TESTING FOR THE VERIFICATION OF COMPLIANCE OF PV INVERTER WITH:

TECHNICAL PRESCRIPTION C10/11 OF SYNERGRID. EDITION 2.1 (01.09.2019)

(REQUIREMENTS FOR TYPE A GENERATING PLANT)

Procedure: PE.T-LE-62

Test Report Number ..... :	**2220 / 0296**
Type ..... :	Solar Grid-tied Inverter
Tested Model ..... :	**SOFAR 6KTLM-G2**
Variant Models ..... :	**SOFAR 5KTLM-G2, SOFAR 4.6KTLM-G2, SOFAR 4KTLM-G2, SOFAR 3.6KTLM-G2 SOFAR 3KTLM-G2**

APPLICANT

Name ..... :	Shenzhen SOFAR SOLAR Co., Ltd.
Address ..... :	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China

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)
Reviewed and Approved by ..... :	Jacobo Tevar (Technical Reviewer)
Date of issue ..... :	11/09/2020
Number of pages ..... :	62

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

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Test Report Historical Revision:

Test Report Version	Date	Resume
2220/0296	11/09/2020	First issuance

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1 SCOPE

SGS Tecnos, S.A. (Electrical Testing Laboratory) has been contract by **Shenzhen SOFAR SOLAR Co., Ltd.**, in order to perform testing according to Technical Prescription C10/11 of Synergrid. Edition 2.1 (01.09.2019). Specific technical prescriptions regarding power-generating plants operating in parallel to the distribution network.

EUT comply with requirements for **type A** generating plant connect to LV grid define in the standard as following:

> The power limits considered for application in the scope of this regulation are the following :
>
> - Type A : $0{,}8\ \mathrm{kW} \leq P_{MAX}^{Capacity} < 1\ \mathrm{MW}$
> - Type B : $1\ \mathrm{MW} \leq P_{MAX}^{Capacity} < 25\ \mathrm{MW}$

2 GENERAL INFORMATION

2.1 TESTING PERIOD AND CLIMATIC CONDITIONS

The necessary testing has been performed on 1st and 2nd Sep. of 2020

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

SITE TEST

Name ..... : Shenzhen SOFAR SOLAR Co., Ltd.

Address ..... : 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China

2.2 EQUIPMENT UNDER TESTING

Apparatus type ..... : Solar Grid-tied Inverter

Installation ..... : Fixed installation

Manufacturer ..... : Shenzhen SOFAR SOLAR Co., Ltd.

Trade mark ..... : SOFAR SOLAR

Model / Type reference ..... : SOFAR 6KTLM-G2

Serial Number ..... : ZH1CS160J1P195

Software Version ..... : V2.70

Checksum ..... : N/A

Rated Characteristics ..... : DC input: 90-580V (Max. 600V), 11/11A
AC output: 230V, 50Hz, 26.1A, 6000VA

Date of manufacturing: 2020

Test item particulars

Input..... : DC

Output..... L/N/PE

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

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

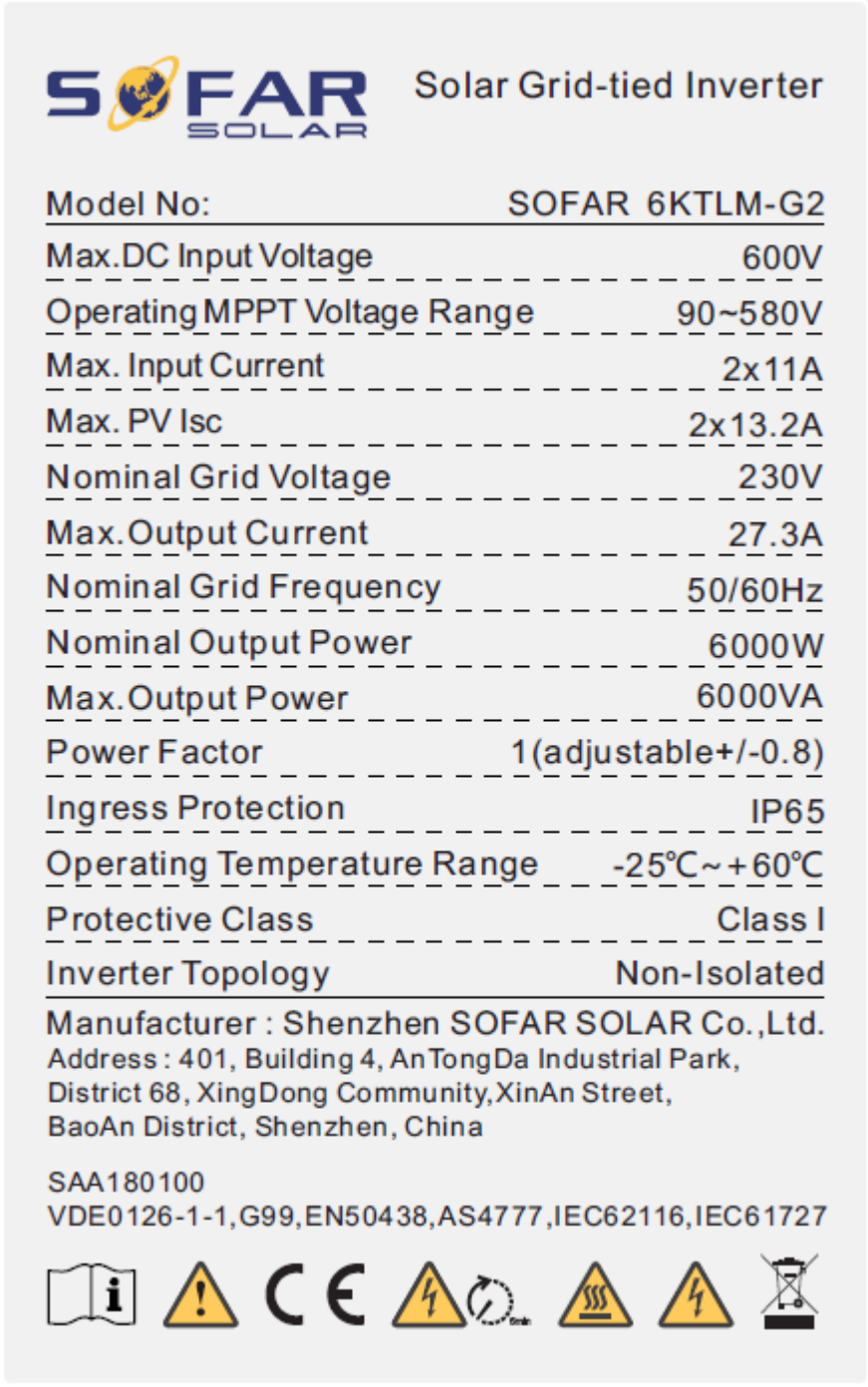
Type of connection to the main supply..... : Signal phase – Fixed installation

Cooling group ..... : Heat sink

Modular ..... : No

Internal Transformer..... : No

Copy of marking plate (representative):



Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation
3. Labels of other models are as the same with SOFAR 6KTLM-G2's except the parameters of rating.

Equipment under testing:

- **SOFAR 6KTLM-G2**

The variants models are:

- **SOFAR 5KTLM-G2**
- **SOFAR 4.6KTLM-G2**
- **SOFAR 4KTLM-G2**
- **SOFAR 3.6KTLM-G2**
- **SOFAR 3KTLM-G2**

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

Following table shows the full ratings of the variant models:

Product Model	SOFAR 3KTLM-G2	SOFAR 3.6KTLM-G2	SOFAR 4KTLM-G2	SOFAR 4.6KTLM-G2	SOFAR 5KTLM-G2	SOFAR 6KTLM-G2
Input (DC)						
Max.DC Input Power	3500W	4000W	4400W	5000W	5500W	6600W
Max.DC Voltage	600V					
Power Turn on	80V					
Start-up input voltage	120V					
Rated input voltage	360V					
MPPT Voltage Range	90-580V					
Full load DC voltage range	160-520V	180-520V	200-520V	230-520V	250-520V	300-520V
MAX input current per MPPT	11A/11A					
Number of DC inputs	2/2					
Output (AC)						
Max AC Output power	3000VA	3680VA	4000VA	4600VA	5000VA	6000VA
Nominal AC Output power	3000W	3680W	4000W	4600W	5000W	6000W
Max AC Output Current	13.7A	16.8A	18.2A	21A	22.8A	27.3A
Nominal AC output current	13.0	16.0	17.4	20.0	21.7	26.1
Nominal Grid Voltage	230Vac (Single phase)					
Nominal Frequency	50Hz					
Power factor	1(adjustable+/-0.9)					
Topology	Transformerless					
Operating temperature range	-25-60℃					
Degree of protection	IP65					

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.

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

- Same connection system and hardware topology
- Same control algorithm.
- Output power within 1/√10 and 2 times of the rated output power 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 comma ~~(point)~~ is used as the decimal separator.

2.3 REFERENCE VALUES

The values presented in the following table have been used for calculation of referenced values (p.u.; %) thougth the report.

Reference Values	
Design active power, P_D in kW	5.4
Rated apparent power, **Sn** in kVA	6
Rated wind speed (only WT), **vn** in m/s	N/A
Rated current (determined), **In** in A	26.1
Rated output voltage, (phase to phase) **Un** in Vac	230
Note: In this report p.u. values are calculated as follows: -For Active & Reactive Power p.u values are reference to**Sn** -For Currents p.u values, the reference is always **In** -For Voltages p.u values, the reference is always **Un**	

2.4 TEST EQUIPMENT LIST

From	No.	Equipment Name	Model No.	Equipment No.	Calibration Date	Equipment calibration due date
Sofar Solar	1	Voltage probe	SanHua / SI-9110	152627	2020/01/14	2021/01/13
	2	Voltage probe	SanHua / SI-9110	111134	2020/01/14	2021/01/13
	3	Power analyzer	ZLG / PA5000	C820290908200211 0001	2020/03/02	2021/03/01
	4	Current probe	CYBERTEK / CP1000A	C181000922	2020/01/14	2021/01/13
	5	Current probe	CYBERTEK / CP1000A	C181000925	2020/01/14	2021/01/13
	6	Temperature & Humidity meter	Anymeters / TH101B	ZB-WSDJ-001	2020/01/14	2021/01/13
SGS	7	True RMS Multimeter	Fluke / 187	80780025 (GZE012-8)	2019/12/05	2020/12/04

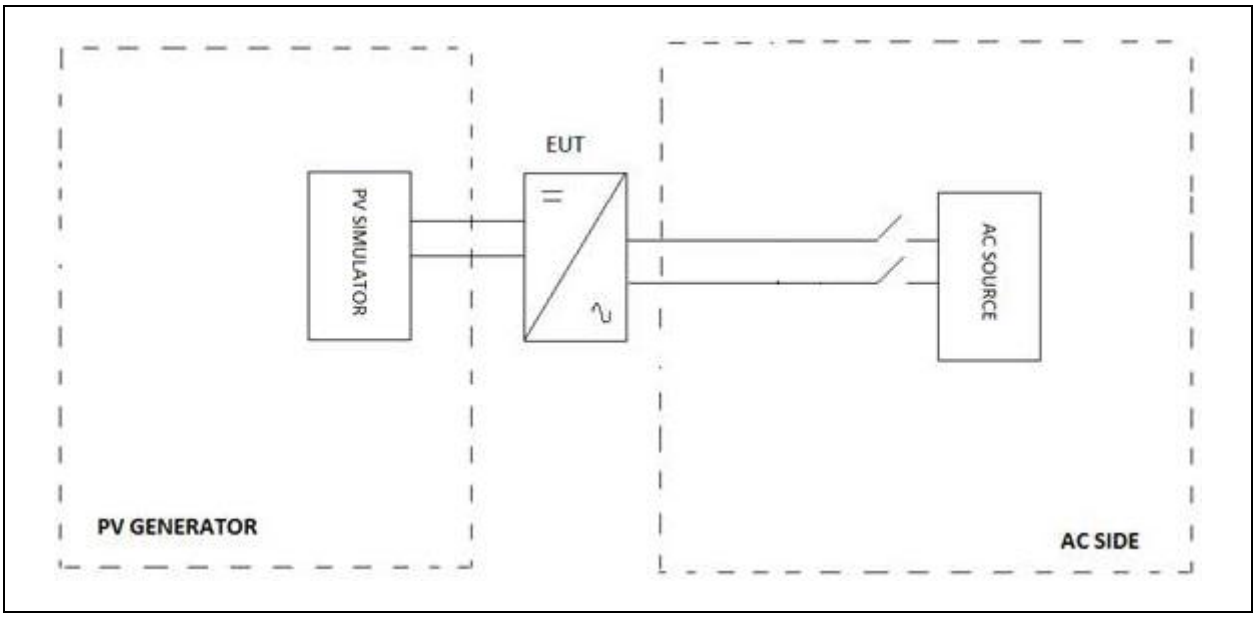
2.5 MEASUREMENT UNCERTAINTY

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 petitioner. Note2: Where the standard requires lower uncertainties that those in this table. Most restrictive uncertainty has been considered.	

2.6 TEST SET UP

Below is the simplified construction of the test set up.



Test Conditions		
Condition	**Value**	**Comments**
Point of measurement	EUT Output (Low Voltage)	Equipment enounced in section 2.4 of this report has been used in the point of measurement
Short circuit ratio at the measurement point (S_k /Sn)	S_k /Sn =60kVA / 6Kva = 10	
If the PGU is connected directly to the medium-voltage grid and a step-up transformer is installed between the PGU and the grid (which is not part of the PGU), a standard transformer must be used, the rated apparent power of which corresponds at least to the rated apparent power of the PGU being evaluated.	Connect to LV grid only	
MV Tansformer: Short circuit Power	--	Not applicable measured in Low voltage side
MV Tansformer: Network impedance Phase Angle	--	Not applicable measured in Low voltage side
MV Tansformer: Service voltage Uc	--	Not applicable measured in Low voltage side
LV Isolation transformer: Nominal Power (kVA)	--	Transformerless
LV Isolation transformer: Short circuit voltage U_k (%)	--	Transformerless
LV Isolation transformer: Tap possition	--	Transformerless
MV Side:	--	Not applicable measured in Low

Test Conditions		
Condition	**Value**	**Comments**
Additional impedance		voltage side
LV Side: Additional impedance	Active 0 Ω Reactive 0 Ω	
The THDSU of the voltage which includes all integer harmonics up to the 50th order must be smaller than 5%. It is measured as the 10-minute mean at the PGU terminals while the PGU is not generating any power.	See section 2.5.2 of this report	
The voltage, measured as a 10-minute mean at the PGU terminals, must lie within a range of ±10% of the rated voltage	Phase A: 0.11% Phase B: 0.07% Phase C: 0.14%	
The voltage unbalance, measured as a 10-minute mean at the PGU terminals, must be less than 2%.	-0.335%	
The grid frequency, measured as a 0.2 second mean, must lie within a range of ±1% of the rated frequency around the rated frequency. The rate of change of the grid fre-quency, measured as a 0.2 second mean, must be smaller than 0.2% of the rated fre-quency per 0.2 seconds.	Tested Max. Value 50.008Hz Tested Min. Value 49.993Hz Tested Avg. Value:50.002Hz	
Note 1: These test conditions have been used in all the test performed in Sections 4 of this report. Note 2: See also the test bench information table in this section		

Different equipments have 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.

The test bench used includes:

EQUIPMENT	MARK / MODEL	RATED CHARACTERISTICS	OWNER / ID. CODE
AC source	Keysight / N8957APV	60kVA max. 45-65Hz	Sofar Solar / DE17202422
PV source	Chroma / 61860	60kVA max.	Sofar Solar / 6186038000446

2.7 DEFINITIONS

EUT	Equipment Under Testing	Hz	Hertz
A	Ampere	V	Volt
Un	Nominal Voltage	p.u	Per unit
In	Nominal Current	Pn	Rated Active Power
Ia	Active Current	Qn	Rated Reactive Power
Ir	Reactive Current	Sn	Rated Apparent Power
MV	Medium Voltage	THC	Total Harmonic Current
LV	Low Voltage	TDD	Total Demand Distortion
HV	High Voltage	I_h	Harmonic Current
UVRT	Under-Voltage Ride Through	Plt	Severity of Flicker Long-Term
OVRT	Over-Voltage Ride Through	ms	Millisecond
Pst	Severity of Flicker Short-Term	s	Second
dc	Maximum Variation of Voltage	min	Minute
d max	Maximum Absolute Value of	P	Active Power
	Voltage Variation	Q	Reactive Power
fn	Nominal frequency	PF	Power Factor
IGBT	Insulated-Gate Bipolar Transistor	Nr.	Number
RMS	Root Mean Square	POC	Point of Connection
$S_{k,fic}$	Short-circuit apparent power	Meas.	Measured
AC	Alternating Current	Des.	Desired
DC	Direct Current	PGU	Power Generating Unit
DSO	Distribution System Operator	P_D	Design active power
EESS	Electrical energy storage system	P_M	Momentary active power
EES	Electrical energy storage	Smax	Maximum apparent power
Pmax	Maximum active power		
P_A	Available active power		

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

REPORT SECTION	C10/11: 2019 SECTION	CHAPTER OF THE STANDARD	RESULT
4.1	**4.1.7 (2)**	**Automatic Separation System**	**N/R (*)(**)**
4.2	**8.2**	**Power quality**	**--**
4.2.1	8.2.2	Rapid voltage changes	P
4.2.2	8.2.3	Flickers	P
4.2.3	8.2.4	Harmonic	P
4.2.4	8.2.5	Unbalances	N/A
4.3	**D.3**	**Integrated automatic separation system**	**N/R (*)**
4.4	**D.4**	**Operating ranges**	**--**
4.4.1	D.4.1	Operating frequency range	P
4.4.1	D.4.2	Maximum admissible power reduction in case of underfrequency	P
4.4.2	D.4.3	Continuous operating voltage range	N/R (*)
4.5	**D.5**	**Inmunity to disturbance**	**--**
4.5.1	D.5.1	RoCoF immunity	P
4.5.2	D.5.2	Under-voltage ride through UVRT	N/A
4.5.2	D.5.3	Over-voltage ride through (OVRT)	N/A
4.6	**D.6**	**Active response to frequency deviations**	**--**
4.6.1	D.6.1	Power response to overfrequency	N/R (*)
4.6.2	D.6.2	Power response to underfrequency	N/R (*)
4.7	**D.7**	**Power response to voltage changes**	**--**
4.7.1	D.7.1	Q(P) Capabilities	N/R (*)
4.7.2	D.7.1	Q(U) capabilities	P
4.7.3	D.7.1	Cos φ setpoint	N/R (*)
4.7.4	D.7.1	Cos φ(P) capabilities	N/R (*)
4.7.5	D.7.1.1	Specific for a small power-generating plant	N/R (*)
4.7.6	D.7.1.2	Specific for another (not small) power-generating plant	N/A
4.7.7	D.7.2	Voltage related active power reduction P(U)	N/R (*)
4.7.8	D.7.3	Provision of additional fast reactive current during faults and voltage steps	N/A
4.8	**D.8**	**Connection and starting to generate electrical power**	**--**
4.8.1	--	Automatic reconnection after tripping	P
4.8.2	--	Starting to generate electrical power	P
4.9	**D.9**	**Ceasing and reduction of active power on set point**	**--**
4.9.1	4.9.1	Ceasing active power	N/R (*)
4.9.2	4.9.2	Reduction of active power on set point	N/A
4.10	**D.10**	**Communication – Remote monitoring and control**	N/A

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

(*) The compliances with this requirement is stated in following test report according to **EN 50549-1:2019: Report nº 2219/0338-E1** on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory).

(**) The compliances with this requirement is stated in following test report according to
IEC 62116:2014 Test Report nº 2217 /1094-1 which was issued by SGS Tecnos, S.A. (Laboratory of Electrical Tests) on December 5th, 2017
IEC/EN 62109-1:2010, IEC/EN 62109-2:2011: Test Report nº LD170829N003 on 06/12/2017 which was issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch

4 TEST RESULTS

4.1 AUTOMATIC SEPARATION SYSTEM

The grid parameters for the connection point of the EUT (Measured at LV side of the transformer) are offered below.

Each power-generating unit must be equipped with an automatic separation system.

