TEST REPORT

Product	:	LED Bulb
Trade mark	:	ST
Model/Type reference	:	BC090
Serial number	:	N/A
Ratings	:	AC 120V/60Hz
FCC ID	:	TZI-BC090
Report number	:	EESZG08200016
Date	:	Sep. 18, 2014
Regulations	:	See below

Test Standards	Results
☒ 47 CFR FCC Part 15 Subpart C 15.247: 2013	PASS

Prepared for:

Arts Electronics Co., Ltd.
No. 1, Shangxing Lu, Shangjiao Community, Changan Town, Dongguan, Guangdong, China

Prepared by:

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Tested by: _____ Reviewed by: _____

Approved by: _____ Date: Sep. 18, 2014

Jimmy Li
Lab manager

Check No.: 1996250152

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N/A means not applicable.

1. CERTIFICATION INFORMATION

Applicant:	Arts Electronics Co., Ltd. No. 1, Shangxing Lu, Shangjiao Community, Changan Town, Dongguan, Guangdong, China
Manufacturer:	Arts Electronics Co., Ltd. No. 1, Shangxing Lu, Shangjiao Community, Changan Town, Dongguan, Guangdong, China
FCC ID:	TZI-BC090
Product:	LED Bulb
Model/Type reference:	BC090
Trade Name:	ST
Serial Number:	N/A
Report Number:	EESZG08200016
Sample Received Date:	Aug. 21, 2014
Sample tested Date:	Aug. 21, 2014 to Sep. 18, 2014

The above equipment was tested by Centre Testing International (Shenzhen) Corporation for compliance with the requirements set forth in the FCC Rules and the measurement procedure according to ANSI C63.4:2009.

2. TEST SUMMARY

No.	Test Item	Rule	Result
1	6dB Bandwidth	FCC PART15.247(a)(2)	**PASS**
2	Transmitter Output Power	FCC PART15.247(b)(3)	**PASS**
3	Power Spectral Density	FCC PART15.247(e)	**PASS**
4	Conducted Bandedge Emission / Conducted Spurious Emission	FCC PART15.247(d)	**PASS**
5	Radiated Bandedge Emission / Radiated Spurious Emission	FCC PART15.247(d)	**PASS**
6	AC Conducted Emission	FCC PART15.207	**PASS**
7	Antenna requirements	FCC PART15.203	**PASS** (See Notes)

*: According to Section 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. The EUT has a built in antenna which is a short wire solder on the PCB, this is permanently attached antenna and meets the requirements of this section.

3. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test item	Value (dB)
Conducted Emission Test	3.2 dB
Radiated Emissions / Bandedge Emission	4.5 dB

4. PRODUCT INFORMATION

Items	Description
Rating	AC 120V/60Hz
Type of Modulation	BT4.0/BLE
Antenna Type	Integral antenna
Frequency Range	2402 ~ 2480 MHz
Gain	0dBi

5. TEST EQUIPMENT LIST

Equipment	Manufacturer	Model	Serial No.	Due Date
3M Chamber & Accessory Equipment	ETS-LINDGREN	FACT-3	3510	07/12/2016
Spectrum Analyzer	Agilent	E4443A	MY45300910	01/15/2015
Receiver	R&S	ESCI	100435	07/19/2015
TRILOG Broadband Antenna	schwarzbeck	VULB 9163	618	06/25/2015
Multi device Controller	ETS-LINGREN	2090	00057230	N/A
Horn Antenna	ETS-LINGREN	3117	00057407	07/19/2015
Microwave Preamplifier	Agilent	8449B	3008A02425	03/19/2015
Spectrum Analyzer	R&S	FSP40	100416	07/06/2015
Receiver	R&S	ESCI	100009	07/19/2015
LISN	R&S	ENV216	100098	07/19/2015

6. SUPPORT EQUIPMENT LIST

Device Type	Brand	Model	Series No.	Data Cable	Remark
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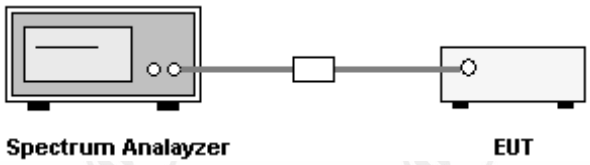
---	---	---	---	---	---

7. 6DB BANDWIDTH MEASUREMENT

7.1. LIMITS

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

7.2. BLOCK DIAGRAM OF TEST SETUP



7.3. TEST PROCEDURE

a) Set RBW = 100 kHz.

b) Set the video bandwidth (VBW) ≥ 3×RBW.

c) Detector = Peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

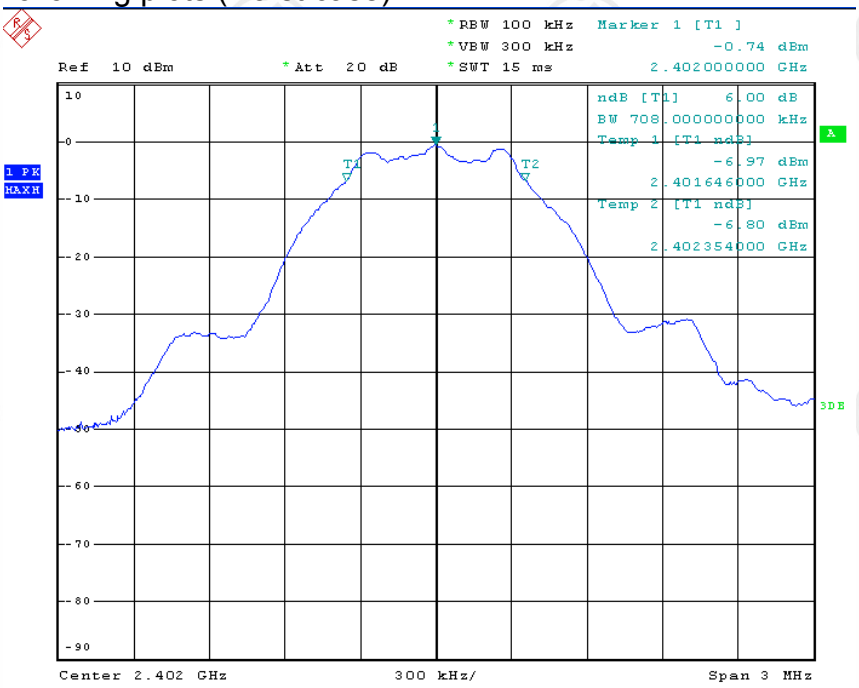
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

7.4. TEST RESULT

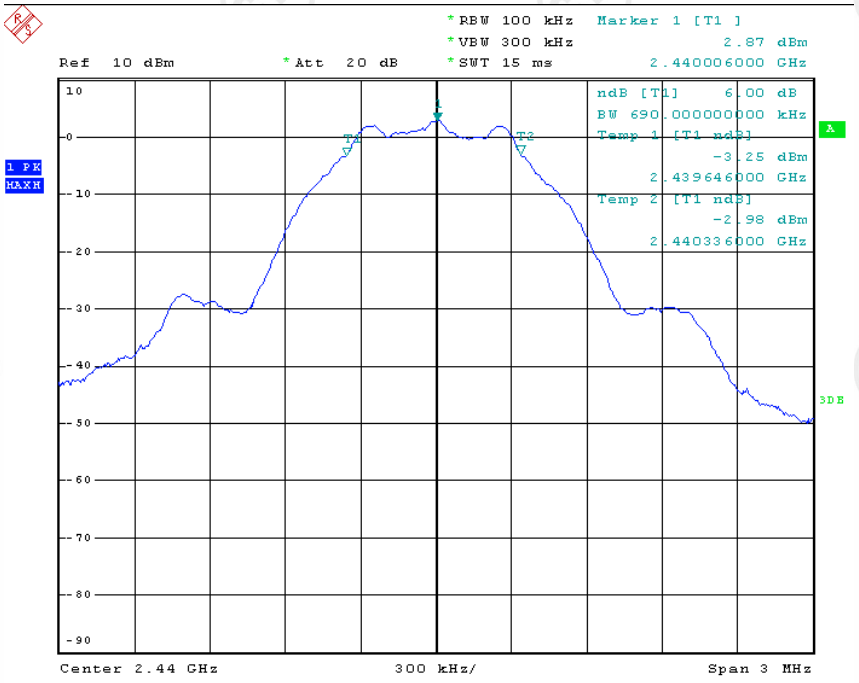
The test data of worst case are below:

Frequency (MHz)	Measured Value (kHz)	Result
2402	708	PASS
2440	690	PASS
2480	702	PASS

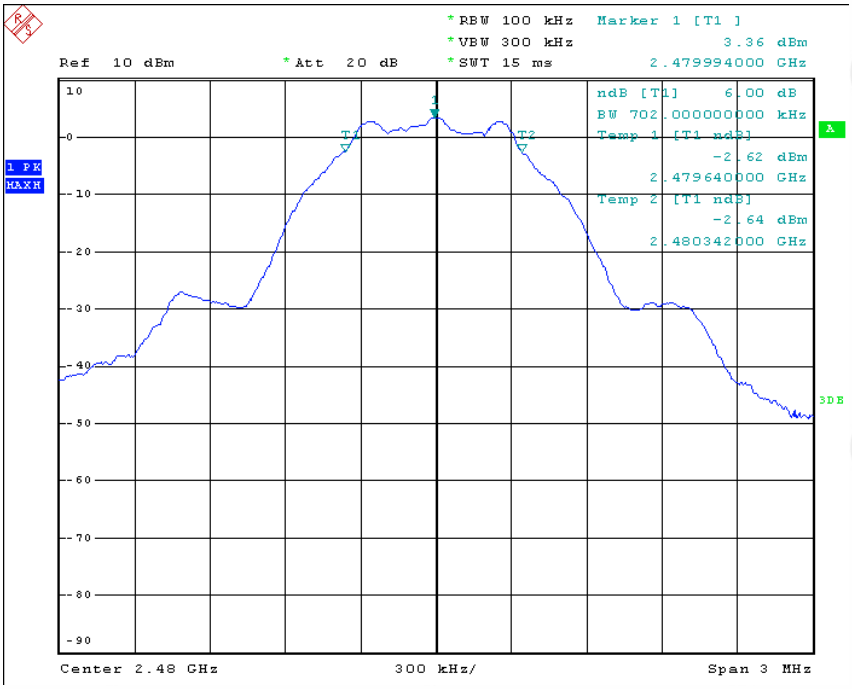
Please see the following plots (worst case):



