FCC RF Test Report

APPLICANT	:	**LITE-ON Technology Corp.**
EQUIPMENT	:	**802.11 a/b/g/n/ac 2T2R+BT V4.2LE combo module**
BRAND NAME	:	**LITE-ON**
MODEL NAME	:	**WCBN3510A**
FCC ID	:	**PPQ-WCBN3510A**
STANDARD	:	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	:	**(DTS) Digital Transmission System**

The product was installed into Lenovo Smart Display (Brand Name: Lenovo, Model Name: Lenovo SD-8501F) during test.

The product was received on Feb. 08, 2018 and testing was completed on Apr. 25, 2018. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

James Huang

Approved by: James Huang / Manager

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TESTING
NVLAP LAB CODE 600155-0

Sporton International (Kunshan) Inc.
No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR820813B	Rev. 01	Initial issue of report	Apr. 28, 2018

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
-	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	1
-	-	99% Bandwidth	-	Pass	1
3.1	15.247(b)(3)	Peak Output Power	≤ 30dBm	Pass	-
-	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	1
-	15.247(d)	Conducted Band Edges and Spurious Emission	≤ 20dBc	Pass	1
3.2	15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 4.84 dB at 41.640 MHz
3.3	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 18.18 dB at 0.479 MHz
3.4	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-
Remark 1: All conducted test items were leverage from module RF report which can refer to Report No. "FR7N1336AL".					

1 General Description

1.1 Applicant

LITE-ON Technology Corp.
Bldg. C, 90, Chien 1 Road, Chung Ho, New Taipei City 23585, Taiwan, R.O.C

1.2 Manufacturer

LITE-ON TECHNOLOGY (Changzhou) CO., LTD
A9 Building, No.88 Yanghu Road, Wujin Hi-Tech Industrial Development Zone, Changzhou City, Jiangsu Province 213100 China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	802.11 a/b/g/n/ac 2T2R+BT V4.2LE combo module
Brand Name	LITE-ON
Model Name	WCBN3510A
FCC ID	PPQ-WCBN3510A
EUT supports Radios application	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ac VHT20/VHT40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth v2.1+EDR, Bluetooth v4.2 LE
EUT Stage	Identical Prototype

Host Feature & Specification	
Equipment	Lenovo Smart Display
Brand Name	Lenovo
Model Name	Lenovo SD-8501F
Applicant	**Lenovo (Shanghai) Electronics Technology Co., Ltd.** NO.68 BUILDING, 199 FENJU RD, China (Shanghai) Pilot Free Trade Zone, Shanghai, 200131 China
Manufacturer	**Lenovo PC HK Limited** 23/F, Lincoln House, Taikoo Place, 979 King's Road, Quarry Bay Hong Kong

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	40
Carrier Frequency of Each Channel	40 Channel(37 hopping + 3 advertising channel)
Maximum Output Power to Antenna	3.64 dBm (0.0023 W)
Antenna Type / Gain	PIFA Antenna with gain 2.86 dBi
Type of Modulation	Bluetooth LE : GFSK

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Component List

Object	Specifications	Supplier
CPU	APQ-8053-A-792NSP-MT-01-1-AA	Qualcomm
Memory	EMMC04G-M627X02U(4G+32G)	Kingston
PANEL	P080DDD-AB4 W134.2*H202.05*3.5MM 800*RGB*1280	longhai
Camera	CBFH53520004950LH 2592*1994 megapixel	chicony
loudspeaker	1.75" 6Ω 10W fullrange driver	sanfu
PCB	L102*W91*T0.8MM 94V0	tripod
Module	WCBN3510A QCA9379-3 WIFI and Bluetooth combo	Liteon

1.7 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0) and the FCC designation No is CN5013.

