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TEST REPORT IEC 61727: 2004 Photovoltaic (PV) systems - Characteristics of the utility interface IEC 62116: 2014 Utility-interconnected photovoltaic inverters-Test procedure of islanding prevention measures	
Report Reference No.	ES191023018S
Compiled by (name + signature)	Winson Huang
Approved by (name + signature)	William Guo
Date of issue	October 30, 2019
Total number of pages	16 pages
Testing Laboratory name	EMTEK (Shenzhen) Co., Ltd.
Address	Bldg 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China
Testing location/ address	Same as above
Applicant's name	Cellcronic Technologies Private Limited
Address	Daniyalpur Chowk, Airport Road, Karnal, Haryana, India (132001)
Test specification:	
Standard.....	IEC 61727:2004 IEC 62116:2014
Test procedure.....	IEC report
Non-standard test method.....	N/A
Test Report Form No.	EN61727A
Test Report Form(s) Originator.....	EMTEK
Master TRF	Dated 2013-06
Test item description.....	Hybrid solar inverter
Trade Mark.....	 CELLCRONIC
Manufacturer	Cellcronic Technologies Private Limited
Address	Daniyalpur Chowk, Airport Road, Karnal, Haryana, India (132001)
Model/Type reference	Alpha V III 3Kw, 5kw-48v
Ratings	See the rating labels.

Summary of testing:

The product has been tested according to standard IEC 61727: 2004 & IEC 62116: 2014.

Copy of marking plate:

Model No. : Alpha V III 5kw-48v Serial No. :  96121512100001		Model No. : Alpha V III 3Kw-48v Serial No. :  96121512100001	
PV INPUT	Nominal operating voltage 360Vdc	PV INPUT	Nominal operating voltage 360Vdc
	Vmax PV 450Vdc		Vmax PV 450Vdc
	PV input voltage range 120-450Vdc		PV input voltage range 120-450Vdc
	Isc PV 18A		Isc PV 18A
	MPPT voltage range 225 ~ 430Vdc		MPPT voltage range 225 ~ 430Vdc
AC OUTPUT	Nominal operating voltage 230 Vac	AC OUTPUT	Nominal operating voltage 230 Vac
	Nominal output current 22A		Nominal output current 13A
	Nominal operating frequency 50/60Hz		Nominal operating frequency 50/60Hz
	Maximum power 5000W		Maximum power 3000W
	Power factor range 0.9 lead-0.9lag	AC INPUT	Nominal operating voltage 230Vac
AC INPUT	Nominal operating voltage 230Vac		Maximum input current 40A
	Maximum input current 40A	BATTERY	Nominal operating frequency 50/60Hz
	Nominal operating frequency 50/60Hz		Battery rated voltage 48Vdc
BATTERY	Battery rated voltage 48Vdc		Maximum battery current 82A
	Maximum battery current 137A		
Ambient temperature:-10~+55°C Enclosure:IP 21 Safety class I		Ambient temperature:-10~+55°C IP protection class :IP 21 Safety class I	
       		       	
WARNING-FIRE HAZARD. SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY CAUTION:THE DC AND AC BREAKER MUST HAVE BEEN TURNED OFF BEFORE SERVICING		WARNING-FIRE HAZARD. SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY CAUTION:THE DC AND AC BREAKER MUST HAVE BEEN TURNED OFF BEFORE SERVICING	

Possible test case verdicts:

- test case does not apply to the test object : N(/A, Not applicable)
- test object does meet the requirement..... : P (Pass)
- test object does not meet the requirement : F (Fail)

Testing

Date of receipt of test item..... : October 24, 2019

Date (s) of performance of tests..... : October 24, 2019 to October 30, 2019

General remarks:

"(see Attachment #)" refers to additional information appended to the report.

"(see appended table)" refers to a table appended to the report.

The tests results presented in this report relate only to the object tested.

This report shall not be reproduced except in full without the written approval of the testing laboratory.

List of test equipment must be kept on file and available for review.

Additional test data and/or information provided in the attachments to this report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

General product information:

1. Between the charger and PV input there has to be a 450VDC/18A circuit breaker. Between the charger and battery there has to be a 48VDC/82A breaker.

2. The charger is enclosed in the metal enclosure designed. It is manufactured to be mounted on a wall and its degree of protection is IP21.

3. Battery is not provided by manufacturer and is not checked in this report. A battery is only used as tool for test.

4. All model are identical to each other except for model number and output power rating.

The model InfiniSolar V II-5KW was choosed the main model for all test.

IEC 61727																			
Clause	Requirement – Test	Result - Remark	Verdict																
4	Utility compatibility		P																
4.1	Voltage, current and frequency	(see appended table)	P																
4.2	Normal voltage operating range		P																
4.3	Flicker	(see appended table)	P																
	The operation of the PV system should not cause voltage flicker in excess of limits stated in the relevant sections of IEC 61000-3-3 for systems less than 16 A or IEC 61000-3-5 for systems with current of 16 A and above		P																
4.4	DC injection	(see appended table)	P																
	The PV system shall not inject DC current greater than 1 % of the rated inverter output current, into the utility AC interface under any operating condition.		P																
4.5	Normal frequency operating range	(see appended table)	P																
	The PV system shall operate in synchronism with the utility system, and within the frequency trip limits defined in 5.2.2.		P																
4.6	Harmonics and waveform distortion	(see appended table)	P																
	Total harmonic current distortion shall be less than 5 % at rated inverter output. Each individual harmonic shall be limited to the percentages listed in Table 1 Table 1 – Current distortion limits <table><tr><td>Odd harmonics</td><td>Distortion limit</td></tr><tr><td>3rd through 9rd</td><td>Less than 4,0 %</td></tr><tr><td>11rd through 15rd</td><td>Less than 2,0 %</td></tr><tr><td>17rd through 21rd</td><td>Less than 1,5 %</td></tr><tr><td>23rd through 33rd</td><td>Less than 0,6 %</td></tr><tr><td>Even harmonics</td><td>Distortion limit</td></tr><tr><td>2rd through 8rd</td><td>Less than 1,0 %</td></tr><tr><td>10rd through 32rd</td><td>Less than 0,5 %</td></tr></table>	Odd harmonics	Distortion limit	3 rd through 9 rd	Less than 4,0 %	11 rd through 15 rd	Less than 2,0 %	17 rd through 21 rd	Less than 1,5 %	23 rd through 33 rd	Less than 0,6 %	Even harmonics	Distortion limit	2 rd through 8 rd	Less than 1,0 %	10 rd through 32 rd	Less than 0,5 %		P
Odd harmonics	Distortion limit																		
3 rd through 9 rd	Less than 4,0 %																		
11 rd through 15 rd	Less than 2,0 %																		
17 rd through 21 rd	Less than 1,5 %																		
23 rd through 33 rd	Less than 0,6 %																		
Even harmonics	Distortion limit																		
2 rd through 8 rd	Less than 1,0 %																		
10 rd through 32 rd	Less than 0,5 %																		
4.7	Power factor	(see appended table)	P																
	The PV system shall have a lagging power Factor greater than 0.9 when the output is Greater than 50% of the rated inverter		P																
	Output power		P																
5	Personnel safety and equipment protection		P																