2402MHz



2440MHz


RBW 100 kHz
VBW 300 kHz
SWT 15 ms
Marker 1 [T1]
3.36 dBm
2.479994000 GHz
Ref 10 dBm
Att 20 dB
ndB [T1] 6.00 dB
BW 702.000000000 kHz
Temp 1 [T1 ndB]
-2.62 dBm
2.479640000 GHz
Temp 2 [T1 ndB]
-2.64 dBm
2.480342000 GHz
1 PK
MAXH
3DB
Center 2.48 GHz
300 kHz/
Span 3 MHz

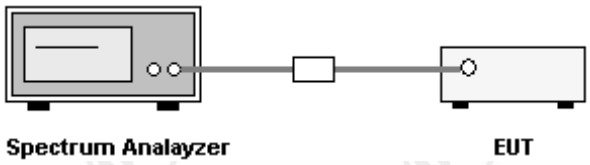
2480MHz

8. POWER SPECTRAL DENSITY

8.1. LIMITS

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.2. BLOCK DIAGRAM OF TEST SETUP



8.3. TEST PROCEDURE

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz.

d) Set the VBW ≥ 3×RBW.

e) Detector = peak.

f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

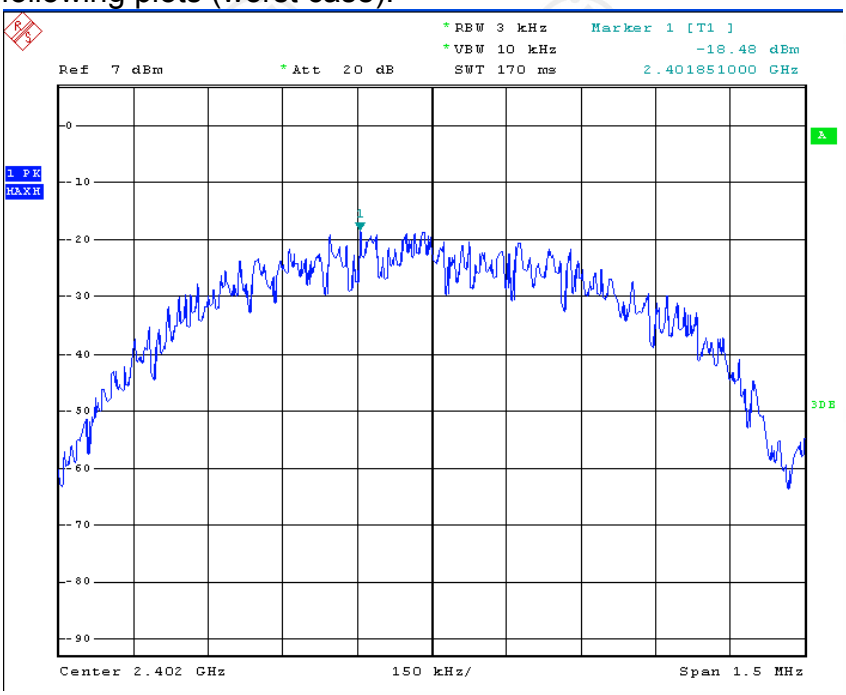
i) Use the peak marker function to determine the maximum amplitude level within the RBW.

8.4. TEST RESULT

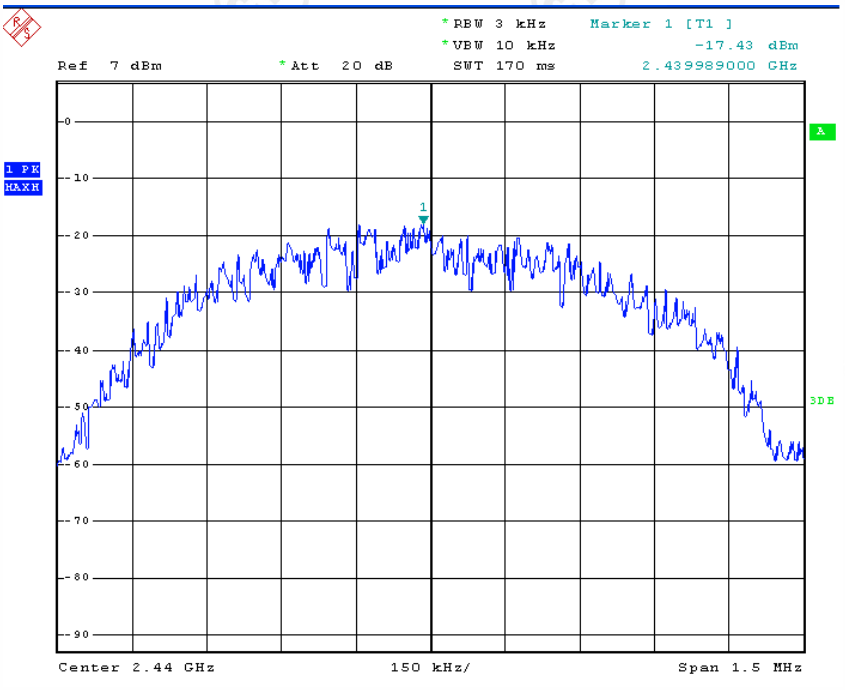
The test data of worst case are below:

Frequency (MHz)	Measured Value (dBm)	Result
2402	-18.48	PASS
2440	-17.43	PASS
2480	-17.47	PASS

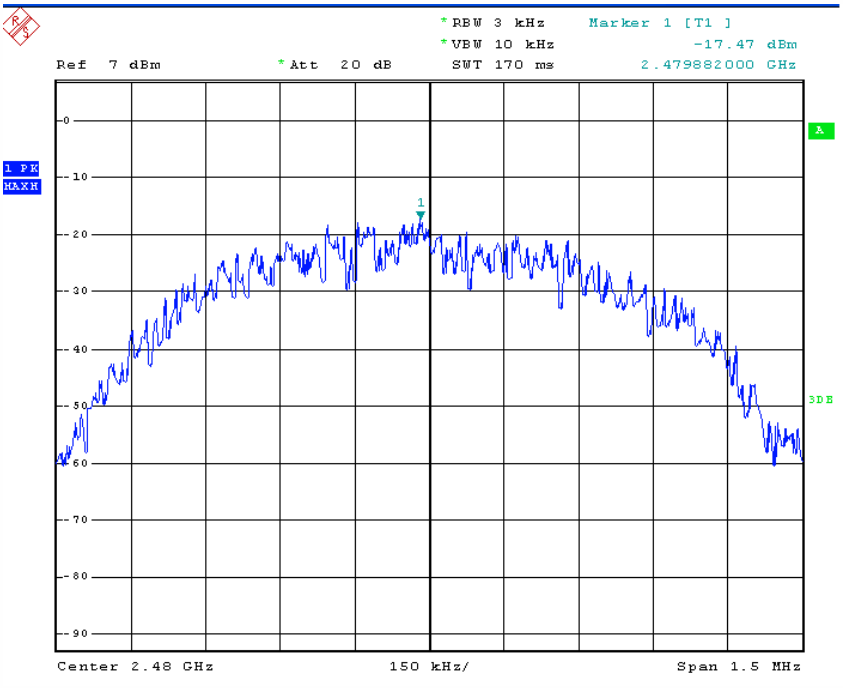
Please see the following plots (worst case):



2402MHz



2440MHz


RBW 3 kHz
VBW 10 kHz
SWT 170 ms
Marker 1 [T1]
-17.47 dBm
2.479882000 GHz
Ref 7 dBm
Att 20 dB
1 PK
MAXH
3DB
Center 2.48 GHz
150 kHz/
Span 1.5 MHz

2480MHz

9. MAXIMUM PEAK CONDUCTED OUTPUT POWER MEASUREMENT

9.1. LIMITS

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt (30dBm).

9.2. BLOCK DIAGRAM OF TEST SETUP

9.3. TEST PROCEDURE

a) Set the RBW ≥ DTS bandwidth.

b) Set the VBW ≥ 3 x RBW

c) Set span ≥ 3 x RBW

d) Sweep time = auto couple.

e) Detector = peak.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use peak marker function to determine the peak amplitude level.

