

**TESTING FOR THE VERIFICATION OF COMPLIANCE OF PV
INVERTER WITH:**

**IEC 60068-2-1, Environmental Testing. Part 2-1:
Tests. Test Ae: Cold.**

**IEC 60068-2-2, Environmental Testing. Part 2-2:
Tests. Test Be: Dry heat.**

**IEC 60068-2-14, Environmental Testing. Part 2-14:
Tests. Test Nb: Change of temperature.**

**IEC 60068-2-30, Environmental Testing. Part 2-30:
Tests. Test Db-Variant 1: Damp heat, cyclic (12 h + 12 h cycle).**

Procedure: PE.T-LE-62

Test Report Number: **2217 / 1094 – 2 – M2(*)**

()This is a co-report of the report 2217 / 1094 –2 – M1, for detailed information refer to Test Report Historical Revision in page 2.*

Trademark

Tested Model.....: **EVVO 6000TLG2**

Variant Models: **EVVO 5000TLG2, EVVO 4600TLG2, EVVO 4000TLG2,
EVVO 3600TLG2, EVVO 3000TLG2**

APPLICANT

Name: **EVOLVE ENERGY GROUP CO., LIMITED**

Address: **RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG
WAN, HK**

TESTING LABORATORY

Name: **SGS Tecnos, S.A. (Electrical Testing Laboratory)**

Address: **C/ Trespaderne, 29 - Edificio Barajas 1
28042 MADRID (Spain)**

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(Project Engineer)

Reviewed and Approved by: **Jacobo Tévar**
(Technical Reviewer)

Date of issue.....: **18 / 06 / 2019**

Number of pages: **26**

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Test Report Historical Revision:

Test Report Version	Date	Resume
2217 / 1094 – 2	24 / 11 / 2017	First issuance
2217 / 1094 – 2 – M1	06/ 05 / 2019	<p>1. Modified the Applicant address from: 5/F, Building 4, Antongda Industrial Park, No. 1 Liuxian Avenue, Xin'an Street, Bao'an District, Shenzhen City, Guangdong Province, P.R. China</p> <p>to 401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China</p> <p>2. Modified the Factory name and address from: Shenzhen SOFARSOLAR Co., Ltd. 5/F, Building 4, Antongda Industrial Park, No. 1 Liuxian Avenue, Xin'an Street, Bao'an District, Shenzhen City, Guangdong Province, P.R. China</p> <p>to Dongguan SOFAR SOLAR Co., Ltd. 1F - 6F, Building E, No. 1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City, Guangdong Province, P.R. China.</p>
2217 / 1094 – 2 – M1	18/06/2019	This report is a first issuance for a co-license based on report number 2217 / 1094 – 2– M1. Editorial changes have been included to change the applicant and trademark references.

INDEX

1	SCOPE	4
2	GENERAL INFORMATION.....	5
2.1	Testing Period and Climatic conditions	5
2.2	Equipment under Testing	5
2.3	Manufacturer and Factory information	7
2.4	Test equipment list	8
2.5	Measurement uncertainty.....	8
2.6	Test set up of the different standard	8
2.7	Definitions.....	9
3	RESUME OF TEST RESULTS.....	10
4	TEST RESULTS	11
4.1	Test Ae: Cold.....	11
4.2	Test Be: Dry heat	12
4.3	Test Nb: Change of temperature.....	13
4.4	Test Db: Damp heat, Cyclic (12 h + 12 h).....	15
5	PICTURES.....	17
6	ELECTRICAL SCHEME	26

1 SCOPE

SGS Tecnos, S.A.U. (Electrical Testing Laboratory) has been contract by **Shenzhen SOFARSOLAR Co., Ltd.** in order to perform the testing according to the following Standards:

- IEC 60068-2-1:2007, Environmental Testing. Part 2-1: Tests. Test Ae: Cold.
- IEC 60068-2-2:2007, Environmental Testing. Part 2-2: Tests. Test Be: Dry heat.
- IEC 60068-2-14:2009, Environmental Testing. Part 2-14: Tests. Test Nb: Changes of temperature.
- IEC 60068-2-30:2005, Environmental Testing. Part 2-30: Tests. Test Db – Variant 1: Damp heat, cyclic (12 h + 12 h).

2 GENERAL INFORMATION

2.1 Testing Period and Climatic conditions


The necessary testing has been performed along between the 04th of November and the 12th of November of 2017

Laboratory ambient temperature tests and checks have been performed at $25 \pm 5^\circ\text{C}$, $96 \text{ kPa} \pm 10 \text{ kPa}$ and $40\% \text{ RH} \pm 10\% \text{ RH}$.

SITE TEST

Name: Shenzhen SOFAR SOLAR Co., Ltd.
Address: 5/F, Building 4, Antongda Industrial Park, No. 1 Liuxian Avenue, Xin'an Street, Bao'an District, Shenzhen City, Guangdong Province, P.R. China

2.2 Equipment under Testing


Apparatus type: **Solar Grid-tied Inverter**
Installation: **Fixed(permanent connection)**
Manufacturer: **EVOLVE ENERGY GROUP CO., LIMITED**
Trade mark: 
Model / Type reference: **EVVO 6000TLG2**
Serial Number.....: **ZG1ES060H61001**
Software Version: **V0.22**
Rated Characteristics: **DC input: 90-580V, 11/11A**
AC output: 230V, 50Hz, 27.3A, 6000VA

Date of manufacturing: 2017

Test item particulars

Input.....: 90-580V, 11/11A
Output.....: 230V, 50Hz, 27.3A, 6000VA
Class of protection against electric shock ...: Class I
Degree of protection against moisture: IP 65
Type of connection to the main supply.....: TN
Cooling group: Heat sink
Modular.....: No
Internal Transformer.....: No

Copy of marking plate (representative):

EVVO Solar Grid-tied Inverter	
Model No:	EVVO 6000TLG2
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90~580V
Max. Input Current	2x11A
Max. PV Isc	2x13.2A
Nominal Grid Voltage	230V
Max.Output Current	27.3A
Nominal Grid Frequency	50/60Hz
Nominal Output Power	6000W
Max.Output Power	6000VA
Power Factor	1 (adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25°C~+60°C
Protection Class	Class I
Inverter Topology	Non-Isolated
Factory - Shenzhen China	
Manufacturer : EVOLVE ENERGY GROUP CO., LIMITED	
Address : RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST	
SHEUNG WAN, HK	
Global Head Quarters	
371 Sidco Industrial Estate	
Chennai 600098 India	
VDE0126-1-1,G99,EN50438,AS4777,IEC62116,IEC61727	
	

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 EVVO 6000TLG2's except the parameters of rating.

The Equipment Under Testing (EUT) is:

EVVO 6000TLG2

The variants models are:

EVVO 5000TLG2, EVVO 4600TLG2, EVVO 4000TLG2,
EVVO 3600TLG2, EVVO 3000TLG2

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 rated power output of the EUT.
- Same Firmware Version

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

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

2.3 Manufacturer and Factory information

Manufacturer Name..... : EVOLVE ENERGY GROUP CO., LIMITED
Manufacturer Address : RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST
SHEUNG WAN, HK
Factory Name : Dongguan SOFAR SOLAR Co., Ltd
Factory Address : 1F - 6F, Building E, No. 1 JinQi Road, Bihu
Industrial Park, Wulian Village, Fenggang Town,
Dongguan City, Guangdong Province, P.R. China.

