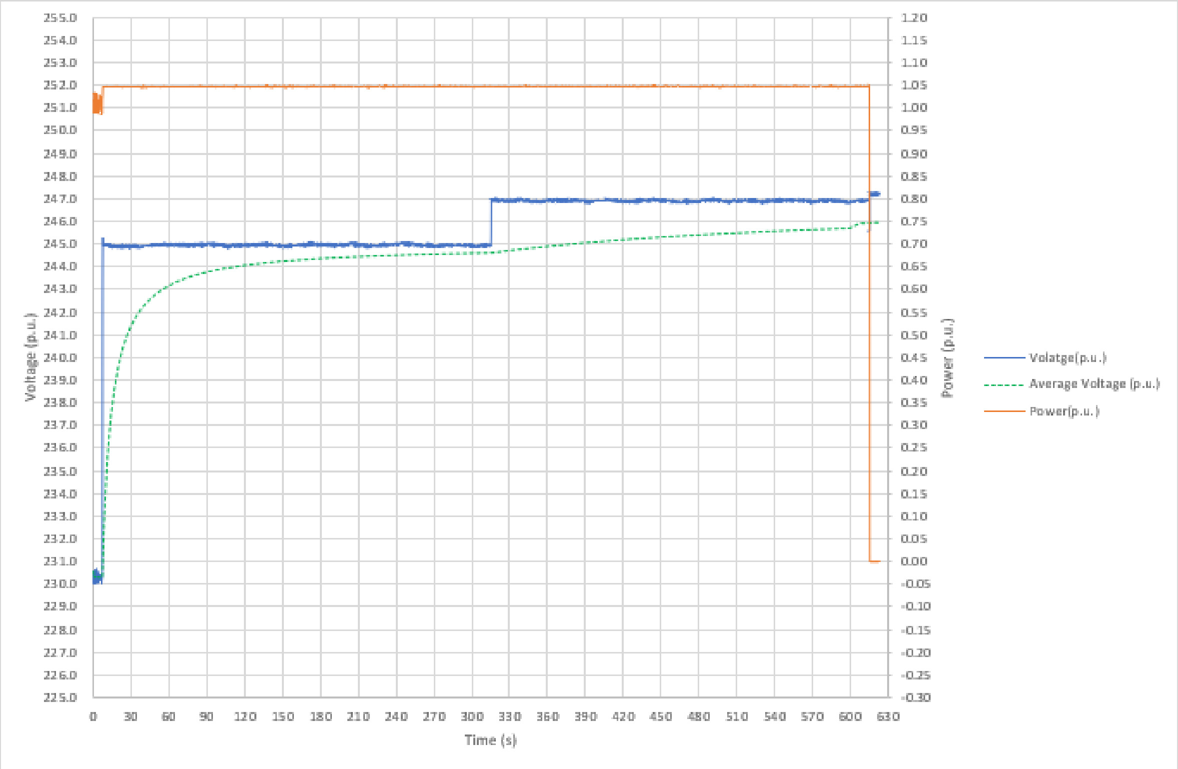


**Sustained operation for Voltage Variations setting at 255V
(Test 3: voltage average trip value test)**

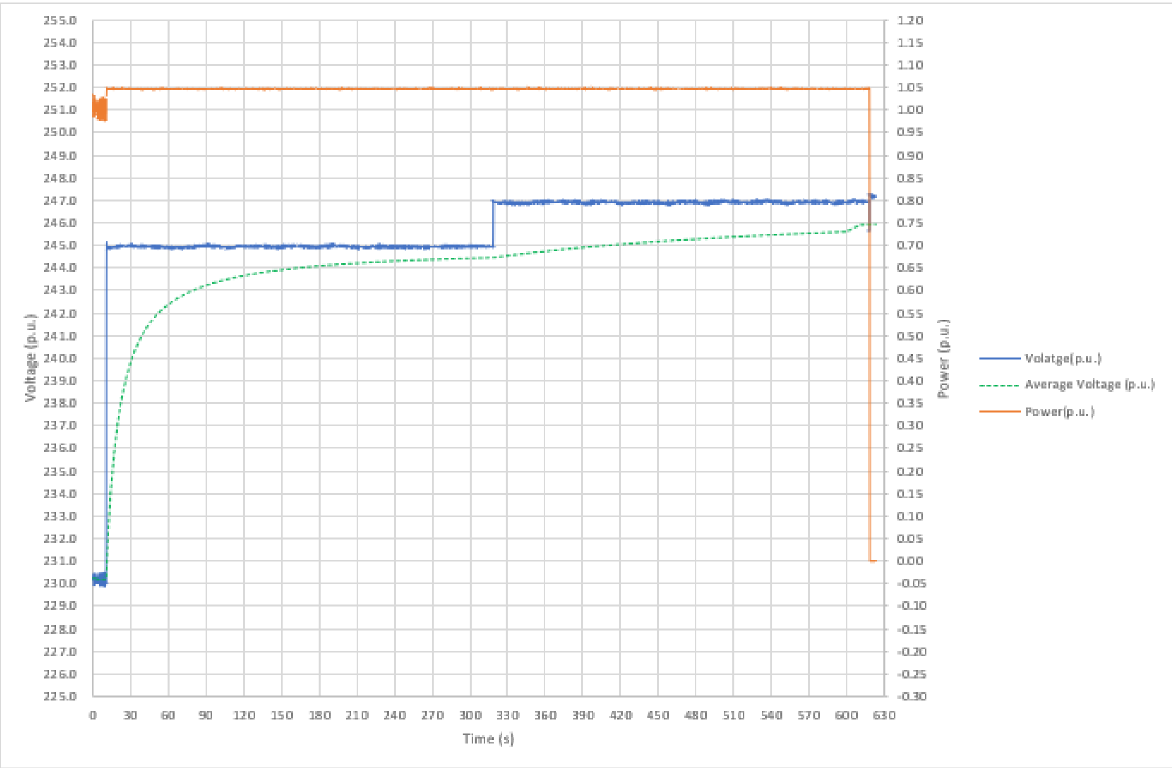


The Vnom_max is set to 246V in the following test:

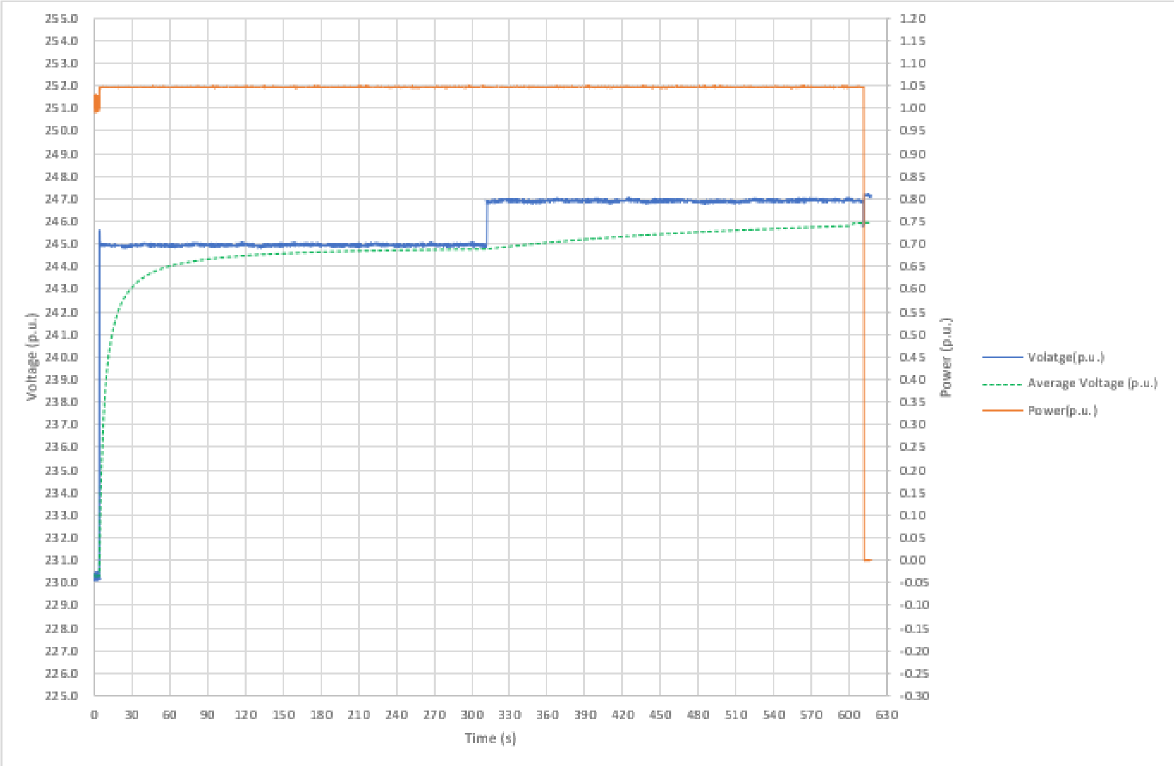
Sustained operation for Voltage Variations setting at 246V
(Test 1: voltage average trip value test)



Sustained operation for Voltage Variations setting at 246V
(Test 2: voltage average trip value test)



Sustained operation for Voltage Variations setting at 246V
(Test 3: voltage average trip value test)



4.19.2 Trip time test

Starting from a voltage level equal to Un, this voltage is maintained a considerable time verifying that voltage averages calculated in each line are close to Un.

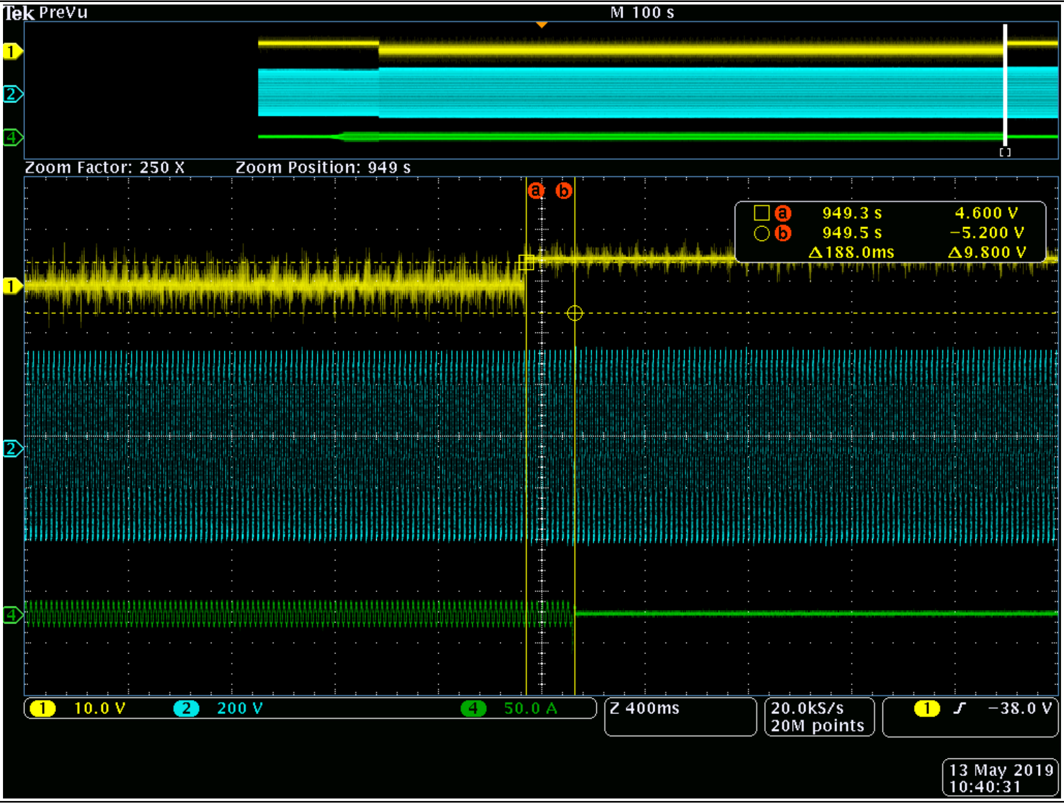
Then, the output voltage is increased up to a voltage equal to the Vnom_max setting calculated after the test 1. This level is maintained for 10 minutes.

After this, the output voltage is increased up to a voltage equal to the Vnom_max setting plus 2V. This level is maintained up to the inverter trips and the voltage average value is recorded. This trip time shall be less than 30 seconds.

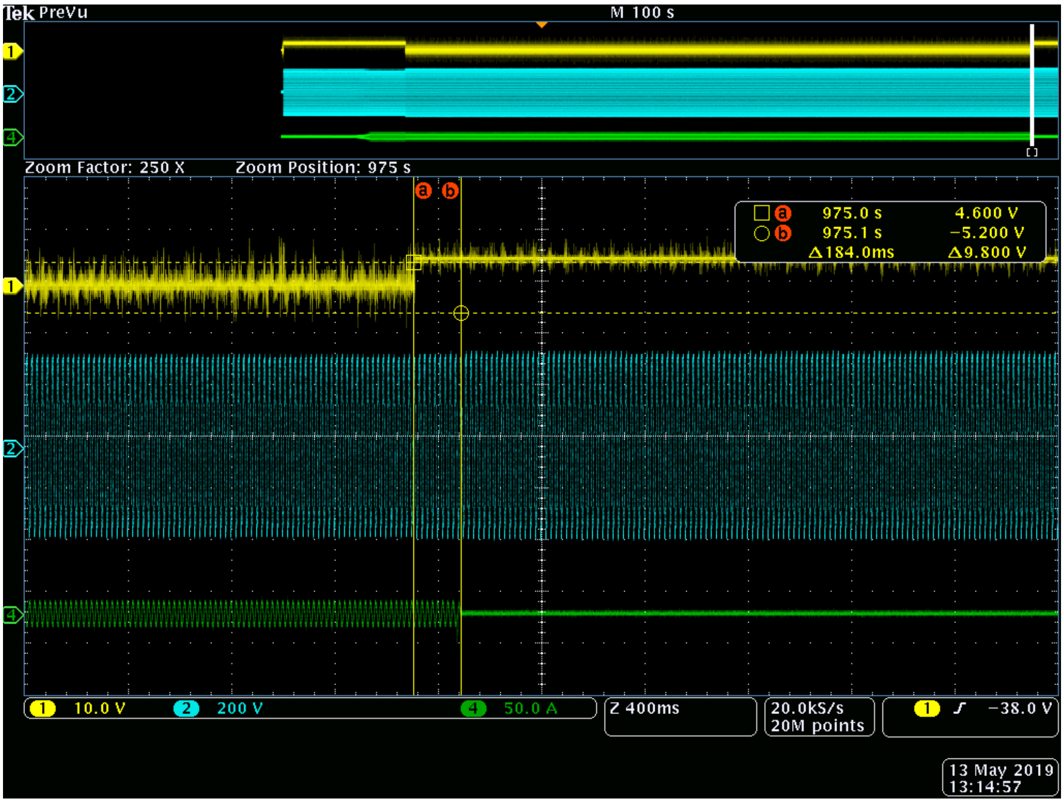
The table below offers test results obtained, where the test procedure above mentioned has been applied.

Threshold Value (V)	No Trip Test			Trip Test		
	Voltage value (V)	Time measured (s)	Trip	Voltage value (%Un)	Trip	Measured Trip time (ms)
Setting according to AS 60038 for Australia						
255	254.5	> 600	☒ NO ☐ YES	257.0	☐ NO ☒ YES	188
Setting according to IEC 60038 for New Zealand						
246	245.3	> 600	☒ NO ☐ YES	246.9	☐ NO ☒ YES	184

Sustained operation for Voltage Variations setting at 255V (trip time test)



Sustained operation for Voltage Variations setting at 246V (trip time test)



4.20 Sustained Operation for Frequency Variations

Sustained operation for frequency variations has been measured according to the Clause 7.5.3 of the standard.

4.20.1 Response to an increase in frequency

According to the clause 7.5.3.1 the inverter must be able to comply with the following requirements:

- Test 1: Linear decrease of the active power up to disconnection in front of over frequency variations up to 52 Hz.
- Test 2: Hysteresis capability once over frequency variations are recovered up to 50.15Hz.

When the inverter's frequency returns to operate with f < 50.15 Hz, the active power must be recovered in both cases according to a power ramp limit and with a delay of at least 60 seconds.

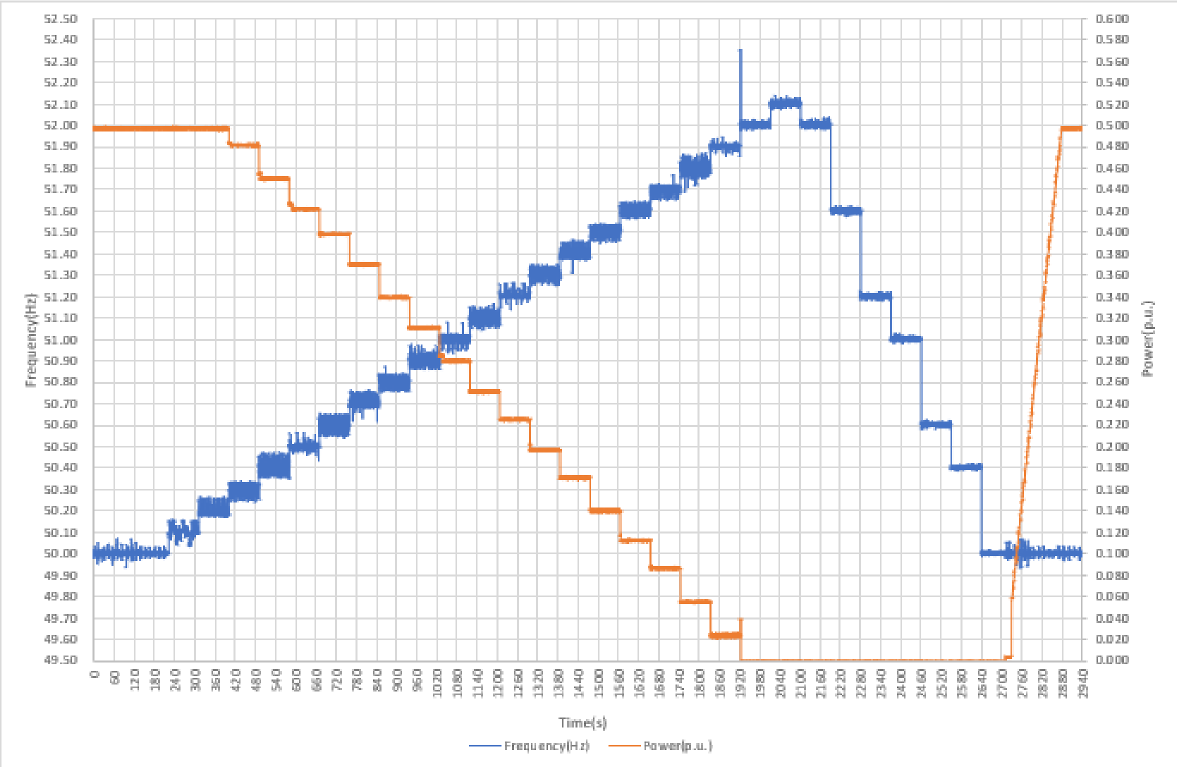
Test results obtained are shown in the following tables and graphs.

Test 1. Over frequency variations up to disconnection and active power recovery				
%Pn	**Frequency (Hz)**	**Power measured (W)**	**Power desired (W)**	**ΔP (%P_M)**
50 %	50.00	2485	2500	-0.60
	50.10	2485	2500	-0.60
	50.20	2485	2500	-0.60
	50.30	2410	2429	-0.76
	50.40	2251	2286	-1.41
	50.50	2110	2143	-1.33
	50.60	1992	2000	-0.32
	50.70	1851	1857	-0.24
	50.80	1696	1714	-0.72
	50.90	1555	1571	-0.64
	51.00	1401	1429	-1.13
	51.10	1256	1286	-1.21
	51.20	1126	1143	-0.68
	51.30	984	1000	-0.64
	51.40	854	857	-0.12
	51.50	699	714	-0.60
	51.60	561	571	-0.40
	51.70	432	429	0.12
	51.80	276	286	-0.40
	51.90	117	143	-1.05
	52.00	-1	0	-0.04
	52.10	-1	0	-0.04
	52.20	-1	0	-0.04
	52.00	-1	0	-0.04
	51.80	-1	0	-0.04
	51.60	-1	0	-0.04
	51.40	-1	0	-0.04
	51.20	-1	0	-0.04
	51.00	-1	0	-0.04
	50.80	-1	0	-0.04
	50.60	-1	0	-0.04
	50.40	-1	0	-0.04
	50.20	-1	0	-0.04

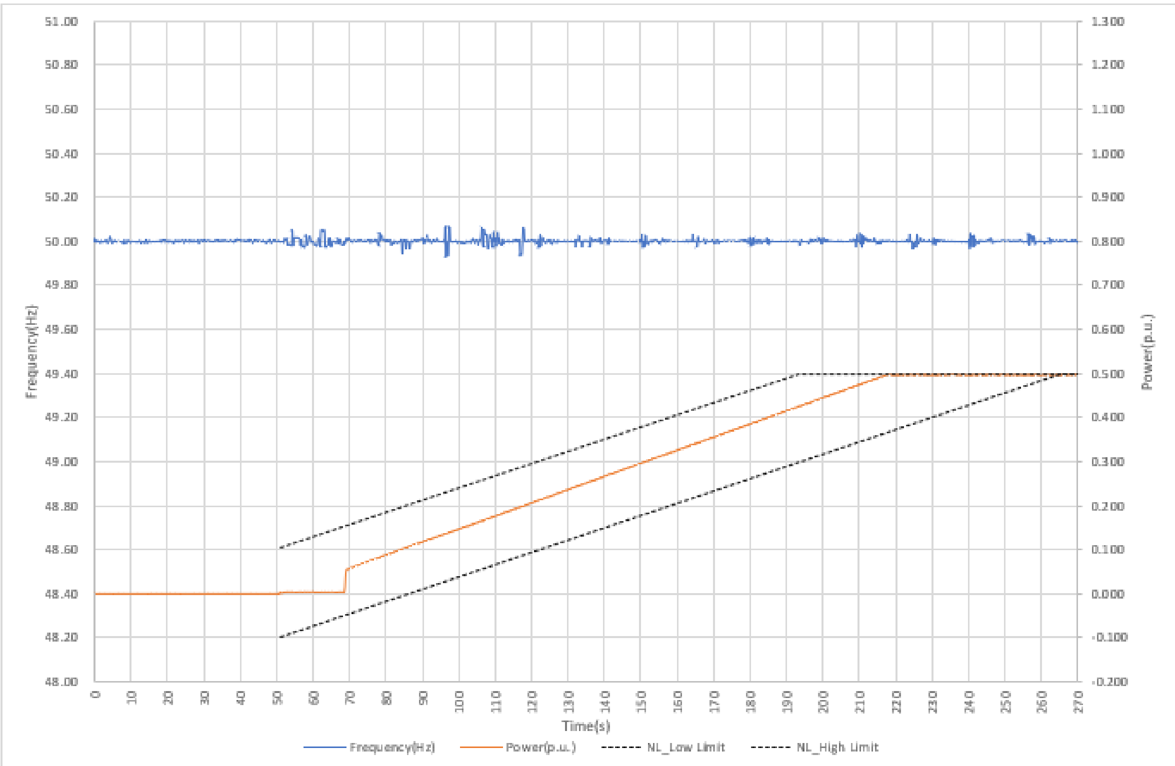
There is allowed a maximum tolerance for active power measurements up to ±5% of the staring power (P_M).

