FCC RF Test Report

APPLICANT	:	**LC Future Center Limited Taiwan Branch**
EQUIPMENT	:	**Notebook**
BRAND NAME	:	**Lenovo**
MODEL NAME	:	**TP00086A**
FCC ID	:	**2AJN7-TP00086AUC**
STANDARD	:	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	:	**(DSS) Spread Spectrum Transmitter**

Equipment: AirPrime EM7455 and Intel 8260NGW tested inside of Lenovo Notebook.

This is a partial report which is included the conducted emission and radiated emission test items. The product was received on Nov. 18, 2016 and testing was completed on Dec. 19, 2016. We, SPORTON INTERNATIONAL 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 INC., the test report shall not be reproduced except in full.

Reviewed by: Joseph Lin / Supervisor

Approved by: Jones Tsai / Manager

Testing Laboratory 1190

SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR6N0822-08A	Rev. 01	Initial issue of report	Jan. 04, 2017

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 9.75 dB at 30.000 MHz
3.2	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 14.80 dB at 0.478 MHz

1 General Description

1.1 Applicant

LC Future Center Limited Taiwan Branch
7F., No.780, Bei'an Rd., Zhongshan Dist., Taipei City 104, Taiwan (R.O.C.)

1.2 Manufacturer

LC Future Center Limited Taiwan Branch
7F., No.780, Bei'an Rd., Zhongshan Dist., Taipei City 104, Taiwan (R.O.C.)

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Notebook
Brand Name	Lenovo
Model Name	TP00086A
FCC ID	2AJN7-TP00086AUC
Sample 1	EUT with Antenna 1
Sample 2	EUT with Antenna 2
Integrated WWAN Module	Manufacturer: Sierra Wireles Brand Name: AirPrime Model Name: EM7455
Integrated WLAN Module	Brand Name: Intel Model Name: 8260NGW
EUT supports Radios application	WCDMA/HSPA/LTE WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
EUT Stage	Production Unit

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

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	79
Carrier Frequency of Each Channel	2402+n*1 MHz; n=0~78
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : π /4-DQPSK Bluetooth EDR (3Mbps) : 8-DPSK

1.5 Modification of EUT

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

1.6 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1022 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

Test Site	SPORTON INTERNATIONAL INC.	
Test Site Location	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978	
Test Site No.	**Sporton Site No.**	
	CO05-HY	03CH07-HY

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

1.7 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
- 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

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

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

2.2 Test Mode

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

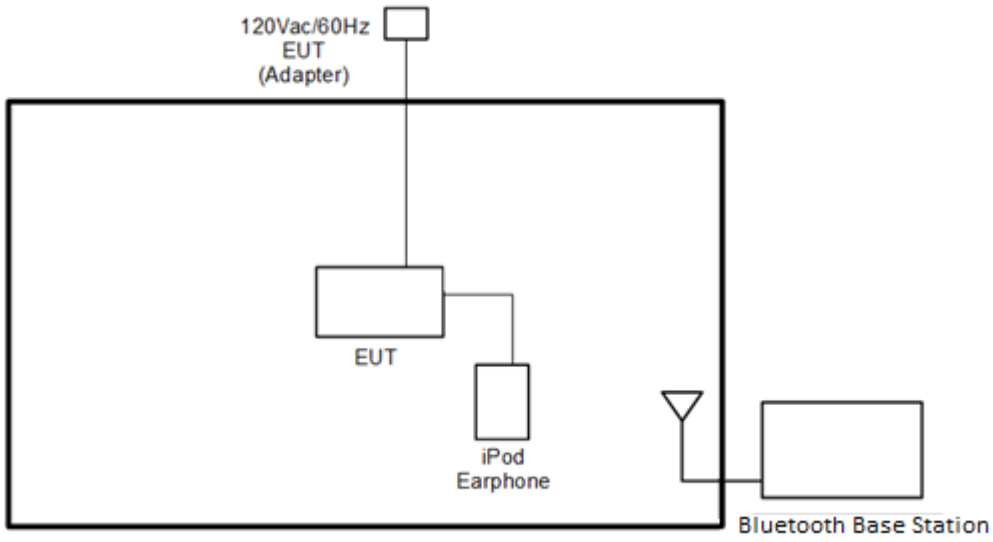
Summary table of Test Cases	
	Bluetooth BR 1Mbps GFSK
Radiated Test Cases	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz
AC Conducted Emission	Mode 1 :Bluetooth Link + TF + TC Mode 2 :WLAN (2.4GHz) Link + TF + TC

Remark:

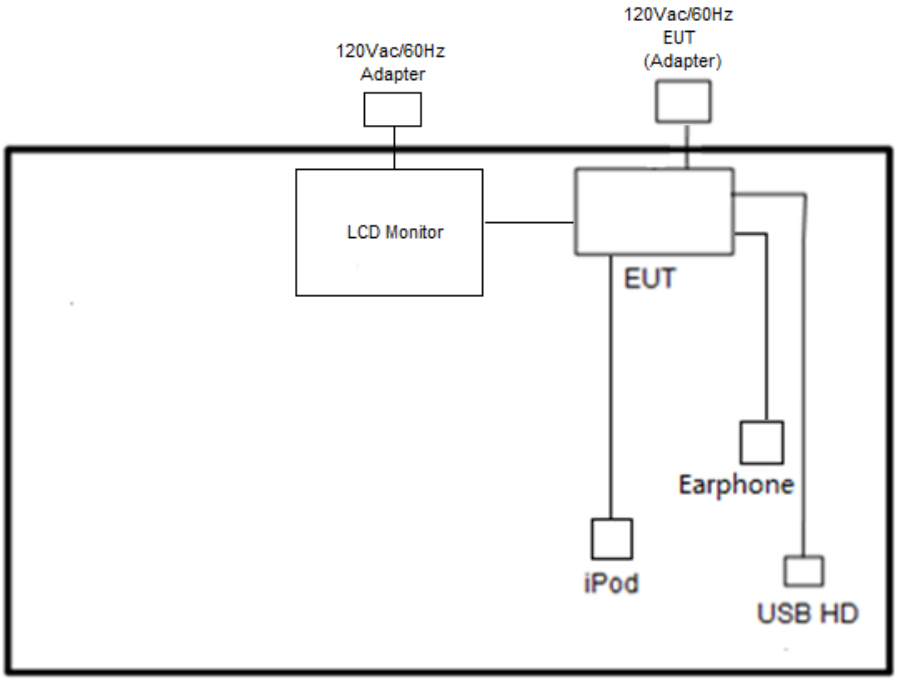
1. For radiated test cases, the worst mode data rate 1Mbps was reported only, because this data rate has the highest RF output power at preliminary tests.
2. The worst case of conducted emission is mode 2; only the test data of it was reported.
3. All the test cases were performed with sample 2.
4. TF stands for Test Function, and consists of MPEG4 and Camera.
5. TC stands for Test Configuration, and consists of Earphone, USB HD, iPod, Adapter, SD Card, and HDMI.

