

TEST REPORT

Reference No..... : WTU14U1019331E
FCC ID : 2ADL4-QBULB01
Applicant..... : Belleds Technologies LLC
Address..... : 100 Memorial Drive RM 8-8C Cambridge,MA02142
Manufacturer : Bellnet Technologies Co.,Ltd.
Address..... : No.51 Zhujiang Road, New District, Wuxi,JiangSu,214028, PRC
Product Name..... : 2.4G RGB LED Bulb
Model No..... : BQ-BU-E26-07-CL-01
Trade Mark..... : N/A
Standards : FCC CFR47 Part 15 Section 15.249: 2014
Date of Receipt sample : Oct.23,2014
Date of Test : Oct.25~29, 2014
Date of Issue..... : Oct.30,2014
Test Result..... : Pass

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

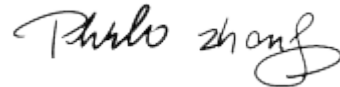
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Compiled by:

Approved by:



Zero Zhou / Project Engineer

Philo Zhong / Manager

2 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	PASS
Radiated Emission	15.249(a) 15.209 15.205(a)	PASS
Periodic Operation	15.35(c)	PASS
Outside of Band Emission	15.249 15.205 15.209	PASS
20dB Bandwidth	15:215(c)	PASS
Antenna Requirement	15.203	PASS

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4 General Information

4.1 General Description of E.U.T.

Product Name : 2.4G RGB LED Bulb
 Model No. : BQ-BU-E26-07-CL-01
 Model Differences : N/A
 Type of Modulation : GFSK
 Frequency Range : 2462MHz
 The Lowest Oscillator : 12MHz
 Antenna installation : PCB Printed Antenna

4.2 Details of E.U.T.

Technical Data : N/A
 Adapter :

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2462	/	/	/	/	/	/
/	/	/	/	/	/	/	/

4.4 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **IC – Registration No.:7760A-1**

Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration number 7760A-1, July 12, 2012.

- **FCC – Registration No.: 880581**

Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 880581, October 30, 2014.

4.4.1 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Middle channel
Transmitting	2462MHz

5 Equipment Used during Test

5.1 Equipments List

3m Semi-anechoic Chamber for Radiation						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	EMC Analyzer	Agilent	E7405A	MY4511494 3	Sep.15,2014	Sep.14,2015
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Sep.15,2014	Sep.14,2015
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Sep.15,2014	Sep.14,2015
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.15,2014	Sep.14,2015
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Sep.15,2014	Sep.14,2015
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Sep.15,2014	Sep.14,2015
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Sep.15,2014	Sep.14,2015
8	Coaxial Cable (above 1GHz)	Top	25MHz-18GHz	EW02014-7	Sep.15,2014	Sep.14,2015

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-6}$
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)

5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

6 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.4:2003
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class/Severity:	Class B
Limit:	66-56 dB μ V between 0.15MHz & 0.5MHz 56 dB μ V between 0.5MHz & 5MHz 60 dB μ V between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)

6.1 E.U.T. Operation

Operating Environment :

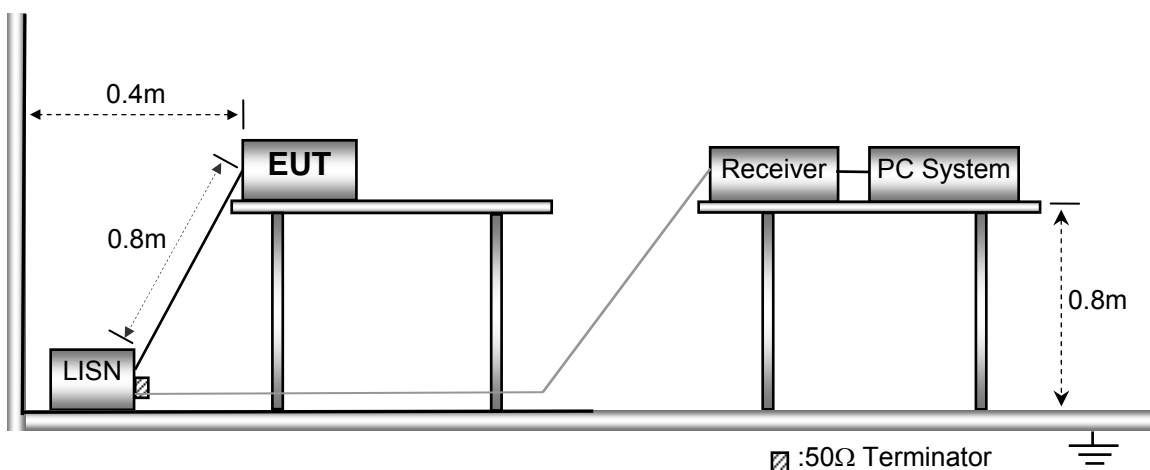
Temperature:	25.5 °C
Humidity:	51 % RH
Atmospheric Pressure:	101.2kPa

EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

6.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.4:2003.