Test 1

PvsF behaviour

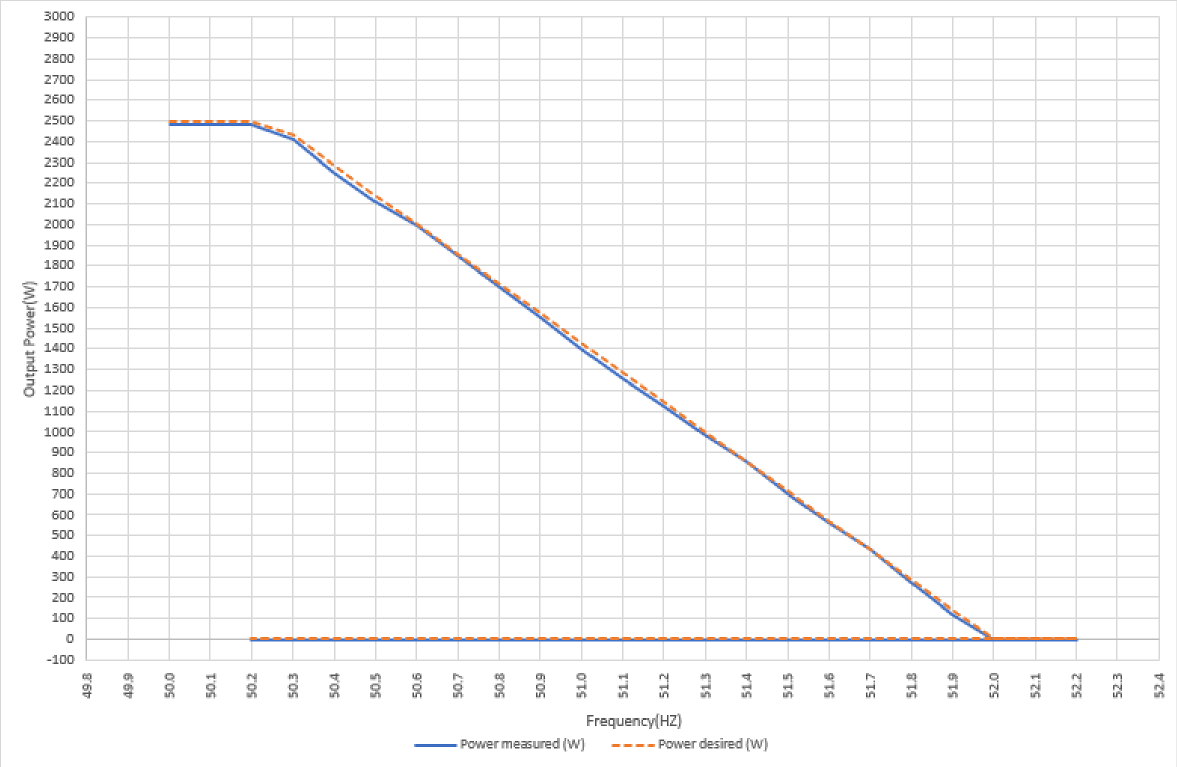


Reconnection Power gradient



Reconnection Value: 50.00 Hz	Reconnection time: 72.00 s
Increase of active power desired: 16.7 % Pn/min	Increase measured: 17.8 % Pn/min

Output power reduction



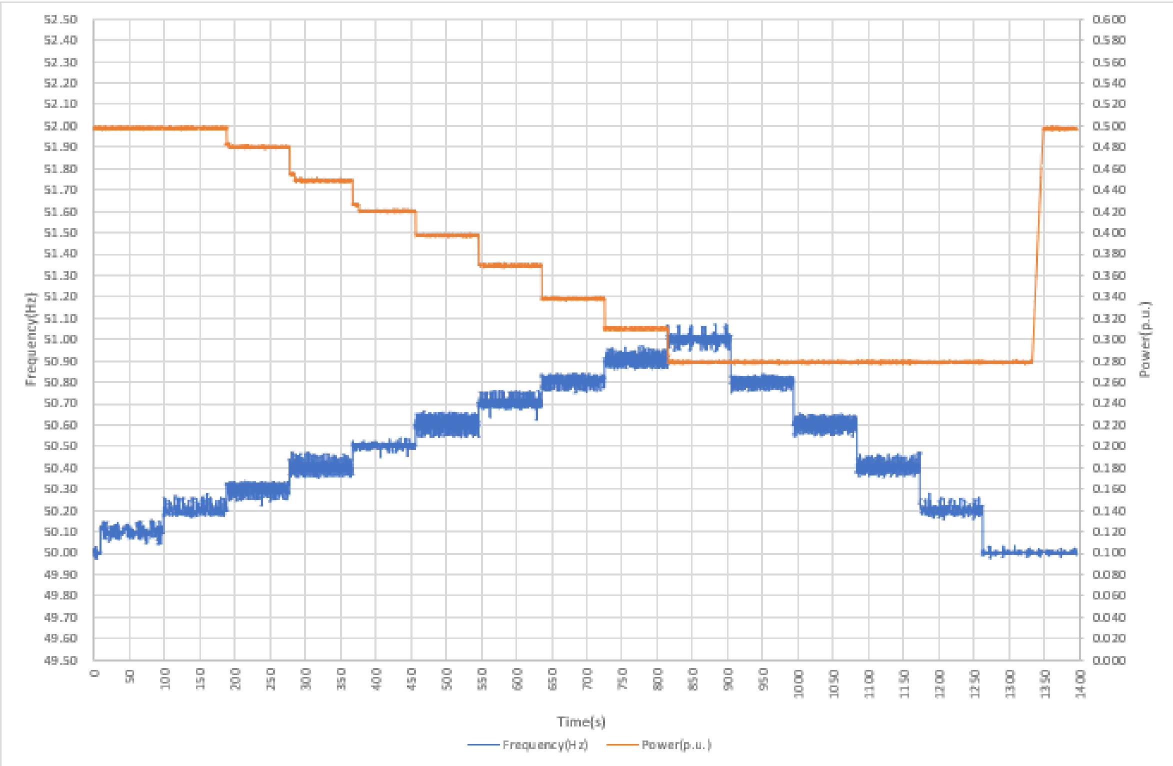
Test 2. Hysteresis capability and active power recovery				
%Pn	**Frequency**	**Power measured (W)**	**Power desired (W)**	**ΔP (%P_M)**
50 %	50.00	2489	2500	-0.44
	50.10	2489	2500	-0.44
	50.20	2489	2500	-0.44
	50.30	2401	2429	-1.12
	50.40	2244	2286	-1.69
	50.50	2103	2143	-1.61
	50.60	1988	2000	-0.48
	50.70	1847	1857	-0.40
	50.80	1691	1714	-0.92
	50.90	1550	1571	-0.84
	51.00	1394	1429	-1.41
	50.80	1394	1429	-1.41
	50.60	1394	1429	-1.41
	50.40	1394	1429	-1.41
	50.20	1394	1429	-1.41

There is allowed a maximum tolerance for active power measurements up to ±5% of the staring power (P_M).

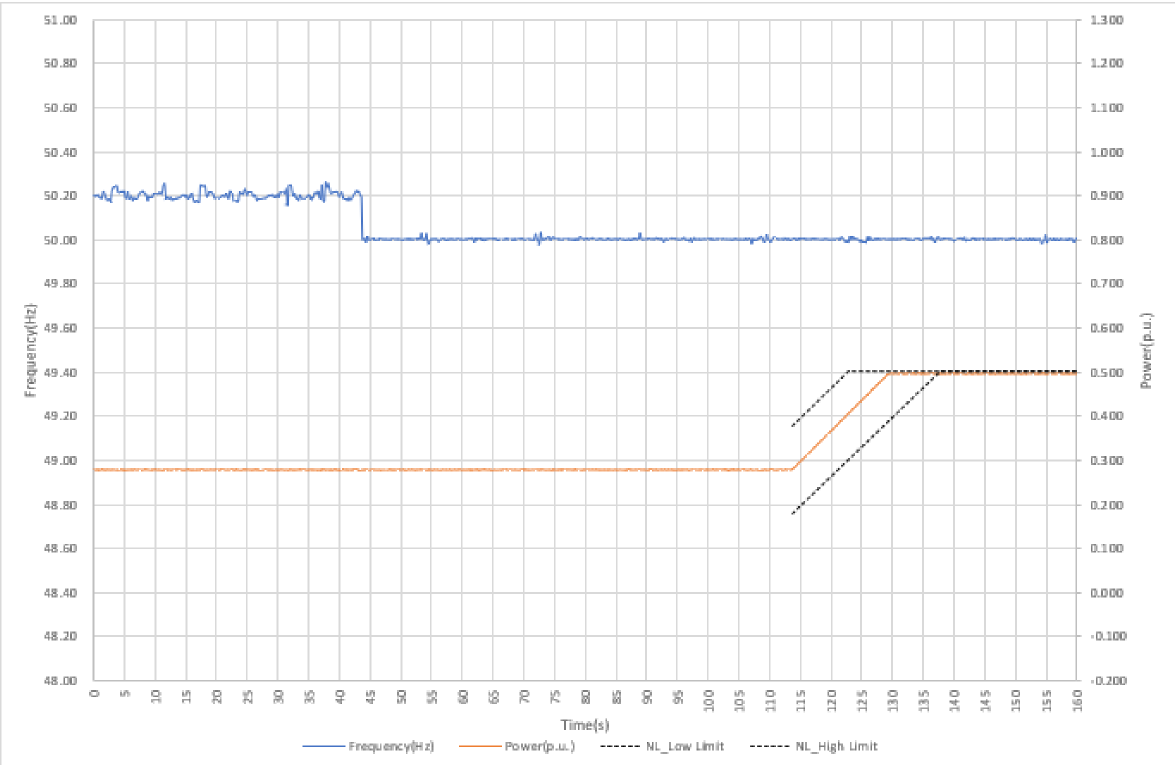
Test results are graphically shown in following pages.

Test 2

PvsF behaviour

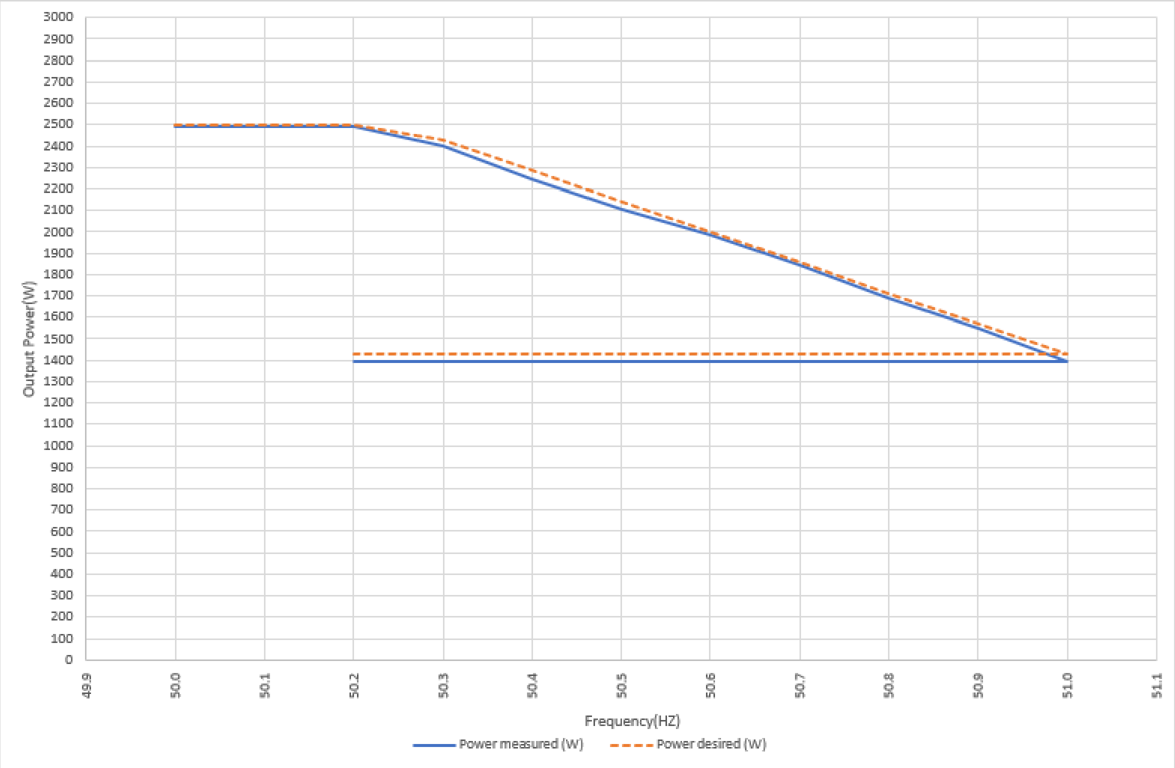


Power Recovery Gradient



Recovery Value: 50.00 Hz	Power recovery time: 69.80 s
Increase of active power desired: 80% Pn/min	Increase measured: 81.1% Pn/min

Output power reduction



4.20.2 Response to a decrease in grid frequency

According to the clause 7.5.3.2, the inverter must be capable of supplying rated power between 49 Hz and 49.75 Hz for Australia.

- Test 1: Linear decrease of the active power up to disconnection in front of under frequency variations up to 49.0 Hz.
- Test 2: Hysteresis capability once over frequency variations are recovered up 49.5Hz.

When the inverter's frequency returns to operate with f >49.85 Hz, the active power must be recovered in both cases according to a power ramp limit and with a delay of at least 60 seconds.

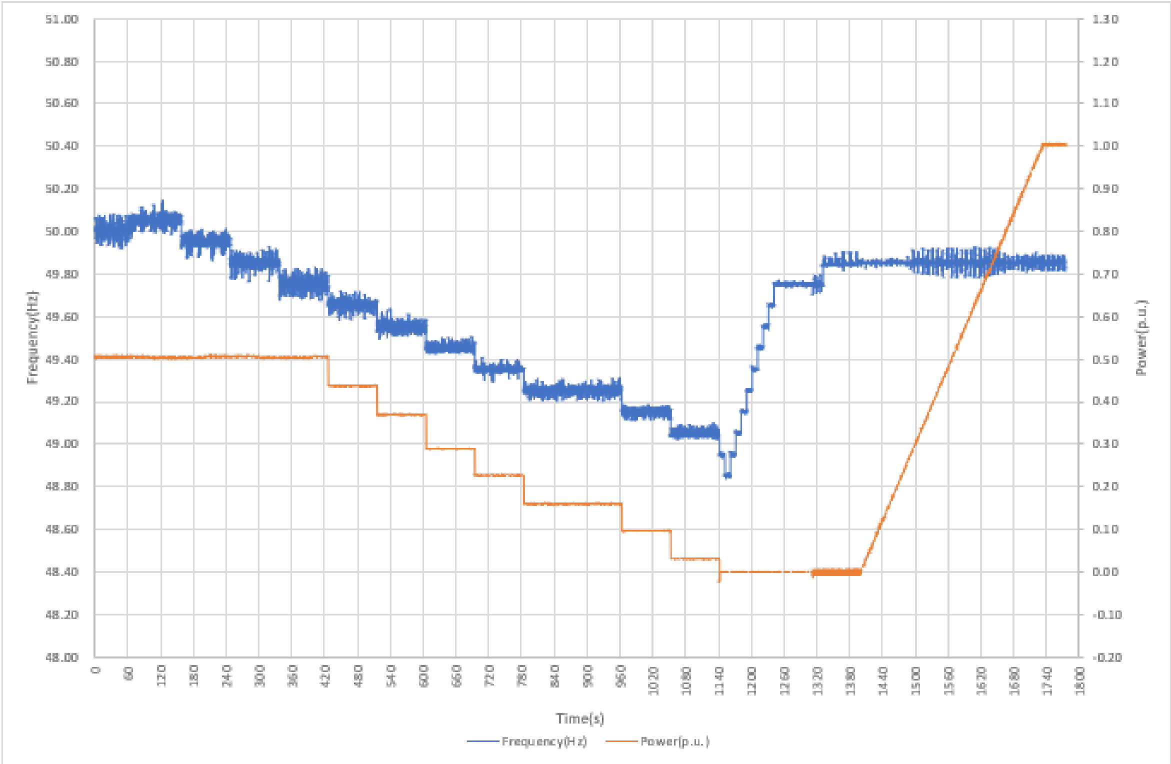
Test results obtained are shown in the following tables and graphs.

Test 1. Under frequency variations up to disconnection and active power recovery				
%Pn	Frequency (Hz)	Power measured (W)	Power desired (W)	ΔP (%P_M)
50 %	50.05	2518	2500	0.72
	49.95	2532	2500	1.28
	49.85	2532	2500	1.28
	49.75	2519	2500	0.76
	49.65	2184	2167	0.68
	49.55	1848	1833	0.60
	49.45	1447	1500	-2.12
	49.35	1134	1167	-1.32
	49.25	797	833	-1.44
	49.15	487	500	-0.52
	49.05	152	167	-0.60
	48.95	1	0	0.04
	48.85	1	0	0.04
	48.95	1	0	0.04
	49.05	1	0	0.04
	49.15	1	0	0.04
	49.25	1	0	0.04
	49.35	1	0	0.04
	49.45	1	0	0.04
	49.55	1	0	0.04
	49.65	1	0	0.04
	49.75	1	0	0.04

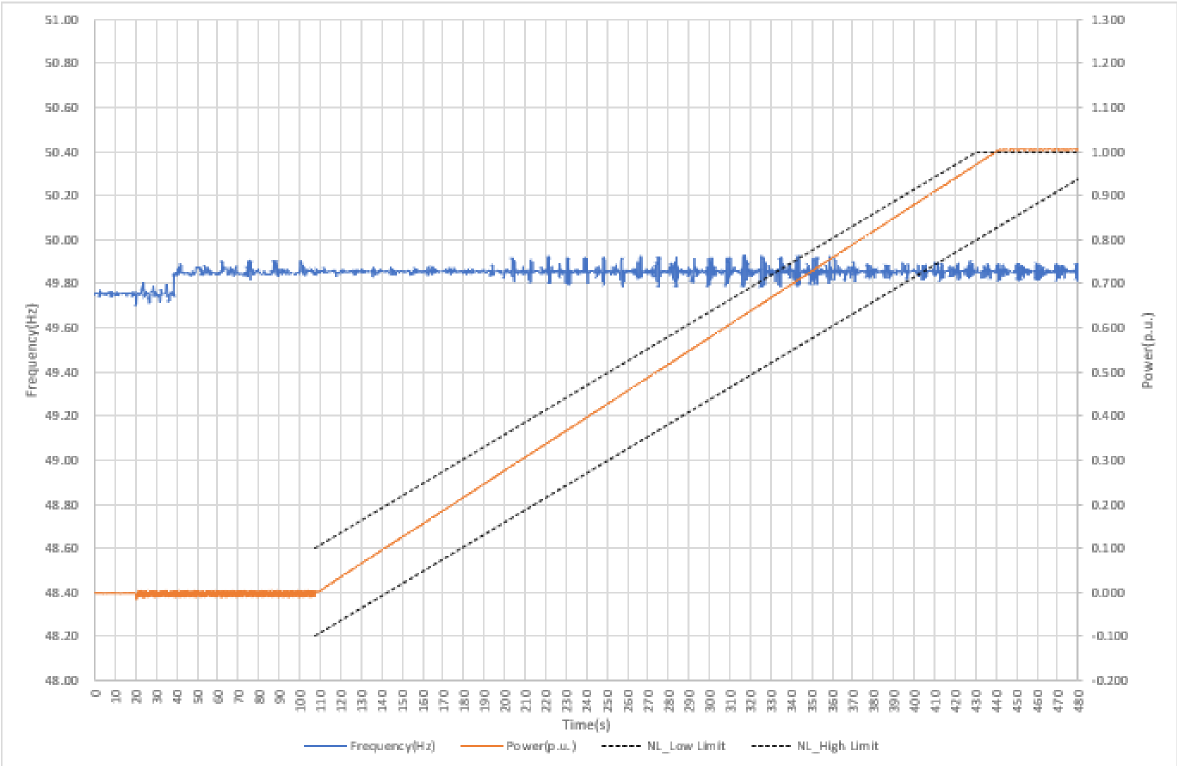
There is allowed a maximum tolerance for active power measurements up to ±5% of the staring power (P_M).

Test 1

PvsF behaviour

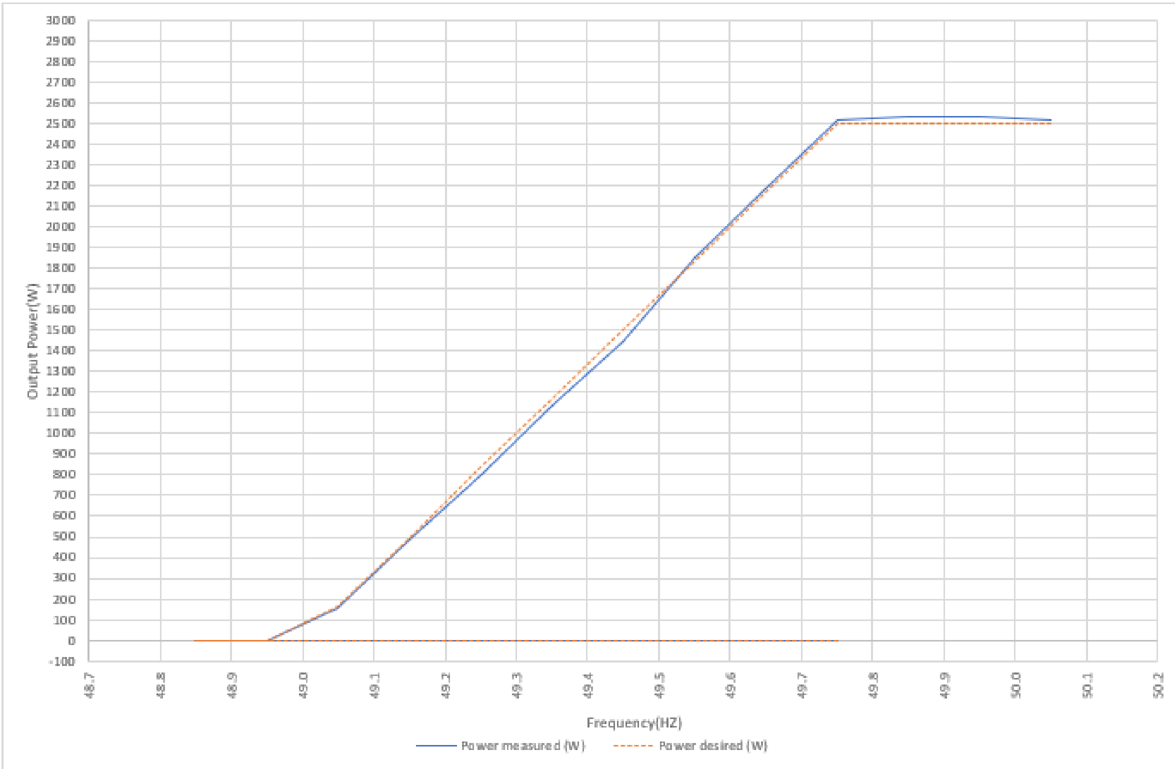


Reconnection Power gradient



Reconnection Value: 49.85 Hz	Reconnection time: 68.9 s
Increase of active power desired: 16.7% Pn/min	Increase measured: 18.0 % Pn/min

Output power reduction



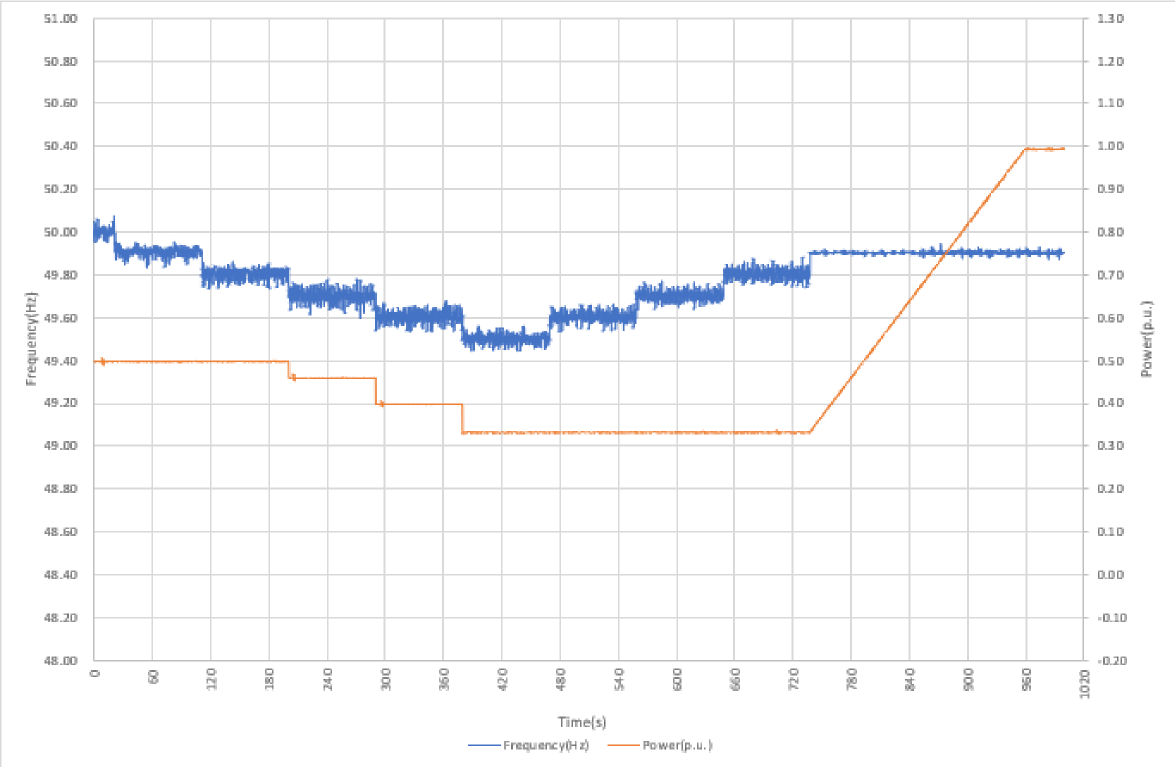
Test 2. Hysteresis capability and active power recovery				
%Pn	**Frequency**	**Power measured (W)**	**Power desired (W)**	**ΔP (%P_M)**
50 %	50.00	2487	2500	-0.52%
	49.90	2487	2500	-0.52%
	49.80	2487	2500	-0.52%
	49.70	2295	2333	-1.52%
	49.60	1990	2000	-0.40%
	49.50	1659	1667	-0.32%
	49.60	1658	1667	-0.36%
	49.70	1659	1667	-0.32%
	49.80	1659	1667	-0.32%

There is allowed a maximum tolerance for active power measurements up to ±5% of the staring power (P_M).