2.3 Connection Diagram of Test System

<Bluetooth 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.	Bluetooth Base Station	R&S	CBT32	N/A	N/A	Unshielded, 1.8 m
2.	LCD Monitor	DELL	U2410	FCC DoC	Shielded, 1.6 m	Unshielded, 1.8 m
3.	iPod	Apple	A1285	DoC	Shielded, 1.0m	N/A
4.	Earphone	lenovo	TS300-01MS21-8S	FCC DoC	Unshielded,1.2m	N/A
5.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A
6.	HD USB	lenovo	F310S	FCC DoC	Shielded, 0.5m	N/A
7.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A

2.5 EUT Operation Test Setup

The programmed RF utility “Tx Tool”, is installed in EUT to provide channel selection, power level, data rate and the application type. RF Utility can send transmitting signal for all testing. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

3 Test Result

3.1 Radiated Band Edges and Spurious Emission Measurement

3.1.1 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. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 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

3.1.2 Measuring Instruments

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

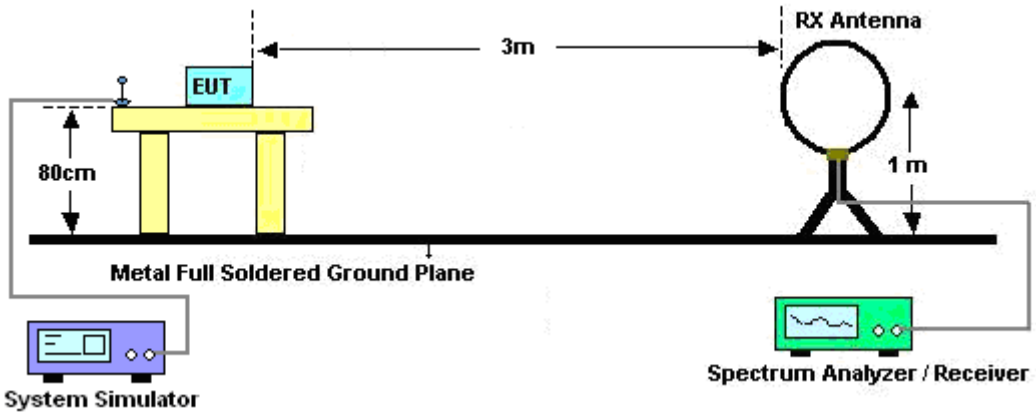
3.1.3 Test Procedures

1. 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.
1. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
2. For each suspected emission, 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 to comply with the guidelines.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. 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, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time/100 milliseconds
   On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

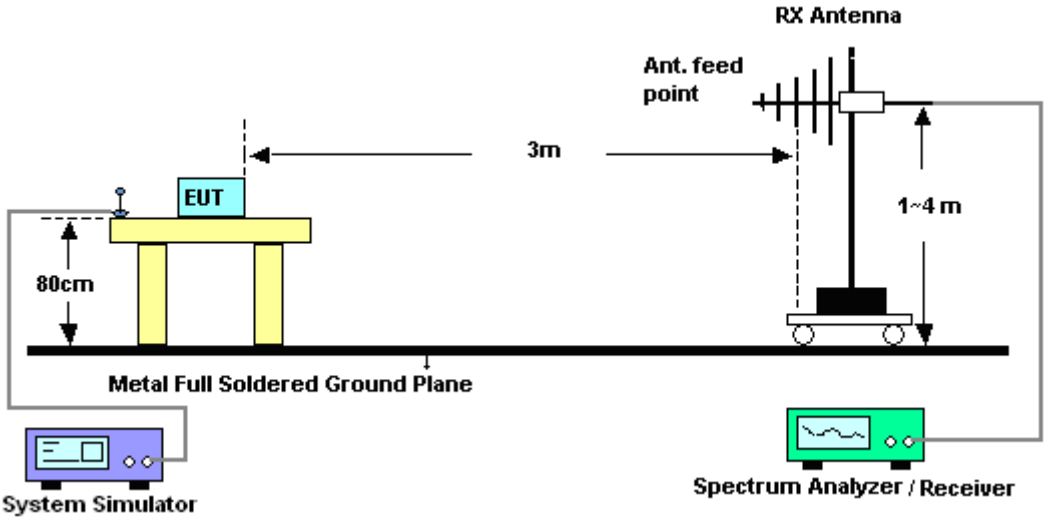
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (24.76dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