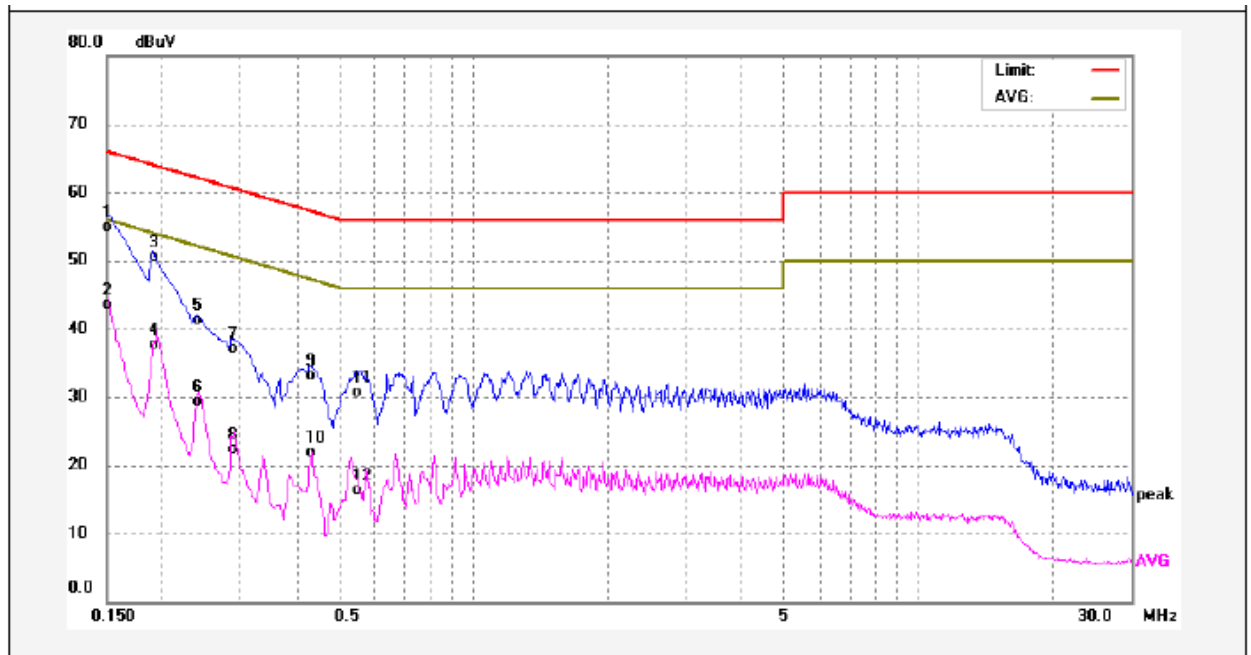


6.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

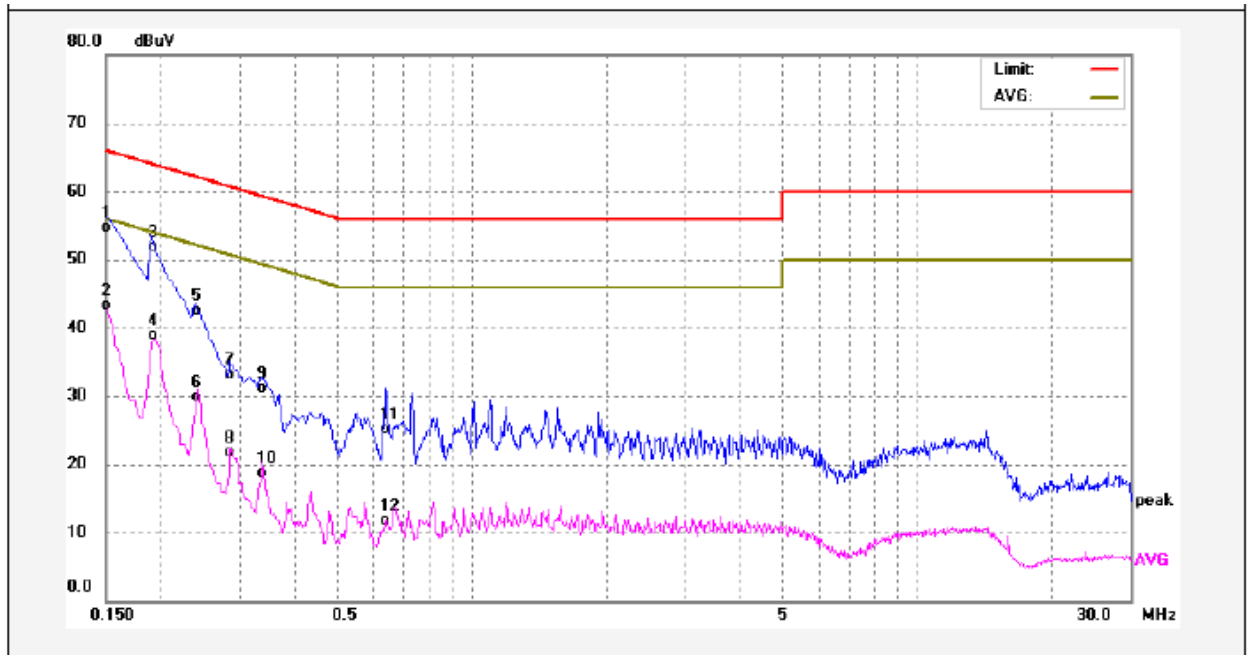
6.4 Test Result

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	45.23	9.76	54.99	65.99	-11.00	QP	
2	0.1500	33.69	9.76	43.45	55.99	-12.54	AVG	
3	0.1900	40.72	9.74	50.46	64.03	-13.57	QP	
4	0.1900	27.97	9.74	37.71	54.03	-16.32	AVG	
5	0.2380	31.59	9.72	41.31	62.16	-20.85	QP	
6	0.2380	19.54	9.72	29.26	52.16	-22.90	AVG	
7	0.2860	27.32	9.72	37.04	60.64	-23.60	QP	
8	0.2860	12.57	9.72	22.29	50.64	-28.35	AVG	
9	0.4300	23.42	9.69	33.11	57.25	-24.14	QP	
10	0.4300	12.29	9.69	21.98	47.25	-25.27	AVG	
11	0.5580	21.08	9.67	30.75	56.00	-25.25	QP	
12	0.5580	6.67	9.67	16.34	46.00	-29.66	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Remark
1	0.1500	45.00	9.62	54.62	65.99	-11.37	QP	
2	0.1500	33.70	9.62	43.32	55.99	-12.67	AVG	
3	0.1900	42.31	9.64	51.95	64.03	-12.08	QP	
4	0.1900	29.19	9.64	38.83	54.03	-15.20	AVG	
5	0.2380	32.91	9.64	42.55	62.16	-19.61	QP	
6	0.2380	20.23	9.64	29.87	52.16	-22.29	AVG	
7	0.2860	23.48	9.65	33.13	60.64	-27.51	QP	
8	0.2860	12.01	9.65	21.66	50.64	-28.98	AVG	
9	0.3339	21.39	9.66	31.05	59.35	-28.30	QP	
10	0.3339	8.97	9.66	18.63	49.35	-30.72	AVG	
11	0.6380	15.44	9.68	25.12	56.00	-30.88	QP	
12	0.6380	1.94	9.68	11.62	46.00	-34.38	AVG	

