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-X501F) during test.

The product was received on Feb. 26, 2018 and testing was completed on Apr. 24, 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

NVLAP®
TESTING
NVLAP LAB CODE 600155-0

Approved by: James Huang / Manager

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TABLE OF CONTENTS

REVISION HISTORY **3**

SUMMARY OF TEST RESULT **4**

1 GENERAL DESCRIPTION **5**

1.1 Applicant 5
1.2 Manufacturer 5
1.3 Product Feature of Equipment Under Test 5
1.4 Product Specification of Equipment Under Test 6
1.5 Modification of EUT 6
1.6 Component List 6
1.7 Testing Location 7
1.8 Applicable Standards 7

2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST **9**

2.1 Carrier Frequency and Channel 9
2.2 Test Mode 10
2.3 Connection Diagram of Test System 11
2.4 Support Unit used in test configuration and system 11
2.5 EUT Operation Test Setup 11

3 TEST RESULT **12**

3.1 Output Power Measurement 12
3.2 Radiated Band Edges and Spurious Emission Measurement 14
3.3 AC Conducted Emission Measurement 18
3.4 Antenna Requirements 22

4 LIST OF MEASURING EQUIPMENT **23**

5 UNCERTAINTY OF EVALUATION **24**

APPENDIX A. RADIATED SPURIOUS EMISSION

APPENDIX B. DUTY CYCLE PLOTS

APPENDIX C. SETUP PHOTOGRAPHS

REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR922206C	Rev. 01	Initial issue of report	Apr. 22, 2019

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)	Power Output Measurement	≤ 30dBm	Pass	-
-	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	1
-	15.247(d)	Conducted Band Edges	≤ 20dBc	Pass	1
		Conducted Spurious Emission		Pass	1
3.2	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 3.09 dB at 2484.10 MHz
3.3	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 15.98 dB at 0.156 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. "FR7N1336AC".

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-X501F
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 Channel Frequency Range	2412 MHz ~ 2462 MHz
Maximum (Peak) Output Power to antenna	**MIMO<Ant. 1+2>** 802.11b : 18.55 dBm (0.0716 W) 802.11g : 18.94 dBm (0.0783 W) 802.11ac VHT20 : 19.01 dBm (0.0796 W) 802.11ac VHT40 : 14.75 dBm (0.0299 W)
Antenna Type / Gain	Ant. 1: PIFA Antenna with gain 3.45 dBi Ant. 2: PIFA Antenna with gain 3.45 dBi
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)
Antenna Function for Transmitter	<table><tr><td></td><td>Ant. 1</td><td>Ant. 2</td></tr><tr><td>802.11 b/g/n/ac SISO</td><td>V</td><td>V</td></tr><tr><td>802.11 b/g/n/ac MIMO</td><td>V</td><td>V</td></tr></table>

Note: MIMO Ant. 1+2 is a calculated result from sum of the power MIMO Ant. 1 and MIMO Ant. 2.

1.5 Modification of EUT

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

1.6 Component List

Sample 1		
Object	Specifications	Supplier
CPU	APQ-8053-A-792NSP-MT-01-1-AA 3.3V 1.2V SMD NSP 792 14*12.*0.85 TR Qualcomm	Qualcomm
FLASH	KLM4G1FETE-B041001 1.8V 4G SMD FBGA 153 TR	Samsung
DDR	MT52L512M32D2PF-107 WT:B 1.8V 512Mb*32 SMD-V WFBGA178 T&R 2GB 933MHz	Micron
LCD	2081101CH8032018-59F L228.6*W143*H2.5mm ±3.3V 800*1280 DIP-V Tray RoHS	XINYUAN
PANEL	B132366E1 L243.36*W165.76*H0.95mm 2.8V Tray RoHS	MUTTO
Camera	F4E8YAM S5K4E8YX FF:SPY8133B ZIF/MIPI/COB W-1057 V1.0 Box RoHS REACH	Qtech
loudspeaker	2" 6Ω 10W speaker	3nod
PCB	L102*W91*T0.8MM FR-4 0.5OZ UL94 V0 W-1057 MAIN V1.0 RoHS REACH	Hannstar
Module	WCBN3510A QCA9379-3 WIFI and Bluetooth combo W-1013/1014 V01 Tray	Liteon

Sample 2		
Object	Specifications	Supplier

CPU	APQ-8053-A-792NSP-MT-01-1-AA 3.3V 1.2V SMD NSP 792 14*12.*0.85 TR Qualcomm	Qualcomm
FLASH	EMMC04G-M627X02U 1.8V SMD FBGA 153 T&R NAND 15nm Flash	Samsung
DDR	K4E6E304EC-EGCF 1.8V 2GB*32 SMD WFBGA178 11*11.5 T&R	Samsung
LCD	KD101N89-45NI-A001 L228.6*W143*H2.5mm ±3.3V 800*1280 DIP-V Tray RoHS	kingdisplay
PANEL	99101D0017 L243.36*W165.76*H0.95mm 2.8V Tray RoHS	AVC
Camera	L4E8F00 S5K4E8YX FF:SPY8133B /MIPI/COB W-1057 V1.0 Box RoHS	Chicony
loudspeaker	2" 6Ω 10W speaker	3nod
PCB	L102*W91*T0.8MM FR-4 0.5OZ UL94 V0 W-1057 MAIN V1.0 RoHS REACH	Hannstar
Module	WCBN3510A QCA9379-3 WIFI and Bluetooth combo W-1013/1014 V01 Tray	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
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- 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

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 (X plane) were recorded in this report.

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

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437		

2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

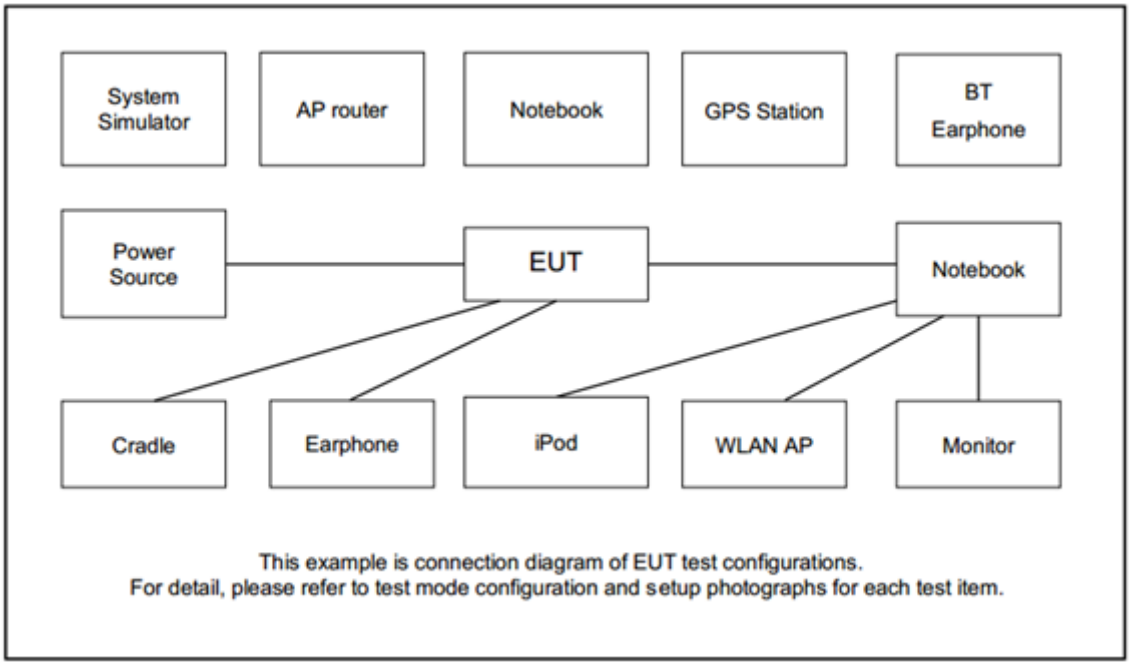
For 802.11b/g, 802.11ac VHT20/VHT40 mode, we only test MIMO mode for RSE by referring to the higher conducted power.