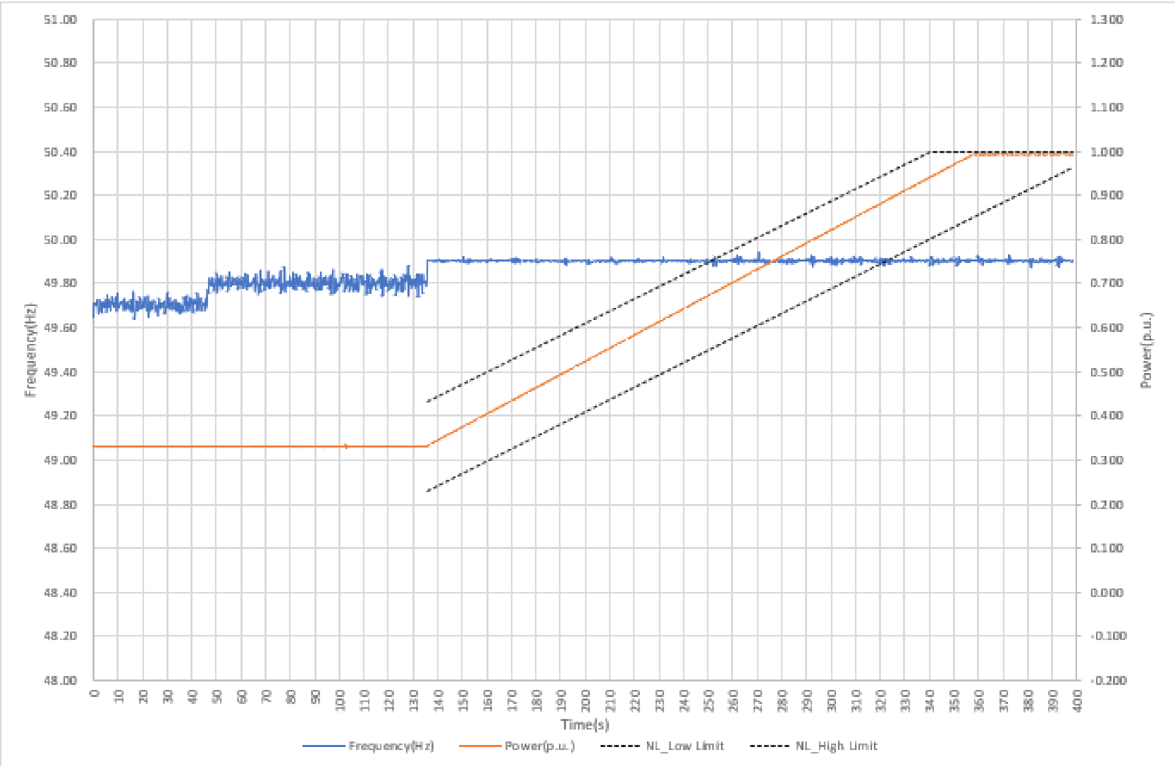
Test results are graphically shown in following pages.

Test 2

PvsF behaviour

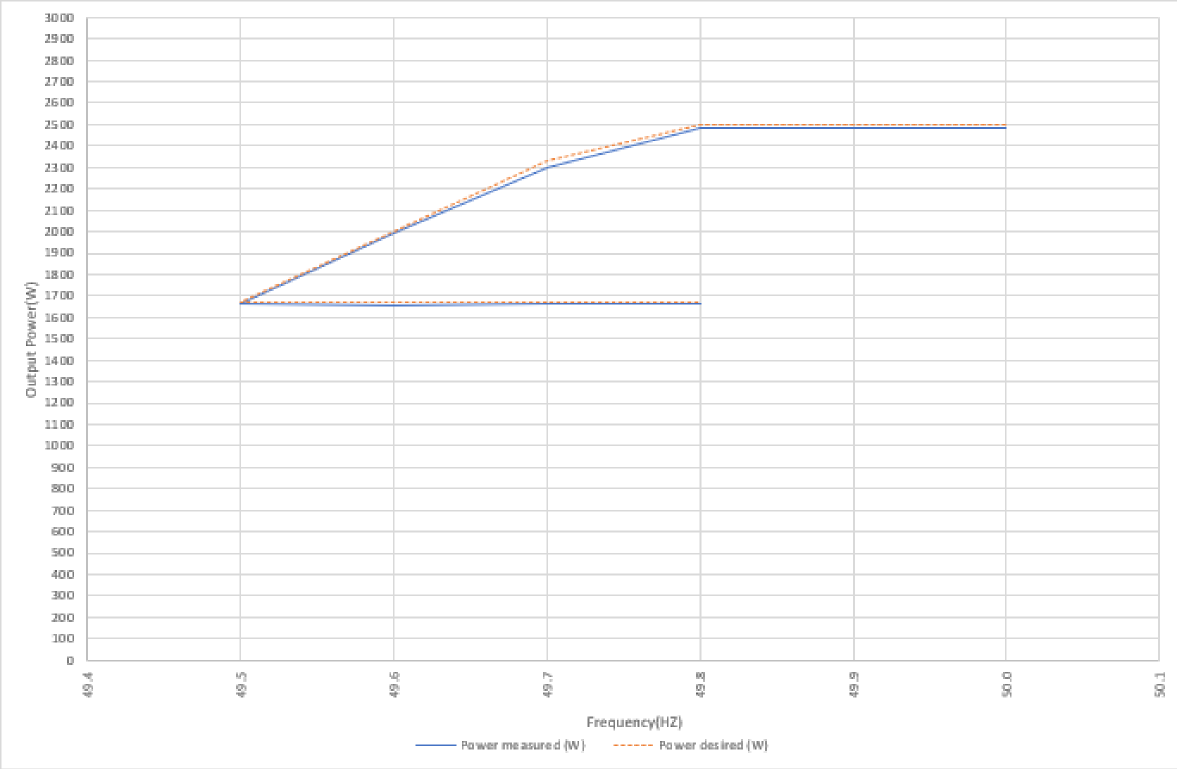


Reconnection and Power Gradient



Increase of active power desired: 16.7% Pn/min	Increase measured: 17.9 % Pn/min

Output power reduction



4.21 Connection and Reconnection Procedure

According to the clause 7.7 of the standard, voltage and frequency conditions for allowing the connection or reconnection of the equipment to the grid are as follows:

- The voltage of the grid has to be maintained within the limits of AS 60038, for Australia, for at least 60 s.
- The frequency of the grid has to be maintained within the range 47.5 Hz to 50.15 Hz for at least 60 s.

4.21.1 Frequency Connection

Test results are offered in the following tables:

Frequency Connection Value Limit	No Connection Test			Connection Test		
	Frequency value (Hz)	Time measured (s)	Connection	Frequency value (Hz)	Connection	Time measured (s)
F ≥ 47.50 Hz	47.45	>120	☒ NO ☐ YES	47.55	☐ NO ☒ YES	70.80
F ≤ 50.15 Hz	50.30	>120	☒ NO ☐ YES	50.10	☐ NO ☒ YES	72.60

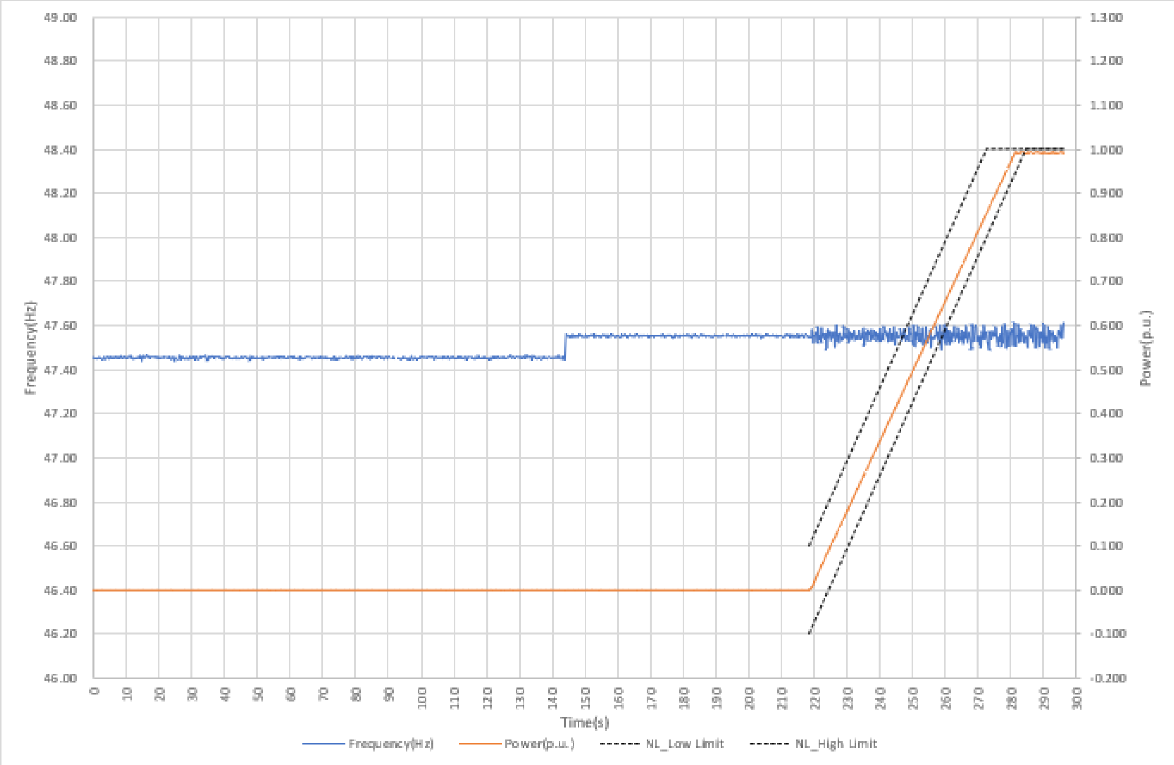
In addition to this requirement, it has been verified that according to the point 7.7 of the standard, the Control System of the inverter has a function to start connection following an adjustable Ramp Rate. In this case, the adjusted gradient has been an increasing rate of 100%Pn per minute.

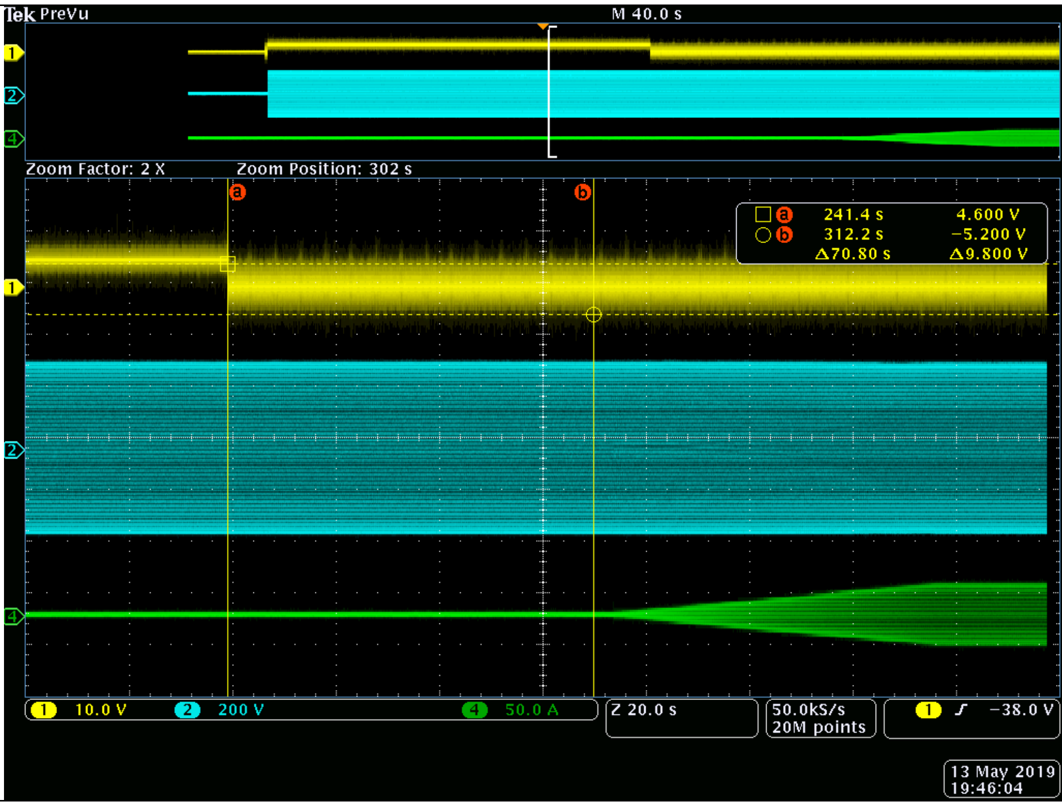
Frequency Connection Value Limit	Gradient (ΔP) desired (%Pn/min)	Gradient measured (%P_n/min)
F ≥ 47.50 Hz	≤ 100.0%	90.4%
F ≤ 50.15 Hz	≤ 100.0%	95.8%

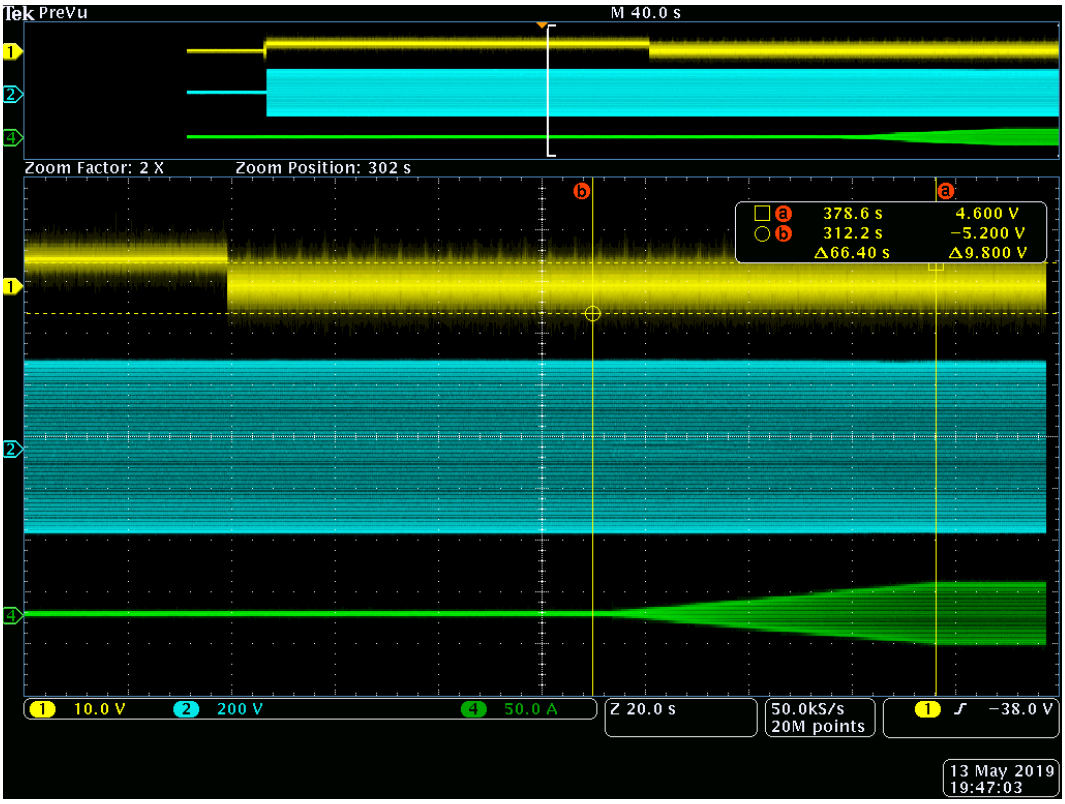
Note: it has been considered a minimum delay of 60 seconds to proceed with the start-up once the equipment is inside the required ranges.

Test results are graphically shown in following pages.