This automatic separation system can be either integrated in the power-generating unit itself (which is generally the case), or external to it. When using an external system,

- it must have a “single fault tolerance” according to EN 50549-1, and
- it must be of a type approved by Synergrid, as listed in the C10/21 list of Synergrid published on the website http://www.synergrid.be/download.cfm?fileId=C10-21_DecouplingRelays_NF_20200515.pdf

According to user’s manual, an external AC relays need to install on at the final plant. This external realy, as defined on the manual on page 30, must be approved by Synergrid.

The compliances with the requirements of clause 4.1.7(2) of the standard is stated in section 4.9 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

And compliances with the requirements of Section 4.4 of following test report

IEC/EN 62109-2:2011: Test Report nº LD170829N003 on 06/12/2017 which was issued by Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch

4.2 POWER QUALITY.

The test has been done according to the clause 8.2 of the standard. The grid parameters for the connection point of the EUT (Measured at LV side of the transformer) are offered below.

R (Ω)	X (Ω)	Z (Ω)	Ψ (°)	S_k/Sn
0.24	0.15	0.39	0.04	10

4.2.1 Rapid voltage changes

The test method is according to VDE-AR-N 4105:2018-11. During operation, any sudden power variation may not influence the voltage level at the point of con-nection by more than 3%.

$$\Delta u_{max} \leq 3\ \%$$

$$\Delta u_{max} = k_{imax} \frac{S_{Emax}}{S_{kV}} = \frac{I_a}{I_{rE}} \cdot \frac{S_{Emax}}{S_{kV}}$$

- SEmax is the maximum apparent power of inverter.
- Skv is the network short circuit power.
- Ia is staring current
- IrE is rated current

$$k_{imax} = \frac{I_a}{I_{rE}}$$

Used settings of the measurement device for this measurement:

Measurement device	Date of measurement	Recording	Sampling frequency
PA5000	2020/09/02	100ms values	10kHz

The following are the result for calculated k_i

Making operation at reference conditions (of primary energy carrier)	k_i	0.046
Worst case at switch over of generator sections	k_i	0.107
Making operation without default (of primary energy carrier)	k_i	0.096
Breaking operation at nominal power	k_i	0.027
Worst-case value of all switching operations	k_{imax}	0.107

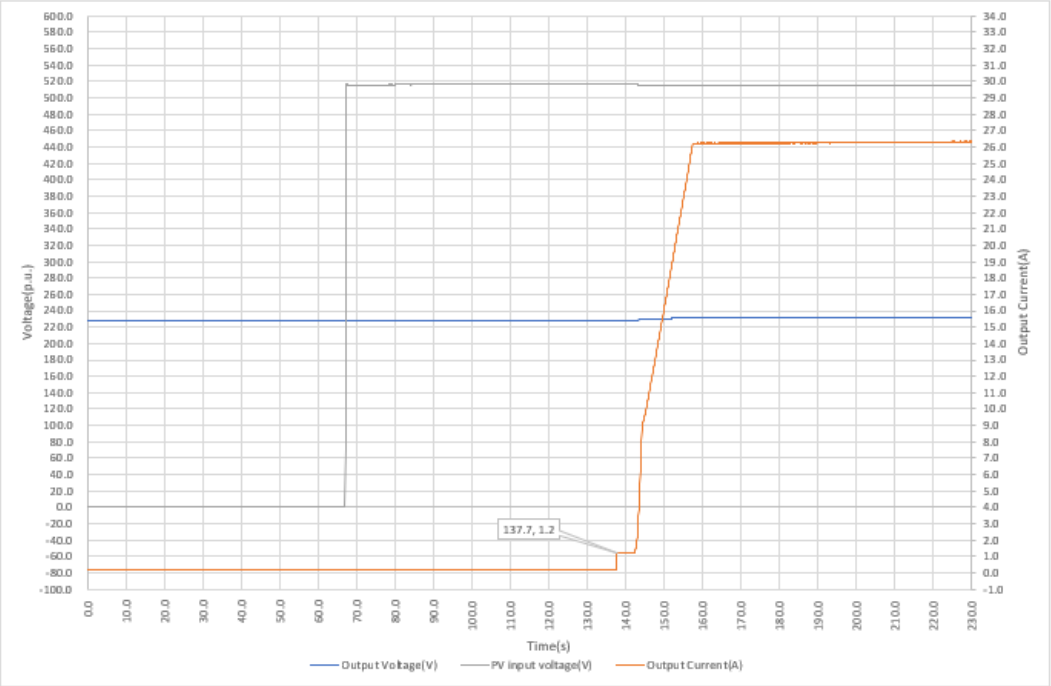
According to the performed tests, the Skv minimum for with the inverter can be installed is 60kVA.

After calculating:

Δumax= 1.07%

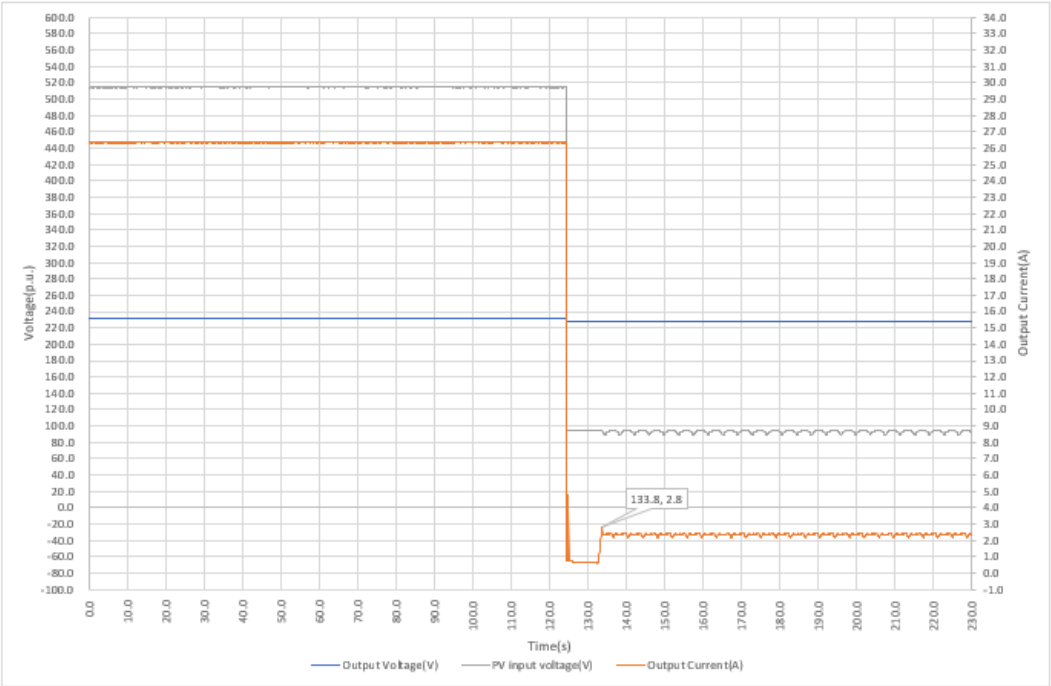
The information provided above should be taken into account for the particular conditions of the installation of the inverter.

Making operation at reference conditions (of primary energy carrier)
(Normal start working)



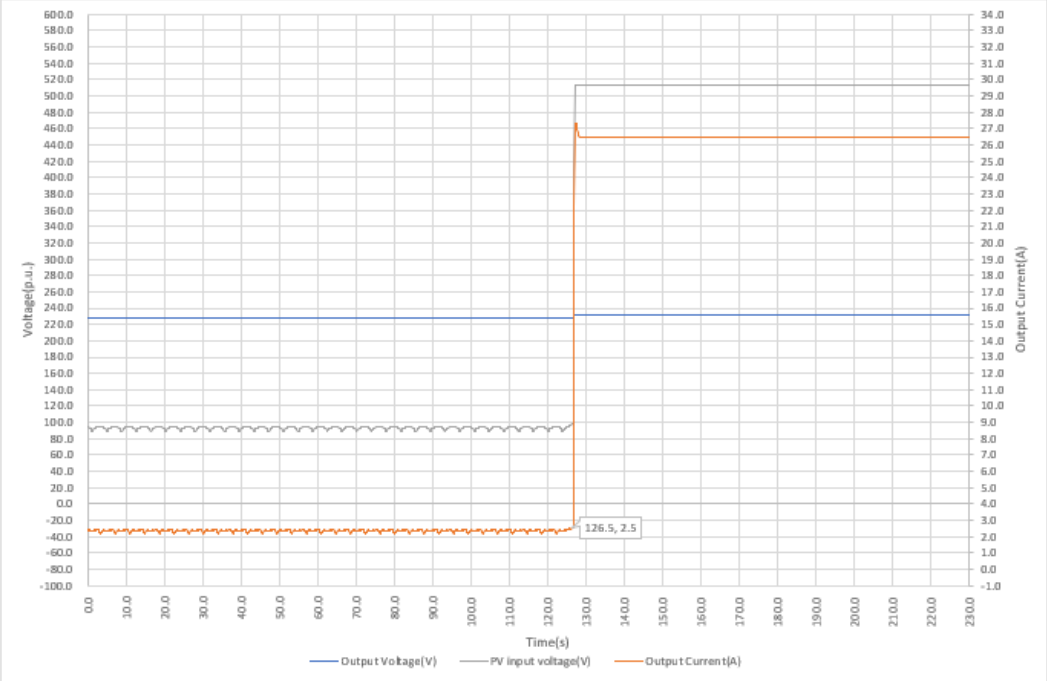
$k_i = I_a / I_{re} = 0.046$

Worst case at switch over of generator sections
(Vmax (dc) to Vmin (dc) at 100% Pn)



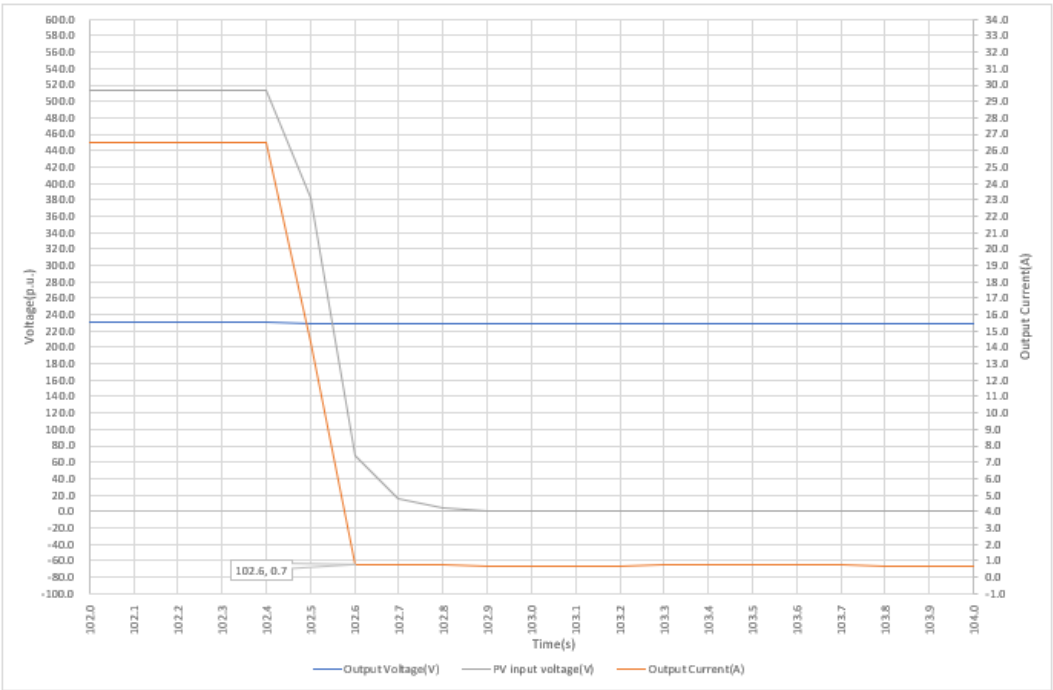
$k_i = I_a / I_{re} = 0.107$

Making operation without default (of primary energy carrier)
(Vmin (dc) to Vmax (dc) at 100% Pn)



$k_i = I_a / I_{re} = 0.096$

Breaking operation at nominal power
(PV input shut down)



$k_i = I_a / I_{re} = 0.027$

4.2.2 Flickers

The aim of this test is to determine the flicker coefficient c as a function of the grid impedance phase angle.

This requirement is according to point 8.2.3 of the standard. It applies to both PV and storage systems.

The compliances with the requirements of clause 8.2.3 of the standard is stated in section 4.5.2 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

4.2.3 Harmonic

The aim of this test is to determine relevant values for PGU continuous operation.

Test performed according to point 8.2.4 of the standard. It can be applied at both PV and storage systems.

The reactive power setpoint is 0 VAr, the harmonics have been measured 5 minutes average values of line to neutral current.

They have been verified limits at different power levels, from 10%Pn to 100% Pn, in 10%Pn steps.

The arithmetic average is formed over the 10 minutes record for each harmonic, interharmonic and higher frequency component of the current.

The total distortion of the current harmonics (TDC) has been calculated according to standard:

$$\mathrm{TDC} = \frac{\sqrt{\sum_{h=2}^{50} I_h^2}}{I_n} \cdot 100$$

See point (Definitions) of this report.
The total distortion of the voltage harmonics (TDD) has been determined using the same procedure.

NOTE: According to Standard, the requirements for Harmonics test are applicable at plant level (according to Synergrid technical prescriptions C10/17(HV connection) and C10/19 (LV connection)), the results shown in this chapter are performed at inverter level. The results shown are informative.

- PGU operation mode; Q (VAr) — Q setpoint = 0 VAr
- Voltage range (V) — 230 V
- Voltage unbalance — Same conditions as point 4.2.4 of this test report (*) (Umbalace Chapter)
- Measured period (min) — 5 min each active power level

(*) As the test procedure for both tests is similar, representing the inverter working in continuous operation in a wide range of power bins, it is considered that the voltage unbalance conditions will be similar at both tests.

Power bin (%Pn)	Number of records
2 %	1
10 %	1
20 %	1
30 %	1
40 %	1
50 %	1
60 %	1
70 %	1
80 %	1
90 %	1
100 %	1

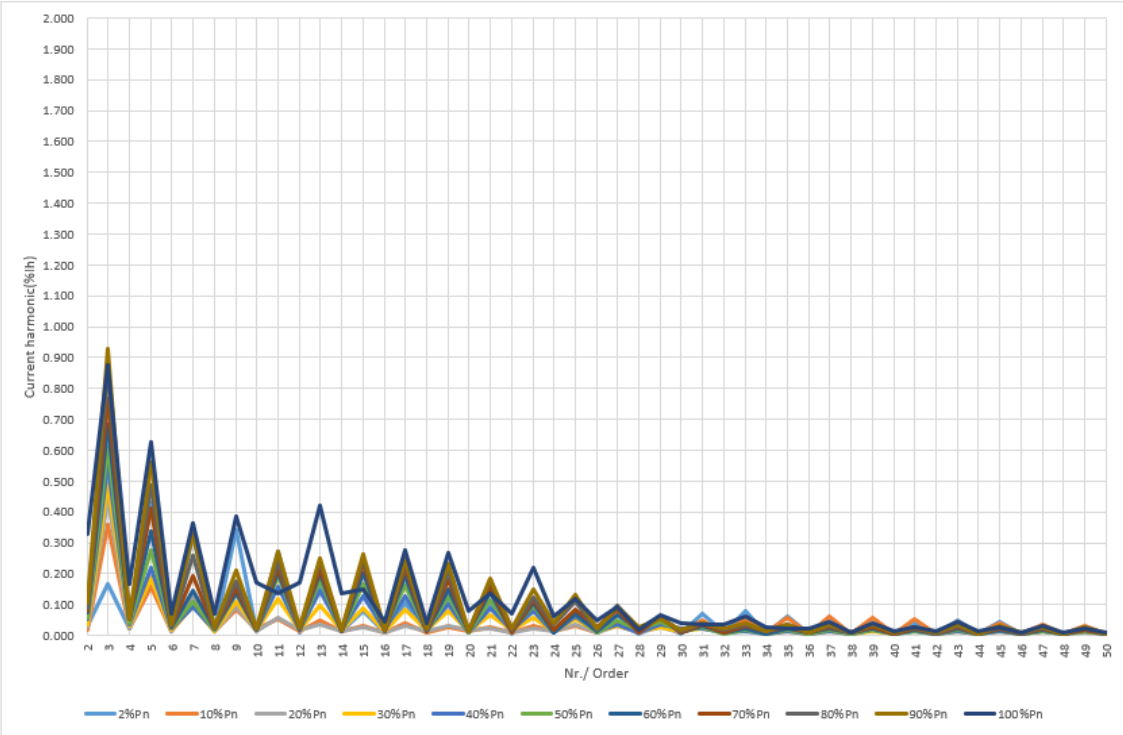
Used settings of the measurement device for this measurement:

Measurement device	Date of measurement	Recording	Sampling frequency
PA5000	2020/09/02	100ms values	10kHz

