



FCC RF Test Report

APPLICANT : Lenovo (Shanghai) Electronics Technology Co., Ltd.
EQUIPMENT : 802.11a/b/g/n/ac + BT 4.1 M.2 2230 Type Card
BRAND NAME : Lenovo
MODEL NAME : QCNFA344A
FCC ID : O57-QCNFA344AH
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

The product was installed into Notebook Computer (Brand Name: Lenovo, Model Name: Lenovo YOGA 920-13IKBXXXXXX, 80Y7XXXXXX, Lenovo YOGA 920-13IKB GlassXXXXXX, 80Y8XXXXXX, Lenovo YOGA 6 ProXXXXXX (The "X" in model name can be 0 to 9, A to Z, a to z, "-" or blank), Marketing Name: Lenovo YOGA 920) during test.

The product was received on Jun. 02, 2017 and testing was completed on Jul. 04, 2017. 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.

Prepared by: James Huang / Manager

Approved by: Jones Tsai / Manager



Sporton International (KunShan) INC.
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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR760219B	Rev. 01	Initial issue of report	Aug. 03, 2017



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
-	15.247(a)(2)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	1
-	-	99% Bandwidth	-	Pass	1
3.1	15.247(b)(3)	Peak and Average Output Power	$\leq 30\text{dBm}$	Pass	-
-	15.247(e)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$	Pass	1
-	15.247(d)	Conducted Band Edges and Spurious Emission	$\leq 20\text{dBc}$	Pass	1
3.2	15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 6.93 dB at 34.850 MHz
3.3	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 10.5 dB at 0.198 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. "RF150107E06B-3".					

1 General Description

1.1 Applicant

Lenovo (Shanghai) Electronics Technology Co., Ltd.

NO.68 BUILDING, 199 FENJU RD, China (Shanghai) Pilot Free Trade Zone, 200131, CHINA

1.2 Product Feature of Equipment Under Test

Product Feature	
Equipment	802.11a/b/g/n/ac + BT 4.1 M.2 2230 Type Card
Brand Name	Lenovo
Model Name	QCNFA344A
FCC ID	O57-QCNFA344AH
EUT supports Radios application	WLAN 2.4GHz 802.11b/g/n/ac HT20/HT40/VHT20/VHT40 WLAN 5GHz 802.11a/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth v3.0+EDR, Bluetooth v4.0 LE, Bluetooth v4.1 LE
EUT Stage	Identical Prototype

Host Product Feature	
Equipment	Notebook Computer
Brand Name	Lenovo
Model Name	Lenovo YOGA 920-13IKBXXXXXX, 80Y7XXXXXX, Lenovo YOGA 920-13IKB GlassXXXXXX, 80Y8XXXXXX, Lenovo YOGA 6 ProXXXXXX (The "X" in model name can be 0 to 9, A to Z, a to z, "-" or blank)
Marketing Name	Lenovo YOGA 920
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.



1.3 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 (Peak) Output Power to antenna	4.13 dBm (0.0026 W)
Antenna Type / Gain	PIFA Antenna with gain 0.56 dBi
Type of Modulation	Bluetooth LE : GFSK

1.4 Modification of EUT

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

1.5 Testing Location

Test Site	Sporton International (KunShan) INC.			
Test Site Location	No.3-2, Pingxiang Road, Kunshan Development Zone, Jiangsu, China TEL: +86-0512-5790-0158 FAX: +86-0512-5790-0958			
Test Site No.	Sporton Site No.			FCC Registration No.
	TH01-KS	CO01-KS	03CH03-KS	306251

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

1.6 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: All test items were verified and recorded according to the standards and without any deviation during the test.

2 Test Configuration of Equipment Under Test

2.1 Descriptions of Test Mode

The RF output power was recorded in the following table:

Channel	Frequency	Bluetooth LE RF Peak Output Power
		Data Rate / Modulation
		GFSK
		1Mbps
Ch00	2402MHz	3.63 dBm
Ch19	2440MHz	3.92 dBm
Ch39	2480MHz	4.13 dBm

Channel	Frequency	Bluetooth LE RF Average Output Power
		Data Rate / Modulation
		GFSK
		1Mbps
Ch00	2402MHz	3.45 dBm
Ch19	2440MHz	3.75 dBm
Ch39	2480MHz	3.91 dBm

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 (150 kHz to 30 MHz), radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

