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 ..... :	2219 / 0019 - 6
Trademark ..... :	
Tested Model ..... :	HYD 6000-ES
Variant Models ..... :	HYD 5000-ES，HYD 4000-ES，HYD 3600-ES，HYD3000-ES

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 ..... :	Hugo Zhang (Project Engineer) Roger Hu (Project Engineer)
Approved by ..... :	Jacobo Tevar (Technical Reviewer)
Date of issue ..... :	23/05/2019
Number of pages ..... :	23

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

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Test Report Historical Revision:

Test Report Version	Date	Resume
2219 / 0019 - 6	23/05/2019	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 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 20th of April and 27th of May of 2019. Laboratory ambient temperature tests and checks have been performed at 25 ± 5ºC, 96 kPa ± 10 kPa and 50% RH ± 10% RH.

SITE TEST

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

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

2.2 Equipment under Testing

Apparatus type ..... : Hybrid Inverter

Installation ..... : Fixed(permanent connection)

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

Trade mark ..... :

Model / Type reference ..... : HYD 6000-ES

Serial Number..... : SM1ES060JCS423

Software Version ..... : V1.60

Rated Characteristics ..... : **DC input:** 90-580V Max.2x15A
AC output: 230Va.c, 50Hz, Max.27.3A,6000VA

Date of manufacturing: 2017

Test item particulars

Input..... : DC

Output..... AC

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

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

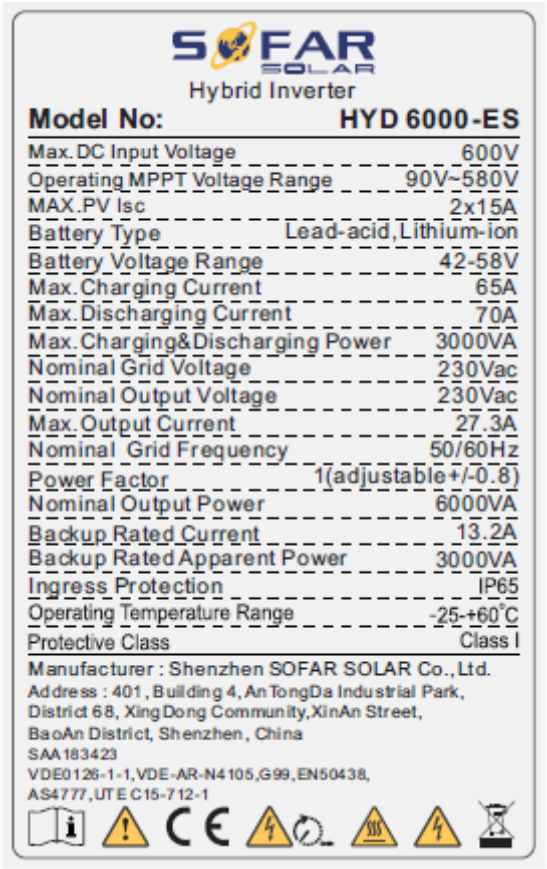
Type of connection to the main supply..... : TN

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 wit HYD 6000-ES's except the parameters of rating.

Equipment Under Testing:

- HYD 6000-ES

Variant models:

– HYD 5000-ES
– HYD 4000-ES
– HYD 3600-ES
– HYD 3000-ES

Model Number	HYD 6000-ES	HYD 5000-ES	HYD4000-ES	HYD 3600-ES	HYD 3000-ES
Max. input voltage	600Vd.c.				
Max. input current	2 x 15.0 A_{dc}	2 x 15.0A_{dc}	2 x 15.0 A_{dc}	2 x 15.0 A_{dc}	2 x 15.0 A_{dc}
MPPT voltage range	90-580Vd.c.				
Rated grid voltage	230Va.c.				
Rated grid frequency	50Hz				
Rated output power	6kW	5kW	4kW	3.68kW	3kW
Rated output current	27.3Aa.c.	22.8Aa.c.	18.2Aa.c.	16Aa.c.	13.7Aa.c.
Power factor	0.8 leading to 0.8 lagging				
Ambient temperature	-25℃~60℃				
Ingress protection	IP65				
Protective class	Class I				

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.
- 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 Test equipment list

From	No.	Equipment Name	Model No.	Equipment No.	Equipment calibration due date
Ba Lun	1	Current clamp	CT6863-05	BZ-EP-L006	2020/2/27
	2	Current clamp	CT6863-05	BZ-EP-L007	2020/2/27
	3	Digital oscilloscope	MS04054B	BZ-EP-L016	2020/2/25
	4	Power analyzer	PW6001-16	BZ-EP-L005	2020/2/26
	5	Power analyzer	PA6006H	BZ-EP-L051	2019/11/04
	6	Differential probe	DP6130	BZ-SFT-L061	2019/11/04
	7	Temperature & Humidity meter	DT-322	BZ-DGD-L005	2020/03/08
	8	Temperature & Humidity Chamber	8m3	BZ-KKX-L018	2019/11/01
	9	AC source	KACM-75-33	BZ-EP-L001	--
	10	PV array simulator	WLPA-150KW	BZ-DGD-L013	--
	11	RLC load	ACLT-38160H	BZ-DGD-L003	--
SGS	12	True RMS Multimeter	Fluke / 289C	GZE012-53	2020/02/26

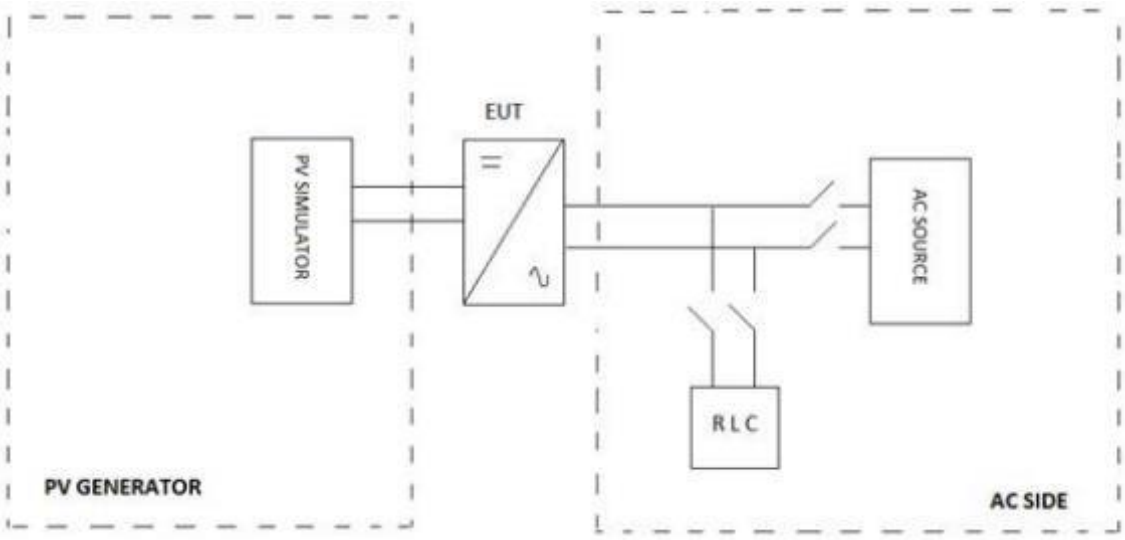
2.4 Measurement uncertainty

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

Magnitude	**Uncertainty**
Voltage measurement uncertainty	±1.5 %
Current measurement uncertainty	±2.0 %
Frequency measurement uncertainty	±0.2 %
Time measurement uncertainty	±0.2 %
Power measurement uncertainty	±2.5 %
Phase Angle	±1º
Temperature	±3º C
Note1: Measurements uncertainties showed in this table are maximum allowable uncertainties. The measurement uncertainties associated with other parameters measured during the tests are in the laboratory at disposal of the solicitant.	