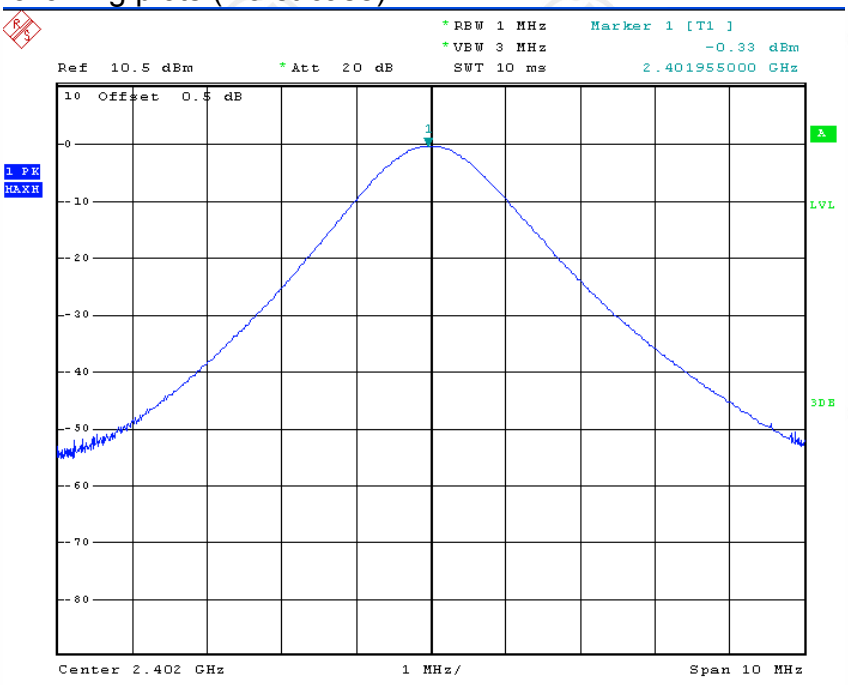
9.4. TEST RESULT

The test data of worst case are below:

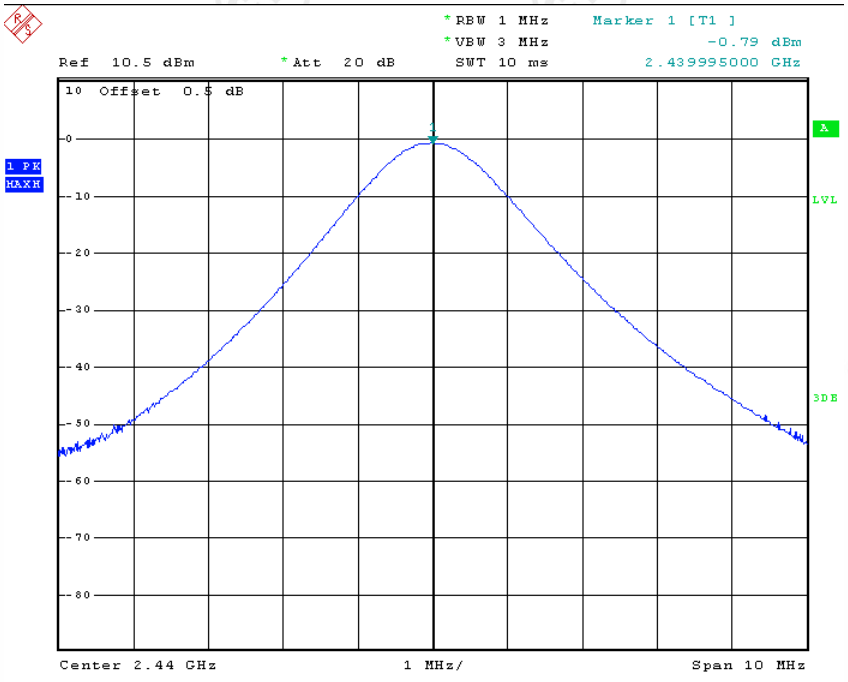
Frequency (MHz)	Measured Value (dBm)	Result
2402	-0.33	PASS
2440	-0.79	PASS
2480	-1.40	PASS

Remark:
Antenna Gain: 0dBi

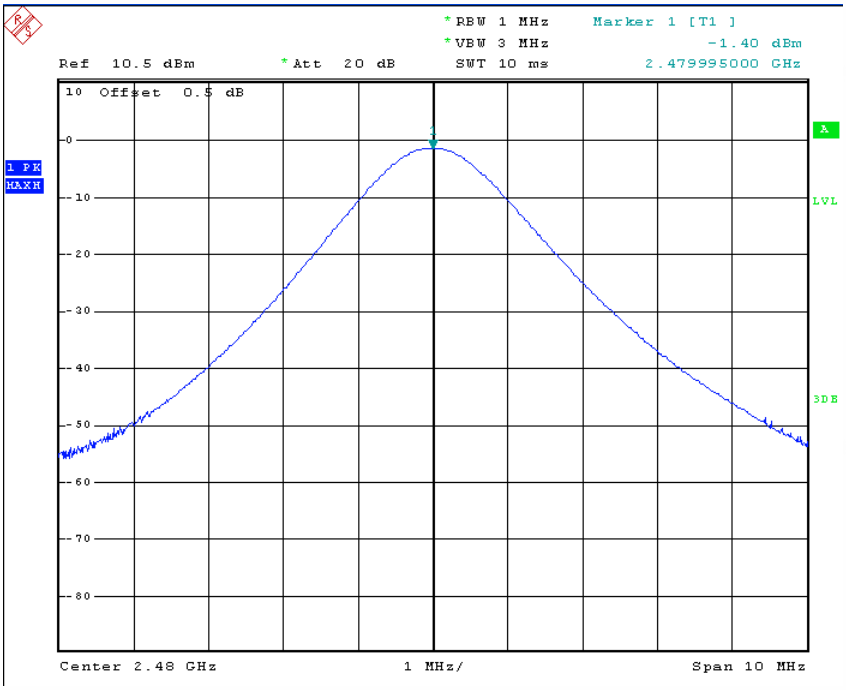
Please see the following plots (worst case):



2402MHz



2440MHz


RBW 1 MHz
VBW 3 MHz
SWT 10 ms
Marker 1 [T1]
-1.40 dBm
2.479995000 GHz
Ref 10.5 dBm
Att 20 dB
10 Offset 0.5 dB
1 PK
MAXH
A
LVL
3DB
Center 2.48 GHz
1 MHz/
Span 10 MHz

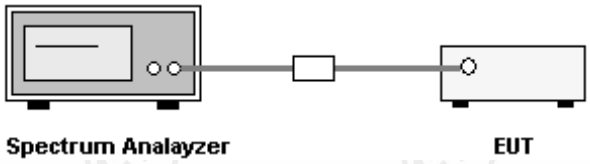
2480MHz

10. CONDUCTED BANDEDGE EMISSION MEASUREMENT

10.1. LIMITS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

10.2. BLOCK DIAGRAM OF TEST SETUP



10.3. TEST PROCEDURE

a) Set to the maximum power setting and enable the EUT transmit continuously.

b) Set RBW = 100 kHz, VBW = 300 kHz (≥ RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

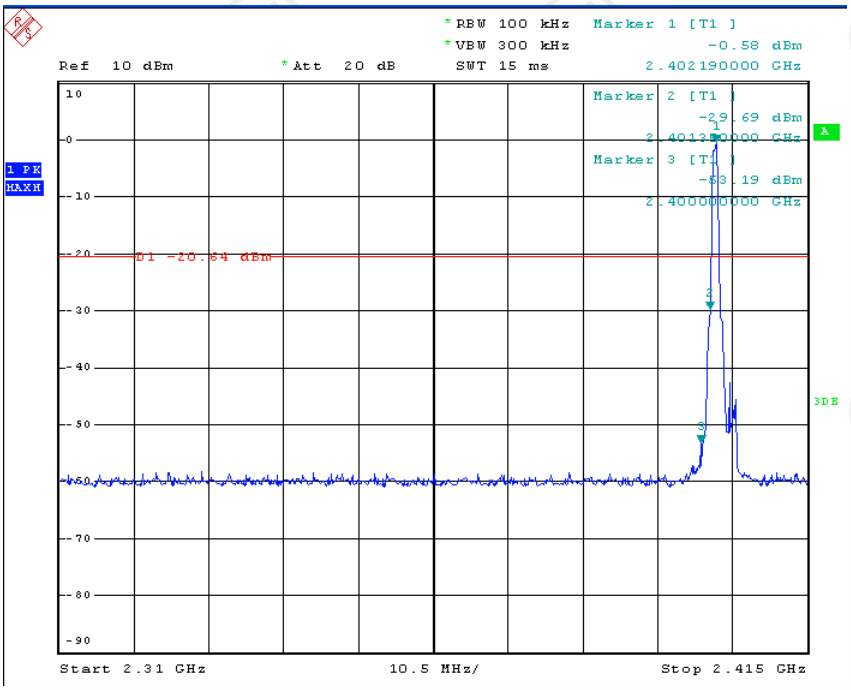
c) Enable hopping function of the EUT and then repeat step a and b.

d) Measure and record the results in the test report.

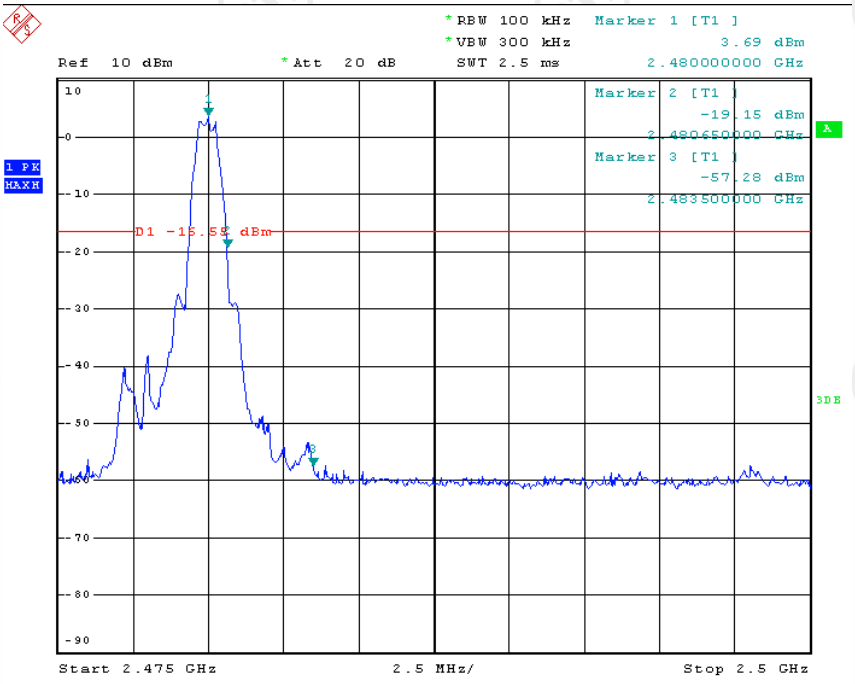
10.4. TEST RESULT

Worst case data attached.--- please see the following plots.