IEC 61727															
Clause	Requirement – Test	Result - Remark	Verdict												
5.1	Loss of utility voltage		P												
	To prevent islanding ,a utility connected PV system shall cease to energize the utility System from a de-energized Distribution line irrespective of connected loads or other generators within specified Time limits	See clause 5.3	P												
	A utility distribution line can become de-energized for several reasons. For example a substation breaker opening due to fault conditions or the distribution line switched out during maintenance	AC relay is used	P												
	If inventers (single or multiple) have DC SELV Input and have accumulated power below 1 kW then no mechanical disconnect (relay) is required		P												
5.2	Over/under voltage and frequency		P												
5.2.1	Over/under voltage	See appended table	P												
	<div>When the interface voltage deviates Outside the conditions specified in Table 2, the photovoltaic system shall cease to energize the utility distribution system. This applies to any phase of a multiphase system</div> <div>Table 2 – Response to abnormal voltages</div> <table><tr><th>Voltage (at point of utility connection)</th><th>Maximum trip time*</th></tr><tr><td>V < 0,5 x V nominal</td><td>0,1 s</td></tr><tr><td>50 % ≤ 85 %</td><td>2,0 s</td></tr><tr><td>85 % ≤ V ≤ 110 %</td><td>Continuous operation</td></tr><tr><td>10 % < V < 135 %</td><td>2,0 s</td></tr><tr><td>135 % ≤ V</td><td>0,05 s</td></tr></table> <div>* Trip time refers to the time between the abnormal condition occurring and the inverter ceasing to energize the utility line. The PV system control circuits shall actually remain connected to the utility to allow sensing of utility electrical conditions for use by the “reconnect” feature.</div>	Voltage (at point of utility connection)	Maximum trip time*	V < 0,5 x V nominal	0,1 s	50 % ≤ 85 %	2,0 s	85 % ≤ V ≤ 110 %	Continuous operation	10 % < V < 135 %	2,0 s	135 % ≤ V	0,05 s		P
Voltage (at point of utility connection)	Maximum trip time*														
V < 0,5 x V nominal	0,1 s														
50 % ≤ 85 %	2,0 s														
85 % ≤ V ≤ 110 %	Continuous operation														
10 % < V < 135 %	2,0 s														
135 % ≤ V	0,05 s														
5. 2. 2	Over/under frequency	See appended table	P												
	When the utility frequency deviates outside the specified conditions the photovoltaic system shall		P												

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict
	cease to energize the utility line. The unit does not have to cease to energize if the frequency returns to the normal utility continuous operation condition within the specified trip time.		
	When the utility frequency is outside the range of ± 1 Hz, the system shall cease to energize the utility line within 0,2 s. The purpose of the allowed range and time delay is to allow continued operation for short-term disturbances and to avoid excessive nuisance tripping in weak-utility system conditions.		P
5.3	Islanding protection	See appended table	P
	The PV system must cease to energize the utility line within 2 s of loss of utility.	The test is performed in accordance with IEC62116	P
5.4	Response to utility recovery		P
	Following an out-of-range utility condition that has caused the photovoltaic system to cease energizing, the photovoltaic system shall not energize the utility line for 20 s to 5 min after the utility service voltage and frequency have recovered to within the specified ranges.	90s	P
5.5	Earthing		P
	The utility interface equipment shall be earthed/grounded in accordance with IEC 60364-7-712.	Protective bonding conductors are installed and they are parallel to and in close contacts with DC cables and AC cables	P
5.6	Short circuit protection		P
	The photovoltaic system shall have short-circuit Protection in accordance with IEC 60634-7-712		P
5.7	Isolation and switching		P
	A method of isolation and switching shall be provided in accordance with IEC 60634-7-712		P

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

Table 4.1a Voltage					P
Location	Measure(V)	Rated(V)	deviation	limit	Verdict
Output	230.60	230	0.261%	+7%, -7%	P
Remark: This measured is signal phase voltage and at 100% load					

TABLE 4.1 b Frequency					P
Location	Measured	Rate	deviation	limit	Verdict
Output	50.005Hz	50Hz	+0.005Hz	±0.5Hz	P

TABLE 4.3:flicker			P
Interval(10min)	Pst	Limits	
1	0.322	1	
2	0.344		
3	0.331		
4	0.324		
5	0.342		
6	0.332		
7	0.362		
8	0.338		
9	0.355		
10	0.362		
11	0.321		
12	0.336		
Plt	Limits		
0.42	0.65		

TABLE 4.4 DC current injection					P
Mains frequency Isolation transformer	Max output Current (A)	Required limit (mA)	Adc (mA)		
			10% output Power	50% output Power	100% output Power
No	137	1370	25	42	67