2.5 Test set up of the different standard

The test bench used includes:



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

2.6 Definitions

EUT	Equipment Under Testing	Hz	Hertz
A	Ampere	V	Volt
VAr	Volt-Ampere reactive	W	Watt
Un	Nominal Voltage	p.u	Per unit
In	Nominal Current	Pn	Nominal Active Power
Ia	Active Current	Qn	Nominal Reactive Power
Ir	Reactive Current	Sn	Nominal Apparent Power
MV	Medium Voltage	ºC	Celsius degree
LV	Low Voltage	K	Kelvin degree
RH	Relative Humidity		

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	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

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

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 operating conditions.

Test condition:

Test Temperature: -25℃

Test Duration : 16h

Test result:

Measurements Pre-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	428.6	Voltage AC (V)	230.1
Current DC (A)	14.3	Current AC (A)	26.0
Power DC (W)	6139	Active Power AC (W)	5960

Measurements During the test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	428.0	Voltage AC (V)	230.0
Current DC (A)	14.4	Current AC (A)	25.9
Power DC (W)	6150	Active Power AC (W)	5940

Measurements Post-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	420.0	Voltage AC (V)	230.0
Current DC (A)	14.8	Current AC (A)	26.1
Power DC (W)	6190	Active Power AC (W)	5990

After the test, the EUT 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 operating conditions.

Test condition:
Test Temperature: +60℃
Test Duration : 16h
Test result:
Measurements Pre-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	421.0	Voltage AC (V)	230.0
Current DC (A)	14.6	Current AC (A)	26.1
Power DC (W)	6185	Active Power AC (W)	5988

Measurements During test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	419.4	Voltage AC (V)	230.0
Current DC (A)	14.8	Current AC (A)	26.1
Power DC (W)	6148	Active Power AC (W)	5939

Measurements Post-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	434.69	Voltage AC (V)	229.9
Current DC (A)	14.0	Current AC (A)	25.5
Power DC (W)	6061	Active Power AC (W)	5858.9

After the test, the EUT 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.

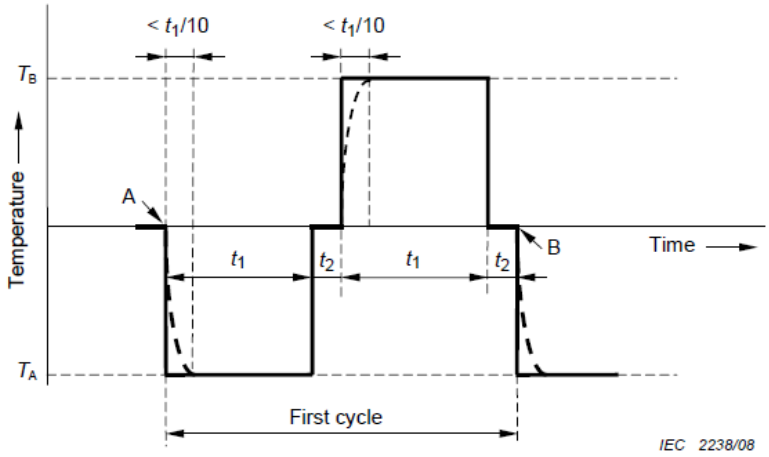
The inverter has been subjected to thermal changes according to the test Nb in order to evaluate the ability of components, equipment or other articles to withstand rapid changes of ambient temperature. With this method, variations of temperature are controlled with a specified speed of change.

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, TA, 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, TB, 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, t1, 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.



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℃
High temperature T_B: +60℃
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)	4220.0	Voltage AC (V)	230.0
Current DC (A)	14.8	Current AC (A)	26.1
Power DC (W)	6200	Active Power AC (W)	5997

Measurements During test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	423.3	Voltage AC (V)	230.0
Current DC (A)	14.6	Current AC (A)	26.0
Power DC (W)	6182	Active Power AC (W)	5981

Measurements Post-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	417.0	Voltage AC (V)	230.0
Current DC (A)	14.9	Current AC (A)	26.1
Power DC (W)	6206	Active Power AC (W)	6002

After the test, the EUT 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.

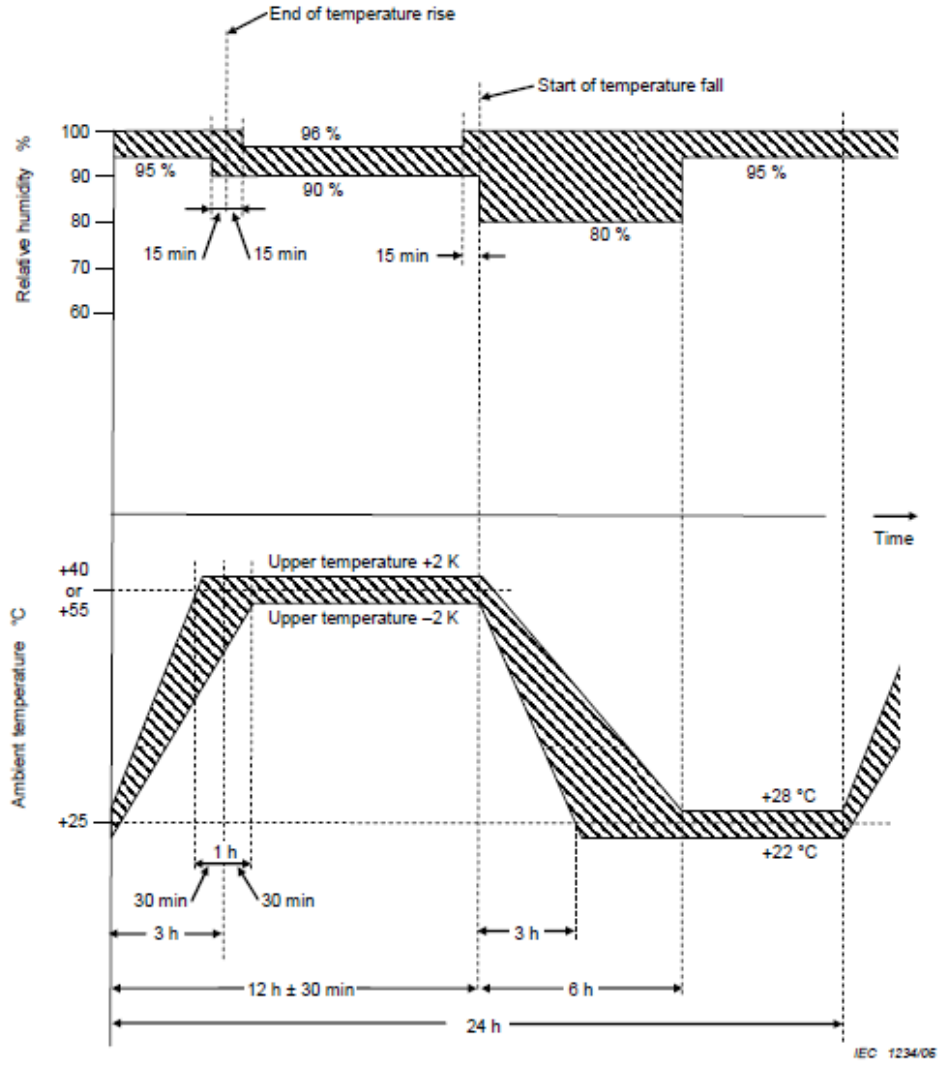


Figure 2b – Test Db – Test cycle – Variant 2

Test condition:

Test Db, variant 2, b-cycle
The humidity level shall be 95 % ± 5 %
A minimum number of 3 cycles
Lower temperature: 25°C
Upper temperature: 55°C

Test result:

Measurements Pre-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	414.6	Voltage AC (V)	230.0
Current DC (A)	15.0	Current AC (A)	26.2
Power DC (W)	6211	Active Power AC (W)	6007

Measurements During test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	428.3	Voltage AC (V)	229.9
Current DC (A)	14.4	Current AC (A)	25.9
Power DC (W)	615	Active Power AC (W)	5953

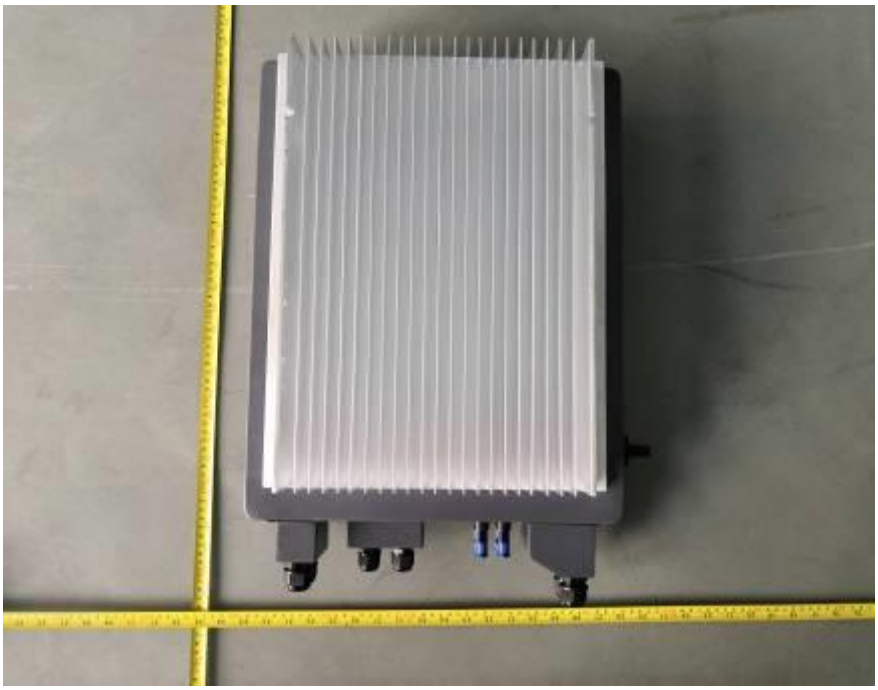
Measurements Post-functional test:

PV Input:		AC grid output (line to neutral):	
Voltage DC (V)	429.5	Voltage AC (V)	230.0
Current DC (A)	25.8	Current AC (A)	14.3
Power DC (W)	6135	Active Power AC (W)	5916

After the test, the EUT can operation normally.