7 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249

Test Method: ANSI 63.4: 2003

Measurement Distance: 3m

Test Result: PASS

15.249(a)Limit:

Fundamental frequency	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBuV/m	uV/m	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	108	2500	68

15.209 Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

Note: RF Voltage(dBuV)= $20 \log_{10}$ RF Voltage(uV)

7.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

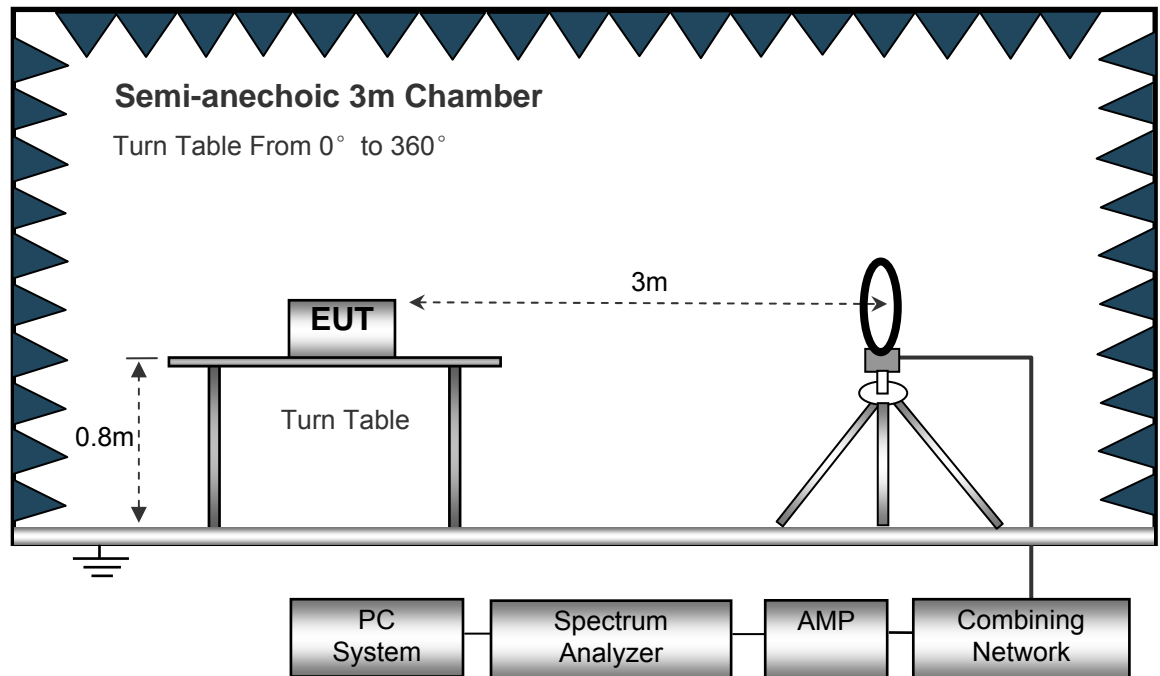
EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

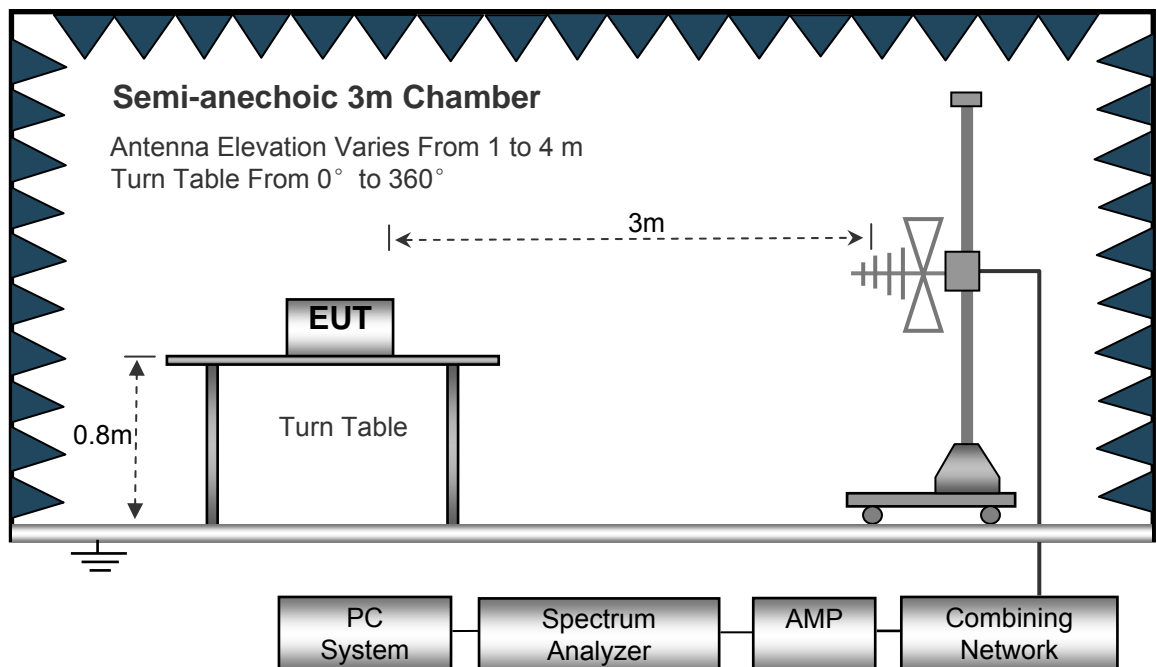
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.4: 2003.