TABLE 4.6 Harmonic							
ODD HARMONIC CURRENT				EVEN HARMONIC CURRENT			
Order	Limits	Measurements (%)	Verdict	Order	Limits	Measurements (%)	Verdict
3rd	4.00%	1.444	P	2nd	1.00%	0.533	P
5th	4.00%	1.432	P	4th	1.00%	0.521	P
7th	4.00%	1.432	P	6th	1.00%	0.483	P
9th	4.00%	1.411	P	8th	1.00%	0.492	P
11th	2.00%	1.220	P	10th	0.50%	0.204	P
13th	2.00%	1.183	P	12th	0.50%	0.184	P
15th	2.00%	1.102	P	14th	0.50%	0.172	P
17th	1.50%	0.762	P	16th	0.50%	0.162	P
19th	1.50%	0.734	P	18th	0.50%	0.132	P
21st	1.50%	0.710	P	20th	0.50%	0.124	P
23rd	0.60%	0.218	P	22nd	0.50%	0.102	P
25th	0.60%	0.220	P	24th	0.50%	0.088	P
27th	0.60%	0.206	P	26th	0.50%	0.082	P
29th	0.60%	0.196	P	28th	0.50%	0.064	P
31st	0.60%	0.187	P	30th	0.50%	0.054	P
33rd	0.60%	0.182	P	32nd	0.50%	0.042	P

IEC 61727			
Clause	Requirement – Test	Result - Remark	Verdict

Total harmonic distortion (to the 33rd harmonic)		
LIMITS	MEASUREMENTS	Verdict
5%	3.768	P
Remark: this test is performed at full load		

Table 4.7: power factor			P
Load%	measured	limit	Verdict
50%	0.986	>0.9	P
100%	0.985	>0.9	P
Remark:			

Table 5.2: Under/over Voltage			P
Voltage (V)	Time (ms)	Limit (s)	Reconnection time (s)
180V ($U < 0.5 \times U_{\text{nominal}}$)	102.2ms	0.1s	90
300V ($0.5 \times U_{\text{nominal}} < U < 0.85 \times U_{\text{nominal}}$)	130.8ms	2.0s	90
306V ($U = 0.85 \times U_{\text{nominal}}$)	Continuous operation	Continuous operation	90
396V ($U = 1.1 \times U_{\text{nominal}}$)	Continuous operation	Continuous operation	90
480V ($1.1 \times U_{\text{nominal}} < U < 1.35 \times U_{\text{nominal}}$)	424.4ms	2.0s	90
500V ($1.35 \times U_{\text{nominal}} < U$)	25.30ms	0.05s	90
Remark:			

Table 5.2: Under/over frequency					P
Frequency (Hz)	Time (ms)			limit	Reconnection time (s)
	20%load	50%load	100%load		
51Hz	115.2ms	124.4ms	135.5ms	0.2s	90
49Hz	186.0ms	165.0ms	146.2ms	0.2s	90
Remark:					

IEC 62116			
Clause	Requirement – Test	Result - Remark	Verdict

Table 5.3: Islanding protection								P
Test No.	P _{EUT} (%EUT rating)	Reactive Power (%Q _L)	P _{AC} (% of nominal)	Q _{AC} (% of nominal)	Cut off time (ms)	P _{EUT} (kW)	V _{DC}	Remark
1	100	100	0	0	115.3	5.00	420	Test A BL
2	66	66	0	0	182.2	3.0	285	Test B BL
3	33	33	0	0	226.9	1.50	150	Test C BL
4	100	100	-5	-5	60.3	5.00	420	Test A IB
5	100	100	-5	0	100.0	5.00	420	Test A IB
6	100	100	-5	+5	55.2	5.00	420	Test A IB
7	100	100	0	-5	63.2	5.00	420	Test A IB
8	100	100	0	+5	69.5	5.00	420	Test A IB
9	100	100	+5	-5	63.1	5.00	420	Test A IB
10	100	100	+5	0	109.4	5.00	420	Test A IB
11	100	100	+5	+5	33.1	5.00	420	Test A IB
12	66	66	0	-5	154.2	3.0	285	Test B IB
13	66	66	0	-4	182.4	3.0	285	Test B IB
14	66	66	0	-3	130.0	3.0	285	Test B IB
15	66	66	0	-2	155.6	3.0	285	Test B IB
16	66	66	0	-1	171.2	3.0	285	Test B IB
17	66	66	0	+1	166.7	3.0	285	Test B IB
18	66	66	0	+2	149.2	3.0	285	Test B IB
19	66	66	0	+3	143.6	3.0	285	Test B IB
20	66	66	0	+4	208.5	3.0	285	Test B IB
21	66	66	0	+5	197.7	3.0	285	Test B IB
22	33	33	0	-5	195.2	1.50	150	Test C IB
23	33	33	0	-4	238.0	1.50	150	Test C IB
24	33	33	0	-3	190.5	1.50	150	Test C IB
25	33	33	0	-2	163.6	1.50	150	Test C IB
26	33	33	0	-1	184.3	1.50	150	Test C IB
27	33	33	0	+1	172.4	1.50	150	Test C IB
28	33	33	0	+2	143.1	1.50	150	Test C IB
29	33	33	0	+3	176.0	1.50	150	Test C IB
30	33	33	0	+4	165.7	1.50	150	Test C IB
31	33	33	0	+5	150.5	1.50	150	Test C IB
Remark: This test is performed in accordance with IEC62116								