Test Site	Sporton International (Kunshan) Inc.			
Test Site Location	No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China TEL : +86-512-57900158 FAX : +86-512-57900958			
Test Site No.	**Sporton Site No.**			**FCC Test Firm Registration No.**
	TH01-KS	03CH03-KS	CO01-KS	630927

Note: The test site complies with ANSI C63.4 2014 requirement.

1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
	20	2442	-	-

2.2 Descriptions of Test Mode

The RF output power was recorded in the following table:

Channel	Frequency	Bluetooth LE RF Output Power
		Data Rate / Modulation
		GFSK
		1Mbps
Ch00	2402MHz	0.80 dBm
Ch19	2440MHz	2.48 dBm
Ch39	2480MHz	**3.64** dBm

2.3 Test Mode

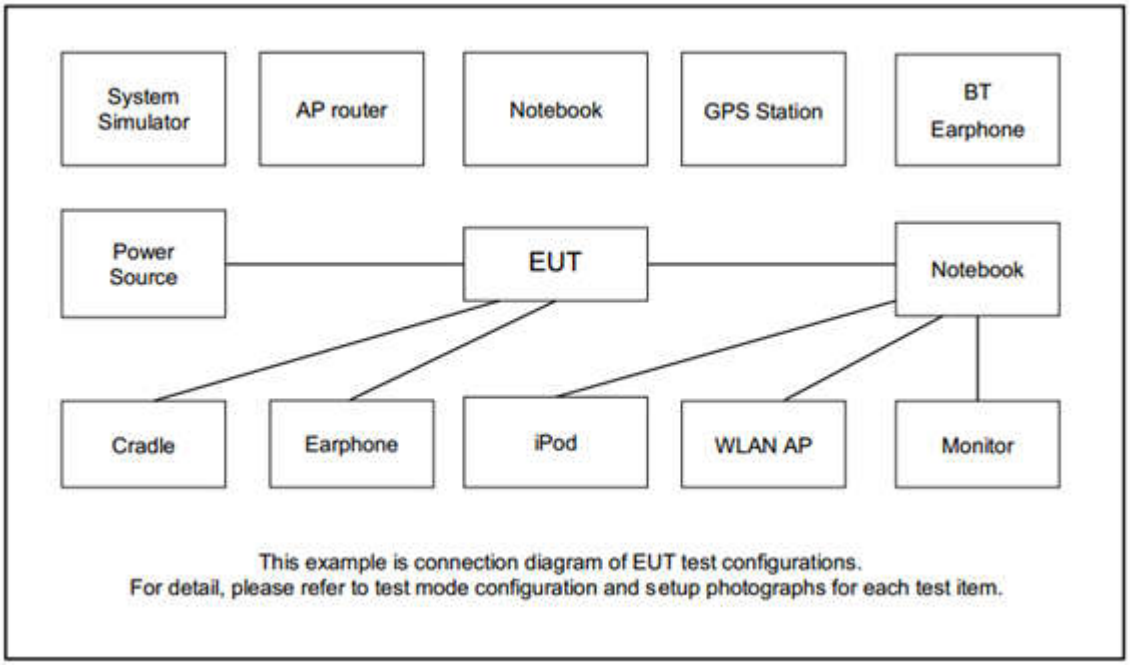
a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases were recorded in this report.

b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	**Data Rate / Modulation**
	Bluetooth LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
Radiated TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
AC Conducted Emission	Mode 1 :**Bluetooth Idle + WLAN Idle(2.4G) + Adapter 1** Mode 2 :Bluetooth Idle + WLAN Idle(2.4G) + Adapter 2
Remark: **1.** For Radiated Test Cases, The tests were performed with Adapter 1. **2.** The worst case of AC is mode 1; only the test data of this mode is reported.	