2.4 Test equipment list

No.	Equipment Name	MARK/Model No.	Equipment No.	Equipment calibration due date
1	AC source	Chroma / 61860	--	--
2	DC source	Chroma / 62150H-1000S	--	--
3	Temperature & Humidity meter	VICTOR / VC230A	WS01	2018-09-03
4	Power analyzer	YOKOGAWA / WT 3000	EP-011	2018-08-05
5	Temperature & Humidity Chamber	Dongguan Qiya / QYH-150L	GZE015-2	2018-03-04

2.5 Measurement uncertainty

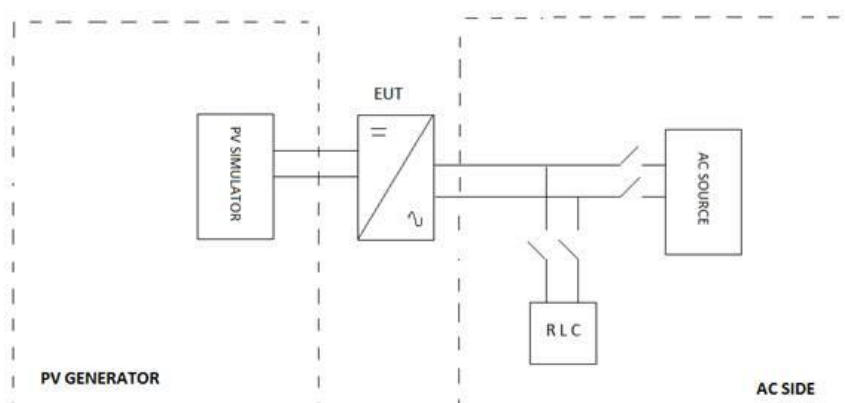
Associated uncertainties through measurements showed in this this report are the maximum allowable uncertainties.

Magnitude	Uncertainty
Voltage measurement	$\pm 0.05\%$
Current measurement	$\pm 0.05\%$
Frequency measurement	$\pm 0.001\text{ Hz}$
Time measurement	$\pm 0.001\text{ s}$
Power measurement	$\pm 0.5\%$
Phase Angle	$\pm 0.1^\circ$
Temperature	$\pm 3^\circ\text{ C}$

Note1: Measurements uncertainties showed in this table are maximum allowable uncertainties. The measurement uncertainties associated with other parameters measured during the tests are in the laboratory at disposal of the solicitant.

2.6 Test set up of the different standard

The test bench used includes:



2.7 Definitions

EUT	Equipment Under Testing	Hz	Hertz
A	Ampere	V	Volt
VA _r	Volt-Ampere reactive	W	Watt
EMC	Electromagnetic Compatibility	p.u	Per unit
U _n	Nominal Voltage	P _n	Nominal Active Power
I _n	Nominal Current	Q _n	Nominal Reactive Power
I _a	Active Current	S _n	Nominal Apparent Power
I _r	Reactive Current	THD	Total Harmonic Distortion
MV	Medium Voltage	TDD	Total Demand Distortion
LV	Low Voltage	U _i	Current Imbalance
LVRT	Low Voltage Ride Through	U _v	Voltage Imbalance
V ₁₊	Voltage positive sequence	I ₁₊	Current Positive Sequence
V ₁₋	Voltage negative sequence	I ₁₋	Current Negative Sequence
NL	Nonlinearity	I _{sc}	Short Circuit Current
PST	Severity of Flicker Short-Term	PLT	Severity of Flicker Long-Term
dc	Maximum Variation of Voltage	d(t)	Variation of Voltage
d max	Maximum Absolute Value of Voltage Variation	ZNI	Zone Non Interconnected

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

TEST AND CHECKS			
Point	Standard	Test procedure	
4.1	IEC 60068-2-1	Test Ae: Cold Soak	P
4.2	IEC 60068-2-2	Test Be: Dry heat.	P
4.3	IEC 60068-2-14	Test Nb: Change of temperature.	P
4.4	IEC 60068-2-30	Test Db: Damp heat, cyclic	P

4 TEST RESULTS

4.1 TEST AE: COLD

The test purpose is the determination of the aptitude of the components, equipment and other items for use, transport or store at low temperature, according to the standard IEC 60068-2-1. Environmental testing. Part 2-1: Test. Test A: Cold.

Due to the nature of EUT, the applicable Test is Ae: This procedure is applied to specimens heat dissipative which are subjected to low temperature during an enough period for the specimen to reach the thermal stability. The EUT is required to be operating during all test duration.

Test Severities

The specimen is introduced into the chamber which is at the temperature of the laboratory. The temperature is then adjusted to the temperature appropriate to the degree of severity, as specified in the relevant specification. After temperature stability of the test specimen has been reached, the specimen is exposed to these conditions for the specified duration. For specimens that are required to be operational (even though they do not meet the requirements of being heat dissipating), power shall then be applied to the specimen and a functional test is performed as necessary. A further period of stabilization may be necessary and the specimen shall then be exposed to the low temperature conditions for a duration as specified in the relevant specification. Specimens under test are normally in non-operating conditions.

Specimens under test are normally in non-operating conditions.

Test condition:

Test Temperature: -25°C

Test Duration : 16h

Test result:

Measurements Pre-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	364.48	Voltage AC (V)	231.29
Current DC (A)	17.06	Current AC (A)	26.08
Power DC (W)	6179.39	Active Power AC (W)	6007.43

Measurements Post-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	364.47	Voltage AC (V)	231.25
Current DC (A)	17.06	Current AC (A)	26.09
Power DC (W)	6181.67	Active Power AC (W)	6009.23

After the test, the specimens can operation normally.

4.2 TEST BE: DRY HEAT

The test purpose is the determination of the aptitude of the components, equipment and other items for use, transport or storage at high temperature, according to the standard IEC 60068-2-2. Environmental testing. Part 2-2: Tests. Test B: Dry heat

Due to the nature of EUT applicable test Be: This procedure is applied to specimens heat dissipative which are subjected to high temperature during an enough period time for the specimen to reach the thermal stability. The EUT is required to be operating during all test duration.

Test Severities

The specimen is introduced into the chamber, which is at the temperature of the laboratory. The temperature is then adjusted to the temperature appropriate to the degree of severity as specified in the relevant specification. After temperature stability of the test specimen has been reached, the specimen is exposed to these conditions for the specified duration. For specimens that are required to be operational (even though they do not meet the requirements of being heat dissipating) power shall then be applied to the specimen and a functional test is performed as necessary. A further period of stabilization may be necessary and the specimen shall then be exposed to the high temperature conditions for a duration as specified in the relevant specification.

Specimens under test are normally in non-operating conditions.

Test condition:

Test Temperature : +60°C

Test Duration : 16h

Test result:

Measurements Pre-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	363.85	Voltage AC (V)	231.34
Current DC (A)	17.10	Current AC (A)	26.09
Power DC (W)	6186.02	Active Power AC (W)	6013.48

Measurements Post-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	364.37	Voltage AC (V)	231.34
Current DC (A)	17.07	Current AC (A)	26.08
Power DC (W)	6180.34	Active Power AC (W)	6008.19

After the test, the specimens can operation normally.