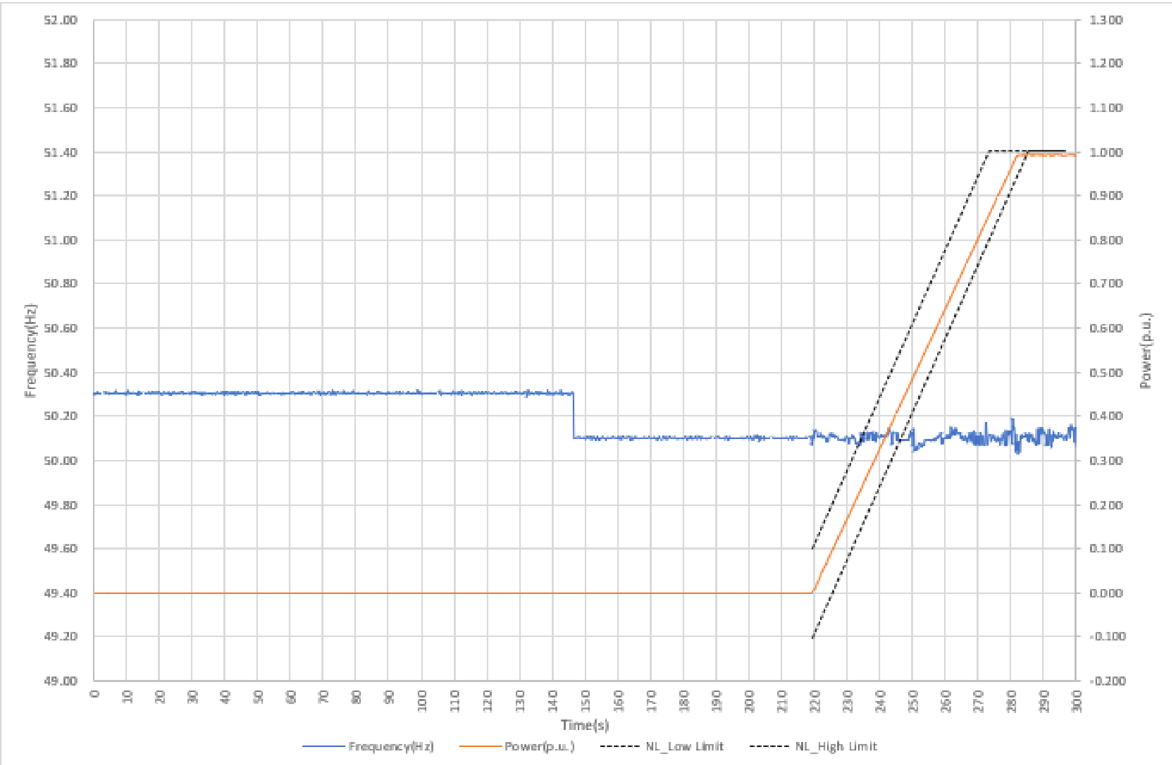
Under Frequency Connection

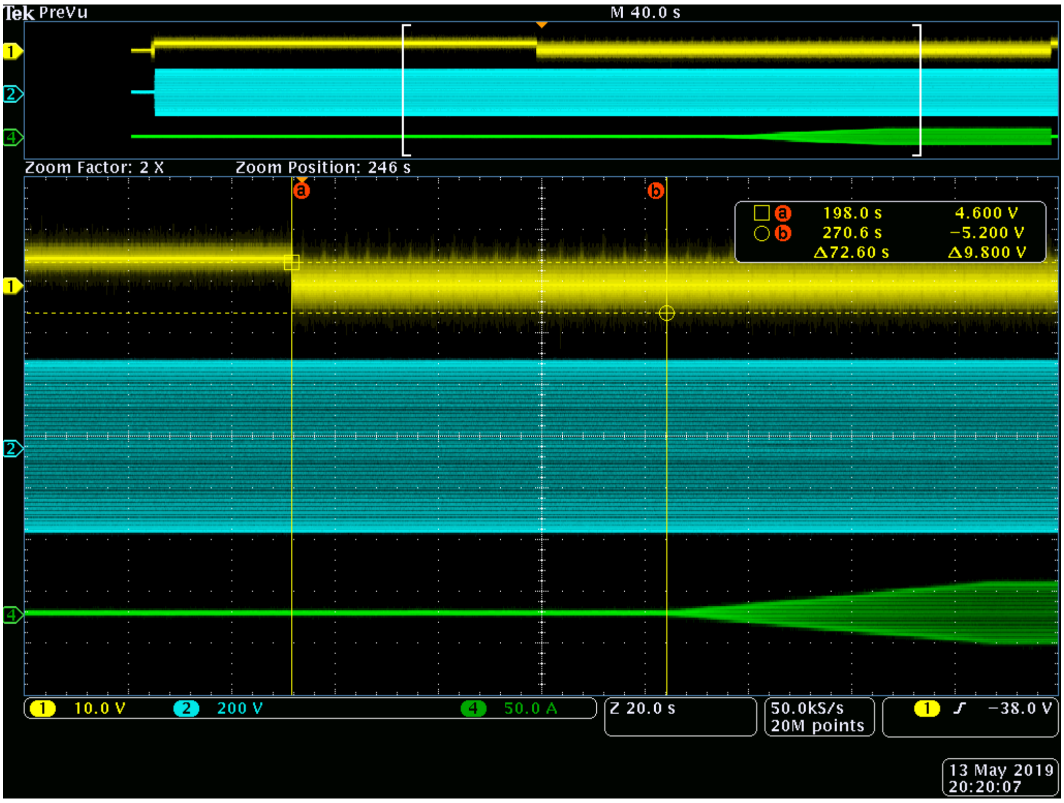




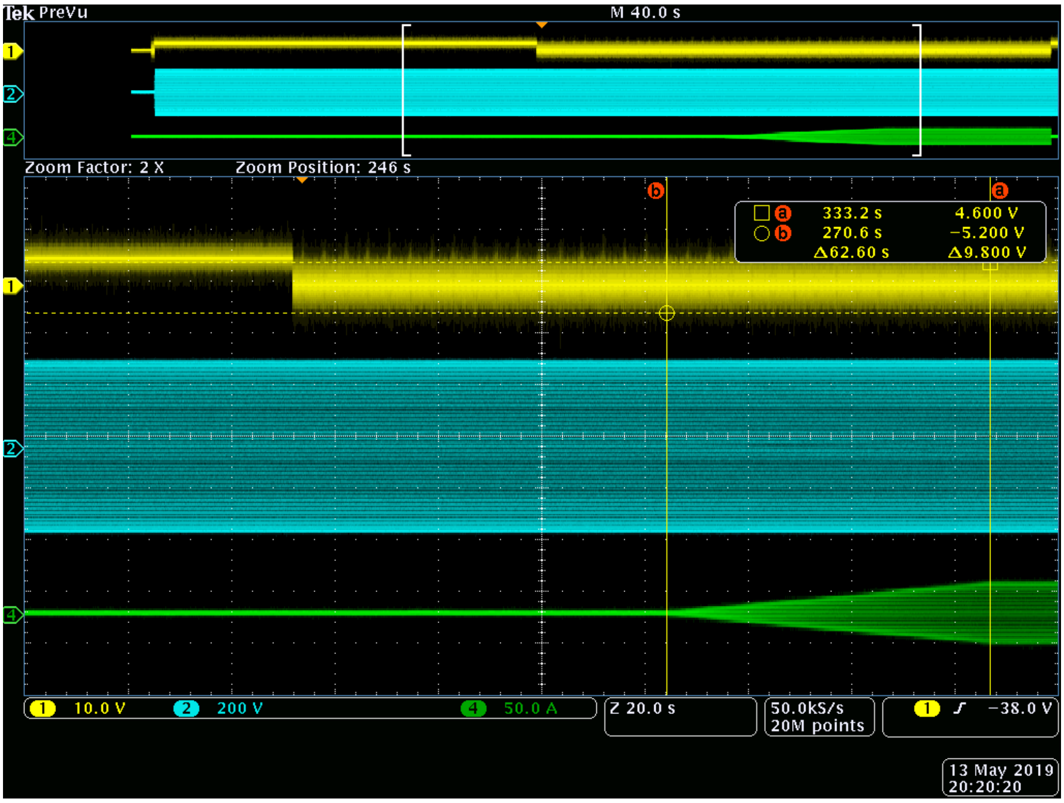


Over Frequency Connection





Tek PreVu
M 40.0 s
Zoom Factor: 2 X
Zoom Position: 246 s
a 198.0 s 4.600 V
b 270.6 s −5.200 V
Δ72.60 s Δ9.800 V
1 10.0 V
2 200 V
4 50.0 A
Z 20.0 s
50.0kS/s
20M points
1 −38.0 V
13 May 2019
20:20:07



Tek PreVu
M 40.0 s
Zoom Factor: 2 X
Zoom Position: 246 s
a 333.2 s 4.600 V
b 270.6 s −5.200 V
Δ62.60 s Δ9.800 V
1 10.0 V
2 200 V
4 50.0 A
Z 20.0 s
50.0kS/s
20M points
1 −38.0 V
13 May 2019
20:20:20

4.21.2 Frequency Reconnection

Test results are offered in the following tables:

Frequency Reconnection Value Limit	No Reconnection Test			Reconnection Test		
	Frequency value (Hz)	Time measured (s)	Reconnection	Frequency value (Hz)	Reconnection	Time measured (s)
F ≥ 47.50 Hz	47.40	>120	☒ NO ☐ YES	50.00	☐ NO ☒ YES	76.80
F ≤ 50.15 Hz	50.25	>120	☒ NO ☐ YES	50.10	☐ NO ☒ YES	71.60

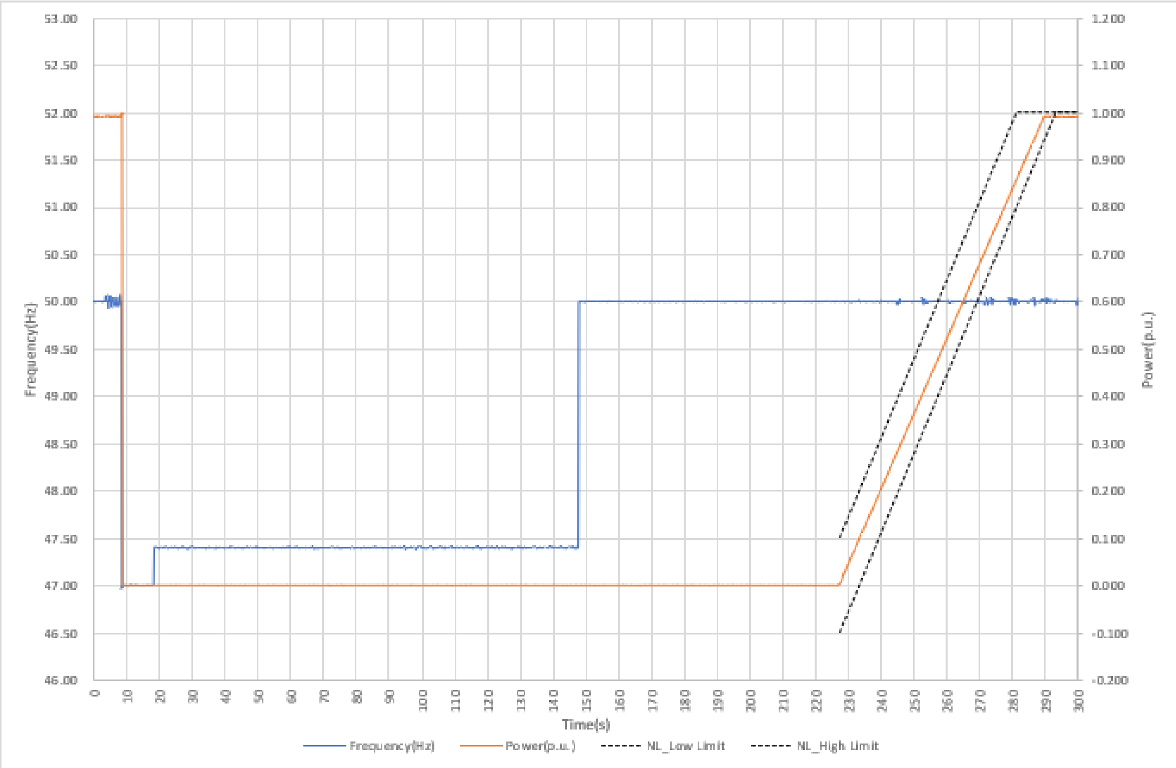
In addition to this requirement, it has been verified that according to the point 7.7 of the standard, the Control System of the inverter has a function to start reconnection following an adjustable Ramp Rate. In this case, the adjusted gradient has been an increasing rate of 100%Pn per minute.

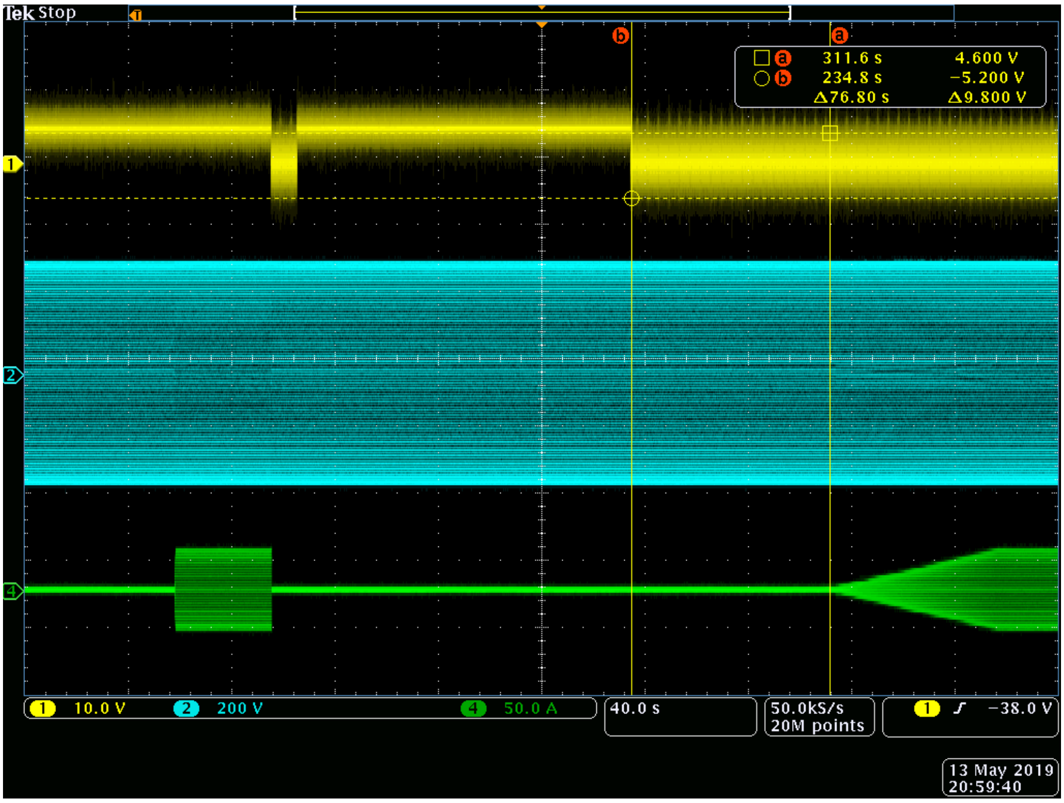
Frequency Reconnection Value Limit	Gradient (ΔP) desired (%P_n/min)	Gradient measured (%P_n/min)
F ≥ 47.50 Hz	≤ 100.0%	90.9%
F ≤ 50.15 Hz	≤ 100.0%	94.9%

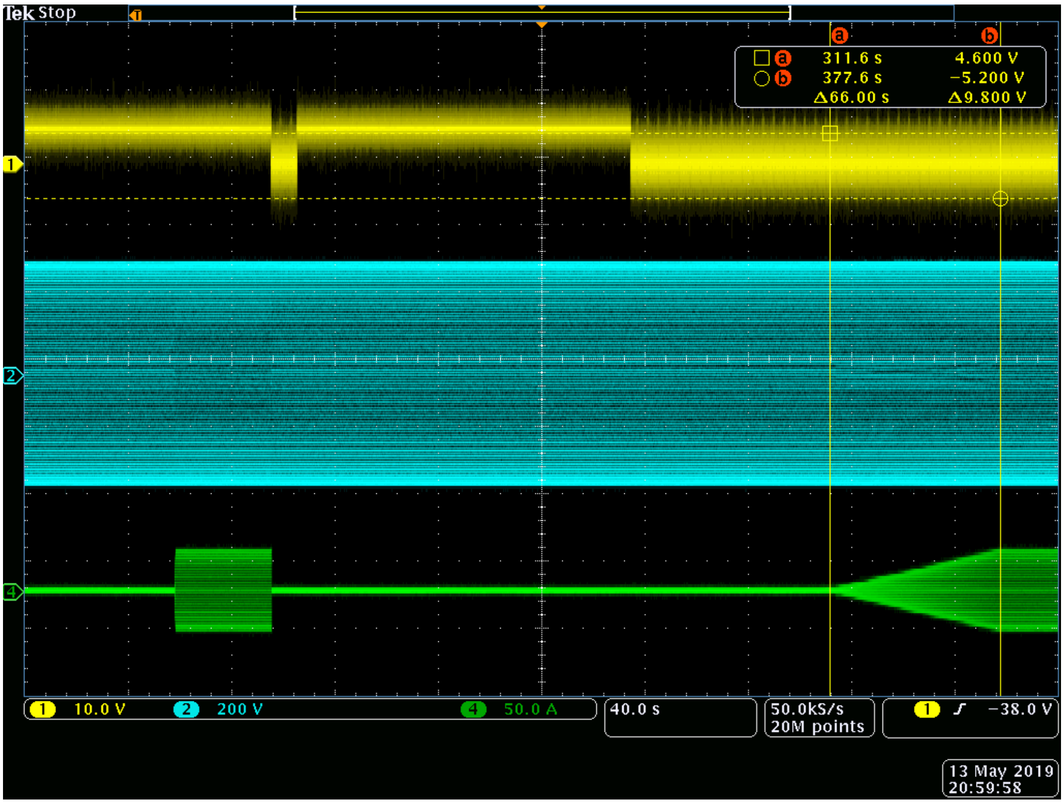
Note: it has been considered a minimum delay of 60 seconds to proceed with the start-up once the equipment is inside the required ranges.

Test results are graphically shown in following pages.

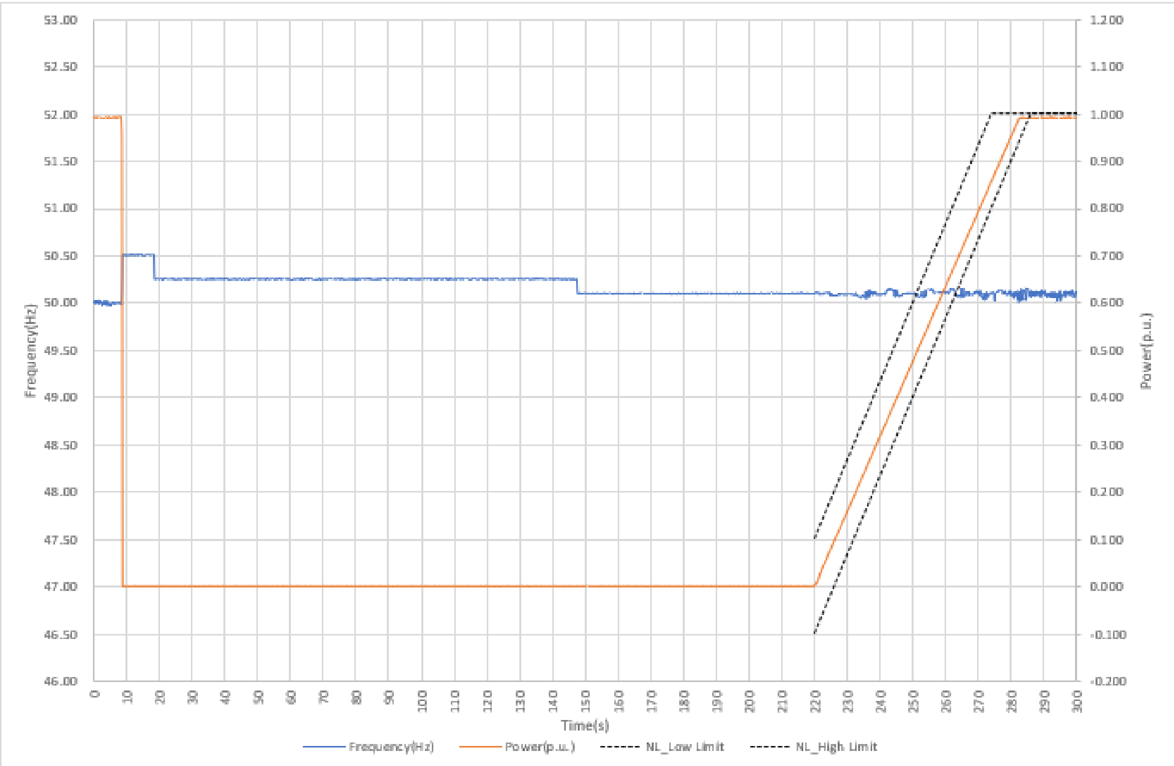
Under Frequency Reconnection

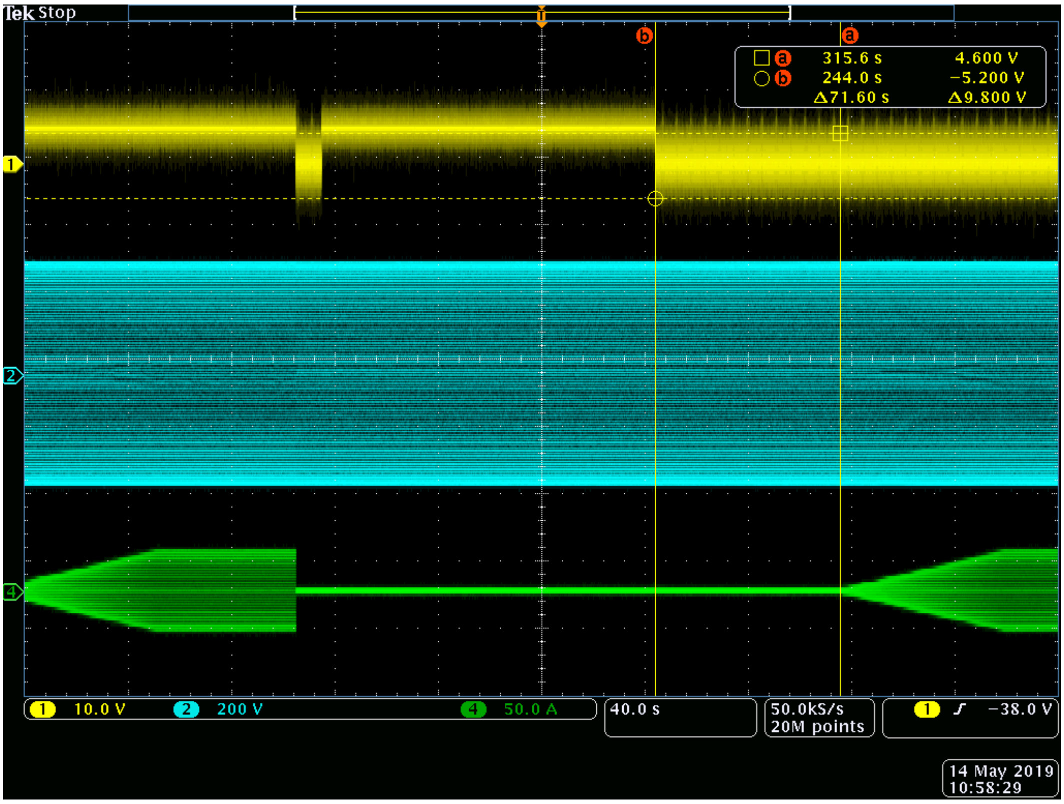


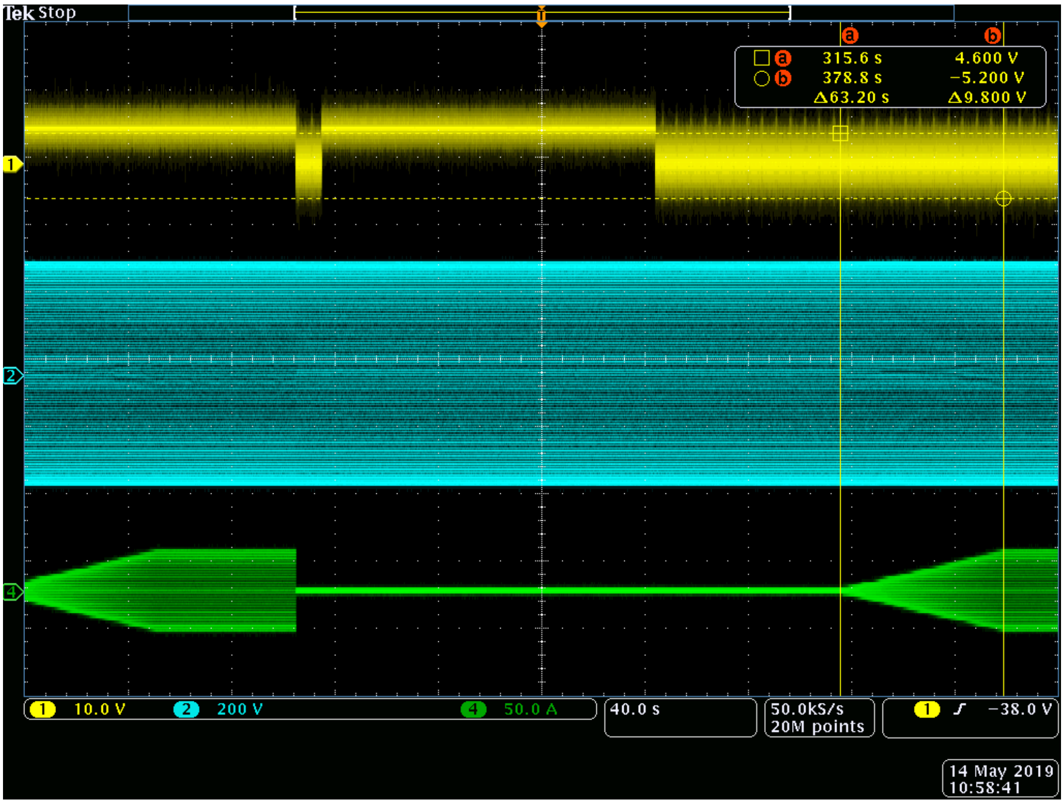




Over Frequency Reconnection




Tek Stop
a 315.6 s 4.600 V
b 244.0 s −5.200 V
Δ71.60 s Δ9.800 V
1 10.0 V
2 200 V
4 50.0 A
40.0 s
50.0kS/s
20M points
1 −38.0 V
14 May 2019
10:58:29


Tek Stop
a 315.6 s 4.600 V
b 378.8 s −5.200 V
Δ63.20 s Δ9.800 V
1 10.0 V
2 200 V
4 50.0 A
40.0 s
50.0kS/s
20M points
1 −38.0 V
14 May 2019
10:58:41

4.21.3 Voltage Connection

Test results are offered in the following tables:

Voltage Connection Value Limit	No Connection Test			Connection Test		
	Voltage value (%Un)	Time measured (s)	Connection	Voltage value (%Un)	Connection	Time measured (s)
V ≥ 94.0% Un	94.0%	>120	☒ NO ☐ YES	94.7%	☐ NO ☒ YES	70.80
V ≤ 110.0% Un	110.0%	>120	☒ NO ☐ YES	109.4%	☐ NO ☒ YES	74.40

The standard states that the tolerance limit for voltage connection values is ± 2 V, which is a 0,8% Un over 230 V, the reference voltage considered by the standard. So 0.8% Un is the allowed tolerance to be considered for voltage connection value tests.