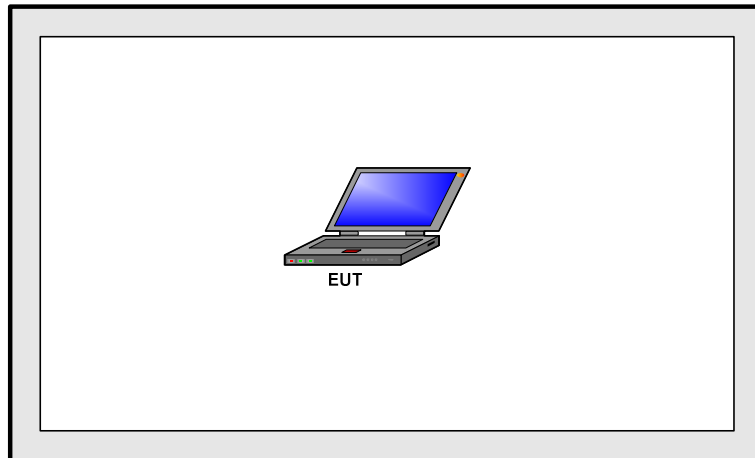
2.2 Test Mode

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

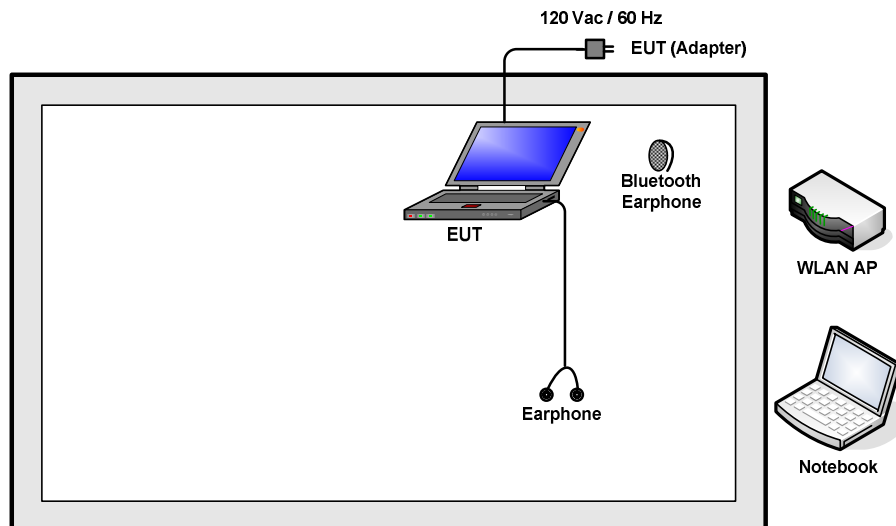
Summary table of Test Cases	
Test Item	Bluetooth LE / GFSK
Radiated TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
AC Conducted Emission	Mode 1 :Bluetooth Link + WLAN (2.4G) Link + Camera + Earphone + Battery 1 + USB Link with U Disk USB Port + Paly H Plane + Adapter 1 With Type C 1 + USB Link with Type C 2 for Sample 1
	Mode 2 : Bluetooth Link + WLAN (2.4G) Link + Camera + Earphone + Battery 1 + USB Link with U Disk USB Port + MPEG4/Color Bar + Adapter 1 With Type C 1 + USB Link with Type C 2 for Sample 1
	Mode 3 : Bluetooth Link + WLAN (2.4G) Link + Camera + Earphone + Battery 2 + USB Link with U Disk USB Port + Adapter 2 With Type C 1 + USB Link with Type C 2 for Sample 2
	Mode 4 : Bluetooth Link + WLAN (2.4G) Link + Camera + Earphone + Battery 3 + USB Link with U Disk USB Port + Adapter 3 With Type C 1 + USB Link with Type C 2 for Sample 3
	Mode 5 : Bluetooth Link + WLAN (2.4G) Link + Camera + Earphone + Battery 4 + USB Link with U Disk USB Port + Adapter 4 With Type C 1 + USB Link with Type C 2 for Sample 4
	Mode 6 : Bluetooth Link + WLAN (2.4G) Link + Camera + Earphone + Battery 5 + USB Link with U Disk USB Port + Adapter 1 With Type C 1 + USB Link with Type C 2 for Sample 5
Remark: - The worst case of conducted emission is mode 3; only the test data of it was reported. - Type C 1 is USB charging port, Type C 2 is USB link port.	

2.3 Connection Diagram of Test System

<Bluetooth LE Tx Mode>



<AC Conducted Emission Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	D-Link	DIR-855	KA2DIR855A2	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	Nokia	BH-102	PYAHS-107W	N/A	N/A

2.5 EUT Operation Test Setup

For Bluetooth LE test items, an engineering test program was provided and enabled to make EUT transmitting and receiving signals.

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 and Average Output Power Measurement

3.1.1 Limit of Peak and Average 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.

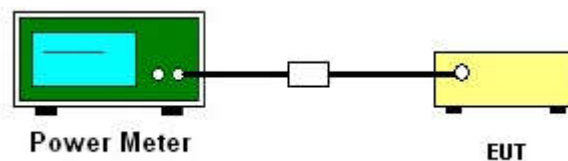
3.1.2 Measuring Instruments

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 No. 558074 DTS D01 Meas. Guidance v03r05.
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 Peak Output Power

Test Mode :	1Mbps	Temperature :	21~25°C
Test Engineer :	Silent Hai	Relative Humidity :	51~55%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
Ch00	2402MHz	3.63	30.00	Pass
Ch19	2440MHz	3.92	30.00	Pass
Ch39	2480MHz	4.13	30.00	Pass

3.1.6 Test Result of Average Output Power

Test Mode :	1Mbps	Temperature :	21~25°C
Test Engineer :	Silent Hai	Relative Humidity :	51~55%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
Ch00	2402MHz	3.45	-	-
Ch19	2440MHz	3.75	-	-
Ch39	2480MHz	3.91	-	-

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

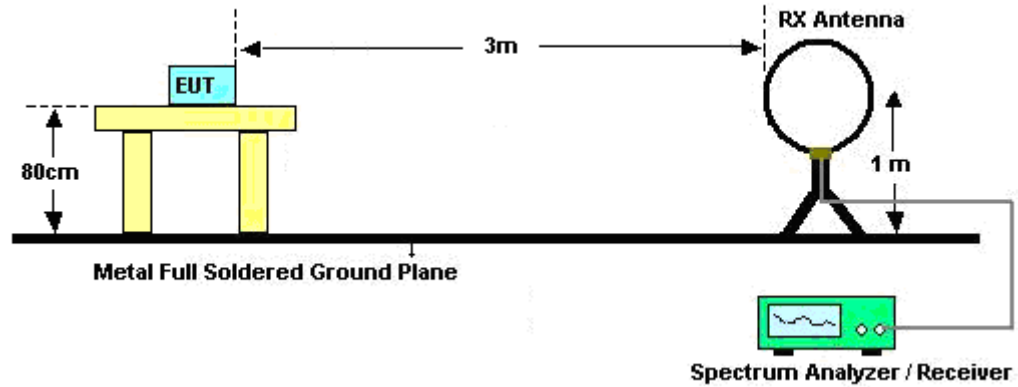
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test 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 measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. 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 $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement.

For average measurement:

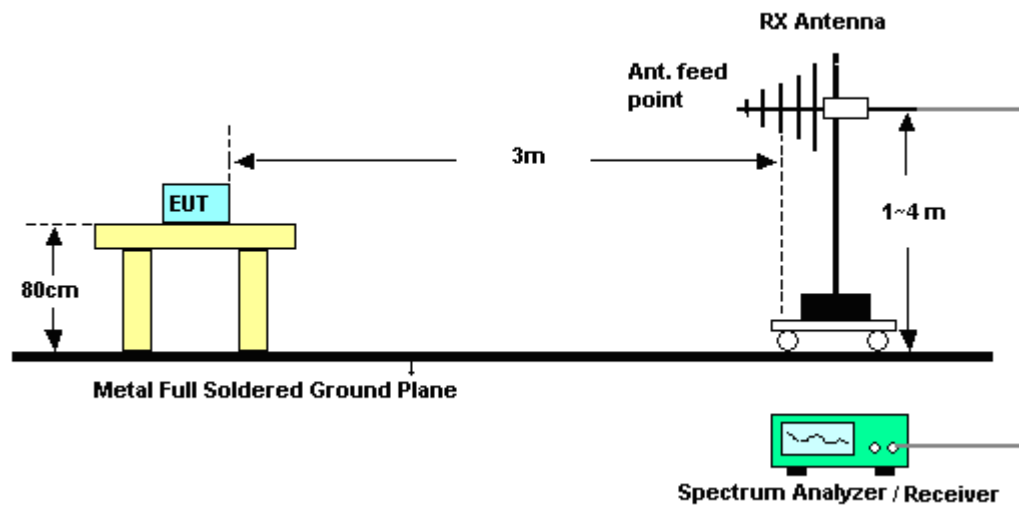
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.2.4 Test Setup