Low Band Edge Plot on 2402MHz:



High Band Edge Plot on 2480MHz:

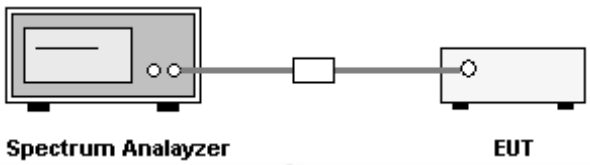


11. CONDUCTED SPURIOUS EMISSION MEASUREMENT

11.1. LIMITS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

11.2. BLOCK DIAGRAM OF TEST SETUP



11.3. TEST PROCEDURE

a) The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.

b) Set to the maximum power setting and enable the EUT transmit continuously.

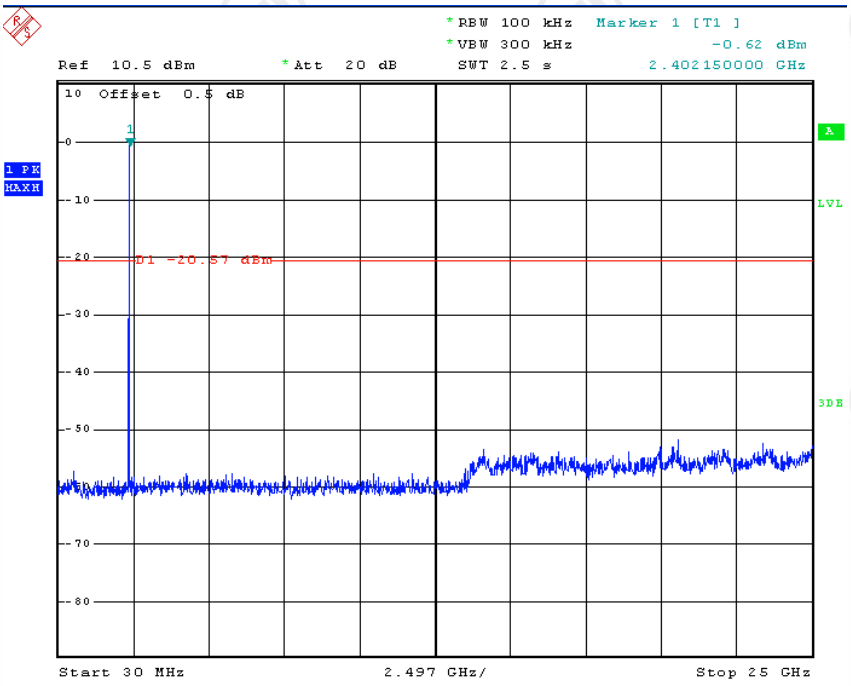
c) Set RBW = 100 kHz, VBW = 300 kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

d) Measure and record the results in the test report.

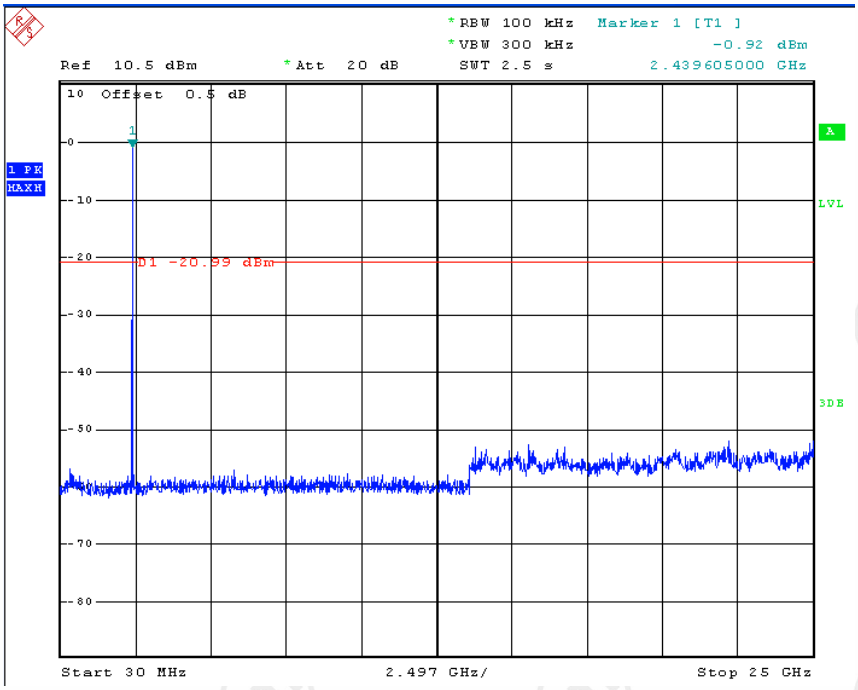
e) The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

11.4. TEST RESULT

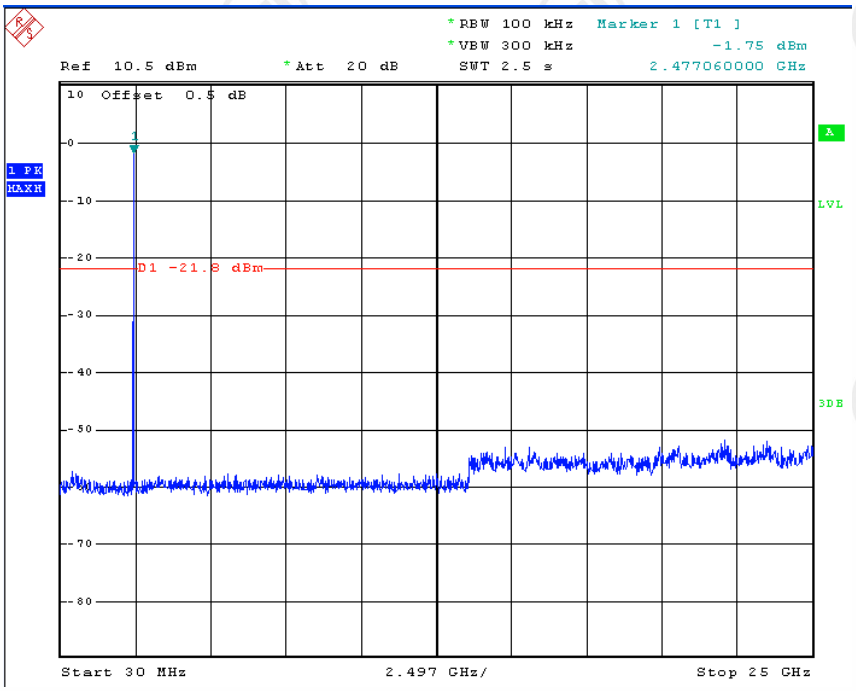
Worst case data---Please see the following plots.



2402MHz:



2440MHz:


RBW 100 kHz
Marker 1 [T1]
VBW 300 kHz
-1.75 dBm
Ref 10.5 dBm
Att 20 dB
SWT 2.5 s
2.477060000 GHz
10 Offset 0.5 dB
1 PK
MAXH
D1 -21.8 dBm
A
LVL
3DB
Start 30 MHz
2.497 GHz/
Stop 25 GHz

2480MHz:

12. RADIATED BANDEDGE EMISSION / RADIATED SPURIOUS EMISSION MEASUREMENT

12.1. LIMITS

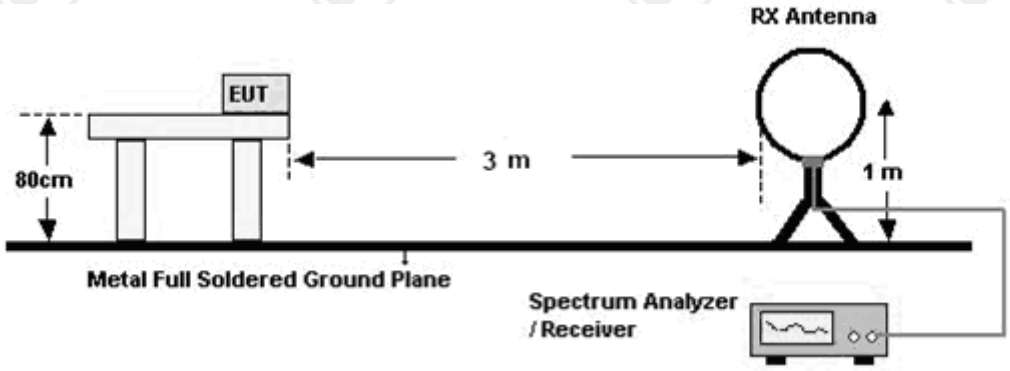
The field strength of any emissions, which appear outside of operating frequency band and restricted band specified on 15.205(a), shall not exceed the general radiated emission limits as below.

Frequency (MHz)	Field strength (μV/m)	Distance (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

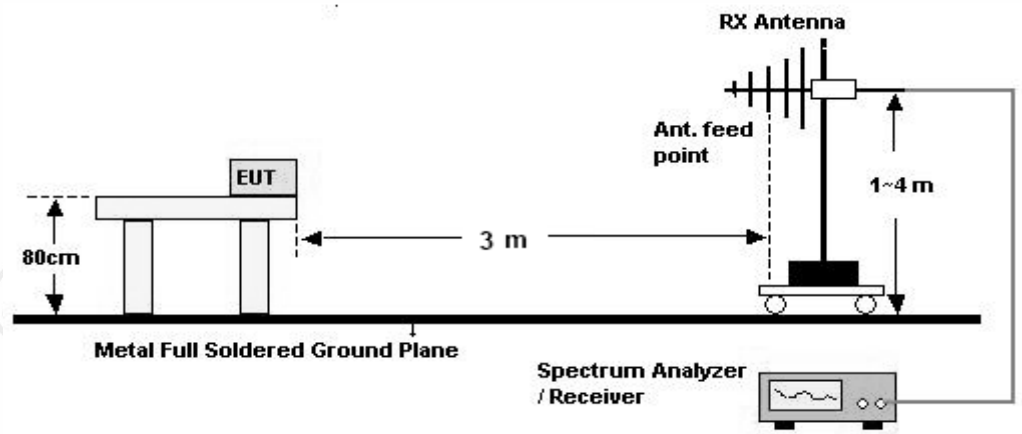
Note: the tighter limit applies at the band edges.