4.3 TEST NB: CHANGE OF TEMPERATURE

This test includes alternating periods of high and low temperature with a good definition of transference between both temperatures. The test has been performed according to the standard IEC 60068-2-14. Environmental testing. Part 2-14: Tests. Test N: Change of temperature.

The inverter has been subjected to thermal changes according to the test Nb in order to evaluate the ability of components, equipment or other articles to withstand rapid changes of ambient temperature. With this method, variations of temperature are controlled with a specified speed of change.

The complete test performed includes:

1. Variation from standard atmospheric conditions to the temperature of conditioning "A".
2. Variation from temperature of conditioning "A" to temperature of conditioning "B".
3. Variation from temperature of conditioning "B" to temperature of conditioning "A".
4. Variation from temperature of conditioning "A" to temperature of conditioning "B".
5. Variation from the temperature of conditioning "B" to the ambient temperature of laboratory.

Test Severities

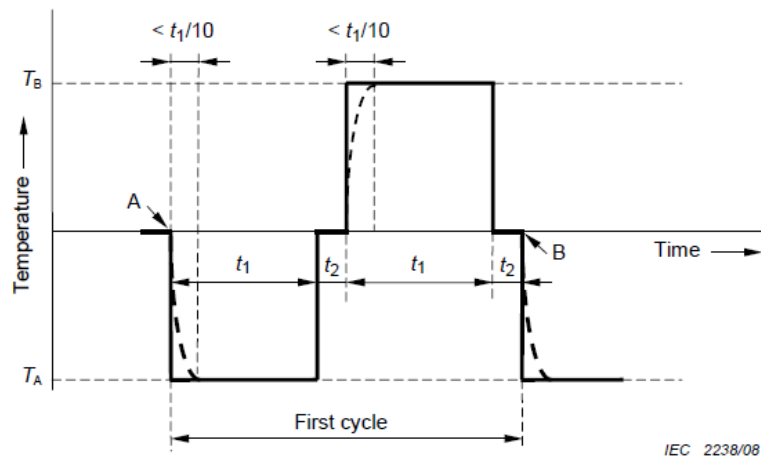
The severity of the test is defined by the combination of the two temperatures, the transfer time, the exposure time of the specimen and the number of cycles.

The lower temperature, T_A , shall be specified in the relevant specification and should be chosen from the test temperatures of IEC 60068-2-1 and IEC 60068-2-2.

The higher temperature, T_B , shall be specified in the relevant specification and should be chosen from the test temperatures of IEC 60068-2-1 and IEC 60068-2-2.

The exposure time, t_1 , of each of the two temperatures depends upon the heat capacity of the specimen. It may be 3 h, 2 h, 1 h, 30 min or 10 min, or as specified in the relevant specification. Where no exposure period is specified in the relevant specification, it is understood to be 3 h.

The preferred number of test cycles is five, unless otherwise specified in the relevant specification.



IEC 2238/08

Key

- A start of first cycle
- B end of first cycle and start of second cycle

NOTE The dotted curve is explained above.

Figure 2 – Na test cycle

Test condition:

Low temperature T_A : -25°C

High temperature T_B : +60°C

Duration of exposure time t_1 : 3h

Duration of transfer time t_2 : 3min

Number of cycles: 5

Recovery: 2h

Test result:

Measurements Pre-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	364.07	Voltage AC (V)	231.37
Current DC (A)	17.09	Current AC (A)	26.09
Power DC (W)	6184.12	Active Power AC (W)	6011.39

Measurements Post-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	364.52	Voltage AC (V)	231.36
Current DC (A)	17.06	Current AC (A)	26.09
Power DC (W)	6182.03	Active Power AC (W)	6009.80

After the test, the specimens can operation normally.

4.4 TEST DB: DAMP HEAT, CYCLIC (12 H + 12 H)

The test purpose is the determination of the suitability of components, equipment or other articles for the use, transportation and storage abnormal conditions of high humidity, combined with cyclic temperature changes and, in general, producing condensation on the surface of the specimen, according to the standard IEC 60068-2-30. Environmental testing. Part 2-30: Tests. Test Db-Variant 1: Damp heat, Cyclic (12 h + 12 h).

Test Severities

Variant 2 (see Figure 2b)

The temperature shall be lowered to 25 °C ± 3 K within 3 h to 6 h, but without the additional requirement for the first hour and one half as in variant 1. The relative humidity shall be not less than 80 % RH.

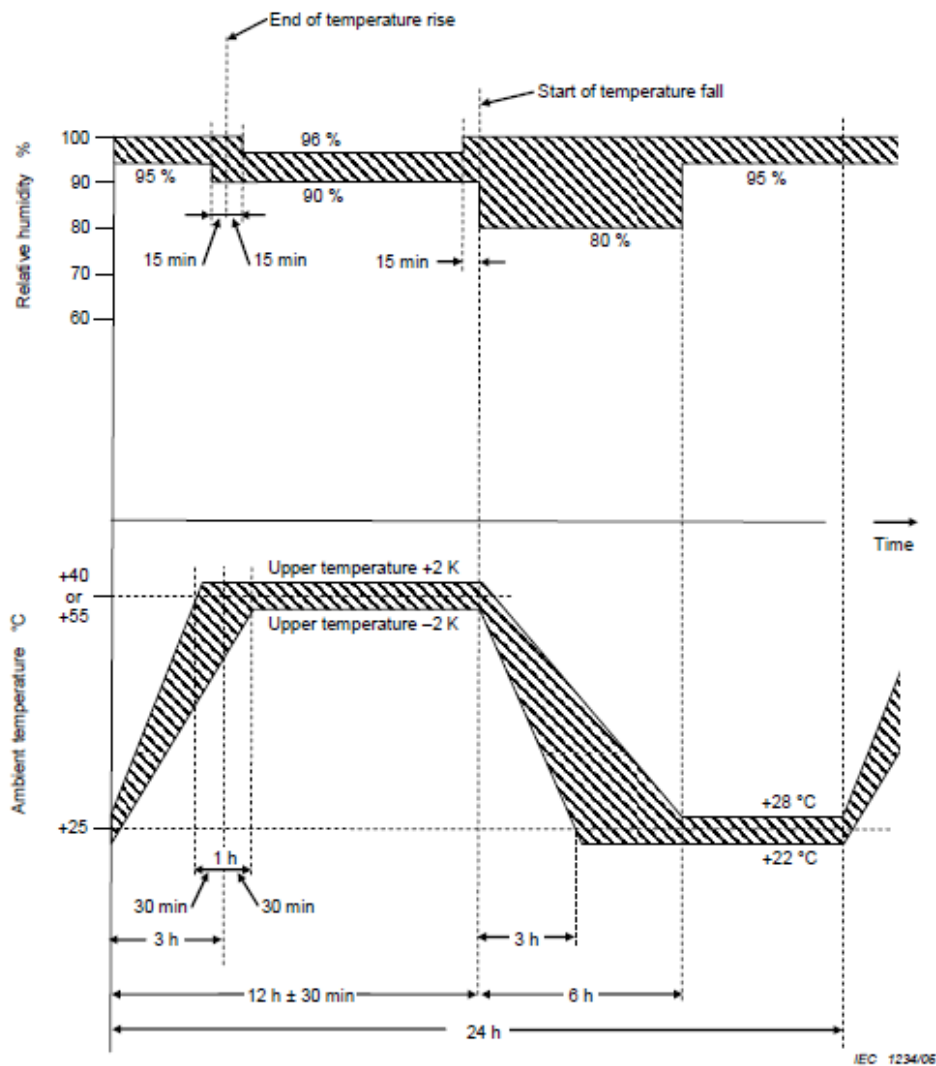


Figure 2b – Test Db – Test cycle – Variant 2

Test condition:

Test Db, variant 2, b-cycle
The humidity level shall be 95 % \pm 5 %
A minimum number of 3 cycles
Lower temperature: 25°C
Upper temperature: 75°C

Test result:

Measurements Pre-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	364.07	Voltage AC (V)	231.37
Current DC (A)	17.09	Current AC (A)	26.09
Power DC (W)	6184.12	Active Power AC (W)	6011.39

Measurements Post-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	364.52	Voltage AC (V)	231.36
Current DC (A)	17.06	Current AC (A)	26.09
Power DC (W)	6182.03	Active Power AC (W)	6009.80

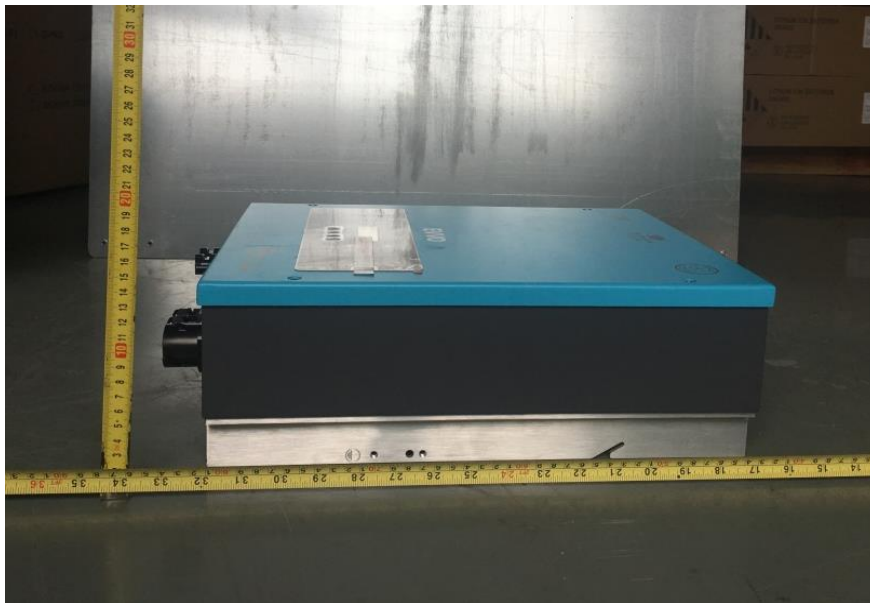
After the test, the specimens can operation normally.