MIMO Antenna

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11ac VHT20	MCS0
802.11ac VHT40	MCS0

Test Cases	
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 2; only the test data of this mode is reported.	

2.3 Connection Diagram of Test System



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	LINKSYS	WRT600N	Q87-WRT600NV11	N/A	Unshielded, 1.8 m
2.	Bluetooth Earphone	Lenovo	LBH308	N/A	N/A	N/A

2.5 EUT Operation Test Setup

For WLAN RF 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 Output Power Measurement

3.1.1 Limit of 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 are 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.

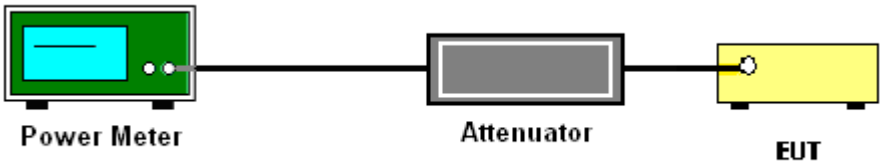
3.1.2 Measuring Instruments

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

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

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)		Average Conducted Power (dBm)		
					Ant 1	Ant 2	Ant 1	Ant 2	SUM
11b	1Mbps	2	1	2412	0.00	0.00	14.92	13.73	17.38
11b	1Mbps	2	6	2437	0.00	0.00	14.68	14.33	17.52
11b	1Mbps	2	11	2462	0.00	0.00	16.03	14.98	18.55
11g	6Mbps	2	1	2412	0.24	0.24	15.62	14.27	18.00
11g	6Mbps	2	2	2417	0.24	0.24	16.21	15.46	18.86
11g	6Mbps	2	6	2437	0.24	0.24	15.36	16.43	18.94
11g	6Mbps	2	10	2457	0.24	0.24	13.91	13.56	16.75
11g	6Mbps	2	11	2462	0.24	0.24	12.57	12.49	15.54
VHT20	MCS0	2	1	2412	0.51	0.45	15.63	14.13	17.95
VHT20	MCS0	2	2	2417	0.51	0.45	15.56	14.51	18.08
VHT20	MCS0	2	6	2437	0.51	0.45	15.54	16.41	19.01
VHT20	MCS0	2	10	2457	0.51	0.45	14.17	13.28	16.76
VHT20	MCS0	2	11	2462	0.51	0.45	13.56	13.26	16.42
VHT40	MCS0	2	3	2422	0.81	0.90	12.87	8.66	14.27
VHT40	MCS0	2	4	2427	0.81	0.90	10.30	9.59	12.97
VHT40	MCS0	2	6	2437	0.81	0.90	11.97	11.49	14.75
VHT40	MCS0	2	8	2447	0.81	0.90	10.23	9.96	13.11
VHT40	MCS0	2	9	2452	0.81	0.90	8.54	7.84	11.21

3.2 Radiated Band Edges and Spurious Emission Measurement

3.2.1 Limit of Radiated band edge and Spurious Emission Measurement

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

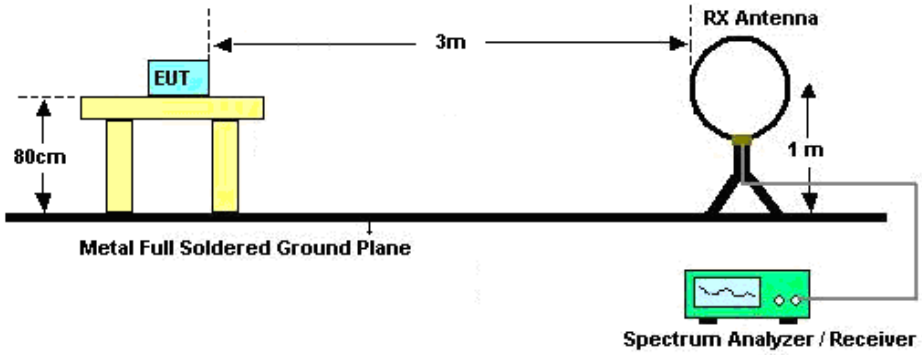
The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

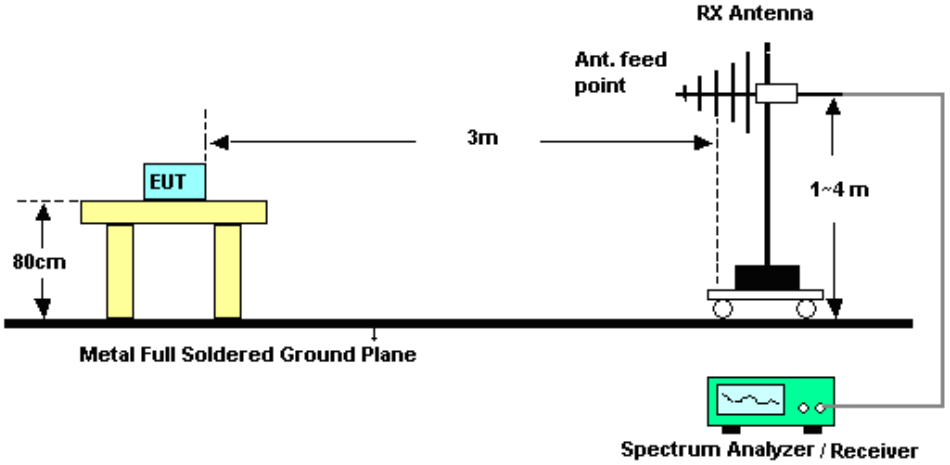
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test 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

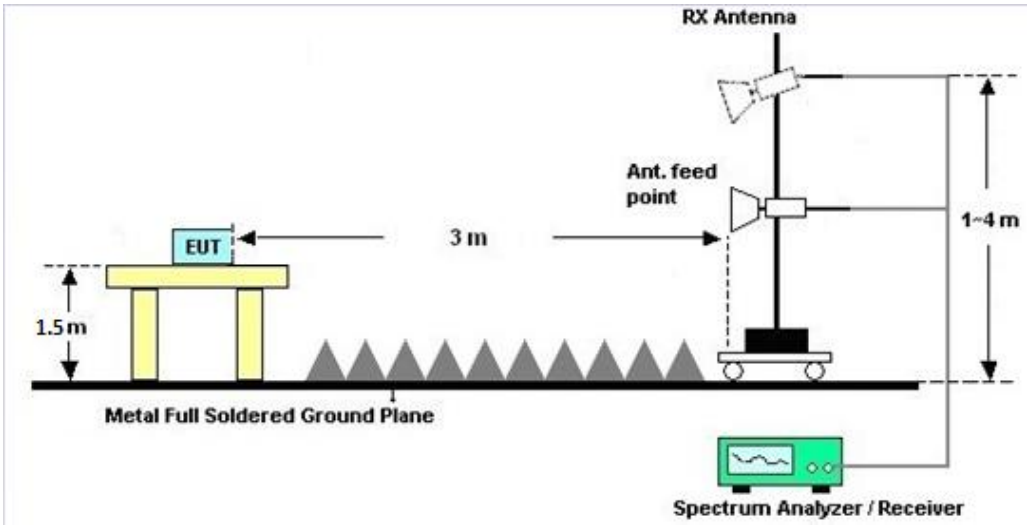
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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

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 Appendix A.

Note: The worst cases of mode (BT3.0/BLE/WLAN2.4GHz) is tested

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.