Pictures

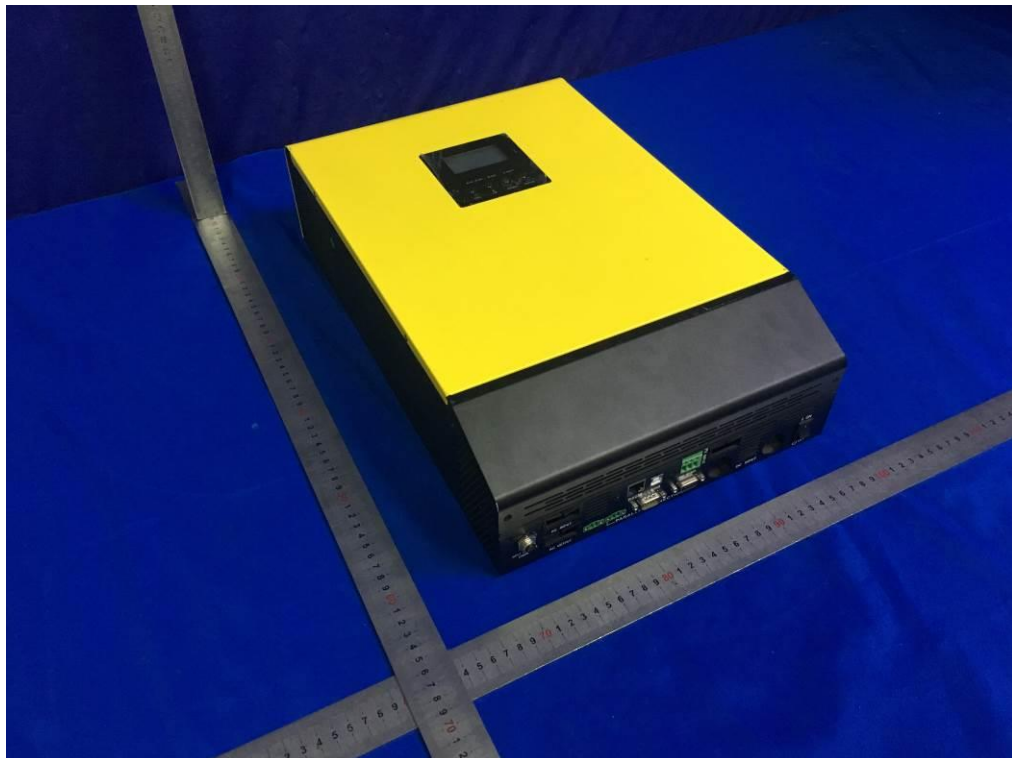


Fig.1---Over View I



Fig. 2---Over View II

Pictures

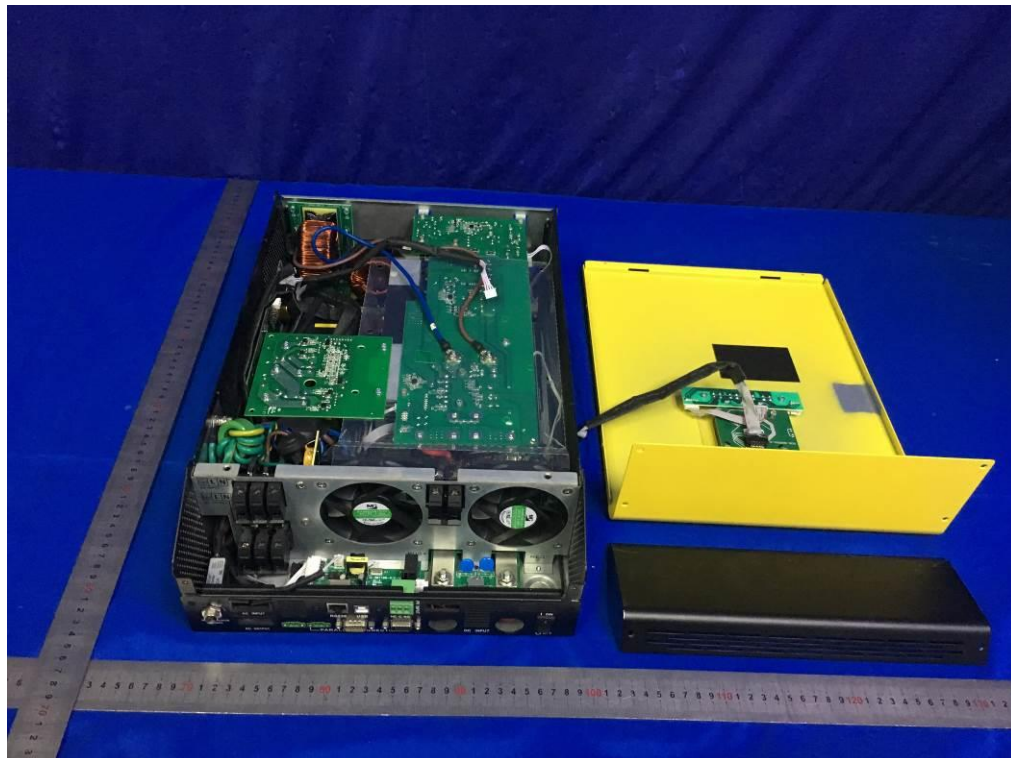


Fig. 3---Internal View (I)



Fig. 4---Internal View (II)