2.4 Connection Diagram of Test System



2.5 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	LINKSYS	WRT600N	Q87-WRT600NV11	N/A	Unshielded, 1.8 m
2.	Notebook	Lenovo	G480	N/A	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m
3.	Bluetooth Earphone	Lenovo	LBH308	N/A	N/A	N/A

2.6 EUT Operation Test Setup

For Bluetooth LE test items, an engineering test program was provided and enabled to make EUT continuous transmit/receive.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

3 Test Result

3.1 Peak Output Power Measurement

3.1.1 Limit of Peak Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

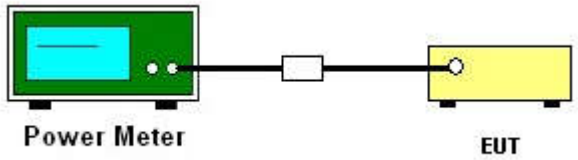
3.1.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.1.3 Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB 558074, clause 9.2.3.1 Method AVGPM (using an RF average power meter).
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of Average Output Power

Test Mode :	Bluetooth LE	Temperature :	21~25℃
Test Engineer :	Silent Hai	Relative Humidity :	51~55%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
00	2402	0.80	30.00	Pass
19	2440	2.48	30.00	Pass
39	2480	3.64	30.00	Pass

3.2 Radiated Band Edges and Spurious Emission Measurement

3.2.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.2.2 Measuring Instruments

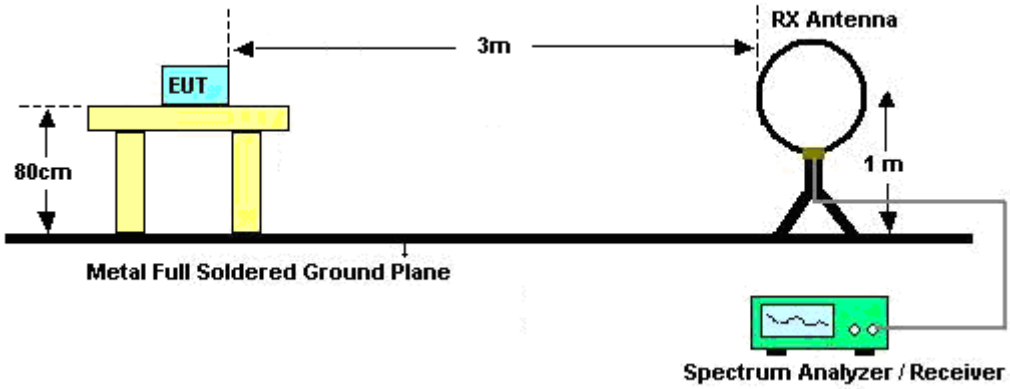
The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.2.3 Test Procedures

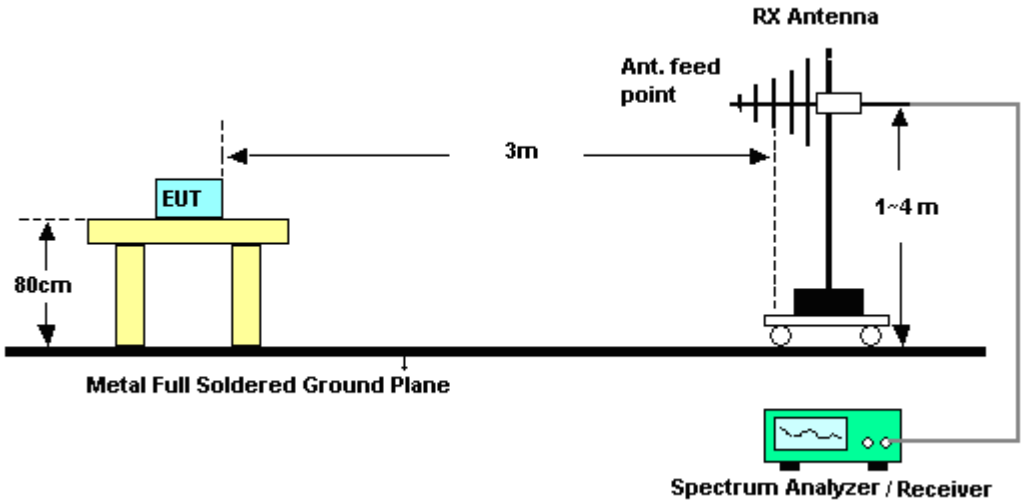
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.2.4 Test Setup

