TESTING FOR THE VERIFICATION OF COMPLIANCE OF PV INVERTER WITH :

ORDER NO. 208 OF 14.12.2018:

APPROVING THE TECHNICAL NORM ON THE TECHNICAL REQUIREMENTS TO CONNECT POWER-GENERATING MODULES, POWER PLANTS MODULES AND OFFSHORE POWER PARK MODULES TO PUBLIC ELECTRICAL GRIDS

Test Report Number	:	**2220-0204**
Trademark	:	Solar Grid-tied Inverter
Tested Model	:	**SOFAR 3300TL-G3**
Variant Models	:	SOFAR 3000TL-G3, SOFAR 2700TL-G3, SOFAR 2200TL-G3, SOFAR 1600TL-G3, SOFAR 1100TL-G3

APPLICANT

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Hired by	:	Shenzhen SOFAR SOLAR Co., Ltd.
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TESTING LABORATORY

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Conducted (tested) by	:	Michael Tong (Project Engineer)
Reviewed & Approved by	:	Jacobo Tevar (Technical Reviewer)
Date of issue	:	17/06/2020
Number of pages	:	40

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

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Test Report Historical Revision:

Test Report Version	Date	Resume
2220-0204	17/06/2020	First issuance

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1 SCOPE

SGS Tecnos, S.A. (Electrical Testing Laboratory) has been contracted by SGS Tecnos S.A. (Certification Body), in order to perform the testing according the standard:

- Order no. 208 of 14.12.2018
  approving the technical norm on the technical requirements to connect power-generating modules, power plants modules and offshore power park modules to public electrical grids

Note: The tests offered at this test report evaluate the EUT compliance with the requirements of CHAPTER II REQUIREMENTS FOR POWER-GENERATING MODULES - Section 2. GENERAL REQUIREMENTS FOR TYPE A POWER-GENERATING MODULES

2 GENERAL INFORMATION

2.1 Testing Period and Climatic conditions

The necessary testing has been performed along 4 working days between the 29th of May and the 9th of June of 2020.

All the tests and checks have been performed in accordance with the reference Standard (the tests are done at 25 ± 5ºC, 96 kPa ± 10 kPa and 50% 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..... :

Model / Type reference ..... : SOFAR 3300TL-G3

Serial Number ..... : SA3ES033KAR413

Software Version..... : V2.40

Rated Characteristics..... : DC input: 50-550V (Max. 550V), 12A
AC output: 230V, 50Hz, 14.3A*(16A Max), 3300VA
(*) The rated output current is calculated base on rated power and rated voltage.

Date of manufacturing: 2019

Test item particulars

Input..... : DC

Output ..... AC

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

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

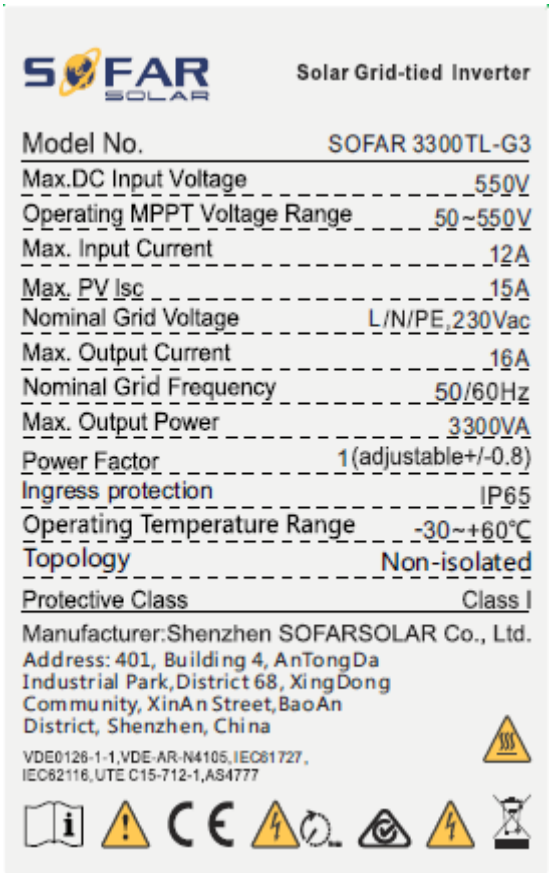
Type of connection to the main supply..... : Signal phase – Fixed installation

Cooling group..... : Heat sink

Modular..... : No

Internal Transformer..... : No

Copy of prototype 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 3300TL-G3's except the parameters of rating.

Equipment under testing:

- **SOFAR 3300TL-G3**

The variants models are:

- **SOFAR 3000TL-G3**
- **SOFAR 2700TL-G3**
- **SOFAR 2200TL-G3**
- **SOFAR 1600TL-G3**
- **SOFAR 1100TL-G3**

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 between 1/√10 times and twice of the rated power of the measured model.
- Same Firmware Version

Following table shows the full ratings of the variant models:

Model Number	SOFAR 3300TL-G3	SOFAR 3000TL-G3	SOFAR 2700TL-G3	SOFAR 2200TL-G3	SOFAR 1600TL-G3	SOFAR 1100TL-G3
Max. input voltage	550Vd.c.			500Vd.c		
Max. input current	12Ad.c.	12Ad.c.	12Ad.c.	12Ad.c.	12Ad.c.	12Ad.c.
Operating MPPT voltage range	50-550Vd.c.			50-500Vd.c.		
Full load DC Voltage Range	300-500 Vd.c.	275-500 Vd.c.	250-500 Vd.c.	200-450 Vd.c.	150-450 Vd.c.	110-450 Vd.c.
Rated voltage	360V					
Rated grid voltage	230Va.c.					
Rated grid frequency	50Hz					
Rated output power	3.3kW	3.0kW	2.7kW	2.2kW	1.6kW	1.1kW
Rated output current	14.3Aa.c.	13 Aa.c.	11.8Aa.c.	9.6Aa.c.	7Aa.c.	4.8Aa.c.
Max. Output Current	16Aa.c.	14.5 Aa.c.	13Aa.c.	10.6Aa.c.	7.7Aa.c.	5.3Aa.c.
Power factor	0.8 leading to 0.8 lagging					
Ambient temperature	-30 ºC ~60ºC					
Ingress protection	IP65					
Protective class	Class I					

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 Test Equipment List

From	No.	Equipment Name	Model No.	Equipment No.	Calibration Date	Equipment calibration due date
Sofarsolar	1	Voltage probe	SanHua / SI-9110	111152	2020/1/14	2021/1/13
	2	Voltage probe	SanHua / SI-9110	152627	2020/1/14	2021/1/13
	3	Power analyzer	ZLG / PA5000H	C8202909082002110002	2020/3/2	2021/3/1
	4	Current probe	CYBERTEK / CP1000A	C181000922	2020/1/14	2021/1/13
	5	Current probe	CYBERTEK / CP1000A	C181000925	2020/1/14	2021/1/13
	6	Oscilloscope	Agicent / DSO5014A	MY50070266	2020/1/14	2021/1/13
	7	Temperature & Humidity meter	Anymeters / TH101B	ZB-WSDJ-001	2020/1/14	2021/1/13
SGS	8	True RMS Multimeter	Fluke / 289C	GZE012-53	2020/2/22	2021/2/21

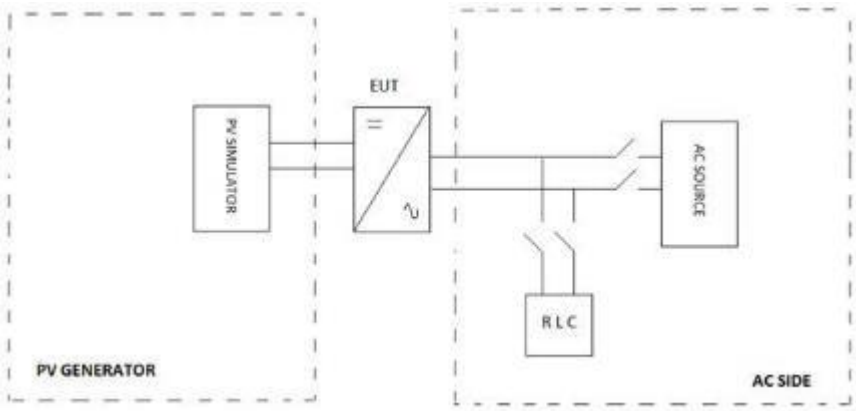
2.4 Measurement Uncertainty

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.	

2.5 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.

The test bench used includes:

EQUIPMENT	MARK / MODEL	RATED CHARACTERISTICS	OWNER / ID.CODE
AC source	Kwell / AFG-S-33800	Voltage: 0-600 V 750KVA	Sofarsolar / EP-026
PV source	Kwell / TVS-630kW	Voltage: 0 - 1000 V 630kW	Sofarsolar / EP-027

2.6 Definitions

In	Nominal Current	P	Power
p.u	Per unit	I	Current
Pn	Nominal Power	Pmax	Maximum Power
Sn	Apparent Power	F	Frequency
PGU	Power Generation Unit	LV	Low Voltage
MV	Medium Voltage	Un	Nominal Voltage
a.c.	alternating current	EUT	Equipment under test
PV	photovoltaic	d.c.	direct current
POC	point of connection	RSO	Relevant System Operator
TSO	Transmission And System Operator		

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

CHAPTER OF THE STANDARD, DESCRIPTION AND VERIFICATION			
Section 2	**Point in report**	**GENERAL REQUIREMENTS FOR TYPE A POWER-GENERATING MODULES**	
Article 6.	4.1	Normal operating range	P
	4.1.1	Normal frequency operating range	P
	4.1.2	Rate of change of frequency (ROCOF) immunity	P
Article 7	4.2	Power response to overfrequency	P
Article 8	4.3	Maintaining constant output	N/R (*)
Article 9			
Article 10			
Article 11	4.4	Logic interface: Rapid Shutdown.	P
Article 12	4.5	Connection	P
Article 13	4.6	Rapid Voltage Changes	P
Article 14	4.7	Power Quality and compliance with European standards	N/R (**)
Article 15	4.8	Monitor of Power Quality	N/A
Article 16	4.9	Means to detect island situation	N/R (*)

Note: The declaration of conformity has been evaluated considering the IEC Guide 115.

(*) The compliances with these requirements are stated in the following test report:

- EN 50549-1:2019: Test Report nº 190411082GZU-001 which was issued by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch on November 5th, 2019.

(**) The compliances with these requirements are stated in the following test report:

- IEC 62109-1:2010, IEC/EN 62109-2:2011: Test Report nº BL-SZ1930601-B01 and BL-SZ1930601-B01 attachment 1 on 10/04/2019 which was issued by Shenzhen BALUN Technology Co., Ltd
- EN 61000-6-1:2019, EN 61000-6-3:2007/A1:2011/AC:2012, EN 61000-3-2:2014, EN 61000-3-3:2013: Test Report nº BL-SZ1960495-402 on 23/08/2019 which was issued by Shenzhen BALUN Technology Co., Ltd

4 TEST RESULTS

4.1 NORMAL OPERATING RANGE

4.1.1 Normal Frequency Operating Range

According to Article 6 of the standard, the power-generating module shall be capable of remaining connected to the network and operate within the frequency ranges and time periods specified in table 1A;

Table 1A. *The minimum duration for which a type A power-generating module has to be capable to remain connected to the network and to operate on different frequencies, deviating from a nominal value*

Frequency range	Duration for operation
47.5 Hz – 48.5 Hz	Minimum 30 minutes
48.5 Hz – 49 Hz	Minimum 30 minutes
49 Hz – 51 Hz	Unlimited
51.0 Hz – 51.5 Hz	30 minutes

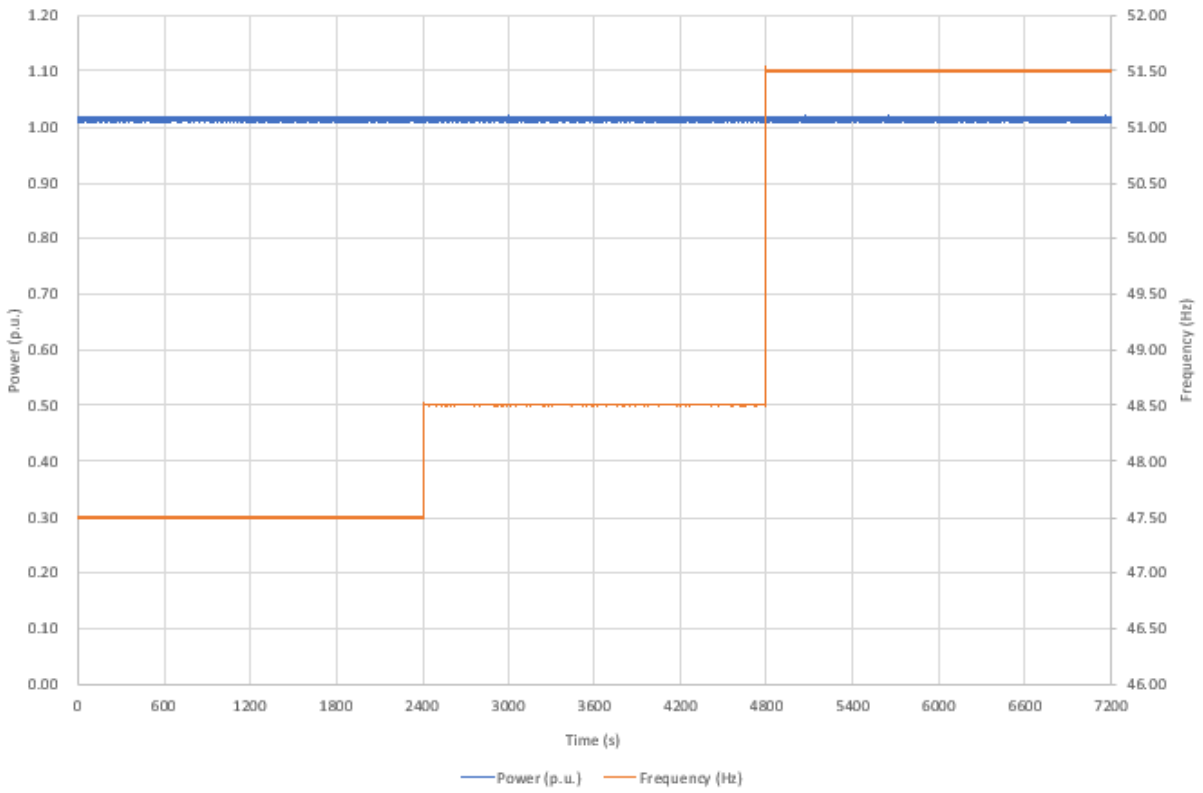
The inverter has a wide range of voltage and frequency protection settings, the table below shows the settings used in the tests:

Protection Stages	Threshold Settings	Trip Time Settings
V>	1.10Un	10.0s
V>>	1.20Un	0.1s
V<	0.90Un	10.0s
V<<	0.80Un	0.1s
F>	54.0Hz	10.0s
F>>	55.0Hz	0.1s
F<	46.0Hz	10.0s
F<<	45.0Hz	0.1s

In order to verify this function, parameter settings as in the following table have been considered to perform the test. Time requirements considered are the “minimum requirement” according to Table 1 from the standard:

Steps	f (Hz) Setting	Time requirement	f Measured (Hz)	Time Measured	Power measured (p.u.)
1	47.5	>30 min	47.50	40 min	1.014
2	48.5	>30 min	48.50	40 min	1.014
3	51.5	>30 min	51.50	40 min	1.014

Operating frequency range



4.1.2 Rate of change of frequency (ROCOF) immunity

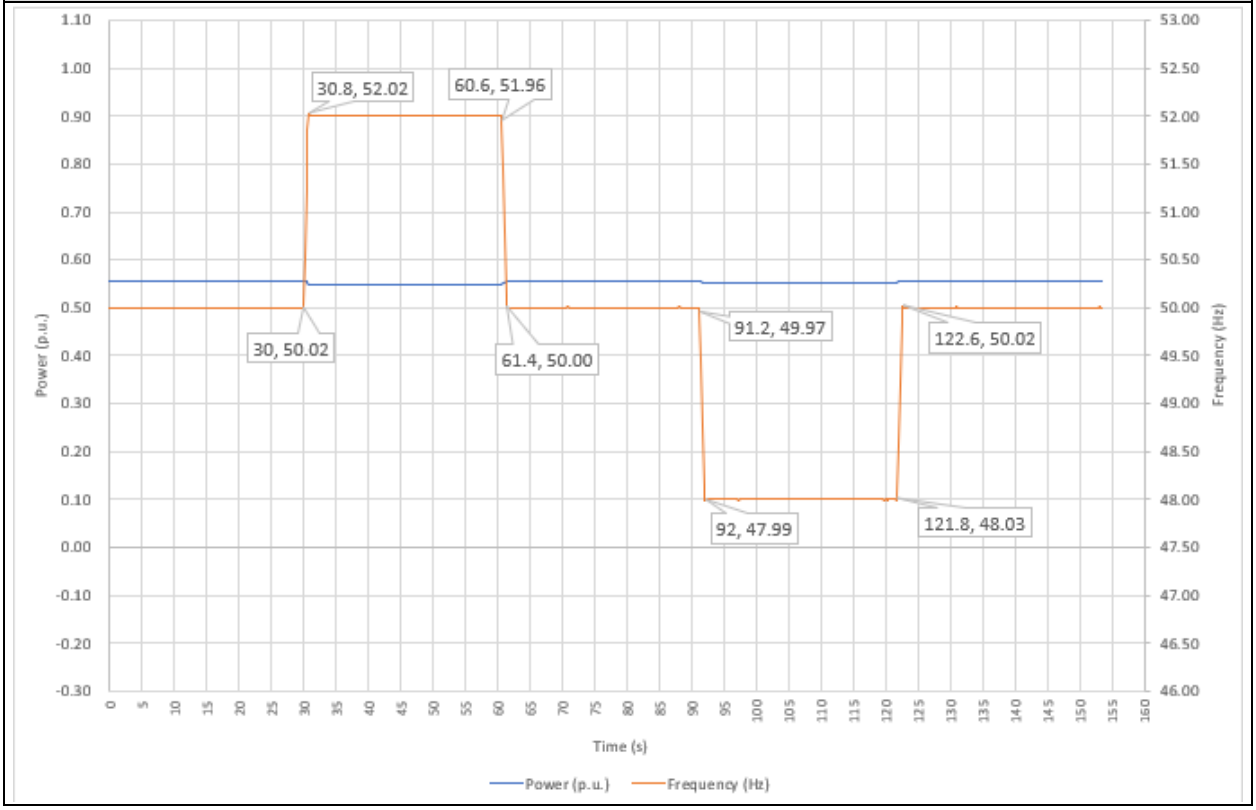
According to Article 6 of the standard, the power-generating module must remain connected to the network and must operate at frequency variation rates of 2 Hz/s for a period of 500 ms, of 1.5 Hz/s for a period of 1000 ms and of 1.25 Hz/s for a period of 2000 ms, depending on the technology type and the short-circuit power of the system at the connection point (a value provided by the RSO in the TCA). The protection controls at the connection point must allow operation of the power-generating module for these frequency variation profiles.

4.1.2.1 At least 2 Hz/s, for a period of 500ms.

The ROCOF immunity is defined with a sliding measurement window of 200 ms as following:

Steps	f (Hz)	ROCOF requirement (Hz/s)	Step time	Measured Frequency (Hz)	Measured step change time (s)	ROCOF meas. (Hz/s)	Disconnection
1	50.00 ± 0.05	N/A	>10 s	50.00	--	--	No
2	52.00 ± 0.05	≥2	>10 s	52.00	0.8	2.50	No
3	50.00 ± 0.05	≥2	>10 s	50.00	0.8	2.45	No
4	48.00 ± 0.05	≥2	>10 s	48.00	0.8	2.48	No
5	50.00 ± 0.05	≥2	>10 s	50.00	0.8	2.49	No

Rate of change of frequency (ROCOF) immunity

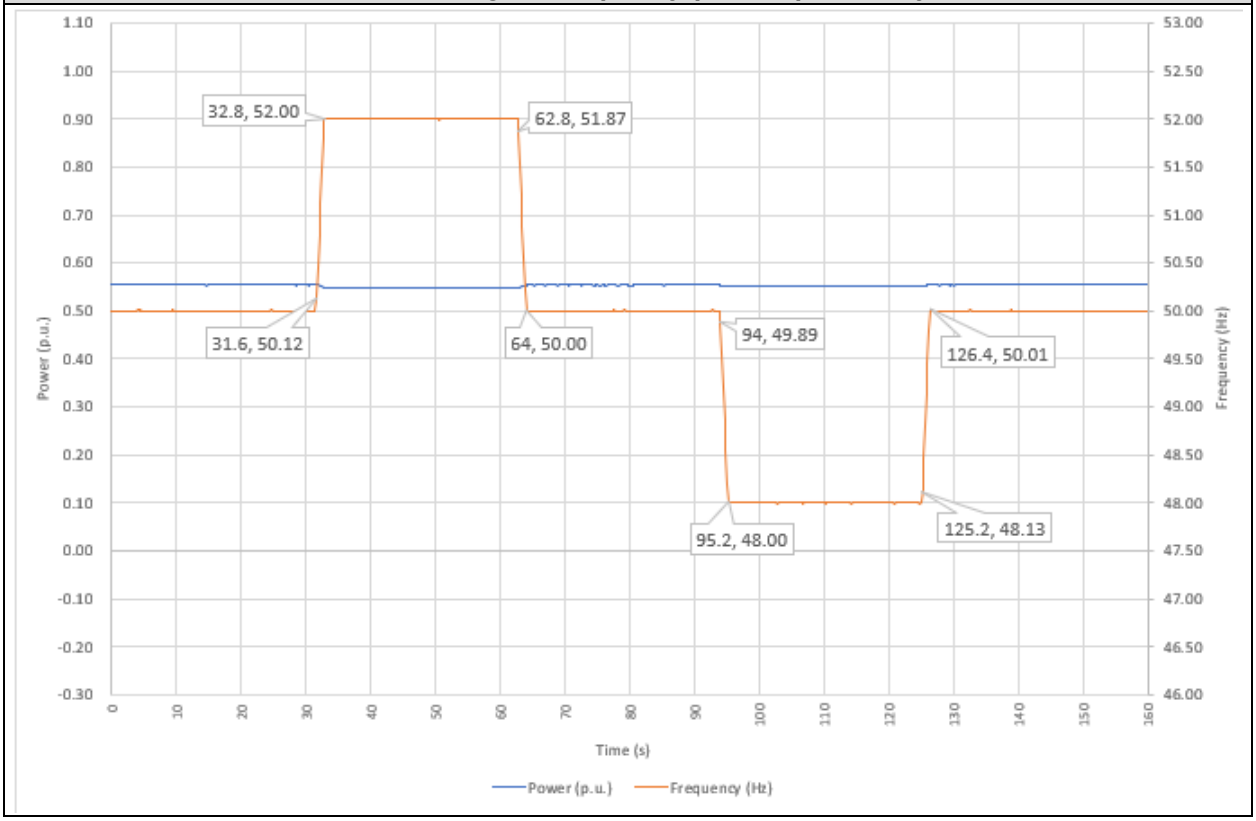


4.1.2.2 At least 1.5 Hz/s, for a period of 1000ms.

The ROCOF immunity is defined with a sliding measurement window of 200 ms as following:

Steps	f (Hz)	ROCOF requirement (Hz/s)	Step time	Measured Frequency (Hz)	Measured step change time (s)	ROCOF meas. (Hz/s)	Disconnection
1	50.00 ± 0.05	N/A	>10 s	50.00	--	--	No
2	52.00 ± 0.05	≥1.5	>10 s	52.00	1.2	1.57	No
3	50.00 ± 0.05	≥1.5	>10 s	50.00	1.2	1.56	No
4	48.00 ± 0.05	≥1.5	>10 s	48.00	1.2	1.58	No
5	50.00 ± 0.05	≥1.5	>10 s	50.00	1.2	1.57	No

Rate of change of frequency (ROCOF) immunity

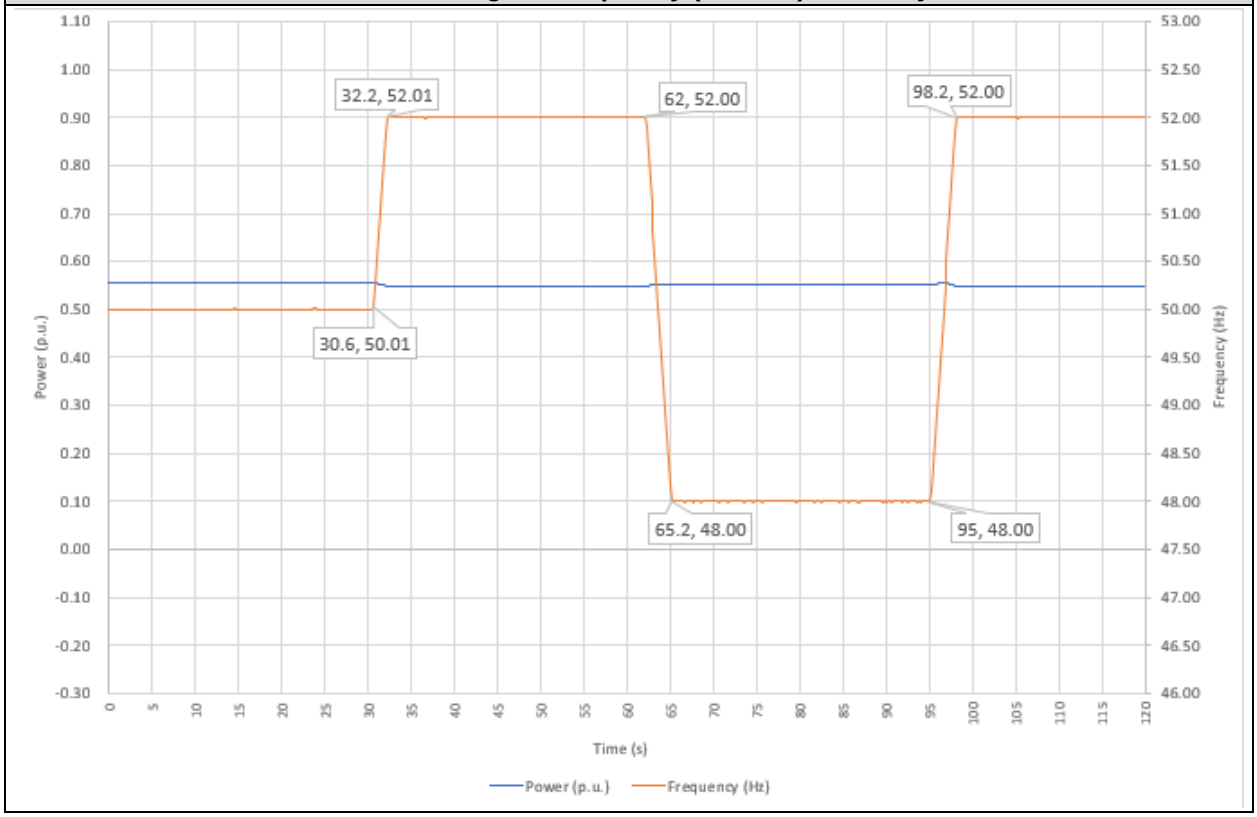


4.1.2.3 At least 1.25 Hz/s, for a period of 2000ms.

The ROCOF immunity is defined with a sliding measurement window of 200 ms as following:

Steps	f (Hz)	ROCOF requirement (Hz/s)	Step time	Measured Frequency (Hz)	Measured step change time (s)	ROCOF meas. (Hz/s)	Disconnection
1	50.00 ± 0.05	N/A	>10 s	50.00	--	--	No
2	52.00 ± 0.05	≥1.25	>10 s	52.00	1.6	1.25	No
3	48.00 ± 0.05	≥1.25	>10 s	48.00	3.2	1.25	No
4	52.00 ± 0.05	≥1.25	>10 s	52.00	3.2	1.25	No