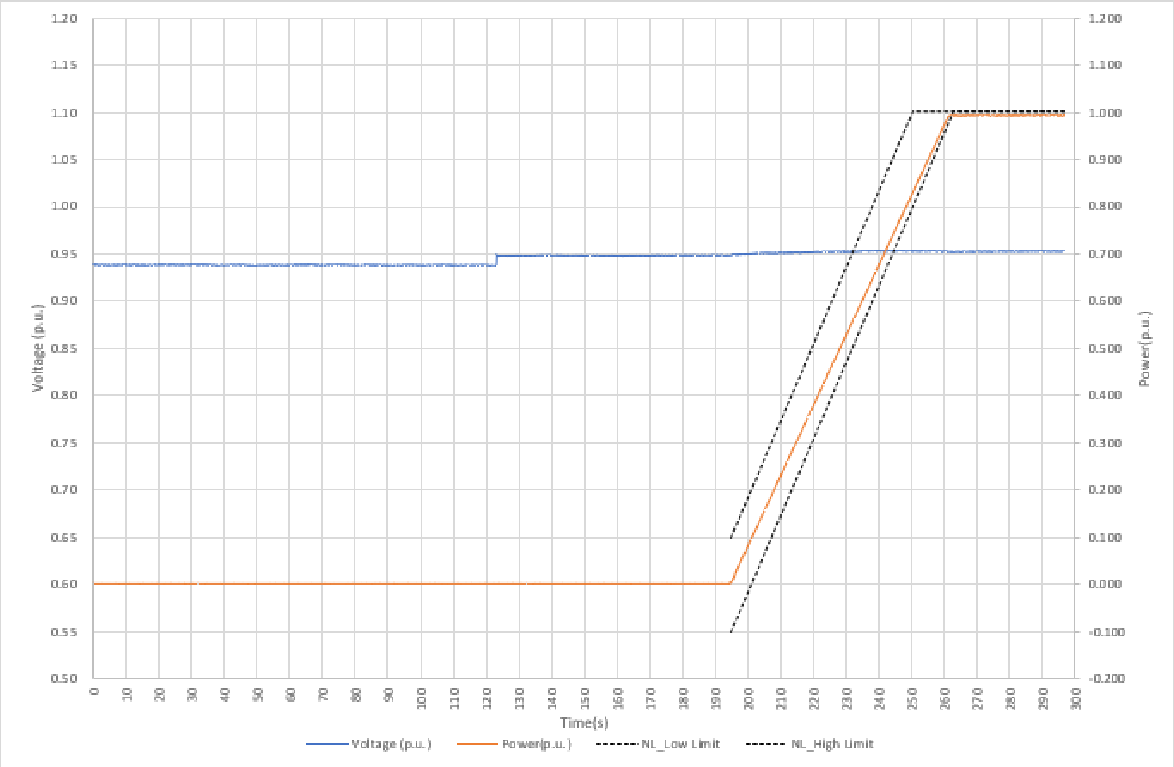
In addition to this requirement, it has been verified that according to the point 7.7 of the standard, the Control System of the inverter has a function to start connection following an adjustable Ramp Rate. The following table shows the programmed gradient for the different reconnections:

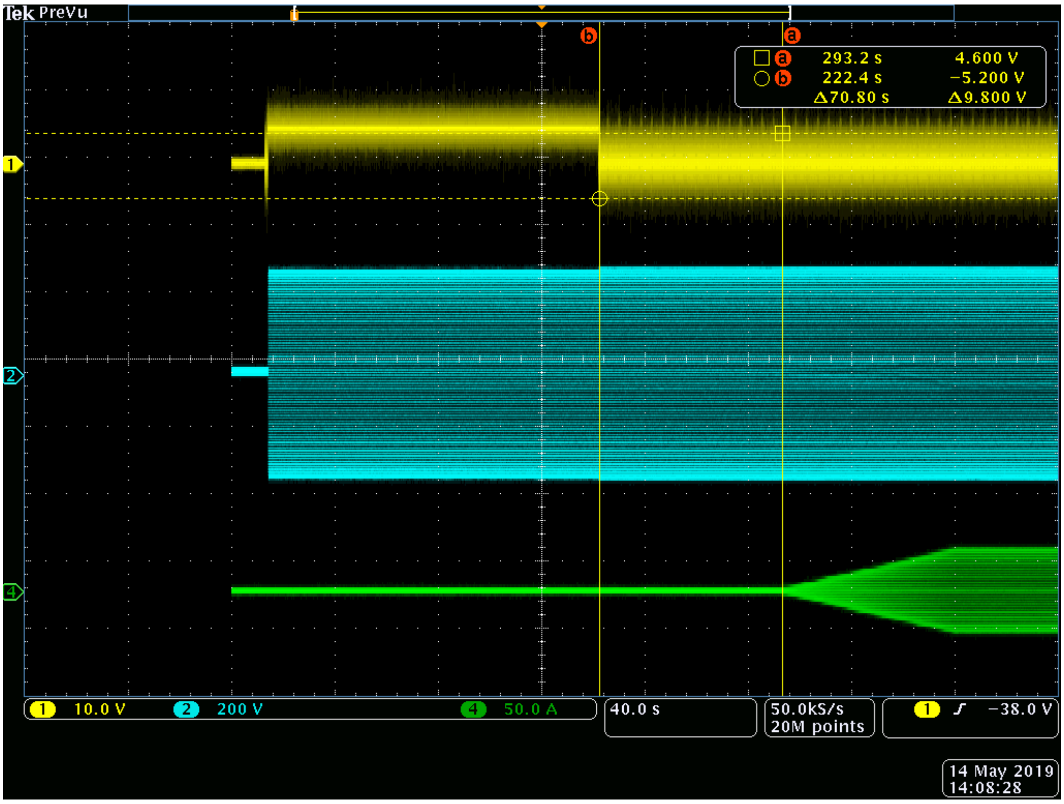
Voltage Connection Value Limit	Gradient (ΔP) desired ($\%P_n$/min)	Gradient measured ($\%P_n$/min)
V ≥ 94.0% Un	≤ 100.0%	90.0%
V ≤ 110.0% Un	≤ 100.0%	90.0%

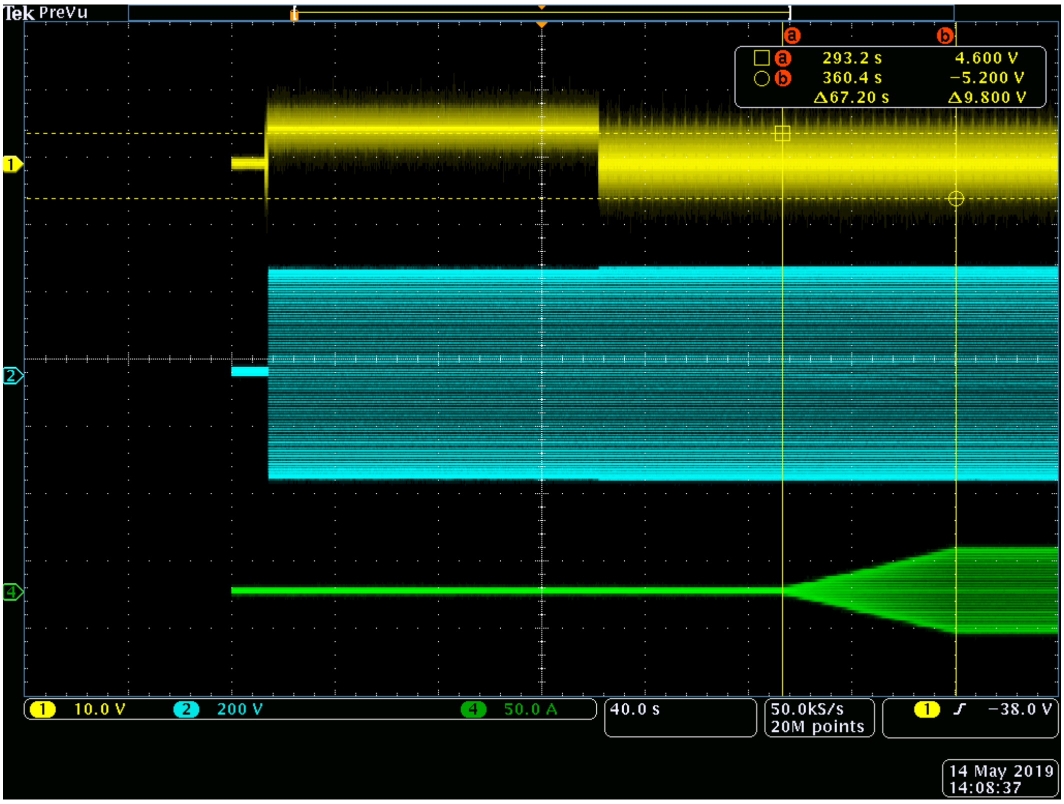
Note: it has been considered a minimum delay of 60 seconds to proceed with the start-up once the equipment is inside the required ranges.

Test results are graphically shown in following pages.

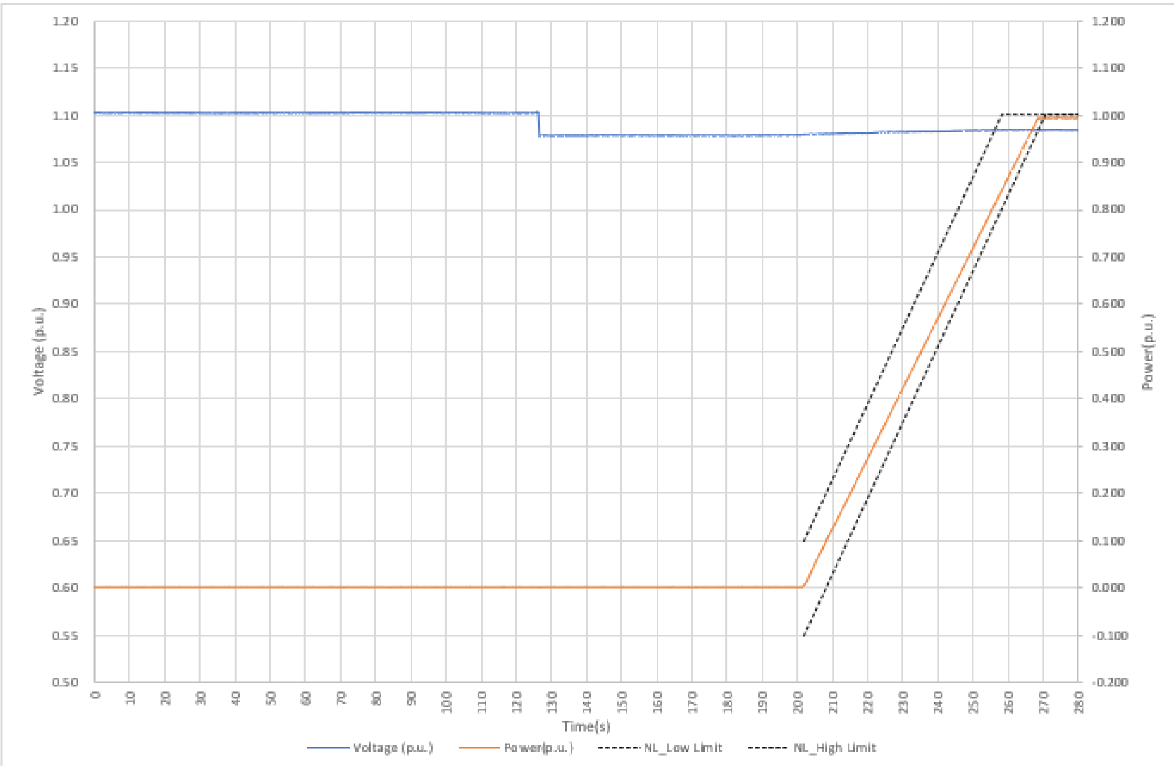
Under Voltage Connection

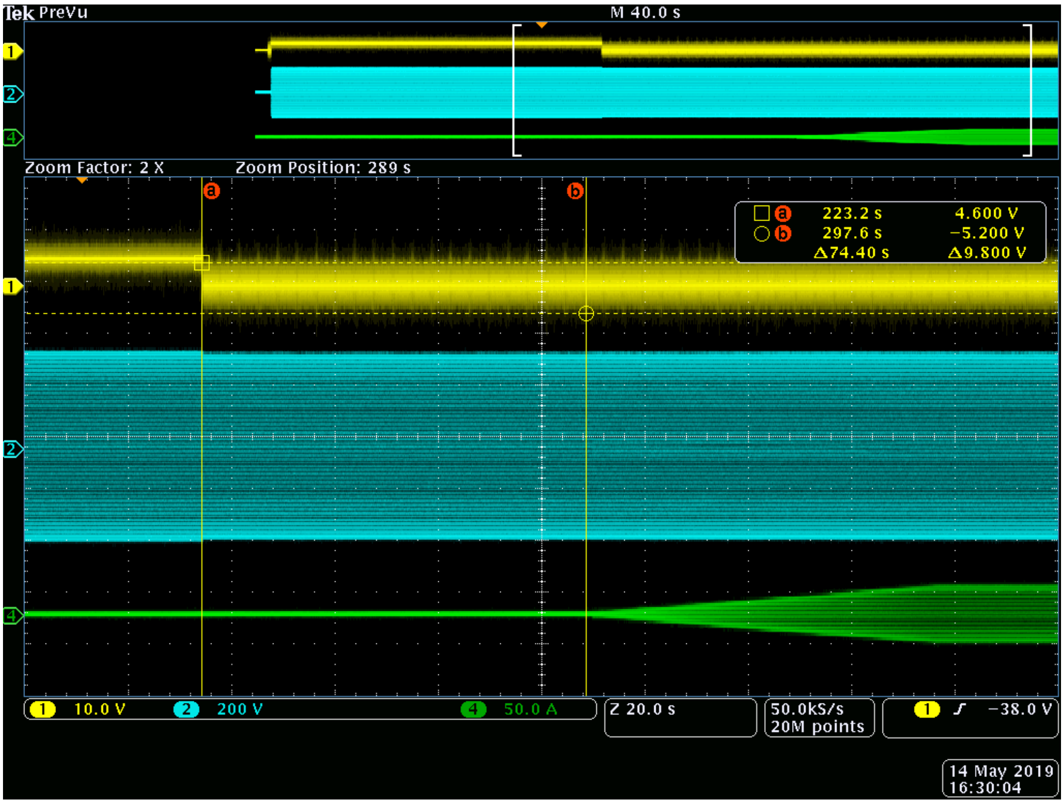




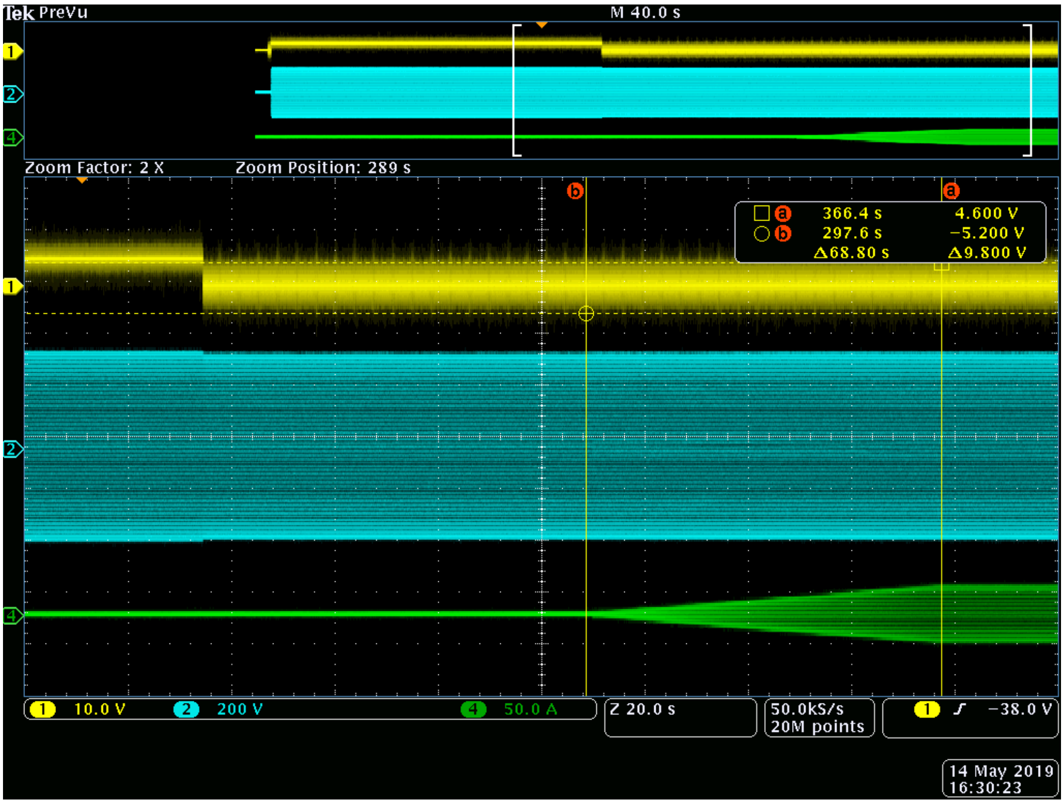


Over Voltage Connection





Tek PreVu
M 40.0 s
Zoom Factor: 2 X
Zoom Position: 289 s
a 223.2 s 4.600 V
b 297.6 s −5.200 V
Δ74.40 s Δ9.800 V
1 10.0 V
2 200 V
4 50.0 A
Z 20.0 s
50.0kS/s
20M points
1 −38.0 V
14 May 2019
16:30:04



Tek PreVu
M 40.0 s
Zoom Factor: 2 X
Zoom Position: 289 s
a 366.4 s 4.600 V
b 297.6 s −5.200 V
Δ68.80 s Δ9.800 V
1 10.0 V
2 200 V
4 50.0 A
Z 20.0 s
50.0kS/s
20M points
1 −38.0 V
14 May 2019
16:30:23

4.21.4 Voltage Reconnection

Test results are offered in the following tables:

Voltage Reconnection Value Limit	No Reconnection Test			Reconnection Test		
	Voltage value (%Un)	Time measured (s)	Reconnection	Voltage value (%Un)	Reconnection	Time measured (s)
V ≥ 94.0% Un	94.0%	>120	☒ NO ☐ YES	94.7%	☐ NO ☒ YES	71.20
V ≤ 110.0% Un	110.0%	>120	☒ NO ☐ YES	109.4%	☐ NO ☒ YES	78.00

The standard states that the tolerance limit for voltage reconnection values is ± 2 V, which is a 0,8% Un over 230 V, the reference voltage considered by the standard. So 0.8% Un is the allowed tolerance to be considered for voltage reconnection value tests.

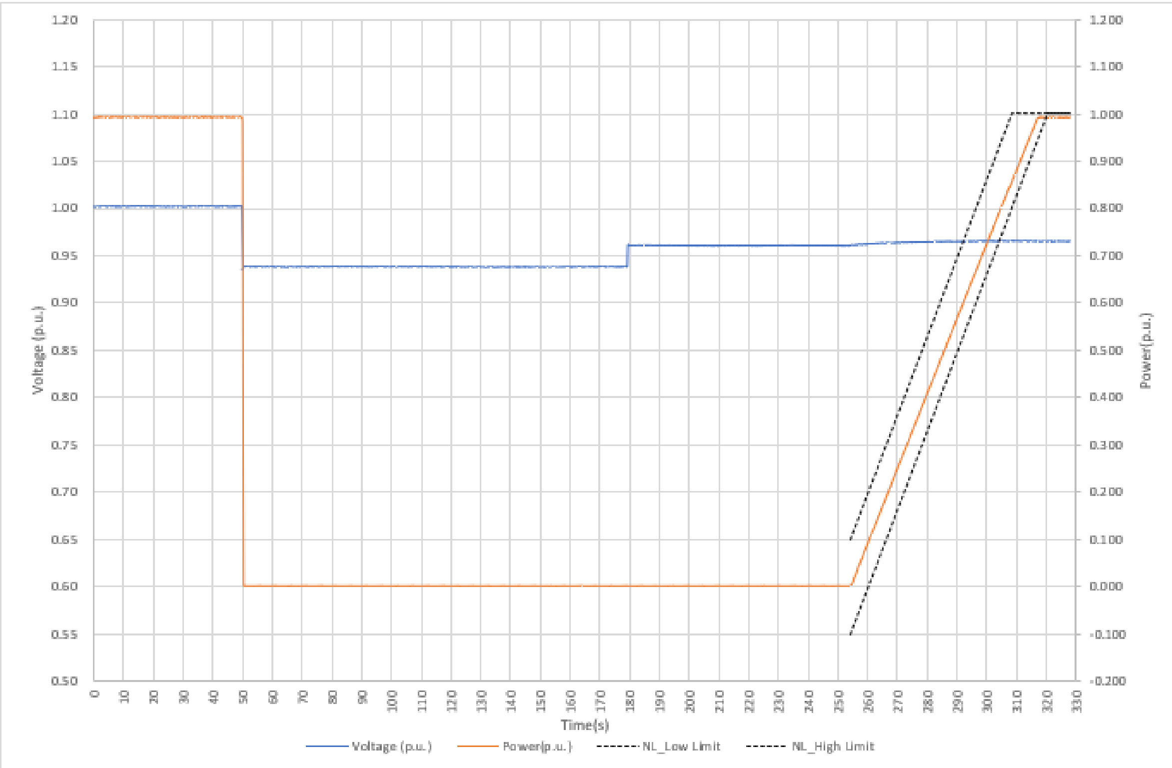
In addition to this requirement, it has been verified that according to the point 7.7 of the standard, the Control System of the inverter has a function to start reconnection following an adjustable Ramp Rate. The following table shows the programmed gradient for the different reconnections:

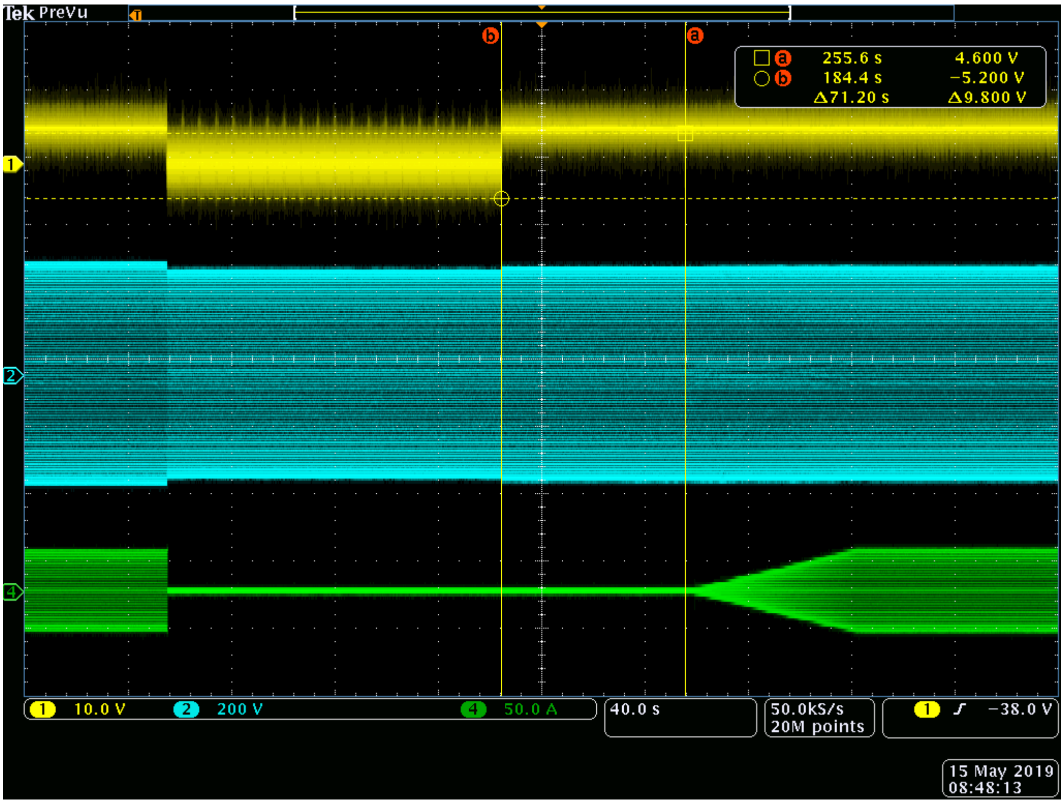
Voltage Reconnection Value Limit	Gradient (ΔP) desired (%P_n/min)	Gradient measured (P_n/min)
V ≥ 94.0% Un	≤ 100.0%	90.0%
V ≤ 110.0% Un	≤ 100.0%	91.5%