3.1.4 Test Setup

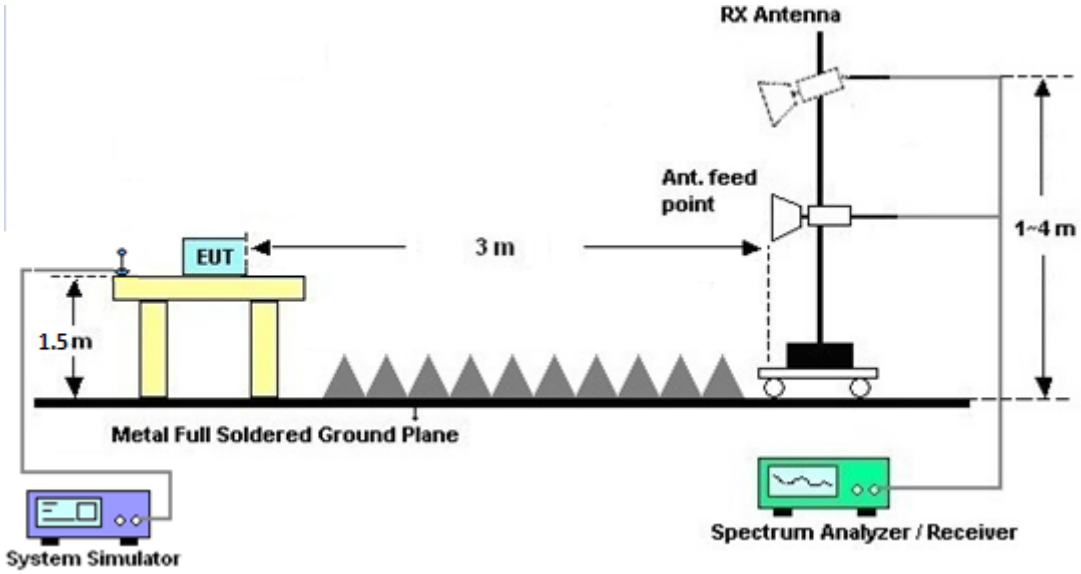
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz

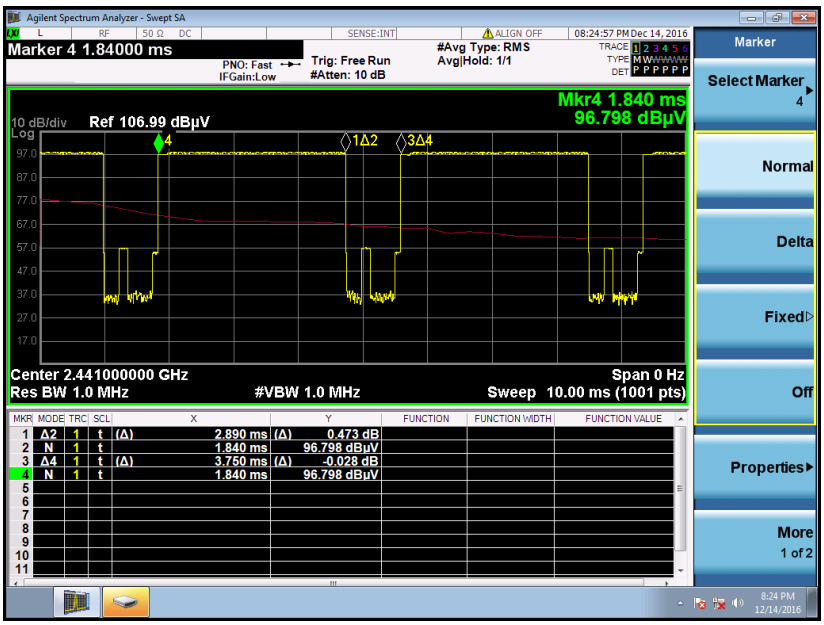


3.1.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

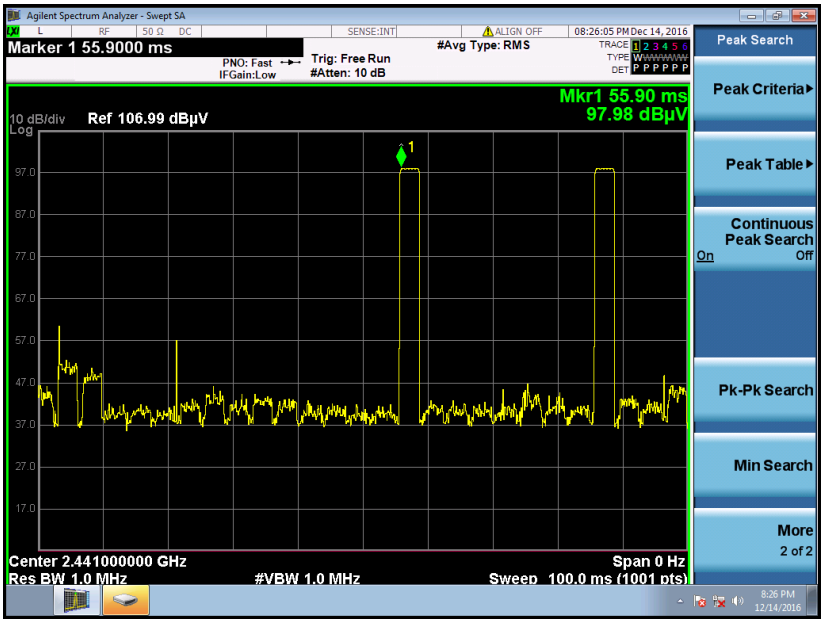
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

3.1.6 Duty cycle correction factor for average measurement

3DH5 on time (One Pulse) Plot on Channel 39



3DH5 on time (Count Pulses) Plot on Channel 39



Note:

1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.89 / 100 = 5.78 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.76 dB
3. 3DH5 has the highest duty cycle worst case and is reported.

Duty Cycle Correction Factor Consideration for AFH mode:

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the period to have DH5 packet completing one hopping sequence is

2.89 ms x 20 channels = 57.8 ms

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period. [100ms / 57.6ms] = 2 hops

Thus, the maximum possible ON time:

2.89 ms x 2 = 5.78 ms

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

20 x log(5.78 ms/100ms) = -24.76 dB

3.1.7 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

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

Please refer to Appendix A and B.

3.2 AC Conducted Emission Measurement

3.2.1 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.