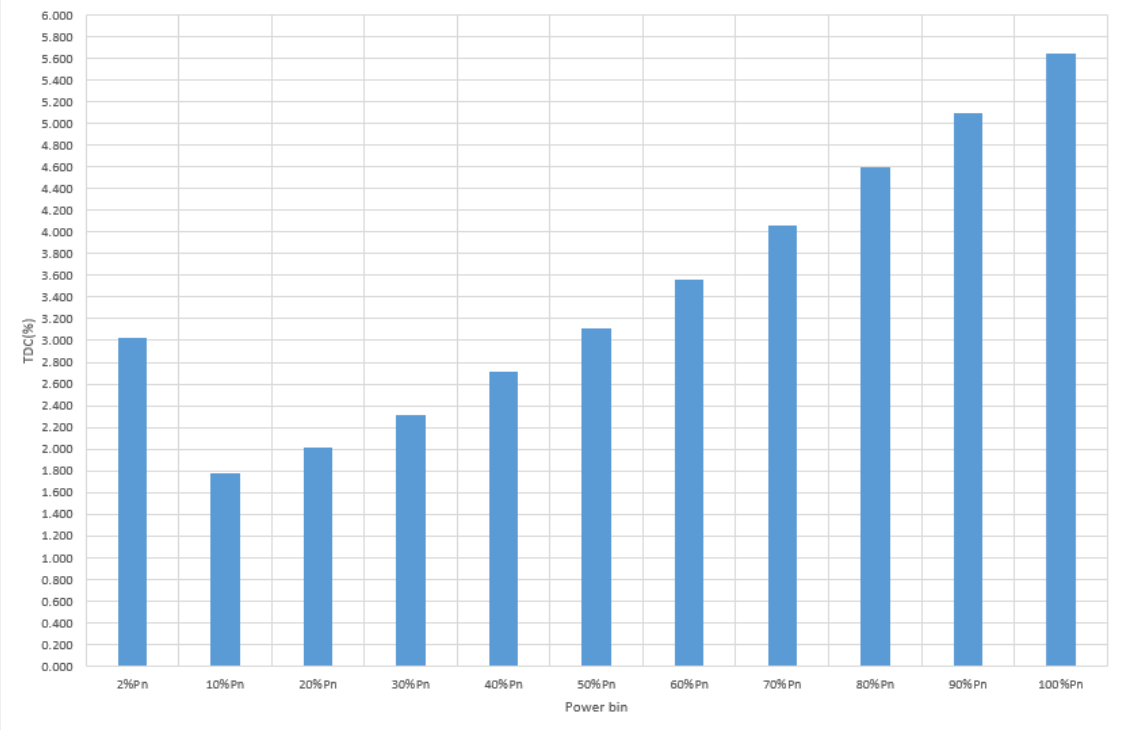
4.2.3.1 Current harmonics

P_n (%)	2	10	20	30	40	50	60	70	80	90	100	Max (%)
Nr./ Order	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	
2	0.030	0.017	0.027	0.037	0.052	0.058	0.074	0.081	0.086	0.107	0.330	0.330
3	0.168	0.362	0.444	0.492	0.553	0.610	0.682	0.765	0.853	0.929	0.876	0.929
4	0.024	0.022	0.025	0.032	0.038	0.042	0.052	0.054	0.053	0.053	0.169	0.169
5	0.430	0.156	0.189	0.183	0.221	0.275	0.337	0.411	0.485	0.561	0.628	0.628
6	0.016	0.014	0.015	0.018	0.025	0.022	0.026	0.026	0.027	0.037	0.069	0.069
7	0.323	0.098	0.124	0.098	0.092	0.108	0.145	0.194	0.259	0.328	0.363	0.363
8	0.014	0.013	0.015	0.014	0.018	0.016	0.024	0.022	0.023	0.026	0.073	0.073
9	0.340	0.085	0.091	0.112	0.136	0.142	0.141	0.153	0.174	0.209	0.386	0.386
10	0.016	0.021	0.015	0.017	0.019	0.017	0.020	0.020	0.020	0.021	0.172	0.172
11	0.273	0.054	0.059	0.117	0.159	0.193	0.207	0.221	0.240	0.273	0.135	0.273
12	0.010	0.014	0.018	0.018	0.019	0.017	0.022	0.018	0.018	0.027	0.170	0.170
13	0.166	0.048	0.038	0.097	0.144	0.180	0.200	0.217	0.242	0.251	0.422	0.422
14	0.015	0.016	0.014	0.016	0.018	0.013	0.014	0.014	0.015	0.020	0.137	0.137
15	0.079	0.030	0.028	0.088	0.129	0.166	0.204	0.231	0.249	0.265	0.150	0.265
16	0.008	0.011	0.011	0.016	0.020	0.023	0.020	0.015	0.015	0.020	0.042	0.042
17	0.106	0.040	0.030	0.085	0.126	0.163	0.193	0.220	0.239	0.244	0.275	0.275
18	0.010	0.011	0.016	0.019	0.018	0.012	0.014	0.013	0.019	0.024	0.041	0.041
19	0.116	0.026	0.030	0.078	0.103	0.127	0.151	0.179	0.204	0.231	0.268	0.268
20	0.010	0.014	0.016	0.015	0.011	0.012	0.013	0.013	0.014	0.016	0.079	0.079
21	0.103	0.028	0.023	0.066	0.090	0.114	0.139	0.159	0.180	0.185	0.137	0.185
22	0.006	0.008	0.009	0.019	0.020	0.018	0.016	0.011	0.016	0.021	0.071	0.071
23	0.092	0.034	0.022	0.059	0.080	0.096	0.107	0.114	0.124	0.148	0.220	0.220
24	0.009	0.012	0.013	0.015	0.010	0.009	0.009	0.019	0.037	0.041	0.063	0.063
25	0.078	0.032	0.035	0.055	0.064	0.069	0.071	0.085	0.111	0.133	0.119	0.133
26	0.010	0.008	0.009	0.012	0.014	0.011	0.016	0.029	0.019	0.021	0.051	0.051
27	0.044	0.038	0.030	0.032	0.036	0.047	0.064	0.084	0.097	0.091	0.091	0.097
28	0.007	0.009	0.011	0.013	0.010	0.018	0.021	0.008	0.024	0.027	0.018	0.027
29	0.040	0.042	0.029	0.028	0.034	0.045	0.061	0.063	0.060	0.053	0.067	0.067
30	0.007	0.008	0.008	0.016	0.020	0.016	0.008	0.012	0.012	0.019	0.040	0.040
31	0.069	0.047	0.030	0.022	0.023	0.029	0.033	0.037	0.039	0.039	0.036	0.069
32	0.008	0.010	0.012	0.012	0.008	0.006	0.008	0.012	0.018	0.021	0.036	0.036
33	0.078	0.052	0.032	0.021	0.014	0.018	0.025	0.029	0.035	0.040	0.063	0.078
34	0.007	0.009	0.009	0.006	0.005	0.005	0.007	0.012	0.015	0.013	0.029	0.029
35	0.061	0.059	0.029	0.015	0.014	0.019	0.022	0.027	0.034	0.037	0.023	0.061
36	0.005	0.005	0.005	0.005	0.005	0.005	0.007	0.009	0.008	0.008	0.022	0.022
37	0.029	0.060	0.024	0.015	0.014	0.019	0.022	0.026	0.032	0.038	0.045	0.060
38	0.005	0.005	0.005	0.005	0.006	0.006	0.008	0.009	0.010	0.008	0.010	0.010
39	0.020	0.057	0.021	0.015	0.017	0.020	0.023	0.026	0.034	0.037	0.041	0.057
40	0.004	0.005	0.005	0.005	0.005	0.005	0.006	0.007	0.007	0.007	0.015	0.015
41	0.042	0.053	0.020	0.017	0.014	0.015	0.019	0.023	0.027	0.028	0.028	0.053
42	0.005	0.005	0.004	0.004	0.005	0.005	0.007	0.006	0.007	0.008	0.013	0.013
43	0.050	0.046	0.015	0.015	0.015	0.018	0.022	0.026	0.030	0.036	0.043	0.050
44	0.004	0.004	0.004	0.004	0.005	0.006	0.005	0.006	0.007	0.007	0.015	0.015
45	0.044	0.041	0.013	0.014	0.014	0.017	0.020	0.023	0.029	0.030	0.027	0.044
46	0.004	0.004	0.003	0.004	0.004	0.004	0.006	0.007	0.006	0.007	0.011	0.011
47	0.029	0.038	0.012	0.013	0.013	0.015	0.018	0.024	0.027	0.028	0.033	0.038
48	0.004	0.004	0.003	0.004	0.004	0.004	0.006	0.005	0.006	0.007	0.009	0.009
49	0.015	0.032	0.011	0.013	0.012	0.015	0.019	0.020	0.026	0.029	0.024	0.032
50	0.004	0.004	0.004	0.004	0.004	0.005	0.004	0.006	0.007	0.006	0.011	0.011
TDC (%)	3.019	1.774	2.015	2.311	2.714	3.118	3.564	4.059	4.593	5.098	5.643	5.643

Current Harmonics



Total Distortion Current Harmonic

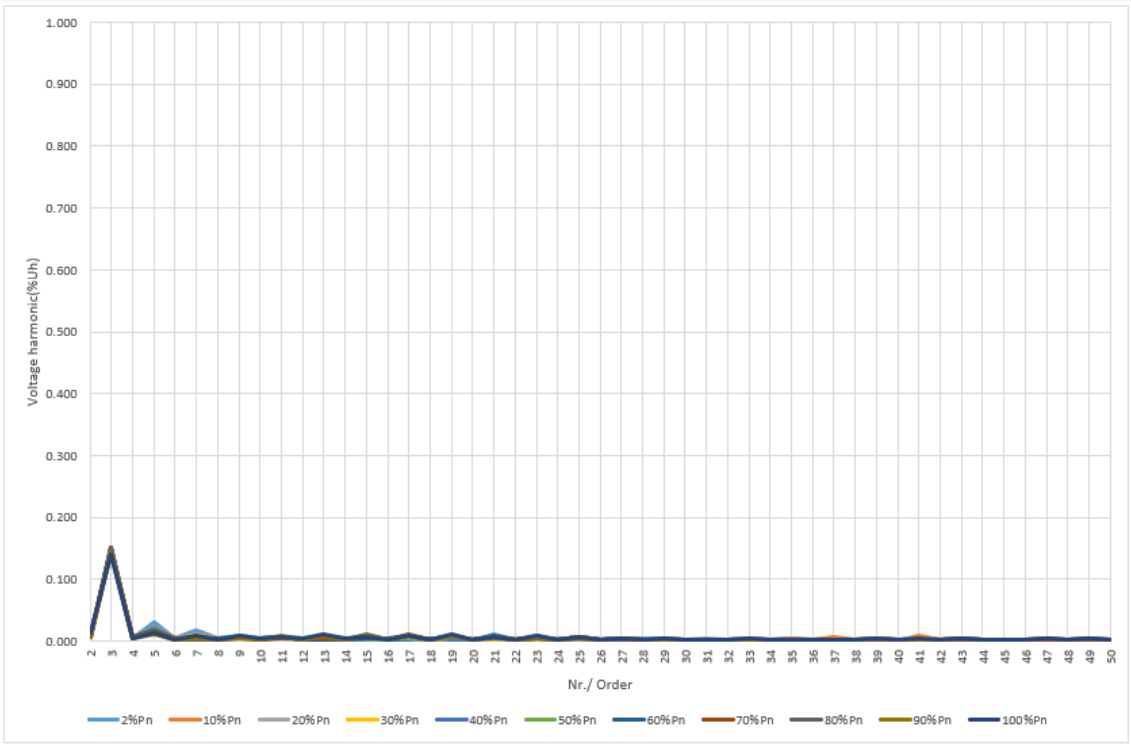


4.2.3.2 Voltage harmonics

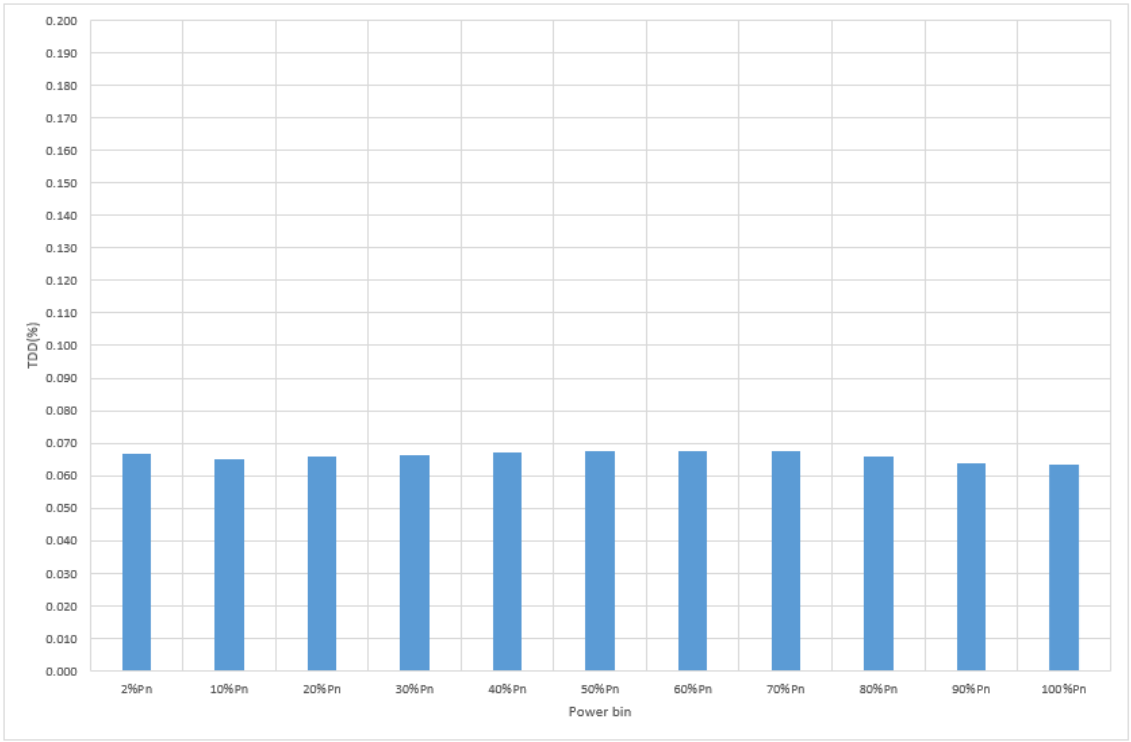
Measurements of voltage harmonics at continuous operation are done according to IEC 61000-4-7:2002

P_n (%)	2	10	20	30	40	50	60	70	80	90	100	Max (%)
Nr./ Order	U_h(%)	U_h(%)	U_h(%)	U_h(%)	U_h(%)	U_h(%)	U_h(%)	U_h(%)	U_h(%)	U_h(%)	U_h(%)	
2	0.008	0.006	0.007	0.006	0.006	0.007	0.010	0.008	0.010	0.012	0.013	0.013
3	0.146	0.145	0.147	0.149	0.151	0.152	0.152	0.151	0.148	0.143	0.140	0.152
4	0.005	0.005	0.005	0.005	0.006	0.006	0.007	0.006	0.006	0.005	0.005	0.007
5	0.030	0.021	0.021	0.022	0.021	0.020	0.019	0.016	0.013	0.011	0.013	0.030
6	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.003	0.002	0.003	0.005
7	0.017	0.011	0.009	0.008	0.007	0.005	0.003	0.003	0.003	0.004	0.009	0.017
8	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.002	0.002	0.003	0.002	0.005
9	0.009	0.006	0.005	0.005	0.005	0.006	0.006	0.006	0.004	0.005	0.010	0.010
10	0.005	0.005	0.005	0.004	0.004	0.003	0.002	0.003	0.004	0.003	0.004	0.005
11	0.007	0.004	0.005	0.005	0.006	0.006	0.006	0.005	0.006	0.009	0.006	0.009
12	0.004	0.004	0.003	0.003	0.002	0.002	0.003	0.004	0.003	0.002	0.005	0.005
13	0.006	0.005	0.006	0.005	0.005	0.004	0.003	0.005	0.009	0.008	0.012	0.012
14	0.004	0.004	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.002	0.004	0.004
15	0.004	0.007	0.008	0.006	0.005	0.003	0.006	0.009	0.010	0.009	0.006	0.010
16	0.003	0.002	0.001	0.002	0.003	0.004	0.004	0.002	0.002	0.002	0.002	0.004
17	0.006	0.008	0.007	0.004	0.002	0.004	0.009	0.011	0.010	0.009	0.010	0.011
18	0.002	0.001	0.002	0.003	0.004	0.004	0.003	0.001	0.002	0.002	0.002	0.004
19	0.010	0.007	0.006	0.003	0.003	0.006	0.009	0.009	0.009	0.009	0.011	0.011
20	0.001	0.002	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.003	0.003
21	0.012	0.008	0.005	0.002	0.004	0.007	0.008	0.008	0.008	0.008	0.006	0.012
22	0.002	0.002	0.003	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.003	0.004
23	0.010	0.007	0.003	0.003	0.006	0.007	0.006	0.005	0.005	0.006	0.010	0.010
24	0.003	0.003	0.004	0.003	0.002	0.001	0.002	0.002	0.002	0.003	0.003	0.004
25	0.007	0.005	0.003	0.005	0.006	0.006	0.005	0.005	0.006	0.008	0.008	0.008
26	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.004
27	0.002	0.003	0.003	0.005	0.005	0.004	0.003	0.004	0.006	0.005	0.005	0.006
28	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004
29	0.003	0.002	0.004	0.004	0.004	0.003	0.003	0.003	0.004	0.003	0.004	0.004
30	0.004	0.003	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.003	0.004
31	0.003	0.002	0.004	0.004	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.004
32	0.003	0.003	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.002	0.002	0.003
33	0.005	0.004	0.004	0.003	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.005
34	0.003	0.002	0.001	0.002	0.002	0.001	0.002	0.002	0.002	0.002	0.002	0.003
35	0.005	0.004	0.003	0.002	0.003	0.003	0.002	0.002	0.002	0.003	0.002	0.005
36	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.002	0.003	0.003
37	0.004	0.006	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.006
38	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
39	0.003	0.005	0.002	0.002	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.005
40	0.001	0.001	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002
41	0.006	0.009	0.005	0.005	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.009
42	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
43	0.004	0.004	0.001	0.002	0.003	0.003	0.003	0.003	0.004	0.004	0.005	0.005
44	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002
45	0.004	0.004	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.004
46	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.002	0.002	0.002	0.002
47	0.003	0.003	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004	0.004	0.004
48	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
49	0.002	0.003	0.002	0.002	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004
50	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
TDD (%)	0.067	0.065	0.066	0.066	0.067	0.068	0.068	0.067	0.066	0.064	0.063	0.068

Voltage Harmonics



Total Voltage Distortion



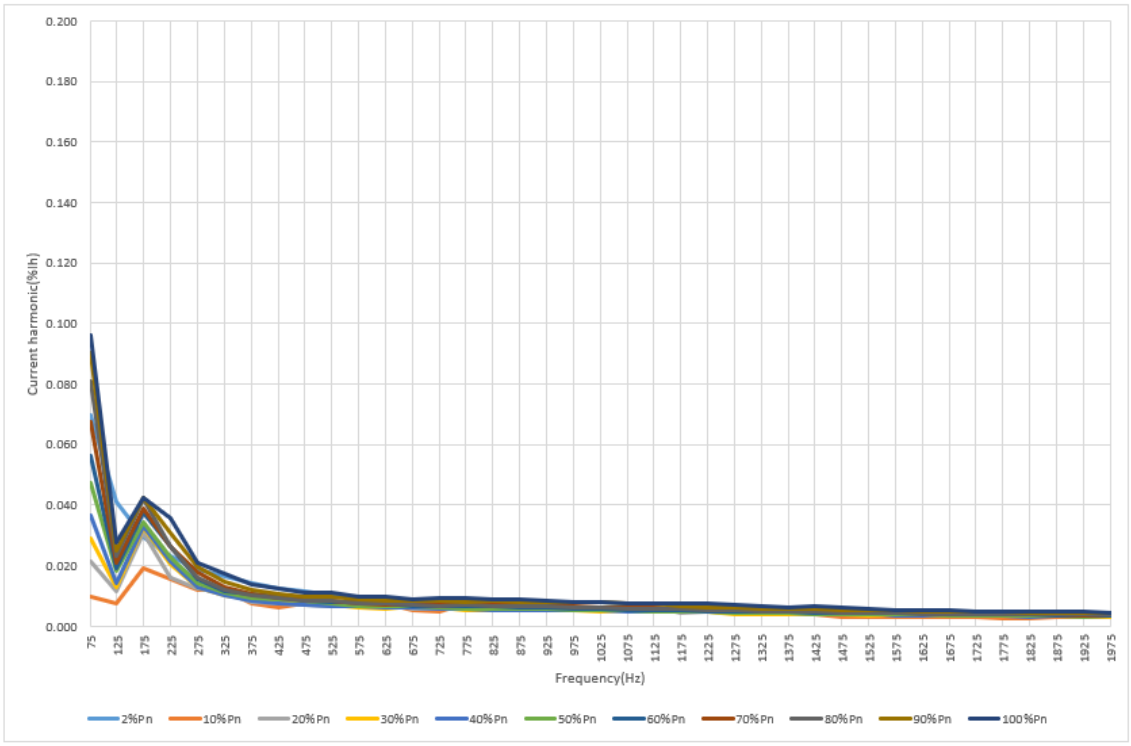
4.2.3.3 Interharmonics at continuous operation

Test performed according to point 8.2 of the standard.

Measurements of interharmonics at continuous operation are done according to IEC 61000-4-7:2002.