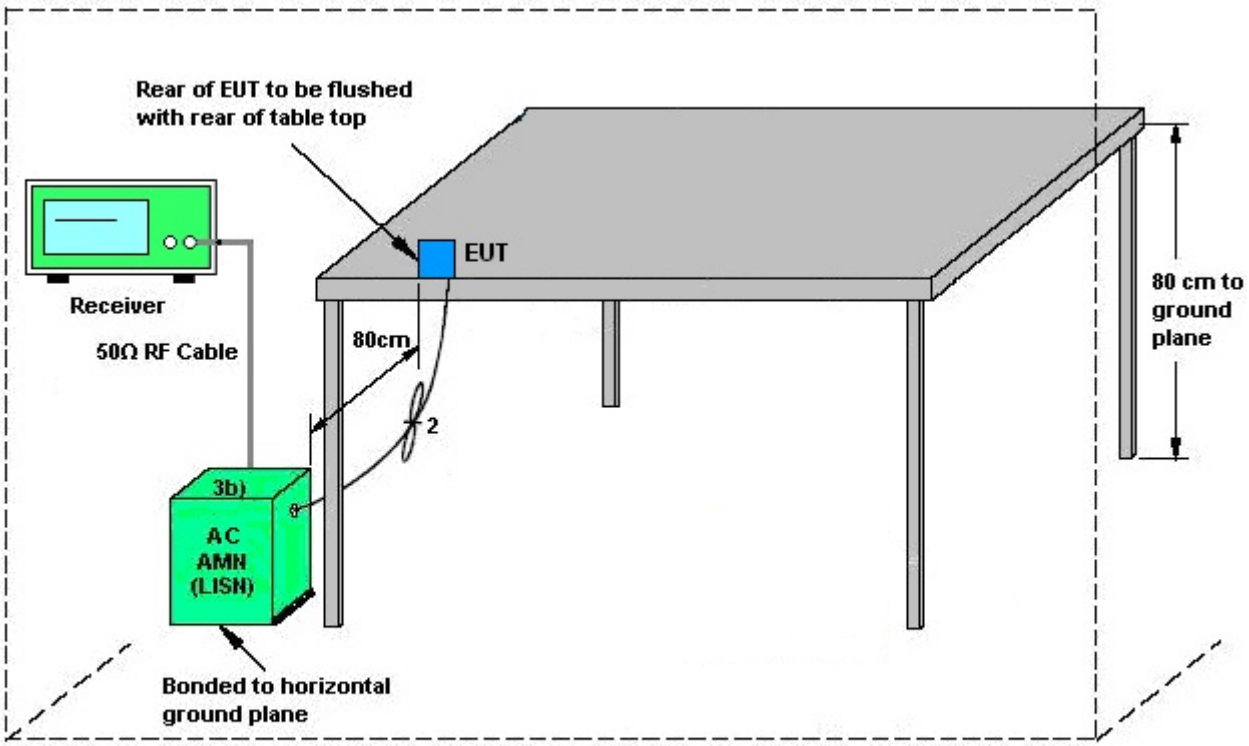
3.3.2 Measuring Instruments

The 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, and it 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.

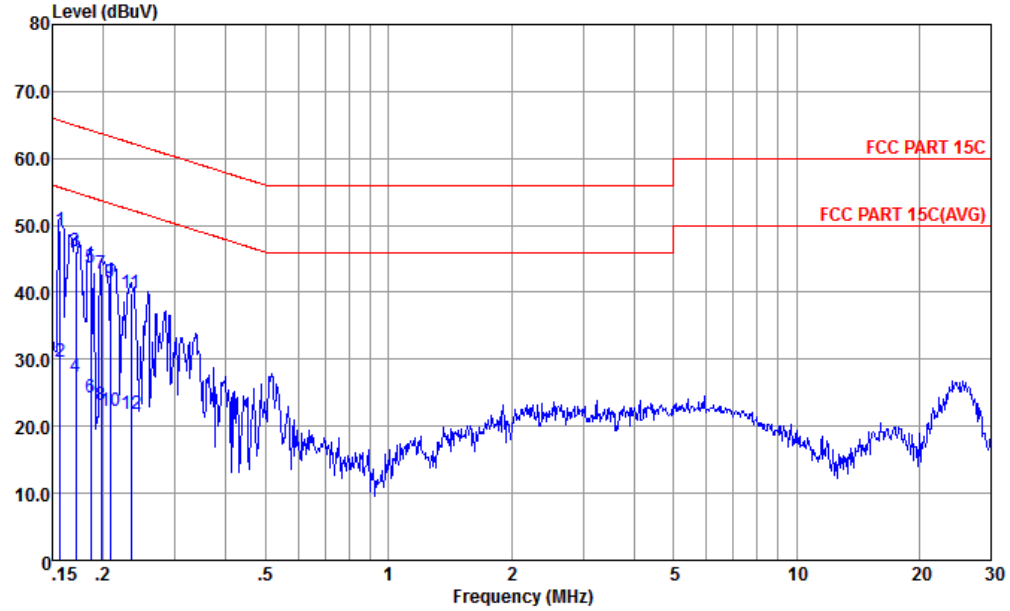
3.3.4 Test Setup



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

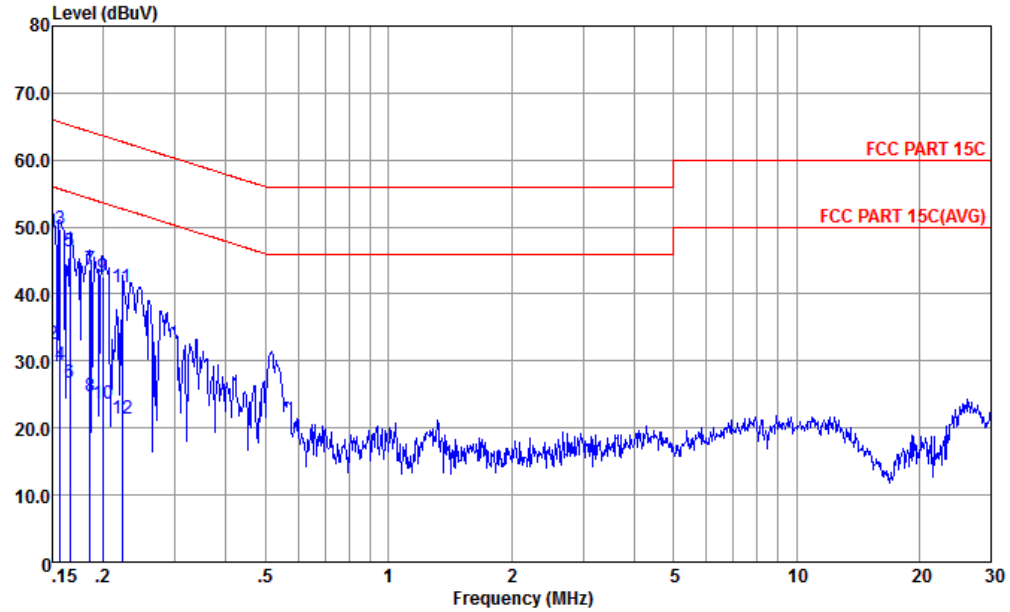
Test Mode :	Mode 2	Temperature :	21.2~21.7℃
Test Engineer :	Amos Zhang	Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	Bluetooth Idle + WLAN Idle(2.4G) + Adapter 2		



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 *	0.156	49.36	-16.29	65.65	38.60	0.17	10.59	QP
2	0.156	29.66	-25.99	55.65	18.90	0.17	10.59	Average
3	0.171	46.02	-18.88	64.90	35.29	0.18	10.55	QP
4	0.171	27.32	-27.58	54.90	16.59	0.18	10.55	Average
5	0.186	43.59	-20.61	64.20	32.90	0.19	10.50	QP
6	0.186	24.29	-29.91	54.20	13.60	0.19	10.50	Average
7	0.198	42.86	-20.85	63.71	32.20	0.20	10.46	QP
8	0.198	23.26	-30.45	53.71	12.60	0.20	10.46	Average
9	0.208	41.55	-21.72	63.27	30.90	0.20	10.45	QP
10	0.208	22.25	-31.02	53.27	11.60	0.20	10.45	Average
11	0.234	39.85	-22.45	62.30	29.20	0.21	10.44	QP
12	0.234	21.85	-30.45	52.30	11.20	0.21	10.44	Average