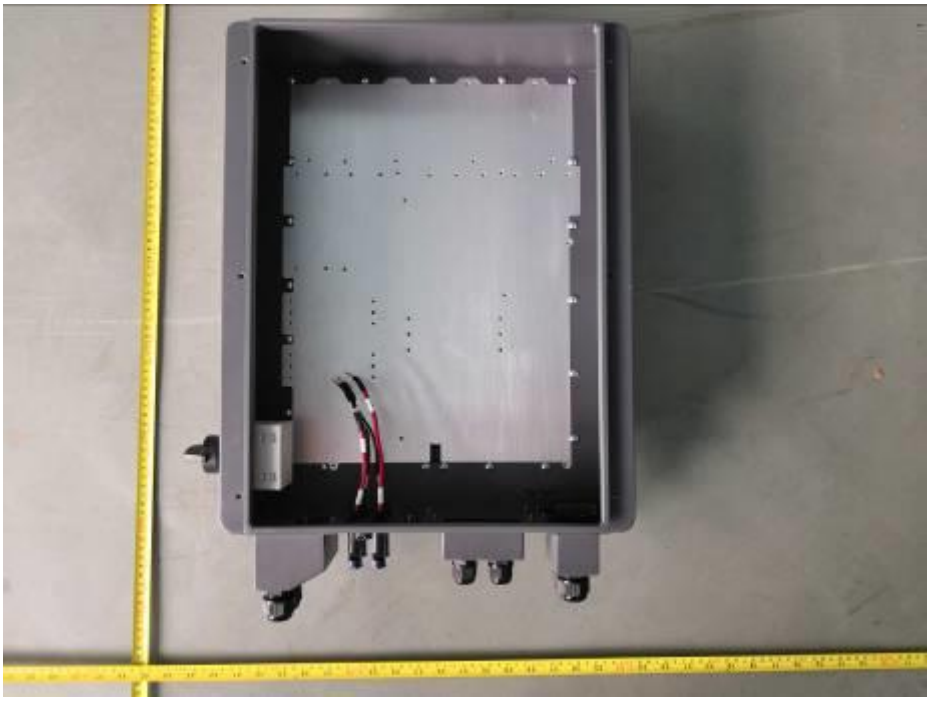
5 PICTURES

Front view

Back view


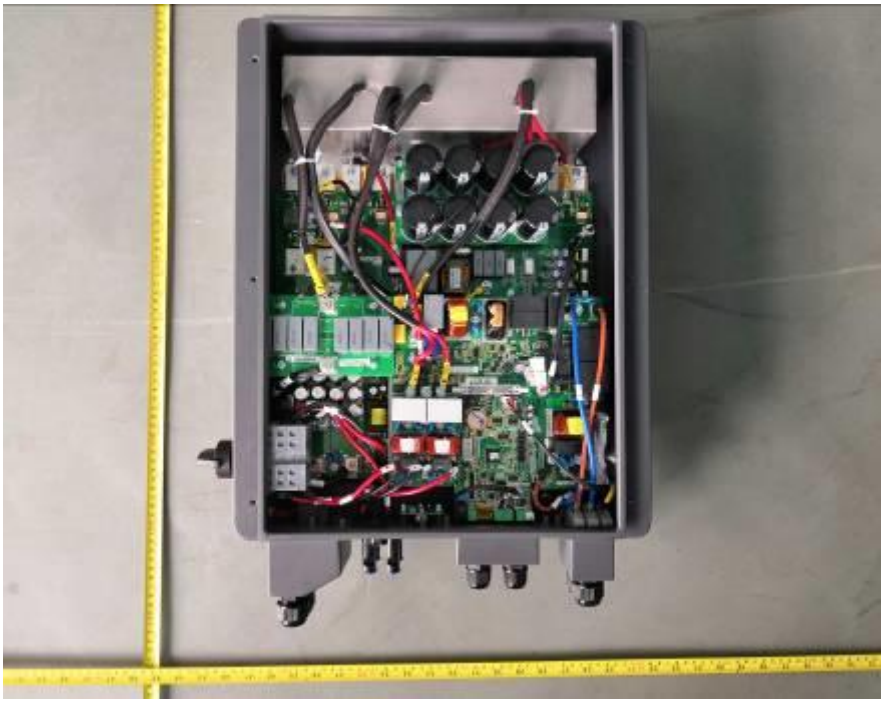
Side View

Internal view of enclosure

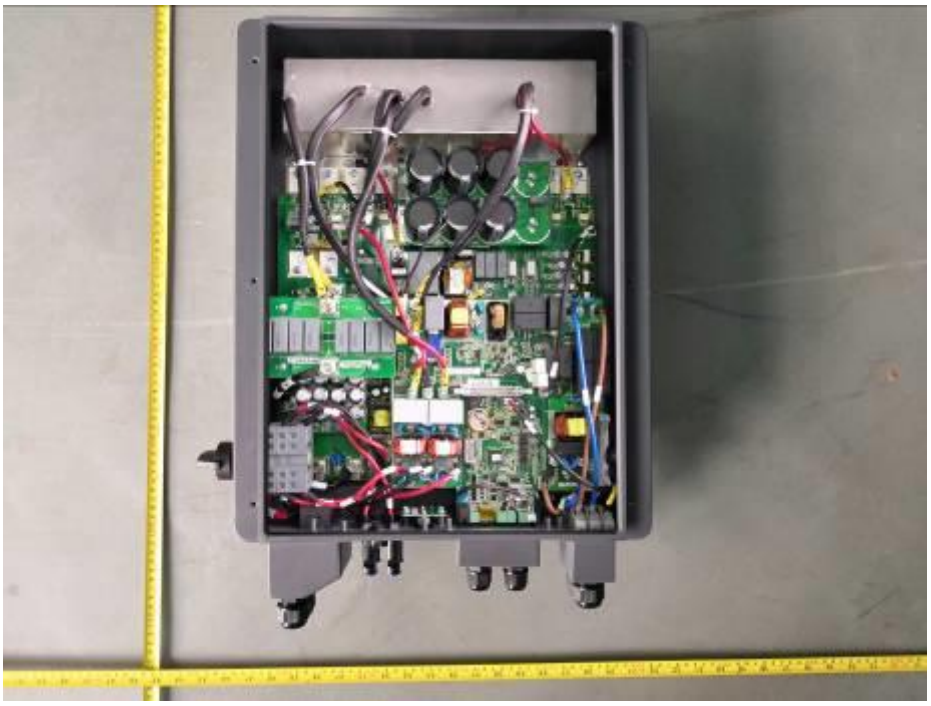


Top View

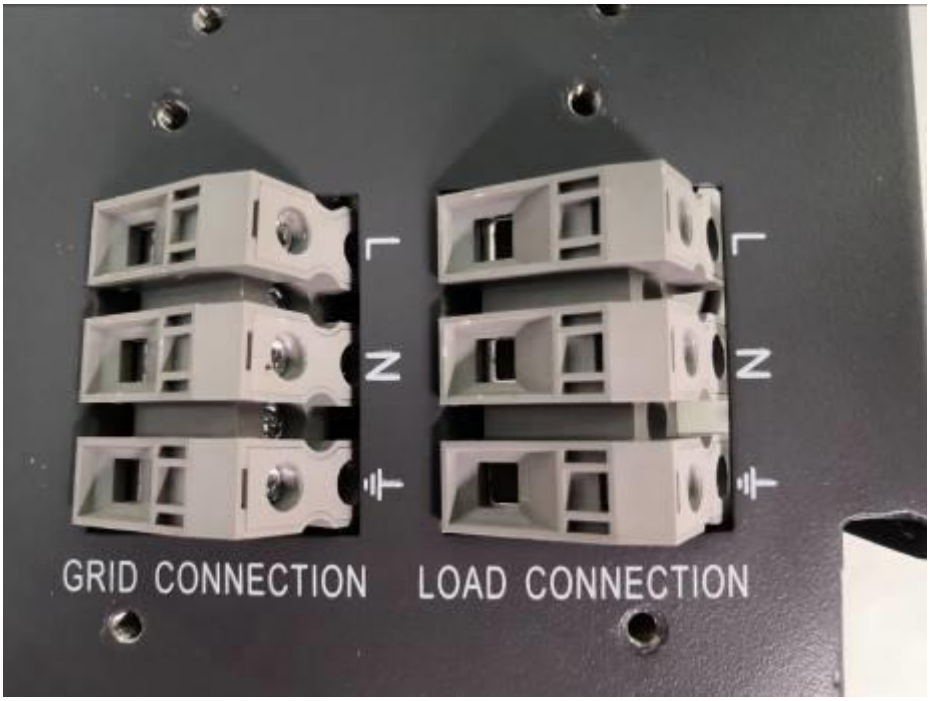
Internal View of Model HYD 5000-ES, HYD 6000-ES



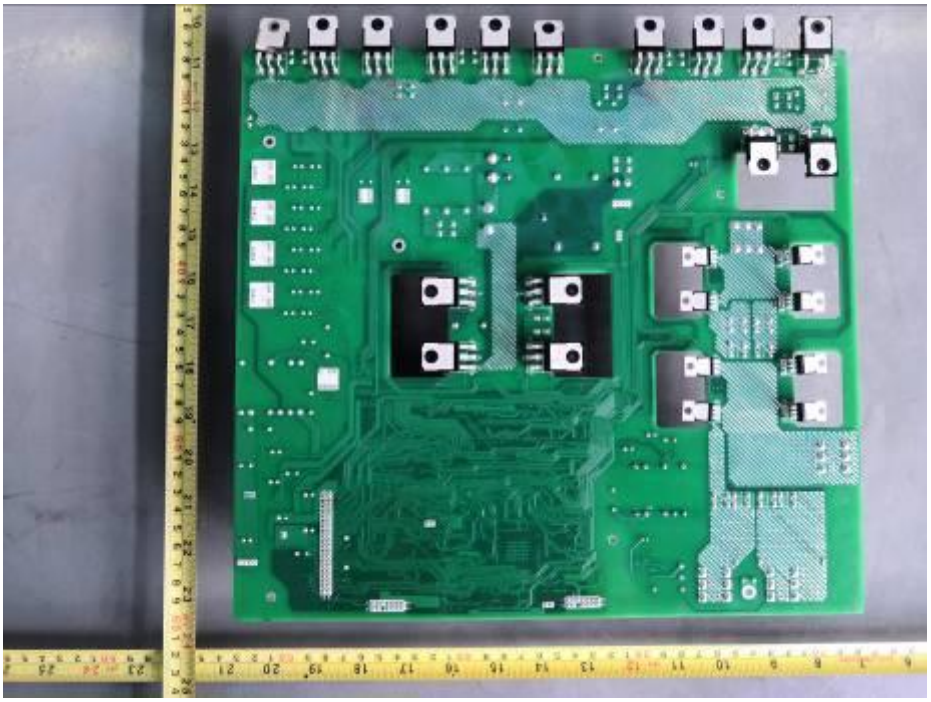
Internal View of Model HYD 3000-ES, HYD 3600-ES, HYD 4000-ES