Rate of change of frequency (ROCOF) immunity



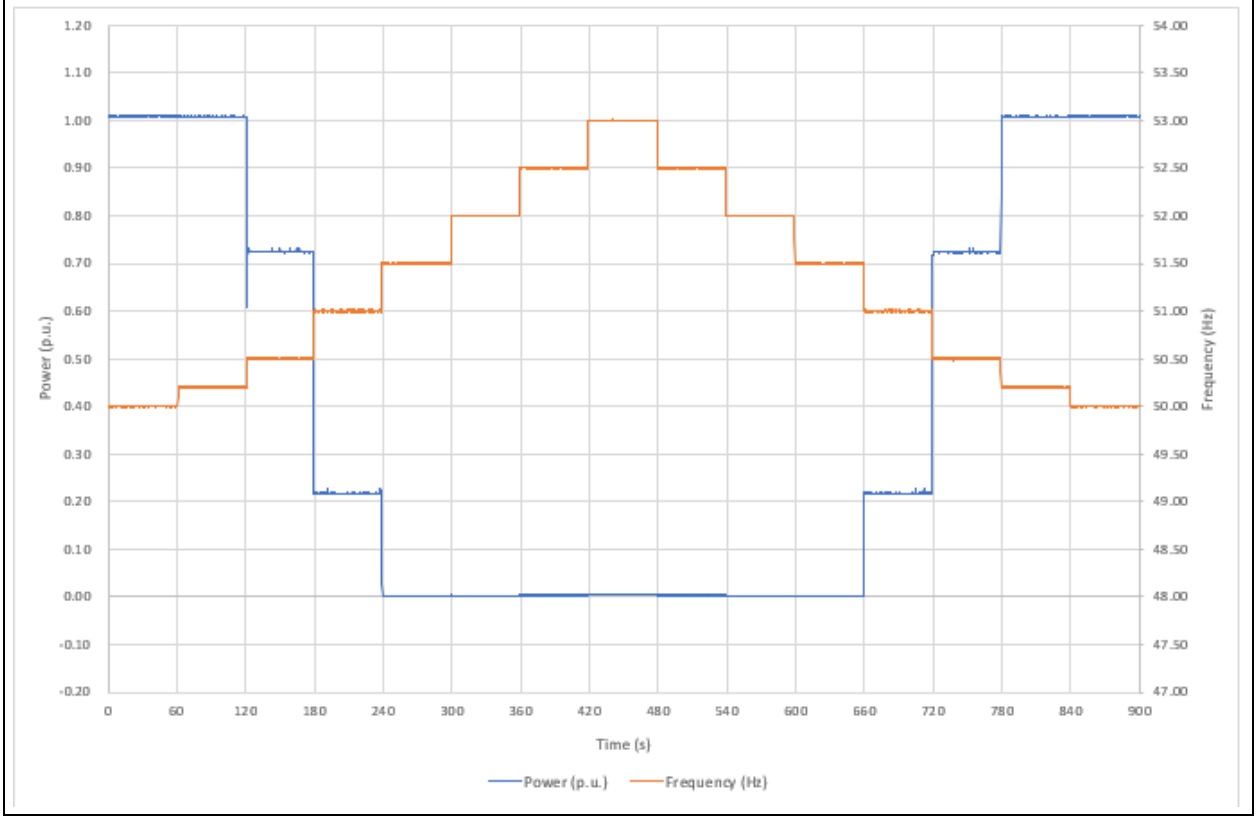
4.2 POWER RESPONSE TO OVERFREQUENCY

The test has been done according to the article 7 of the standard. The following definitions apply to the test to verify the clause:

- Test 1: P=100%Pn ; f1 =50.2Hz; droop=2%;
- Test 2: P=50%; f1=50.2Hz; droop=2%;
- Test 3: P=100%Pn ; f1 =50.2Hz; droop=12%;
- Test 4: P=50%; f1=50.2Hz; droop=12%;

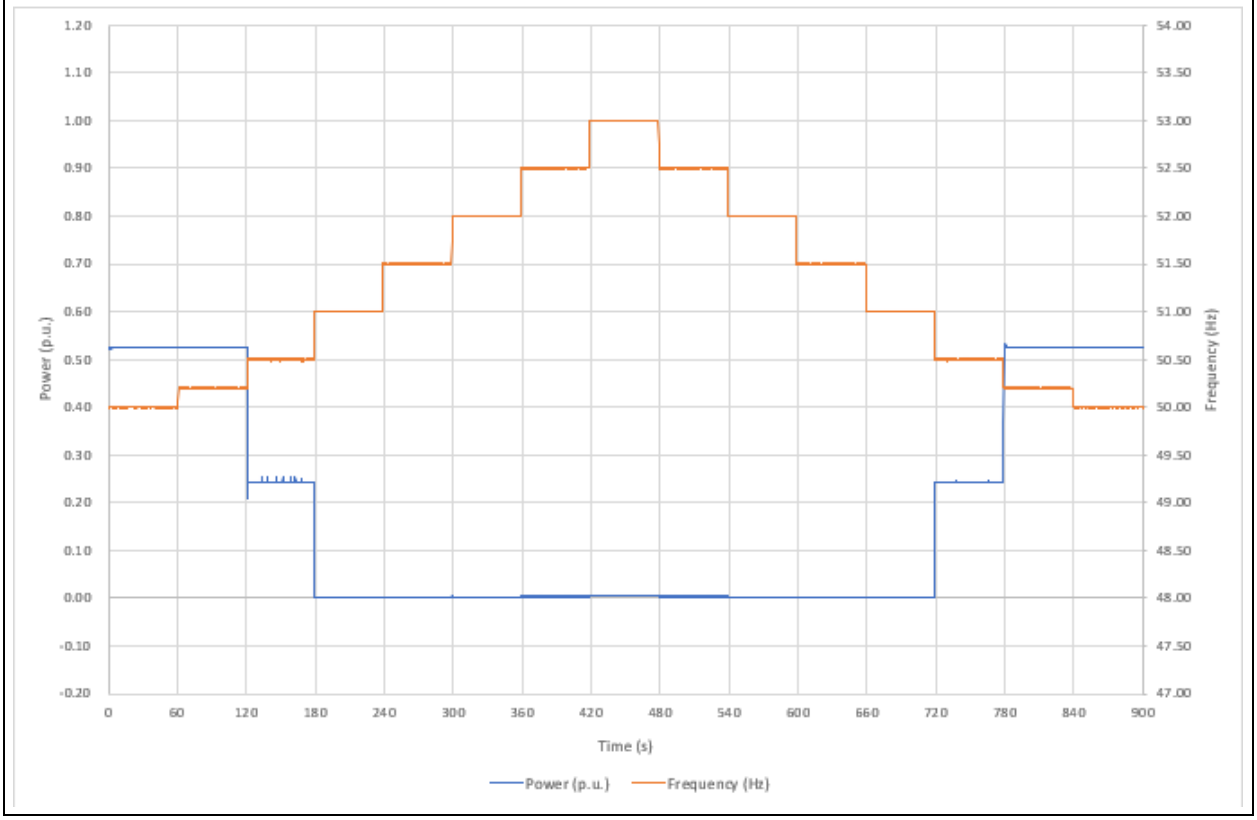
Test 1						
Step	f (Hz)	P desired (%Pn)	Frequency meas. (Hz)	t meas. (s)	P meas. (%Pn)	P deviation (%Pn) (Within ± 5 %Pmax)
1	50.00 ± 0.05 Hz	100.0	50.00	>30	100.9	0.9
2	50.20 ± 0.05 Hz	100.0	50.20	>30	100.9	0.9
3	50.50 ± 0.05 Hz	70.0	50.50	>30	72.4	2.4
4	51.00 ± 0.05 Hz	20.0	51.00	>30	21.8	1.8
5	51.50 ± 0.05 Hz	0.0	51.50	>30	0.3	0.3
6	52.00 ± 0.05 Hz	0.0	52.00	>30	0.3	0.3
7	52.50 ± 0.05 Hz	0.0	52.50	>30	0.4	0.4
8	53.00 ± 0.05 Hz	0.0	53.00	>30	0.5	0.5
9	52.50 ± 0.05 Hz	0.0	52.50	>30	0.4	0.4
10	52.00 ± 0.05 Hz	0.0	52.00	>30	0.3	0.3
11	51.50 ± 0.05 Hz	0.0	51.50	>30	0.3	0.3
12	51.00 ± 0.05 Hz	20.0	51.00	>30	21.8	1.8
13	50.50 ± 0.05 Hz	70.0	50.50	>30	72.3	2.3
14	50.20 ± 0.05 Hz	100.0	50.20	>30	100.9	0.9
15	50.00 ± 0.05 Hz	100.0	50.00	>30	100.9	0.9
Time delay setting from step 2 to step 3						
Frequency changed time	120.8 s					
Power start to change	121.0 s					
Response time	0.2 s					
Power end of change	121.4 s					
Setting time	0.6 s					

P vs F chart for Test 1



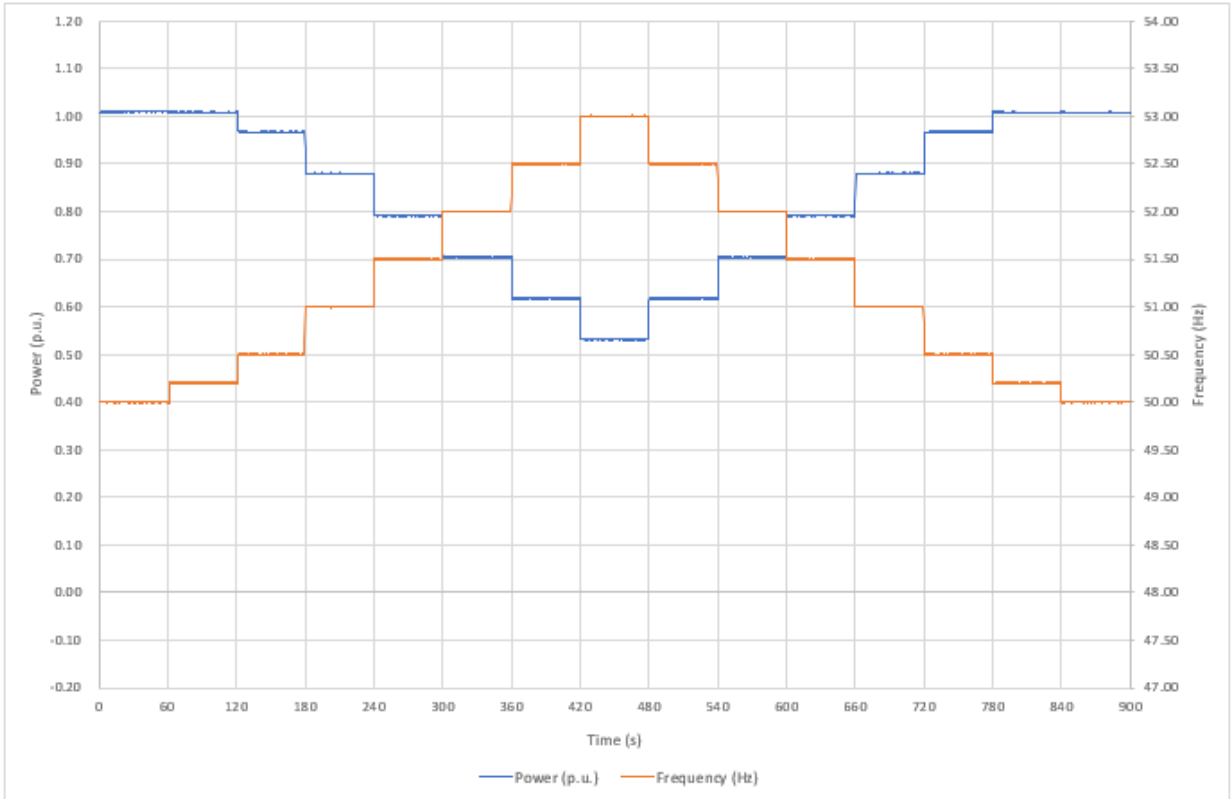
Test 2						
Step	f (Hz)	P desired (%Pn)	Frequency meas. (Hz)	t meas. (s)	P meas. (%Pn)	P deviation (%Pn) (Within ± 5 %Pmax)
1	50.00 ± 0.05 Hz	50.0	50.00	>30	52.4	2.4
2	50.20 ± 0.05 Hz	50.0	50.20	>30	52.4	2.4
3	50.50 ± 0.05 Hz	20.0	50.50	>30	24.3	4.3
4	51.00 ± 0.05 Hz	0.0	51.00	>30	0.2	0.2
5	51.50 ± 0.05 Hz	0.0	51.50	>30	0.3	0.3
6	52.00 ± 0.05 Hz	0.0	52.00	>30	0.3	0.3
7	52.50 ± 0.05 Hz	0.0	52.50	>30	0.4	0.4
8	53.00 ± 0.05 Hz	0.0	53.00	>30	0.5	0.5
9	52.50 ± 0.05 Hz	0.0	52.50	>30	0.4	0.4
10	52.00 ± 0.05 Hz	0.0	52.00	>30	0.3	0.3
11	51.50 ± 0.05 Hz	0.0	51.50	>30	0.3	0.3
12	51.00 ± 0.05 Hz	00.0	51.00	>30	0.2	0.2
13	50.50 ± 0.05 Hz	20.0	50.50	>30	24.3	4.3
14	50.20 ± 0.05 Hz	50.0	50.20	>30	52.4	2.4
15	50.00 ± 0.05 Hz	50.0	50.00	>30	52.4	2.4
Time delay setting from step 2 to step 3						
Frequency changed time	120.6 s					
Power start to change	120.8 s					
Response time	0.2 s					
Power end of change	121.0 s					
Setting time	0.4 s					