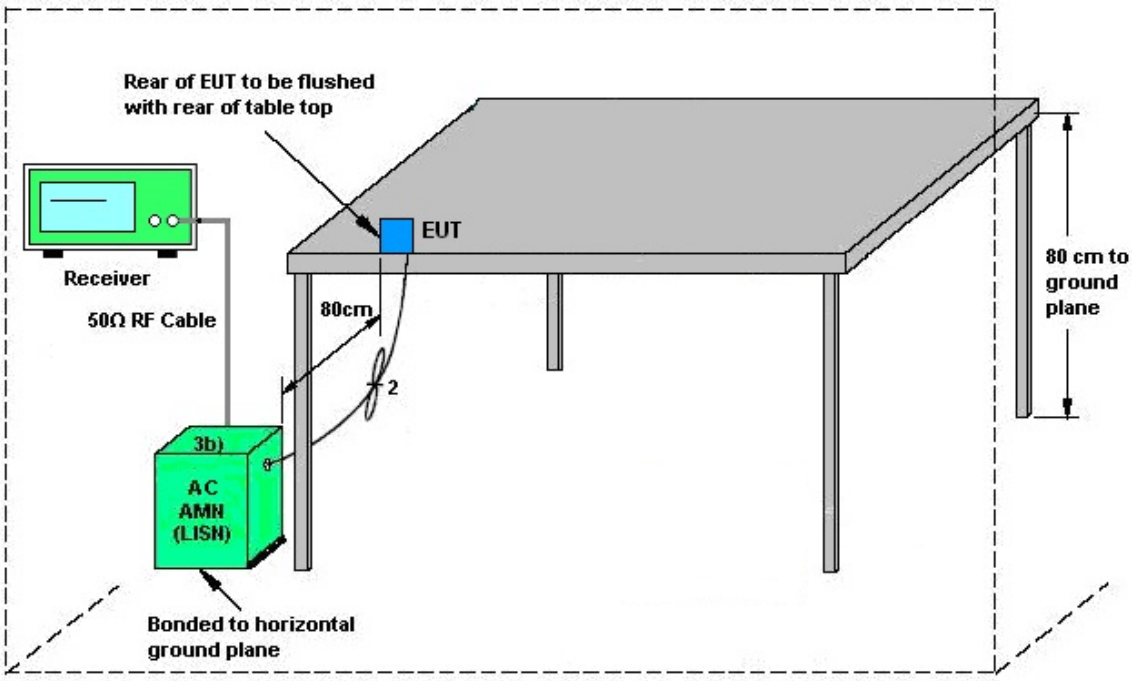
3.2.2 Measuring Instruments

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

3.2.3 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.

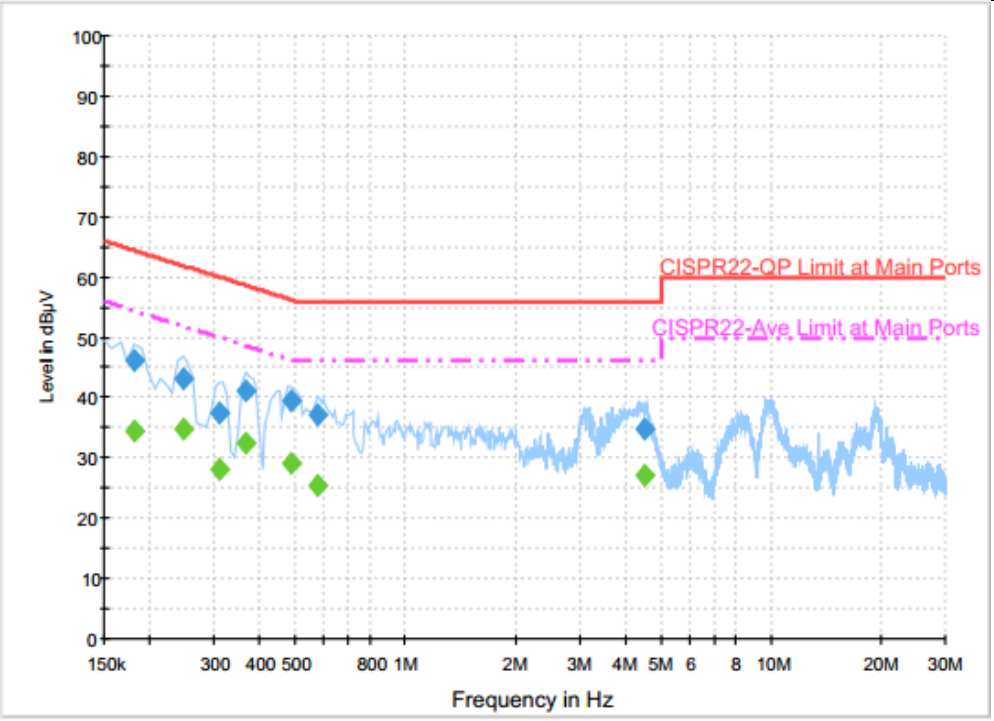
3.2.4 Test Setup



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

3.2.5 Test Result of AC Conducted Emission

Test Mode :	Mode 2	**Temperature :**	22~24℃
Test Engineer :	Arthur Hsieh	**Relative Humidity :**	50~53%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Function Type :	WLAN (2.4GHz) Link + TF + TC		