P_n (%)	2	10	20	30	40	50	60	70	80	90	100	MAX
F [Hz]	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	(%)
75	0.070	0.010	0.021	0.029	0.037	0.047	0.056	0.067	0.081	0.090	0.096	0.096
125	0.041	0.008	0.011	0.013	0.014	0.018	0.019	0.021	0.023	0.025	0.028	0.041
175	0.029	0.019	0.031	0.033	0.033	0.034	0.038	0.039	0.042	0.042	0.042	0.042
225	0.023	0.016	0.016	0.020	0.021	0.023	0.026	0.027	0.026	0.031	0.036	0.036
275	0.019	0.012	0.013	0.013	0.013	0.014	0.016	0.018	0.016	0.020	0.021	0.021
325	0.016	0.012	0.011	0.010	0.010	0.011	0.012	0.013	0.012	0.015	0.017	0.017
375	0.014	0.008	0.008	0.009	0.009	0.009	0.011	0.011	0.010	0.012	0.014	0.014
425	0.013	0.006	0.007	0.008	0.008	0.009	0.010	0.009	0.009	0.011	0.012	0.013
475	0.011	0.007	0.007	0.007	0.007	0.008	0.008	0.009	0.008	0.010	0.011	0.011
525	0.010	0.007	0.007	0.007	0.007	0.007	0.008	0.009	0.008	0.010	0.011	0.011
575	0.009	0.008	0.007	0.006	0.007	0.007	0.008	0.008	0.008	0.009	0.010	0.010
625	0.009	0.008	0.007	0.006	0.006	0.006	0.008	0.007	0.008	0.008	0.010	0.010
675	0.008	0.005	0.006	0.007	0.006	0.006	0.007	0.007	0.007	0.008	0.009	0.009
725	0.007	0.005	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.008	0.009	0.009
775	0.007	0.008	0.008	0.005	0.006	0.006	0.007	0.007	0.007	0.008	0.009	0.009
825	0.007	0.007	0.008	0.005	0.005	0.006	0.007	0.007	0.007	0.008	0.009	0.009
875	0.006	0.005	0.006	0.006	0.005	0.006	0.006	0.007	0.007	0.008	0.009	0.009
925	0.006	0.005	0.006	0.006	0.005	0.006	0.006	0.007	0.006	0.008	0.009	0.009
975	0.006	0.006	0.006	0.005	0.005	0.005	0.006	0.007	0.006	0.008	0.008	0.008
1025	0.005	0.006	0.006	0.005	0.005	0.005	0.006	0.006	0.006	0.008	0.008	0.008
1075	0.005	0.006	0.006	0.005	0.005	0.005	0.005	0.006	0.006	0.008	0.008	0.008
1125	0.005	0.006	0.007	0.005	0.005	0.005	0.005	0.006	0.006	0.007	0.007	0.007
1175	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.007	0.007	0.007
1225	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.006	0.007	0.007
1275	0.005	0.005	0.005	0.004	0.005	0.005	0.005	0.006	0.005	0.006	0.007	0.007
1325	0.004	0.004	0.005	0.004	0.004	0.004	0.005	0.005	0.005	0.006	0.007	0.007
1375	0.004	0.004	0.005	0.004	0.004	0.004	0.005	0.005	0.005	0.006	0.006	0.006
1425	0.004	0.004	0.005	0.004	0.004	0.004	0.005	0.005	0.005	0.006	0.006	0.006
1475	0.004	0.003	0.004	0.004	0.005	0.004	0.004	0.005	0.005	0.005	0.006	0.006
1525	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.006	0.006
1575	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005
1625	0.004	0.003	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.005	0.005	0.005
1675	0.004	0.003	0.004	0.004	0.004	0.003	0.004	0.004	0.004	0.005	0.005	0.005
1725	0.004	0.003	0.004	0.003	0.004	0.003	0.004	0.004	0.004	0.005	0.005	0.005
1775	0.004	0.003	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.005	0.005	0.005
1825	0.003	0.003	0.004	0.004	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.005
1875	0.004	0.003	0.004	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.005
1925	0.003	0.003	0.004	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.005	0.005
1975	0.004	0.003	0.005	0.003	0.003	0.004	0.004	0.004	0.004	0.005	0.005	0.005

Inter-Harmonics Current



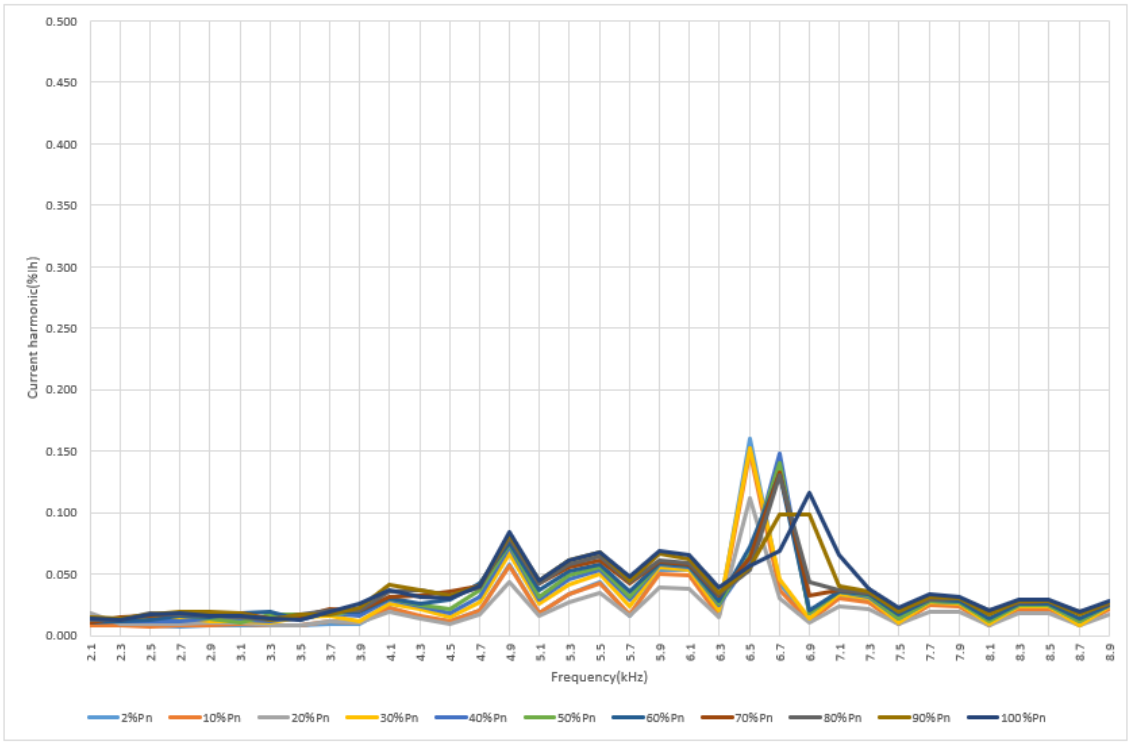
4.2.3.4 Higher frequency components

Test performed according to point 8.2 of the standard.

Measurements of Higher frequency are done according to IEC 61000-4-7:2002.

P_{bin} (%)	2	10	20	30	40	50	60	70	80	90	100	MAX
F [kHz]	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	I_h(%)	(%)
2.1	0.008	0.009	0.018	0.012	0.012	0.011	0.011	0.011	0.013	0.015	0.013	0.018
2.3	0.008	0.008	0.010	0.013	0.011	0.014	0.011	0.015	0.013	0.013	0.013	0.015
2.5	0.008	0.008	0.009	0.014	0.011	0.016	0.012	0.016	0.018	0.017	0.018	0.018
2.7	0.008	0.008	0.010	0.015	0.011	0.017	0.016	0.018	0.017	0.020	0.018	0.020
2.9	0.008	0.009	0.011	0.012	0.014	0.014	0.014	0.017	0.016	0.019	0.016	0.019
3.1	0.009	0.010	0.010	0.012	0.013	0.010	0.019	0.019	0.015	0.018	0.016	0.019
3.3	0.008	0.008	0.008	0.010	0.012	0.017	0.020	0.014	0.013	0.012	0.014	0.020
3.5	0.008	0.008	0.009	0.015	0.016	0.017	0.013	0.015	0.017	0.017	0.013	0.017
3.7	0.010	0.011	0.012	0.016	0.018	0.017	0.019	0.022	0.020	0.017	0.020	0.022
3.9	0.010	0.011	0.011	0.012	0.016	0.021	0.019	0.020	0.021	0.022	0.026	0.026
4.1	0.023	0.023	0.019	0.026	0.029	0.030	0.030	0.031	0.036	0.042	0.037	0.042
4.3	0.015	0.016	0.014	0.021	0.024	0.025	0.026	0.033	0.037	0.037	0.031	0.037
4.5	0.011	0.011	0.010	0.015	0.019	0.021	0.029	0.036	0.032	0.032	0.031	0.036
4.7	0.021	0.021	0.017	0.027	0.032	0.036	0.043	0.040	0.039	0.040	0.040	0.043
4.9	0.058	0.057	0.043	0.067	0.073	0.074	0.076	0.079	0.080	0.082	0.084	0.084
5.1	0.018	0.019	0.016	0.026	0.030	0.032	0.036	0.042	0.043	0.045	0.045	0.045
5.3	0.034	0.033	0.027	0.041	0.046	0.049	0.052	0.056	0.058	0.062	0.061	0.062
5.5	0.043	0.042	0.034	0.050	0.054	0.056	0.058	0.061	0.064	0.068	0.067	0.068
5.7	0.016	0.017	0.016	0.023	0.029	0.031	0.036	0.043	0.044	0.045	0.048	0.048
5.9	0.053	0.050	0.040	0.056	0.058	0.058	0.059	0.061	0.062	0.067	0.069	0.069
6.1	0.053	0.049	0.038	0.054	0.056	0.057	0.057	0.058	0.059	0.062	0.065	0.065
6.3	0.017	0.016	0.015	0.020	0.025	0.026	0.028	0.033	0.034	0.035	0.039	0.039
6.5	0.161	0.149	0.111	0.153	0.062	0.065	0.072	0.064	0.054	0.055	0.056	0.161
6.7	0.042	0.037	0.030	0.046	0.148	0.140	0.131	0.133	0.131	0.099	0.069	0.148
6.9	0.012	0.012	0.011	0.014	0.018	0.018	0.021	0.032	0.044	0.098	0.116	0.116
7.1	0.033	0.031	0.024	0.034	0.035	0.035	0.036	0.037	0.037	0.040	0.066	0.066
7.3	0.029	0.027	0.022	0.030	0.032	0.032	0.033	0.035	0.035	0.036	0.038	0.038
7.5	0.009	0.010	0.009	0.010	0.014	0.014	0.017	0.022	0.022	0.020	0.023	0.023
7.7	0.026	0.025	0.020	0.027	0.028	0.029	0.030	0.031	0.030	0.032	0.033	0.033
7.9	0.025	0.023	0.019	0.025	0.027	0.028	0.029	0.031	0.030	0.031	0.032	0.032
8.1	0.008	0.009	0.008	0.009	0.012	0.012	0.014	0.019	0.020	0.017	0.021	0.021
8.3	0.023	0.022	0.018	0.024	0.025	0.025	0.026	0.028	0.027	0.028	0.029	0.029
8.5	0.023	0.022	0.018	0.023	0.025	0.025	0.026	0.028	0.028	0.028	0.029	0.029
8.7	0.008	0.009	0.008	0.009	0.012	0.012	0.014	0.018	0.020	0.017	0.020	0.020
8.9	0.023	0.021	0.018	0.023	0.024	0.025	0.025	0.026	0.026	0.027	0.028	0.028

Current high frequency harmonics



4.2.4 Unbalances

The aim of this test is to determinate the unbalance in the PGU's fed-in current.

Requirements according to point 8.2.5 of the standard.

They have been determined the unbalance between positive and negative sequences for currents (U_i) using following equation:

$$U_i = (I_{1-} / I_{1+}) \cdot 100\ \%$$

It is not applicable because the EUT is single phase output inverter.

4.3 INTEGRATED AUTOMATIC SEPARATION SYSTEM

These tests have been done according to chapter D.3 of the standard. The aim is to verify the protection settings of the EUT for both voltage and frequency.

It has been tested, for both frequency and voltage, two different protection stages for both undervoltage/underfrequency and overvoltage/overfrequency.

It has to be tested also a 10 min mean overvoltage protection stage which function shall be based on the calculation of the square root of the arithmetic mean of the squared input values over 10 min. The calculation of a new 10 min value at least every 3s is sufficient, which is then to be compared with the threshold value.

The standard present for each protection stage a defined threshold as well as an operation time response. These configurations are:

Function	Trip setting
Overvoltage 10 min mean	230 V + 10 % no delay*
Overvoltage	230 V +15 % no delay*
Undervoltage	230 V -20 % no delay*
Overfrequency	51,5 Hz no delay*
Underfrequency	47,5 Hz no delay*
LoM	according to EN 62116
*« No delay » means that no time delay is added to the intrinsic technical duration required to initiate the disconnection. The operate time may not exceed 200ms.	

The compliances with the requirements of clause D.3 of the standard is stated in section 4.6 of following test report:

IEC 62116:2014 Test Report nº 2217 /1094-1 which was issued by SGS Tecnos, S.A. (Laboratory of Electrical Tests) on December 5th, 2017

4.4 OPERATING RANGES

4.4.1 Operating frequency range and Maximum admissible power reduction in case of underfrequency

This test has been done according to chapter D.4.1 of the standard. The aim of the test is to verify if the EUT is capable of operating at different frequency ranges without disconnection and power reduction for the amount of time.

The compliances with the requirements of clause D.4.1 of the standard is stated in section 4.1.1 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

According to the standard, the capability of the power-generating unit to operate in the frequency range from 51.5 Hz and 52.5 Hz and, where appropriate, the maximum duration of operation in this frequency range. The additional test performed to verify the capability to work at 52.5Hz

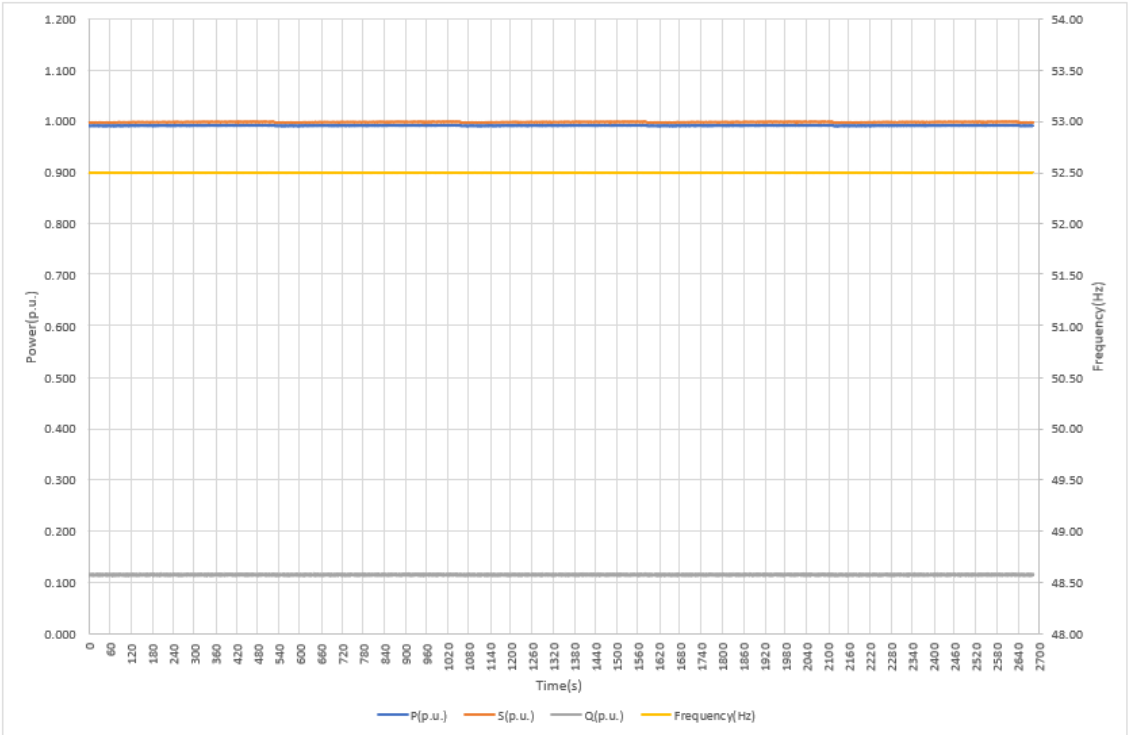
Used settings of the measurement device for this measurement:

Measurement device	Date of measurement	Recording	Sampling frequency
PA5000	2020/09/01	100ms values	10kHz

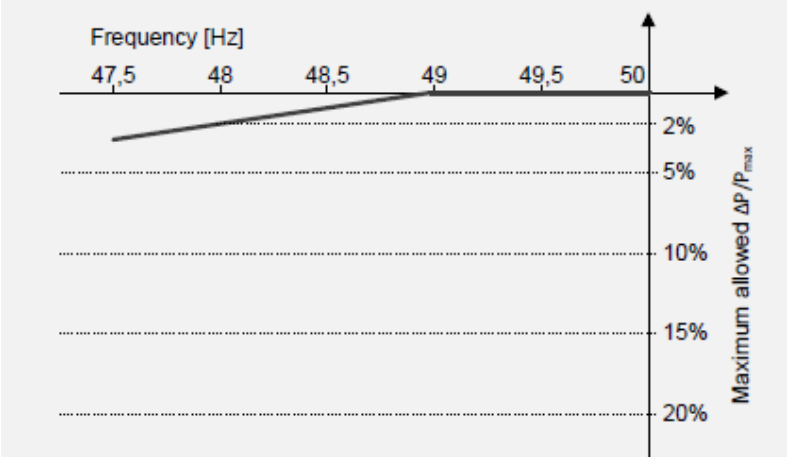
Test result and graph as following:

f (Hz) Setting	Time requirement	f Measured (Hz)	Time Measured(min)	Power measured (p.u.)
52.5Hz	≥ 30 min	52.50	44.7	0.992

Test 1



For frequencies below 49.0 Hz, according to chapter D.4.2 of the standard, the EUT shall be capable of keeping its active power output constant and not lower than the following characteristic:



According to the standard, following test will perform to verify it.

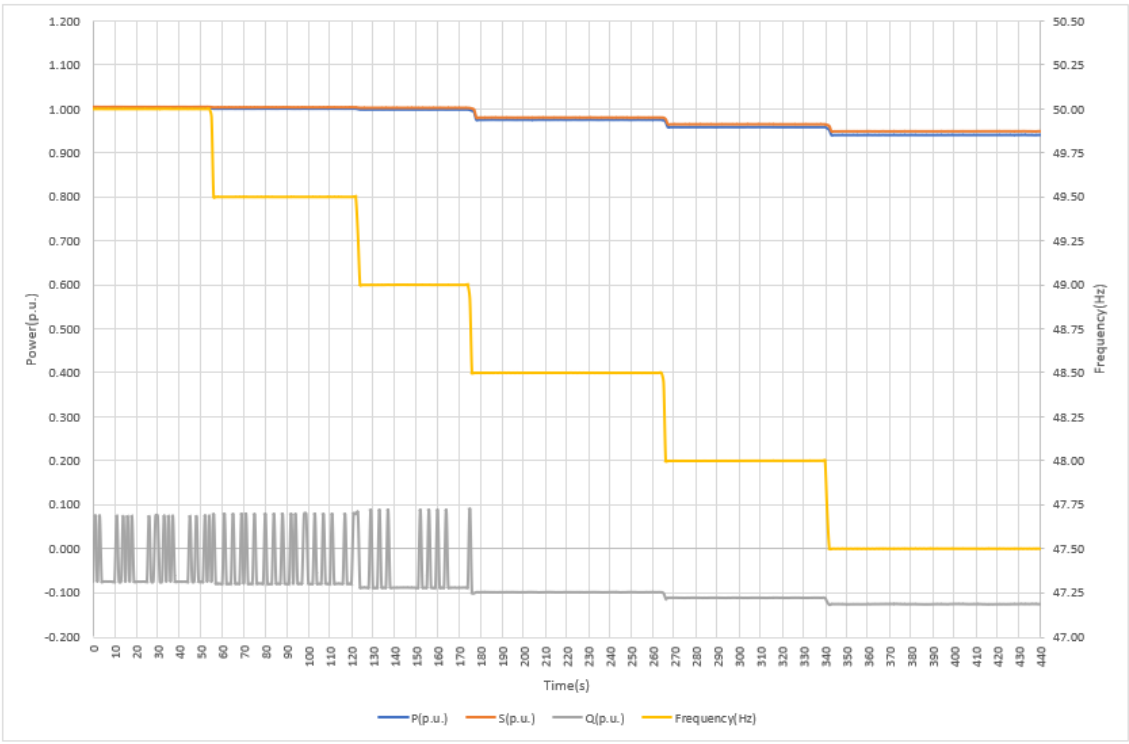
	Parameter	Value
Transient domain	Frequency threshold	49 Hz
	Slope	2 %/Hz
	t 1	≤ 2 seconds
	t 2	30 seconds
Steady state domain	Frequency threshold	49,5 Hz
	Slope	10 %/Hz
	t 3	≥ 30 minutes

Test results are presented in the following table and graphs:

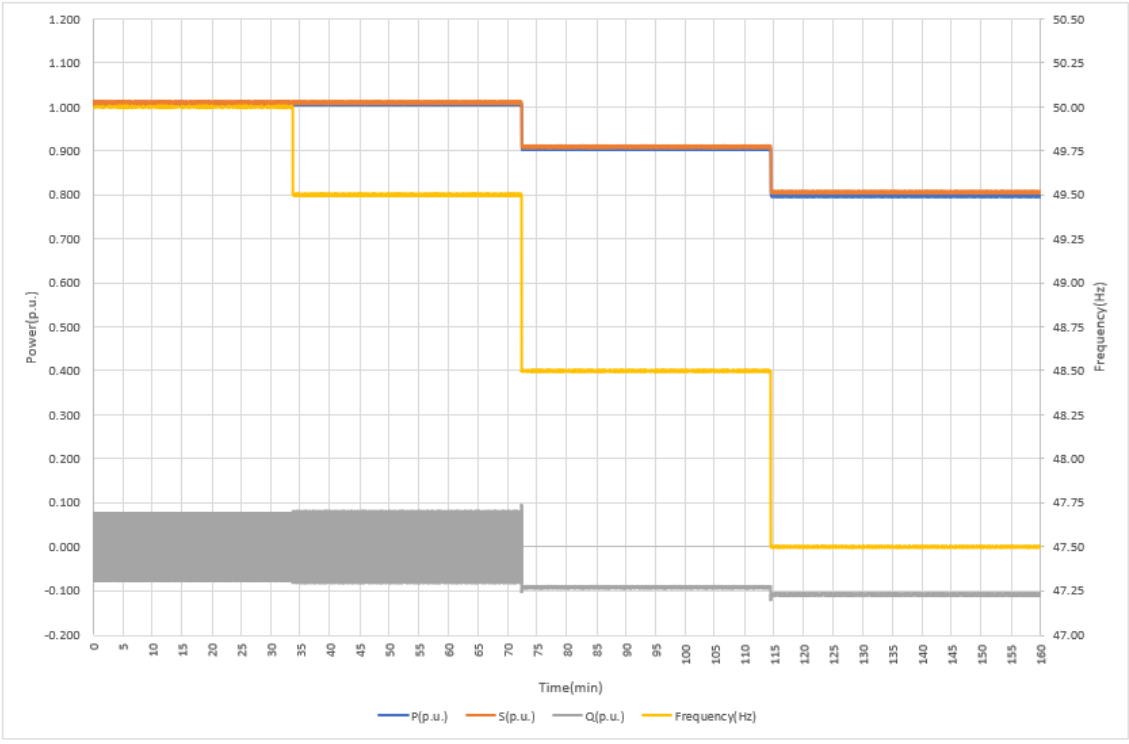
Transient domain						
Step	f (Hz)	f Meas. (Hz)	T (s)	P desired (p.u.)	P Meas. (p.u.)	P deviation (p.u.)
1	50.00 ± 0.05	50.00	>30	1.000	1.002	0.002
2	49.50 ± 0.05	49.50	>30	1.000	1.001	0.001
3	49.00 ± 0.05	49.00	>30	1.000	0.999	-0.001
4	48.50 ± 0.05	48.50	>30	0.980	0.975	-0.005
5	48.00 ± 0.05	48.00	>30	0.960	0.959	-0.001
6	47.50 ± 0.05	47.50	>30	0.940	0.941	0.001

Steady state domain						
Step	f (Hz)	f Meas. (Hz)	T (min)	P desired (p.u.)	P Meas. (p.u.)	P deviation (p.u.)
1	50.00 ± 0.05	50.00	>30	1.000	1.007	0.007
2	49.50 ± 0.05	49.50	>30	1.000	1.007	0.007
3	48.50 ± 0.05	48.50	>30	0.900	0.905	0.005
4	47.50 ± 0.05	47.50	>30	0.800	0.798	-0.002

Transient domain



Steady state domain



4.4.2 Continuous operating voltage range

This test has been done according to chapter D.4.3 of the standard. The aim of the test is to verify that the EUT is capable of operating continuously when the voltage stays inside of following ranges:

- For LV connections: Inside of the range of 85-110%Un.
- For HV connections: Inside of the range of 90-110%Un.