P vs F chart for Test 2



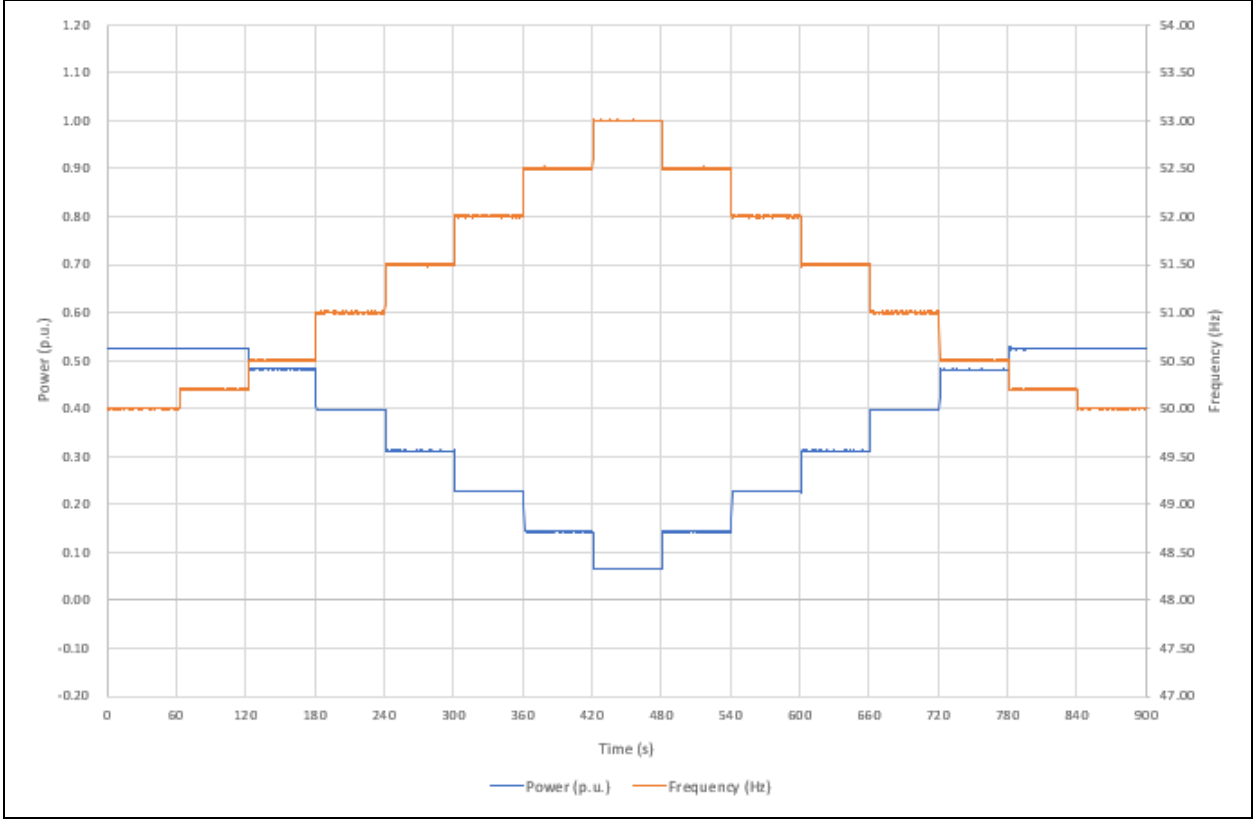
Test 3						
Step	f (Hz)	P desired (%Pn)	Frequency meas. (Hz)	t meas. (s)	P meas. (%Pn)	P deviation (%Pn) (Within ± 5 %Pmax)
1	50.00 ± 0.05 Hz	100.0	50.00	>30	100.9	0.9
2	50.20 ± 0.05 Hz	100.0	50.20	>30	100.9	0.9
3	50.50 ± 0.05 Hz	95.0	50.50	>30	96.7	1.7
4	51.00 ± 0.05 Hz	86.7	51.00	>30	88.0	1.3
5	51.50 ± 0.05 Hz	78.3	51.50	>30	79.1	0.8
6	52.00 ± 0.05 Hz	70.0	52.00	>30	70.4	0.4
7	52.50 ± 0.05 Hz	61.7	52.50	>30	61.7	0.0
8	53.00 ± 0.05 Hz	53.3	53.00	>30	53.1	-0.2
9	52.50 ± 0.05 Hz	61.7	52.50	>30	61.7	0.0
10	52.00 ± 0.05 Hz	70.0	52.00	>30	70.4	0.4
11	51.50 ± 0.05 Hz	78.3	51.50	>30	79.1	0.8
12	51.00 ± 0.05 Hz	86.7	51.00	>30	88.0	1.3
13	50.50 ± 0.05 Hz	95.0	50.50	>30	96.8	1.8
14	50.20 ± 0.05 Hz	100.0	50.20	>30	100.9	0.9
15	50.00 ± 0.05 Hz	100.0	50.00	>30	100.8	0.8
Time delay setting from step 3 to step 4						
Frequency changed time	179.6 s					
Power start to change	180.0 s					
Response time	0.4 s					
Power end of change	180.2 s					
Setting time	0.6 s					

P vs F chart for Test 3



Test 4						
Step	f (Hz)	P desired (%Pn)	Frequency meas. (Hz)	t meas. (s)	P meas. (%Pn)	P deviation (%Pn) (Within ± 5 %Pmax)
1	50.00 ± 0.05 Hz	50.0	50.00	>30	52.4	2.4
2	50.20 ± 0.05 Hz	50.0	50.20	>30	52.4	2.4
3	50.50 ± 0.05 Hz	45.0	50.50	>30	48.2	3.2
4	51.00 ± 0.05 Hz	36.7	51.00	>30	39.7	3.0
5	51.50 ± 0.05 Hz	28.3	51.50	>30	31.1	2.8
6	52.00 ± 0.05 Hz	20.0	52.00	>30	22.7	2.7
7	52.50 ± 0.05 Hz	11.7	52.50	>30	14.4	2.7
8	53.00 ± 0.05 Hz	3.3	53.00	>30	6.6	3.3
9	52.50 ± 0.05 Hz	11.7	52.50	>30	14.3	2.6
10	52.00 ± 0.05 Hz	20.0	52.00	>30	22.7	2.7
11	51.50 ± 0.05 Hz	28.3	51.50	>30	31.1	2.8
12	51.00 ± 0.05 Hz	36.7	51.00	>30	39.6	2.9
13	50.50 ± 0.05 Hz	45.0	50.50	>30	48.1	3.1
14	50.20 ± 0.05 Hz	50.0	50.20	>30	52.4	2.4
15	50.00 ± 0.05 Hz	50.0	50.00	>30	52.4	2.4
Time delay setting from step 3 to step 4						
Frequency changed time	180.8 s					
Power start to change	181.2 s					
Response time	0.4 s					
Power end of change	181.4 s					
Setting time	0.6 s					

P vs F chart for Test 4



4.3 MAINTAINING CONSTANT OUTPUT

According to the article 8,9 and 10 of the standard, the type A power-generating module shall be capable of maintaining constant output at its target active power value regardless of changes in frequency, within the limits of the power offered by the primary source.

As defined by manufacturer, the power will not reduce when the frequency is below 49.5Hz

The compliances with these requirements are stated on page 37 in the following test report:

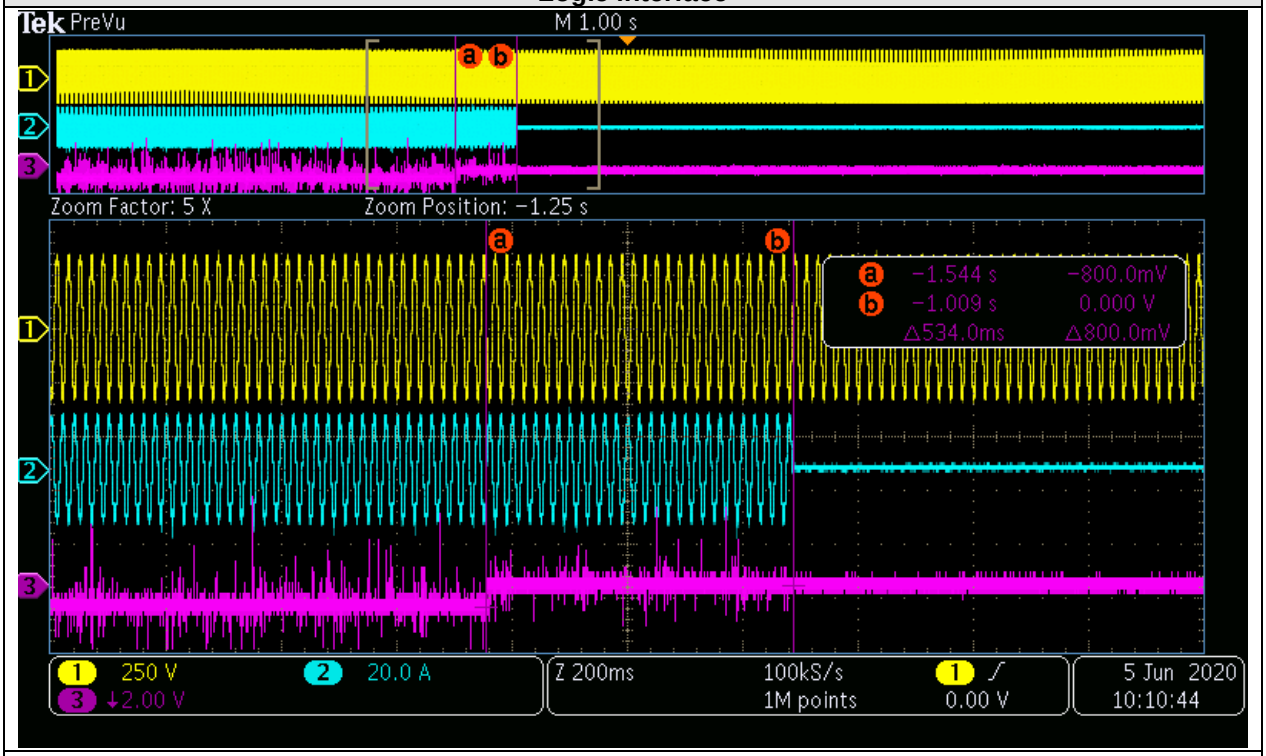
EN 50549-1:2019: Test Report nº 190411082GZU-001 which was issued by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch on November 5th, 2019.

4.4 LOGIC INTERFACE. RAPID SHUTDOWN.

According to the article 11 of the standard,

(1). The power-generating module shall be equipped with a logic interface in order to reduce the active power to the point of shut-down in a time period of no more than five seconds following a disconnection instruction being received at the input port. The RSO shall have the right to specify requirements for equipment to make this reduction controllable remotely.
(2). The technical requirements for the logic interface described in paragraph (1) are mandatory for type A power-generating modules connected in MV.
(3). For type A power-generating modules connected in LV, the RSO shall specify, in agreement with the power-generating module owner, the technical requirements and the mode of utilization of the logic interface.

The following table shows the test results:

Logic interface

Tested ceasing active power time: 534ms
Ch1: Grid voltage, Ch2 Output current, Ch3 Ceasing active power signal

4.5 CONNECTION

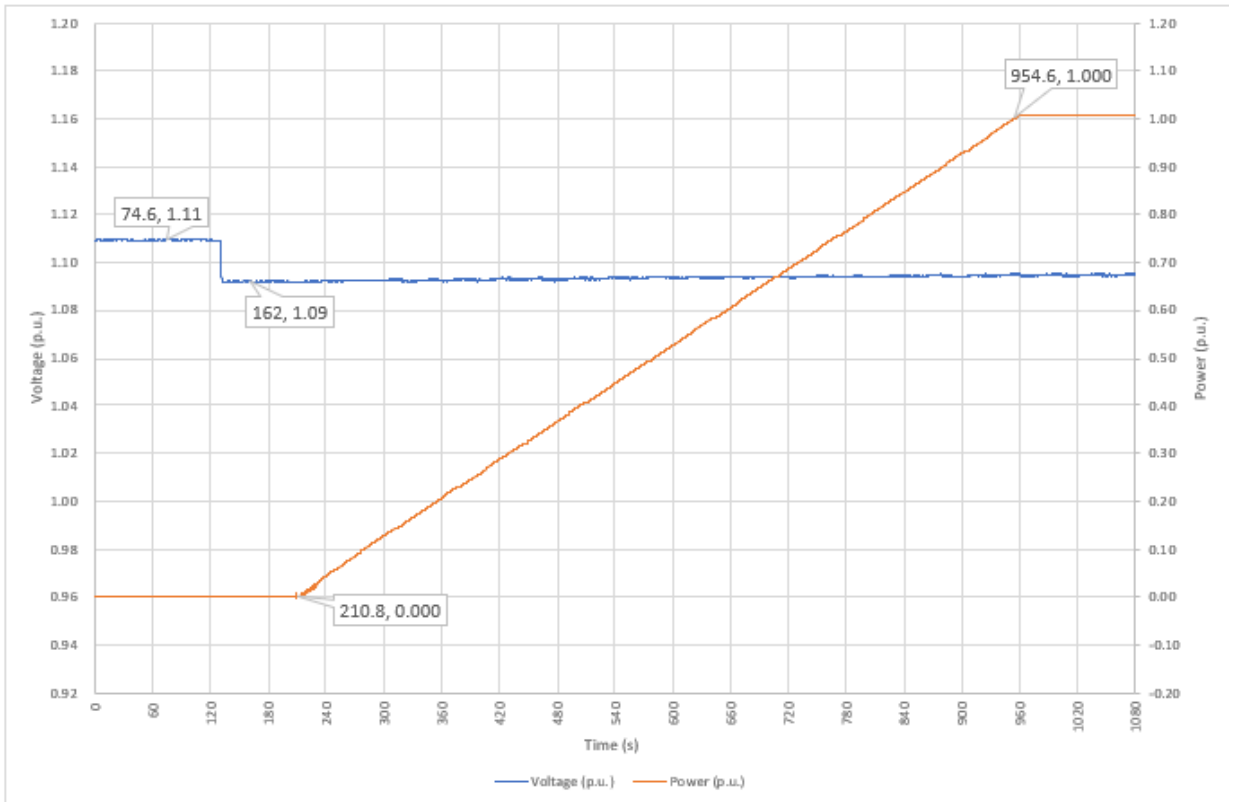
According to the article 12 of the standard,

(1). The RSO sets forth the requirements for the automatic connection of a power-generating module to the network, after these requirements have been agreed upon with the TSO.
(2). The requirements provided in paragraph (1) include:
(a) the frequency range in which the automatic connection is accepted, namely 47.5-51 Hz, the voltage range (0.9-1.1 Un), the observation/validation period (including the synchronization time) and the period for maintaining the metered parameters within the determined range, of maximum 300 seconds;
(b) the slope admitted for the active power increase after connection (≤ 20 % Pmax/min), usually 10% of the Pmax/min (the setpoint is chosen within the range indicated by the power-generating module manufacturer)