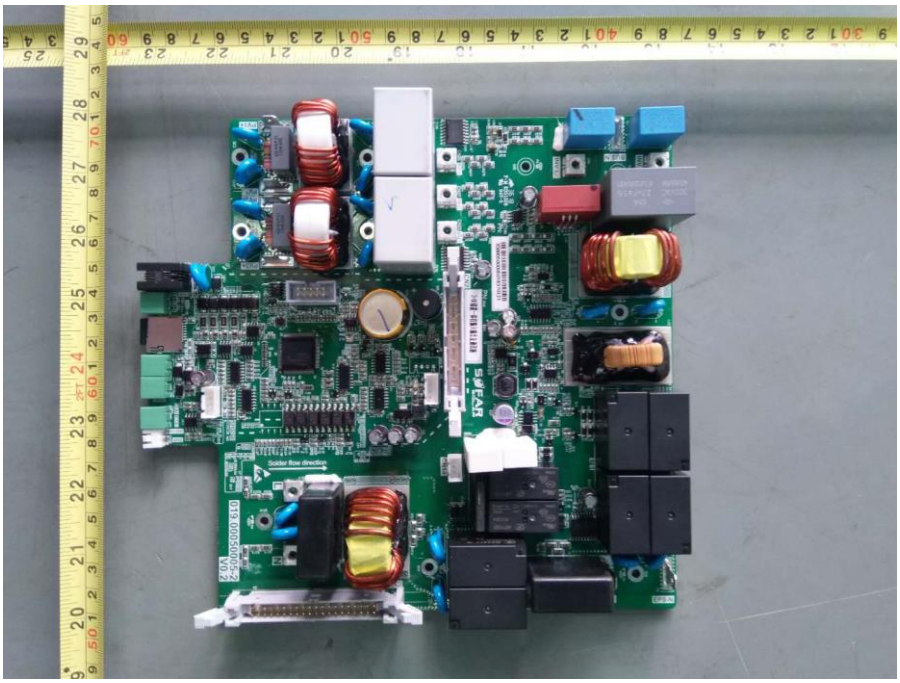
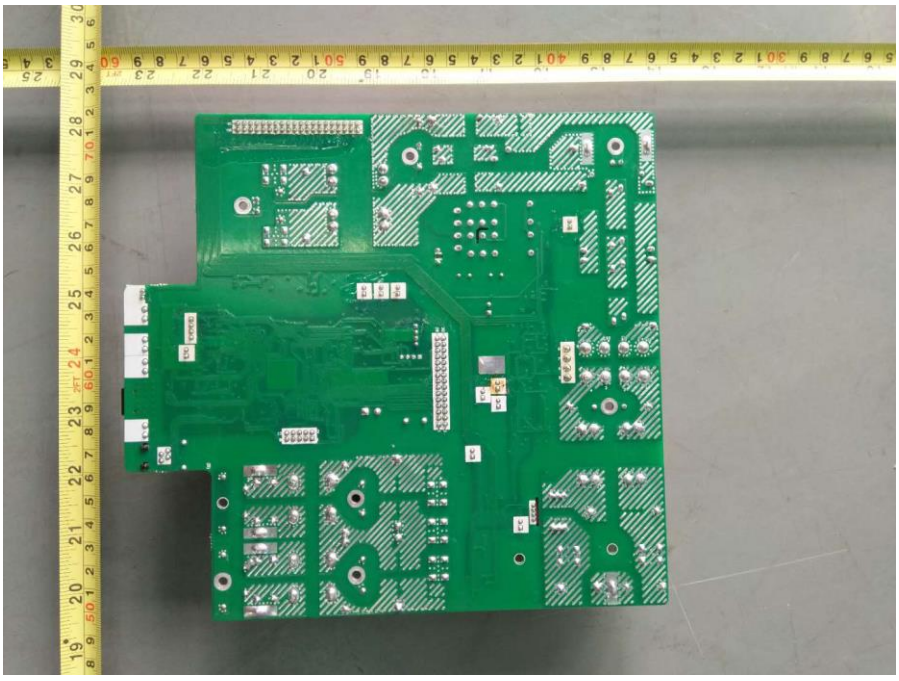


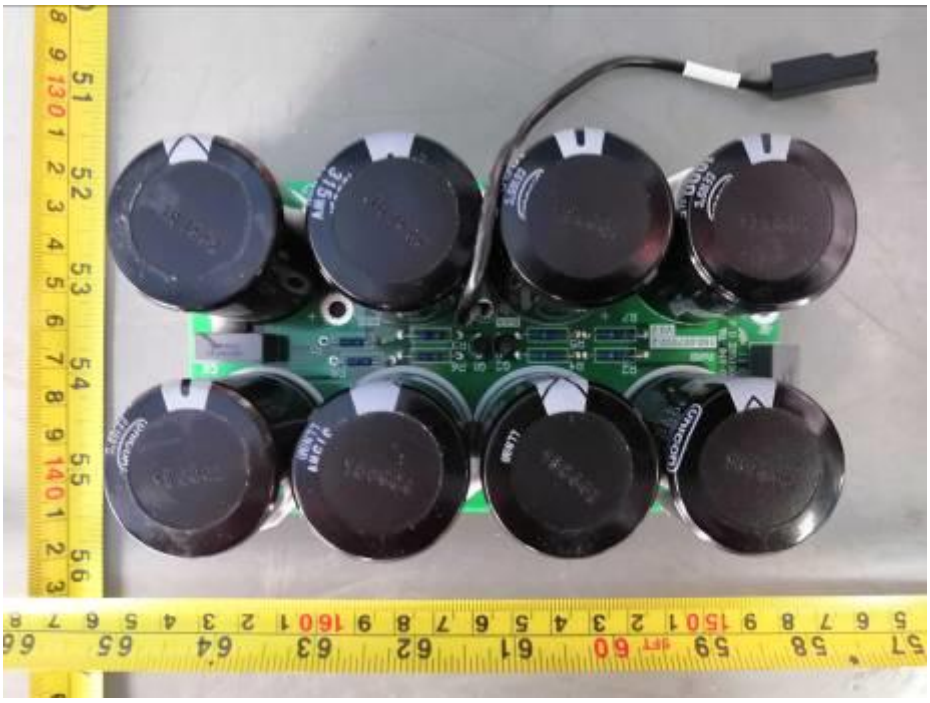
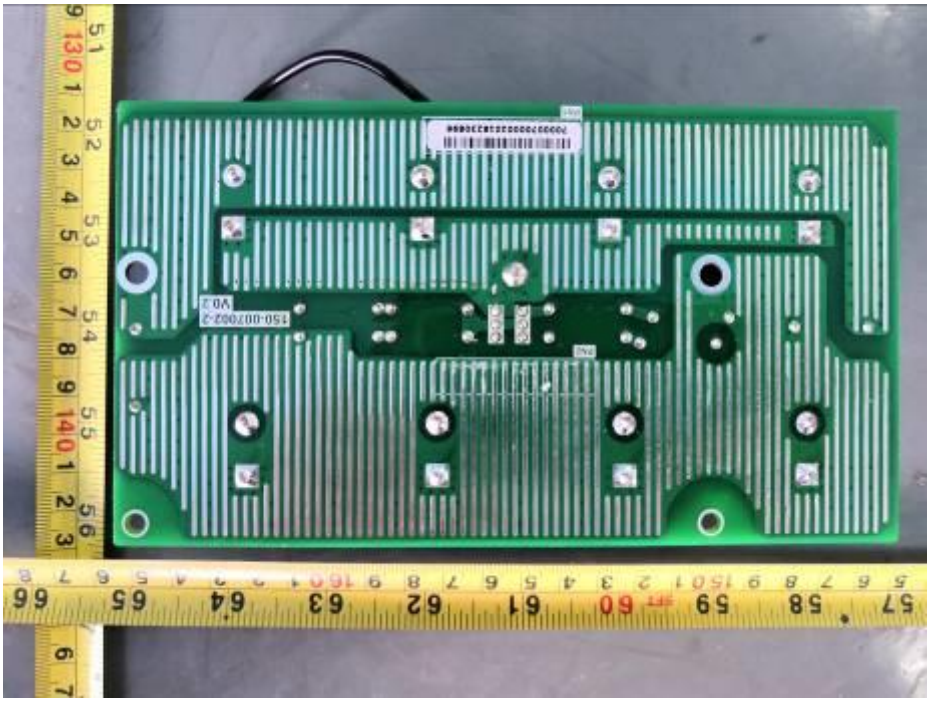
Grounding