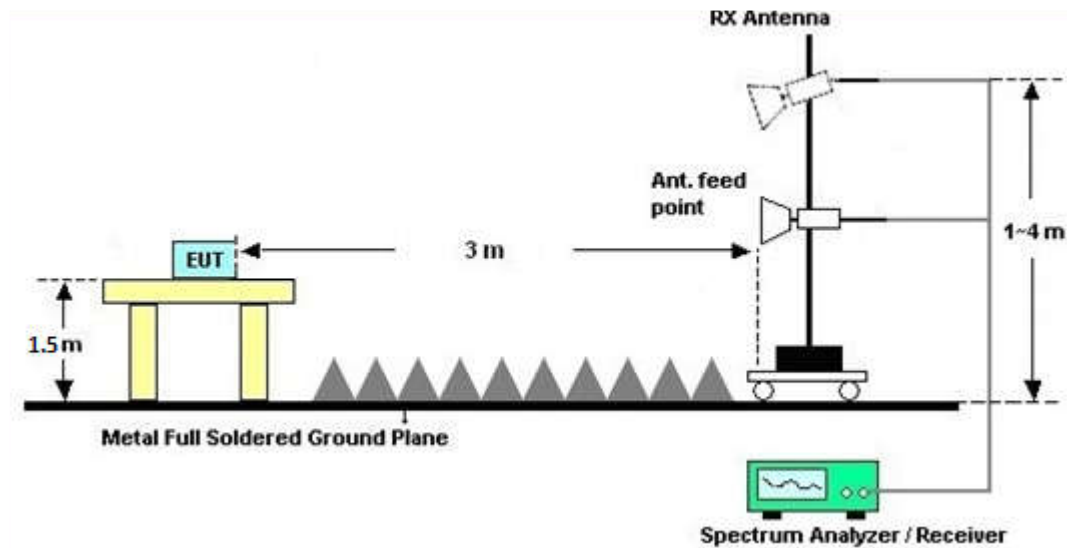
For radiated emissions below 30MHz



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.

3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

3.2.7 Duty Cycle

Please refer to Appendix C.

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

Please refer to Appendix A and B.

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 (dB μ V)	
	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.

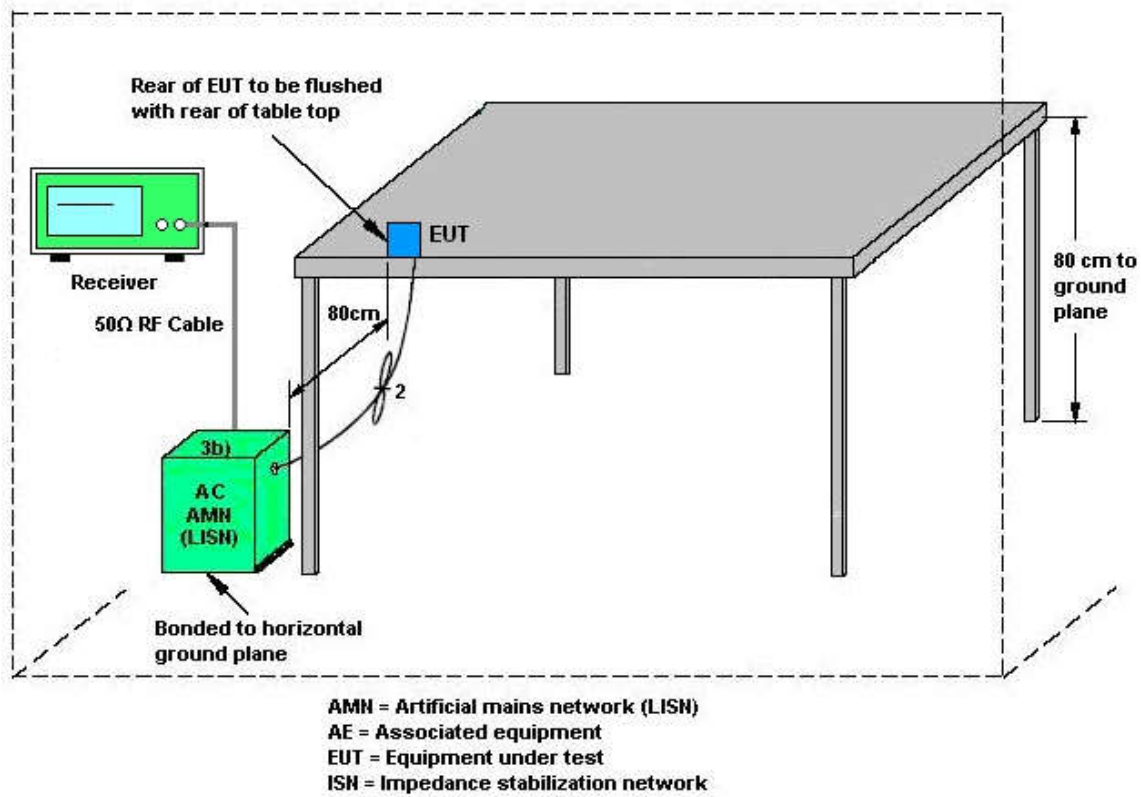
3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

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.