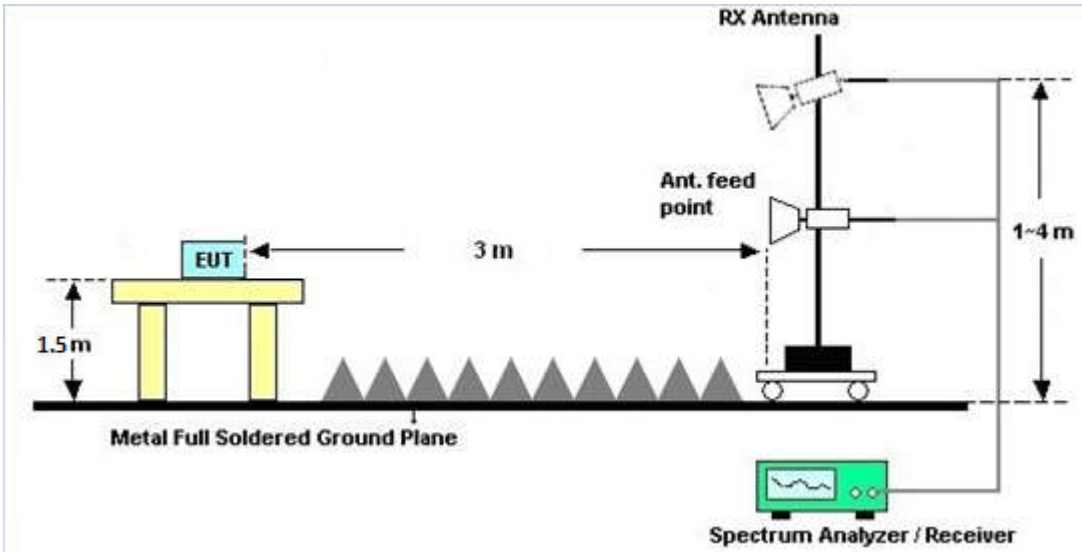
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.2.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A.

3.2.7 Duty Cycle

Please refer to Appendix B.

3.2.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix A.

3.2.9 Test Result of Radiated Spurious Emission (Simultaneous TX)

Please refer to test report (FR820813C).