Test Mode :	Mode 2	Temperature :	21.2~21.7℃
Test Engineer :	Amos Zhang	Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Idle + WLAN Idle(2.4G) + Adapter 2		



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		0.150	49.20	-16.80	66.00	38.30	0.28	10.62	QP
2		0.150	32.50	-23.50	56.00	21.60	0.28	10.62	Average
3	*	0.156	49.67	-15.98	65.65	38.80	0.28	10.59	QP
4		0.156	29.47	-26.18	55.65	18.60	0.28	10.59	Average
5		0.166	46.44	-18.72	65.16	35.60	0.28	10.56	QP
6		0.166	26.74	-28.42	55.16	15.90	0.28	10.56	Average
7		0.185	43.58	-20.66	64.24	32.80	0.28	10.50	QP
8		0.185	24.68	-29.56	54.24	13.90	0.28	10.50	Average
9		0.200	42.64	-20.98	63.62	31.90	0.28	10.46	QP
10		0.200	23.64	-29.98	53.62	12.90	0.28	10.46	Average
11		0.222	40.93	-21.81	62.74	30.20	0.28	10.45	QP
12		0.222	21.33	-31.41	52.74	10.60	0.28	10.45	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

<CDD Modes >

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = 10 log(N_{ANT}/N_{SS}=1) dB.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

Directional gain may be calculated by using the formulas applicable to equal gain antennas with GANT set equal to the gain of the antenna having the highest gain;

The EUT supports CDD mode.

For power, the directional gain G_{ANT} is set equal to the antenna having the highest gain, i.e., F)2)f)i).

For PSD, the directional gain calculation is following F)2)f)ii) of KDB 662911 D01 v02r01.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain “DG” is calculated as following table.

<CDD Modes>

	Ant. 1 (dBi)	Ant. 2 (dBi)	DG for Power (dBi)	DG for PSD (dBi)	Power Limit Reduction (dB)	PSD Limit Reduction (dB)
2.4 GHz	3.45	3.45	3.45	6.46	0.00	0.46

Power Limit Reduction = DG(Power) – 6dBi, (0dB)

PSD Limit Reduction = DG(PSD) – 6dBi, (0.46dB)

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. 20, 2018	Jan. 17, 2019	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 18, 2018	Apr. 20, 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

WIFI 802.11b (Band Edge @ 3m)

WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2388.78	55.22	-18.78	74	52.41	31.3	5.65	34.14	123	251	P	H
		2383.58	45.27	-8.73	54	42.51	31.27	5.63	34.14	123	251	A	H
	*	2412	108.38	-	-	105.54	31.33	5.67	34.16	123	251	P	H
	*	2410	105.27	-	-	102.43	31.33	5.67	34.16	123	251	A	H
		2384.23	54.67	-19.33	74	51.91	31.27	5.63	34.14	327	275	P	V
		2383.58	44.41	-9.59	54	41.65	31.27	5.63	34.14	327	275	A	V
	*	2412	106.48	-	-	103.64	31.33	5.67	34.16	327	275	P	V
	*	2410	103.45	-	-	100.61	31.33	5.67	34.16	327	275	A	V
802.11b CH 11 2462MHz	*	2462	107.2	-	-	104.31	31.41	5.73	34.25	108	252	P	H
	*	2460	104.13	-	-	101.24	31.41	5.73	34.25	108	252	A	H
		2494.3	55.56	-18.44	74	52.62	31.47	5.77	34.3	108	252	P	H
		2495.08	44.35	-9.65	54	41.41	31.47	5.77	34.3	108	252	A	H
	*	2462	106.33	-	-	103.44	31.41	5.73	34.25	304	269	P	V
	*	2460	103.28	-	-	100.39	31.41	5.73	34.25	304	269	A	V
		2489.98	54.38	-19.62	74	51.44	31.47	5.77	34.3	304	269	P	V
		2494.9	43.7	-10.3	54	40.76	31.47	5.77	34.3	304	269	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11b (Harmonic @ 3m)

WIFI Ant. 1+2	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)
802.11b		4824	52.63	-21.37	74	73.65	35.65	7.86	64.53	100	183	P	H
CH 01	!	4824	50.7	-3.3	54	71.72	35.65	7.86	64.53	100	183	A	H
2412MHz		4824	50.96	-23.04	74	71.98	35.65	7.86	64.53	100	360	P	V
		4872	51.81	-22.19	74	72.9	35.61	7.9	64.6	100	186	P	H
802.11b	!	4872	50.08	-3.92	54	71.17	35.61	7.9	64.6	100	186	A	H
CH 06		7308	43.53	-30.47	74	63.15	35.89	9.5	65.01	100	360	P	H
2437MHz		4872	47.75	-26.25	74	68.84	35.61	7.9	64.6	100	360	P	V
		7308	42.22	-31.78	74	61.84	35.89	9.5	65.01	100	360	P	V
		4926	51.12	-22.88	74	72.29	35.57	7.94	64.68	100	360	P	H
802.11b	!	4926	50.05	-3.95	54	71.22	35.57	7.94	64.68	100	360	A	H
CH 11		7386	42.99	-31.01	74	62.57	35.94	9.53	65.05	100	360	P	H
2462MHz		4926	49.17	-24.83	74	70.34	35.57	7.94	64.68	100	360	P	V
		7386	41.5	-32.5	74	61.08	35.94	9.53	65.05	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11g (Band Edge @ 3m)

WIFI Ant. 1+2	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)
802.11g CH 01 2412MHz		2389.69	60.51	-13.49	74	57.7	31.3	5.65	34.14	126	249	P	H
	!	2389.95	49.91	-4.09	54	47.1	31.3	5.65	34.14	126	249	A	H
	*	2414	110.9	-	-	108.06	31.33	5.67	34.16	126	249	P	H
	*	2414	103.15	-	-	100.31	31.33	5.67	34.16	126	249	A	H
		2389.43	56.96	-17.04	74	54.15	31.3	5.65	34.14	300	282	P	V
		2389.95	46.53	-7.47	54	43.72	31.3	5.65	34.14	300	282	A	V
	*	2410	108.19	-	-	105.35	31.33	5.67	34.16	300	282	P	V
	*	2410	99.92	-	-	97.08	31.33	5.67	34.16	300	282	A	V
802.11g CH 11 2462MHz		2484.34	62.65	-11.35	74	59.74	31.44	5.75	34.28	132	248	P	H
	!	2483.5	50.47	-3.53	54	47.56	31.44	5.75	34.28	132	248	A	H
	*	2460	110.24	-	-	107.35	31.41	5.73	34.25	132	248	P	H
	*	2460	102.13	-	-	99.24	31.41	5.73	34.25	132	248	A	H
		2484.16	59.86	-14.14	74	56.95	31.44	5.75	34.28	302	263	P	V
	!	2483.74	48.37	-5.63	54	45.46	31.44	5.75	34.28	302	263	A	V
	*	2460	108.1	-	-	105.21	31.41	5.73	34.25	302	263	P	V
	*	2460	99.57	-	-	96.68	31.41	5.73	34.25	302	263	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11g (Harmonic @ 3m)