12.2. BLOCK DIAGRAM OF TEST SETUP

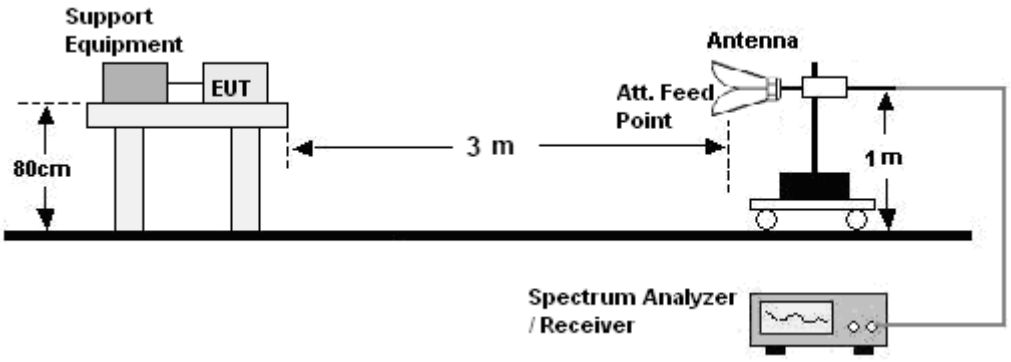
For radiated emissions from 9kHz to 30MHz



For radiated emissions from 30 - 1000MHz



For radiated emissions from 1GHz to 25GHz



12.3. TEST PROCEDURE

Below 30MHz

a. The Product is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The maximum values of the field strength are recorded by adjusting the polarizations of the test antenna and rotating the turntable.

b. For each suspected emission, the Product was arranged to its worst case and then turn table was turned from 0 degrees to 360 degrees to find the maximum reading.

c. The test frequency analyzer system was set to Peak Detect (300Hz RBW in 9kHz to 150kHz and 10kHz RBW in 150kHz to 30MHz) Function and Specified Bandwidth with Maximum Hold Mode.

30MHz ~ 1GHz:

a. The Product was placed on the non-conductive turntable 0.8m above the ground at a chamber.

b. Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 100 kHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied between 1~4 m in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.

c. For each frequency whose maximum record was higher or close to limit, measure its QP value (120 kHz RBW): vary the antenna's height and rotate the turntable from 0 to 360 degrees to find the height and degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to QP Detector and specified bandwidth with Maximum Hold Mode, and record the maximum value.

Above 1GHz:

a. The EUT was placed on the non-conductive turntable 0.8 m above the ground at a chamber.

b. Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 1MHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.

12.4. TEST RESULT

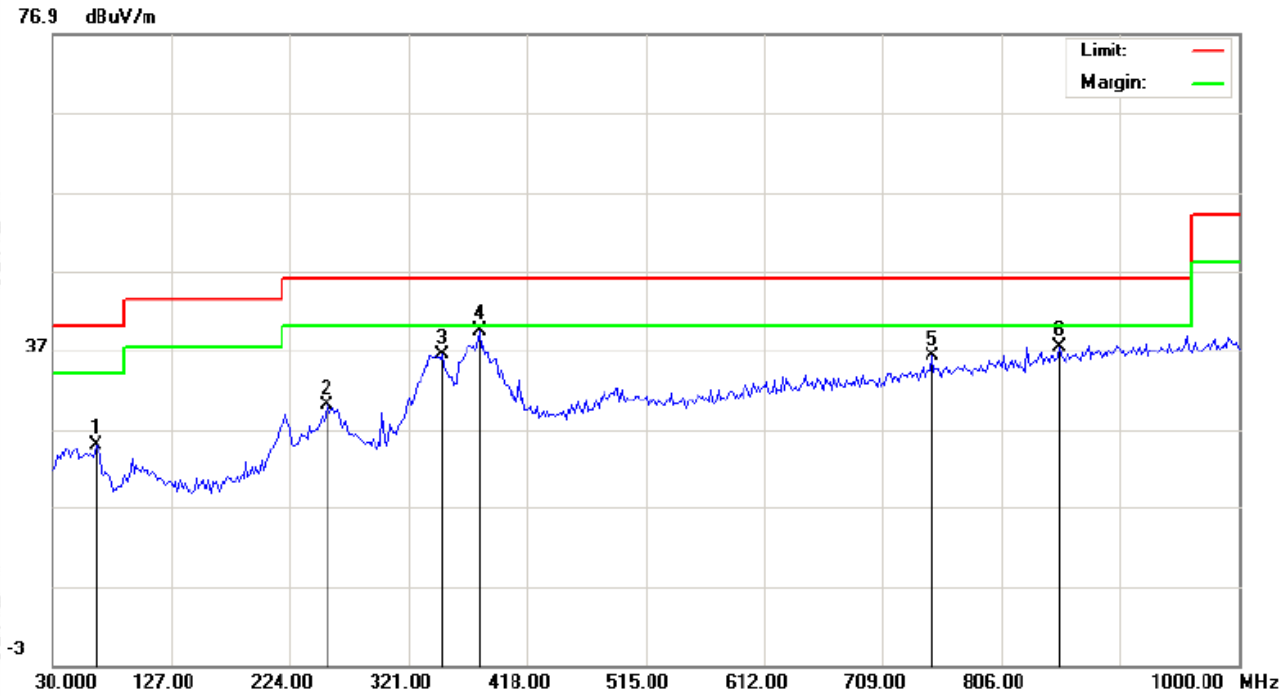
Below 30MHz:

No emissions were found higher than the background below 30MHz and background is lower than the limit, so it deems to compliance with the limit without recorded.

30MHz ～ 1GHz:

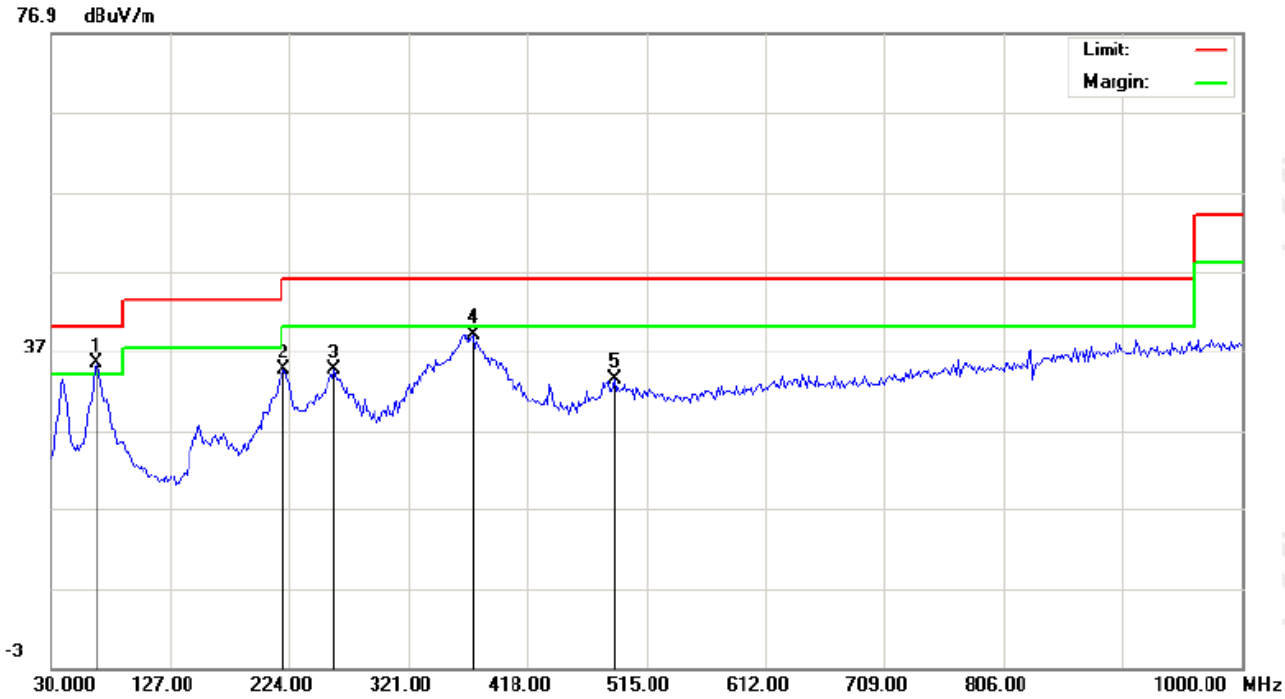
The test data of low channel, middle channel and high channel are almost same in frequency bands 30MHz to 1GHz, and the data of middle channel are chosen as representative in below:

H:



No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV/m)			Limit (dBuV/m)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	65.5667	12.65			12.41	25.06			40.00		-14.94		P	
2	254.7167	14.39			15.61	30.00			46.00		-16.00		P	
3	348.4833	18.34			18.15	36.49			46.00		-9.51		P	
4	379.2000	20.59			18.90	39.49			46.00		-6.51		P	
5	749.4167	10.45			25.78	36.23			46.00		-9.77		P	
6	852.8833	9.98			27.34	37.32			46.00		-8.68		P	