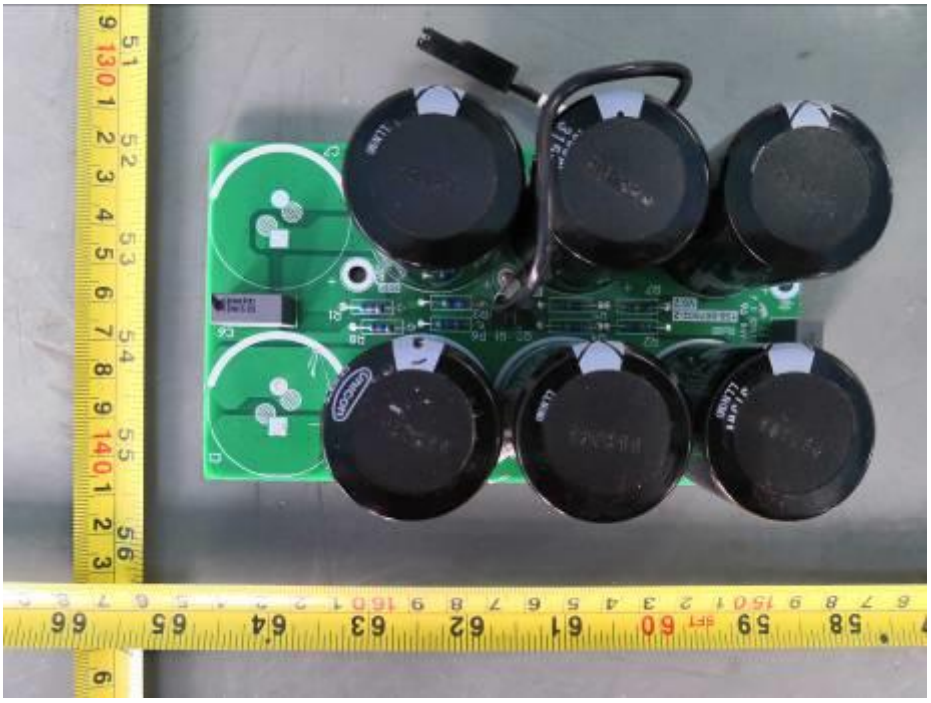
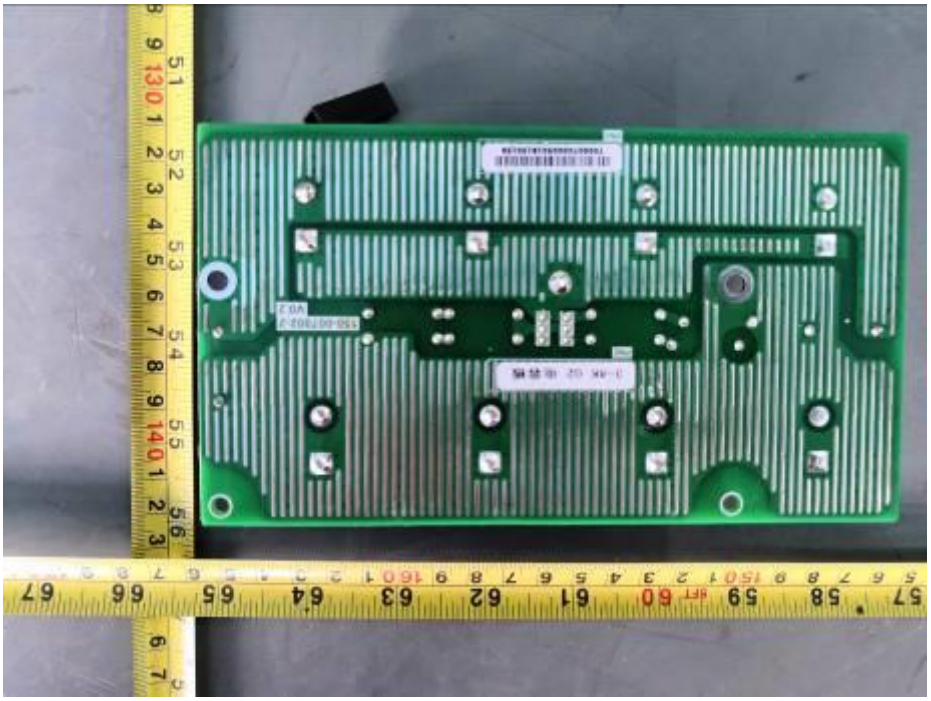
AC Ternimals