5 PICTURES

Front



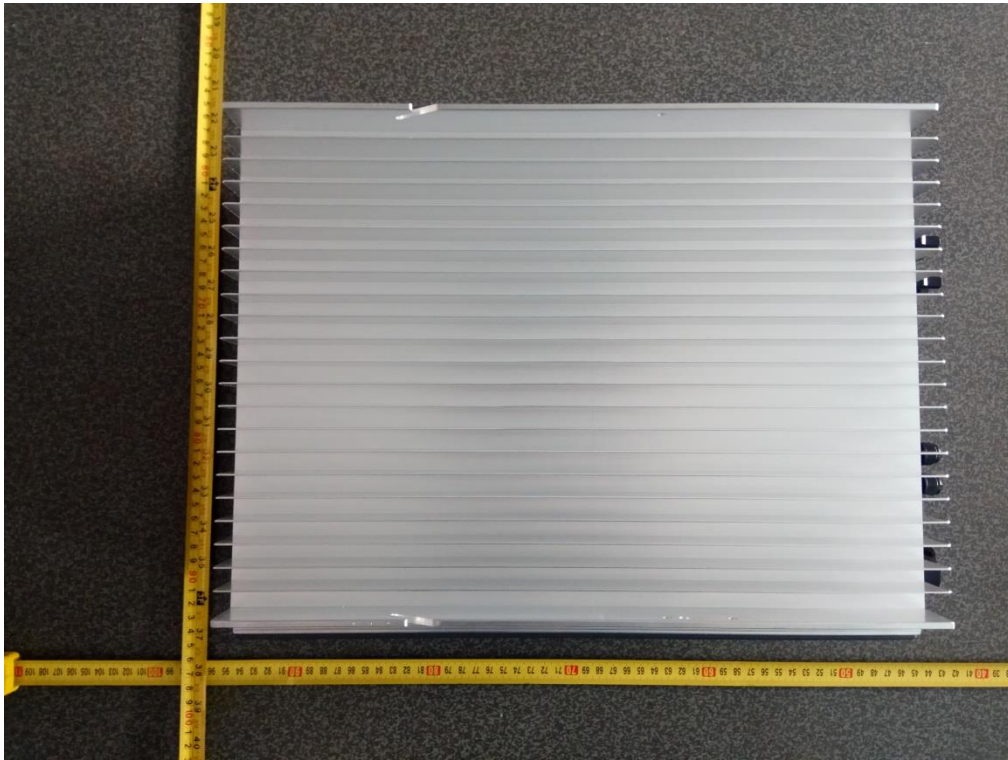
Side



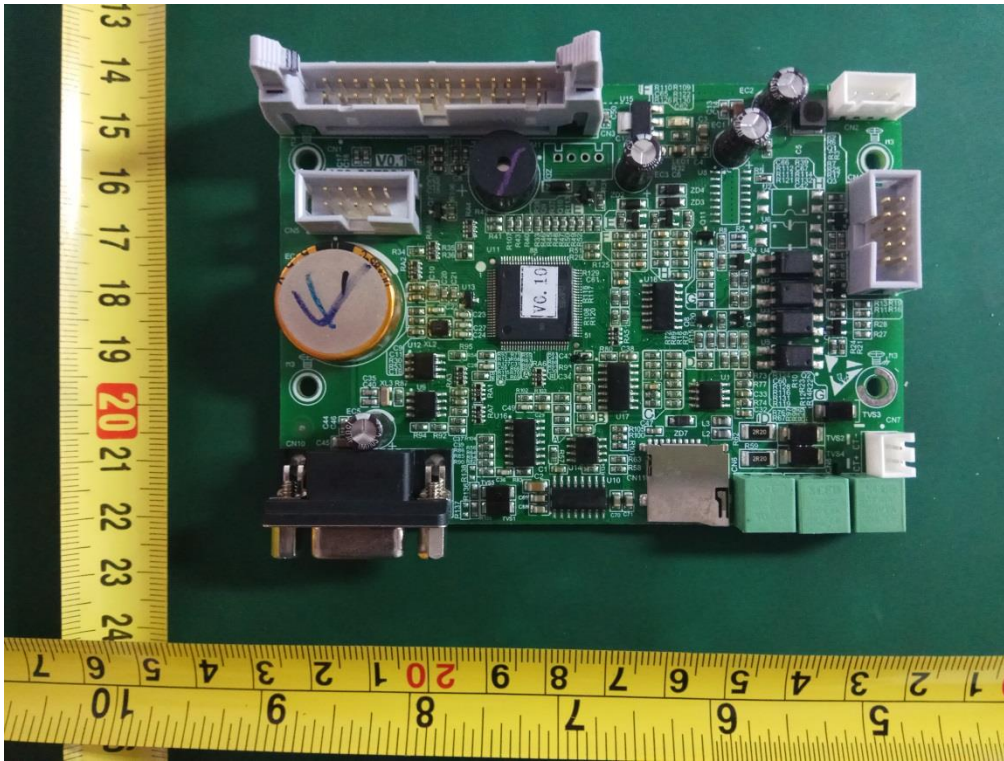
Connection interface



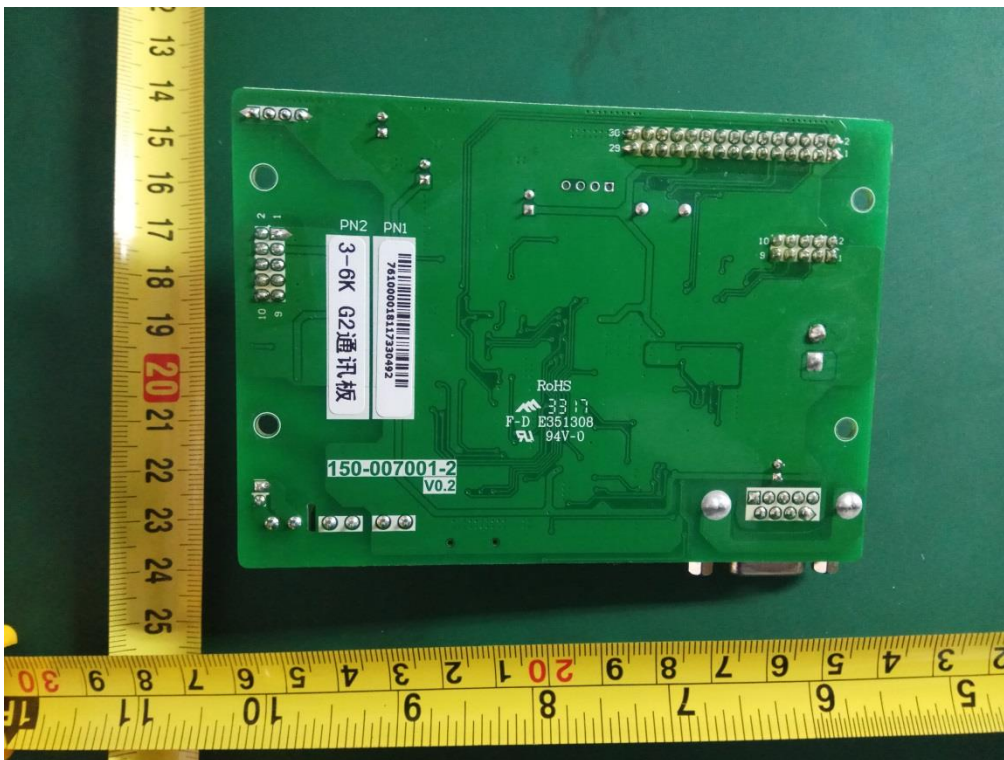
Back Side



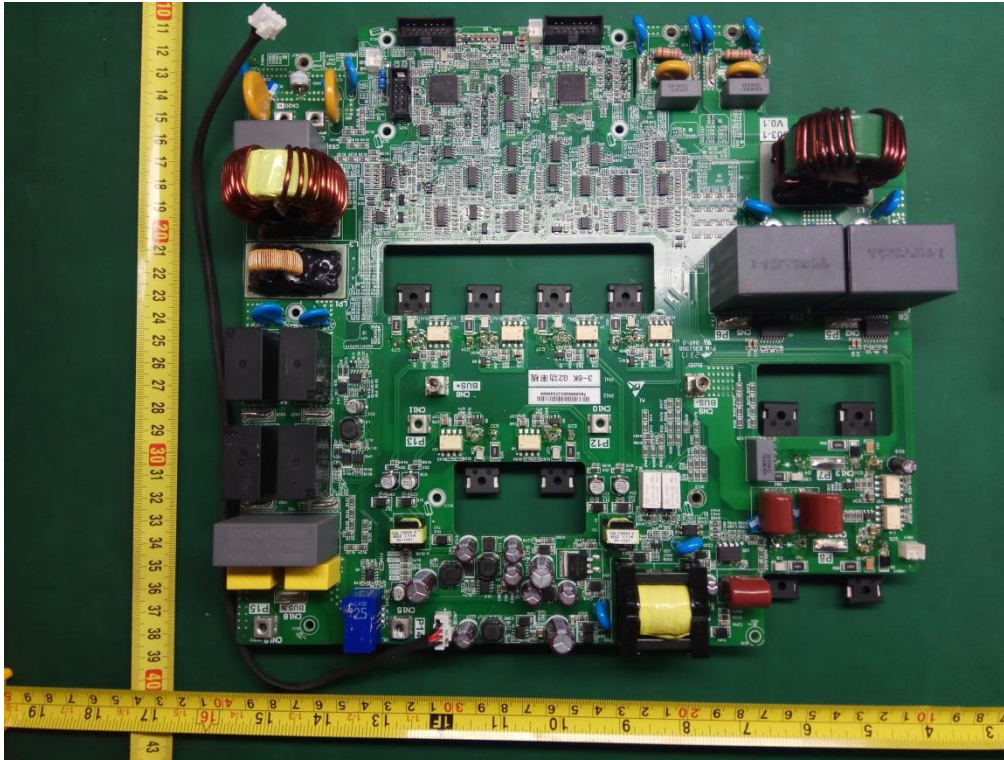
Front side of communication board