3.3 AC Conducted Emission Measurement

3.3.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

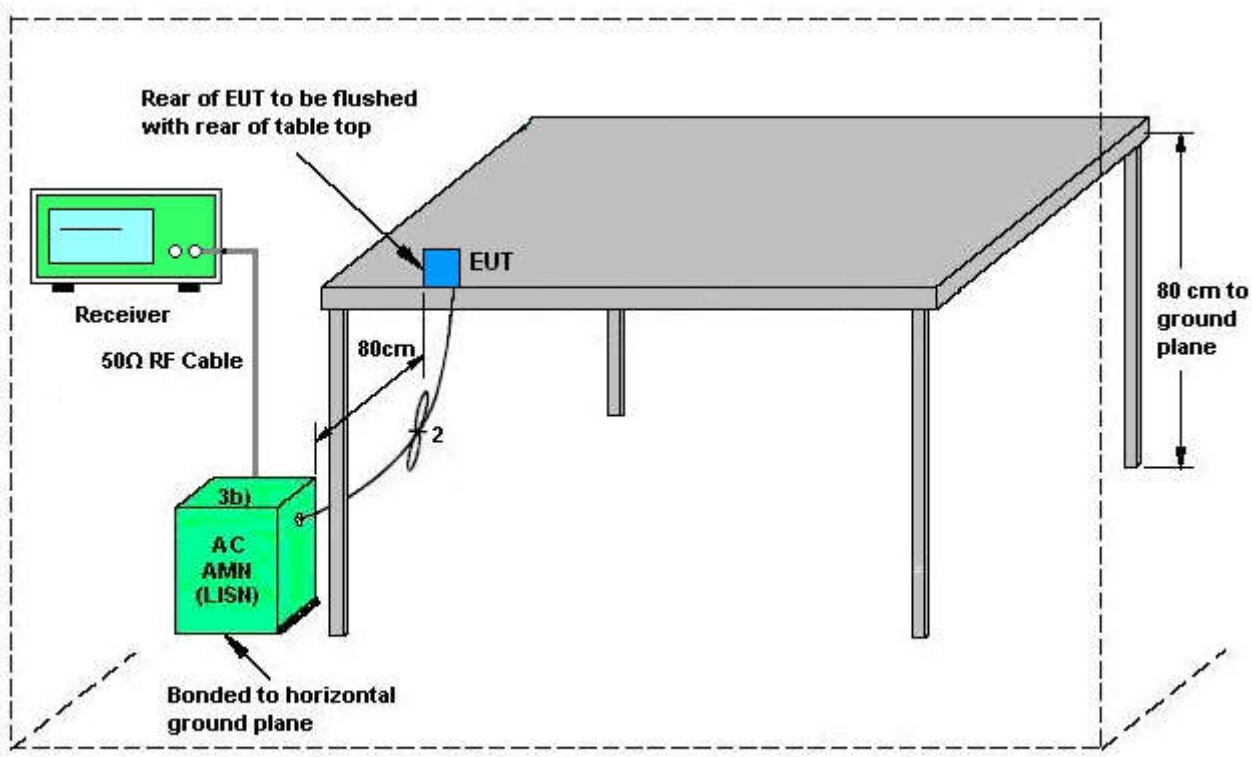
3.3.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.3.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