For voltages below 95%Un, it is allowed to reduce apparent power to maintain the current limits of the generating plant. This reduction shall be as small as technically possible.

The compliances with the requirements of clause D.4.3 of the standard is stated in section 4.1.3 of following test report:

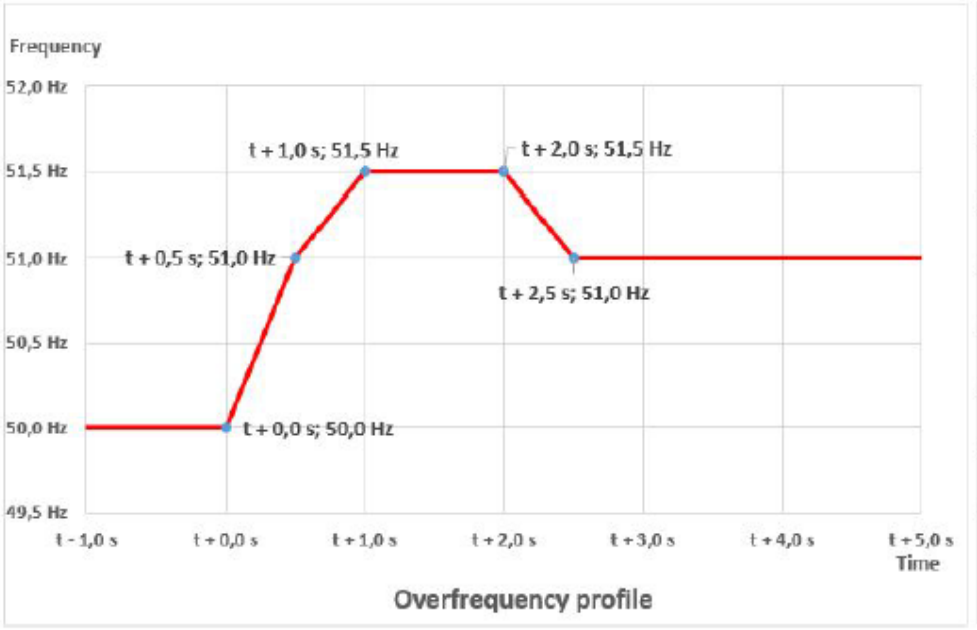
EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

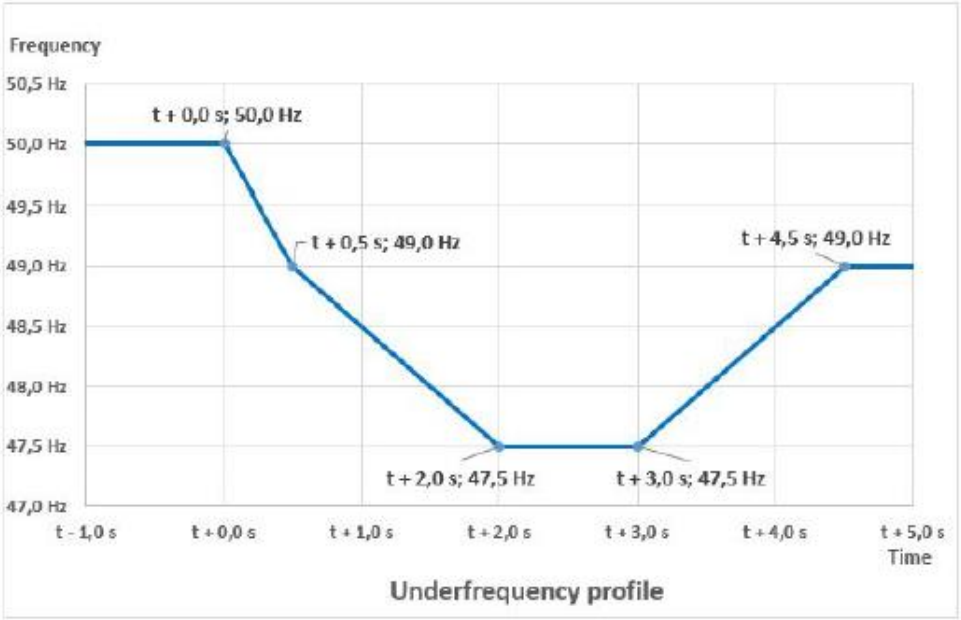
4.5 INMUNITY TO DISTURBANCE

4.5.1 RoCoF inmunity

This test has been done according to chapter D.5.1 of the standard. The aim of the test is to verify if the EUT is capable of operating without disconnection when submitted to frequency jumps.

The test has been done according following graphs.





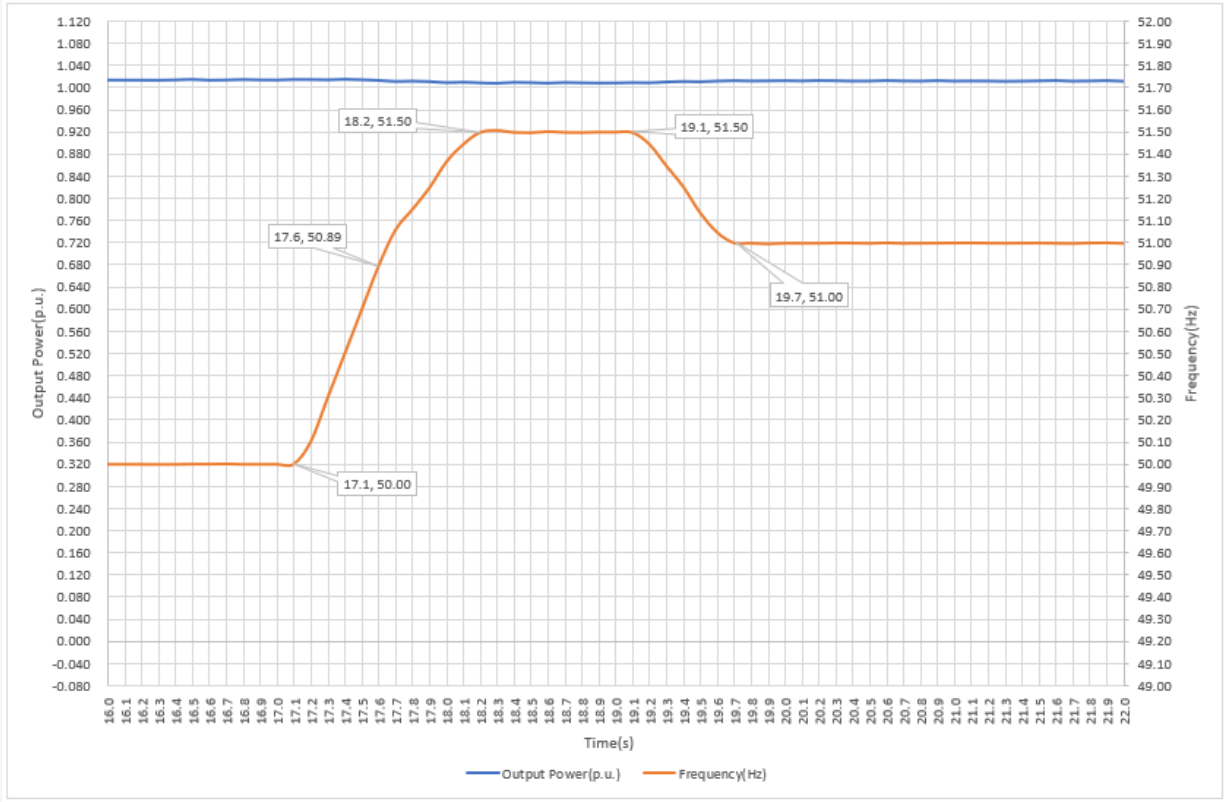
Used settings of the measurement device for this measurement:

Measurement device	Date of measurement	Recording	Sampling frequency
PA5000	2020/09/01	100ms values	10kHz

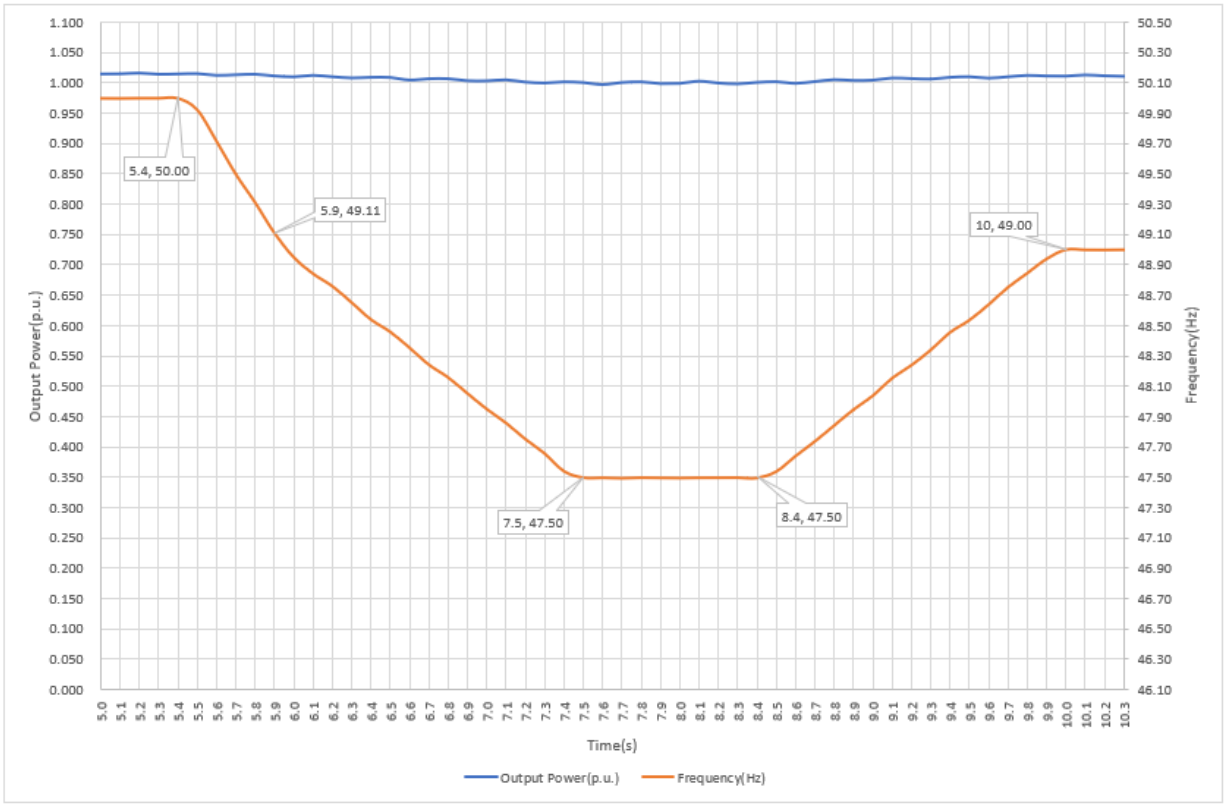
Results are presented in the following table and graphs:

	Ramp range desired	Time Setting (s)	Time Measeured (s)	Final Value (Hz)	Ramp (Hz/s)	Disconnection
Positive frequency drift	50.0 Hz	0.0	--	50.00	--	☒ NO ☐ YES
	50.0Hz to 51.0Hz	0.5	0.5	50.98	1.960	☒ NO ☐ YES
	51.0Hz to 51.5Hz	0.5	0.4	51.50	1.250	☒ NO ☐ YES
	51.5Hz	1.0	0.9	51.50	0.000	☒ NO ☐ YES
	51.5Hz to 51.0Hz	0.5	0.6	51.00	-0.833	☒ NO ☐ YES
Negative frequency drift	50.0 Hz	0.0	--	50.00	--	☒ NO ☐ YES
	50.0Hz to 49.0Hz	0.5	0.6	48.95	-1.750	☒ NO ☐ YES
	49.0Hz to 47.5Hz	1.5	1.5	47.50	-0.967	☒ NO ☐ YES
	47.5 Hz	1.0	0.9	47.50	0.000	☒ NO ☐ YES
	47.5Hz to 49.0Hz	1.5	1.6	49.00	0.938	☒ NO ☐ YES

Positive frequency drift



Negative frequency drift



4.5.2 Voltage ride through (UVRT/OVRT)

These tests have been required according to chapters D.5.2 and D.5.3 of the standard. The aim is to determine whether the EUT is capable of detecting a grid fault and riding through it without disconnecting.

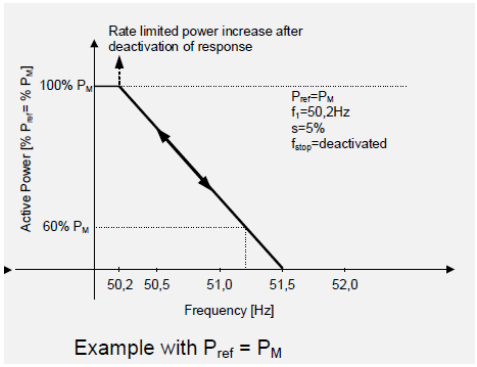
It is not applicable due to the EUT is type A in accordance with NC RfG, which is not goint to connection to the plant above 1MW.

4.6 ACTIVE RESPONSE TO FREQUENCY DEVIATIONS

4.6.1 Power response to overfrequency

This test has been done according to chapter D.6.1 of the standard in order to verify the capability of the EUT of activating power response to overfrequency.

For this automatic response function, an initial delay of less than 2 seconds, between the intentional and the intrinsic delay, shall be configured. This function shall activate once frequency rises over a frequency threshold configurable between 50.2-51.5 Hz. Once activated, this function shall be capable of reducing active power with a configurable droop in a range of 2-12%.



For every step of power decrease (grid frequency increase), an active power rise time of maximum 10s is to be observed for 50 % Pmax. Maximum settling time shall be a maximum of 30 s.

For every step of power increase (grid frequency decrease), an active power rise time of maximum 2s is to be observed for 50 % Pmax. Maximum settling time shall be a maximum of 20 s.

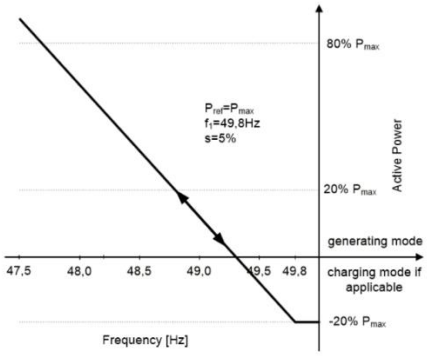
The compliances with the requirements of clause D.6.1 of the standard is stated in section 4.3.1 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

4.6.2 Power response to underfrequency

This test has been done according to chapter D.6.2 of the standard in order to verify the capability of the EUT of activating power response to underfrequency.

For this automatic response function, an initial delay of less than 2 seconds, between the intentional and the intrinsic delay, shall be configured. This function shall activate once frequency rises over a frequency threshold configurable between 49.8-46.0 Hz. Once activated, this function shall be capable of reducing active power with a configurable droop in a range of 2-12%.



For every step of power decrease (grid frequency increase), an active power rise time of maximum 10s is to be observed. Maximum settling time shall be a maximum of 30 s.

For every step of power increase (grid frequency decrease), an active power rise time of maximum 2s is to be observed. Maximum settling time shall be a maximum of 20 s.

The compliances with the requirements of clause D.6.1 of the standard is stated in section 4.3.2 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

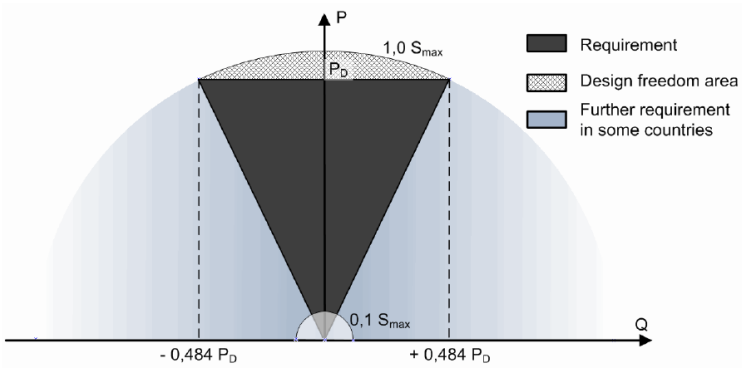
4.7 POWER RESPONSE TO VOLTAGE CHANGES

The aim of this test is to evaluate the reactive power capability of the EUT both at registered capacity and below registered capacity

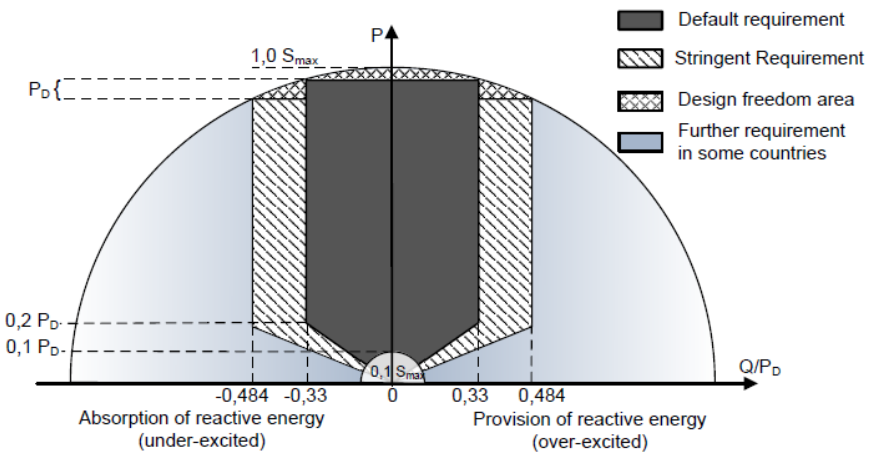
4.7.1 Q(P) Capabilities

These tests have been done according to chapter D.7.1 of the standard. The aim is to verify compliance with the following characteristic included in the standard at rated voltage:

For LV connections:



For HV connections:



Note: for HV connections default requirements of the curve above shall be considered.