V:



No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV/m)			Limit (dBuV/m)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	67.1833	23.85			11.56	35.41			40.00		-4.59		P	
2	219.1500	20.34			14.27	34.61			46.00		-11.39		P	
3	261.1833	18.79			15.77	34.56			46.00		-11.44		P	
4	374.3500	20.28			18.78	39.06			46.00		-6.94		P	
5	489.1333	12.28			21.15	33.43			46.00		-12.57		P	

Above 1GHz:

Test Results-(Measurement Distance: 3m)_Channel low_2402MHz_GFSK mode:

Frequency (MHz)	Reading Level (dBuV/m)	Correct Factor (dB)	Measurement (dBuV/m)	Limit (dBuV/m)	Detector Type	Antenna (H/V)	Result (P/F)
2390.0	33.24	1.99	35.23	74	PK	H	P
2400.0	46.73	2.01	48.74	74	PK	H	P
2402.0*	92.20	2.01	94.21	---	PK	H	P
4804.0	36.23	6.13	42.36	74	PK	H	P
2390.0	30.64	1.99	32.63	74	PK	V	P
2400.0	44.35	2.01	46.36	74	PK	V	P
2402.0*	84.95	2.01	86.96	---	PK	V	P
4804.0	33.50	6.13	39.63	74	PK	V	P

*: fundamental frequency

Test Results-(Measurement Distance: 3m)_Channel middle_2440MHz_GFSK mode:

Frequency (MHz)	Reading Level (dBuV/m)	Correct Factor (dB)	Measurement (dBuV/m)	Limit (dBuV/m)	Detector Type	Antenna (H/V)	Result (P/F)
2440.0*	91.43	2.11	93.54	---	PK	H	P
4880.0	36.18	6.18	42.36	74	PK	H	P
2440.0*	88.01	2.11	90.12	---	PK	V	P
4880.0	33.45	6.18	39.63	74	PK	V	P

*: fundamental frequency

Test Results-(Measurement Distance: 3m)_Channel high_2480MHz_GFSK mode:

Frequency (MHz)	Reading Level (dBuV/m)	Correct Factor (dB)	Measurement (dBuV/m)	Limit (dBuV/m)	Detector Type	Antenna (H/V)	Result (P/F)
2480.0*	91.18	2.18	93.36	---	PK	H	P
2483.5	39.94	2.18	42.12	74	PK	H	P
4960.0	33.42	6.21	39.63	74	PK	H	P
2480.0*	85.15	2.18	87.33	---	PK	V	P
2483.5	37.94	2.18	40.12	74	PK	V	P
4960.0	31.45	6.21	37.66	74	PK	V	P

*: fundamental frequency

Remark:

1. The above tables show that the frequencies peak data are all below the average limit, so the average data of these frequencies are deems to fulfill the average limits and not reported.
2. No emission found from 18GHz to 25GHz.
3. All outside of operating frequency band and restricted band specified are below 15.209.

13. AC CONDUCTED EMISSION TEST

13.1. LIMITS

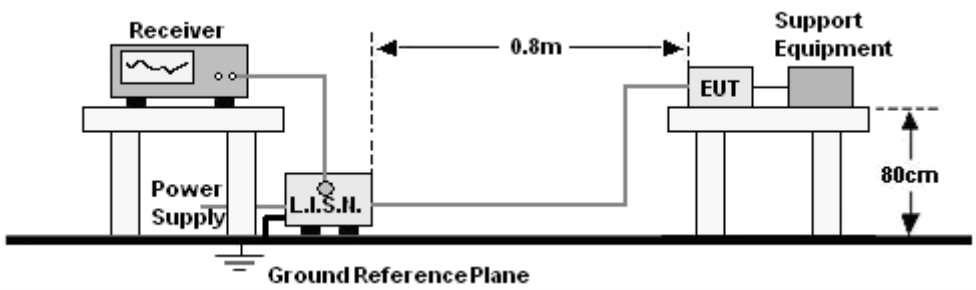
Limits for Class B digital devices

Frequency range (MHz)	Limits dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

NOTE: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 to 0.50 MHz.

13.2. BLOCK DIAGRAM OF TEST SETUP



13.3. PROCEDURE OF CONDUCTED EMISSION TEST

a. The Product was placed on a nonconductive table above the horizontal ground reference plane, and 0.4 m from the vertical ground reference plane, and connected to the main through Line Impedance Stability Network (L.I.S.N).

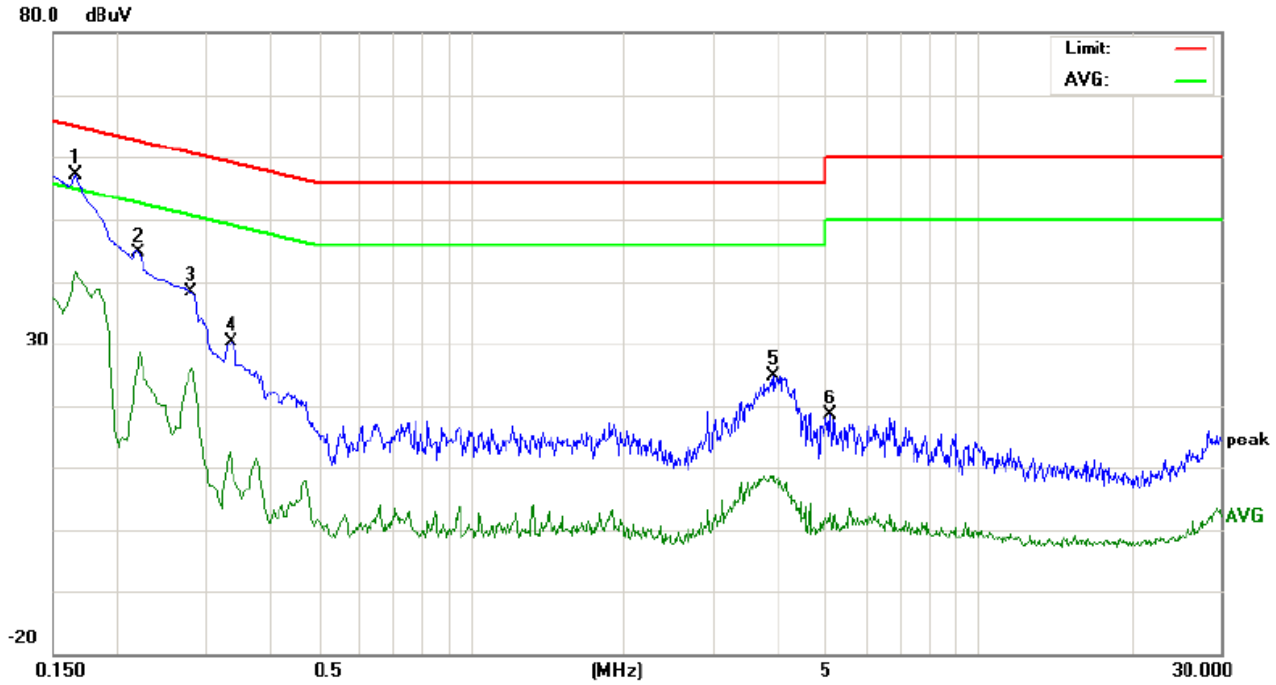
b. The RBW of the receiver was set at 9 kHz in 150 kHz ~ 30MHz with Peak and AVG detector in Max Hold mode. Run the receiver's pre-scan to record the maximum disturbance generated from Product in all power lines in the full band.

c. For each frequency whose maximum record was higher or close to limit, measure its QP and AVG values and record.

13.4. GRAPHS AND DATA

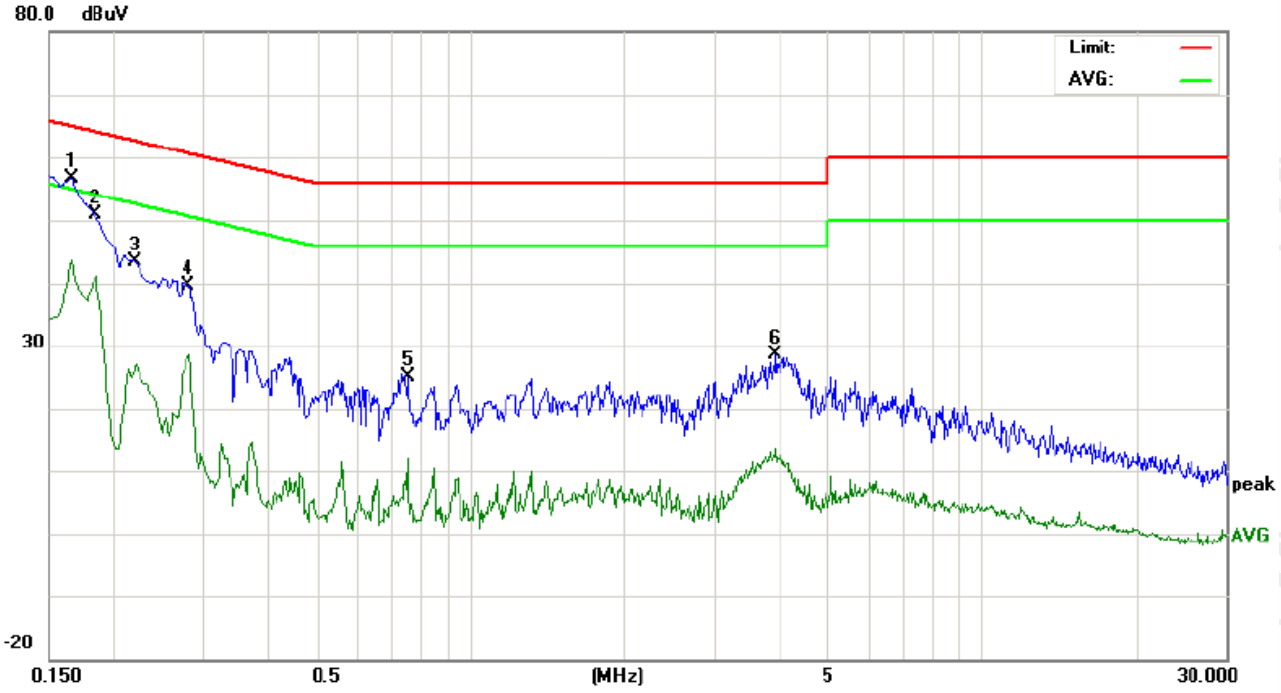
Product	:	LED Bulb	**Model/Type reference**	:	BC090
Power	:	AC 120V/60Hz	**Temperature**	:	23℃
Mode	:	Keeping TX	**Humidity**	:	52%