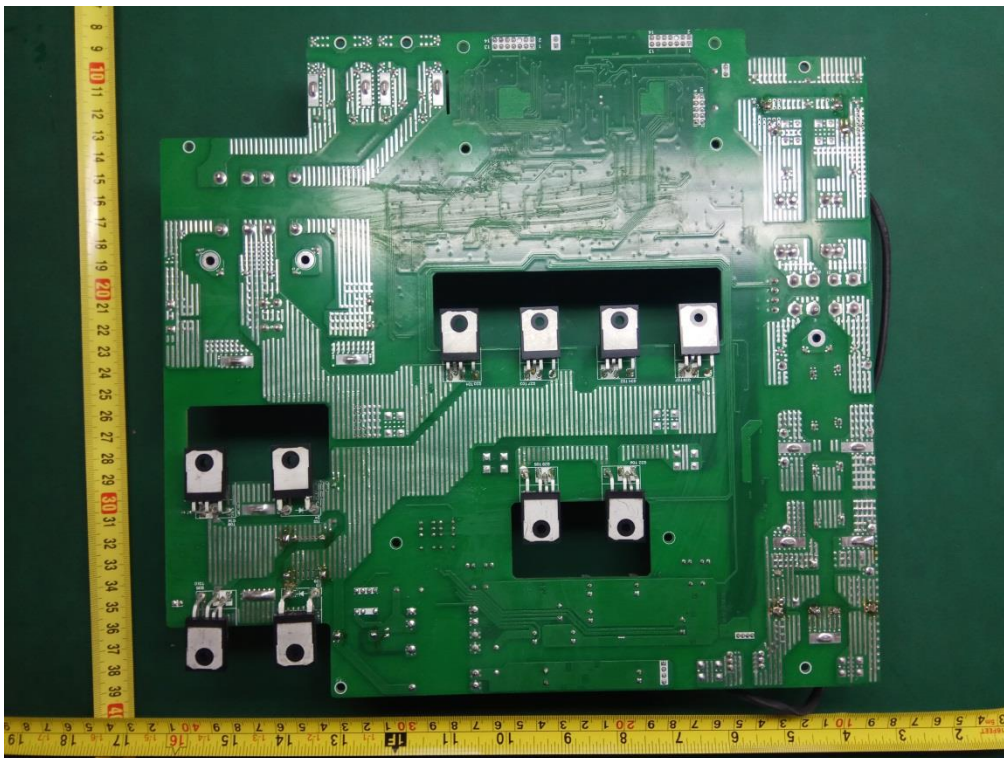
Back side of communication board



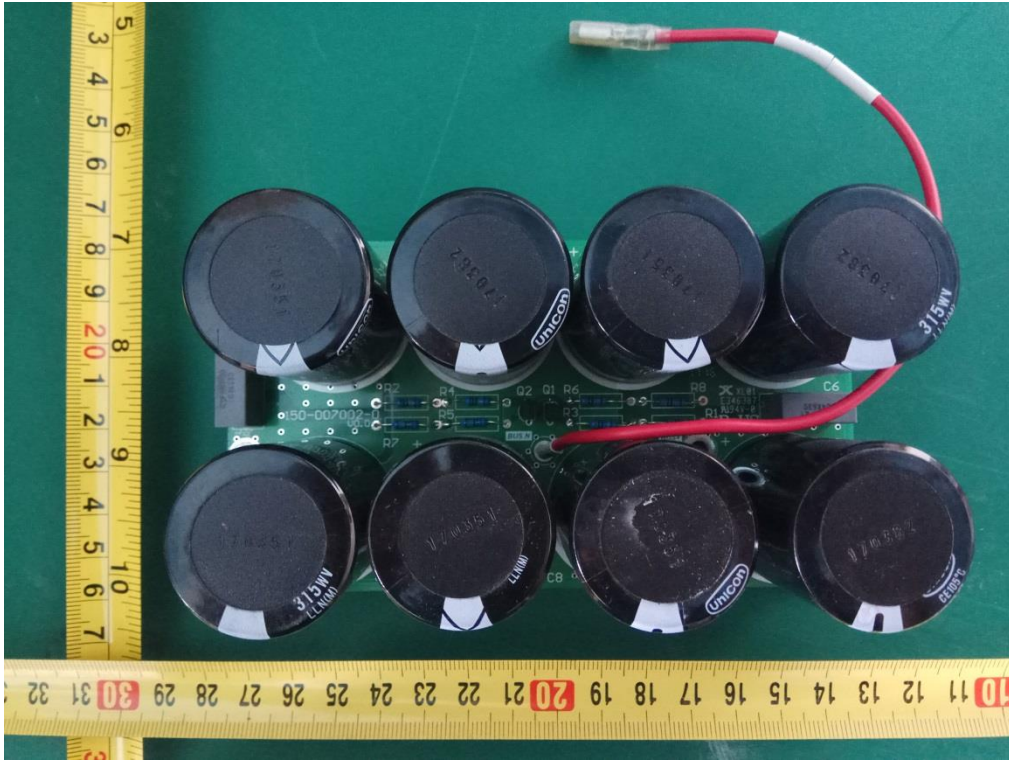
Front side of Main board



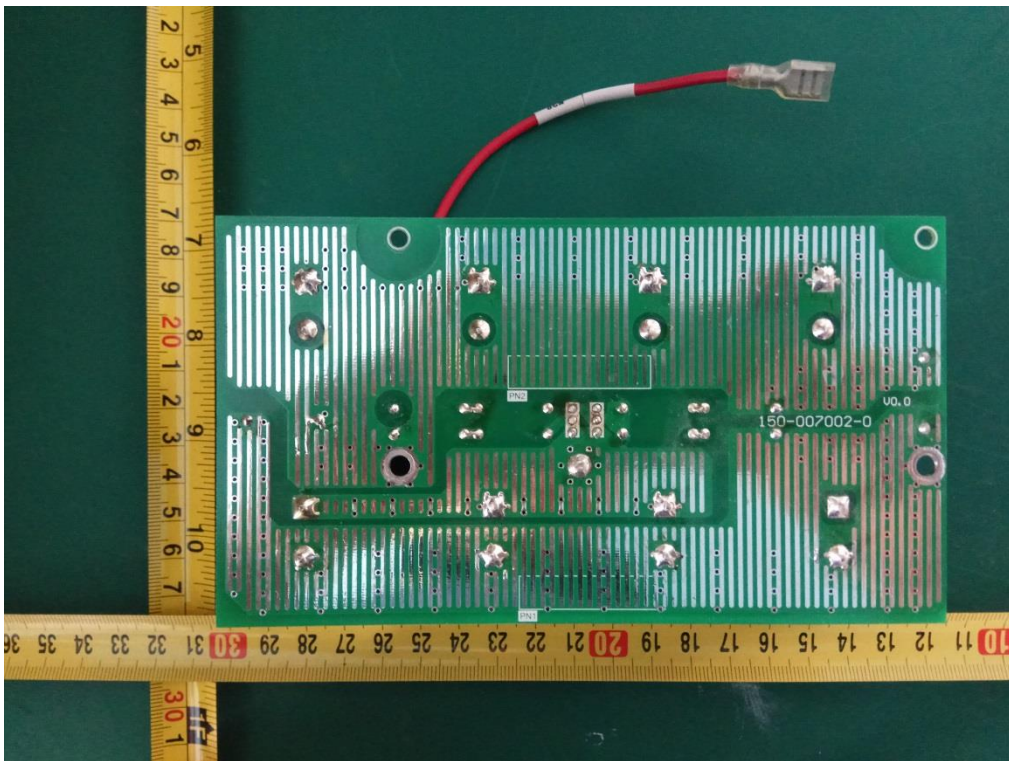
Front side of Main board