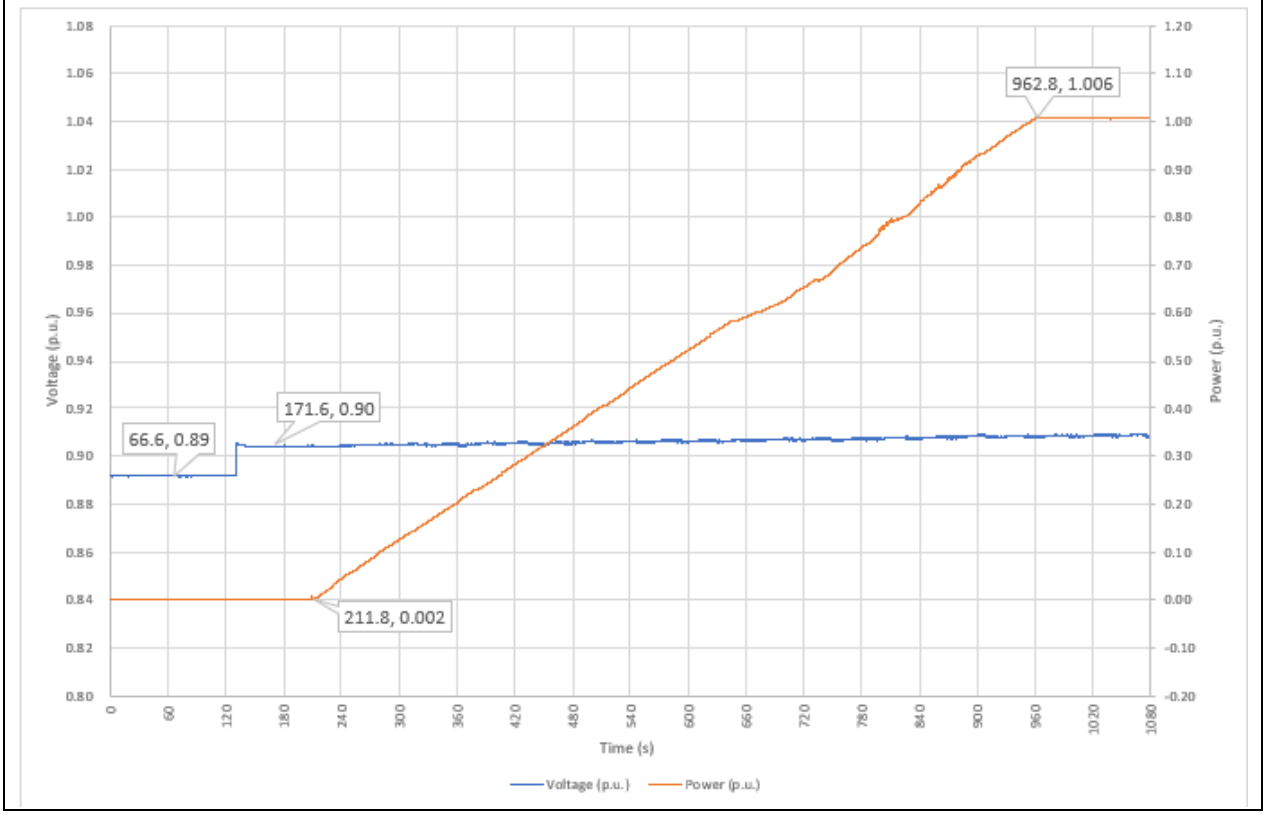
The following definitions apply to the test to verify the clause:

Disconnection		Connection		Meas. Connection time (s)	Setting gradient (%Pn/min)	Meas. gradient (%Pn/min)
U = 111% Un	Yes	U = 109% Un	Yes	80.2	8.0	8.1
U = 89% Un	Yes	U = 90% Un	Yes	81.2	8.0	8.0
F = 51.10 Hz	Yes	F = 50.90 Hz	Yes	79.0	8.0	8.0
F = 47.40 Hz	Yes	F = 47.60 Hz	Yes	83.2	8.0	8.0

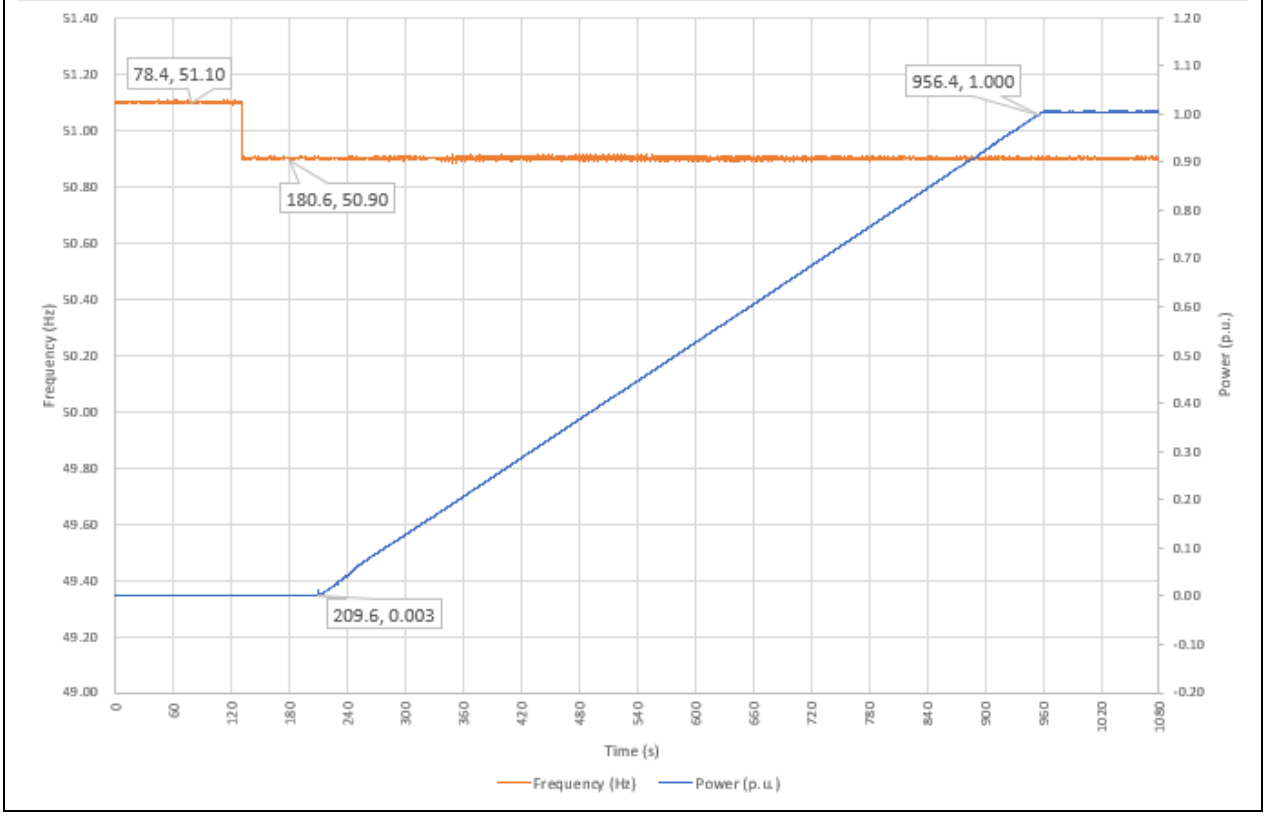
Over voltage Connection



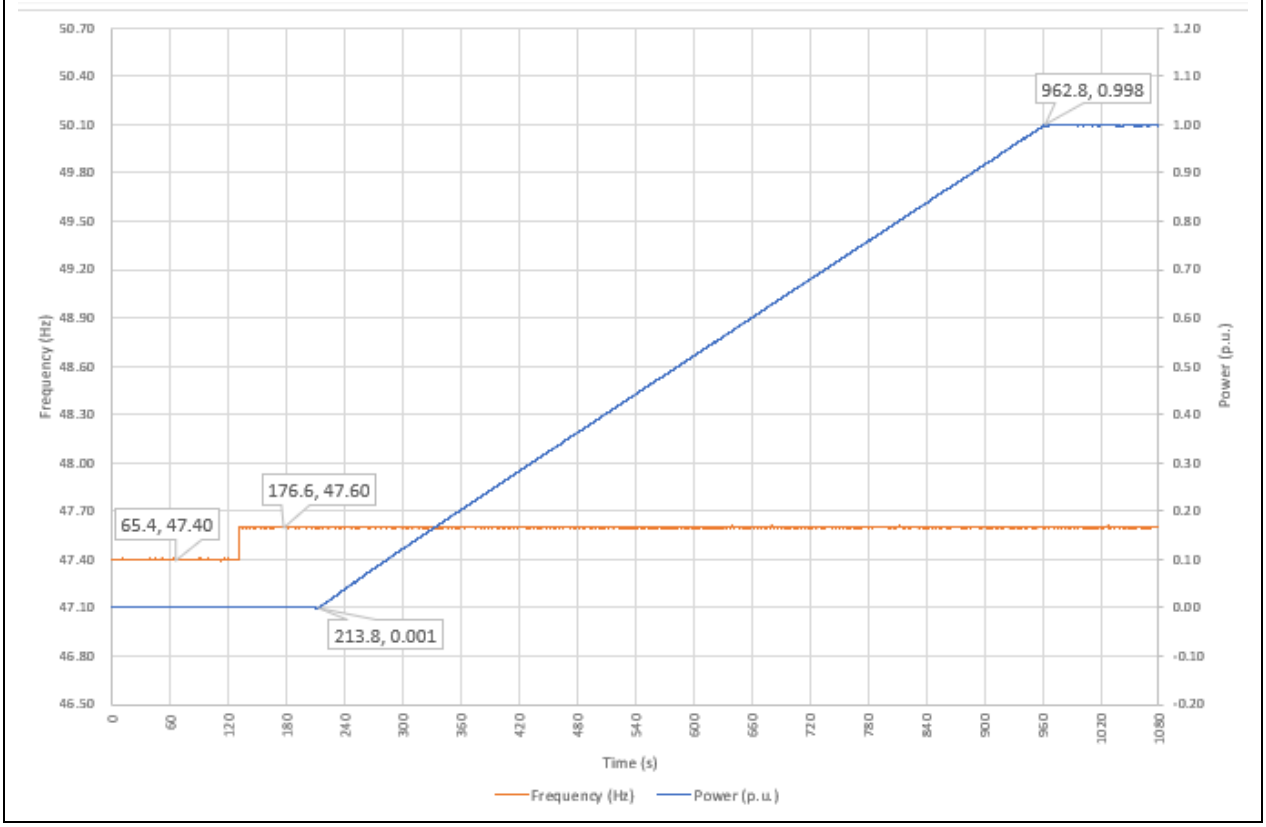
Under voltage Connection



Over frequency Connection



Under frequency Connection

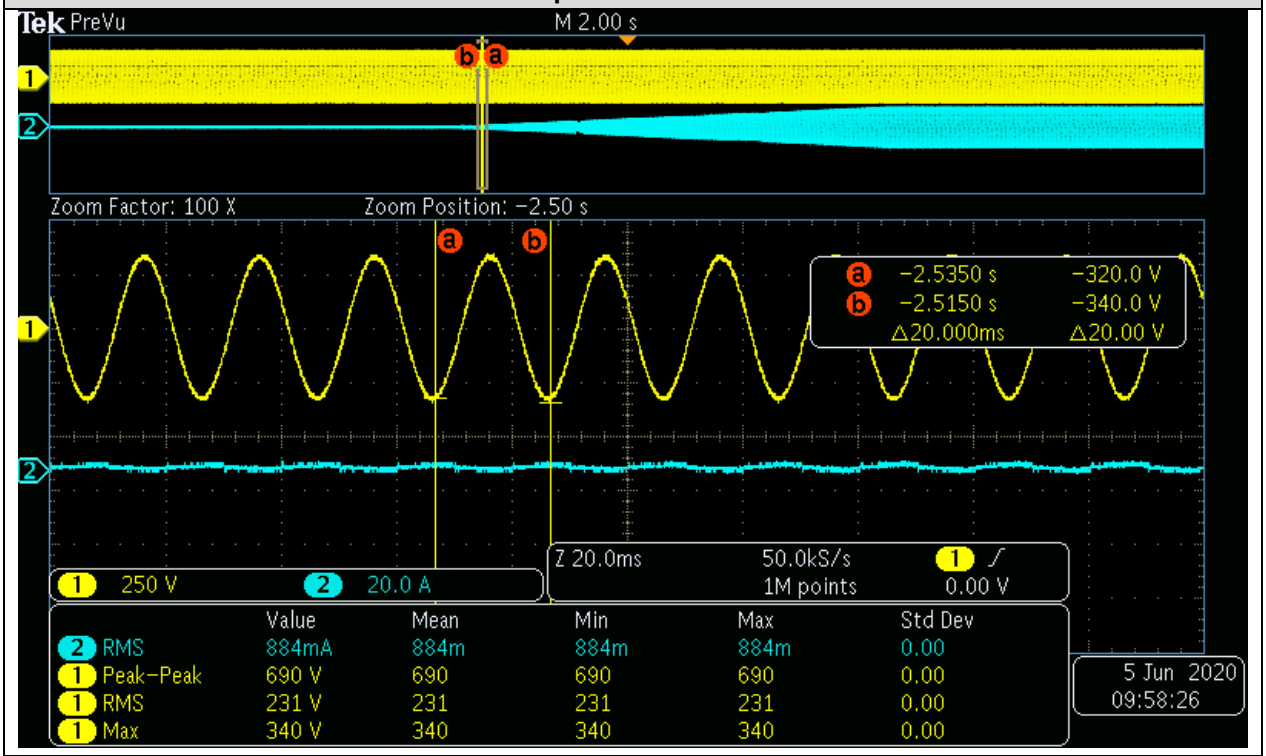


~~4.6~~ RAPID VOLTAGE CHANGES

According to the article 13 of the standard, under normal network operation, the power-generating module shall not produce fast voltage fluctuations at the connection/interface point, as the case may be, greater than ±5% of the nominal voltage of the network to which it is connected.

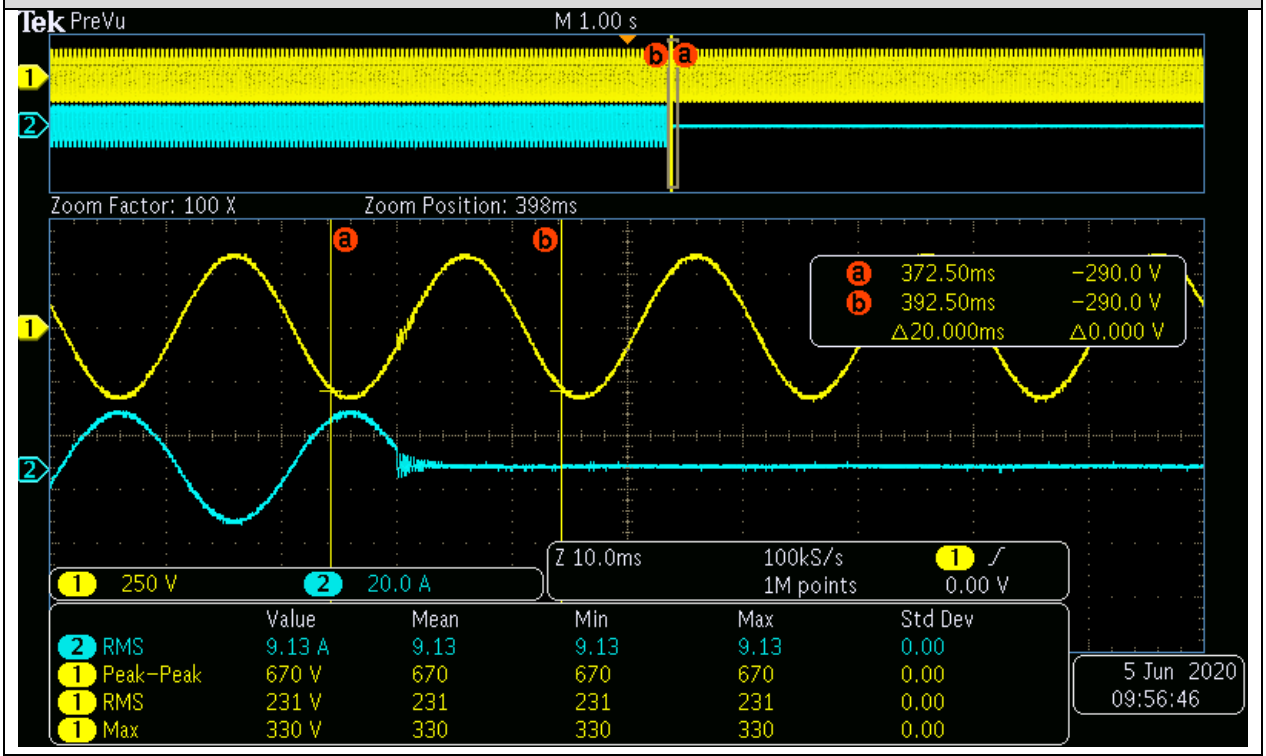
By the next pictures it is obtained that the process of voltage changes for this inverter start up from 0%Pn to 100%Pn or shut down form 100%Pn. The raid voltage changes are calculated base on the RMS voltage value over one cycle.