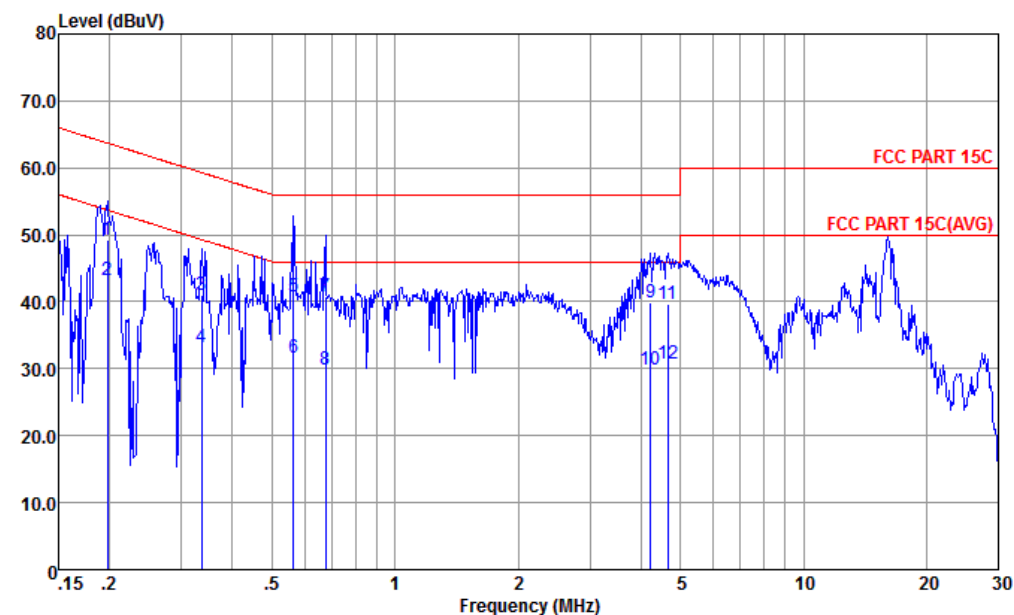
3.3.4 Test Setup





3.3.5 Test Result of AC Conducted Emission

Test Mode :	Mode 3	Temperature :	22~24℃
Test Engineer :	Amos Zhang	Relative Humidity :	42~46%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	Bluetooth Link + WLAN (2.4G) Link + Camera + Earphone + Battery 2 + USB Link with U Disk USB Port + Adapter 2 With Type C 1 + USB Link with Type C 2 for Sample 2		

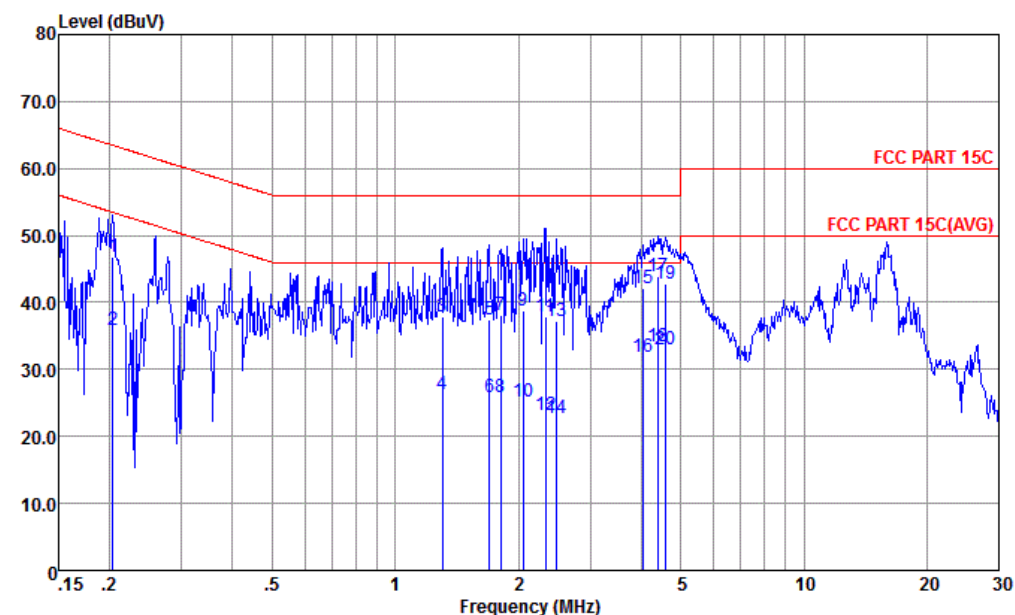


Site : CO01-KS
Condition : FCC PART 15C LISN-L-161017-060103 LINE

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.198	49.21	-14.50	63.71	38.60	0.28	10.33	QP
2 *	0.198	43.21	-10.50	53.71	32.60	0.28	10.33	Average
3	0.336	41.10	-18.21	59.31	30.60	0.27	10.23	QP
4	0.336	33.10	-16.21	49.31	22.60	0.27	10.23	Average
5	0.564	40.75	-15.25	56.00	30.31	0.26	10.18	QP
6	0.564	31.75	-14.25	46.00	21.31	0.26	10.18	Average
7	0.675	40.73	-15.27	56.00	30.30	0.25	10.18	QP
8	0.675	29.93	-16.07	46.00	19.50	0.25	10.18	Average
9	4.224	39.95	-16.05	56.00	29.50	0.21	10.24	QP
10	4.224	29.75	-16.25	46.00	19.30	0.21	10.24	Average
11	4.647	39.65	-16.35	56.00	29.20	0.21	10.24	QP
12	4.647	30.75	-15.25	46.00	20.30	0.21	10.24	Average



Test Mode :	Mode 3	Temperature :	22~24℃
Test Engineer :	Amos Zhang	Relative Humidity :	42~46%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Link + WLAN (2.4G) Link + Camera + Earphone + Battery 2 + USB Link with U Disk USB Port + Adapter 2 With Type C 1 + USB Link with Type C 2 for Sample 2		