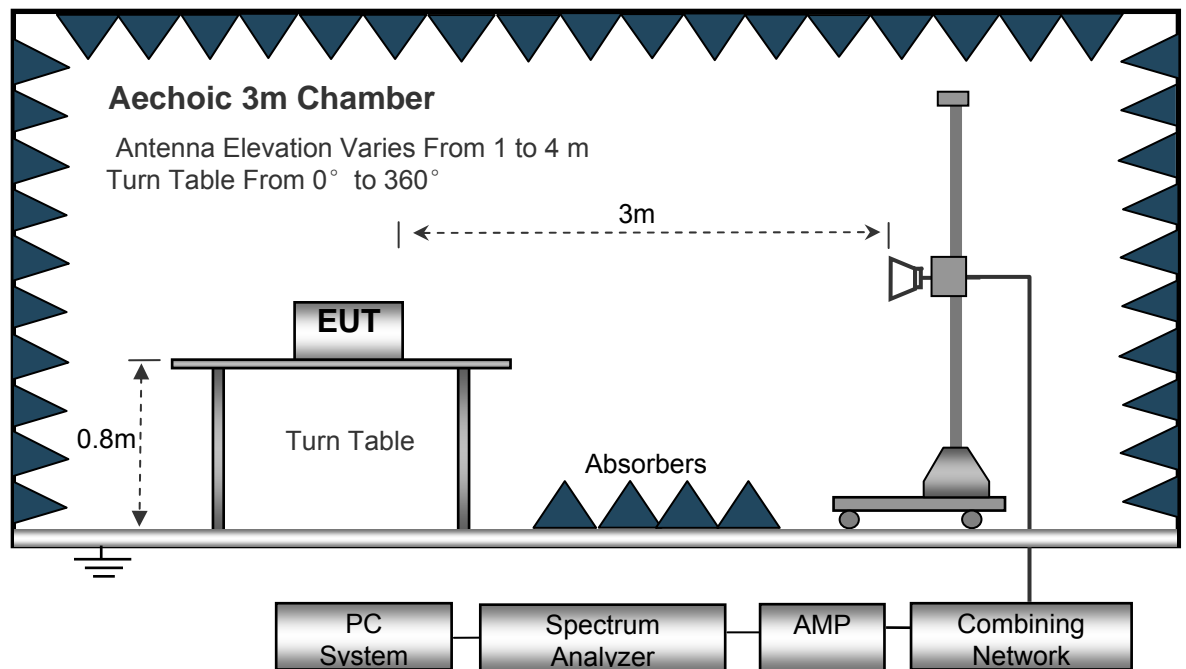
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Below 30MHz

Sweep SpeedAuto
 IF Bandwidth.....10kHz
 Video Bandwidth10kHz
 Resolution Bandwidth10kHz

30MHz ~ 1GHz

Sweep SpeedAuto
 DetectorPK
 Resolution Bandwidth.....100kHz
 Video Bandwidth300kHz

Above 1GHz

Sweep SpeedAuto
 DetectorPK
 Resolution Bandwidth.....1MHz
 Video Bandwidth3MHz
 DetectorAve.
 Resolution Bandwidth.....1MHz
 Video Bandwidth10Hz

7.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

7.5 Test Result

$AV = \text{Peak} + 20\log_{10}(\text{duty cycle}) = PK - 13.62$ [refer to section 8 for more detail]

Test Frequency :Below 30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~ 18GHz

Test Mode: Middle channel Transmitting

Frequency	Receiver Reading (PK)	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude (PK)	FCC Part 15.249/209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
42.63	14.22	296	1.2	V	14.52	28.74	40.00	-11.26
942.01	13.18	54	1.1	V	26.59	39.77	46.00	-6.23
2462.00	112.22	241	1.6	H	-13.08	99.14	114.00	-14.86
2462.00	108.25	164	1.1	V	-13.08	95.17	114.00	-18.83
4924.00	62.34	343	1.0	H	0.09	62.43	74.00	-11.57
4924.00	61.24	100	1.7	V	0.09	61.33	74.00	-12.67
7386.00	54.23	276	1.3	H	3.01	57.24	74.00	-16.76
7386.00	52.49	259	1.8	V	3.01	55.50	74.00	-18.50
9848.00	51.38	57	1.7	H	5.39	56.77	74.00	-17.23
9848.00	52.14	311	1.8	V	5.39	57.53	74.00	-16.47

Frequency	PK	RX Antenna Polar	Duty cycle Factor	Calculated AV	FCC Part 15.249/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2462.00	99.14	H	-13.62	85.52	94.00	-8.48
2462.00	95.17	V	-13.62	81.55	94.00	-12.45
4924.00	62.43	H	-13.62	48.81	54.00	-5.19
4924.00	61.33	V	-13.62	47.71	54.00	-6.29
7386.00	57.24	H	-13.62	43.62	54.00	-10.38
7386.00	55.50	V	-13.62	41.88	54.00	-12.12

9848.00	56.77	H	-13.62	43.15	54.00	-10.85
9848.00	57.53	V	-13.62	43.91	54.00	-10.09

Test Frequency :From 18GHz to 25GHz

The measurements were more than 20 dB below the limit and not reported.