EUT Start up from 0%Pn to 100%Pn



Rapid Voltage Changes: 0.4%

EUT Shut down from 100%Pn



Rapid Voltage Changes: 0.4%

4.7 POWER QUALITY AND COMPLIANCE WITH EUROPEAN STANDARDS

Requirements are stated in article 14 of the standard.

The compliances with these requirements and EMC are stated in page 26 to page 32 of following test report:

EN 61000-6-1:2019, EN 61000-6-3:2007/A1:2011/AC:2012, EN 61000-3-2:2014, EN 61000-3-3:2013, IEC 61000-6-1:2016, IEC 61000-6-3:2006+AMD1:2010, IEC 61000-3-2:2018, IEC 61000-3-3:2013+AMD1:2017: Test Report nº BL-DG2030080-402 on 07/04/2020 which was issued by Shenzhen BALUN Technology Co., Ltd.

The inverter also compliances with LVD European directives. Refer the reports below for details:

IEC 62109-1:2010, IEC/EN 62109-2:2011: Test Report nº **BL-SZ1930601-B01 and BL-SZ1930601-B01 attachment 1** on 10/04/2019 which was issued by Shenzhen BALUN Technology Co., Ltd

4.8 MONITOR OF POWER QUALITY

Requirements are stated in article 15 of the standard.

The requirements need to be evaluated after installation.

4.9 MEANS TO DETECT ISLAND SITUATION

According to the article 16 of the standard, the connection solution of type A power-generating modules with installed capacities lower than 1 MW shall not allow their island operation, including via endowment with protections which trip the power-generating modules at the occurrence of such an operation state.

The test has been done according to IEC 62116.

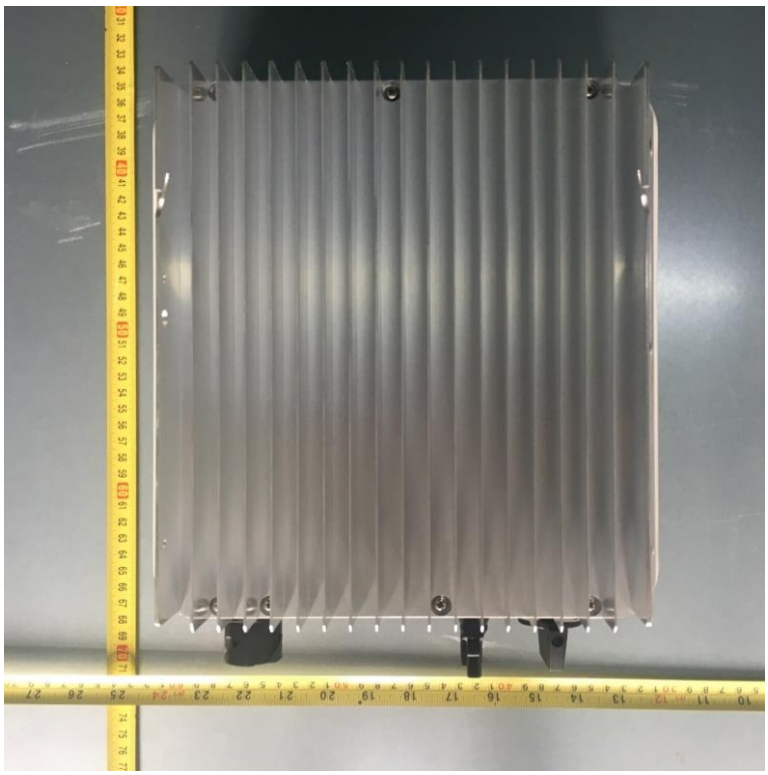
This protection device is also able to detect islanded situations and disconnect the equipment from the grid. Active methods tested with a resonant circuit used for detecting islanding situations.

The compliances with these requirements are stated on page 83 to 84 in the following test report:

EN 50549-1:2019: Test Report nº 190411082GZU-001 which was issued by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch on November 5th, 2019.

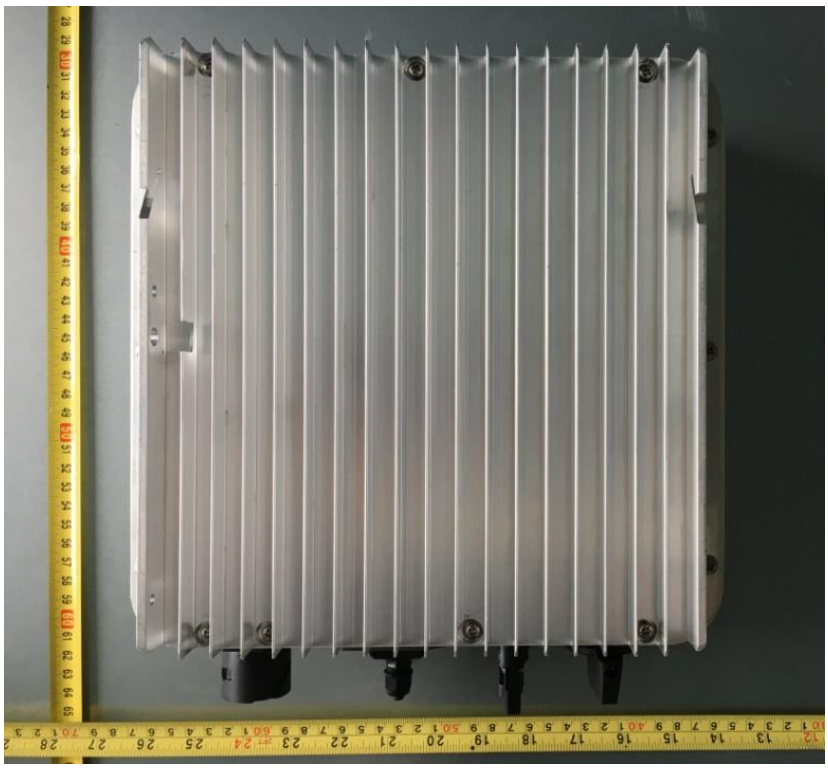
5 PICTURES

Front view 1 (SOFAR 2700TL-G3, SOFAR 3000TL-G3, SOFAR 3300TL-G3)

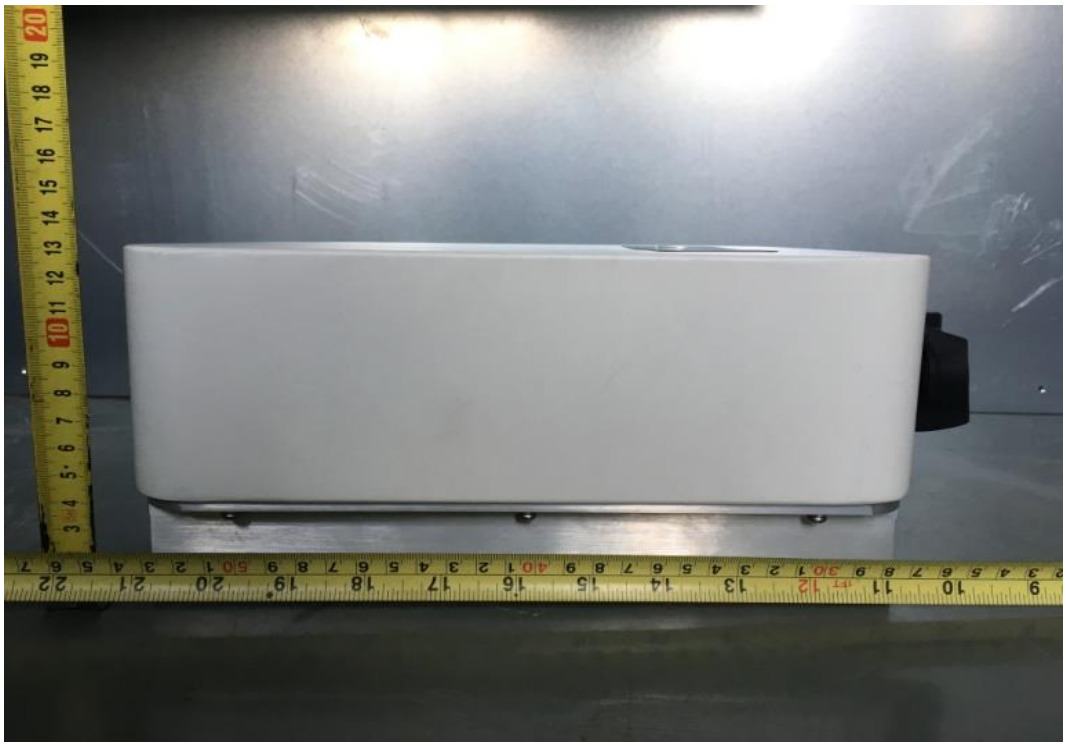
Back view 1 (SOFAR 2700TL-G3, SOFAR 3000TL-G3, SOFAR 3300TL-G3)


Front view 2 (SOFAR 1100TL-G3, SOFAR 1600TL-G3, SOFAR 2200TL-G3)

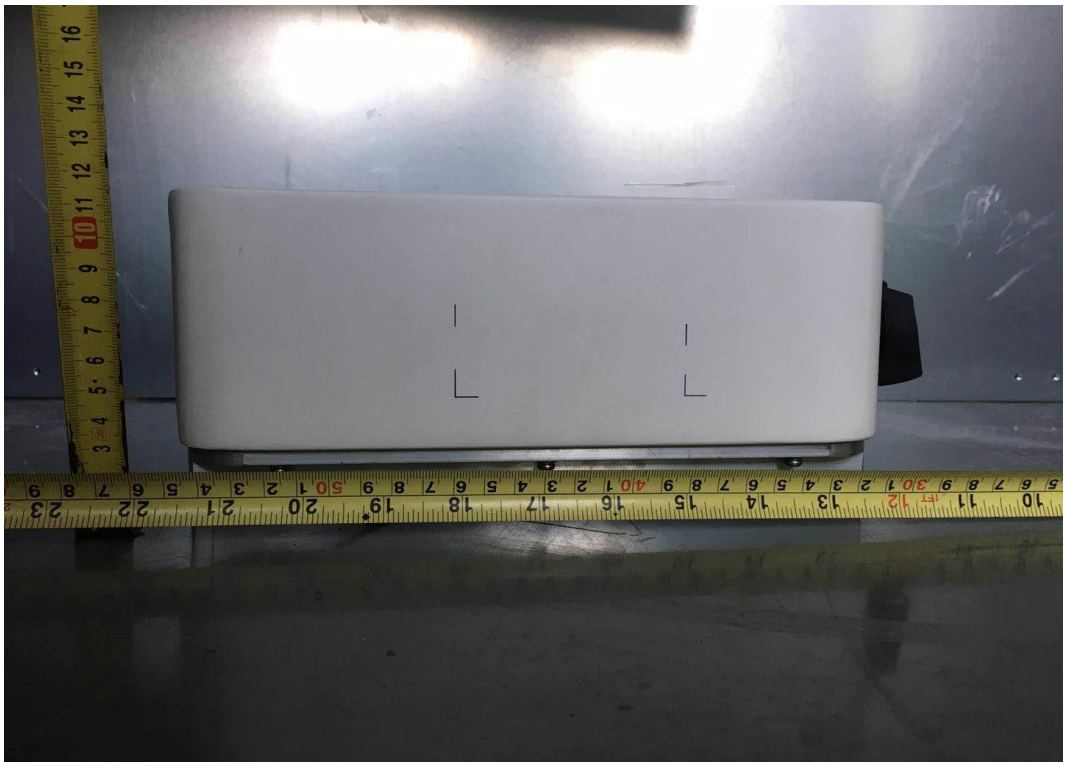
Back view 2 (SOFAR 1100TL-G3, SOFAR 1600TL-G3, SOFAR 2200TL-G3)



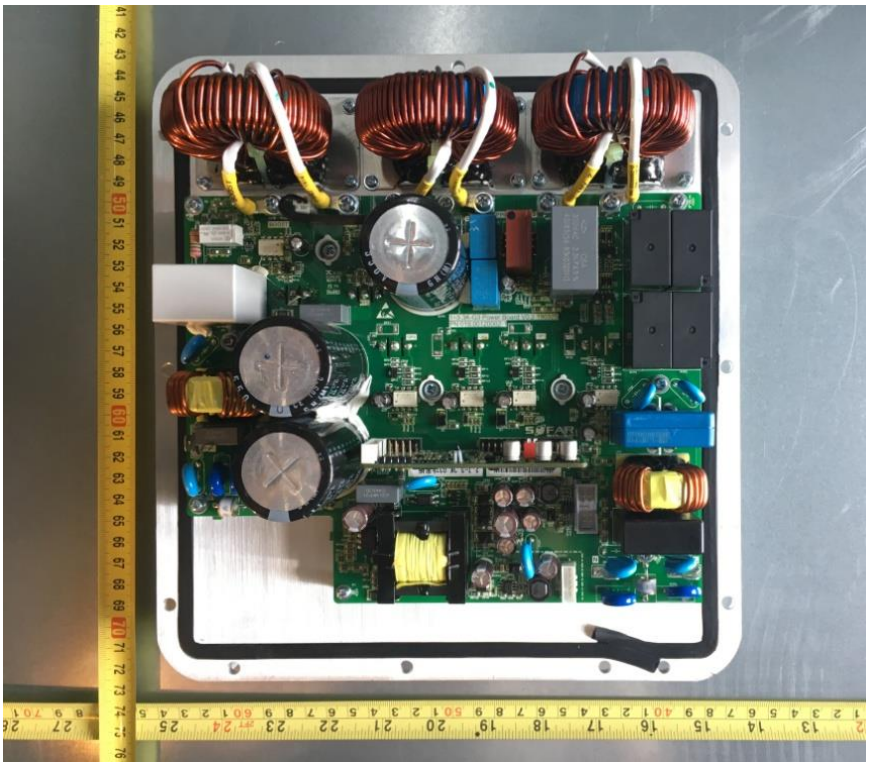
Side View (SOFAR 2700TL-G3, SOFAR 3000TL-G3, SOFAR 3300TL-G3)