Site : CO01-KS
Condition : FCC PART 15C LISN-N-161017-060103 NEUTRAL

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.204	46.86	-16.59	63.45	36.20	0.33	10.33	QP
2	0.204	35.96	-17.49	53.45	25.30	0.33	10.33	Average
3	1.303	37.79	-18.21	56.00	27.20	0.40	10.19	QP
4	1.303	26.19	-19.81	46.00	15.60	0.40	10.19	Average
5	1.698	37.50	-18.50	56.00	26.90	0.41	10.19	QP
6	1.698	25.90	-20.10	46.00	15.30	0.41	10.19	Average
7	1.810	38.20	-17.80	56.00	27.60	0.41	10.19	QP
8	1.810	25.80	-20.20	46.00	15.20	0.41	10.19	Average
9	2.055	38.80	-17.20	56.00	28.20	0.41	10.19	QP
10	2.055	25.20	-20.80	46.00	14.60	0.41	10.19	Average
11	2.334	37.80	-18.20	56.00	27.20	0.40	10.20	QP
12	2.334	23.20	-22.80	46.00	12.60	0.40	10.20	Average
13	2.474	37.21	-18.79	56.00	26.61	0.40	10.20	QP
14	2.474	22.81	-23.19	46.00	12.21	0.40	10.20	Average
15	4.027	42.13	-13.87	56.00	31.50	0.39	10.24	QP
16	4.027	31.93	-14.07	46.00	21.30	0.39	10.24	Average
17 *	4.407	43.83	-12.17	56.00	33.21	0.38	10.24	QP
18	4.407	33.53	-12.47	46.00	22.91	0.38	10.24	Average
19	4.598	42.83	-13.17	56.00	32.21	0.38	10.24	QP
20	4.598	32.93	-13.07	46.00	22.31	0.38	10.24	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
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 19, 2017	Jun. 09, 2017	Jan. 18, 2018	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 19, 2017	Jun. 09, 2017	Jan. 18, 2018	Conducted (TH01-KS)
EMI Test Receiver	R&S	ESR7	101403	9kHz~7GHz; Max 30dBm	Aug. 09, 2016	Jun. 15, 2017	Aug. 08, 2017	Radiation (03CH03-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz~44GHz	Apr. 18, 2017	Jun. 15, 2017	Apr. 17, 2018	Radiation (03CH03-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Nov. 23, 2016	Jun. 15, 2017	Nov. 22, 2017	Radiation (03CH03-KS)
Bilog Antenna	TeseQ	CBL6112D	35406	25MHz~2GHz	Apr. 22, 2017	Jun. 15, 2017	Apr. 21, 2018	Radiation (03CH03-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1356	1GHz~18GHz	Apr. 22, 2017	Jun. 15, 2017	Apr. 21, 2018	Radiation (03CH03-KS)
SHF-EHF Horn	com-power	AH-840	101070	18GHz ~40GHz	Oct. 19, 2016	Jun. 15, 2017	Oct. 18, 2017	Radiation (03CH03-KS)
Amplifier	com-power	PA-103A	161069	1MHz ~1000MHz / 32 dB	Apr. 18, 2017	Jun. 15, 2017	Apr. 17, 2018	Radiation (03CH03-KS)
High Gain Amplifier	MITEQ	AMF-7D-001018 00-30-10P	2025788	1GHz~18GHz	Apr. 18, 2017	Jun. 15, 2017	Apr. 17, 2018	Radiation (03CH03-KS)
Amplifier	Agilent	8449B	3008A02370	1GHz~26.5GHz	Oct. 13, 2016	Jun. 15, 2017	Oct. 12, 2017	Radiation (03CH03-KS)
Amplifier	MITEQ	TTA1840-35-HG	1887435	18GHz~40GHz	Oct. 13, 2016	Jun. 15, 2017	Oct. 12, 2017	Radiation (03CH03-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jun. 15, 2017	NCR	Radiation (03CH03-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Jun. 15, 2017	NCR	Radiation (03CH03-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Jun. 15, 2017	NCR	Radiation (03CH03-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz	Apr. 20, 2017	Jul. 04, 2017	Apr. 19, 2018	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060103	9kHz~30MHz	Oct. 13, 2016	Jul. 04, 2017	Oct. 12, 2017	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060105	9kHz~30MHz	Oct. 13, 2016	Jul. 04, 2017	Oct. 12, 2017	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP0000008 11	AC 0V~300V, 45Hz~1000Hz	Oct. 13, 2016	Jul. 04, 2017	Oct. 12, 2017	Conduction (CO01-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
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.6dB
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Uncertainty of Radiated Emission Measurement (1GHz ~ 18GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.5dB
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Uncertainty of Radiated Emission Measurement (18GHz ~ 40GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.7dB
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Appendix A. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

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)
BLE CH 00 2402MHz		2362.26	49.5	-24.5	74	55.03	25.55	5.43	36.51	297	225	P	H
		2385.14	39.95	-14.05	54	45.29	25.67	5.45	36.46	297	225	A	H
	*	2402	95.01	-	-	100.16	25.8	5.47	36.42	297	225	P	H
	*	2402	94.44	-	-	99.59	25.8	5.47	36.42	297	225	A	H
		2375.39	50.22	-23.78	74	55.56	25.67	5.45	36.46	393	70	P	V
		2386.31	39.94	-14.06	54	45.09	25.8	5.47	36.42	393	70	A	V
	*	2402	94.42	-	-	99.57	25.8	5.47	36.42	393	70	P	V
	*	2402	93.83	-	-	98.98	25.8	5.47	36.42	393	70	A	V
BLE CH 19 2440MHz		2384.1	49.82	-24.18	74	55.16	25.67	5.45	36.46	352	225	P	H
		2367.33	40.19	-13.81	54	45.72	25.55	5.43	36.51	352	225	A	H
	*	2440	95.32	-	-	100.39	25.89	5.49	36.45	352	225	P	H
	*	2440	94.73	-	-	99.8	25.89	5.49	36.45	352	225	A	H
		2498.98	50.16	-23.84	74	55.15	25.97	5.52	36.48	352	225	P	H
		2496.82	40.1	-13.9	54	45.09	25.97	5.52	36.48	352	225	A	H
		2389.04	49.6	-24.4	74	54.75	25.8	5.47	36.42	383	60	P	V
		2382.41	39.86	-14.14	54	45.2	25.67	5.45	36.46	383	60	A	V
	*	2440	95.56	-	-	100.63	25.89	5.49	36.45	383	60	P	V
	*	2440	94.97	-	-	100.04	25.89	5.49	36.45	383	60	A	V
		2485.84	50.18	-23.82	74	55.2	25.94	5.51	36.47	383	60	P	V
		2484.82	40.29	-13.71	54	45.31	25.94	5.51	36.47	383	60	A	V