8 Periodic Operation

The duty cycle was determined by the following equation:

To calculate the actual field intensity, the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %

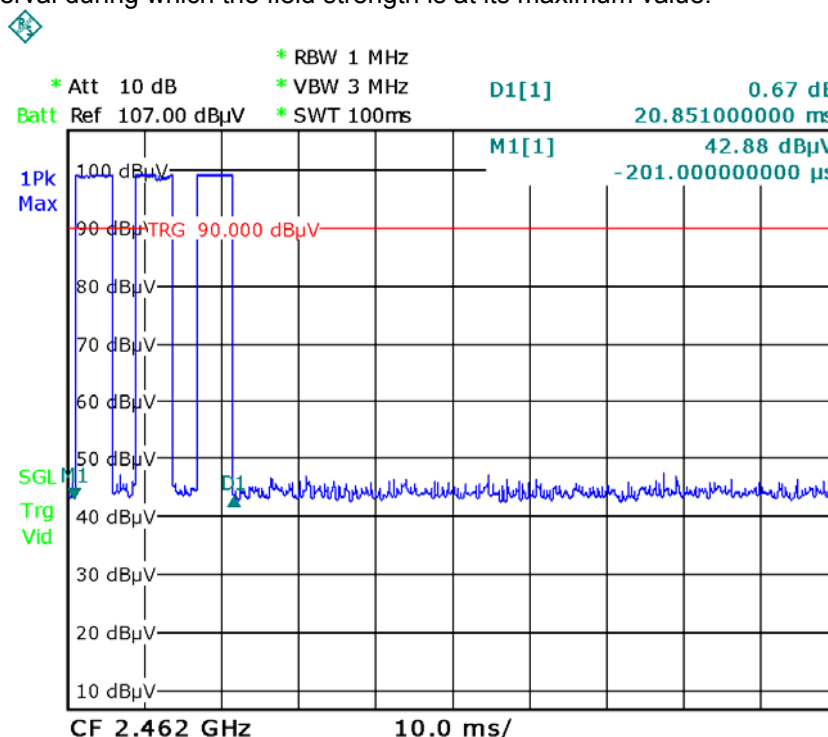
Duty Cycle Correction Factor(dB)=20 * Log₁₀(Duty Cycle(%))

Total transmission time(ms)	20.851
Length of a complete transmission period(ms)	100
Duty Cycle(%)	28.85
Duty Cycle Correction Factor(dB)	-13.6175

Refer to the duty cycle plot (as below), This device meets the FCC requirement.

Length of a complete pulse train:

Remark: FCC part15.35(c) required that a complete pulse train is more than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.



9 Outside of Band Emission

Test Requirement:	15.249(d):Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
Test Method:	ANSI C63.4:2003
Test Mode:	Transmitting

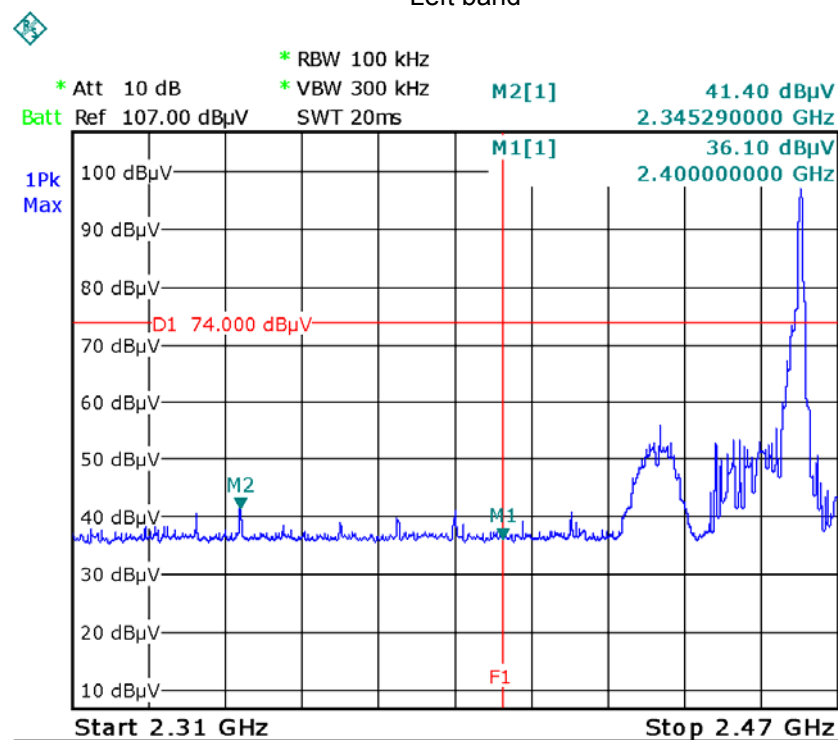
9.1 Test Procedure

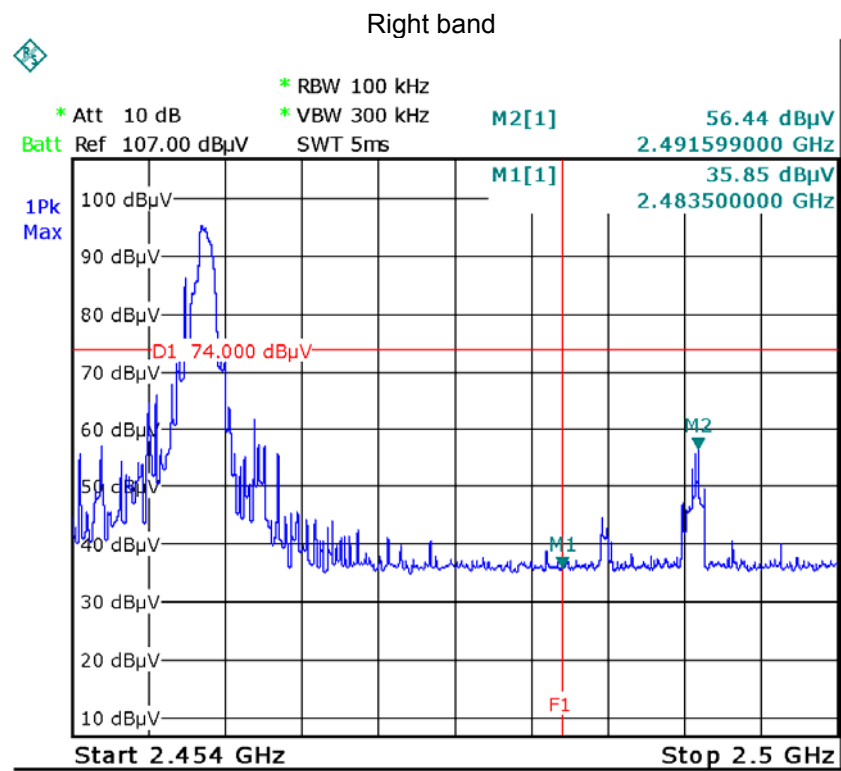
Refer to section 7.4 of this test report.