DC Ternimals


Front View of Power board

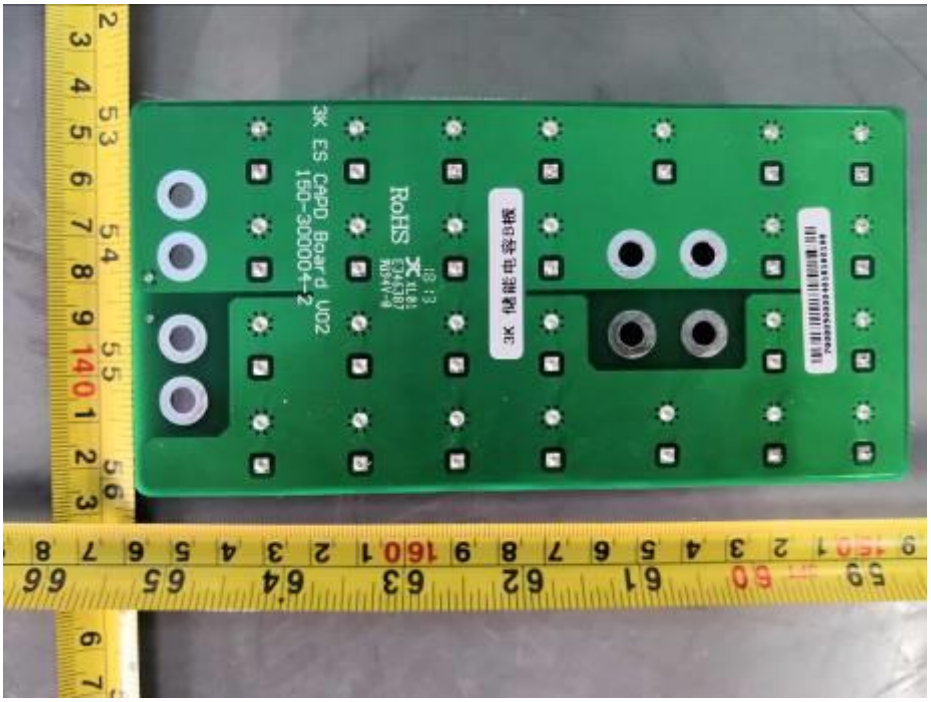
Back View of Power board


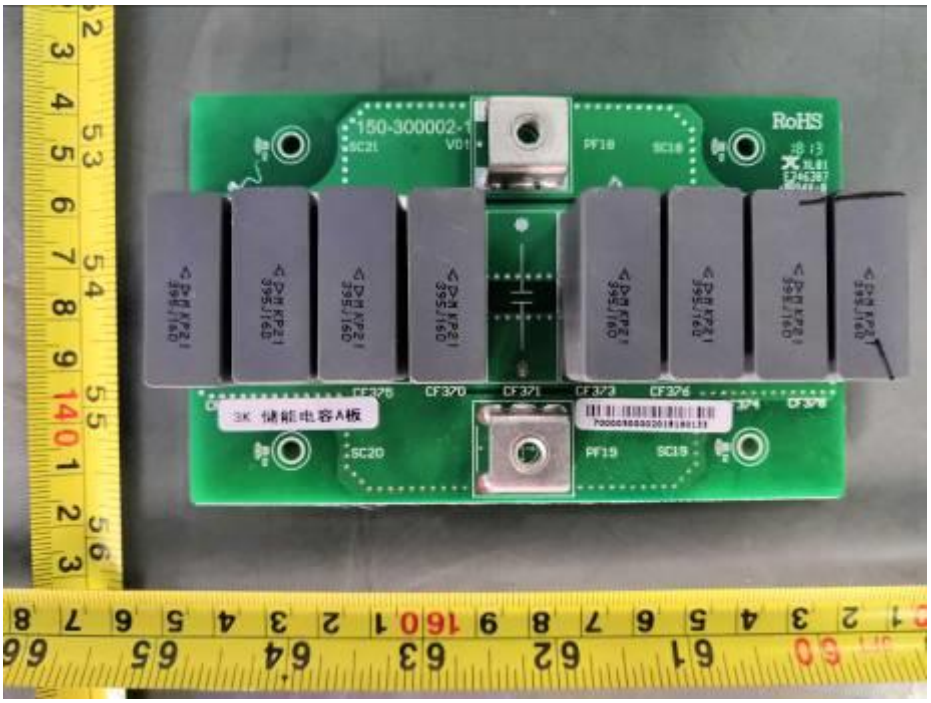
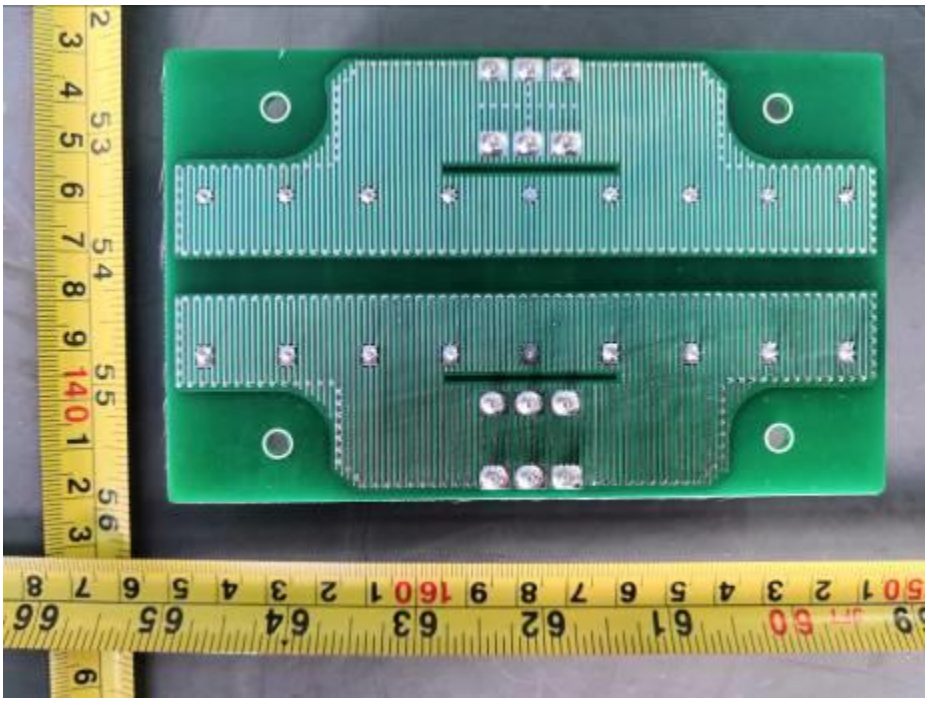
Front View of Input,output and communication board