Pictures

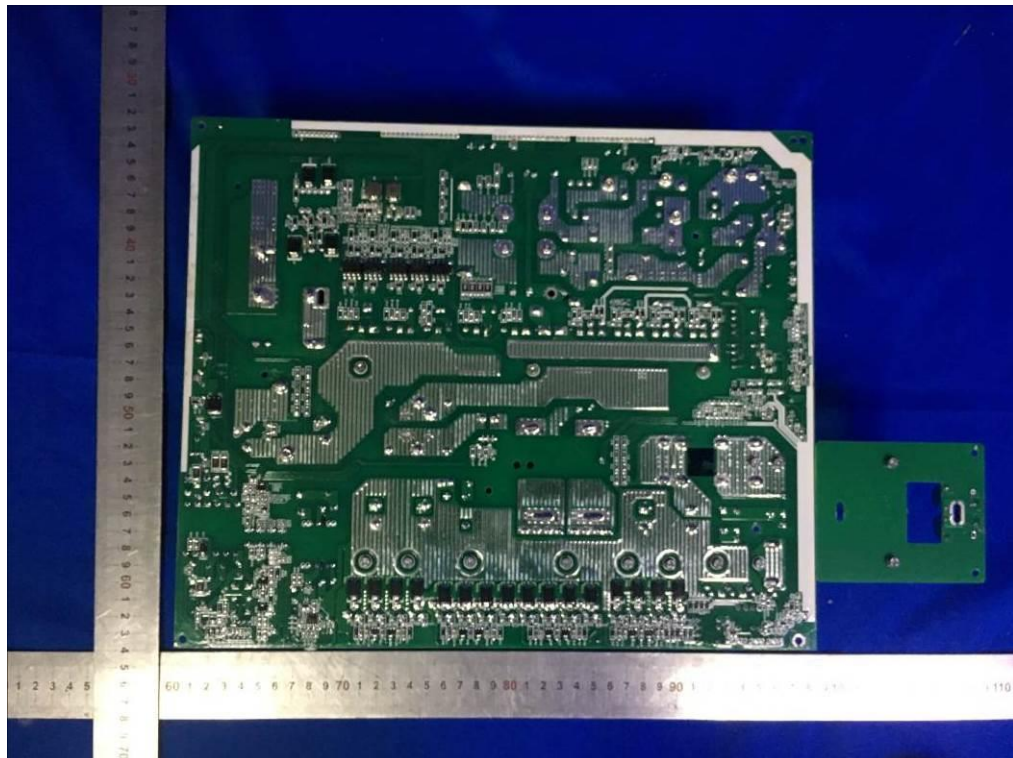


Fig. 5---PCB View

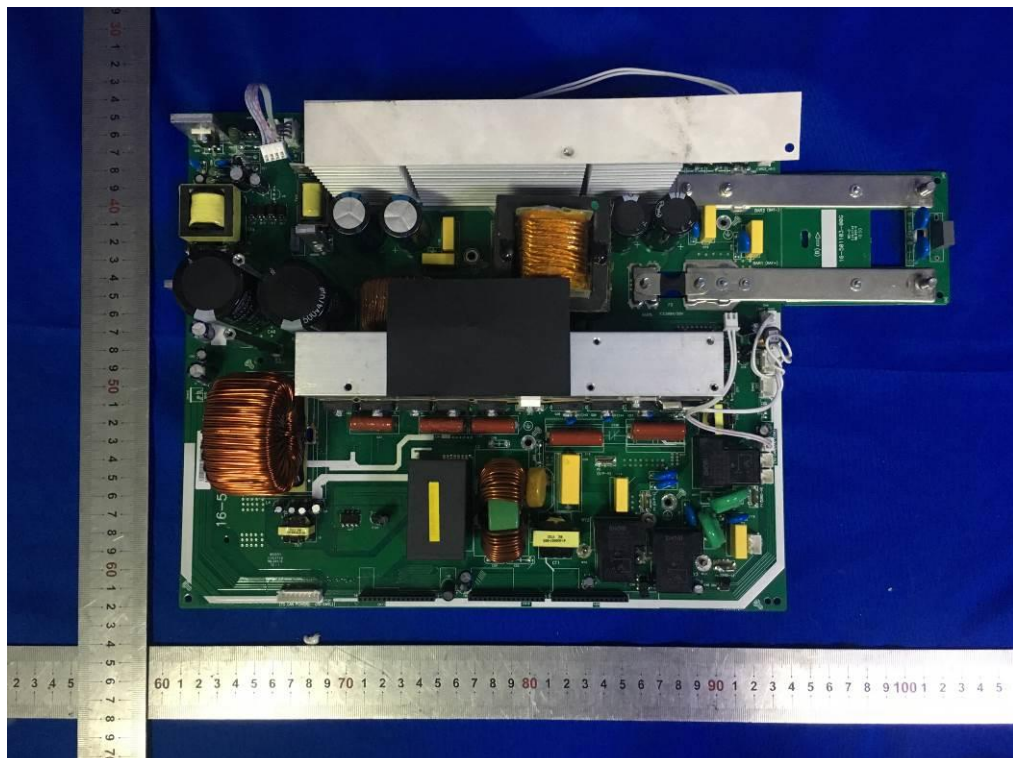


Fig. 6---PCB View

Pictures

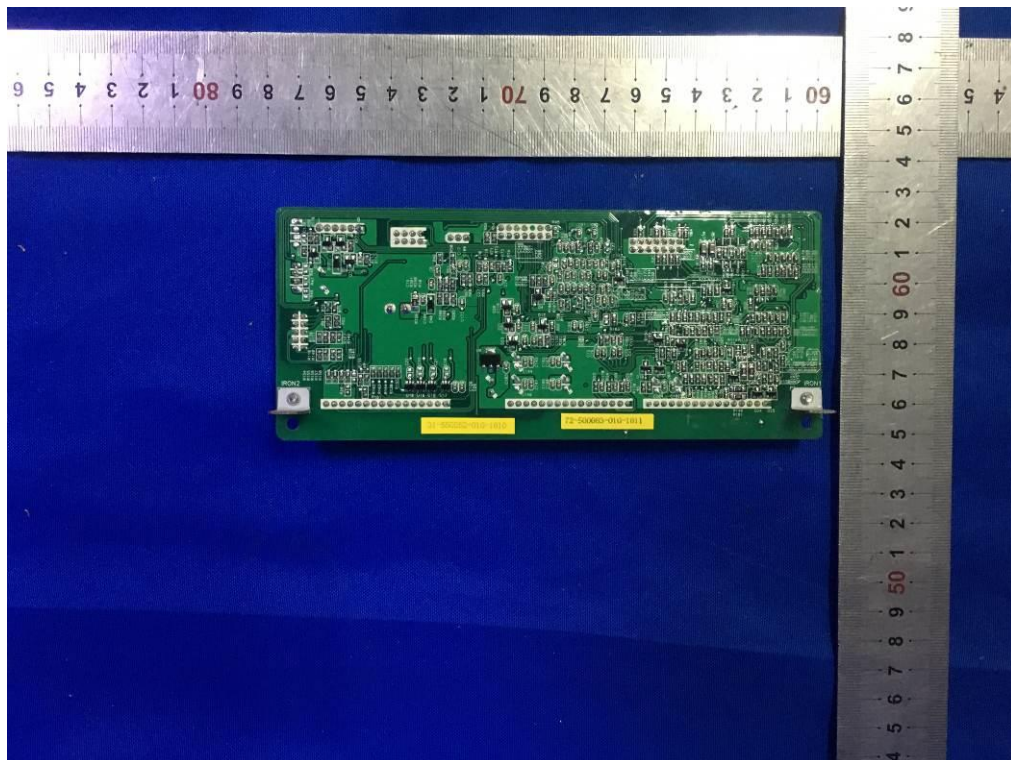