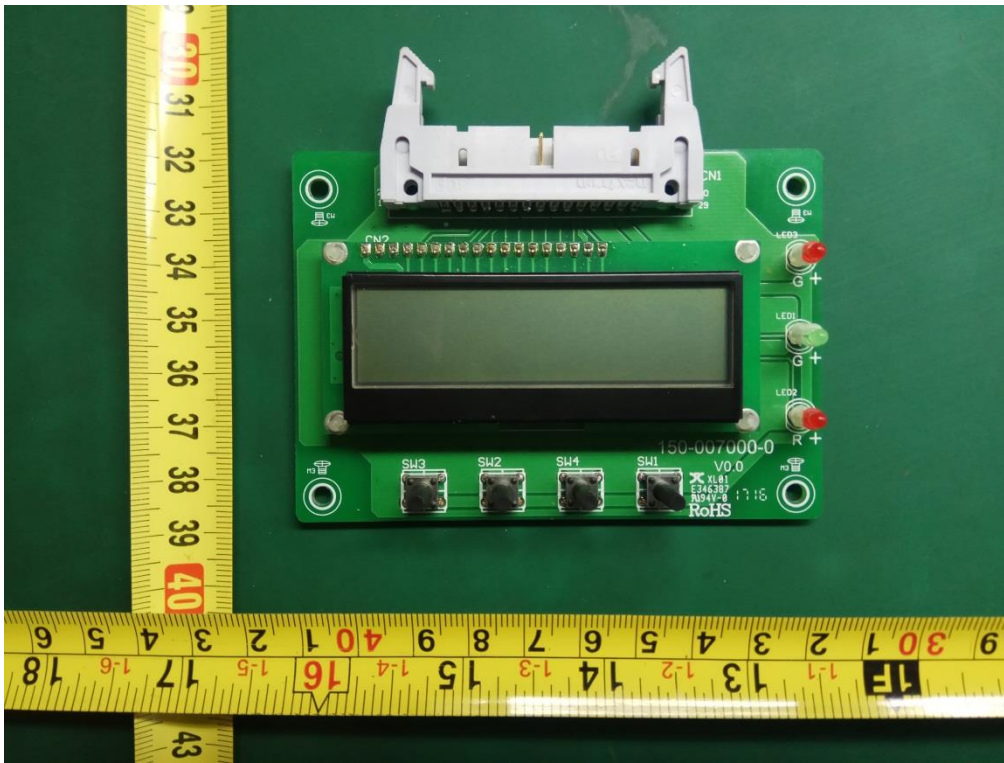
Front side of Bus capacitors board



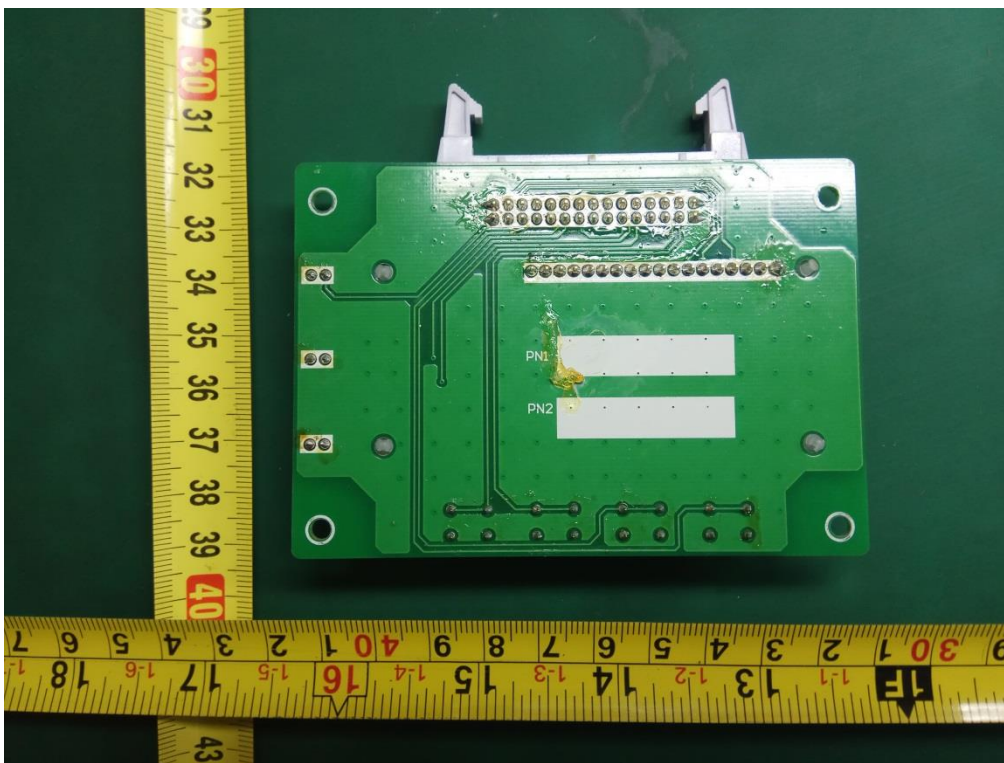
Back side of Bus capacitors board



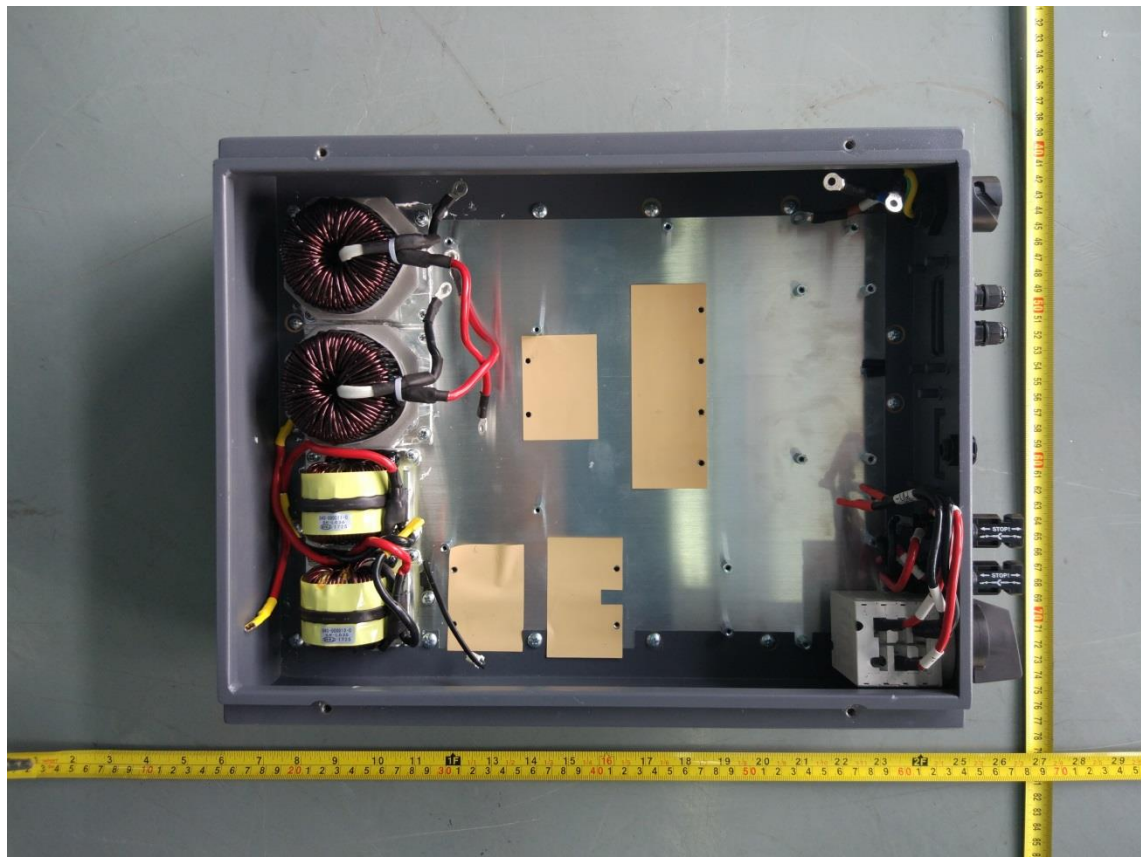
Front side of display board



Back side of display board