BLE CH 39 2480MHz	*	2480	96.23	-	-	101.25	25.94	5.51	36.47	298	226	P	H
	*	2480	95.59	-	-	100.61	25.94	5.51	36.47	298	226	A	H
		2483.56	53.53	-20.47	74	58.55	25.94	5.51	36.47	298	226	P	H
		2483.51	42.15	-11.85	54	47.17	25.94	5.51	36.47	298	226	A	H
	*	2480	95.45	-	-	100.47	25.94	5.51	36.47	375	58	P	V
	*	2480	94.82	-	-	99.84	25.94	5.51	36.47	375	58	A	V
		2483.51	52.6	-21.4	74	57.62	25.94	5.51	36.47	375	58	P	V
		2483.51	41.86	-12.14	54	46.88	25.94	5.51	36.47	375	58	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	43.27	-30.73	74	41.44	30.62	7.71	36.5	300	360	P	H
		4806	42.97	-31.03	74	41.14	30.62	7.71	36.5	300	360	P	V
BLE CH 19 2440MHz		4878	42.08	-31.92	74	40	30.85	7.76	36.53	300	0	P	H
		7320	47.63	-26.37	74	39.25	34.85	9.78	36.25	300	0	P	H
		4880	43.97	-30.03	74	41.89	30.85	7.76	36.53	300	0	P	V
		7320	47.71	-26.29	74	39.33	34.85	9.78	36.25	300	0	P	V
BLE CH 39 2480MHz		4960	43.14	-30.86	74	40.76	31.13	7.82	36.57	300	0	P	H
		7440	47.62	-26.38	74	38.87	35.17	9.87	36.29	300	0	P	H
		4962	42.92	-31.08	74	40.54	31.13	7.82	36.57	300	0	P	V
		7440	47.68	-26.32	74	38.93	35.17	9.87	36.29	300	0	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		34.85	33.07	-6.93	40	38.96	25.7	0.71	32.3	110	50	P	H
		216.24	22.41	-23.59	46	35.82	17.07	1.73	32.21	-	-	P	H
		323.91	25.75	-20.25	46	35.01	20.61	2.21	32.08	-	-	P	H
		456.8	26.27	-19.73	46	30.43	25.12	2.66	31.94	-	-	P	H
		569.32	26.66	-19.34	46	30.78	24.63	2.98	31.73	-	-	P	H
		693.48	29.79	-16.21	46	30.49	27.65	3.33	31.68	-	-	P	H
		33.88	33.07	-6.93	40	38.75	25.92	0.7	32.3	100	20	P	V
		45.52	32.41	-7.59	40	45.09	18.7	0.83	32.21	-	-	P	V
		94.02	26.91	-16.59	43.5	39.77	18.22	1.17	32.25	-	-	P	V
		323.91	27.53	-18.47	46	36.79	20.61	2.21	32.08	-	-	P	V
		552.83	27.03	-18.97	46	30.99	24.86	2.94	31.76	-	-	P	V
		709	29.46	-16.54	46	30.03	27.75	3.37	31.69	-	-	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 over limit line.
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		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		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. Radiated Spurious Emission

Note symbol

-L	Low channel location
-R	High channel location

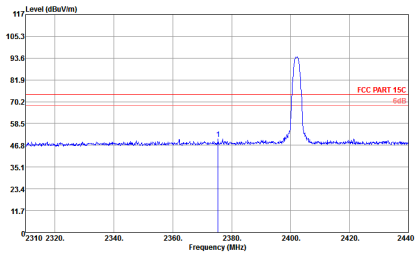
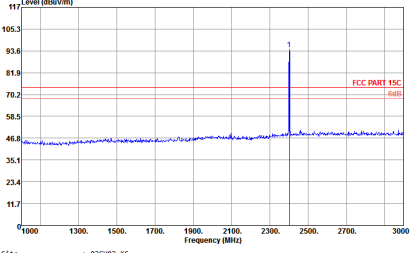
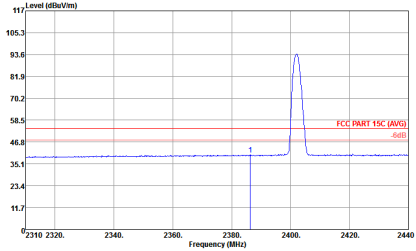
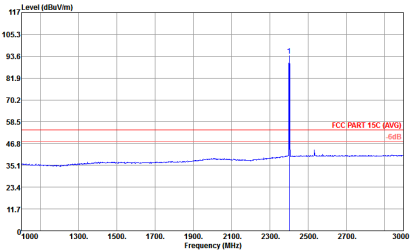


2.4GHz 2400~2483.5MHz

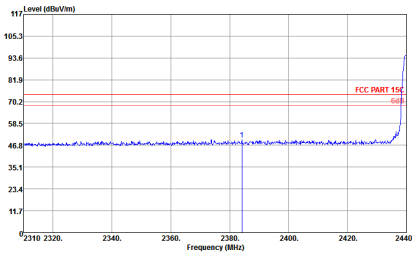
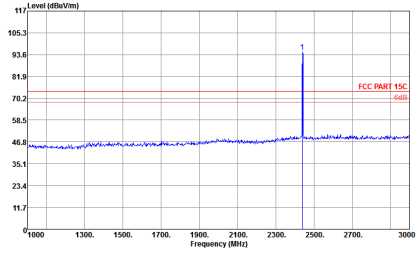
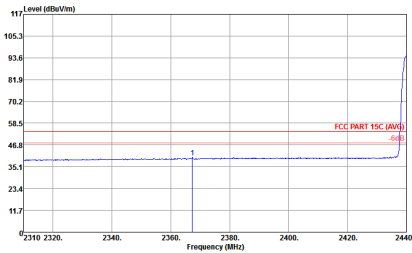
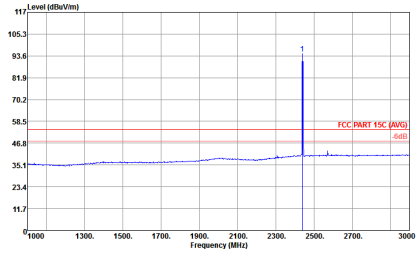
BLE (Band Edge @ 3m)