9.2 Test Result

Test plots

Left band





10 20 dB Bandwidth Measurement

Test Requirement:

FCC CFR47 Part 15 Section 15.215(c)

Test Method:

ANSI C63.4:2003

Test Mode:

Transmitting

10.1 Test Procedure

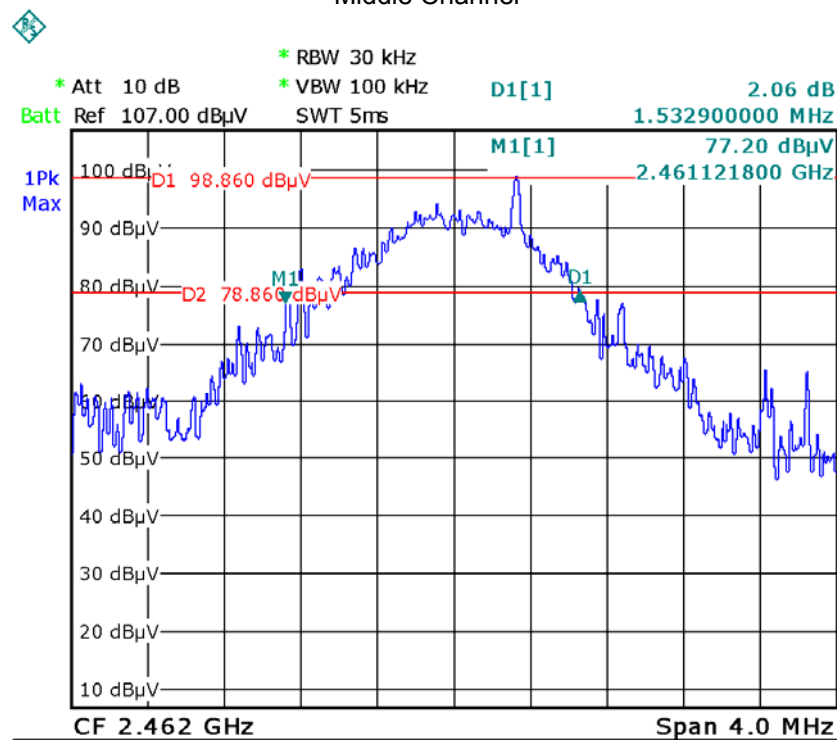
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