WIFI Ant. 1+2	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)
802.11g CH 01 2412MHz		4824	49.93	-24.07	74	70.95	35.65	7.86	64.53	100	360	P	H
		4824	48.04	-25.96	74	69.06	35.65	7.86	64.53	100	360	P	V
802.11g CH 06 2437MHz		4872	53.57	-20.43	74	74.66	35.61	7.9	64.6	100	183	P	H
		4872	46.8	-7.2	54	67.89	35.61	7.9	64.6	100	183	A	H
		7308	51.69	-22.31	74	71.31	35.89	9.5	65.01	100	360	P	H
		7308	44.08	-9.92	54	63.7	35.89	9.5	65.01	100	360	A	H
		4872	50.59	-23.41	74	71.68	35.61	7.9	64.6	100	360	P	V
		7308	50.2	-23.8	74	69.82	35.89	9.5	65.01	100	360	P	V
802.11g CH 11 2462MHz		4926	49.6	-24.4	74	70.77	35.57	7.94	64.68	100	360	P	H
		7386	42.69	-31.31	74	62.27	35.94	9.53	65.05	100	360	P	H
		4926	47.61	-26.39	74	68.78	35.57	7.94	64.68	100	360	P	V
		7386	43.59	-30.41	74	63.17	35.94	9.53	65.05	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT20 (Band Edge @ 3m)

WIFI Ant. 1+2	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)
		2388.26	60.49	-13.51	74	57.68	31.3	5.65	34.14	123	250	P	H
	!	2389.95	50.35	-3.65	54	47.54	31.3	5.65	34.14	123	250	A	H
802.11ac	*	2414	109.8	-	-	106.96	31.33	5.67	34.16	123	250	P	H
VHT20	*	2414	101.79	-	-	98.95	31.33	5.67	34.16	123	250	A	H
CH 01		2389.69	55.51	-18.49	74	52.7	31.3	5.65	34.14	300	280	P	V
2412MHz		2389.82	46.54	-7.46	54	43.73	31.3	5.65	34.14	300	280	A	V
	*	2412	105.79	-	-	102.95	31.33	5.67	34.16	300	280	P	V
	*	2410	98.04	-	-	95.2	31.33	5.67	34.16	300	280	A	V
		2483.62	60.53	-13.47	74	57.62	31.44	5.75	34.28	172	250	P	H
	!	2483.5	50.08	-3.92	54	47.17	31.44	5.75	34.28	172	250	A	H
802.11ac	*	2464	107.39	-	-	104.5	31.41	5.73	34.25	172	250	P	H
VHT20	*	2460	99.44	-	-	96.55	31.41	5.73	34.25	172	250	A	H
CH 11		2483.62	57.45	-16.55	74	54.54	31.44	5.75	34.28	303	261	P	V
2462MHz	!	2483.5	48.37	-5.63	54	45.46	31.44	5.75	34.28	303	261	A	V
	*	2460	105.66	-	-	102.77	31.41	5.73	34.25	303	261	P	V
	*	2460	97.18	-	-	94.29	31.41	5.73	34.25	303	261	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT20 (Harmonic @ 3m)

WIFI Ant. 1+2	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)
802.11ac VHT20 CH 01 2412MHz		4824	49.46	-24.54	74	70.48	35.65	7.86	64.53	100	360	P	H
		4824	47.79	-26.21	74	68.81	35.65	7.86	64.53	100	360	P	V
802.11ac VHT20 CH 06 2437MHz		4872	56.72	-17.28	74	77.81	35.61	7.9	64.6	100	360	P	H
	!	4872	48.95	-5.05	54	70.04	35.61	7.9	64.6	100	360	A	H
		7308	47.93	-26.07	74	67.55	35.89	9.5	65.01	100	360	P	H
		4872	52.56	-21.44	74	73.65	35.61	7.9	64.6	100	360	P	V
		4872	45.85	-8.15	54	66.94	35.61	7.9	64.6	100	360	A	V
		7308	48.61	-25.39	74	68.23	35.89	9.5	65.01	100	360	P	V
802.11ac VHT20 CH 11 2462MHz		4926	47.05	-26.95	74	68.22	35.57	7.94	64.68	100	360	P	H
		7386	41.68	-32.32	74	61.26	35.94	9.53	65.05	100	360	P	H
		4926	45.37	-28.63	74	66.54	35.57	7.94	64.68	100	360	P	V
		7386	42.64	-31.36	74	62.22	35.94	9.53	65.05	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT40 (Band Edge @ 3m)

WIFI Ant. 1+2	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)
		2388.26	67.61	-6.39	74	64.8	31.3	5.65	34.14	111	248	P	H
	!	2389.04	50.84	-3.16	54	48.03	31.3	5.65	34.14	111	248	A	H
	*	2430	103.2	-	-	100.34	31.36	5.69	34.19	111	248	P	H
	*	2430	95.07	-	-	92.21	31.36	5.69	34.19	111	248	A	H
802.11ac		2483.8	61.54	-12.46	74	58.63	31.44	5.75	34.28	111	248	P	H
VHT40		2483.92	45.96	-8.04	54	43.05	31.44	5.75	34.28	111	248	A	H
CH 03		2389.56	62.56	-11.44	74	59.75	31.3	5.65	34.14	346	264	P	V
2422MHz		2388.52	47.27	-6.73	54	44.46	31.3	5.65	34.14	346	264	A	V
	*	2430	99.82	-	-	96.96	31.36	5.69	34.19	346	264	P	V
	*	2430	92.11	-	-	89.25	31.36	5.69	34.19	346	264	A	V
		2485.06	60.19	-13.81	74	57.28	31.44	5.75	34.28	346	264	P	V
		2484.58	44.95	-9.05	54	42.04	31.44	5.75	34.28	346	264	A	V
		2387.09	67.73	-6.27	74	64.92	31.3	5.65	34.14	120	251	P	H
	!	2389.43	50.72	-3.28	54	47.91	31.3	5.65	34.14	120	251	A	H
	*	2428	106.07	-	-	103.21	31.36	5.69	34.19	120	251	P	H
	*	2434	97.98	-	-	95.12	31.36	5.69	34.19	120	251	A	H
802.11ac		2486.44	66.54	-7.46	74	63.63	31.44	5.75	34.28	120	251	P	H
VHT40	!	2484.1	50.91	-3.09	54	48	31.44	5.75	34.28	120	251	A	H
CH 06		2389.82	63.15	-10.85	74	60.34	31.3	5.65	34.14	347	266	P	V
2437MHz		2389.04	46.94	-7.06	54	44.13	31.3	5.65	34.14	347	266	A	V
	*	2428	103.83	-	-	100.97	31.36	5.69	34.19	347	266	P	V
	*	2434	95.99	-	-	93.13	31.36	5.69	34.19	347	266	A	V
		2492.92	64.5	-9.5	74	61.56	31.47	5.77	34.3	347	266	P	V
	!	2486.98	49.11	-4.89	54	46.2	31.44	5.75	34.28	347	266	A	V

		2386.05	62.29	-11.71	74	59.48	31.3	5.65	34.14	100	249	P	H
		2388.65	45.9	-8.1	54	43.09	31.3	5.65	34.14	100	249	A	H
	*	2450	101.88	-	-	99	31.39	5.71	34.22	100	249	P	H
	*	2448	94.11	-	-	91.23	31.39	5.71	34.22	100	249	A	H
802.11ac		2483.74	66.7	-7.3	74	63.79	31.44	5.75	34.28	100	249	P	H
VHT40	!	2484.22	50.79	-3.21	54	47.88	31.44	5.75	34.28	100	249	A	H
CH 09		2387.87	57.49	-16.51	74	54.68	31.3	5.65	34.14	303	268	P	V
2452MHz		2385.79	43.74	-10.26	54	40.93	31.3	5.65	34.14	303	268	A	V
	*	2460	99.74	-	-	96.85	31.41	5.73	34.25	303	268	P	V
	*	2460	91.51	-	-	88.62	31.41	5.73	34.25	303	268	A	V
		2485.18	64.83	-9.17	74	61.92	31.44	5.75	34.28	303	268	P	V
	!	2483.74	49.09	-4.91	54	46.18	31.44	5.75	34.28	303	268	A	V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT40 (Harmonic @ 3m)