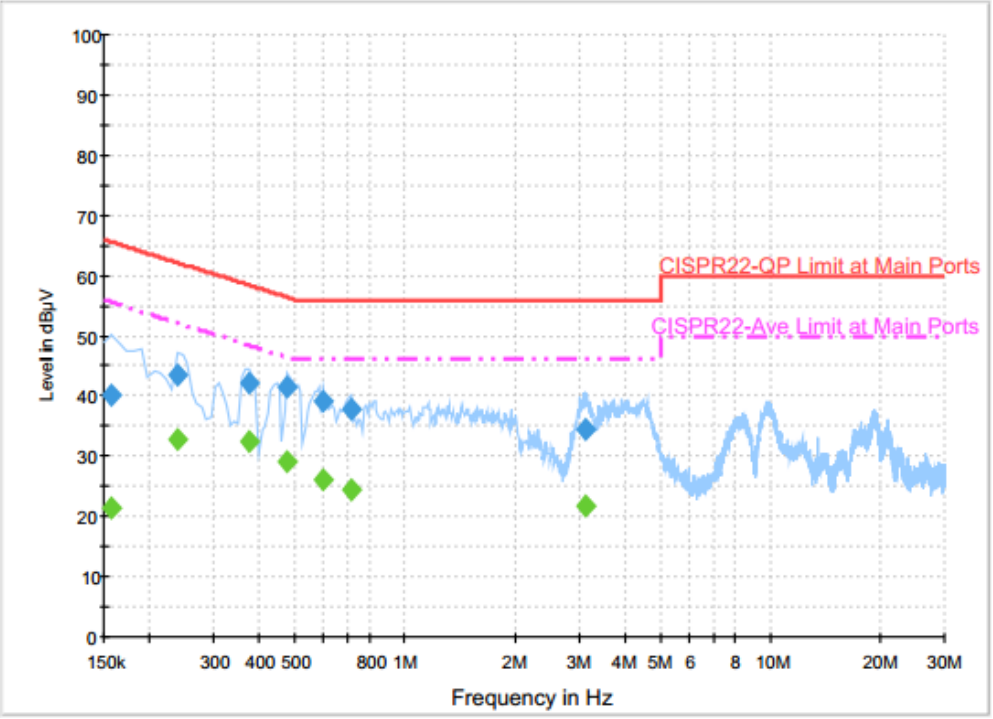
Final Result : Quasi-Peak

Frequency (MHz)	Quasi-Peak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.182000	46.2	Off	L1	19.6	18.2	64.4
0.246000	43.1	Off	L1	19.6	18.8	61.9
0.310000	37.4	Off	L1	19.6	22.6	60.0
0.366000	41.0	Off	L1	19.6	17.6	58.6
0.486000	39.3	Off	L1	19.5	16.9	56.2
0.574000	37.2	Off	L1	19.6	18.8	56.0
4.494000	34.8	Off	L1	19.6	21.2	56.0

Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.182000	34.3	Off	L1	19.6	20.1	54.4
0.246000	34.6	Off	L1	19.6	17.3	51.9
0.310000	28.0	Off	L1	19.6	22.0	50.0
0.366000	32.5	Off	L1	19.6	16.1	48.6
0.486000	29.2	Off	L1	19.5	17.0	46.2
0.574000	25.5	Off	L1	19.6	20.5	46.0
4.494000	27.0	Off	L1	19.6	19.0	46.0

Test Mode :	Mode 2	Temperature :	22~24℃
Test Engineer :	Arthur Hsieh	Relative Humidity :	50~53%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	WLAN (2.4GHz) Link + TF + TC		



Final Result : Quasi-Peak

Frequency (MHz)	Quasi-Peak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.158000	40.1	Off	N	19.5	25.5	65.6
0.238000	43.5	Off	N	19.5	18.7	62.2
0.374000	42.0	Off	N	19.5	16.4	58.4
0.478000	41.6	Off	N	19.5	14.8	56.4
0.598000	39.1	Off	N	19.5	16.9	56.0
0.710000	37.7	Off	N	19.5	18.3	56.0
3.142000	34.3	Off	N	19.5	21.7	56.0

Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.158000	21.4	Off	N	19.5	34.2	55.6
0.238000	32.8	Off	N	19.5	19.4	52.2
0.374000	32.4	Off	N	19.5	16.0	48.4
0.478000	29.0	Off	N	19.5	17.4	46.4
0.598000	26.2	Off	N	19.5	19.8	46.0
0.710000	24.5	Off	N	19.5	21.5	46.0
3.142000	21.9	Off	N	19.5	24.1	46.0

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Dec. 19, 2016	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9kHz~7GHz	Aug. 30, 2016	Dec. 19, 2016	Aug. 29, 2017	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Nov. 29, 2016	Dec. 19, 2016	Nov. 28, 2017	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Dec. 06, 2016	Dec. 19, 2016	Dec. 05, 2017	Conduction (CO05-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	35419&03	30MHz to 1GHz	Jan. 13, 2016	Dec. 14, 2016 ~ Dec. 16, 2016	Jan. 12, 2017	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Aug. 19, 2016	Dec. 14, 2016 ~ Dec. 16, 2016	Aug. 18, 2017	Radiation (03CH07-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	20Hz ~ 8.4GHz	Oct. 26, 2016	Dec. 14, 2016 ~ Dec. 16, 2016	Oct. 25, 2017	Radiation (03CH07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Sep. 02, 2015	Dec. 14, 2016 ~ Dec. 16, 2016	Sep. 01, 2017	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-00101800-30-10P	1590075	1GHz ~ 18GHz	Apr. 15, 2016	Dec. 14, 2016 ~ Dec. 16, 2016	Apr. 14, 2017	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz-1GHz	Mar. 18, 2016	Dec. 14, 2016 ~ Dec. 16, 2016	Mar. 17, 2017	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1GHz~ 26.5GHz	Oct. 12, 2016	Dec. 14, 2016 ~ Dec. 16, 2016	Oct. 11, 2017	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9010A	MY53470118	10Hz~44GHz	Feb. 27, 2016	Dec. 14, 2016 ~ Dec. 16, 2016	Feb. 26, 2017	Radiation (03CH07-HY)
Antenna Mast	Max-Full	MFA520BS	N/A	1m~4m	N/A	Dec. 14, 2016 ~ Dec. 16, 2016	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Dec. 14, 2016 ~ Dec. 16, 2016	N/A	Radiation (03CH07-HY)
Preamplifier	MITEQ	JS44-18004000-33-8P	1840917	18GHz ~ 40GHz	Jun. 14, 2016	Dec. 14, 2016 ~ Dec. 16, 2016	Jun. 13, 2017	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 08, 2016	Dec. 14, 2016 ~ Dec. 16, 2016	Nov. 07, 2017	Radiation (03CH07-HY)