10.2 Test Result

Test Channel	Bandwidth
Middle	1.5329MHz

Test plots

Middle Channel

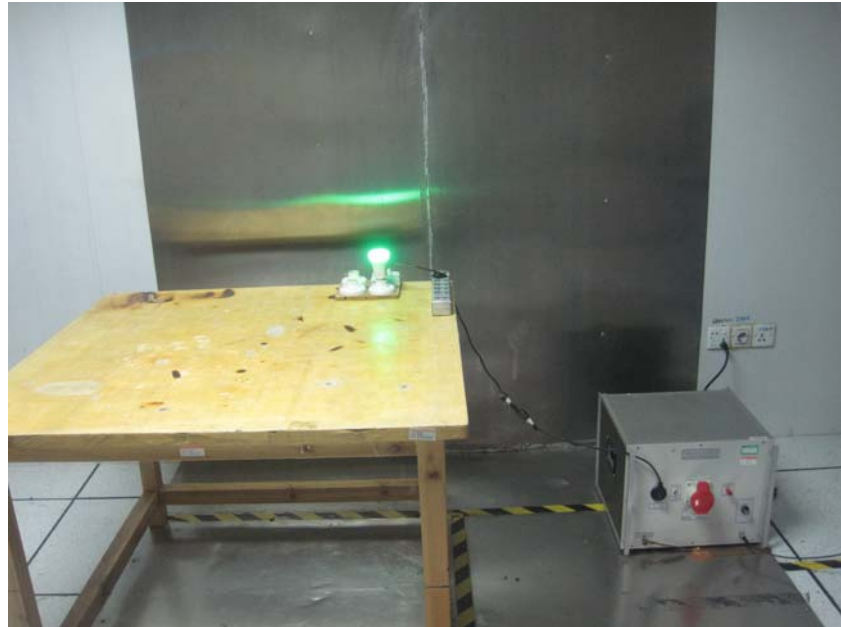


11 Antenna Requirement

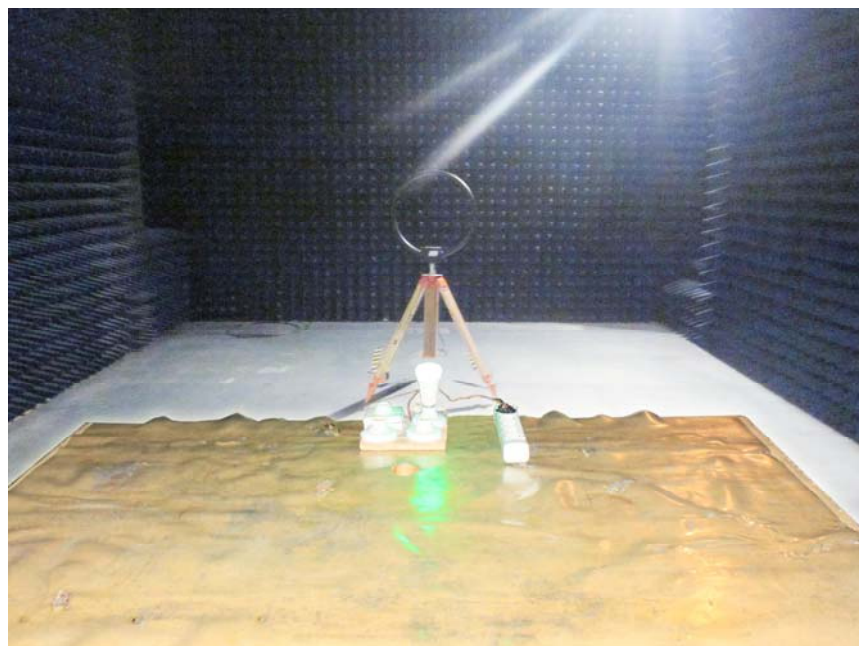
According to the FCC Part 15 Paragraph 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. This product has a PCB printed, fulfil the requirement of this section.

12 Photographs- BQ-BU-E26-07-CL-01 Test Setup

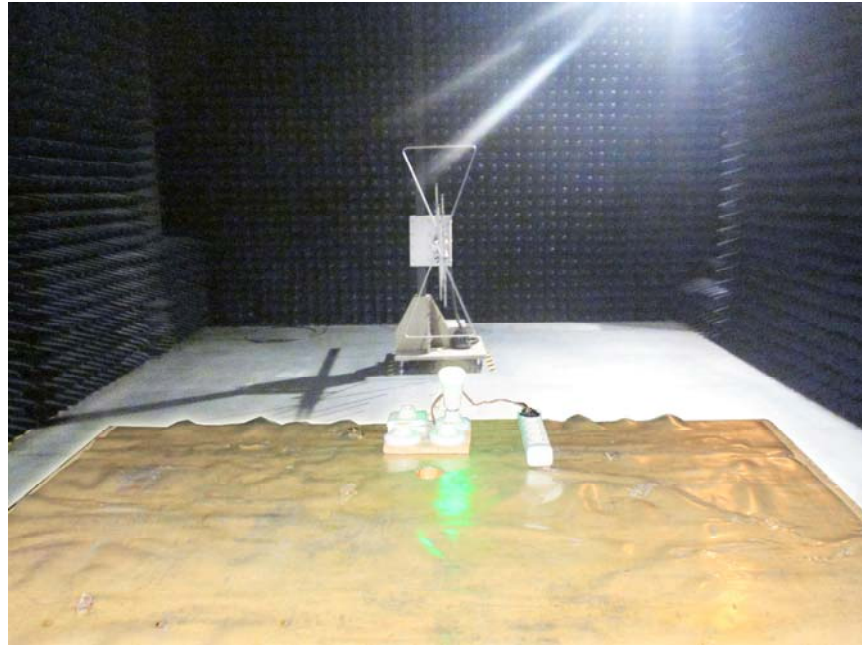
12.1 Conduction Emission



12.2 Radiation Emission below 30MHz



12.3 Radiation Emission From 30MHz-1GHz



12.4 Radiation Emission Above 1GHz

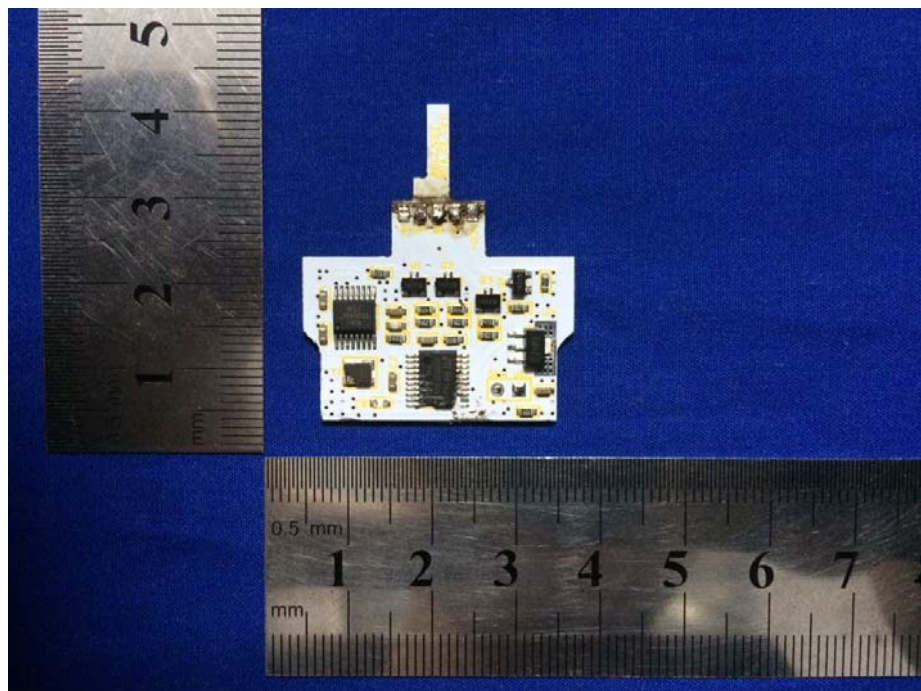
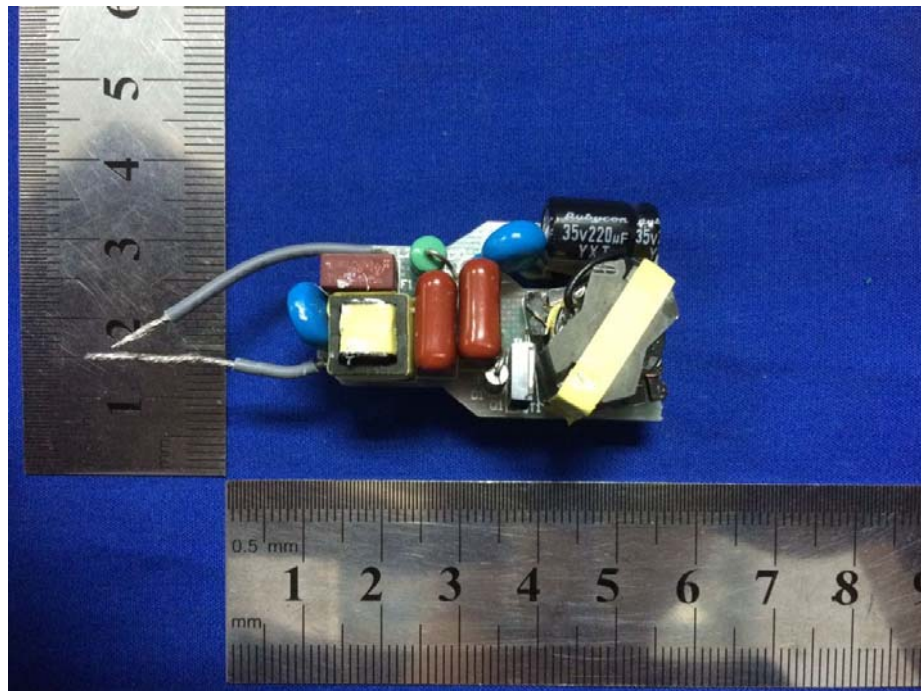