WIFI Ant. 1+2	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)
802.11ac		4842	39.33	-34.67	74	65.08	30.93	7.87	64.55	100	360	P	H
VHT40		7266	43.2	-30.8	74	63.45	35.26	9.48	64.99	100	360	P	H
CH 03		4842	40.21	-33.79	74	65.96	30.93	7.87	64.55	100	360	P	V
2422MHz		7266	41.16	-32.84	74	61.41	35.26	9.48	64.99	100	360	P	V
802.11ac		4872	46.51	-27.49	74	67.6	35.61	7.9	64.6	100	360	P	H
VHT40		7308	46.38	-27.62	74	66	35.89	9.5	65.01	100	360	P	H
CH 06		4872	43.53	-30.47	74	64.62	35.61	7.9	64.6	100	360	P	V
2437MHz		7308	43.78	-30.22	74	63.4	35.89	9.5	65.01	100	360	P	V
802.11ac		4902	39.45	-34.55	74	65.09	31.08	7.93	64.65	100	360	P	H
VHT40		7356	40.92	-33.08	74	60.96	35.47	9.52	65.03	100	360	P	H
CH 09		4902	38.24	-35.76	74	63.88	31.08	7.93	64.65	100	360	P	V
2452MHz		7356	41.24	-32.76	74	61.28	35.47	9.52	65.03	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 WIFI 802.11ac VHT40 (LF)

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)
2.4GHz 802.11n HT40 LF		32.91	25.45	-14.55	40	31.26	24.62	0.61	31.04	100	231	P	H
		167.74	24.04	-19.46	43.5	36.86	16.74	1.41	30.97	-	-	P	H
		235.64	26.85	-19.15	46	39.09	17.27	1.66	31.17	-	-	P	H
		371.44	20.84	-25.16	46	28.44	21.8	2.1	31.5	-	-	P	H
		594.54	26.4	-19.6	46	29.78	25.42	2.7	31.5	-	-	P	H
		717.73	27.82	-18.18	46	28.72	26.98	2.98	30.86	-	-	P	H
		35.82	33.65	-6.35	40	41.22	22.82	0.65	31.04	100	101	P	V
		82.38	22.77	-17.23	40	37.45	15.72	1	31.4	-	-	P	V
		148.34	22.46	-21.04	43.5	34.72	17.32	1.31	30.89	-	-	P	V
		233.7	23.68	-22.32	46	36.02	17.18	1.65	31.17	-	-	P	V
		425.76	22.9	-23.1	46	29.22	22.96	2.27	31.55	-	-	P	V
		639.16	27.3	-18.7	46	29.11	26.13	2.85	30.79	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11g (Band Edge @ 3m)

WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11g CH 02 2417MHz		2384.88	60.42	-13.58	74	57.66	31.27	5.63	34.14	143	257	P	H
	!	2387.22	50.83	-3.17	54	48.02	31.3	5.65	34.14	143	257	A	H
	*	2416	114.01	-	-	111.17	31.33	5.67	34.16	143	257	P	H
	*	2420	106.31	-	-	103.45	31.36	5.69	34.19	143	257	A	H
		2381.76	56.61	-17.39	74	53.85	31.27	5.63	34.14	363	268	P	V
		2389.82	46.45	-7.55	54	43.64	31.3	5.65	34.14	363	268	A	V
	*	2420	111.93	-	-	109.07	31.36	5.69	34.19	363	268	P	V
	*	2420	103.99	-	-	101.13	31.36	5.69	34.19	363	268	A	V
802.11g CH 10 2457MHz		2484.22	60.31	-13.69	74	57.4	31.44	5.75	34.28	157	257	P	H
	!	2484.52	48.98	-5.02	54	46.07	31.44	5.75	34.28	157	257	A	H
	*	2454	111.16	-	-	108.27	31.41	5.73	34.25	157	257	P	H
	*	2454	103.77	-	-	100.88	31.41	5.73	34.25	157	257	A	H
		2484.46	59.3	-14.7	74	56.39	31.44	5.75	34.28	313	269	P	V
		2484.28	46.92	-7.08	54	44.01	31.44	5.75	34.28	313	269	A	V
	*	2454	109.43	-	-	106.54	31.41	5.73	34.25	313	269	P	V
	*	2454	101.67	-	-	98.78	31.41	5.73	34.25	313	269	A	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11g (Harmonic @ 3m)

WIFI Ant. 1+2	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)
802.11g CH 02 2417MHz		4836	57.25	-16.75	74	78.3	35.63	7.87	64.55	100	245	P	H
	!	4836	49.17	-4.83	54	70.22	35.63	7.87	64.55	100	245	A	H
		7248	55.02	-18.98	74	74.66	35.86	9.48	64.98	100	360	P	H
	!	7248	48.56	-5.44	54	68.2	35.86	9.48	64.98	100	360	A	H
		4836	49.24	-24.76	74	70.29	35.63	7.87	64.55	100	29	P	V
		7254	51.55	-22.45	74	71.19	35.86	9.48	64.98	100	29	P	V
		7254	45.56	-8.44	54	65.2	35.86	9.48	64.98	100	29	A	V
802.11g CH 10 2457MHz		4914	52.11	-21.89	74	73.25	35.58	7.93	64.65	100	0	P	H
		7368	44.08	-29.92	74	63.66	35.93	9.53	65.04	100	0	P	H
		4914	47.96	-26.04	74	69.1	35.58	7.93	64.65	100	196	P	V
		7368	42.53	-31.47	74	62.11	35.93	9.53	65.04	100	196	P	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11AC VHT20 (Band Edge @ 3m)

WIFI Ant. 1+2	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)
		2389.69	59.5	-14.5	74	56.69	31.3	5.65	34.14	131	243	P	H
	!	2383.84	49.49	-4.51	54	46.73	31.27	5.63	34.14	131	243	A	H
802.11ac	*	2416	112.23	-	-	109.39	31.33	5.67	34.16	131	243	P	H
VHT20	*	2420	104.02	-	-	101.16	31.36	5.69	34.19	131	243	A	H
CH 02		2389.56	56.02	-17.98	74	53.21	31.3	5.65	34.14	324	277	P	V
2417MHz		2386.57	46.75	-7.25	54	43.94	31.3	5.65	34.14	324	277	A	V
	*	2422	108.64	-	-	105.78	31.36	5.69	34.19	324	277	P	V
	*	2414	100.76	-	-	97.92	31.33	5.67	34.16	324	277	A	V
		2484.64	58.67	-15.33	74	55.76	31.44	5.75	34.28	141	247	P	H
	!	2483.68	49.24	-4.76	54	46.33	31.44	5.75	34.28	141	247	A	H
802.11ac	*	2454	111.23	-	-	108.34	31.41	5.73	34.25	141	247	P	H
VHT20	*	2454	102.98	-	-	100.09	31.41	5.73	34.25	141	247	A	H
CH 10		2484.46	59.14	-14.86	74	56.23	31.44	5.75	34.28	346	271	P	V
2457MHz	!	2484.46	48.05	-5.95	54	45.14	31.44	5.75	34.28	346	271	A	V
	*	2454	108.47	-	-	105.58	31.41	5.73	34.25	346	271	P	V
	*	2454	100.38	-	-	97.49	31.41	5.73	34.25	346	271	A	V

Remark

3. No other spurious found.
4. All results are PASS against Peak and Average limit line.

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT20 (Harmonic @ 3m)