Fig. 7---PCB View

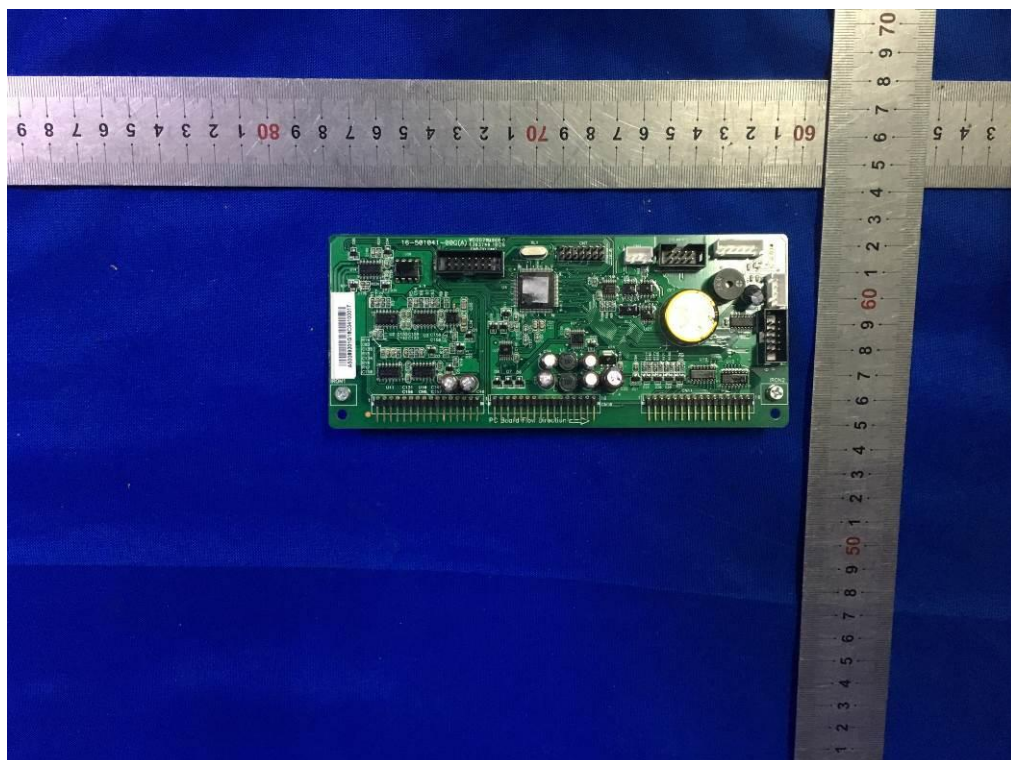


Fig. 8---PCB View

Pictures

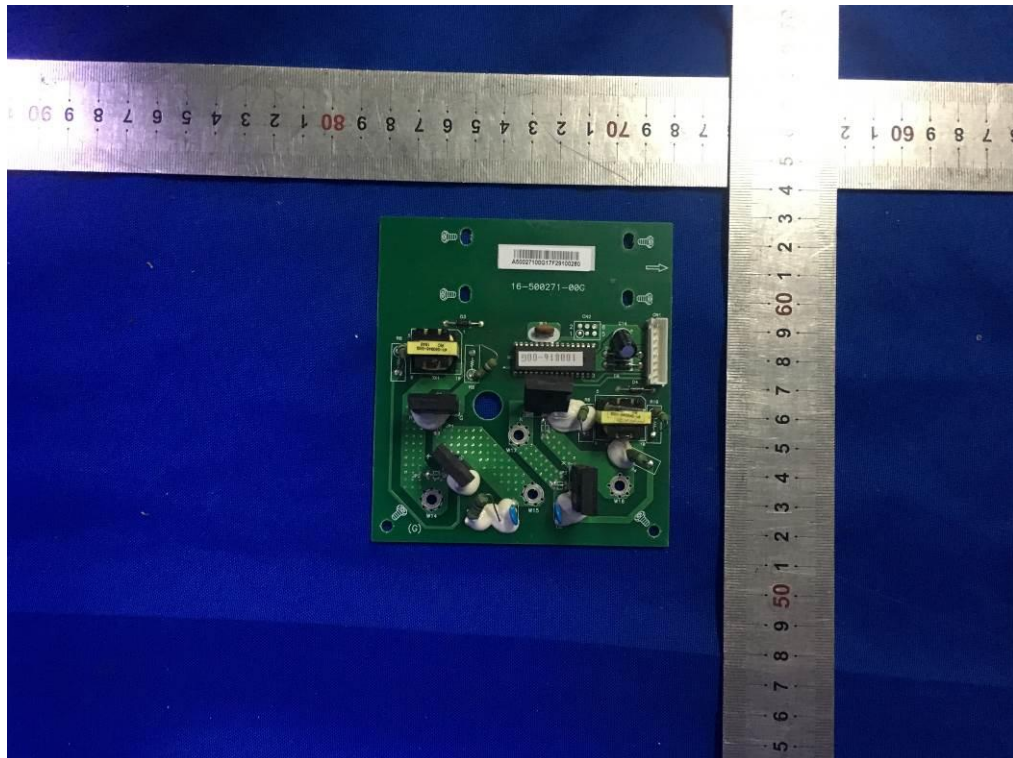


Fig. 9---PCB View