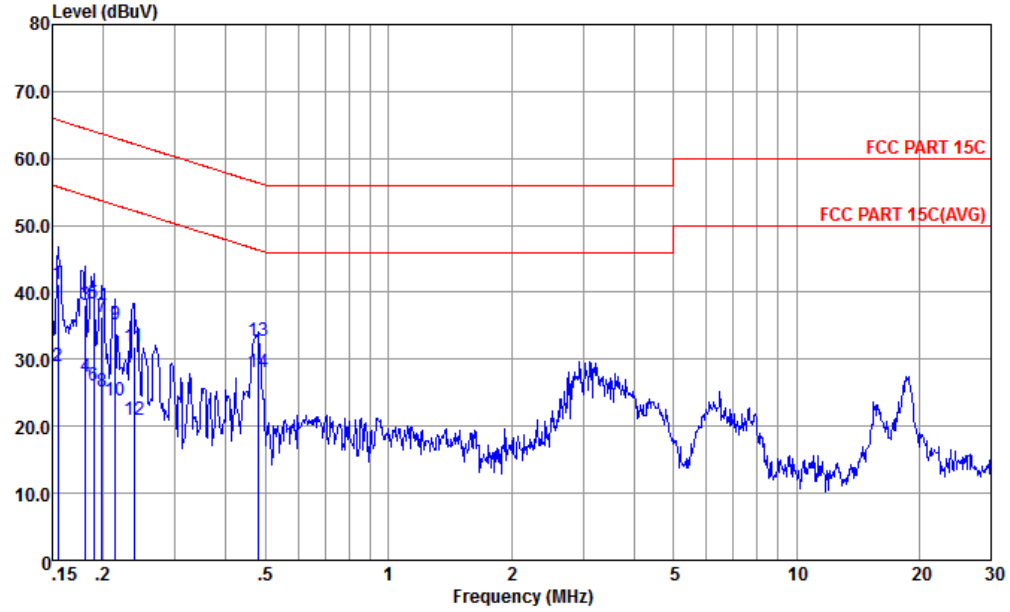
3.3.4 Test Setup



AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

3.3.5 Test Result of AC Conducted Emission

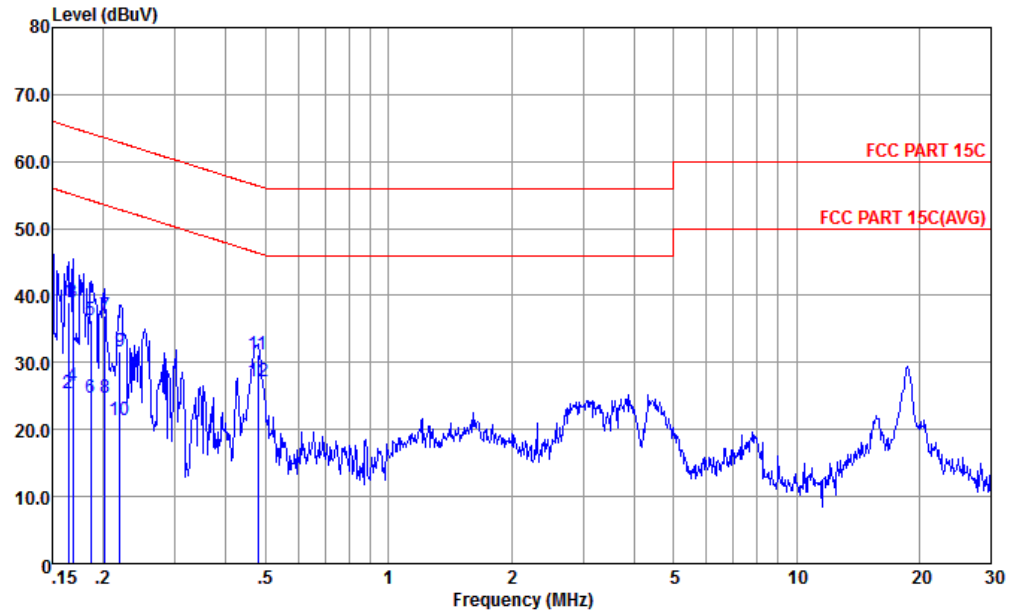
Test Mode :	Mode 1	Temperature :	20.7~21.2℃
Test Engineer :	Amos Zhang	Relative Humidity :	41~43%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	Bluetooth Idle + WLAN Idle(2.4G) + Adapter 1		



Site : CO01-KS
Condition : FCC PART 15C LISN-L-171013-060103 LINE

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.155	41.26	-24.48	65.74	30.50	0.16	10.60	QP
2	0.155	29.06	-26.68	55.74	18.30	0.16	10.60	Average
3	0.181	38.20	-26.26	64.46	27.50	0.19	10.51	QP
4	0.181	27.30	-27.16	54.46	16.60	0.19	10.51	Average
5	0.189	38.28	-25.78	64.06	27.60	0.19	10.49	QP
6	0.189	26.18	-27.88	54.06	15.50	0.19	10.49	Average
7	0.199	36.26	-27.41	63.67	25.60	0.20	10.46	QP
8	0.199	25.26	-28.41	53.67	14.60	0.20	10.46	Average
9	0.214	35.16	-27.89	63.05	24.51	0.20	10.45	QP
10	0.214	23.96	-29.09	53.05	13.31	0.20	10.45	Average
11	0.238	31.85	-30.32	62.17	21.20	0.21	10.44	QP
12	0.238	20.95	-31.22	52.17	10.30	0.21	10.44	Average
13	0.479	32.68	-23.68	56.36	22.10	0.26	10.32	QP
14 *	0.479	28.18	-18.18	46.36	17.60	0.26	10.32	Average

Test Mode :	Mode 1	Temperature :	20.7~21.2℃
Test Engineer :	Amos Zhang	Relative Humidity :	41~43%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Idle + WLAN Idle(2.4G) + Adapter 1		