WIFI Ant. 1+2	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)
802.11ac VHT20 CH 02 2417MHz		4836	51.33	-22.67	74	72.38	35.63	7.87	64.55	100	360	P	H
		4836	47.17	-6.83	54	68.22	35.63	7.87	64.55	100	360	A	H
		7248	48.23	-25.77	74	67.87	35.86	9.48	64.98	100	360	P	H
		4836	48.07	-25.93	74	69.12	35.63	7.87	64.55	100	360	P	V
		7248	47.06	-26.94	74	66.7	35.86	9.48	64.98	100	360	P	V
802.11ac VHT20 CH 10 2457MHz		4914	49.6	-24.4	74	70.74	35.58	7.93	64.65	100	360	P	H
		7368	42.81	-31.19	74	62.39	35.93	9.53	65.04	100	360	P	H
		4914	45.67	-28.33	74	66.81	35.58	7.93	64.65	100	360	P	V
		7368	42.72	-31.28	74	62.3	35.93	9.53	65.04	100	360	P	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT40 (Band Edge @ 3m)

WIFI Ant. 1+2	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)
	!	2388.52	69.36	-4.64	74	66.55	31.3	5.65	34.14	163	256	P	H
	!	2386.7	50.47	-3.53	54	47.66	31.3	5.65	34.14	163	256	A	H
		2490.34	62.16	-11.84	74	59.22	31.47	5.77	34.3	163	256	P	H
		2483.62	46.29	-7.71	54	43.38	31.44	5.75	34.28	163	256	A	H
802.11ac	*	2424	102.97	-	-	100.11	31.36	5.69	34.19	163	256	P	H
VHT40	*	2424	95.2	-	-	92.34	31.36	5.69	34.19	163	256	A	H
CH 04		2382.41	62.17	-11.83	74	59.41	31.27	5.63	34.14	364	267	P	V
2427MHz		2388.91	46.47	-7.53	54	43.66	31.3	5.65	34.14	364	267	A	V
		2484.94	58.78	-15.22	74	55.87	31.44	5.75	34.28	364	267	P	V
		2483.68	44.75	-9.25	54	41.84	31.44	5.75	34.28	364	267	A	V
	*	2418	101.11	-	-	98.27	31.33	5.67	34.16	364	267	P	V
	*	2424	93.51	-	-	90.65	31.36	5.69	34.19	364	267	A	V
	!	2389.43	64.84	-9.16	74	62.03	31.3	5.65	34.14	157	256	P	H
	*	2389.82	48.08	-5.92	54	45.27	31.3	5.65	34.14	157	256	A	H
	*	2452	102.85	-	-	99.97	31.39	5.71	34.22	157	256	P	H
		2450	94.95	-	-	92.07	31.39	5.71	34.22	157	256	A	H
802.11ac	!	2487.28	66.07	-7.93	74	63.16	31.44	5.75	34.28	157	256	P	H
VHT40		2483.74	50.88	-3.12	54	47.97	31.44	5.75	34.28	157	256	A	H
CH 08		2384.49	62.18	-11.82	74	59.42	31.27	5.63	34.14	323	273	P	V
2447MHz		2389.69	46.16	-7.84	54	43.35	31.3	5.65	34.14	323	273	A	V
	*	2444	100.81	-	-	97.93	31.39	5.71	34.22	323	273	P	V
	*	2444	93.02	-	-	90.14	31.39	5.71	34.22	323	273	A	V
		2485.6	63.29	-10.71	74	60.38	31.44	5.75	34.28	323	273	P	V
	!	2484.94	48.76	-5.24	54	45.85	31.44	5.75	34.28	323	273	A	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT40 (Harmonic @ 3m)

WIFI Ant. 1+2	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)
802.11ac		4854	42.64	-31.36	74	63.71	35.62	7.89	64.58	100	360	P	H
VHT40		7284	41.36	-32.64	74	60.99	35.88	9.49	65	100	360	P	H
CH 04		4854	44.1	-29.9	74	65.17	35.62	7.89	64.58	100	360	P	V
2427MHz		7284	41.07	-32.93	74	60.7	35.88	9.49	65	100	360	P	V
802.11ac		4896	41.81	-32.19	74	62.94	35.59	7.91	64.63	100	360	P	H
VHT40		7344	40.34	-33.66	74	59.95	35.91	9.51	65.03	100	360	p	H
CH 08		4896	41.14	-32.86	74	62.27	35.59	7.91	64.63	100	360	P	V
2447MHz		7344	40.79	-33.21	74	60.4	35.91	9.51	65.03	100	360	p	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

For Simultaneous TX

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT40 (Band Edge @ 3m)

WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11ac VHT40 CH 06 2437MHz + BLE CH 39 2480M		2389.82	67.94	-6.06	74	65.13	31.3	5.65	34.14	163	297	P	H
	!	2389.69	50.51	-3.49	54	47.7	31.3	5.65	34.14	163	297	A	H
	*	2434	106.04	-	-	103.18	31.36	5.69	34.19	163	297	P	H
		2480	89.68	-	-	86.77	31.44	5.75	34.28	163	297	P	H
		2434	98.29	-	-	95.43	31.36	5.69	34.19	163	297	A	H
		2480	88.95	-	-	86.04	31.44	5.75	34.28	163	297	A	H
		2484.76	68.27	-5.73	74	65.36	31.44	5.75	34.28	163	297	P	H
		2483.56	50.67	-3.33	54	47.76	31.44	5.75	34.28	163	297	A	H
		2385.66	66.01	-7.99	74	63.2	31.3	5.65	34.14	314	271	P	V
		2385.79	49.44	-4.56	54	46.63	31.3	5.65	34.14	314	271	A	V
		2430	103.77	-	-	100.91	31.36	5.69	34.19	314	271	P	V
	*	2480	86.54	-	-	83.63	31.44	5.75	34.28	314	271	P	V
		2434	95.75	-	-	92.89	31.36	5.69	34.19	314	271	A	V
	!	2480	85.58	-	-	82.67	31.44	5.75	34.28	314	271	A	V
		2485.9	65.06	-8.94	74	62.15	31.44	5.75	34.28	314	271	P	V
		2483.62	49.53	-4.47	54	46.62	31.44	5.75	34.28	314	271	A	V

WIFI Ant. 1+2	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 39 2480M + 802.11ac VHT40 CH 06 2437MHz		2434	95.23	-	-	92.37	31.36	5.69	34.19	165	104	P	H
	!	2480	95.47	-	-	92.56	31.44	5.75	34.28	165	104	P	H
	*	2440	86.69	-	-	83.81	31.39	5.71	34.22	165	104	A	H
		2480	94.52	-	-	91.61	31.44	5.75	34.28	165	104	A	H
		2488.12	57.79	-16.21	74	54.85	31.47	5.77	34.3	165	104	P	H
		2483.5	44.26	-9.74	54	41.35	31.44	5.75	34.28	165	104	A	H
		2444	89.61	-	-	86.73	31.39	5.71	34.22	330	8	P	V
		2480	94.81	-	-	91.9	31.44	5.75	34.28	330	8	P	V
		2444	81.69	-	-	78.81	31.39	5.71	34.22	330	8	A	V
		2480	94.02	-	-	91.11	31.44	5.75	34.28	330	8	A	V
		2484.4	55.55	-18.45	74	52.64	31.44	5.75	34.28	330	8	P	V
	*	2483.5	43.67	-10.33	54	40.76	31.44	5.75	34.28	330	8	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT40 (Harmonic @ 3m)

WIFI Ant. 1+2	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 39 2480M + 802.11ac VHT40 CH 06 2437MHz		4872	44.75	-29.25	74	65.84	35.61	7.9	64.6	100	360	P	H
		4962	42.77	-31.23	74	63.99	35.54	7.97	64.73	100	360	P	H
		7308	44.69	-29.31	74	64.31	35.89	9.5	65.01	100	360	P	H
		7440	41.35	-32.65	74	60.89	35.97	9.57	65.08	100	360	P	H
		4872	42.36	-31.64	74	63.45	35.61	7.9	64.6	100	360	P	V
		4962	42.76	-31.24	74	63.98	35.54	7.97	64.73	100	360	P	V
		7308	41.46	-32.54	74	61.08	35.89	9.5	65.01	100	360	P	V
		7440	41.09	-32.91	74	60.63	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.												