BLE		2.4GHz 2400~2483.5MHz Band Edge @ 3m																																																													
		BLE CH00 2402MHz																																																													
		Horizontal	Fundamental																																																												
Peak		Site : 83CH03-KS Condition : FCC PART 15C 3m HF ANT-201704-91280 HORIZONTAL Project : (FR) 760219 Node : 4 Plane : Pad-X Single-directivity : #4 <table><tr><th>IMEI</th><th>Freq</th><th>Level</th><th>Over Limit</th><th>ReadAntenna</th><th>Cable Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th><th>Pol/Phas</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dB/m</th><th>dB</th><th>cm</th><th>deg</th><th></th></tr><tr><td>1</td><td>2362.26</td><td>49.30</td><td>-24.50</td><td>74.00</td><td>55.03</td><td>25.55</td><td>5.43</td><td>36.51</td><td>297 225 Peak HORIZONTAL</td></tr></table>	IMEI	Freq	Level	Over Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	Pol/Phas		MHz	dBuV/m	dB	dBuV/m	dB/m	dB	cm	deg		1	2362.26	49.30	-24.50	74.00	55.03	25.55	5.43	36.51	297 225 Peak HORIZONTAL	Site : 83CH03-KS Condition : FCC PART 15C 3m HF ANT-201704-91280 HORIZONTAL Project : (FR) 760219 Node : 4 Plane : Pad-X Single-directivity : #4 <table><tr><th>IMEI</th><th>Freq</th><th>Level</th><th>Over Limit</th><th>ReadAntenna</th><th>Cable Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th><th>Pol/Phas</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dB/m</th><th>dB</th><th>cm</th><th>deg</th><th></th></tr><tr><td>1 *</td><td>2402.00</td><td>95.01</td><td>21.01</td><td>74.00</td><td>100.16</td><td>25.00</td><td>5.47</td><td>36.42</td><td>297 225 Peak HORIZONTAL</td></tr></table>	IMEI	Freq	Level	Over Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	Pol/Phas		MHz	dBuV/m	dB	dBuV/m	dB/m	dB	cm	deg		1 *	2402.00	95.01	21.01	74.00	100.16	25.00	5.47	36.42	297 225 Peak HORIZONTAL
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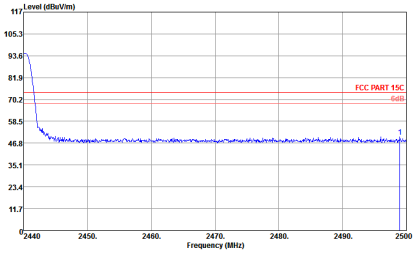
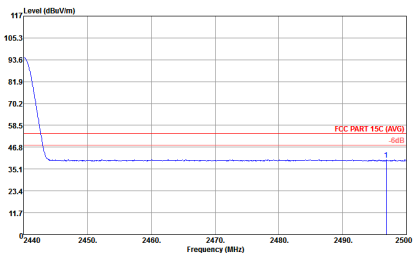


BLE		2.4GHz 2400~2483.5MHz Band Edge @ 3m																																																																																		
BLE CH00 2402MHz																																																																																				
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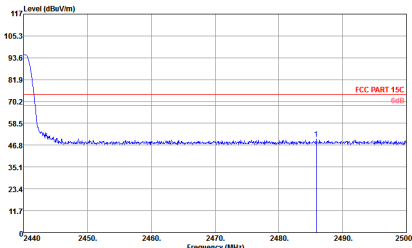
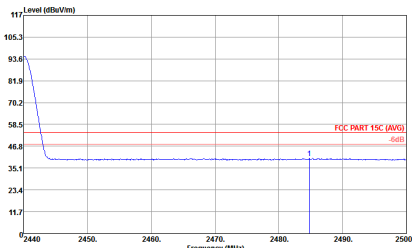


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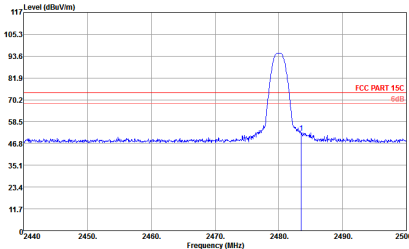
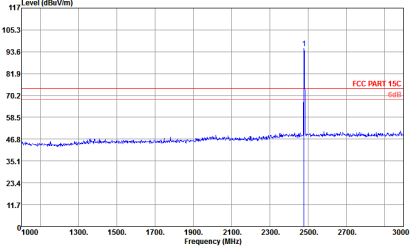
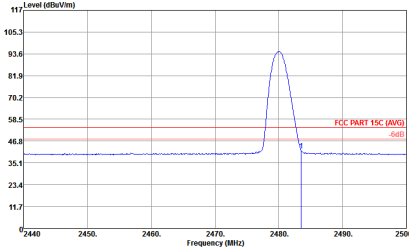
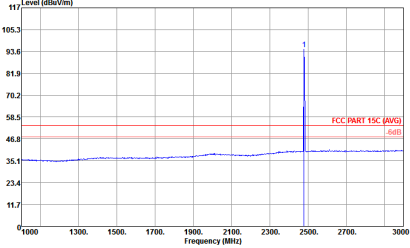


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2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

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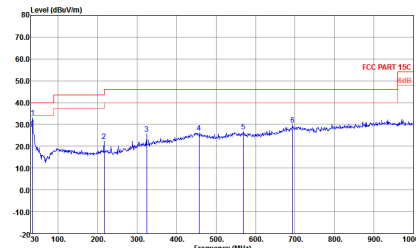
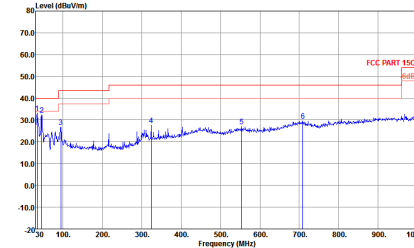


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Peak	Site : 03CH03-KS Condition : FCC PART 15C 3m HF ANT-201704-91280 HORIZONTAL Project : SMT-Retu : (FR) 760219 Mode : 0 Plane : Pad-X : Single-directivity IMEI : 84 <table><tr><th></th><th>Freq</th><th>Level</th><th>Over</th><th>Limit</th><th>ReadAntenna</th><th>Cable</th><th>Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th><th>Pol/Phas</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th><th></th></tr><tr><td>1</td><td>4960.00</td><td>43.14</td><td>-38.86</td><td>74.00</td><td>48.76</td><td>31.13</td><td>7.82</td><td>36.57</td><td>300</td><td>0 Peak</td><td>HORIZONTAL</td></tr><tr><td>2</td><td>7440.00</td><td>47.62</td><td>-26.38</td><td>74.00</td><td>38.87</td><td>35.17</td><td>9.87</td><td>36.29</td><td>300</td><td>0 Peak</td><td>HORIZONTAL</td></tr></table>												Freq	Level	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark	Pol/Phas		MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg		1	4960.00	43.14	-38.86	74.00	48.76	31.13	7.82	36.57	300	0 Peak	HORIZONTAL	2	7440.00	47.62	-26.38	74.00	38.87	35.17	9.87	36.29	300	0 Peak	HORIZONTAL	Site : 03CH03-KS Condition : FCC PART 15C 3m HF ANT-201704-91280 VERTICAL Project : SMT-Retu : (FR) 760219 Mode : 0 Plane : Pad-X : Single-directivity IMEI : 84 <table><tr><th></th><th>Freq</th><th>Level</th><th>Over</th><th>Limit</th><th>ReadAntenna</th><th>Cable</th><th>Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th><th>Pol/Phas</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th><th></th></tr><tr><td>1</td><td>4960.00</td><td>42.92</td><td>-31.08</td><td>74.00</td><td>48.54</td><td>31.13</td><td>7.82</td><td>36.57</td><td>300</td><td>0 Peak</td><td>VERTICAL</td></tr><tr><td>2</td><td>7440.00</td><td>47.68</td><td>-26.32</td><td>74.00</td><td>38.93</td><td>35.17</td><td>9.87</td><td>36.29</td><td>300</td><td>0 Peak</td><td>VERTICAL</td></tr></table>		Freq	Level	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark	Pol/Phas		MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg		1	4960.00	42.92	-31.08	74.00	48.54	31.13	7.82	36.57	300	0 Peak	VERTICAL	2	7440.00	47.68	-26.32	74.00	38.93	35.17	9.87	36.29	300	0 Peak	VERTICAL
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Emission below 1GHz