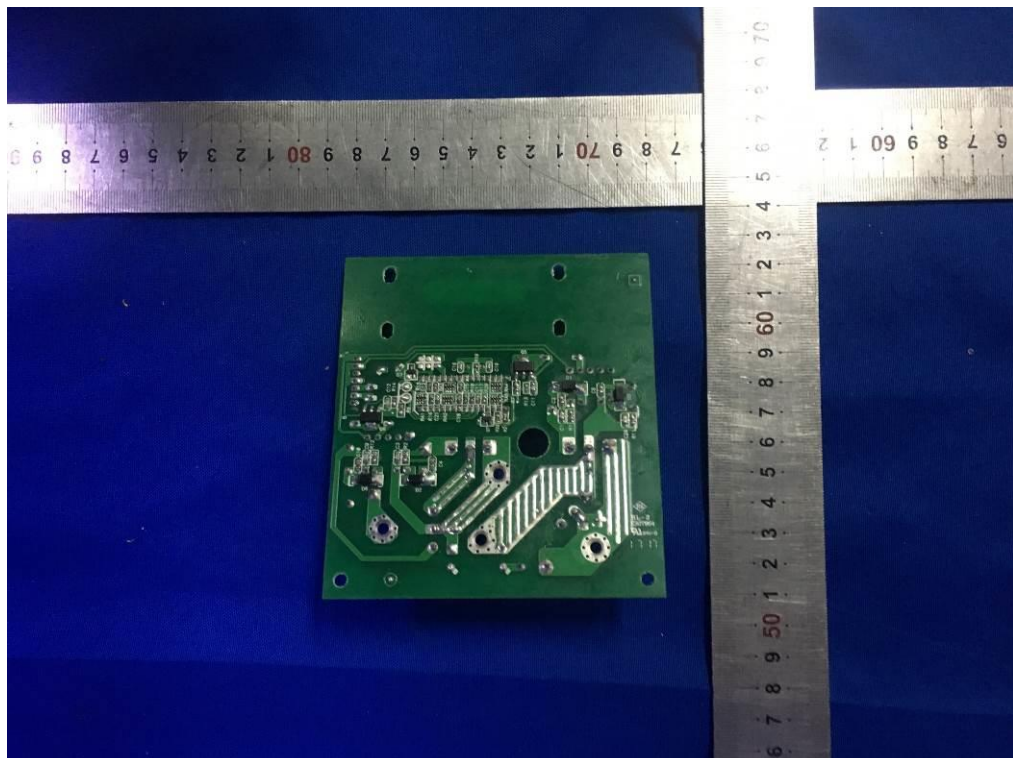


Fig. 10---PCB View

Pictures

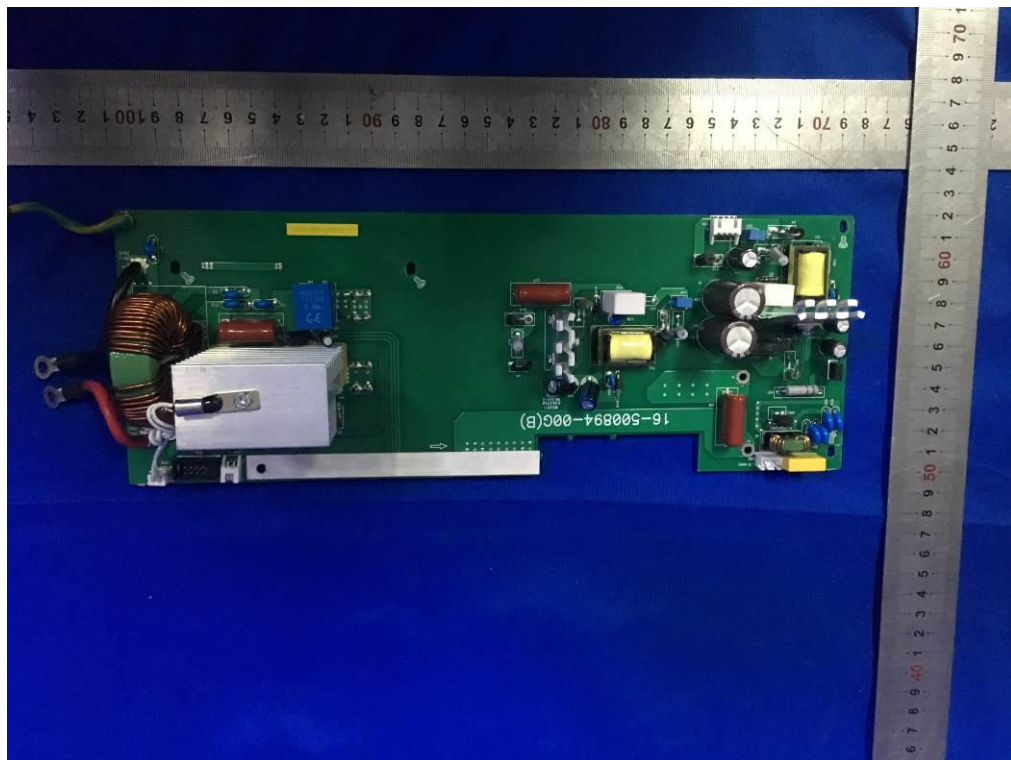


Fig. 11---PCB View

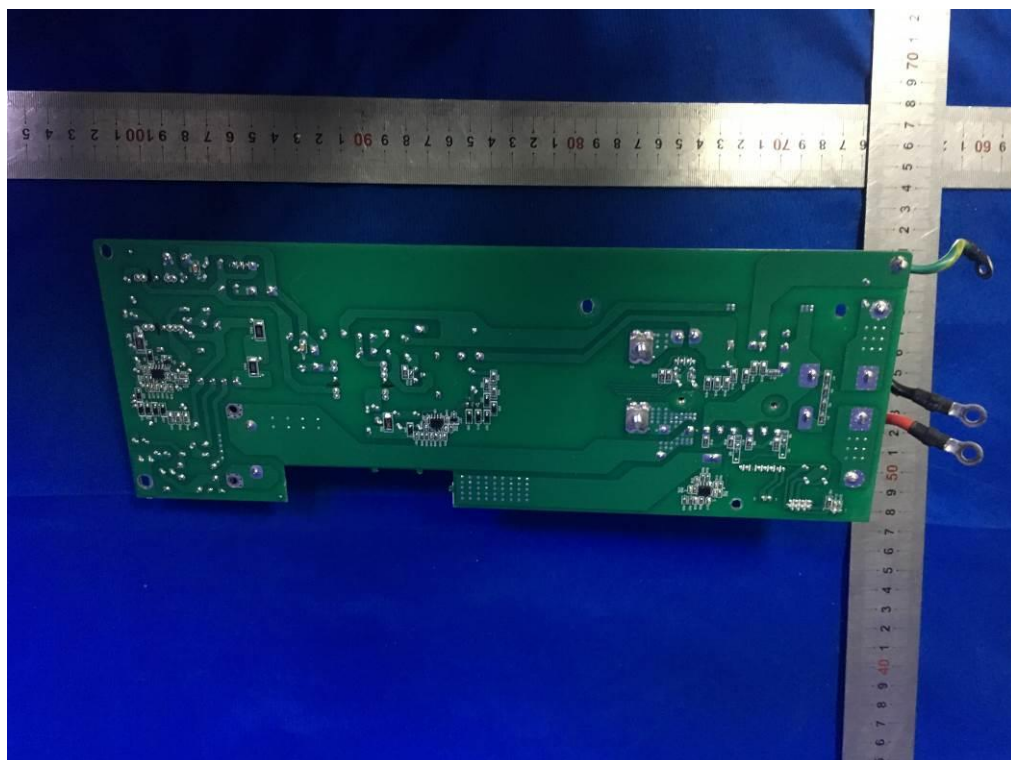