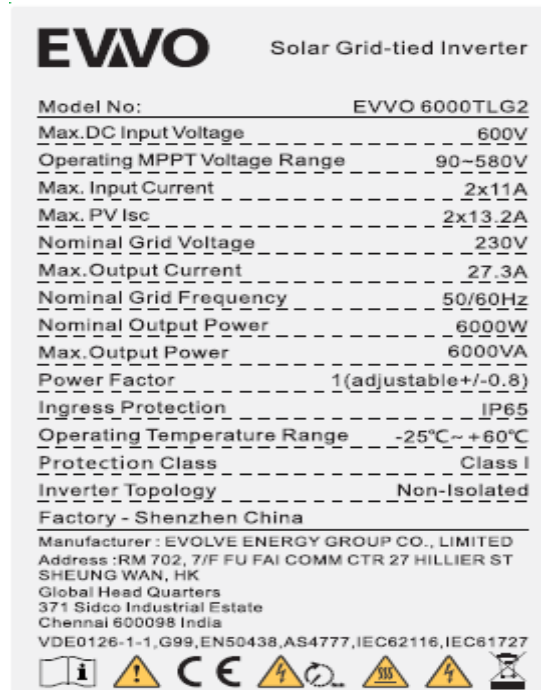
Removed all PCBAs



Cover



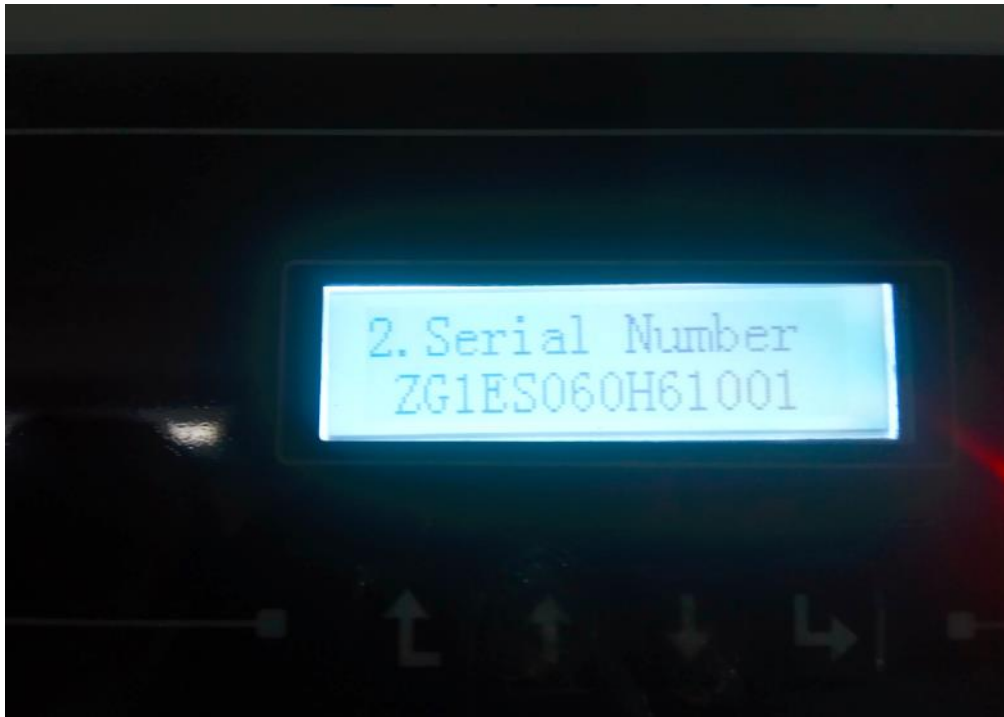
Labels



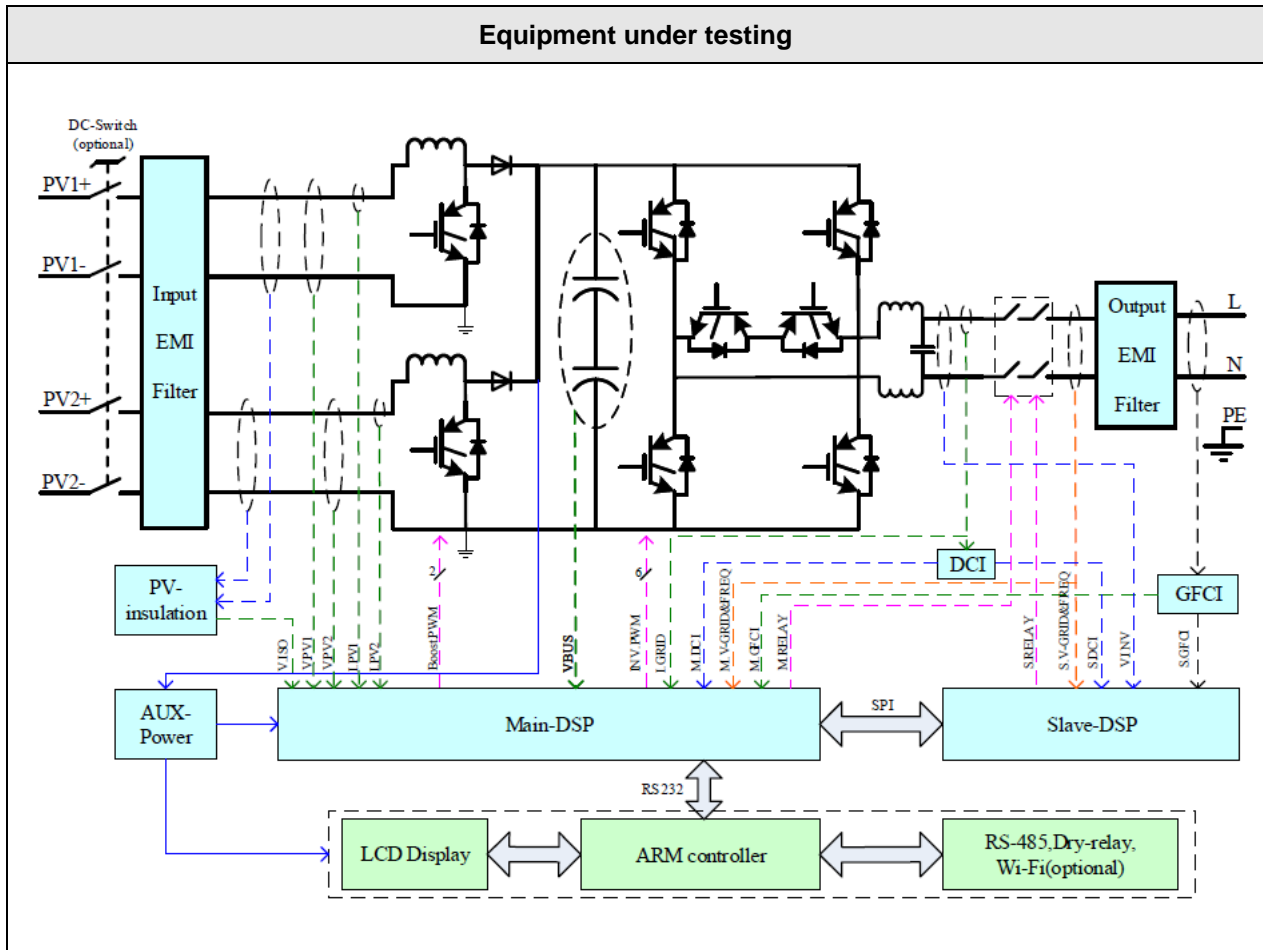
Software Version



Serial Number of the EUT



6 ELECTRICAL SCHEME



--- End of test report---