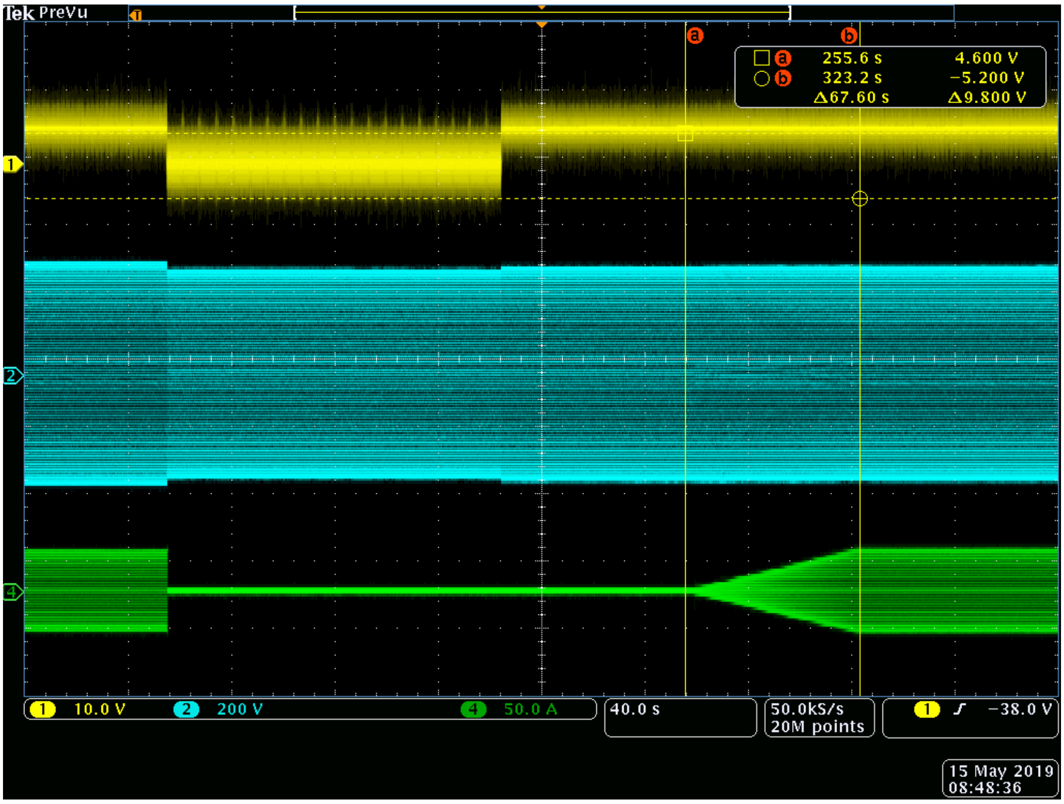
Note: it has been considered a minimum delay of 60 seconds to proceed with the start-up once the equipment is inside the required ranges.

Test results are graphically shown in following pages.

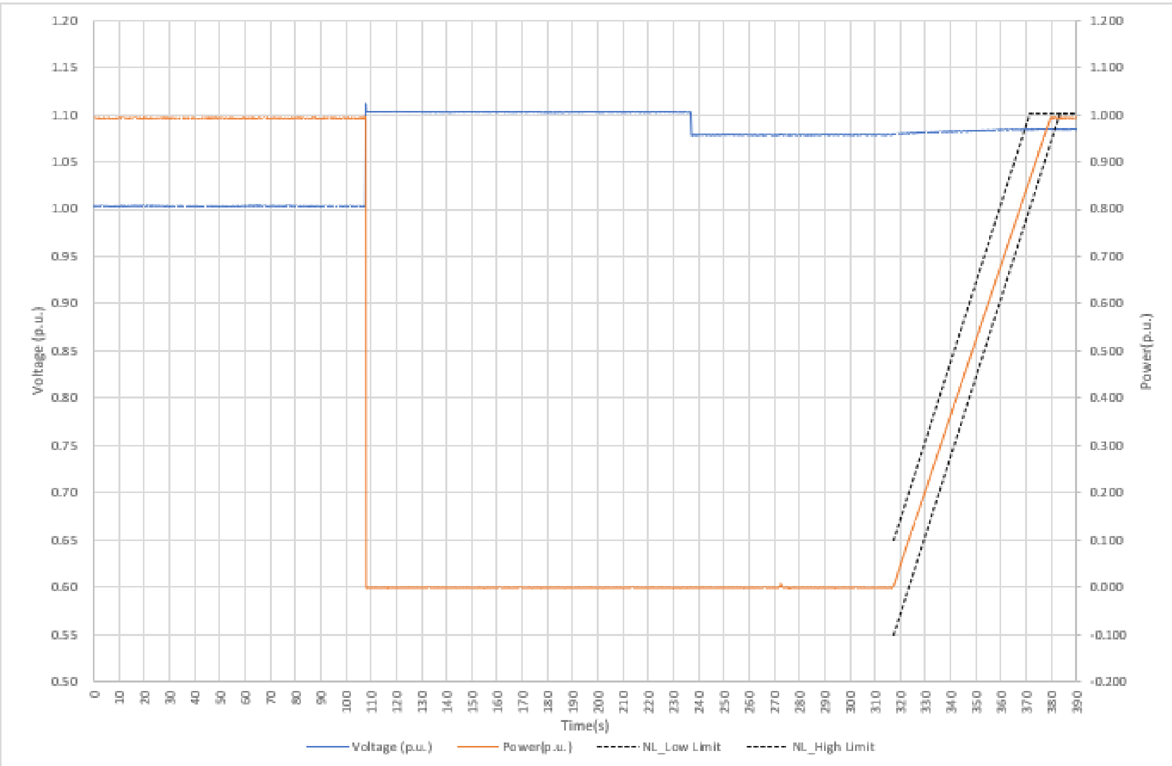
Under Voltage Reconnection

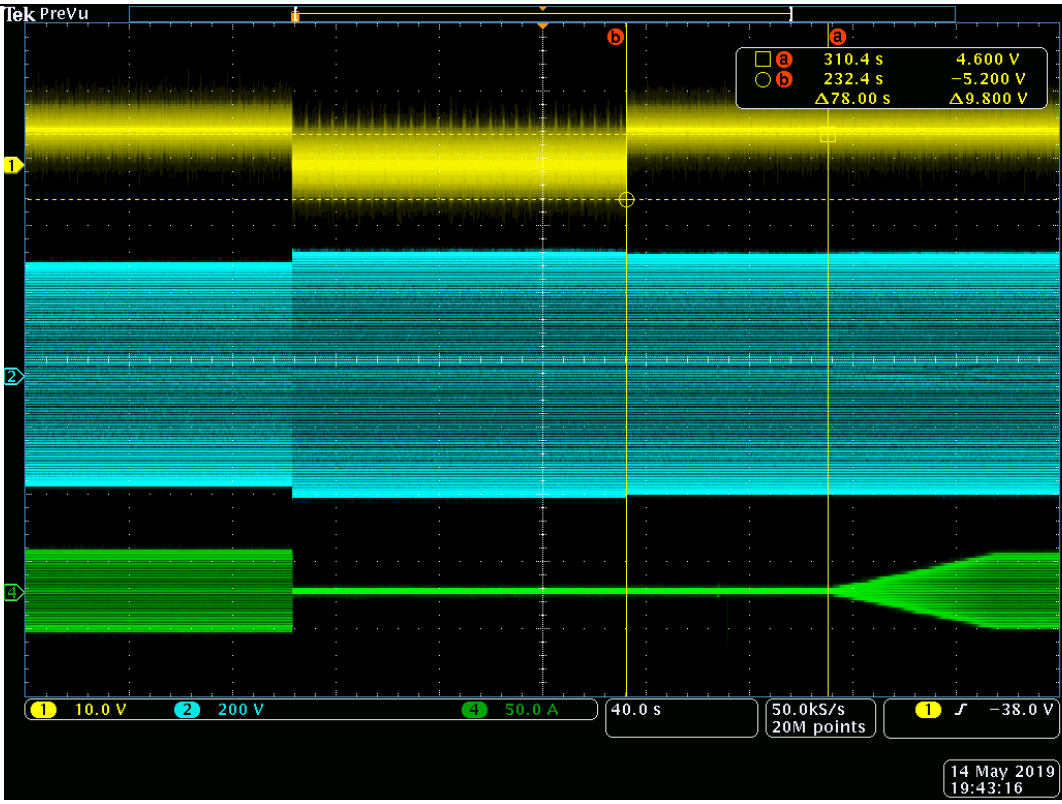




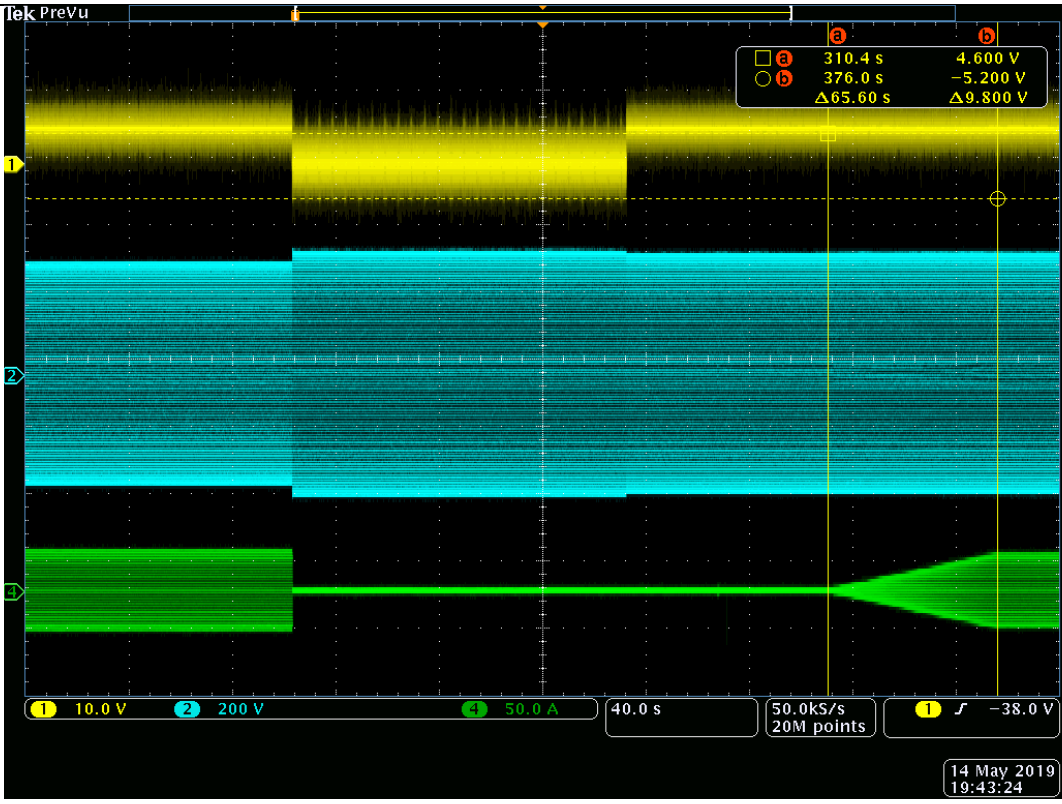


Over Voltage Reconnection





Tek PreVu
a 310.4 s 4.600 V
b 232.4 s −5.200 V
Δ78.00 s Δ9.800 V
1 10.0 V
2 200 V
4 50.0 A
40.0 s
50.0kS/s
20M points
1 −38.0 V
14 May 2019
19:43:16



Tek PreVu
a 310.4 s 4.600 V
b 376.0 s −5.200 V
Δ65.60 s Δ9.800 V
1 10.0 V
2 200 V
4 50.0 A
40.0 s
50.0kS/s
20M points
1 −38.0 V
14 May 2019
19:43:24

4.22 SECURITY OF PROTECTION SETTINGS

The inverter complies with the following requirements according to Clause 7.8 of the standard:

a) The inverter has been checked by inspection that changes to the internal setting shall require the use of a tool and special instructions not provided to unauthorized personnel.

b) The installer-accessible settings of the automatic disconnection device are capable of being adjusted within the limits specified in Clause 7.5 of the standard.

c) The manufacturer settings of the automatic disconnection device, specified in Clause 7.4 of the standard, are secured against changes.

4.23 MULTIPLE INVERTER COMBINATION

According to the clause 8 of the standard, Inverter energy systems are often comprised of multiple inverters used in combination to provide the desired inverter energy capacity or to ensure that voltage balance is maintained in multiple phase connections to the grid.

Possible combinations could be single-phase inverters used in parallel, single-phase inverters used in multiple phase systems.

The inverter under testing doesn't have any of these function incorporated in his control system, so this point is not applicable.

4.24 INVERTER MARKING AND DOCUMENTATION

The inverter is in compliance with marking and documentation requirements of IEC 62109-1, IEC 62109-2, and Clause 9 according AS/NZS 4777.2:2015

- IEC 62109-1 and IEC 62109-2: test report nº BL-SZ1998124-B01 on 2019/04/22 which issued by Shenzhen BALUN Technology Co., Ltd.

According to points 9.2.4 and 9.2.5 the unit shall be marked with the following external or auxiliary systems if those are required to comply with the requirements from the standard:

External equipment requirement	**Required (Yes or No?)**
Isolation transformer	No
RCD / earth fault detection	No
External automatic disconnector (DRM0)	No
External device to enable extra DRM modes	No

AS/NZS 4777.2 : 2015			
Clause	Requirement - Test	Result - Remark	Verdict
9	INVERTER MARKING AND DOCUMENTATION		P
9.1	General		P
	The inverter shall comply with the marking and documentation requirements of IEC 62109-1 and IEC 62109-2, as varied by this Clause (9).		P
	All markings and documentation shall be in the English language.		P
9.2	Marking		P

AS/NZS 4777.2 : 2015			
Clause	Requirement - Test	Result - Remark	Verdict
9.2.1	General		P
	The following variations apply to the marking requirements of IEC 62109-1 and IEC 62109-2:		P
	(a) Inverters that are designated for use in inverter energy systems incorporating energy sources other than PV arrays or batteries shall bear additional or alternative markings appropriate to the energy source.		P
	(b) Inverters that are designated for use in closed electrical operating areas shall be marked with a warning stating that they are not suitable for installation in households or areas of a similar type or use (i.e. domestic).	Not used in closed electrical operationg areas.	N/A
9.2.2	Equipment ratings		P
	The inverter shall be marked with its ratings and the ratings of each port, as specified in Table 15. Only those ratings that are applicable to the type of inverter are required. The ratings shall be plainly and permanently marked on the inverter, in a location that is clearly visible after installation.		P
9.2.3	Ports		P
	Each port shall be marked with its classification and indicate whether a.c or d.c. voltage as appropriate.		P
	Typical classifications include the following:		P
	(a) PV (photovoltaic).		P
	(b) Wind turbine.		N/A
	(c) Energy storage.		N/A
	(d) Battery.		P
	(e) Generator.		N/A
	(f) Grid-interactive.		P
	(g) Stand-alone.		P
	(h) Communications (type).		P
	(i) DRM.		P
	(j) Load.		P
9.2.4	External and ancillary equipment		N/A
	If the inverter requires external or ancillary equipment for compliance with this Standard, the requirement for any such equipment shall be marked on the inverter along with the following or an equivalent statement: ‘Refer to		N/A

AS/NZS 4777.2 : 2015			
Clause	Requirement - Test	Result - Remark	Verdict
	the installation instructions for type and ratings' or symbol.		
	Any external or ancillary equipment shall be marked in accordance with this Clause (9).		N/A
9.2.5	Residual current devices (RCDs)		P
	Inverter energy systems used with PV array systems require residual current detection in accordance with IEC 62109-1 and IEC 62109-2. The requirements can be met by the installation of a suitably rated RCD external to the inverter or by an RCMU integral to the inverter.	An RCMU integral to the inverter used	P
	Where an external RCD is required, the inverter shall be marked with a warning along with the rating and type of RCD required. The warning shall be located in a prominent position and written in lettering at least 5 mm high. It shall contain the following or an equivalent statement:		N/A
	WARNING: AN RCD IS REQUIRED ON THE [NAME] PORTS OF THE INVERTER		N/A
	If the inverter energy system requires a Type B RCD, the inverter shall be marked with a warning. The warning shall be located in a prominent position and written in lettering at least 5 mm high. It shall contain the following:		N/A
	WARNING: A TYPE B RCD IS REQUIRED ON THE [NAME] PORTS OF THE INVERTER		N/A
9.2.6	Demand response modes		P
	The demand response modes supported by the inverter should be permanently marked on the name plate or on a durable sticker located on or near the demand response interface port to indicate the demand response modes of which the unit is capable.	DRM 0	P
	Figure 9 illustrates an acceptable form of marking. If this form of marking is used, each box shall contain a tick or a cross (if the inverter has that capability) or remain blank (if it does not have that capability). Alternatively, only the modes supported may be marked.		P
	If the physical interface is a terminal block, then—	Terminal block used	P
	(a) the terminals shall be engraved or otherwise durably marked; or		P
	(b) a permanent label with 'DRM Port' shall be affixed near the terminal block.		P
	The marking shall indicate which terminal corresponds to which demand response mode.		P

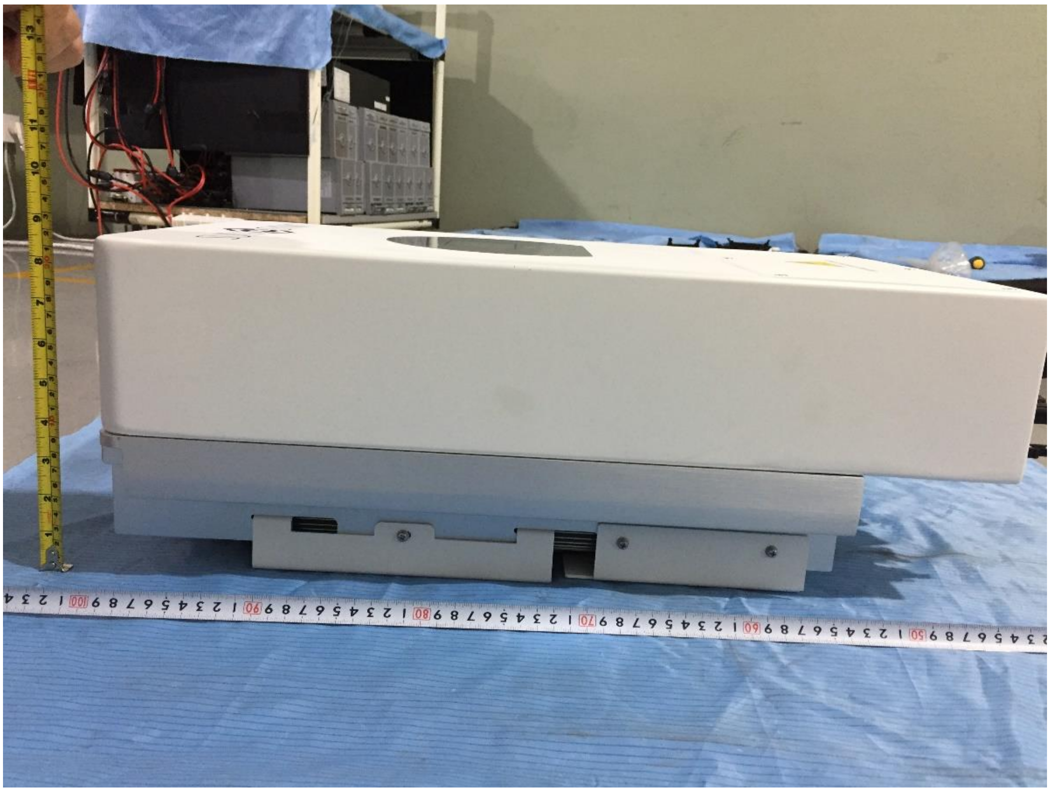
AS/NZS 4777.2 : 2015			
Clause	Requirement - Test	Result - Remark	Verdict
	The range of markings is indicated against Pins 1 to 6 in Table 7.	DRM 0	P
9.3	Documentation		P
9.3.1	General		P
	The documentation supplied with the inverter shall provide all information necessary for the correct installation, operation and use of the system and any required external devices including information specified in Clause 9.2.		P
	All inverters, including those intended for use in systems incorporating energy sources other than PV arrays or batteries, shall comply with the documentation requirements of IEC 62109-1 and IEC 62109-2.		P
9.3.2	Equipment ratings		P
	The documentation supplied with the inverter shall state the ratings of the inverter and the ratings for each port, as specified in Table 16. Only those ratings that are applicable to the type of inverter are required.		P
	For equipment with rated current greater than 16 A per phase, additional documentation requirements apply. See Clause 5.7.		P
9.3.3	Ports		P
	In addition to the requirements of Clause 9.3.2, the documentation supplied with the inverter shall state the following for each port, as a minimum:		P
	(a) Means of connection.		P
	(b) For pluggable equipment type B, the type of matching connectors to be used.		P
	(c) External controls and protection requirements.		P
	(d) Explanation of terminals or pins used for connection including polarity and voltage.		P
	(e) Tightening torque to be applied to terminals.		N/A
	(f) Instructions for protective earthing.		P
	(g) Instructions for connection of loads and installation of RCD protection to stand-alone ports.		N/A
	(h) The decisive voltage class (DVC).		P
9.3.4	External and ancillary equipment		N/A
	Where an inverter or multiple inverter combinations requires external or ancillary		N/A

AS/NZS 4777.2 : 2015			
Clause	Requirement - Test	Result - Remark	Verdict
	equipment for compliance with this Standard, the documentation shall—		
	(a) state the requirement for any such equipment;		N/A
	(b) provide sufficient information to identify the external or ancillary equipment, either by manufacturer and part number or by type and rating; and		N/A
	(c) specify assembly, location, mounting and connection requirements.		N/A
9.3.5	RCDs		N/A
	Where an external RCD is required, the following or an equivalent statement shall be included in the documentation: ‘External RCD Required’. The documentation shall also state the rating and type of RCD required and provide instructions for the installation of the RCD.	An RCMU integral to the inverter used	N/A
9.3.6	Multiple mode inverters	Not Multiple mode inverters	N/A
	Where the inverter is capable of multiple mode operation, the documentation shall include the following:		N/A
	(a) Ratings and means of connection to each source of supply to the inverter or output from the inverter.		N/A
	(b) Any requirements related to wiring and external controls, including the method of maintaining neutral continuity within the electrical installation to any stand-alone ports as required.		N/A
	(c) Disconnection means and isolation means.		N/A
	(d) Overcurrent protection needed.		N/A
9.3.7	Multiple inverter combinations	No in such used	N/A
	Where an inverter has been tested for use in a multiple inverter combination as per Clause 8, the documentation shall include the following:		N/A
	(a) Valid combinations of inverters.		N/A
	(b) Installation instructions for correct operation as a multiple inverter combination.		N/A