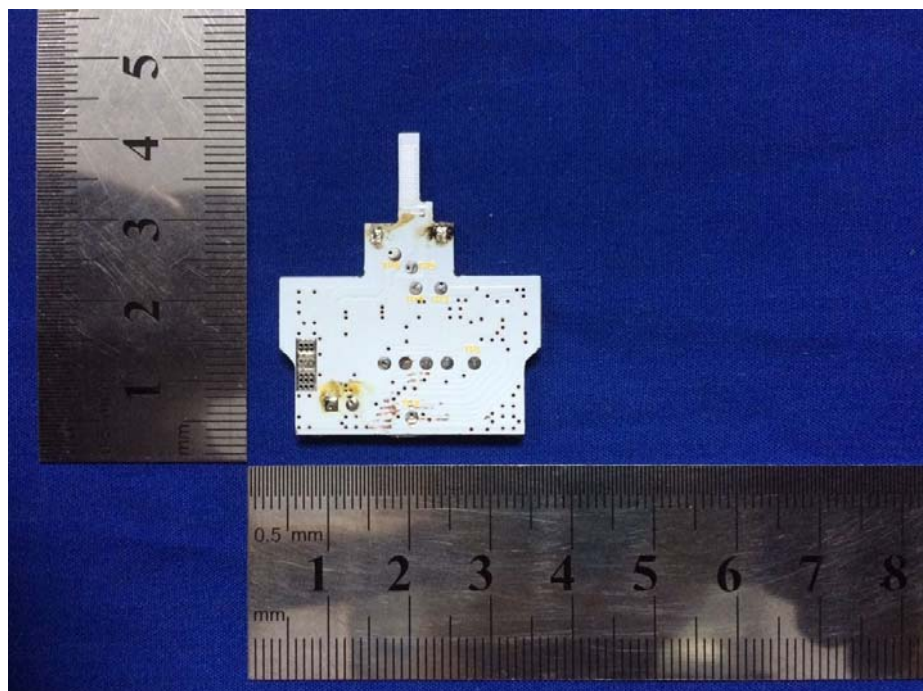
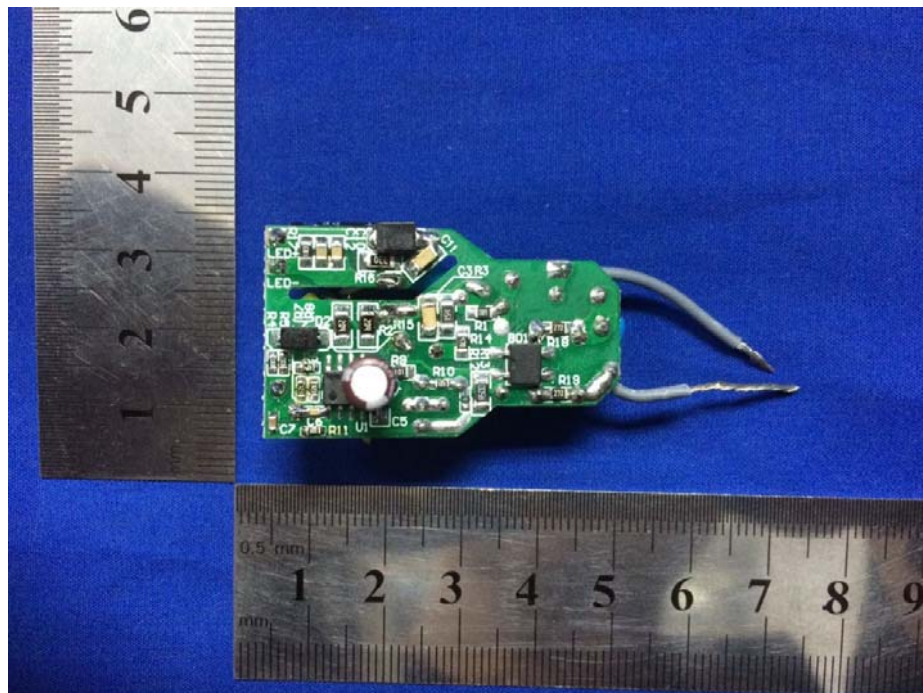
13 Photographs - Constructional Details

13.1 BQ-BU-E26-07-CL-01 - External View



13.2 BQ-BU-E26-07-CL-01 - Internal View





=====End of Report=====