Site : CO01-KS
Condition : FCC PART 15C LISN-N-171013-060103 NEUTRAL

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.164	39.05	-26.20	65.25	28.20	0.28	10.57	QP
2		0.164	25.45	-29.80	55.25	14.60	0.28	10.57	Average
3		0.169	39.03	-26.00	65.03	28.20	0.28	10.55	QP
4		0.169	26.43	-28.60	55.03	15.60	0.28	10.55	Average
5		0.186	36.38	-27.82	64.20	25.60	0.28	10.50	QP
6		0.186	24.68	-29.52	54.20	13.90	0.28	10.50	Average
7		0.202	36.93	-26.61	63.54	26.20	0.28	10.45	QP
8		0.202	24.63	-28.91	53.54	13.90	0.28	10.45	Average
9		0.220	31.63	-31.20	62.83	20.90	0.28	10.45	QP
10		0.220	21.33	-31.50	52.83	10.60	0.28	10.45	Average
11		0.479	31.21	-25.15	56.36	20.60	0.29	10.32	QP
12	*	0.479	27.21	-19.15	46.36	16.60	0.29	10.32	Average

3.4 Antenna Requirements

3.4.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.4.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.4.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 18, 2018	Apr. 25, 2018	Jan. 17, 2019	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 18, 2018	Apr. 25, 2018	Jan. 17, 2019	Conducted (TH01-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 20, 2017	Mar. 30, 2018	Apr. 19, 2018	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060103	9kHz~30MHz	Oct. 13, 2017	Mar. 30, 2018	Oct. 12, 2018	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060105	9kHz~30MHz	Oct. 13, 2017	Mar. 30, 2018	Oct. 12, 2018	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 12, 2017	Mar. 30, 2018	Oct. 11, 2018	Conduction (CO01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct. 19, 2017	Apr. 24, 2018	Oct. 18, 2018	Radiation (03CH03-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz-44GHz	Apr. 17, 2018	Apr. 24, 2018	Apr.16, 2019	Radiation (03CH03-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 22, 2017	Apr. 24, 2018	Oct. 21, 2018	Radiation (03CH03-KS)
Bilog Antenna	TeseQ	CBL6112D	47610	30MHz-1GHz	Sep. 12, 2017	Apr. 24, 2018	Sep. 11, 2018	Radiation (03CH03-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75959	1GHz~18GHz	Jan. 21, 2018	Apr. 24, 2018	Jan. 20, 2019	Radiation (03CH03-KS)
SHF-EHF Horn	Schwarzbeck	BBHA 9170	BBHA170249	15GHz~40GHz	Feb. 07, 2018	Apr. 24, 2018	Feb. 06, 2019	Radiation (03CH03-KS)
Amplifier	com-power	PA-103A	161069	1MHz ~1000MHz / 32 dB	Apr. 17, 2018	Apr. 24, 2018	Apr. 16, 2019	Radiation (03CH03-KS)
Amplifier	MITEQ	TTA1840-35-HG	1887435	18~40GHz	Oct. 12, 2017	Apr. 24, 2018	Oct. 11, 2018	Radiation (03CH03-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1Ghz-18Ghz	Apr. 17, 2018	Apr. 24, 2018	Apr. 16, 2019	Radiation (03CH03-KS)
Amplifier	Agilent	8449B	3008A02370	1GHz~26.5GHz	Oct. 12, 2017	Apr. 24, 2018	Oct. 11, 2018	Radiation (03CH03-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Apr. 24, 2018	NCR	Radiation (03CH03-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Apr. 24, 2018	NCR	Radiation (03CH03-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Apr. 24, 2018	NCR	Radiation (03CH03-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.3dB