L:



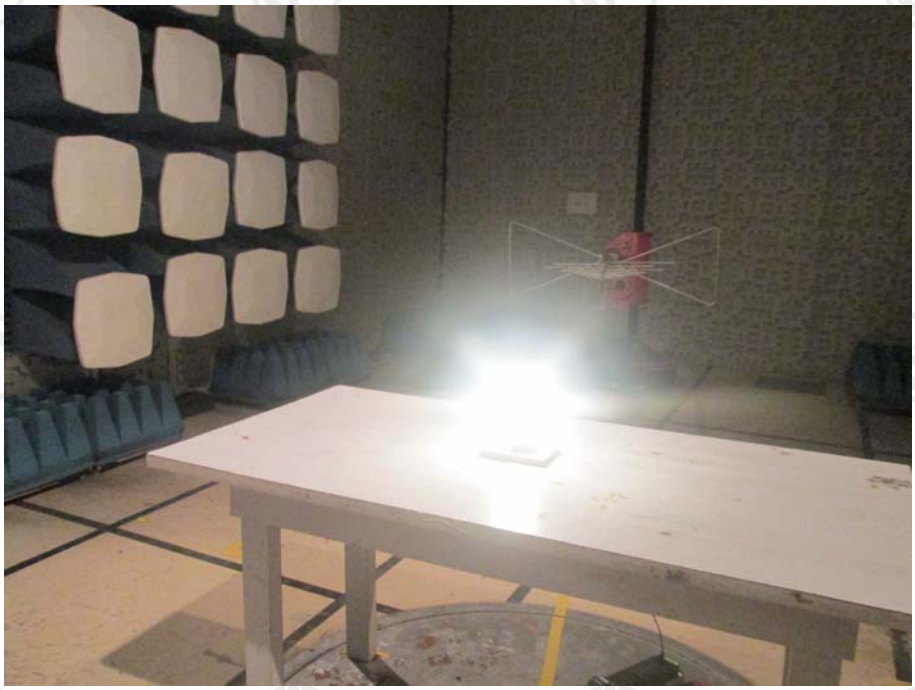
No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	0.1660	47.34	45.12	31.81	9.77	57.11	54.89	41.58	65.15	55.15	-10.26	-13.57	P	
2	0.2220	34.65	31.08	18.78	9.80	44.45	40.88	28.58	62.74	52.74	-21.86	-24.16	P	
3	0.2819	28.53	26.79	16.36	9.80	38.33	36.59	26.16	60.76	50.76	-24.17	-24.60	P	
4	0.3339	20.33	17.39	2.76	9.80	30.13	27.19	12.56	59.35	49.35	-32.16	-36.79	P	
5	3.8940	13.38	11.83	-1.21	9.96	23.34	21.79	8.75	56.00	46.00	-34.21	-37.25	P	
6	5.1339	8.71	7.15	-7.27	10.00	18.71	17.15	2.73	60.00	50.00	-42.85	-47.27	P	

N:



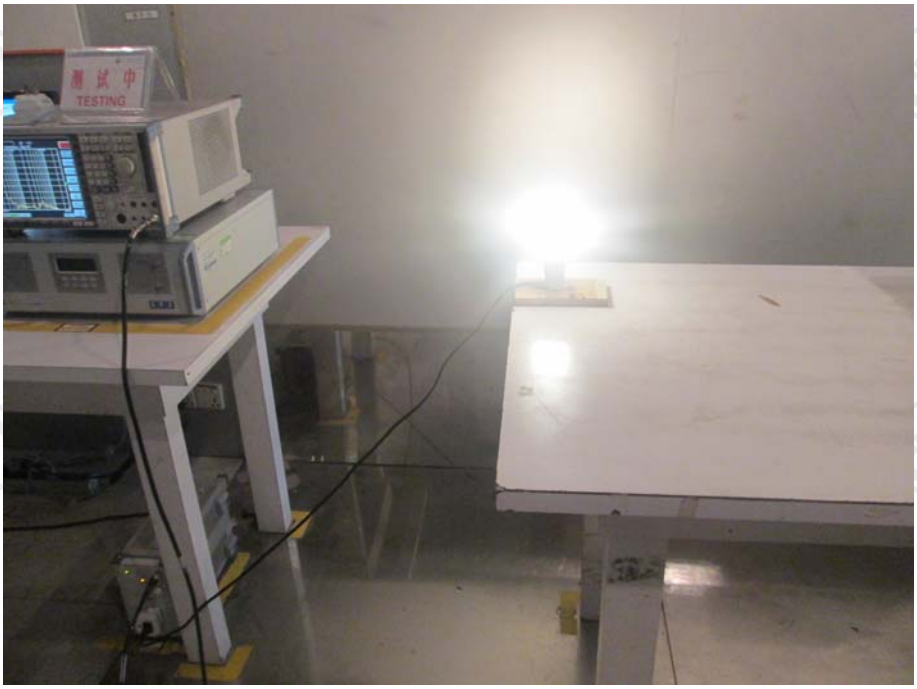
No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	0.1660	46.93	43.01	33.84	9.77	56.70	52.78	43.61	65.15	55.15	-12.37	-11.54	P	
2	0.1860	40.66	38.15	31.40	9.79	50.45	47.94	41.19	64.21	54.21	-16.27	-13.02	P	
3	0.2220	33.68	30.96	17.27	9.80	43.48	40.76	27.07	62.74	52.74	-21.98	-25.67	P	
4	0.2819	29.76	28.10	18.85	9.80	39.56	37.90	28.65	60.76	50.76	-22.86	-22.11	P	
5	0.7539	15.38	14.07	2.24	9.80	25.18	23.87	12.04	56.00	46.00	-32.13	-33.96	P	
6	3.9540	18.57	16.19	3.55	9.97	28.54	26.16	13.52	56.00	46.00	-29.84	-32.48	P	

APPENDIX 1 PHOTOGRAPHS OF TEST SETUP



TEST SETUP OF RADIATED EMISSION (30MHz-1GHz)

TEST SETUP OF RADIATED EMISSION (above 1GHz)