Just operating conditions as requested by the customer LV shall be verified.

The compliances with the requirements of clause D.6.1 of the standard is stated in section 4.4.1 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

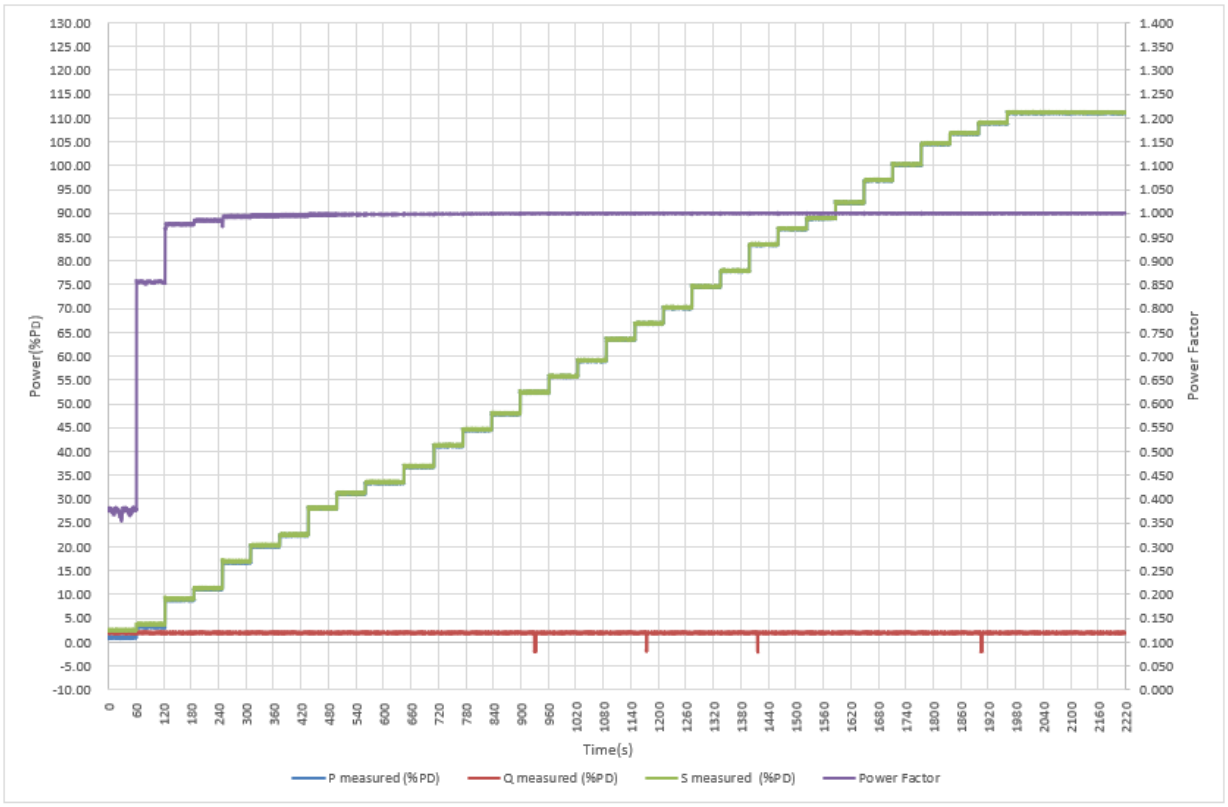
Additionally, the following result is recalculated with P_D is 5.4kW

4.7.1.1 Fixed Power Factor (PF = 1)

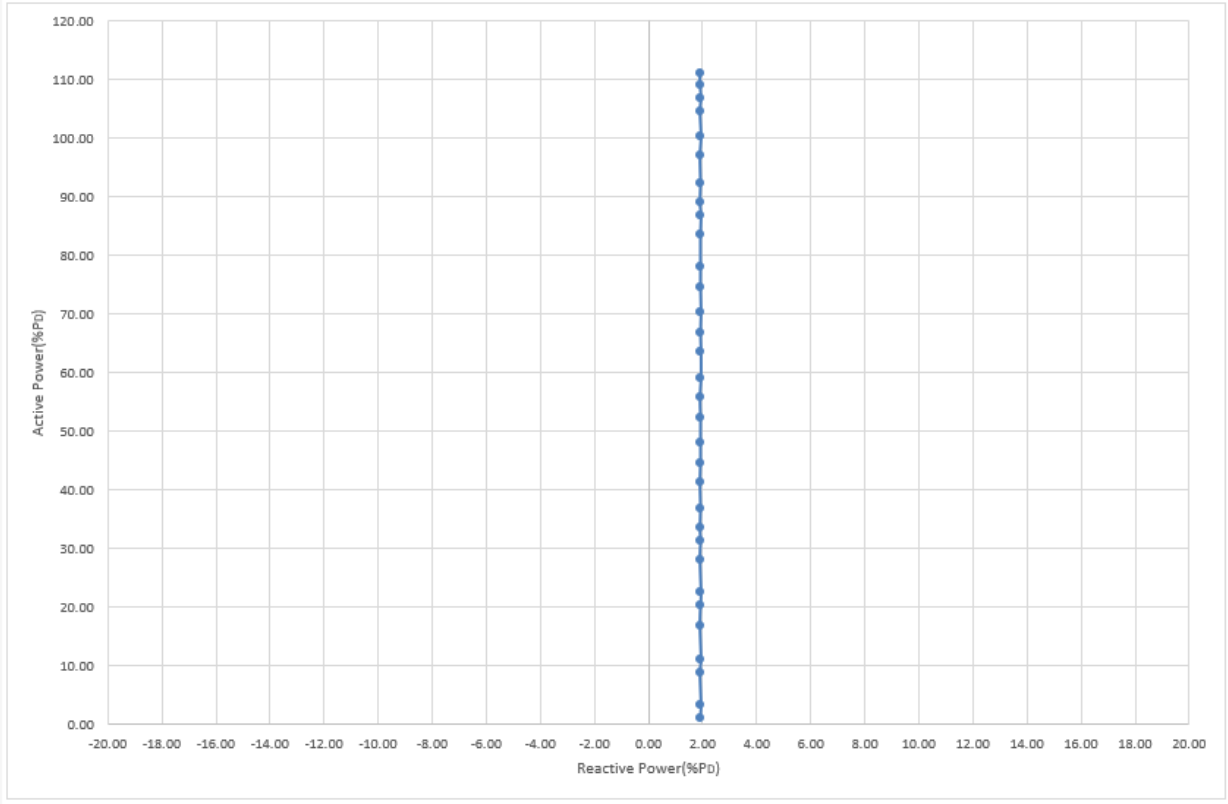
This test has been done configuring a reactive power setpoint of 0 kVAr, therefore obtaining a power factor of 1. Steps measured and results are included in the following table and graph:

Fixed Power Factor (PF=1)						
P Desired ($\%P_D$)	**Power DC (kW)**	**P measured ($\%P_D$)**	**Q desired ($\%P_D$)**	**Q measured ($\%P_D$)**	**Q Deviation ($\%P_D$)**	**Power Factor (cos φ)**
0	0.067	0.83	--	1.73	--	0.374
3	0.192	2.87	--	1.75	--	0.853
8	0.507	7.98	--	1.73	--	0.977
10	0.632	10.02	0.00	1.75	1.75	0.985
15	0.945	15.11	0.00	1.73	1.73	0.993
18	1.134	18.16	0.00	1.74	1.74	0.995
20	1.259	20.19	0.00	1.75	1.75	0.996
25	1.573	25.27	0.00	1.73	1.73	0.997
28	1.747	28.10	0.00	1.74	1.74	0.998
30	1.874	30.12	0.00	1.73	1.73	0.998
33	2.062	33.15	0.00	1.74	1.74	0.998
37	2.306	37.08	0.00	1.73	1.73	0.998
40	2.494	40.10	0.00	1.74	1.74	0.999
43	2.682	43.12	0.00	1.74	1.74	0.999
47	2.933	47.14	0.00	1.74	1.74	0.999
50	3.119	50.15	0.00	1.73	1.73	0.999
53	3.309	53.16	0.00	1.75	1.75	0.999
57	3.558	57.16	0.00	1.75	1.75	0.999
60	3.747	60.16	0.00	1.74	1.74	0.999
63	3.933	63.14	0.00	1.75	1.75	0.999
67	4.184	67.13	0.00	1.74	1.74	0.999
70	4.371	70.11	0.00	1.74	1.74	0.999
75	4.684	75.07	0.00	1.74	1.74	0.999
78	4.871	78.05	0.00	1.75	1.75	0.999
80	4.995	80.02	0.00	1.73	1.73	0.999
83	5.183	82.98	0.00	1.74	1.74	0.999
87	5.452	87.22	0.00	1.73	1.73	0.999
90	5.639	90.18	0.00	1.75	1.75	0.999
94	5.889	94.11	0.00	1.73	1.73	0.999
96	6.008	96.06	0.00	1.75	1.75	0.999
98	6.134	98.02	0.00	1.73	1.73	0.999
100	6.260	99.96	0.00	1.73	1.73	0.999

Power factor and powers vs Time



Active power vs Reactive power



4.7.1.2 Rectangular curve – Fixed reactive power

This requriment has been done for the verification of the rectangular curve at a fixed reactive power level at both the inductive and the capacitive side.

t is not applicable due to the EUT is not going to connect to HV grid.

4.7.1.3 Triangular curve – Fixed power factor (PF = 0.9)

This test has been done for verification of the triangular curve, at both the inductive and the capacitive side:

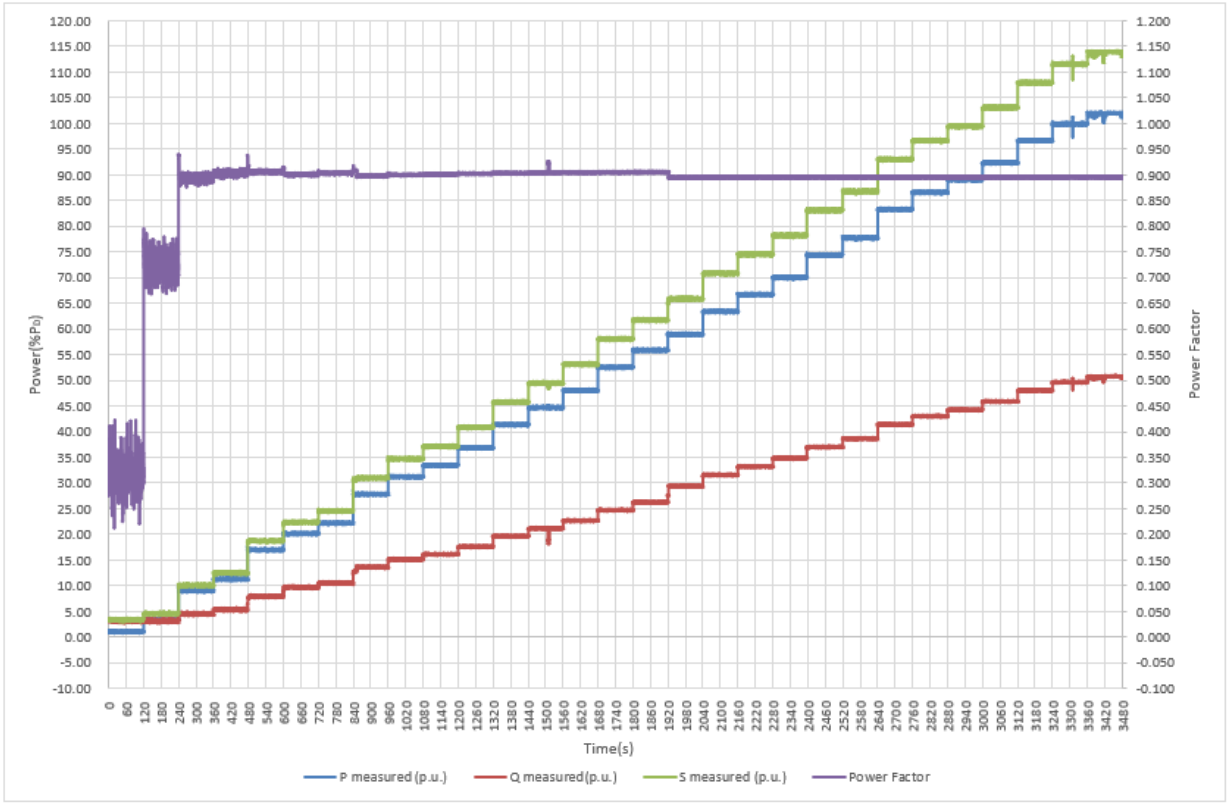
Triangular Curve (PF=0.9 / inductive)						
P Desired (%P_D)	**Power DC (kW)**	**P measured (%P_D)**	**Q measured (%P_D)**	**Power Factor desired (cos φ)**	**Power Factor measured (cos φ)**	**Power Factor Deviation (cos φ)**
0	0.068	1.06	3.17	--	0.317	--
3	0.193	3.34	3.15	--	0.728	--
9	0.505	9.03	4.50	--	0.895	--
11	0.630	11.29	5.33	0.900	0.904	0.004
17	0.942	16.97	7.91	0.900	0.906	0.006
20	1.117	20.14	9.71	0.900	0.901	0.001
22	1.228	22.17	10.53	0.900	0.903	0.003
28	1.541	27.84	13.63	0.900	0.898	-0.002
31	1.728	31.23	15.13	0.900	0.900	0.000
33	1.852	33.45	16.12	0.900	0.901	0.001
37	2.039	36.84	17.61	0.900	0.902	0.002
41	2.288	41.34	19.64	0.900	0.903	0.003
44	2.470	44.62	21.12	0.900	0.904	0.004
48	2.659	48.03	22.67	0.900	0.904	0.004
52	2.908	52.51	24.72	0.900	0.905	0.005
56	3.094	55.86	26.26	0.900	0.905	0.005
59	3.268	58.95	29.34	0.900	0.895	-0.005
63	3.514	63.37	31.58	0.900	0.895	-0.005
67	3.700	66.69	33.21	0.900	0.895	-0.005
70	3.885	70.01	34.84	0.900	0.895	-0.005
74	4.131	74.40	37.01	0.900	0.895	-0.005
78	4.315	77.68	38.63	0.900	0.895	-0.005
83	4.629	83.29	41.41	0.900	0.895	-0.005
87	4.813	86.56	43.02	0.900	0.896	-0.004
89	4.953	89.05	44.24	0.900	0.896	-0.004
92	5.138	92.32	45.88	0.900	0.896	-0.004
97	5.381	96.63	47.99	0.900	0.896	-0.004
100	5.566	99.91	49.63	0.900	0.896	-0.004
102(*)	--	--	--	--	--	--
104(*)	--	--	--	--	--	--
107(*)	--	--	--	--	--	--
109(*)	--	--	--	--	--	--
111(*)	--	--	--	--	--	--

(*) The inverter does not reach the fixed power factor value of 0.9 due to the current limitation function.

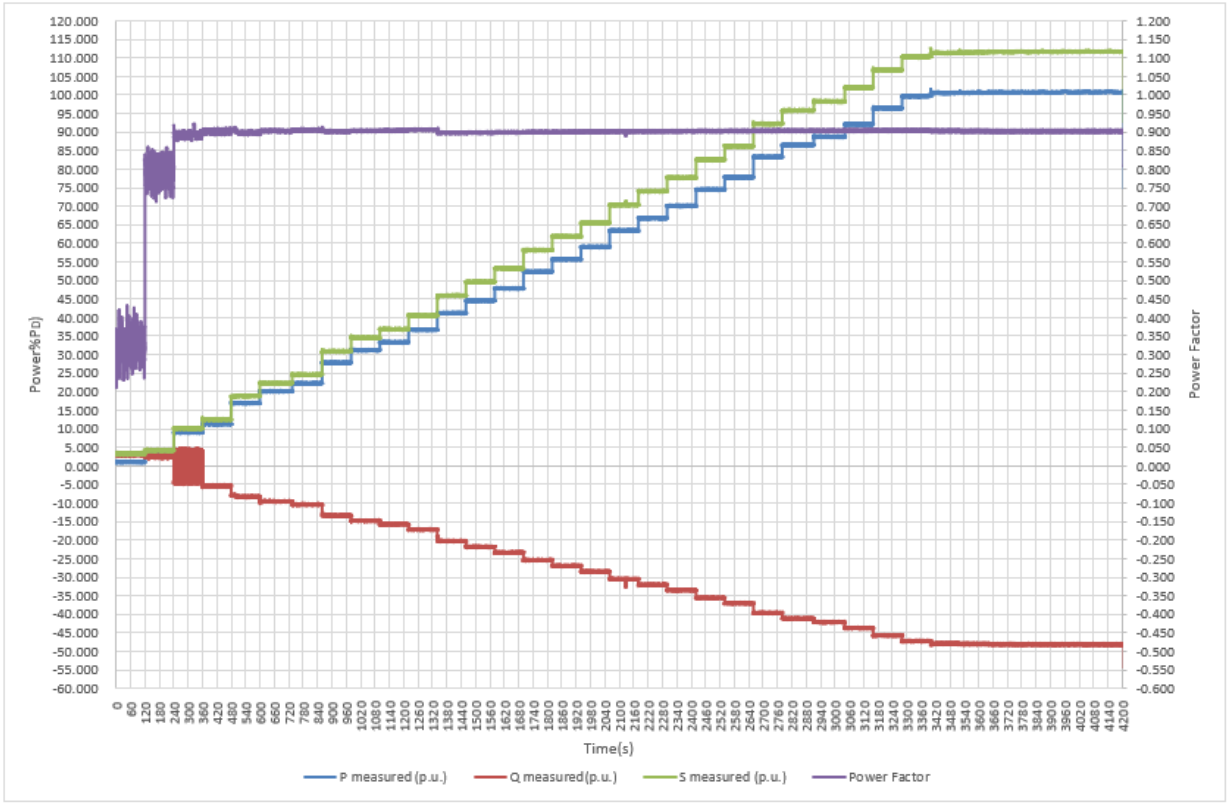
Triangular Curve (PF=0.9 / capacitive)						
P Desired (%P_D)	**Power DC (kW)**	**P measured (%P_D)**	**Q measured (%P_D)**	**Power Factor desired (cos φ)**	**Power Factor measured (cos φ)**	**Power Factor Deviation (cos φ)**
0	0.067	0.01	3.04	--	0.327	--
3	0.193	3.34	2.54	--	0.795	--
9	0.505	9.03	-3.51	--	0.894	--
11	0.630	11.29	-5.38	0.900	0.903	0.003
17	0.942	16.97	-8.28	0.900	0.899	-0.001
20	1.117	20.14	-9.57	0.900	0.903	0.003
22	1.235	22.17	-10.43	0.900	0.906	0.006
28	1.541	27.84	-13.37	0.900	0.901	0.001
31	1.728	31.23	-14.81	0.900	0.903	0.003
33	1.846	33.45	-15.72	0.900	0.904	0.004
37	2.033	36.84	-17.16	0.900	0.906	0.006
41	2.282	41.34	-20.24	0.900	0.898	-0.002
44	2.468	44.62	-21.78	0.900	0.898	-0.002
48	2.653	48.03	-23.31	0.900	0.899	-0.001
52	2.902	52.51	-25.36	0.900	0.900	0.000
56	3.088	55.86	-26.90	0.900	0.900	0.000
59	3.274	58.95	-28.44	0.900	0.901	0.001
63	3.521	63.37	-30.47	0.900	0.901	0.001
67	3.706	66.69	-31.99	0.900	0.902	0.002
70	3.891	70.01	-33.51	0.900	0.902	0.002
74	4.138	74.40	-35.55	0.900	0.902	0.002
78	4.323	77.68	-37.06	0.900	0.903	0.003
83	4.631	83.29	-39.59	0.900	0.903	0.003
87	4.814	86.56	-41.10	0.900	0.903	0.003
89	4.937	89.05	-42.15	0.900	0.903	0.003
92	5.128	92.32	-43.71	0.900	0.903	0.003
97	5.372	96.63	-45.74	0.900	0.904	0.004
100	5.554	99.91	-47.22	0.900	0.904	0.004
102(*)	--		--	--	--	--
104(*)	--	--	--	--	--	--
107(*)	--	--	--	--	--	--
109(*)	--	--	--	--	--	--
111(*)	--	--	--	--	--	--

(*) The inverter does not reach the fixed power factor value of 0.9 due to the current limitation function.