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))	**2.70**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.70**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.50**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.20**

Appendix A. Radiated Spurious Emission

Test Engineer :	Jesse Wang, James Chiu, and Daniel Lee	Temperature :	21~23°C
		Relative Humidity :	47~51%

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BT CH00 2402MHz		2390	45.36	-28.64	74	40.84	32.19	7.31	34.98	364	231	P	H
		2390	20.6	-33.4	54	-	-	-	-	-	-	A	H
	*	2402	97.2	-	-	92.68	32.19	7.31	34.98	364	231	P	H
	*	2402	72.44	-	-	-	-	-	-	-	-	A	H
													H
													H
		2389.695	48.62	-25.38	74	44.09	32.19	7.31	34.97	277	169	P	V
		2389.695	23.86	-30.14	54	-	-	-	-	-	-	A	V
	*	2402	102.16	-	-	97.64	32.19	7.31	34.98	277	169	P	V
	*	2402	77.4	-	-	-	-	-	-	-	-	A	V
													V
													V
BT CH 39 2441MHz		2364.32	45.25	-28.75	74	40.89	32.09	7.24	34.97	350	231	P	H
		2364.32	20.49	-33.51	54	-	-	-	-	-	-	A	H
	*	2442	97.74	-	-	93.03	32.34	7.36	34.99	350	231	P	H
	*	2442	72.98	-	-	-	-	-	-	-	-	A	H
		2493.98	44.82	-29.18	74	39.93	32.5	7.4	35.01	350	231	P	H
		2493.98	20.06	-33.94	54	-	-	-	-	-	-	A	H
		2364.46	49.88	-24.12	74	45.52	32.09	7.24	34.97	296	168	P	V
		2364.46	25.12	-28.88	54	-	-	-	-	-	-	A	V
	*	2442	102.82	-	-	98.11	32.34	7.36	34.99	296	168	P	V
	*	2442	78.06	-	-	-	-	-	-	-	-	A	V
		2490.97	46.52	-27.48	74	41.62	32.5	7.4	35	296	168	P	V
		2490.97	21.76	-32.24	54	-	-	-	-	-	-	A	V

BT CH 78 2480MHz	*	2480	98.92	-	-	94.07	32.45	7.4	35	380	138	P	H
	*	2480	74.16	-	-	-	-	-	-	-	-	A	H
		2489.48	53.11	-20.89	74	48.21	32.5	7.4	35	380	138	P	H
		2489.48	28.35	-25.65	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	103.88	-	-	99.03	32.45	7.4	35	296	166	P	V
	*	2480	79.12	-	-	-	-	-	-	-	-	A	V
		2489.6	59.09	-14.91	74	54.19	32.5	7.4	35	296	166	P	V
		2489.6	34.33	-19.67	54	-	-	-	-	-	-	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

BT	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)
BT CH 00 2402MHz		4806	39.68	-34.32	74	53.25	33.68	11.83	59.08	100	0	P	H
		4806	14.92	-39.08	54	-	-	-	-	-	-	A	H
													H
													H
		4806	40.84	-33.16	74	54.41	33.68	11.83	59.08	100	0	P	V
		4806	16.08	-37.92	54	-	-	-	-	-	-	A	V
													V
													V
BT CH 39 2441MHz		4884	38.64	-35.36	74	52.51	33.54	11.53	58.94	100	0	P	H
		4884	13.88	-40.12	54	-	-	-	-	-	-	A	H
		7320	39.4	-34.6	74	48.9	34.65	13.81	57.96	100	0	P	H
		7320	14.64	-39.36	54	-	-	-	-	-	-	A	H
		4884	39.2	-34.8	74	53.07	33.54	11.53	58.94	100	0	P	V
		4884	14.44	-39.56	54	-	-	-	-	-	-	A	V
		7320	42.09	-31.91	74	51.59	34.65	13.81	57.96	100	0	P	V
		7320	17.33	-36.67	54	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		4962	38.62	-35.38	74	52.8	33.37	11.22	58.77	100	0	P	H
		4962	13.86	-40.14	54	-	-	-	-	-	-	A	H
		7440	38.83	-35.17	74	48.58	34.33	14.05	58.13	100	0	P	H
		7440	14.07	-39.93	54	-	-	-	-	-	-	A	H
		4962	39.74	-34.26	74	53.92	33.37	11.22	58.77	100	0	P	V
		4962	14.98	-39.02	54	-	-	-	-	-	-	A	V
		7440	41.85	-32.15	74	51.6	34.33	14.05	58.13	100	0	P	V
		7440	17.09	-36.91	54	-	-	-	-	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BT (LF)

BT	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 BT LF		30.27	27.42	-12.58	40	31.7	26	1.07	31.35	-	-	P	H
		101.28	31.45	-12.05	43.5	44.93	16.49	1.55	31.52	100	0	P	H
		243.03	25.31	-20.69	46	36.27	18.36	2.07	31.39	-	-	P	H
		489	26.78	-19.22	46	30.83	23.95	3.04	31.04	-	-	P	H
		741	29.99	-16.01	46	29.78	27.06	3.82	30.67	-	-	P	H
		929.3	33.53	-12.47	46	30.23	29.71	4.12	30.53	-	-	P	H
													H
													H
													H
													H
													H
													H
		30	30.25	-9.75	40	34.53	26	1.07	31.35	100	0	P	V
		58.35	27.83	-12.17	40	45.73	12.62	1.07	31.59	-	-	P	V
		119.91	28.23	-15.27	43.5	40.29	17.9	1.55	31.51	-	-	P	V
		414.1	24.34	-21.66	46	30.22	22.6	2.67	31.15	-	-	P	V
		689.2	28.77	-17.23	46	29.56	26.29	3.65	30.73	-	-	P	V
		965	33.82	-20.18	54	30.05	30.23	4.07	30.53	-	-	P	V
													V
													V
													V
													V
													V
													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 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)