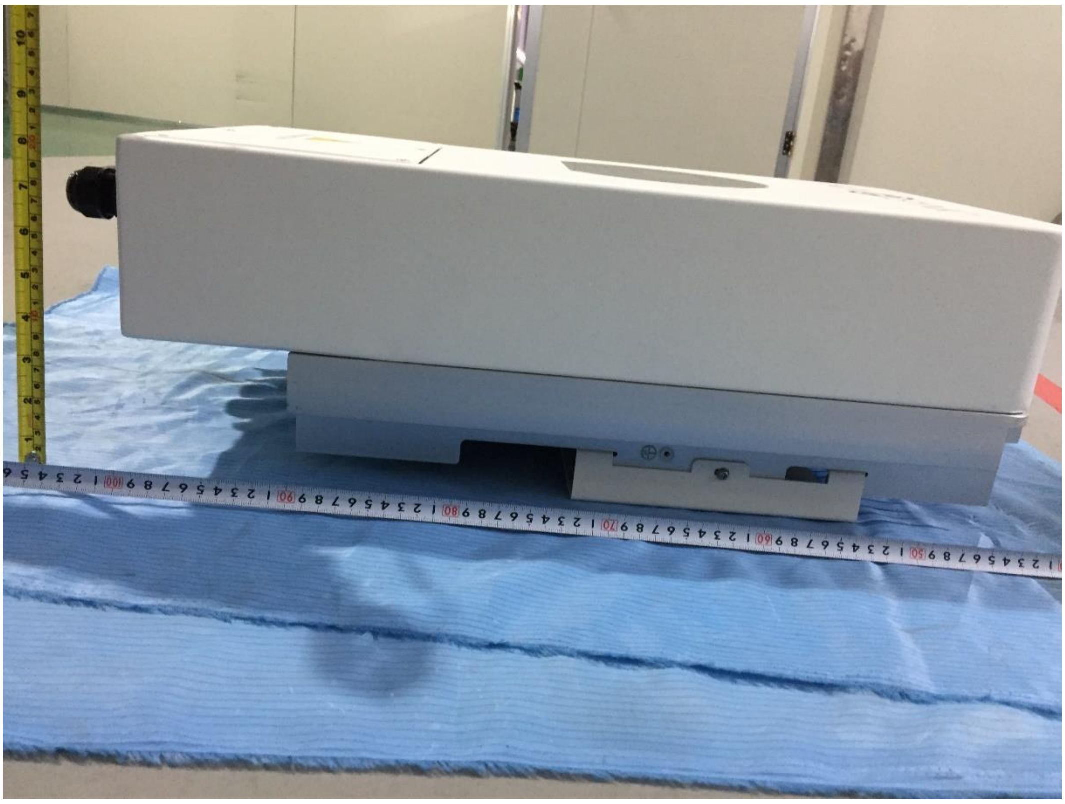
5 PICTURES

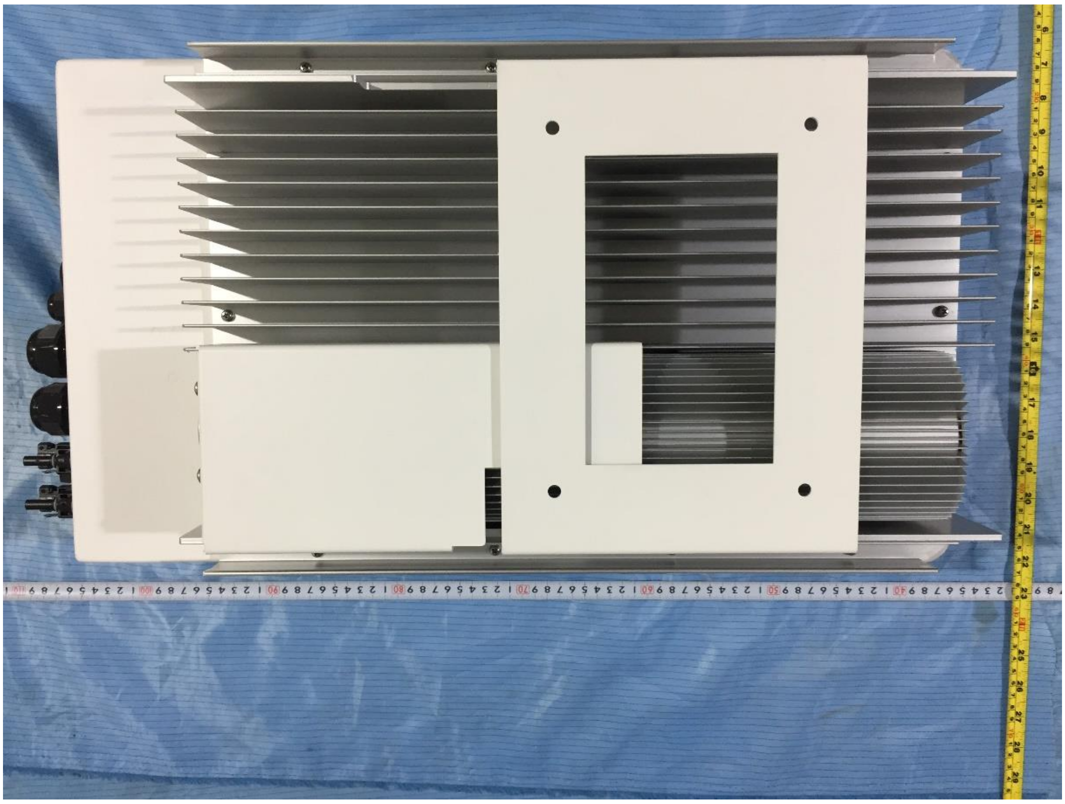
There are two types of enclosures are offered by the manufacturer, one is IP 20 and another is IP 65. Both types are in three colors (White, blue and black). Refer to the pictures below for details.

Front View for IP 65

Side View for IP 65


Side View for IP 65

Side View for IP 65


Back View for IP 65

Connectors for IP 65

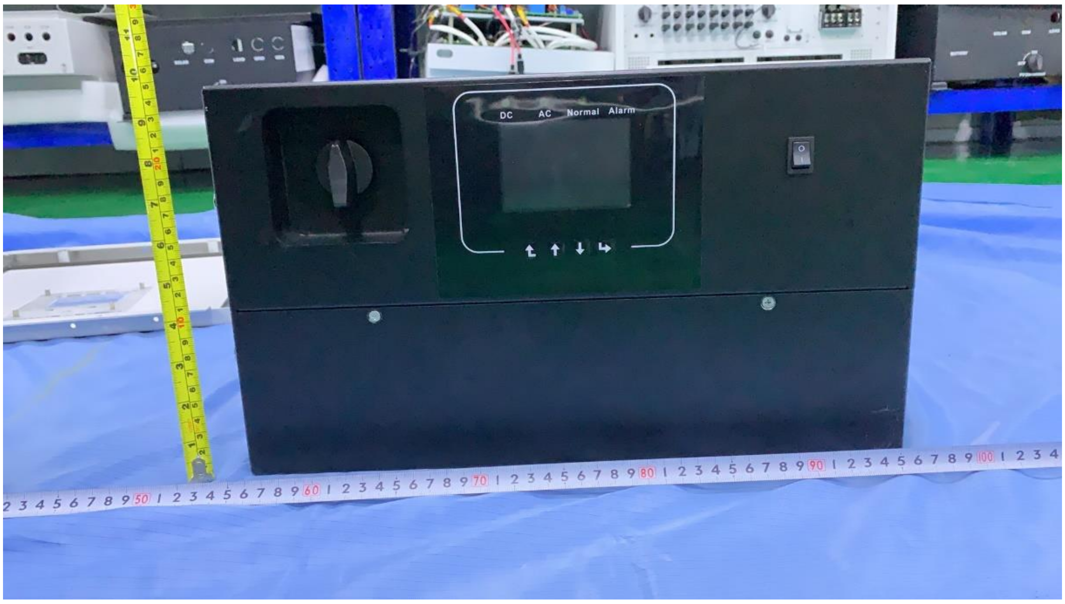

Front View for IP 20

Side View for IP 20


Side View for IP 20

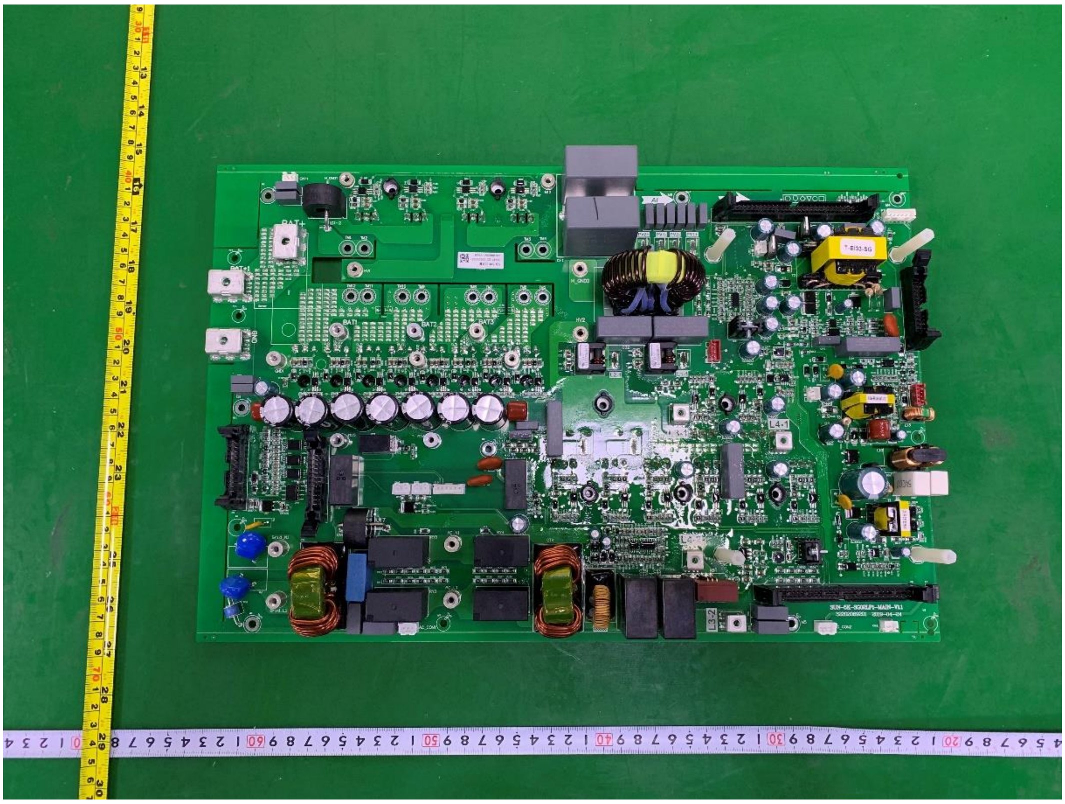

Side View for IP 20


Back View for IP 20

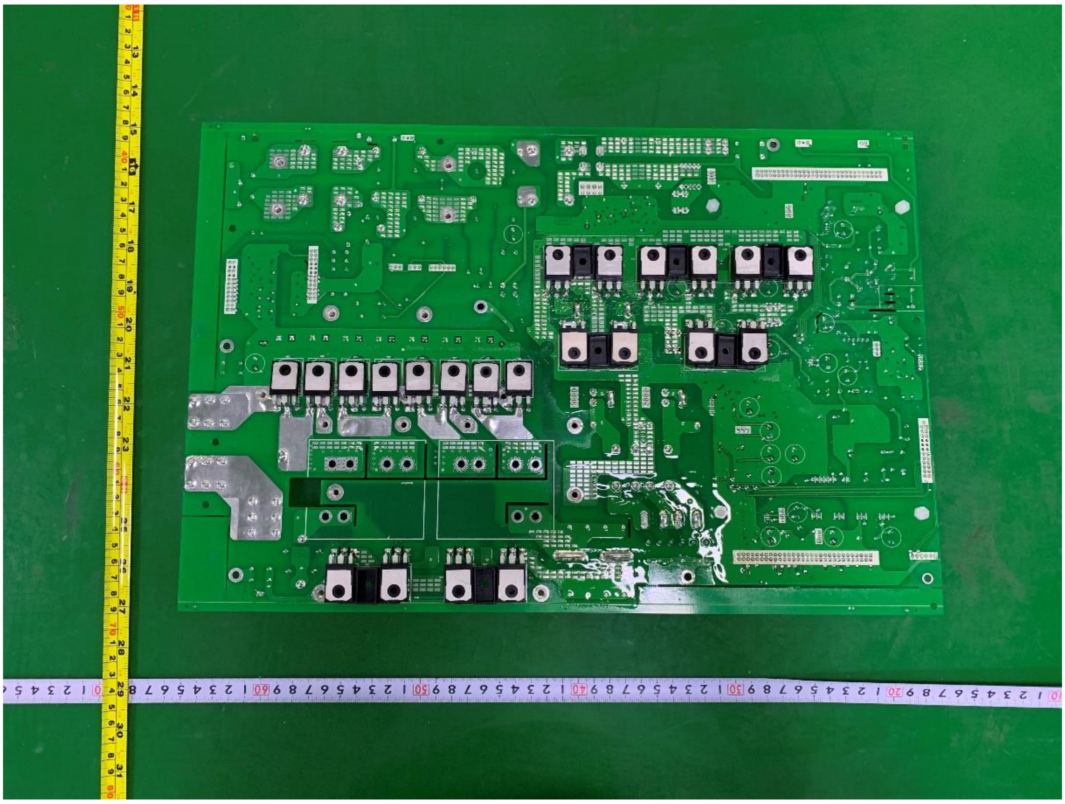
Top View for IP 20


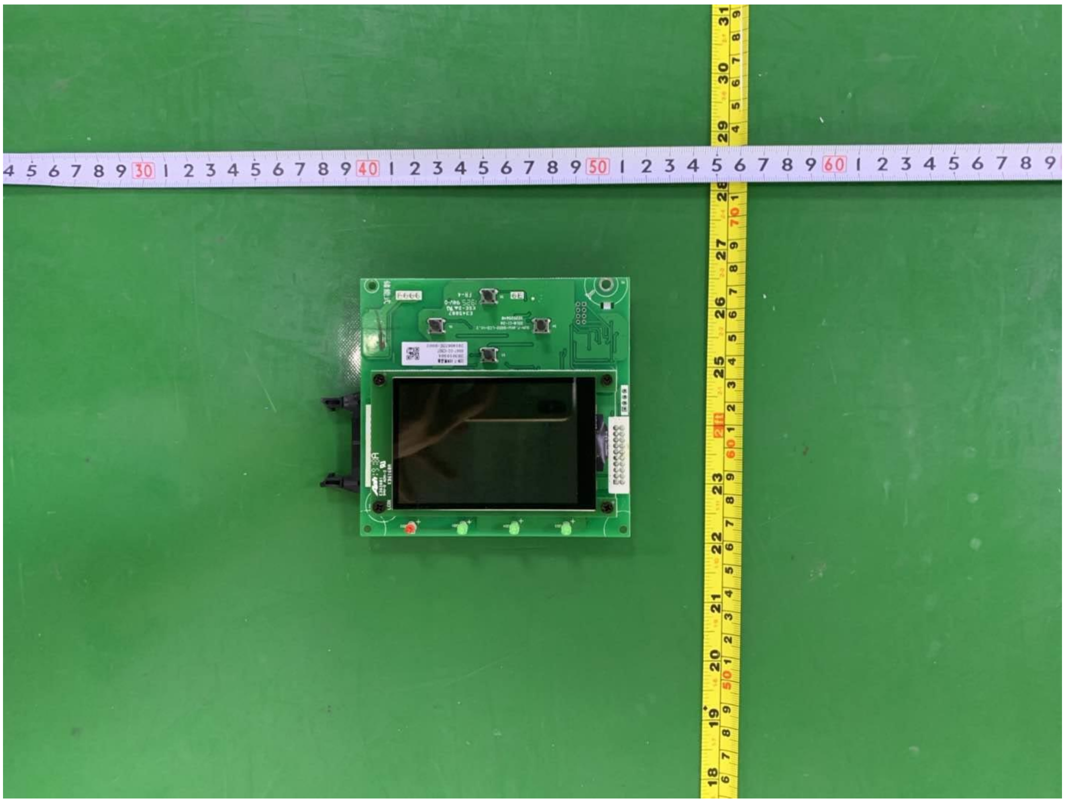
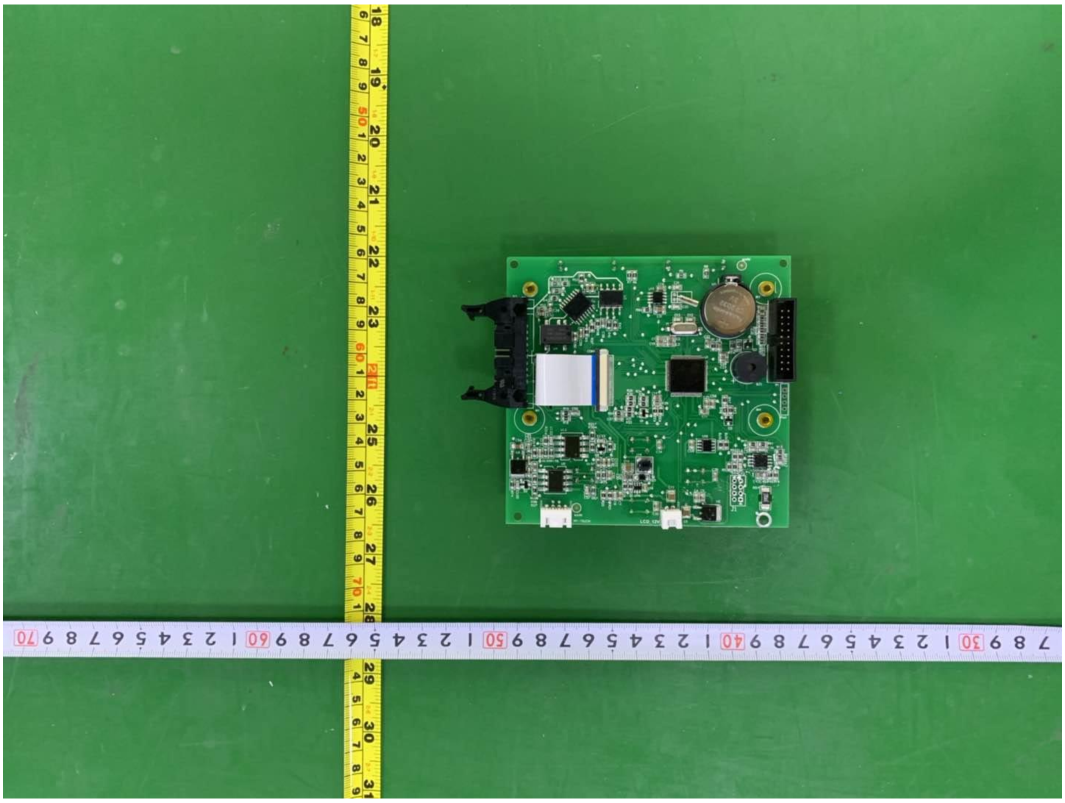
Connectors for IP 20

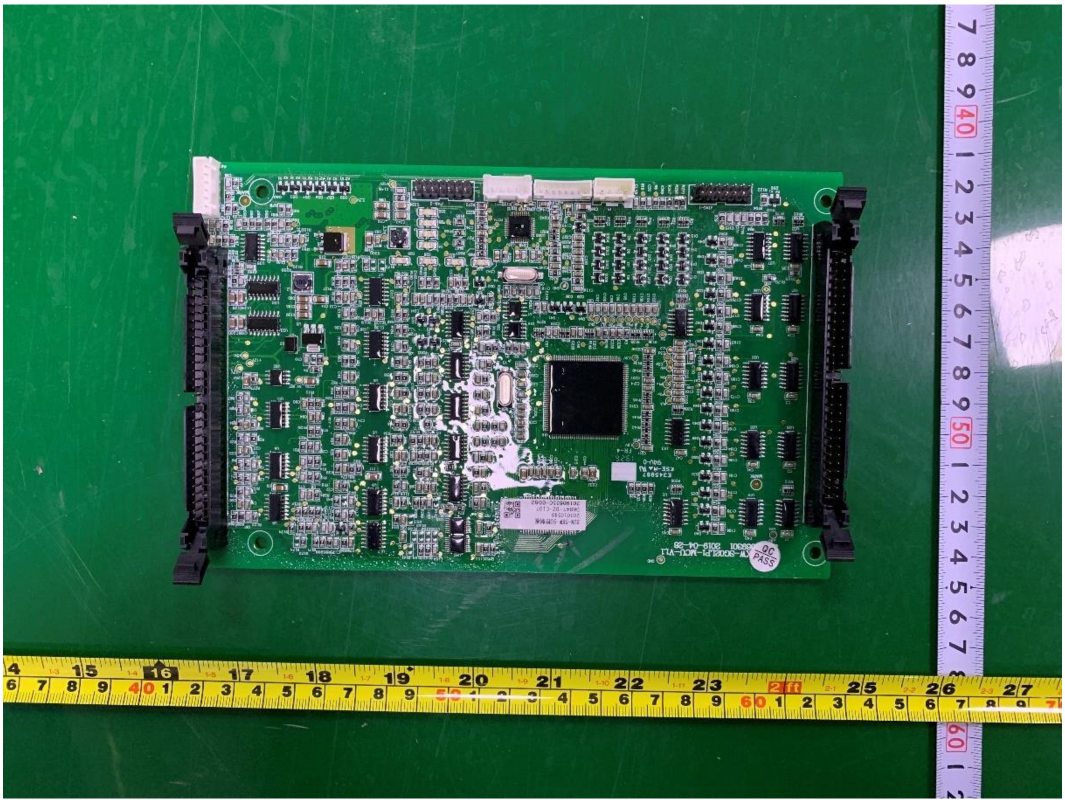
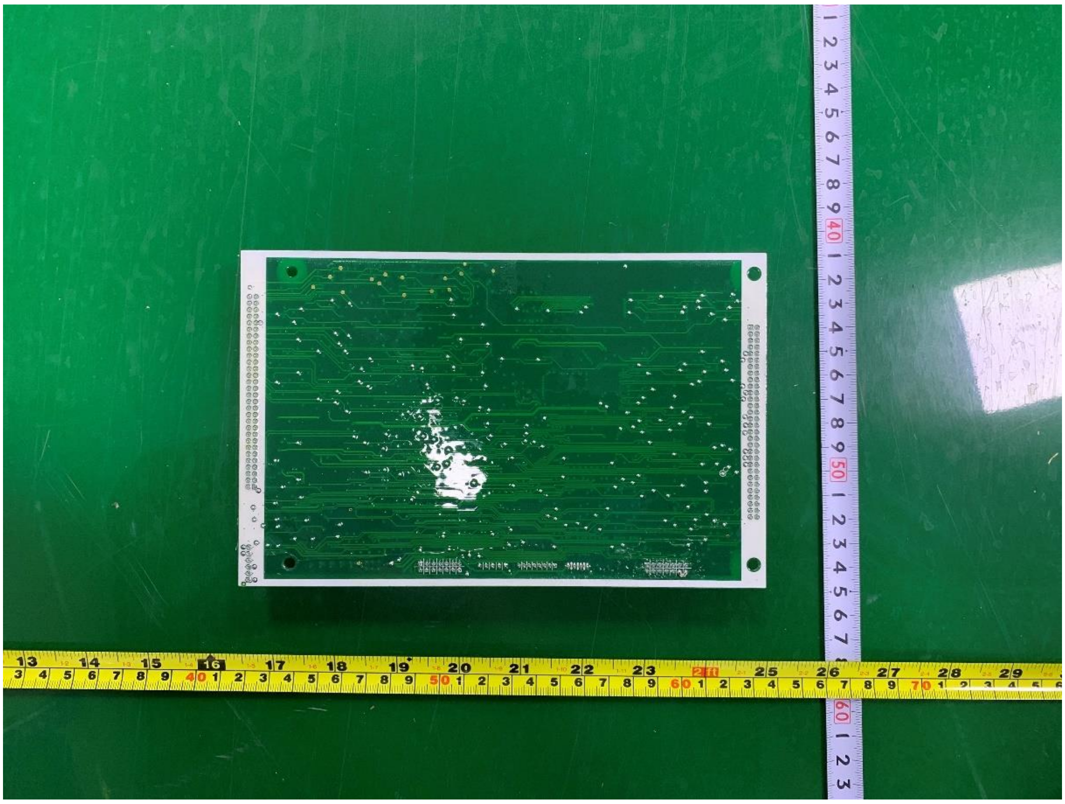