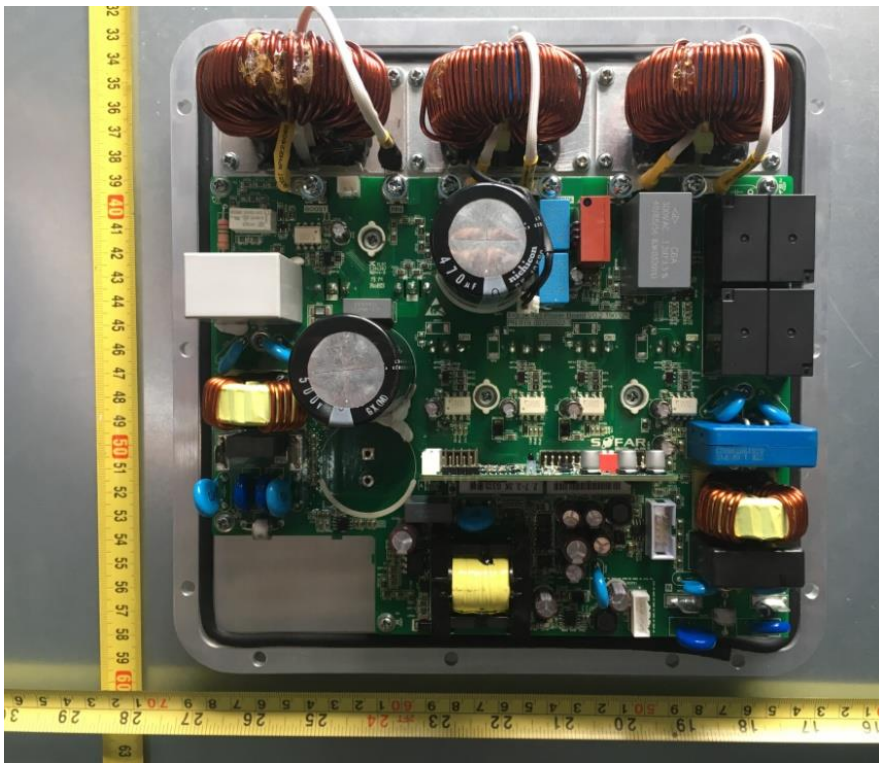
Side View (SOFAR 1100TL-G3, SOFAR 1600TL-G3, SOFAR 2200TL-G3)

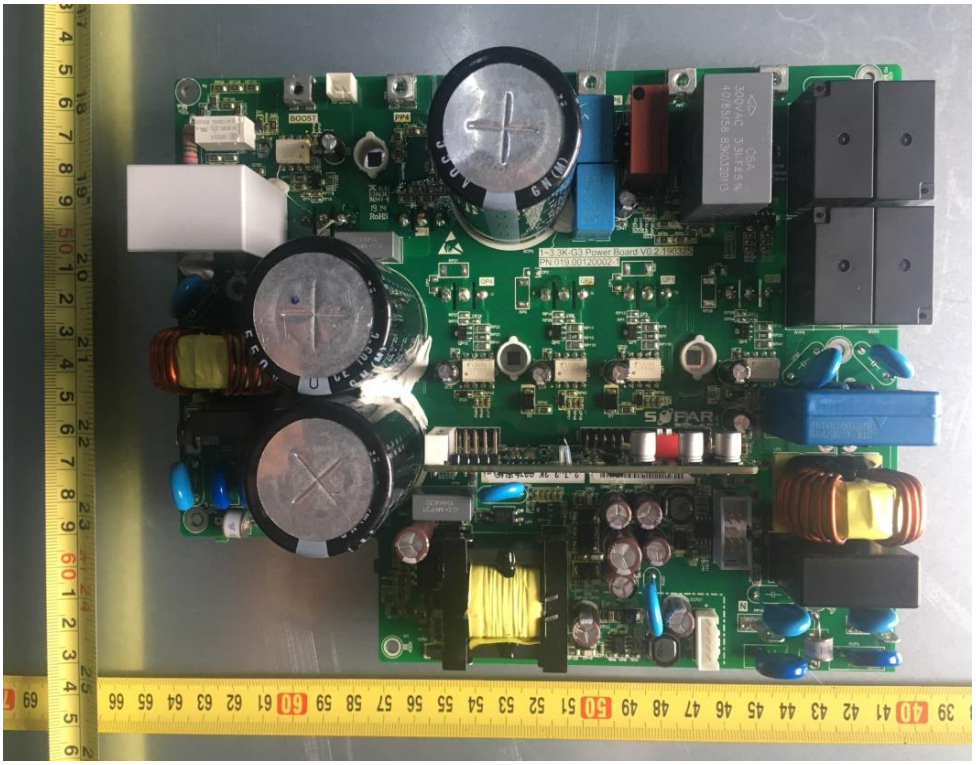
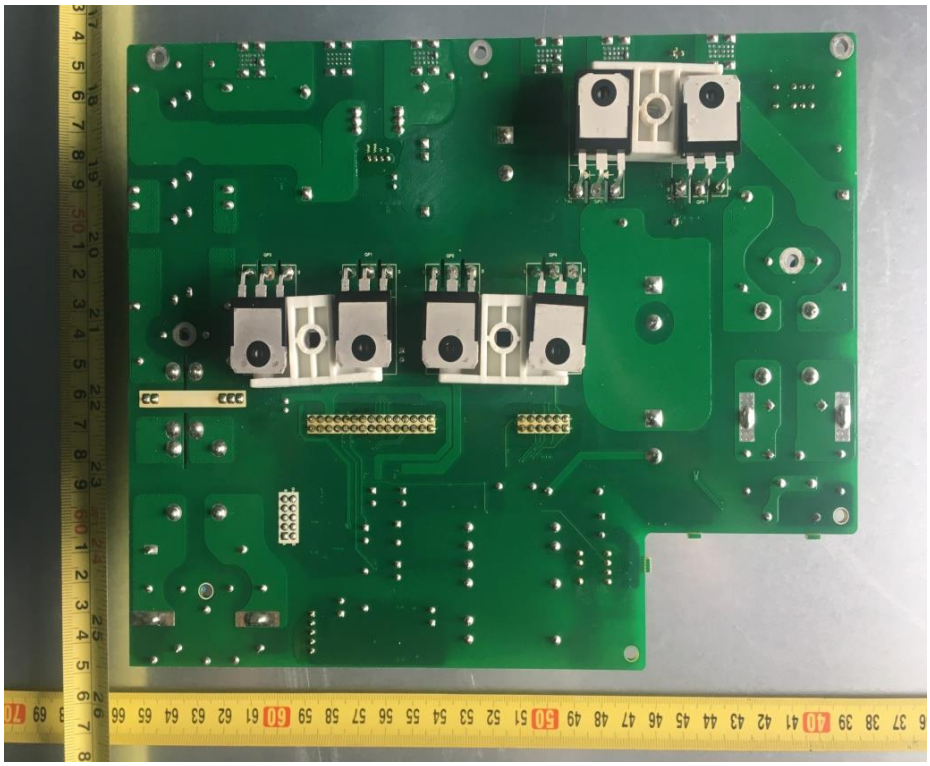


Internal view of enclosure (SOFAR 2700TL-G3, SOFAR 3000TL-G3, SOFAR 3300TL-G3)

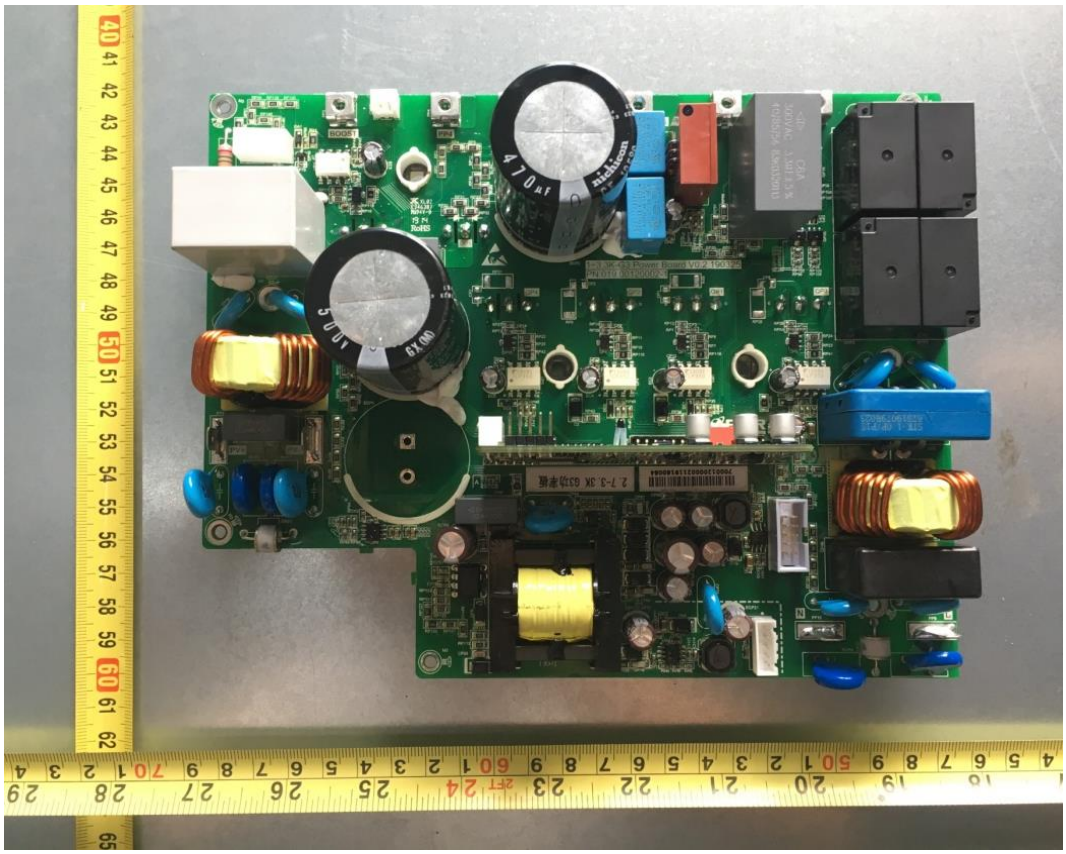


Internal view of enclosure (SOFAR 1100TL-G3, SOFAR 1600TL-G3, SOFAR 2200TL-G3)