Back View of Input,output and communication board


Front View of HYD 5000-ES, HYD 6000-ES Cap. board

Back View of HYD 5000-ES, HYD 6000-ES Cap. board


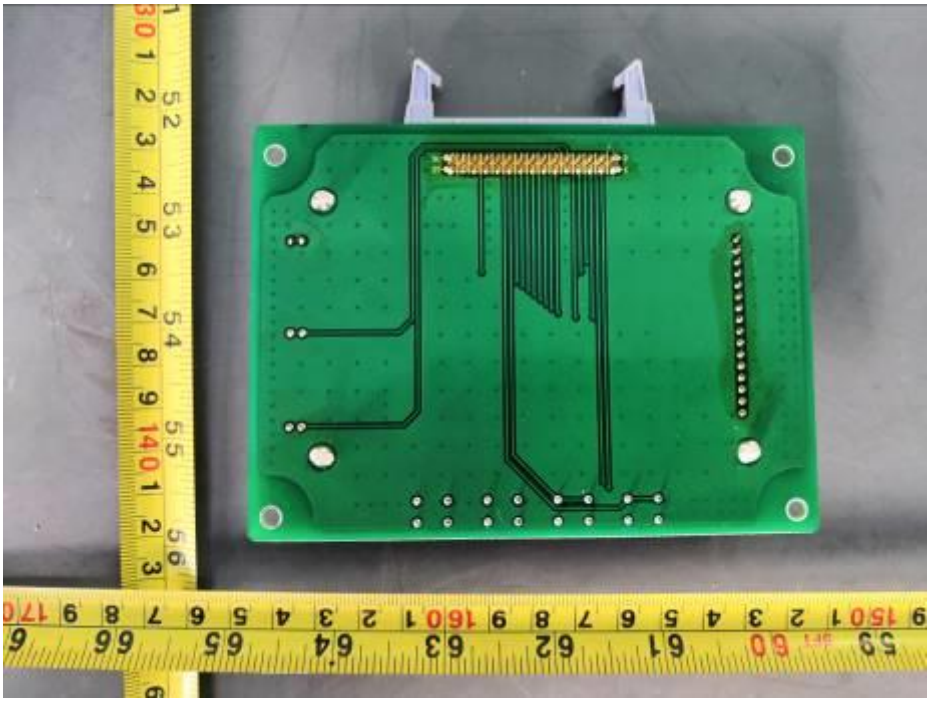
Front View of HYD 3000-ES, HYD 3600-ES, HYD 4000-ES Cap. board

Back View of HYD 3000-ES, HYD 3600-ES, HYD 4000-ES Cap. board


Front View of Cap board B

Back View of Cap board B


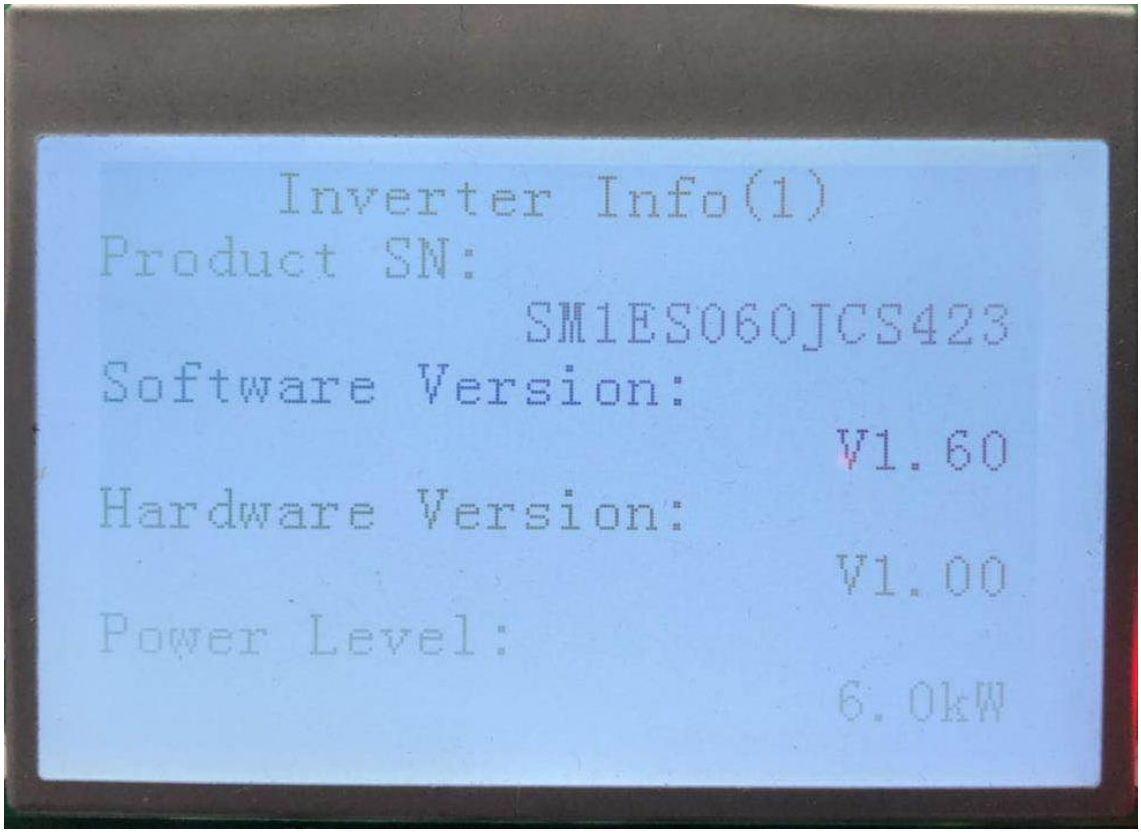
Front View of Cap board A

Back View of Cap board A


Front view of LED board

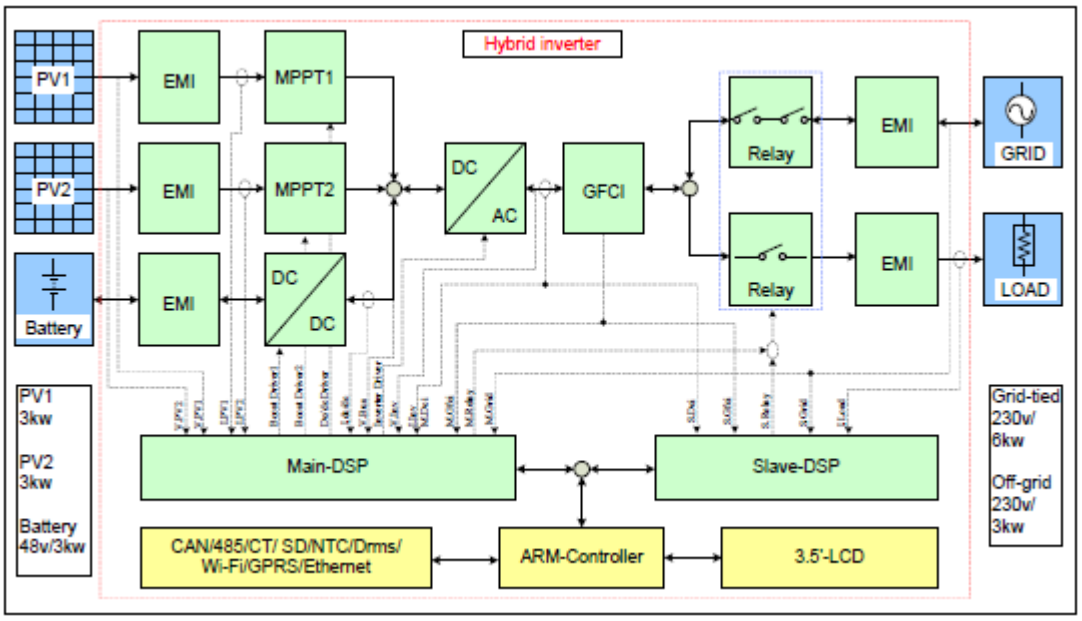
Back view of LED board


Front view of RS 232 board

Back view of RS 232 board


Serial Number and Software Version


6 ELECTRICAL SCHEMES



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