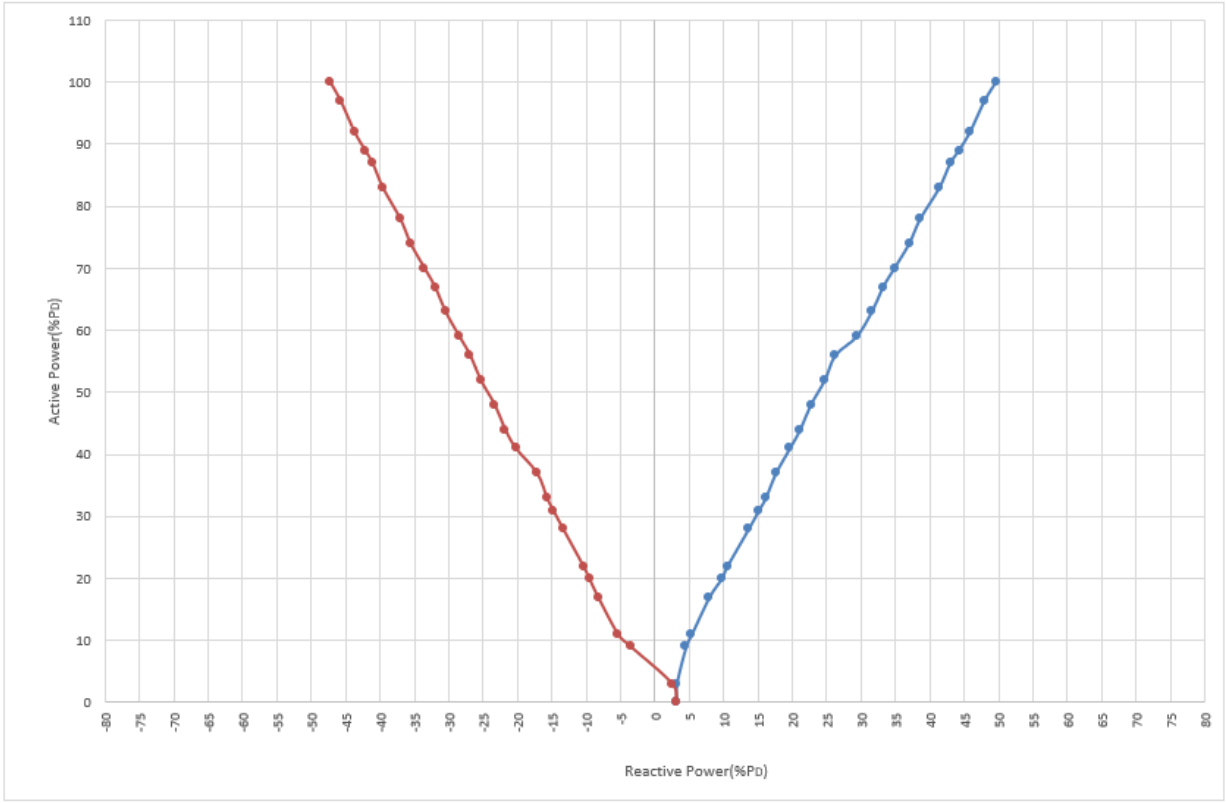
Triangular Curve (PF=0.9), Inductive: Power factor and powers vs Time



Triangular Curve (PF=0.9), Capacitive side: Power Factor and Powers vs Time



Triangular Curve: Active power vs Reactive power



4.7.1.4 Semicircular curve – Maximum apparent power

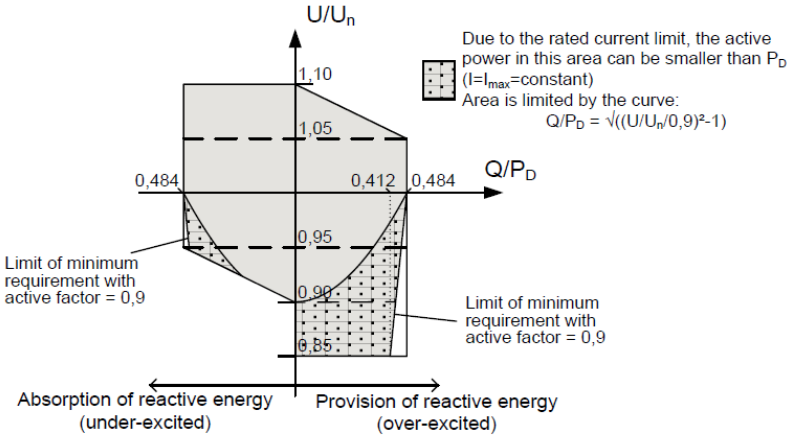
This requriment is for verification of the semicircular characteristic at rated voltage at both the inductive and the capacitive side.

It is not test due to it is optional.

4.7.2 Q(U) capabilities

This test has been done according to chapter D.7.1 of the standard. The aim is to verify the reactive power capabilities of the EUT at different voltage levels than the rated level. For verification of this requirement, the following characteristic from the standard shall be tested:

For LV connections:



The max. Q seting as following table with is stricter than the standard. Only the condition for connection to LV grid had been verified as following,

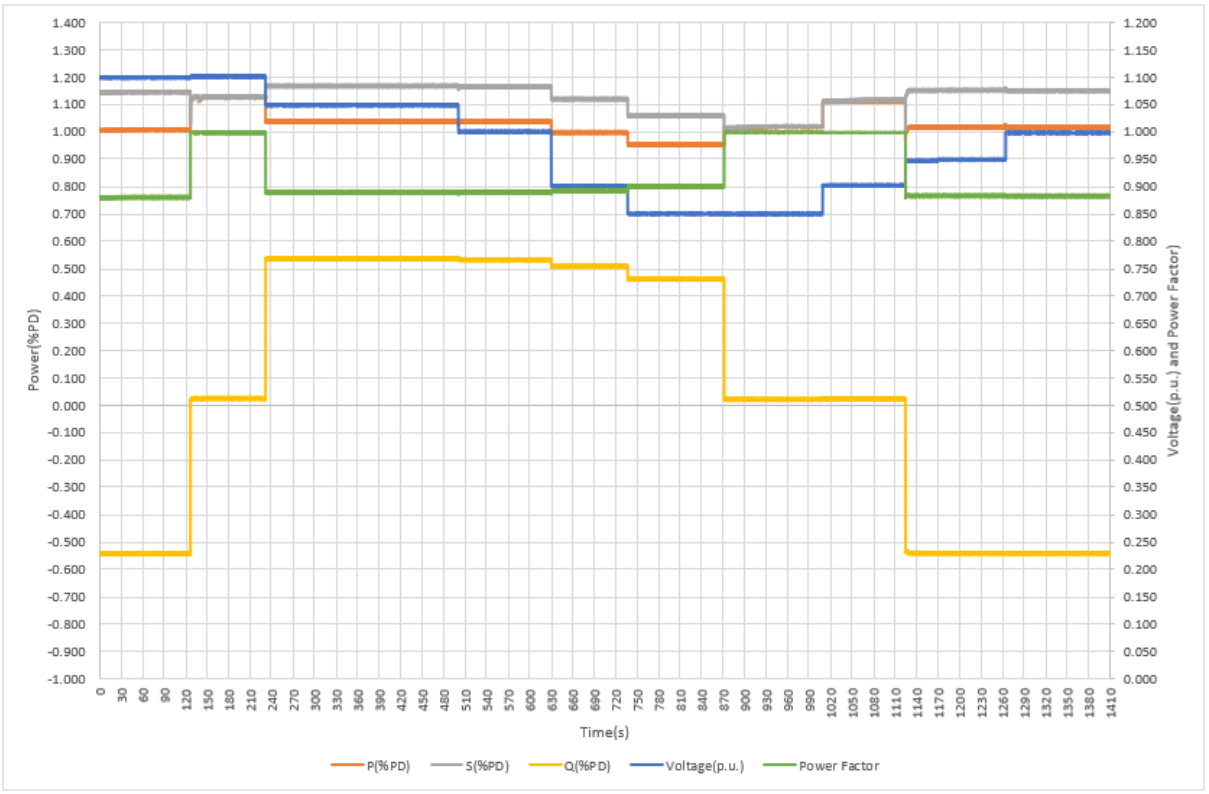
Used settings of the measurement device for this measurement:

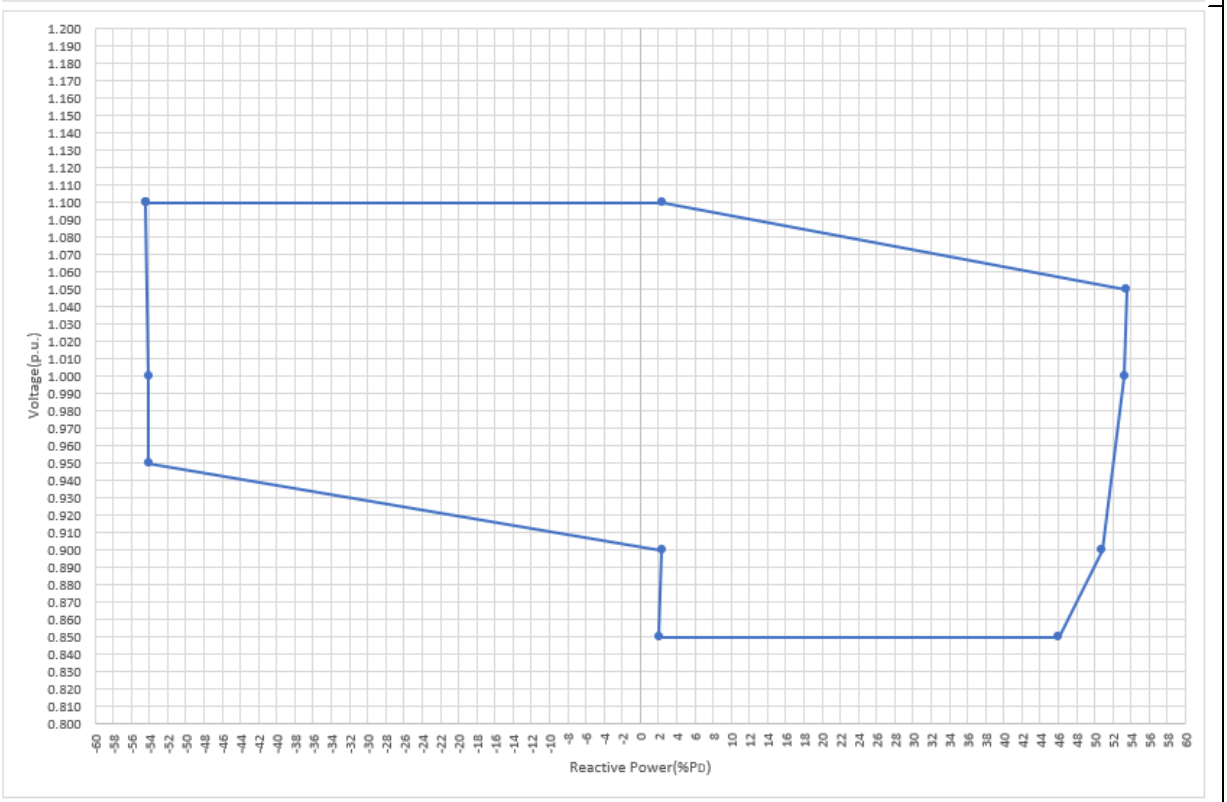
Measurement device	Date of measurement	Recording	Sampling frequency
PA5000	2020/09/02	100ms values	10kHz

Test results are presented in the following table and graph:

Reactive power capability at active power PD in the voltage range							
Step	**Voltage desired (p.u.)**	**Voltage Meas. (p.u.)**	**P measured (%PD)**	**Q measured (%PD)**	**Q desired (%PD)**	**Q devation (%PD)**	**Power Factor measured (cos φ)**
1	1.100	1.100	1.099	100.7	-54.4	-53.8	-0.607
2	1.100	1.100	1.101	112.5	2.5	0.0	2.490
3	1.050	1.050	1.049	103.7	53.5	53.8	-0.231
4	1.000	1.000	1.000	103.6	53.2	53.8	-0.540
5	0.900	0.900	0.900	99.8	50.8	51.1	-0.315
6	0.850	0.850	0.850	95.2	46.0	45.8	0.258
7	0.850	0.850	0.850	101.7	2.1	0.0	2.069
8	0.900	0.900	0.902	111.1	2.4	0.0	2.366
9	0.950	0.950	0.948	101.6	-54.1	-53.8	-0.309
10	1.000	1.000	0.998	101.5	-54.1	-53.8	-0.326

Q(U) capabilities





4.7.3 Cos φ setpoint

This test has been done according to chapter D.7.1 of the standard.

The compliances with the requirements of clause D.7.1 of the standard is stated in section 4.4.2.3 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

4.7.4 Cos φ(P) capabilities

This test has been done according to chapter D.7.1 of the standard.

The compliances with the requirements of clause D.7.1 of the standard is stated in section 4.4.2.4 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

4.7.5 Specific for a small power-generating plant

This test has been done according to chapter D.7.1.1 of the standard.

The compliances with the requirements of clause D.7.1.1 of the standard is stated in section 4.4.2.4 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

4.7.6 Specific for another (not small) power-generating plant

This test has been required according to chapter D.7.1.2 of the standard.

It is not applicable due to the EUT is type A in accordance with NC RfG, which is not goint to connection to the plant above 1MW.

4.7.7 Voltage related active power reduction P(U)

This test has been done according to chapter D.7.2 of the standard. The aim is to verify that the EUT is capable of reducing active power in overvoltage situations to avoid disconnection without causing

The compliances with the requirements of clause D.7.2 of the standard is stated in section 4.4.3 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

4.7.8 Provision of additional fast reactive current during faults and voltage steps

This test has been done according to chapter D.7.3 of the standard.

It is not applicable due to the EUT is type A in accordance with NC RfG, which is not goint to connection to the plant above 1MW.

4.8 CONNECTION AND STARTING TO GENERATE ELECTRICAL POWER

4.8.1 Automatic reconnection after tripping

This test has been done according to chapter D.8 of the standard. The aim of the test is to verify that the EUT reconnects after tripping if set conditions are met. This function shall have configurable thresholds for both voltage and frequency as well as configurable observation time and recuperation gradient. After a disconnection due to a fault, the EUT is allowed to reconnect when frequency and voltage values have been within the thresholds for at least the observation time configured. When reconnecting, this shall occur with the ramp rate stablished.

The following table include default values presented in the standard:

Parameter	Reconnection after tripping of the interface protection relay	Normal operation starting
Lower frequency	49,9 Hz	49,9 Hz
Upper frequency	50,1 Hz	50,1 Hz
Lower voltage	If connection to the LV distribution network: 85% U_n	If connection to the LV distribution network: 85% U_n
	If connection to the HV distribution network: 90 % U_c	If connection to the HV distribution network: 90 % U_c
Upper voltage	If connection to the LV distribution network: 110 % U_n	If connection to the LV distribution network: 110 % U_n
	If connection to the HV distribution network: 110 % U_c	If connection to the HV distribution network: 110 % U_c
Observation time	60 s	60 s
Maximum active power increase gradient	10 %/min*	20 %/min
** Power-generating units that have not the ability to apply a certain gradient shall take into account an additional delay.*		

Used settings of the measurement device for this measurement:

Measurement device	Date of measurement	Recording	Sampling frequency
PA5000	2020/09/02	100ms values	10kHz

Test results are presented in the following table and graphs:

Operation mode	Observation time measured (s)	Gradient measured (%Pn/min)
Overvoltage	110.1	8.29
Undervoltage	73.4	8.04
Overfrequency	71.7	8.20
Underfrequency	69.9	8.18
Setpoint of gradient		8.3%Pn/min

4.8.2 Starting to generate electrical power

This test has been done according to chapter D.8 of the standard. The aim of the test is to verify that the EUT starts to generate power within previously configured conditions. This function shall have configurable thresholds for both voltage and frequency as well as configurable observation time and recuperation gradient. Once the EUT is connected. when frequency and voltage values get within the thresholds for at least the observation time configured, it shall start to generate power with the configured ramp rate.

The following table include default values presented in the standard:

Parameter	Reconnection after tripping of the interface protection relay	Normal operation starting
Lower frequency	49,9 Hz	49,9 Hz
Upper frequency	50,1 Hz	50,1 Hz
Lower voltage	If connection to the LV distribution network: 85% U_n	If connection to the LV distribution network: 85% U_n
	If connection to the HV distribution network: 90 % U_c	If connection to the HV distribution network: 90 % U_c
Upper voltage	If connection to the LV distribution network: 110 % U_n	If connection to the LV distribution network: 110 % U_n
	If connection to the HV distribution network: 110 % U_c	If connection to the HV distribution network: 110 % U_c
Observation time	60 s	60 s
Maximum active power increase gradient	10 %/min*	20 %/min
** Power-generating units that have not the ability to apply a certain gradient shall take into account an additional delay.*		

Used settings of the measurement device for this measurement:

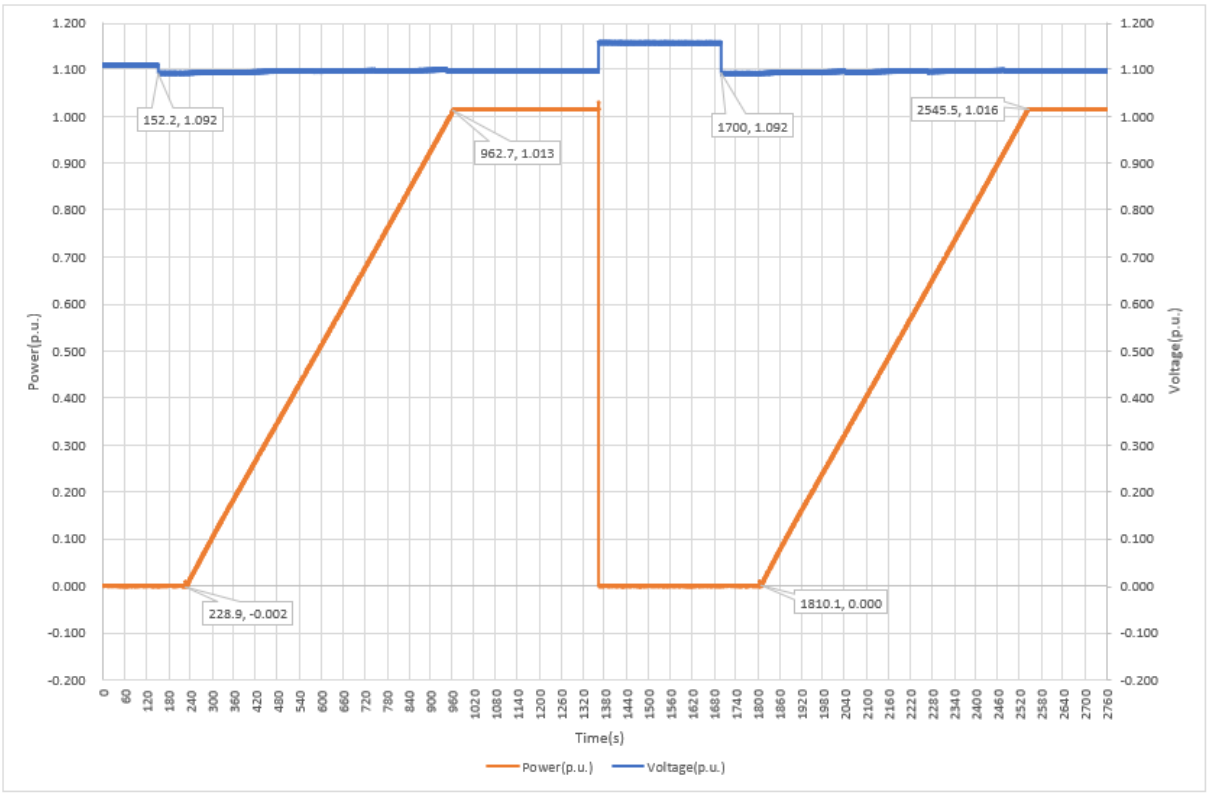
Measurement device	Date of measurement	Recording	Sampling frequency
PA5000	2020/09/02	100ms values	10kHz