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.5dB

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.1dB

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.5dB

Appendix A. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2349	52.7	-21.3	74	50.03	31.22	5.59	34.14	100	30	P	H
		2339.64	42.81	-11.19	54	40.14	31.22	5.59	34.14	100	30	A	H
	*	2402	92.49	-	-	89.68	31.3	5.65	34.14	100	30	P	H
	*	2402	91.82	-	-	89.01	31.3	5.65	34.14	100	30	A	H
		2373.7	52.33	-21.67	74	49.57	31.27	5.63	34.14	323	112	P	V
		2352.51	42.65	-11.35	54	39.93	31.25	5.61	34.14	323	112	A	V
	*	2402	86.4	-	-	83.59	31.3	5.65	34.14	323	112	P	V
	*	2402	85.74	-	-	82.93	31.3	5.65	34.14	323	112	A	V
BLE CH 39 2480MHz	*	2480	100.95	-	-	98.04	31.44	5.75	34.28	331	40	P	H
	*	2480	100.37	-	-	97.46	31.44	5.75	34.28	331	40	A	H
		2483.56	55.83	-18.17	74	52.92	31.44	5.75	34.28	331	40	P	H
		2483.5	45.46	-8.54	54	42.55	31.44	5.75	34.28	331	40	A	H
	*	2480	96.16	-	-	93.25	31.44	5.75	34.28	295	113	P	V
	*	2480	95.53	-	-	92.62	31.44	5.75	34.28	295	113	A	V
		2483.62	53.36	-20.64	74	50.45	31.44	5.75	34.28	295	113	P	V
		2483.5	43.74	-10.26	54	40.83	31.44	5.75	34.28	295	113	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH 00 2402MHz		4806	42.5	-31.5	74	63.5	35.66	7.84	64.5	100	360	P	H
		4806	42.73	-31.27	74	63.73	35.66	7.84	64.5	100	360	P	V
BLE CH 19 2440MHz		4878	42.63	-31.37	74	63.72	35.61	7.9	64.6	100	360	P	H
		7320	40.71	-33.29	74	60.32	35.9	9.51	65.02	100	360	P	H
		4878	43.53	-30.47	74	64.62	35.61	7.9	64.6	100	360	P	V
		7320	41.12	-32.88	74	60.73	35.9	9.51	65.02	100	360	P	V
BLE CH 39 2480MHz		4962	42.16	-31.84	74	63.38	35.54	7.97	64.73	100	360	P	H
		7440	41.08	-32.92	74	60.62	35.97	9.57	65.08	100	360	P	H
		4962	43.43	-30.57	74	64.65	35.54	7.97	64.73	100	360	P	V
		7440	41.4	-32.6	74	60.94	35.97	9.57	65.08	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BLE LF		40.67	21.81	-18.19	40	31.12	22.1	0.64	32.05	-	-	P	H
		100.81	23.11	-20.39	43.5	36.12	17.9	1.02	31.93	100	214	P	H
		155.13	16.08	-27.42	43.5	29.32	17.3	1.28	31.82	-	-	P	H
		374.35	24.13	-21.87	46	30.2	22.75	1.99	30.81	-	-	P	H
		402.48	25.45	-20.55	46	28.41	25.66	2.08	30.7	-	-	P	H
		716.76	25.49	-20.51	46	25.01	26.51	2.78	28.81	-	-	P	H
	!	41.64	35.16	-4.84	40	45.25	21.33	0.65	32.07	100	69	P	V
		100.81	29.65	-13.85	43.5	42.66	17.9	1.02	31.93	-	-	P	V
		149.31	23.74	-19.76	43.5	36.83	17.5	1.25	31.84	-	-	P	V
		193.93	21.33	-22.17	43.5	35.6	16	1.42	31.69	-	-	P	V
		385.02	25.78	-20.22	46	30.64	23.88	2.03	30.77	-	-	P	V
		653.71	25.03	-20.97	46	26.15	25.48	2.69	29.29	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **not under limit 6dB**.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is "PASS".

Appendix B. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
Bluetooth LE	64.81	0.406	2.464	3kHz

Bluetooth LE