Fig. 12---PCB View

Pictures

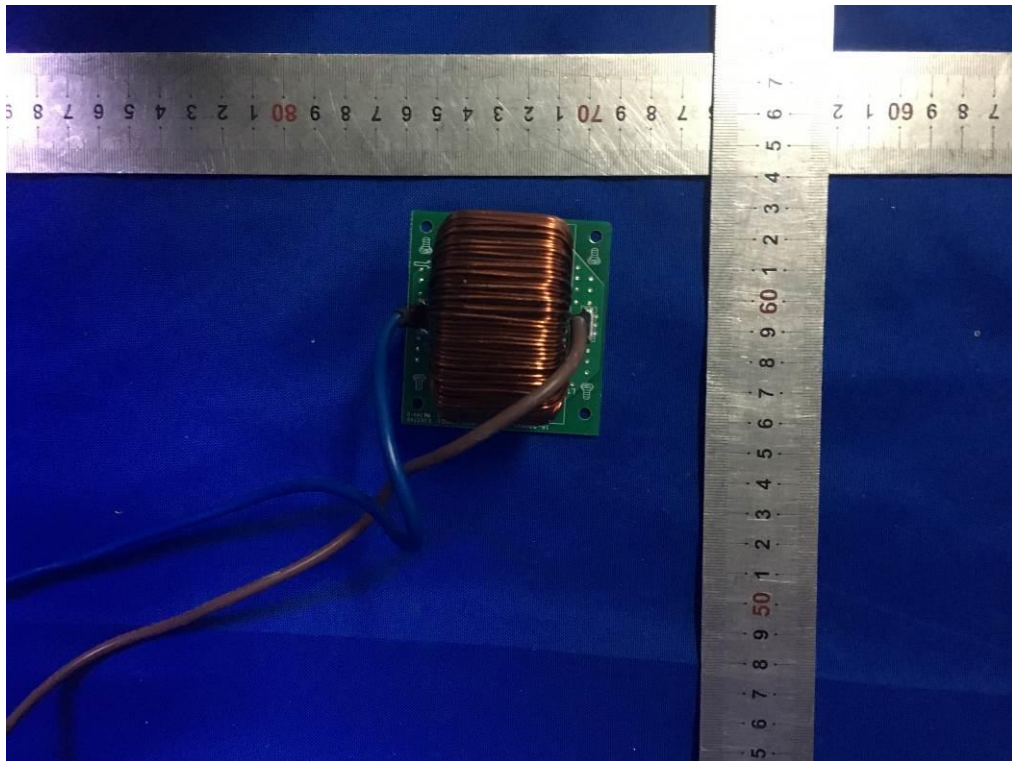


Fig. 13---PCB View

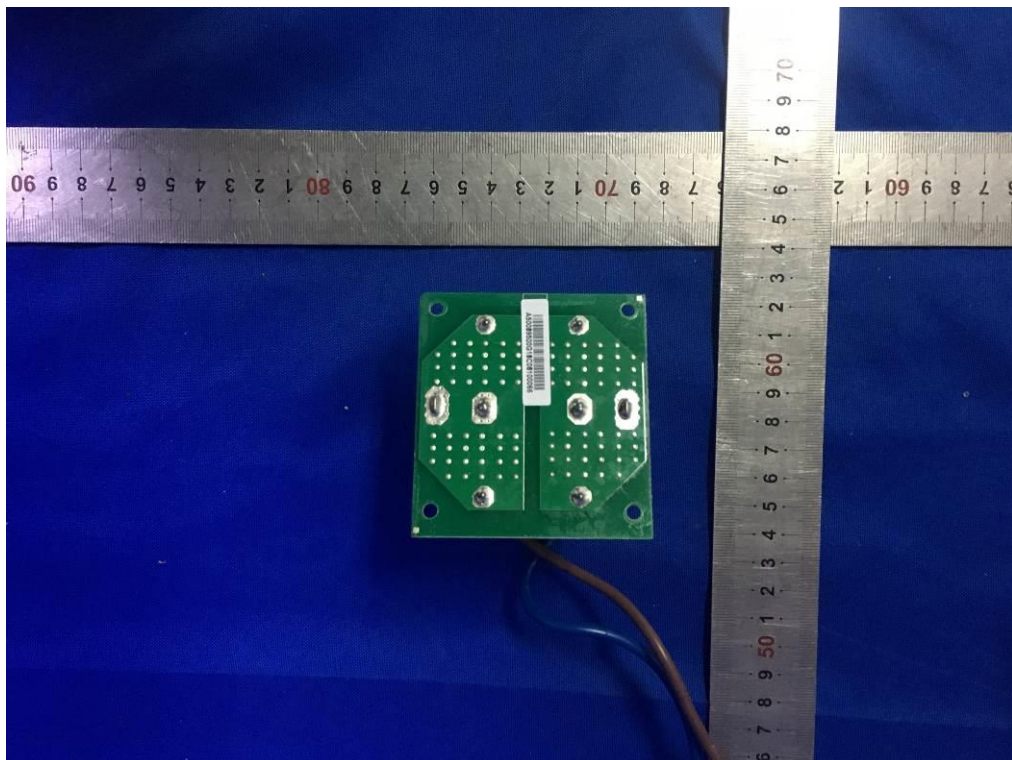


Fig. 14---PCB View