Test results are presented in the following table and graphs:

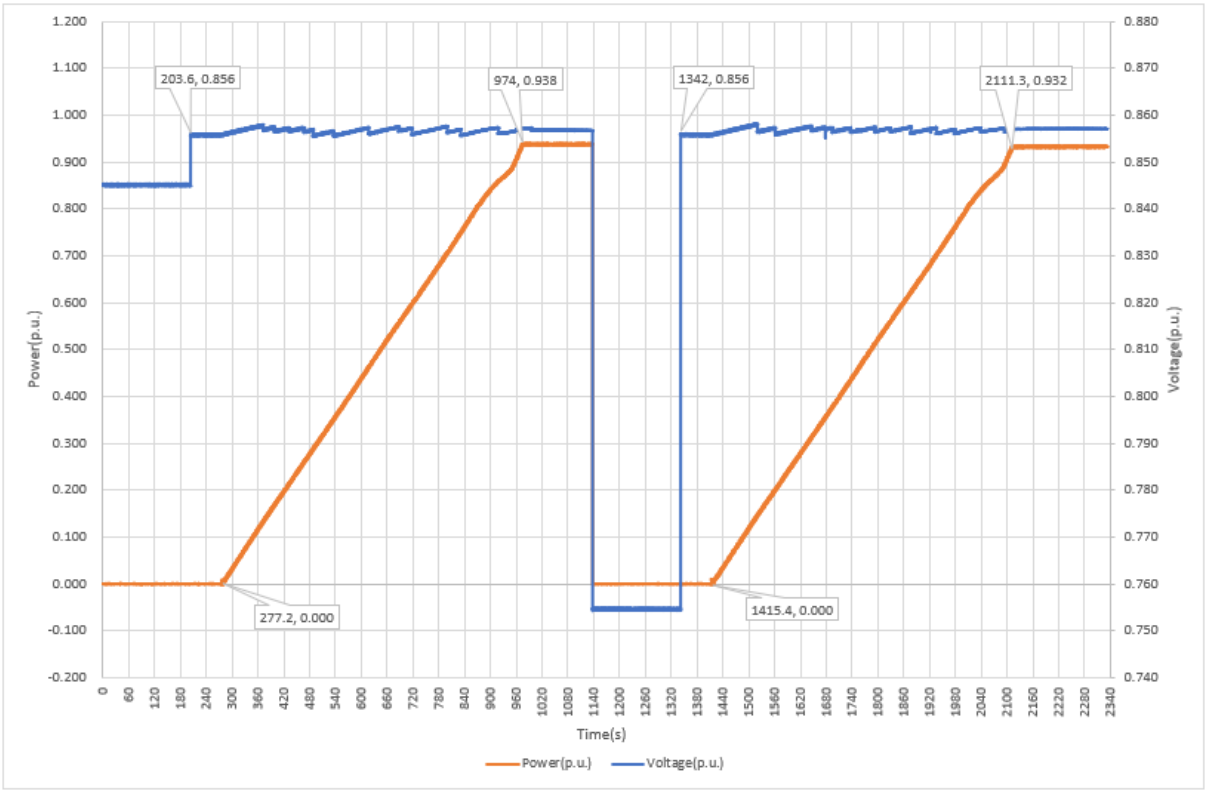
Operation mode	Observation time measured (s)	Gradient measured (%Pn/min)
Overvoltage	76.7	8.30
Undervoltage	73.6	8.08
Overfrequency	84.1	8.23
Underfrequency	76.2	8.26
Setpoint of gradient		8.3%Pn/min

Test results are presented in the following graphs for connection and reconnection

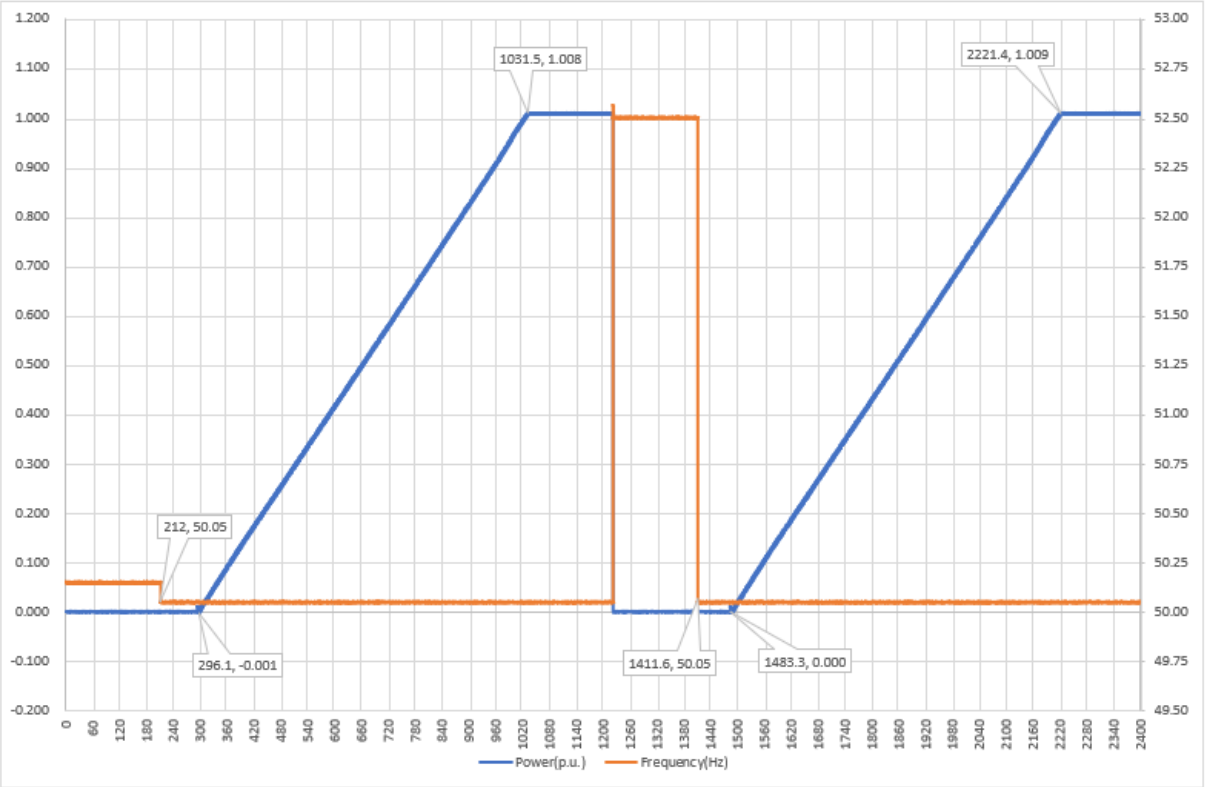
Overvoltage Connection and Reconnection



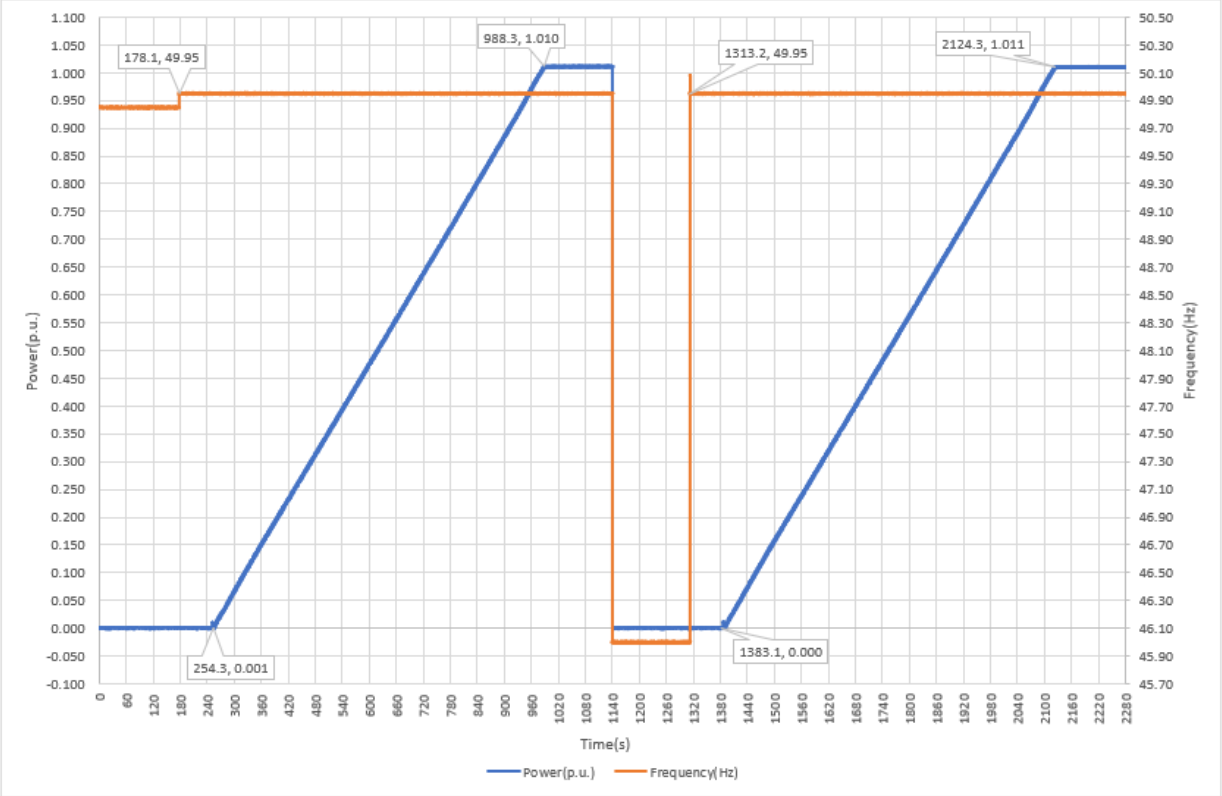
Undervoltage Connection and Reconnection



Overfrequency Connection and Reconnection



Underfrequency Connection and Reconnection



4.9 CEASING AND REDUCTION OF ACTIVE POWER ON SET POINT

4.9.1 Ceasing active power

The test has been required according to the clause D.9.1 of the standard.

Generating plants with a maximum capacity of 0.8 kW or more shall be equipped with a logic interface (input port) in order to cease active power output within 5 seconds following an instruction being received at the input port. If required by the DSO and the responsible party, this includes remote operation.

The compliances with the requirements of clause D.9.1 of the standard is stated in section 4.8.1 of following test report:

EN 50549-1:2019: Test Report nº 2219/0338-E1 on 19/11/2019 which was issued by SGS Tecnos, S.A. (Electrical Testing Laboratory)

4.9.2 Active power reduction following setpoint

This test has been done according to chapter D.9.2 of the standard. The aim is to verify the capacity of the EUT of reducing active power following an instruction at the input port.

It is not test due to it is not mandatory for connections of <1MW, and the inverter is tested only according to requirements for Type A plant generation.

4.10 COMMUNICATION – REMOTE MONITORING AND CONTROL

The requirements of this Section are applicable only to the power-generating units that are part of:

- a power-generating module with a maximum power ≥ 1 MW
- a power-generating plant with a maximum power > 250 kVA, if so required by the DSO, respecting the regional regulatory provisions.

The power-generating unit must have the necessary functionalities to meet the requirements of the section 7.13 of the standard concerning the communication (remote control and monitoring).

- Communication signals of the power-generating module to the DSO

Information	Nature	Max refresh time	Comment
Voltages at the point of connection	Measurement	1 s	
Active poser at the point of connection	Measurement	1 s	
Reactive power at the point of connection	Measurement	1 s	
Active power on the terminals of the power-generating module	Measurement	1 s	Only required if at least one of the following conditions has been met: • $\frac{\text{local consumption power of the DSU}}{P_n \text{ of the power-generating module}} > 30\,\%$ • Local consumption power of the DSU >300 kVA
Reactive power on the terminals of the power-generating module	Measurement	1 s	Only required if at least one of the following conditions has been met: • $\frac{\text{local consumption power of the DSU}}{P_n \text{ of the power-generating module}} > 30\,\%$ • Local consumption power of the DSU >300 kVA
Unavailability of the communication system		1 s	Can be specific to the protocol used
Power-generating plant connected to the distribution network	Binary signal	1 s	For every disconnection breaker and backup disconnection breaker a signal must be given that indicates the status (open/closed) of the breaker.
Watchdog on RTU auxiliary energy source			

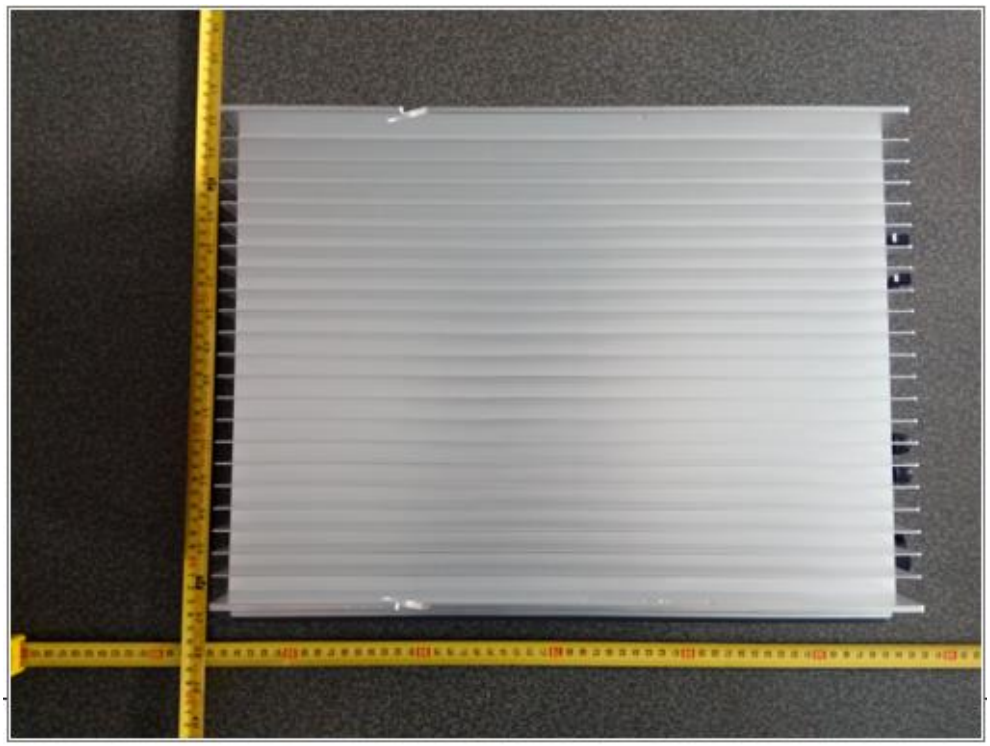
- Communication signals from DSO to power-generating module

Operation parameter	Type of signal	Max. operation time[22]	Comment
Request for disconnect	Binary signal	1 s	1 = Request for disconnection 0 = End of request for disconnection
Limit for the request to limit the produced active power	Value	1 s	Value from 0 to 100 % of Pn
Value of fixed setpoint for reactive power	Value	1 s	-100 %..., 100 % of Pn
Selection of the reactive power control modus		1 s	No control (free use of reactive power capabilities by DSU) Q setpoint Q(U) Q(P) Cosϕ setpoint Cosϕ(P)

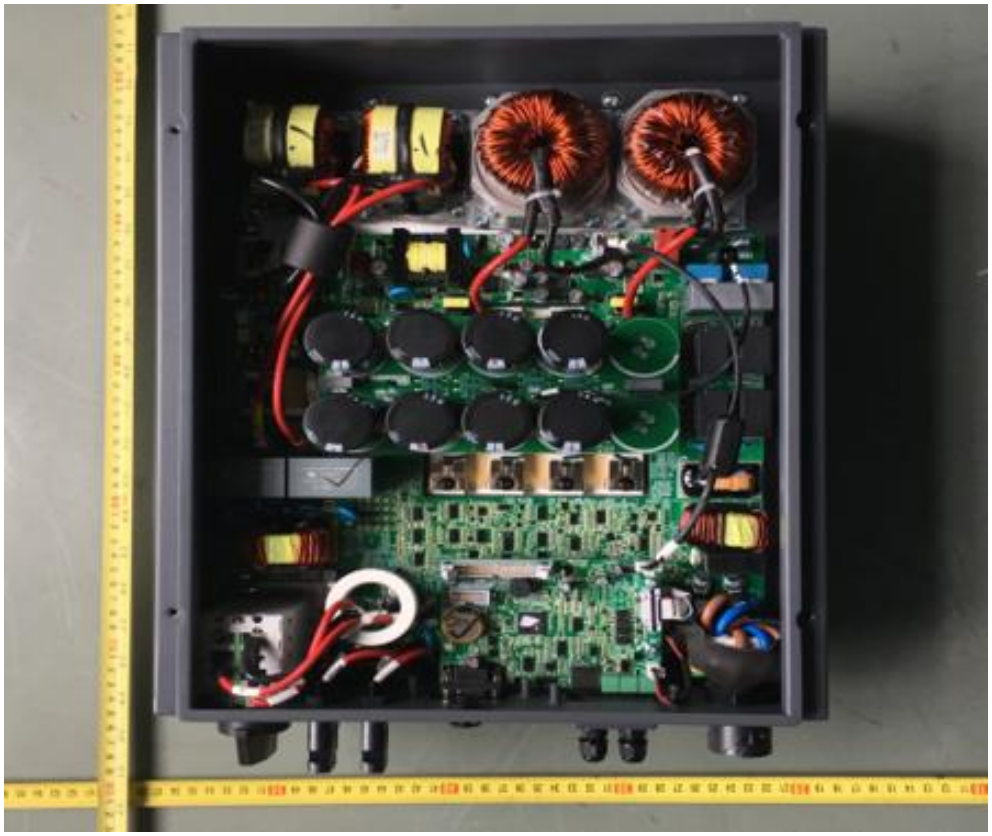
It is not evidenced due to power-generating units is not one of above.

5 PICTURES

Front

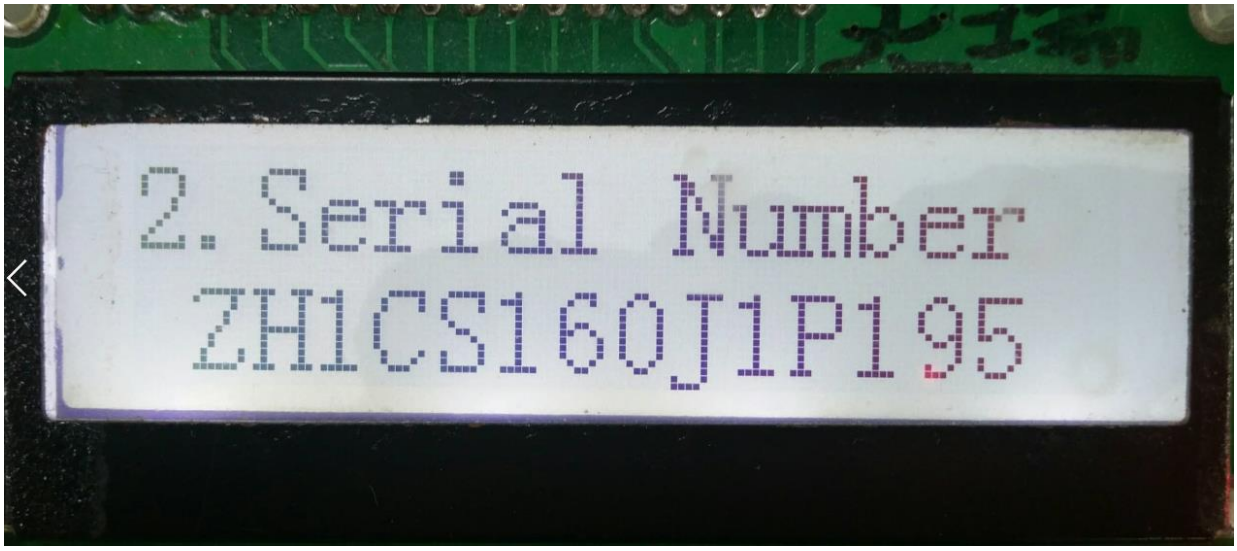
Back Side


Internal



Software Version

Serial Number of the EUT



6 ELECTRICAL SCHEMES

Equipment under testing