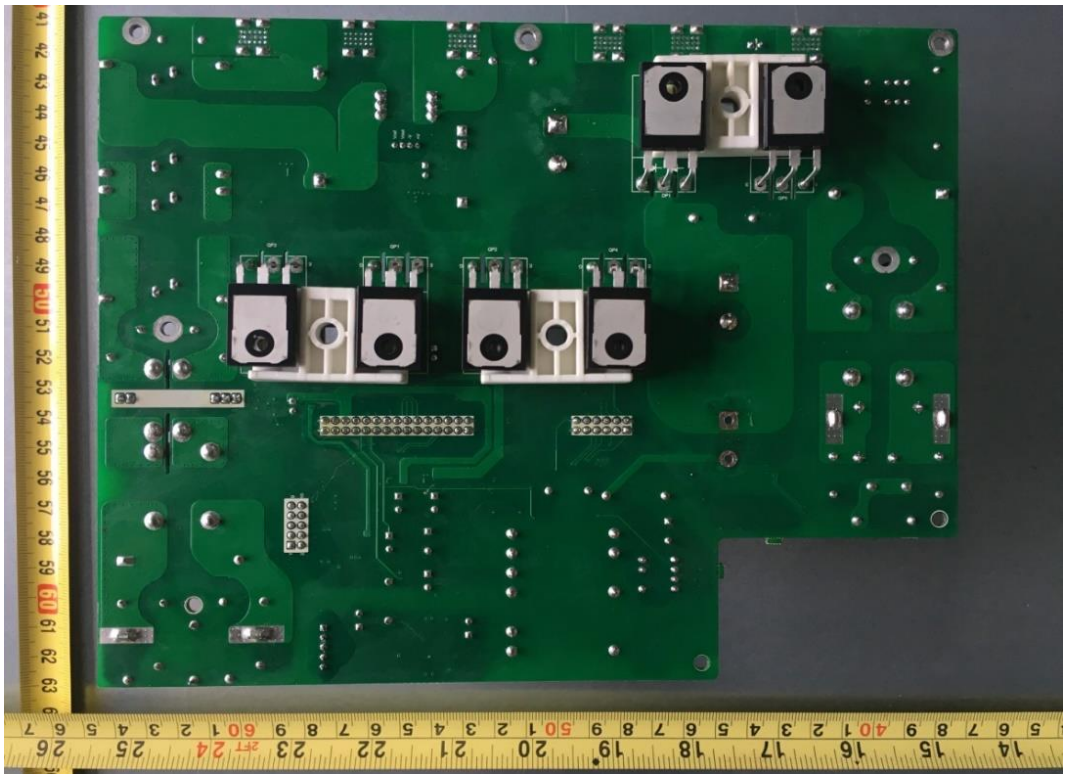


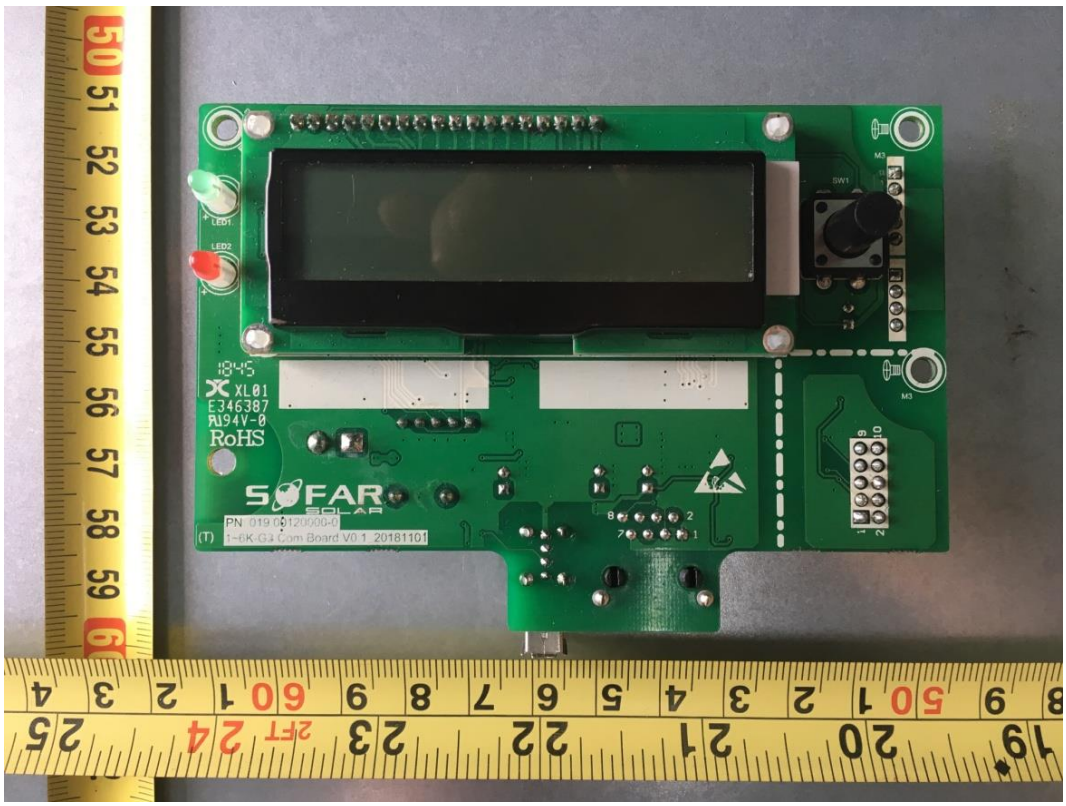
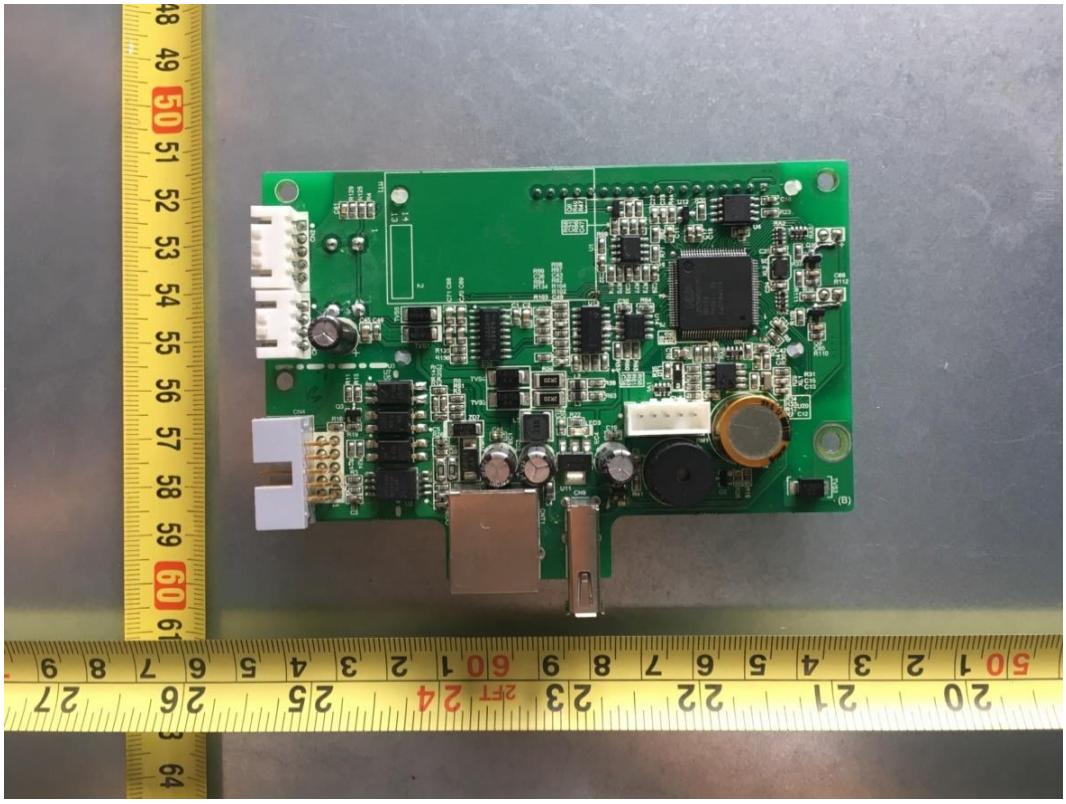
Front side of main board 1 (SOFAR 2700TL-G3, SOFAR 3000TL-G3, SOFAR 3300TL-G3)

Back side of main board 1 (SOFAR 2700TL-G3, SOFAR 3000TL-G3, SOFAR 3300TL-G3)


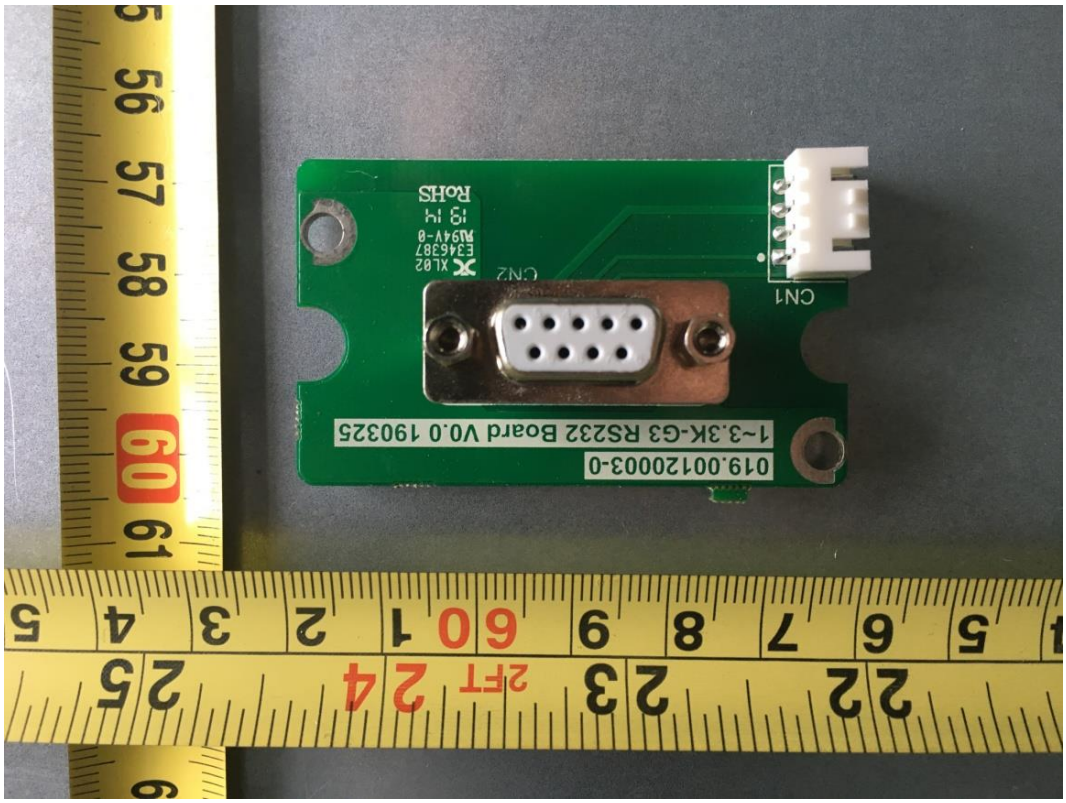
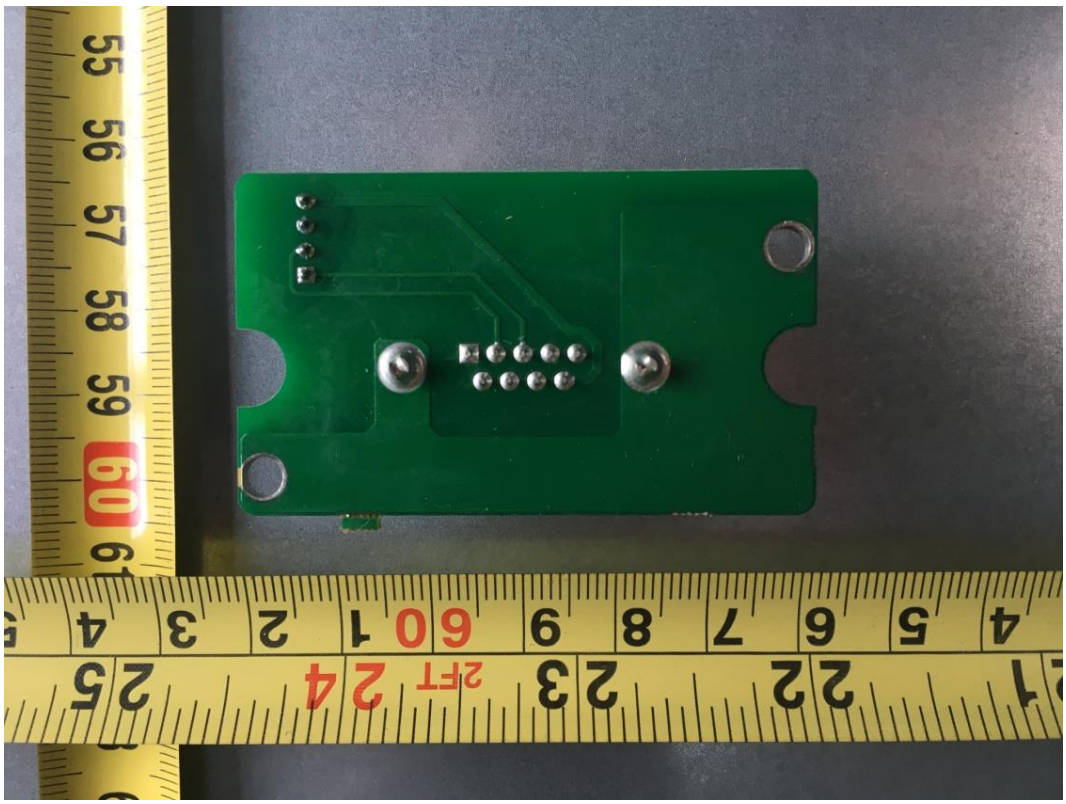
Front side of main board 2 (SOFAR 1100TL-G3, SOFAR 1600TL-G3, SOFAR 2200TL-G3)



Back side of main board 2 (SOFAR 1100TL-G3, SOFAR 1600TL-G3, SOFAR 2200TL-G3)



Front side of Control board

Front side of Control board


Front view of RS 232 board

Back view of RS 232 board


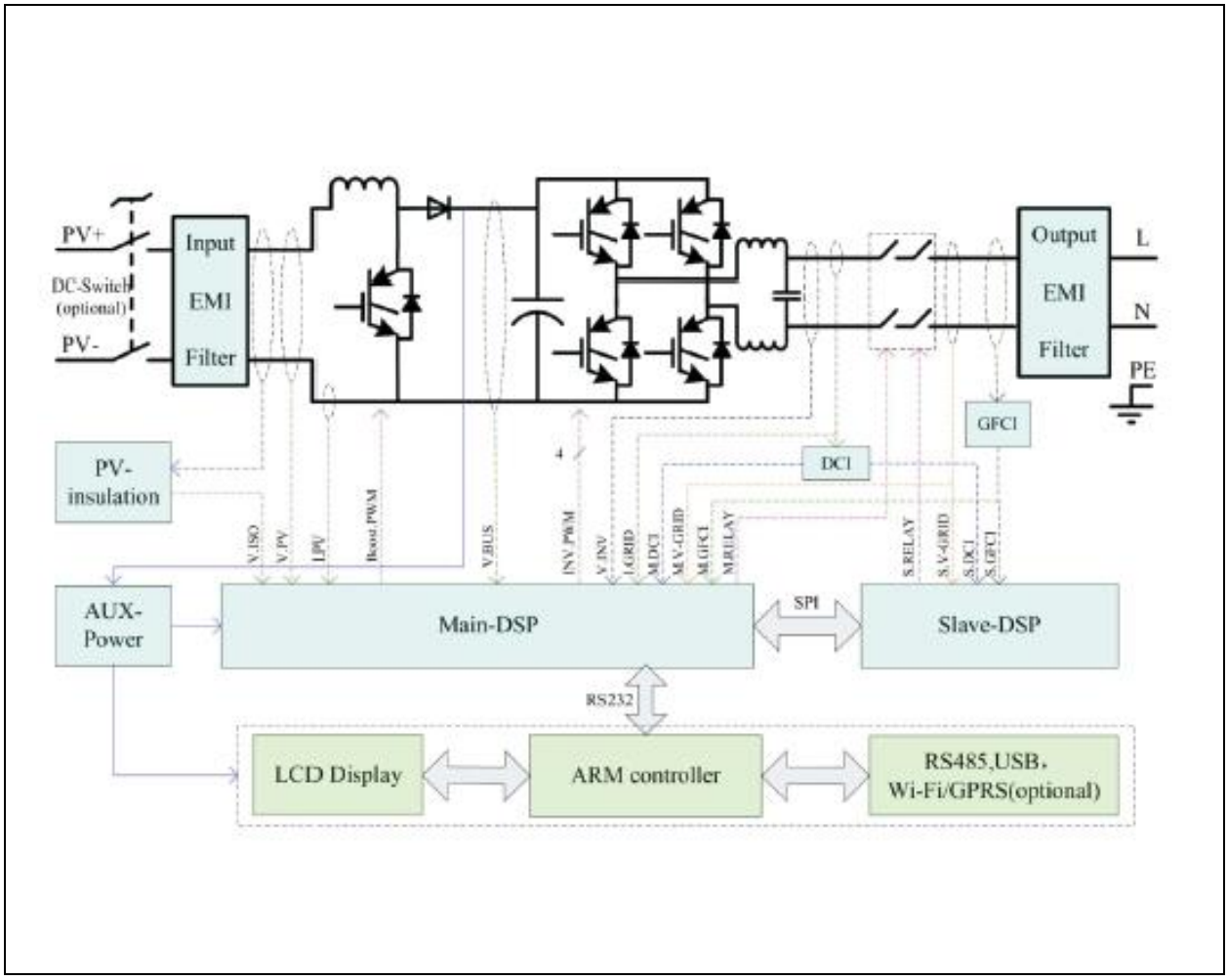
Connection interface

Grounding

ETU Serial Number

Software version

6 ELECTRICAL SCHEMES



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