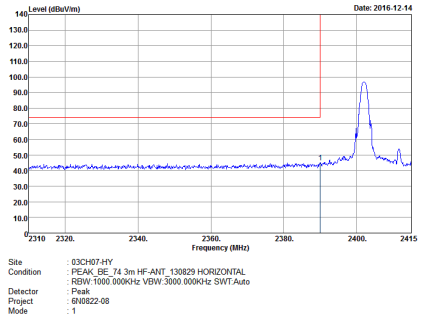
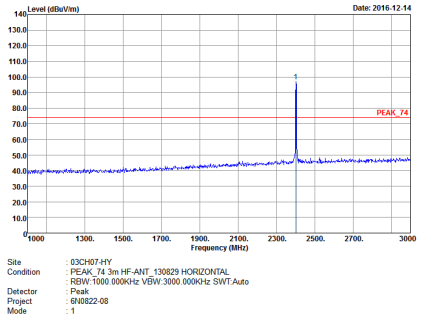
Both peak and average measured complies with the limit line, so test result is "PASS".

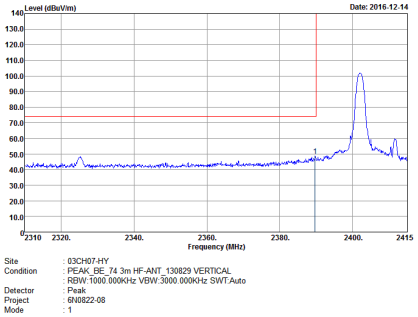
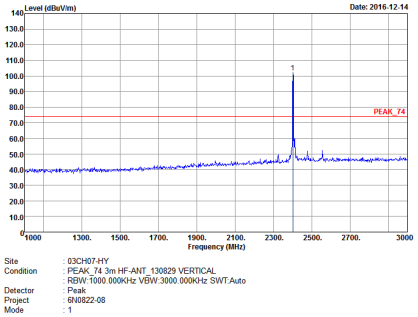
Appendix B. Radiated Spurious Emission Plots

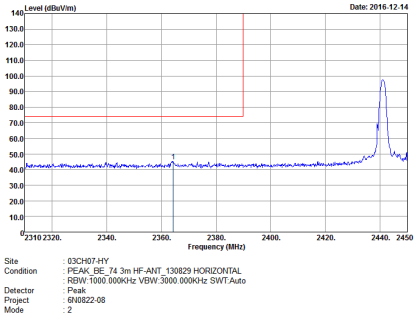
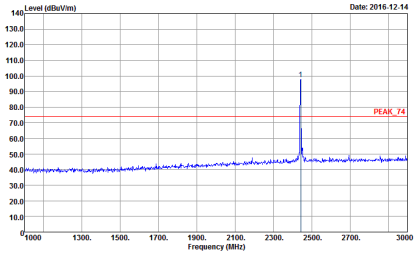
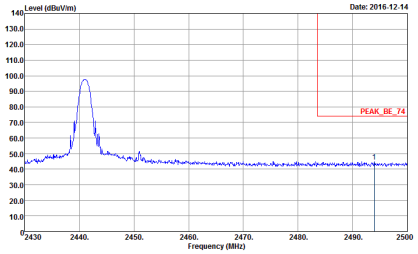
Test Engineer :	Jesse Wang, James Chiu, and Daniel Lee	**Temperature :**	21~23°C
		Relative Humidity :	47~51%

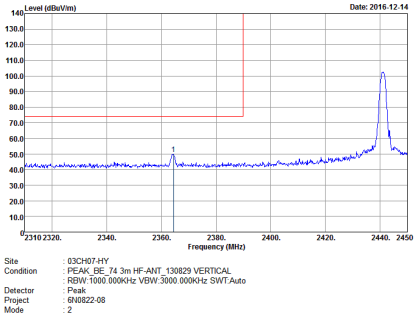
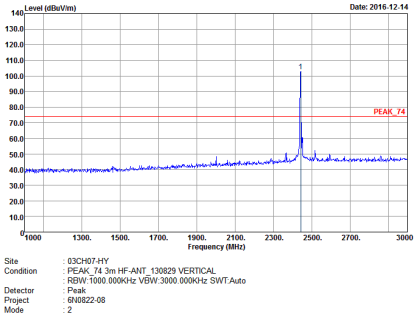
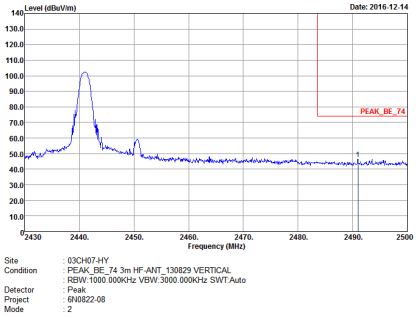
2.4GHz 2400~2483.5MHz

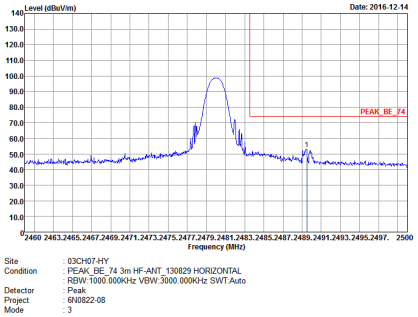
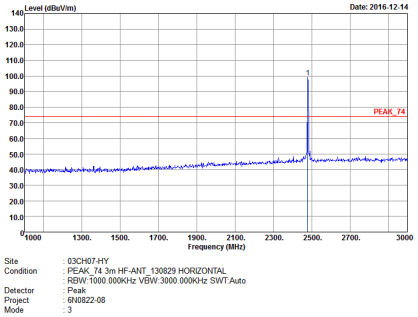
BT (Band Edge @ 3m)