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)

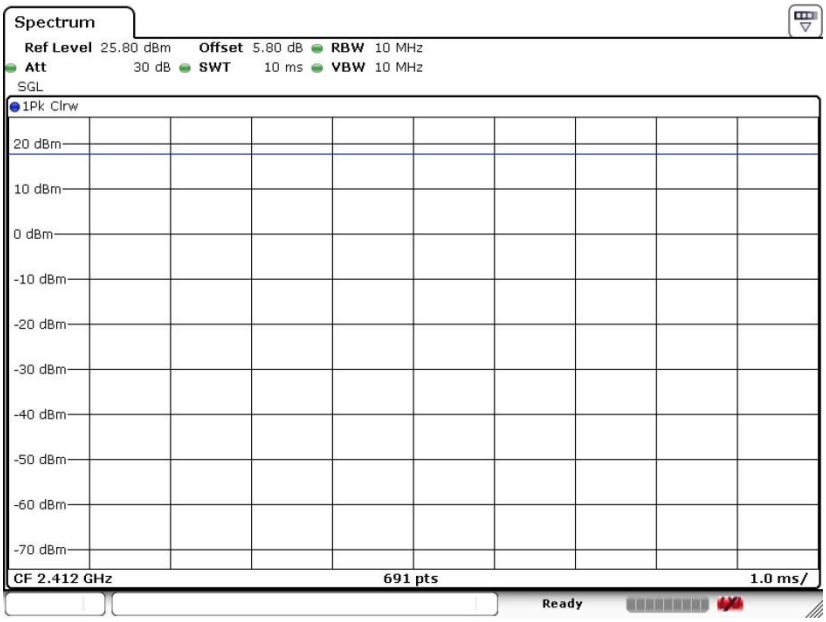
= -10.46(dB)

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

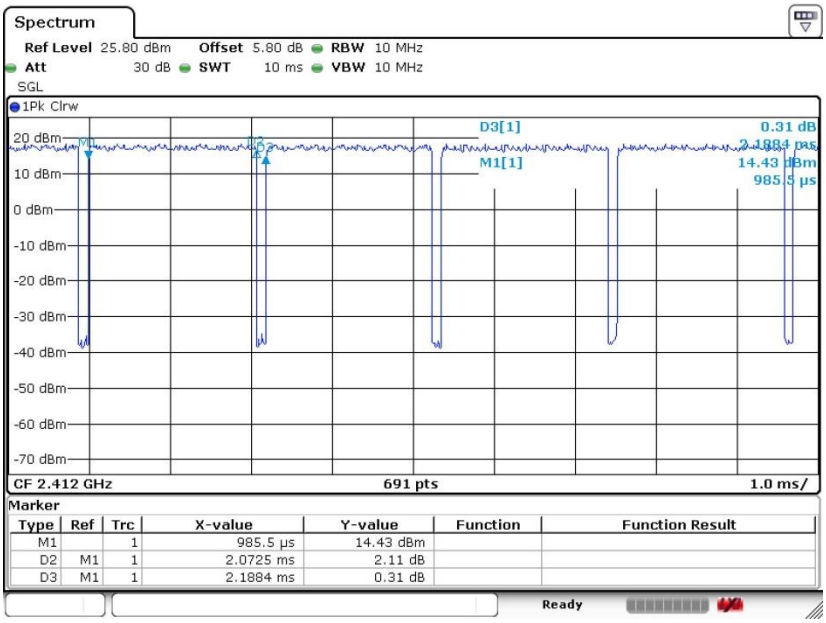
Appendix B. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
1+2	802.11b	100	-	-	10Hz
1+2	802.11g	94.70	2.073	0.483	1kHz
1+2	802.11ac VHT20	88.96	0.993	1.007	3kHz
1+2	802.11ac VHT40	82.93	0.500	2.000	3kHz

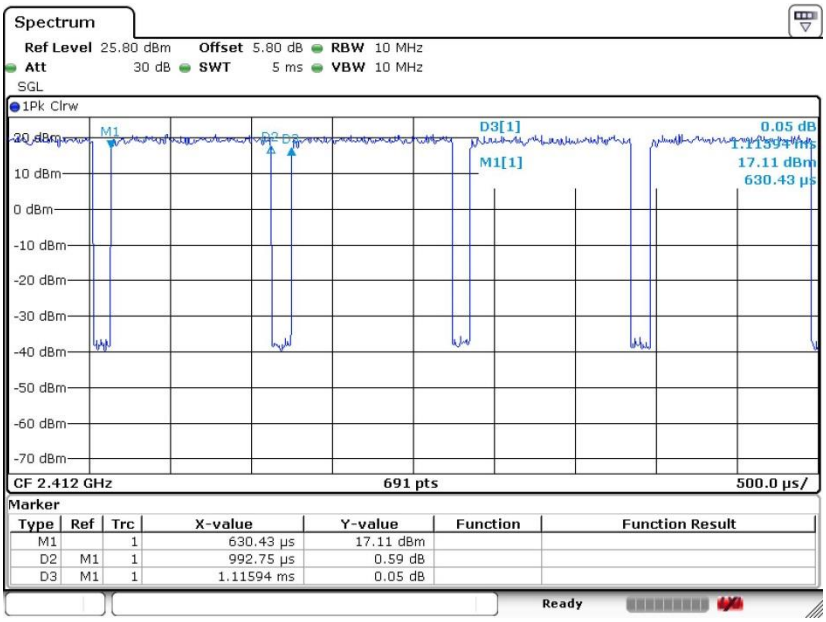
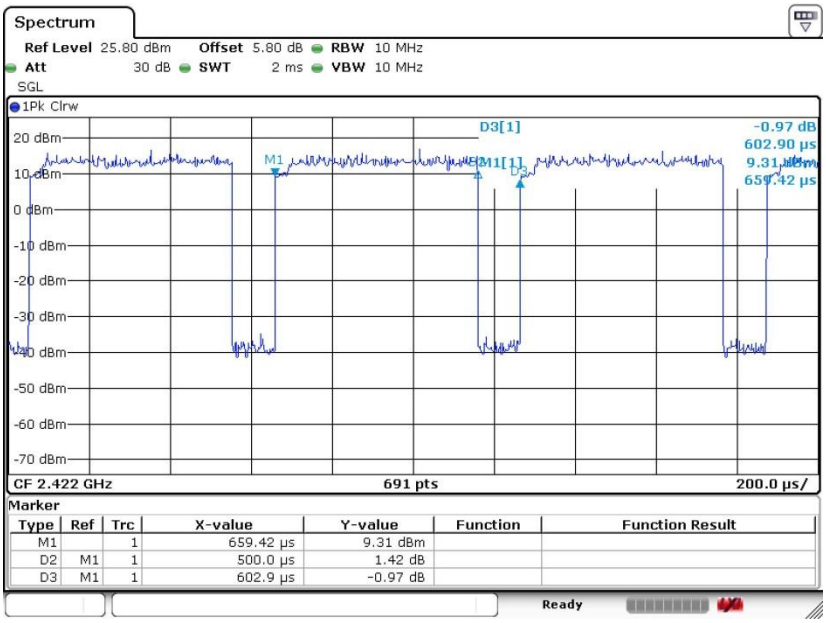
802.11b Ant. 1+2



802.11g Ant. 1+2



802.11ac VHT20 Ant. 1+2



802.11ac VHT40 Ant. 1+2