Front view of Main board

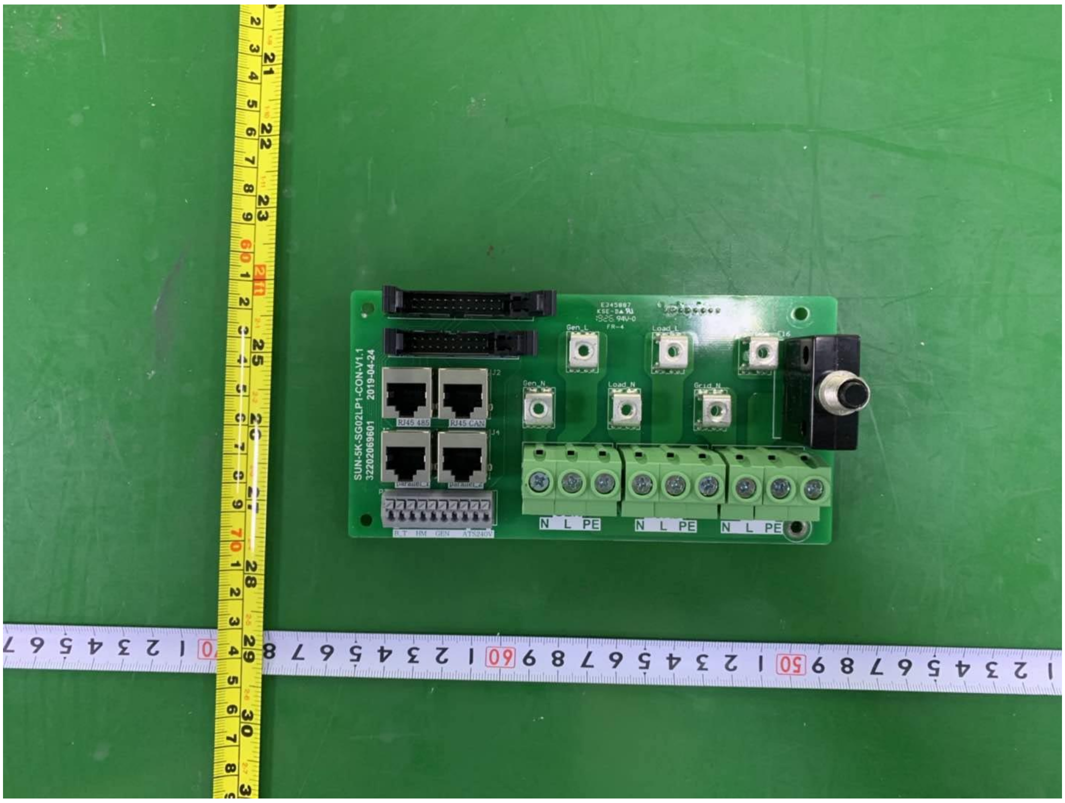
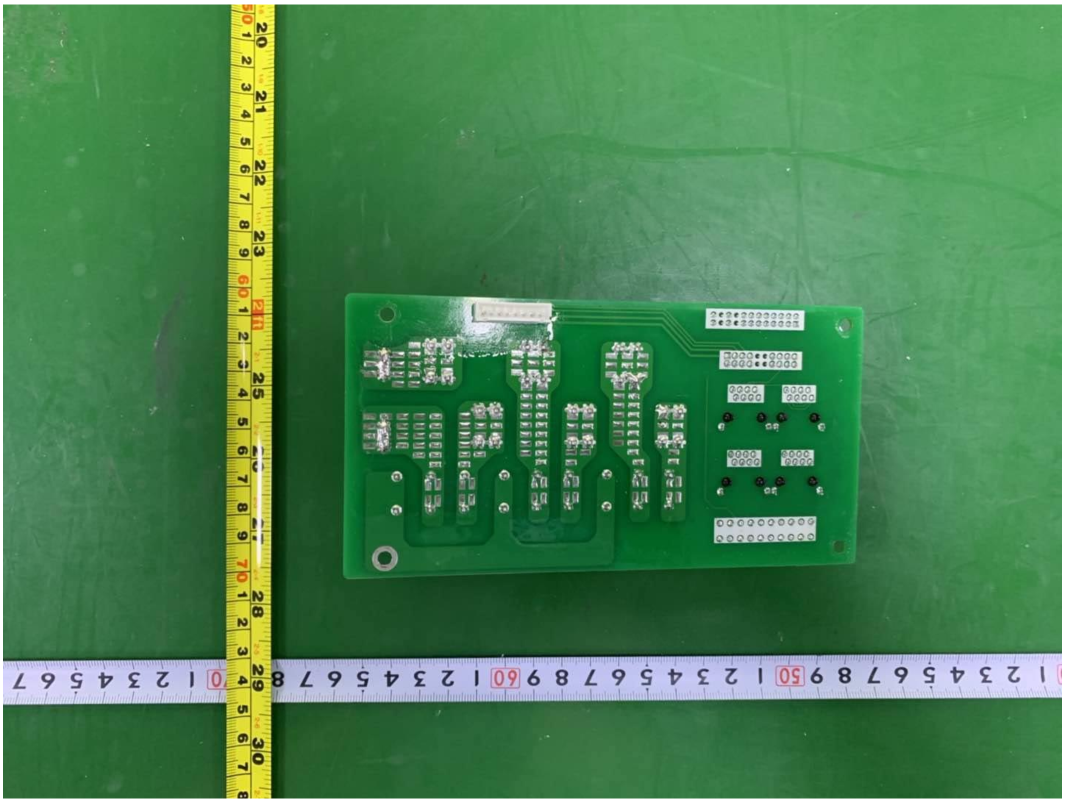


Back view of Main board

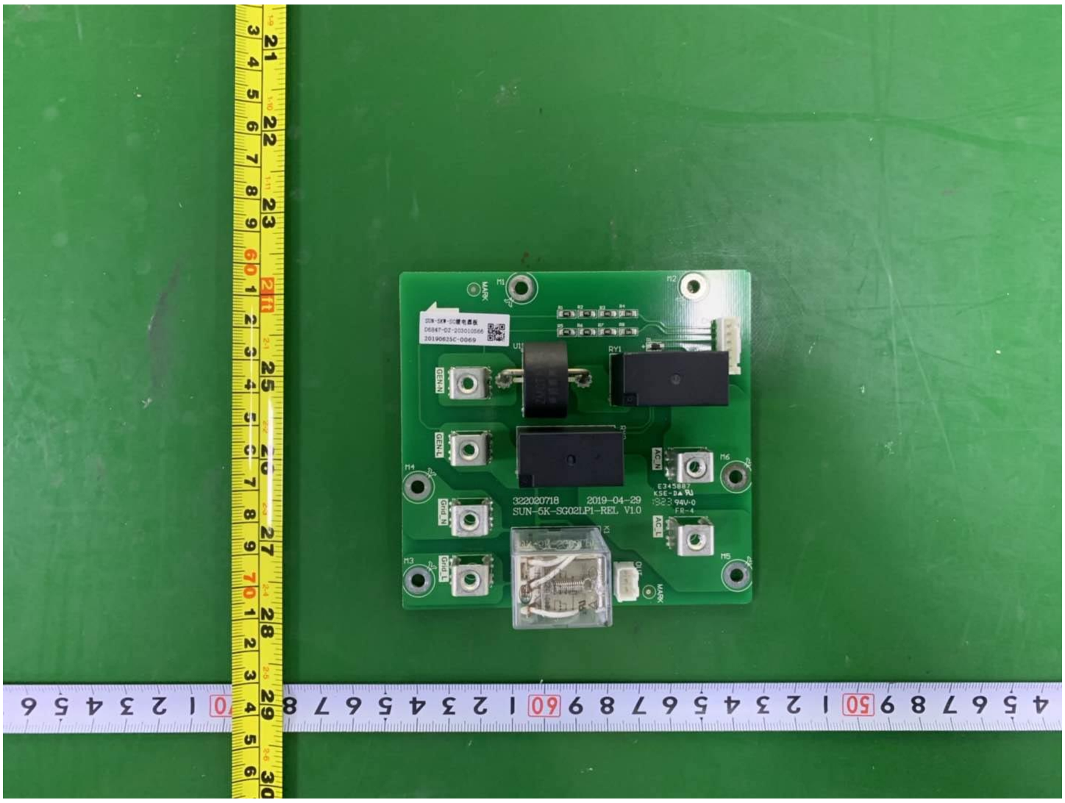


Front View of Display board

Back View of Display board


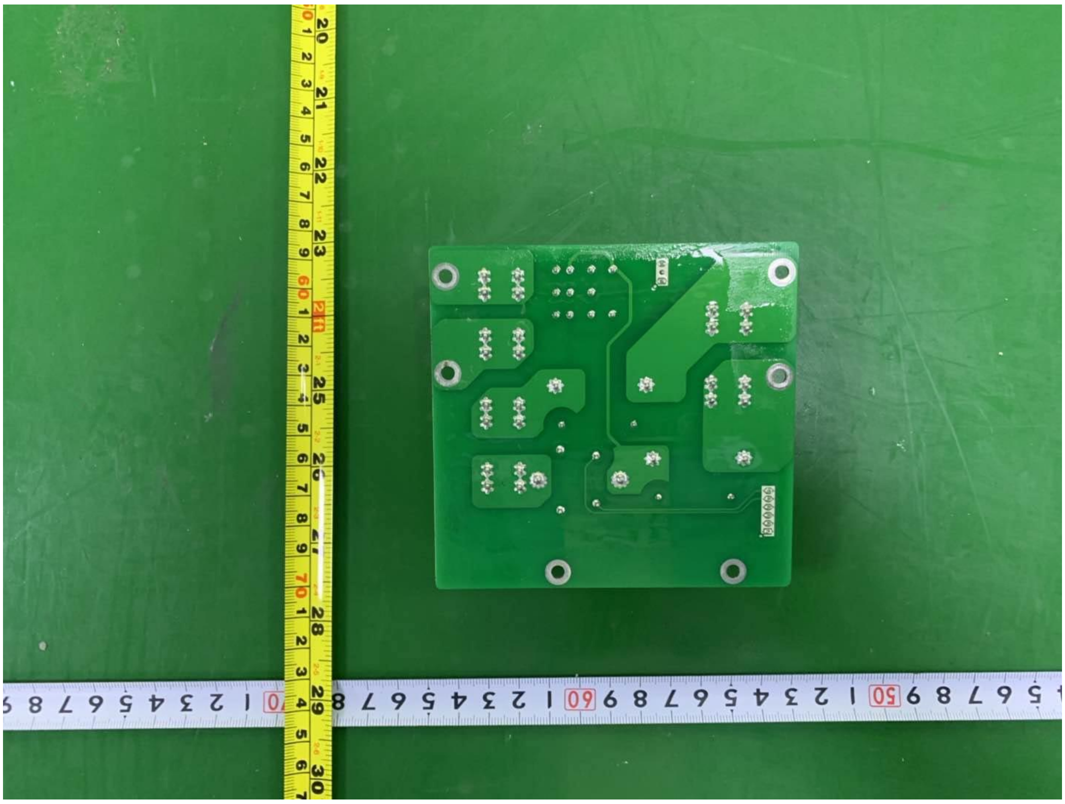
Front View of Control board

Back View of Control board


Front View of Connect board

Back View of Connect board


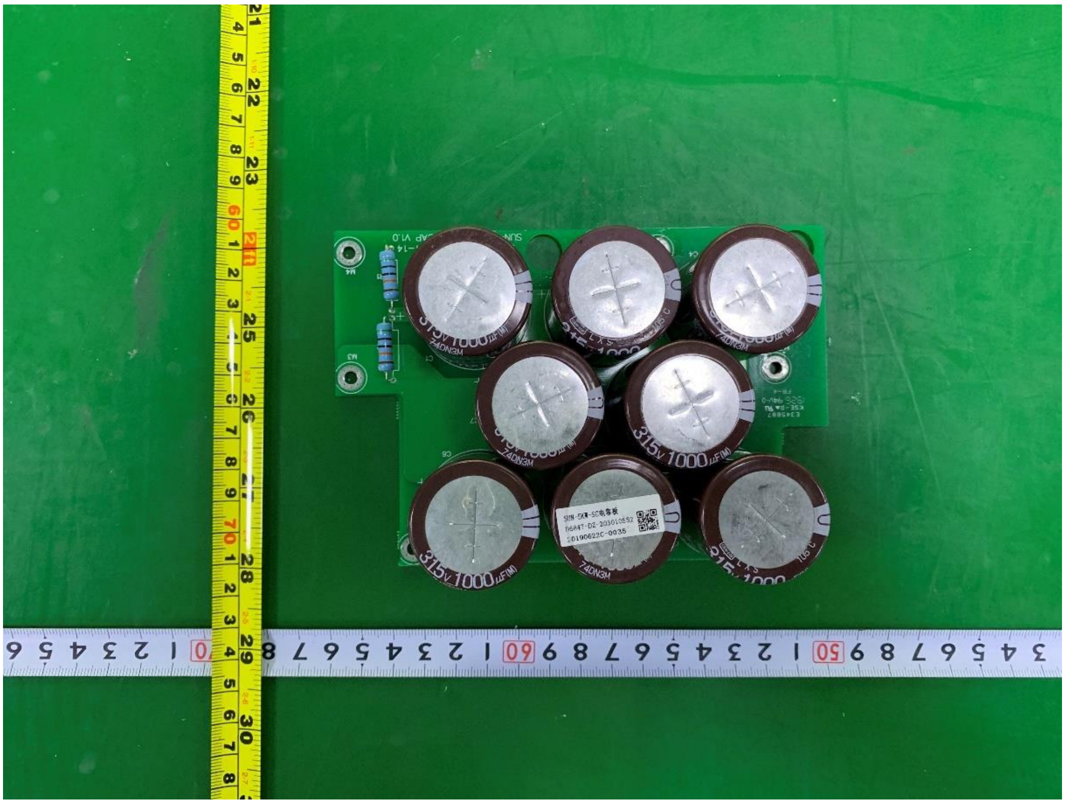
Front View of Relay board



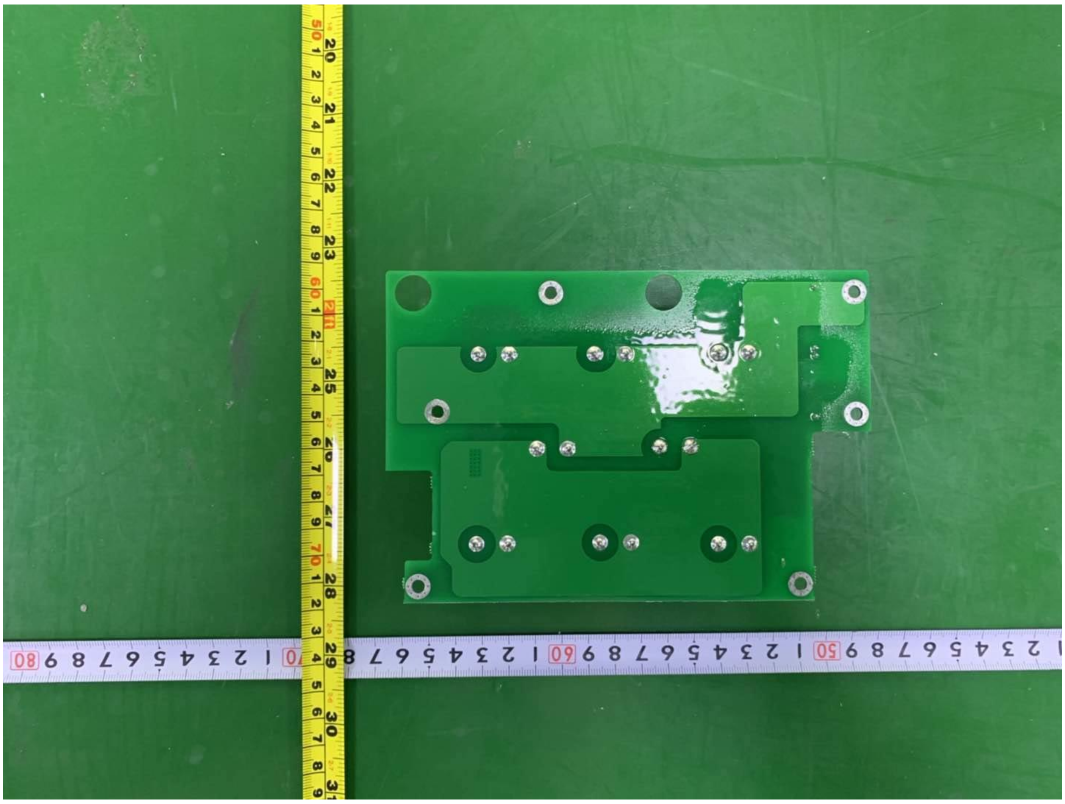
Back View of Relay board



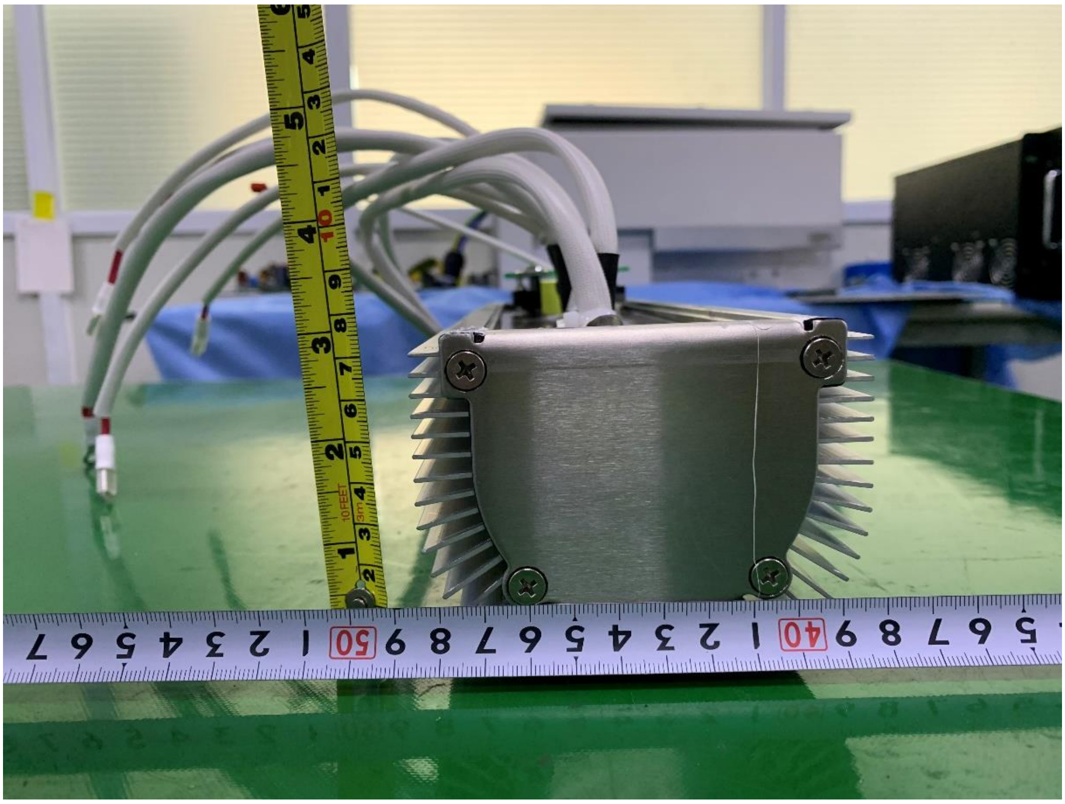
Front View of Capacitor board



Back View of Capacitor board



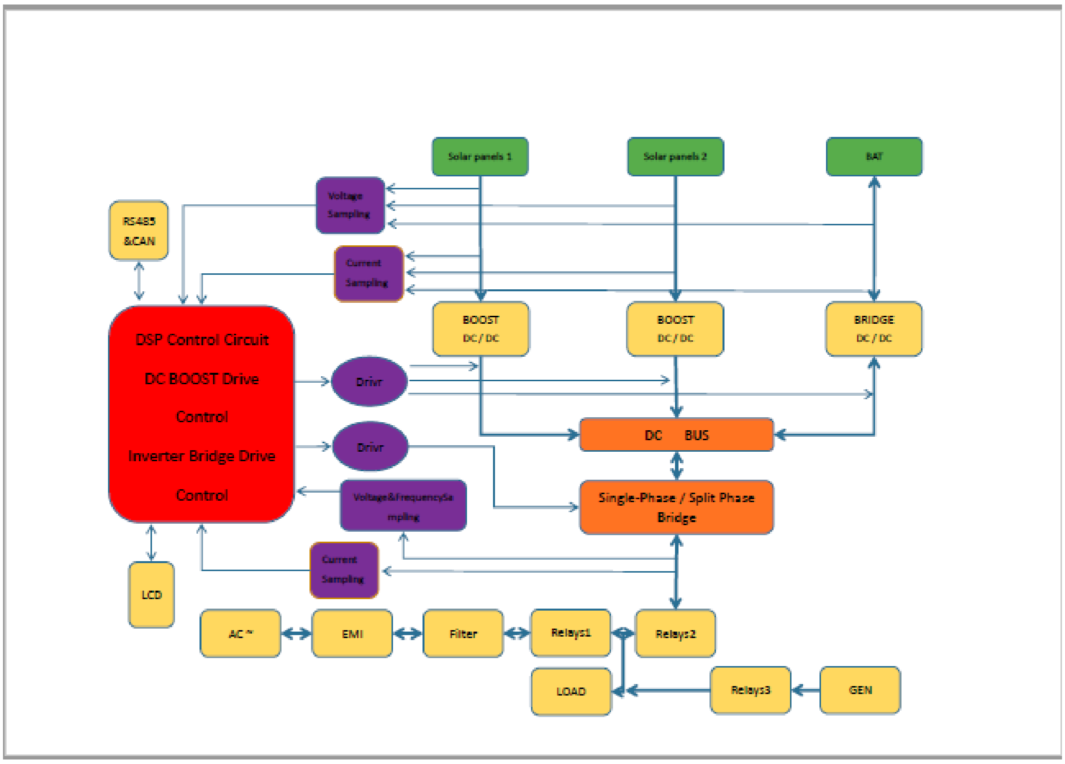
Front View of Inductor

Side View of Inductor


Serial Number and Software Version


6 ELECTRICAL SCHEMES

Equipment under testing



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