TEST SETUP OF CONDUCTED EMISSION

APPENDIX 2 EXTERNAL PHOTOGRAPHS OF PRODUCT

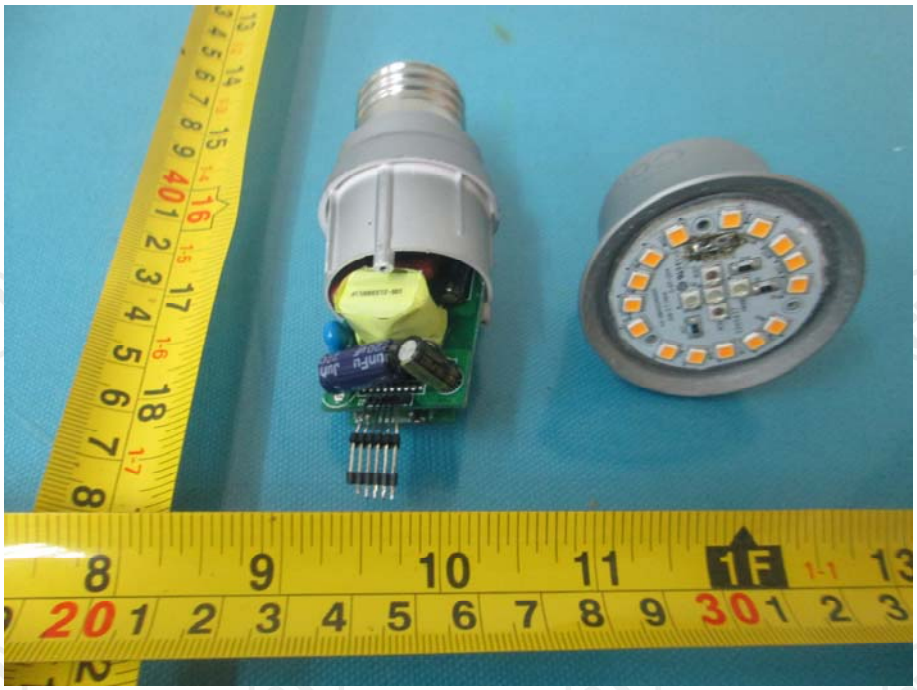
External View of product-1

External View of product-2

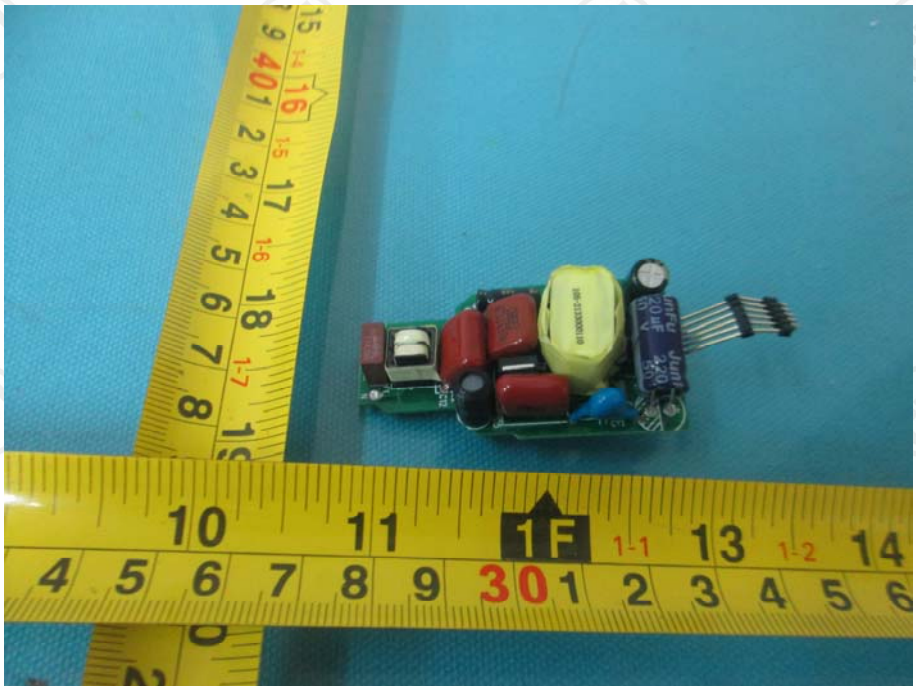
External View of product-3

APPENDIX 3 INTERNAL PHOTOGRAPHS OF PRODUCT

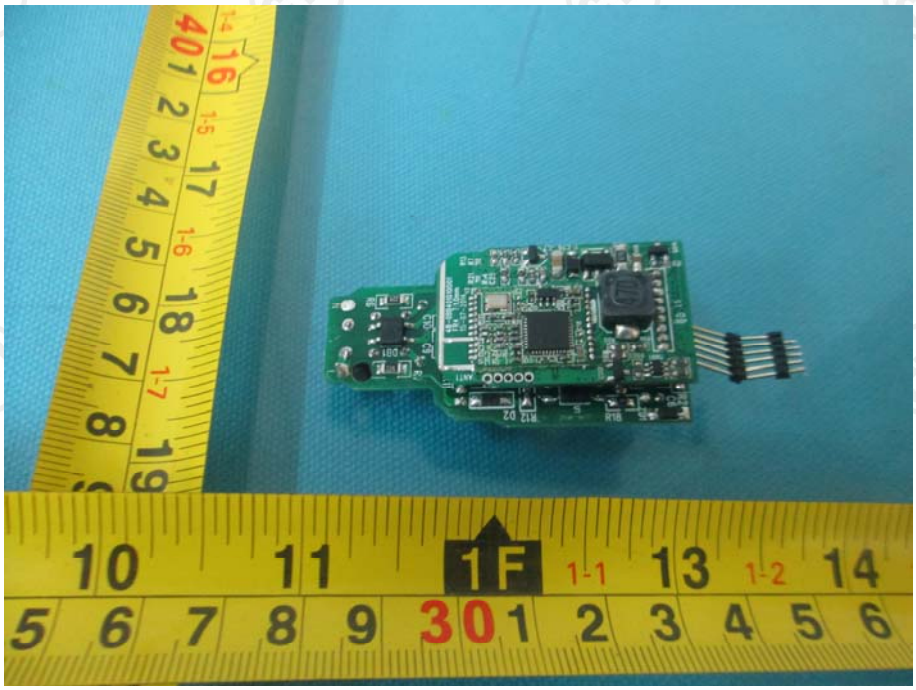
Internal View of product-1



Internal View of product-2

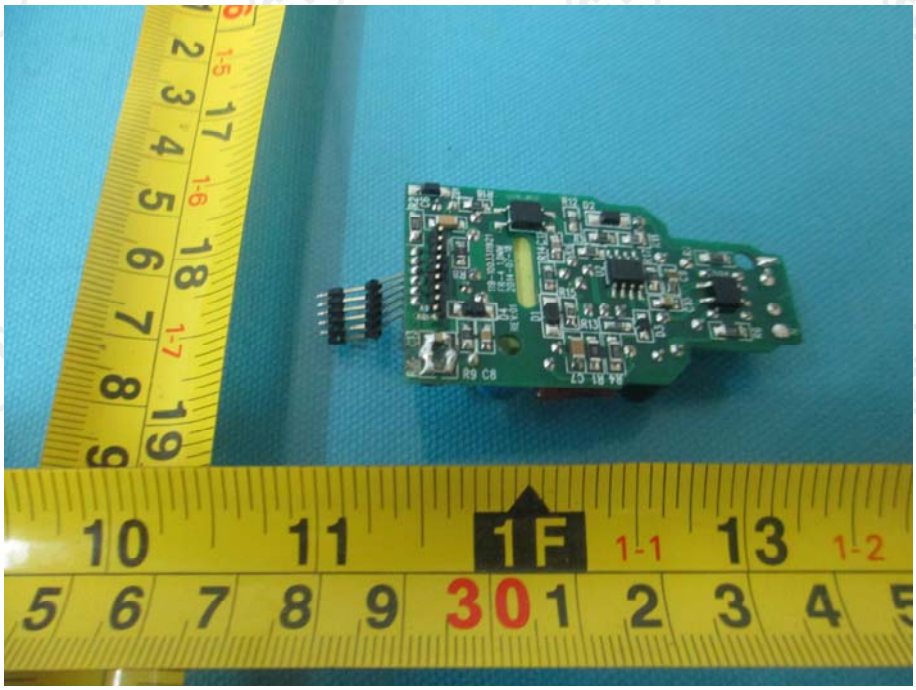


Internal View of product-3

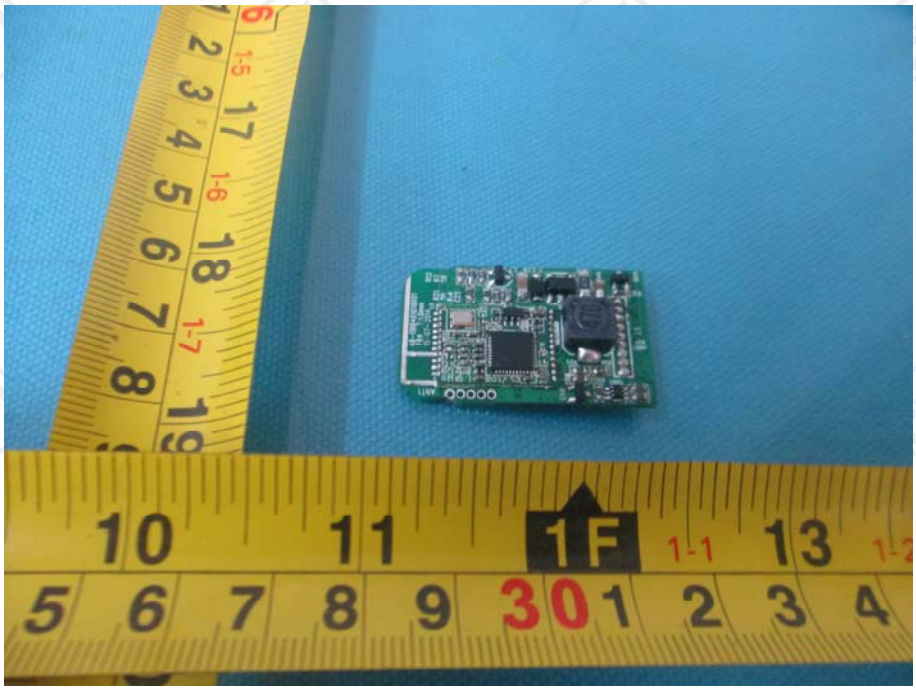


Internal View of product-4

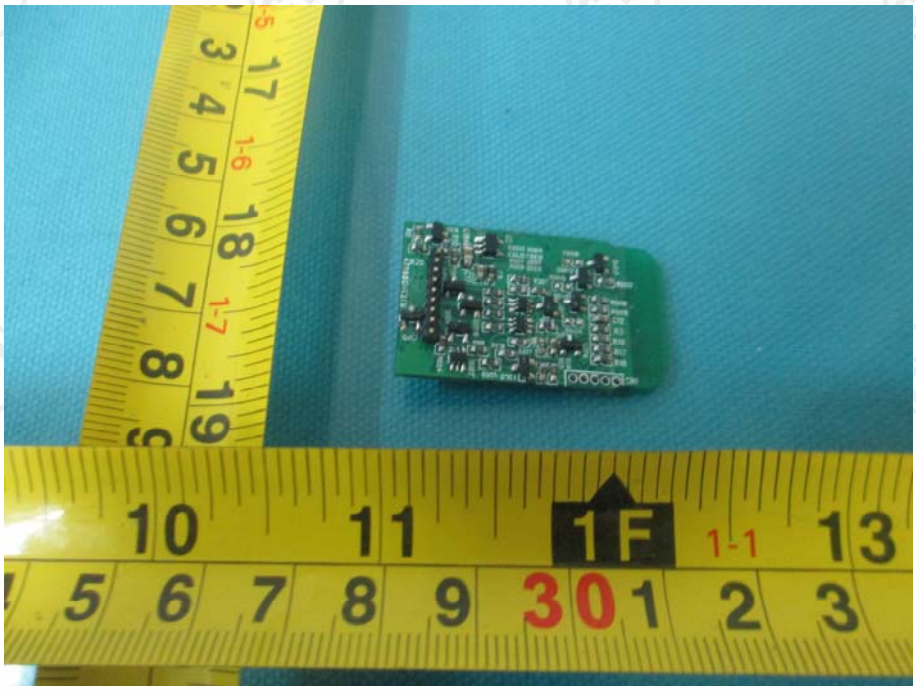
Internal View of product-5



Internal View of product-6



Internal View of product-7



Internal View of product-8

*** End of Report ***