2.4GHz BLE (LF)

BLE	2.4GHz 2400~2483.5MHz																																																																																																										
	BLE LF																																																																																																										
	Horizontal																																																																																																										
QP / Peak																																																																																																											
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Appendix C. Radiated Spurious Emission

Note symbol

-L	Low channel location
-R	High channel location



2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE		2.4GHz 2400~2483.5MHz Band Edge @ 3m																																																													
		BLE CH00 2402MHz																																																													
		Horizontal	Fundamental																																																												
Peak		Site : 83CH03-KS Condition : FCC PART 15C 3m HF ANT-201704-91200 HORIZONTAL Project : (FR) 760219 Node : 4 Plane : Pad-X Single-directivity : #4 <table><tr><th>IMEI</th><th>Freq</th><th>Level</th><th>Over Limit</th><th>ReadAntenna</th><th>Cable Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th><th>Pol/Phas</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dB/m</th><th>dB</th><th>cm</th><th>deg</th><th></th></tr><tr><td>1</td><td>2362.26</td><td>49.30</td><td>-24.50</td><td>74.00</td><td>55.03</td><td>25.55</td><td>5.43</td><td>36.51</td><td>297 225 Peak HORIZONTAL</td></tr></table>	IMEI	Freq	Level	Over Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	Pol/Phas		MHz	dBuV/m	dB	dBuV/m	dB/m	dB	cm	deg		1	2362.26	49.30	-24.50	74.00	55.03	25.55	5.43	36.51	297 225 Peak HORIZONTAL	Site : 83CH03-KS Condition : FCC PART 15C 3m HF ANT-201704-91200 HORIZONTAL Project : (FR) 760219 Node : 4 Plane : Pad-X Single-directivity : #4 <table><tr><th>IMEI</th><th>Freq</th><th>Level</th><th>Over Limit</th><th>ReadAntenna</th><th>Cable Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th><th>Pol/Phas</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dB/m</th><th>dB</th><th>cm</th><th>deg</th><th></th></tr><tr><td>1 *</td><td>2402.00</td><td>95.01</td><td>21.01</td><td>74.00</td><td>100.16</td><td>25.00</td><td>5.47</td><td>36.42</td><td>297 225 Peak HORIZONTAL</td></tr></table>	IMEI	Freq	Level	Over Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	Pol/Phas		MHz	dBuV/m	dB	dBuV/m	dB/m	dB	cm	deg		1 *	2402.00	95.01	21.01	74.00	100.16	25.00	5.47	36.42	297 225 Peak HORIZONTAL
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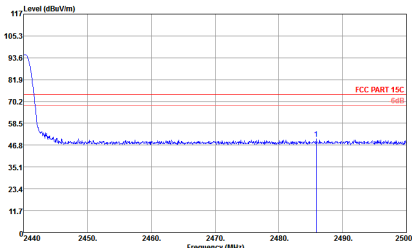
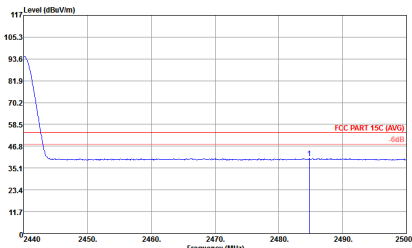


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Avg.	 Site : 03CH03-KS Condition : FCC PART 15C (AVG) 3m HF ANT-201704-91280 VERTICAL Project : (FR) 760219 Mode : S Plane : Pad-X Single-directivity : #4 <table><thead><tr><th>IME1</th><th>Freq</th><th>Level</th><th>Over</th><th>Limit</th><th>ReadAntenna</th><th>Cable Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th><th>Pol/Phas</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr></thead><tbody><tr><td>1</td><td>2484.82</td><td>40.29</td><td>-13.71</td><td>54.00</td><td>45.31</td><td>25.94</td><td>5.51</td><td>36.47</td><td>383</td><td>60 Average</td><td>VERTICAL</td></tr></tbody></table>	IME1	Freq	Level	Over	Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	Pol/Phas		MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg	1	2484.82	40.29	-13.71	54.00	45.31	25.94	5.51	36.47	383	60 Average	VERTICAL		
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BLE		2.4GHz 2400~2483.5MHz Band Edge @ 3m									
		BLE CH39 2480MHz									
		Vertical					Fundamental				
Peak											



2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m										
	BLE CH00 2402MHz										
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BLE		2.4GHz 2400~2483.5MHz Harmonic @ 3m																																																																																																								
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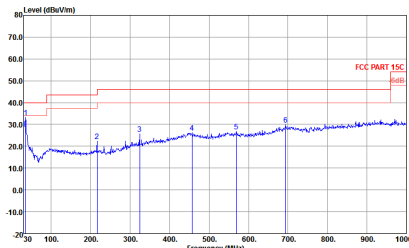
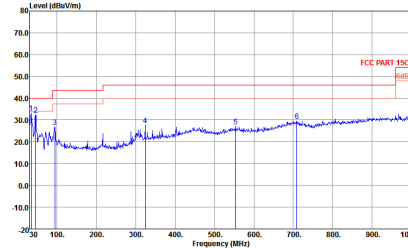


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Emission below 1GHz

2.4GHz BLE (LF)

BLE	2.4GHz 2400~2483.5MHz																																																																																																										
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QP / Peak																																																																																																											
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Appendix C. Duty Cycle Plots

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

Bluetooth LE