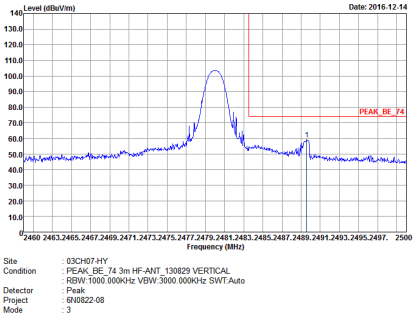
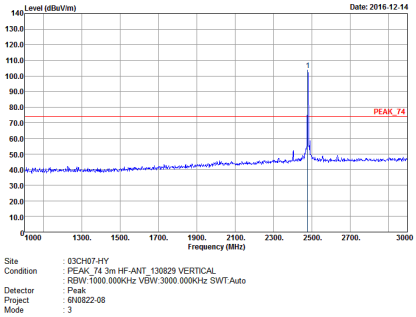
BT	**2.4GHz 2400~2483.5MHz Band Edge @ 3m**	
ANT	**BT CH00 2402MHz**	
2	**Horizontal**	**Fundamental**
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH00 2402MHz	
2	Vertical	Fundamental
Peak		

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH39 2441MHz	
2	Horizontal	Fundamental
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF-ANT_130829 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0822-08 Mode : 2	 Site : 03CH07-HY Condition : PEAK_74 3m HF-ANT_130829 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0822-08 Mode : 2
Peak	 Site : 03CH07-HY Condition : PEAK_BE_74 3m HF-ANT_130829 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0822-08 Mode : 2	Left blank

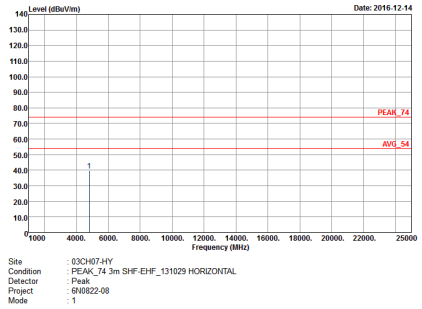
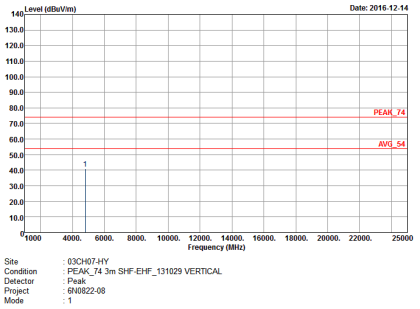
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH39 2441MHz	
2	Vertical	Fundamental
Peak		
Peak		Left blank

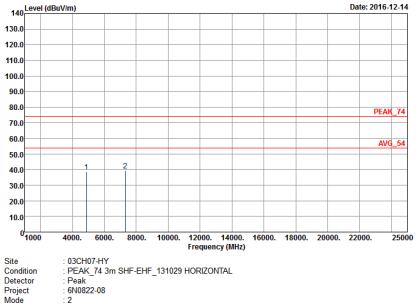
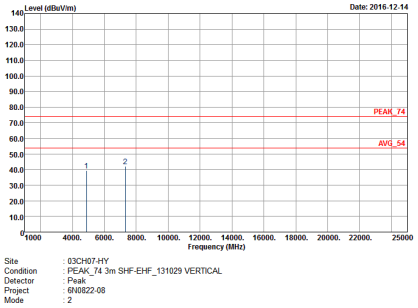
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
2	Horizontal	Fundamental
Peak		

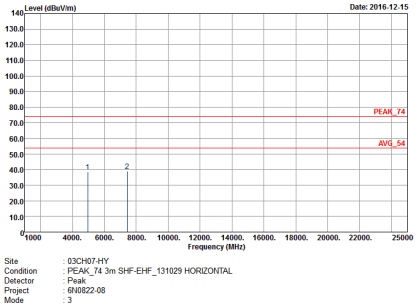
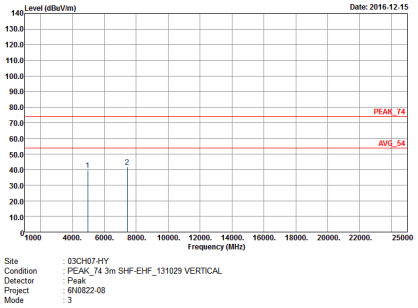
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
2	Vertical	Fundamental
Peak		

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

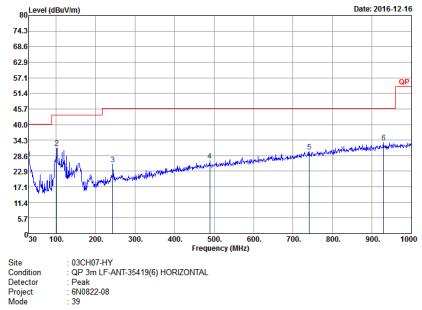
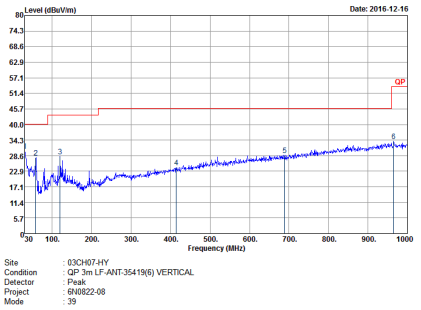
BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BT CH00 2402MHz	
2	Horizontal	Vertical
Peak Avg.		

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BT CH39 2441MHz	
2	Horizontal	Vertical
Peak Avg.		

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BT CH78 2480MHz	
2	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

2.4GHz BT (LF)

BT	2.4GHz 2400~2483.5MHz	
ANT	BT LF	
2	Horizontal	Vertical
QP / Peak		

Appendix D. Antenna Information

Antenna Information			
Antenna 1	Manufacturer	Amphenol	
	Antenna Type	Main:PIFA Antenna	Aux:PIFA Antenna
	Part number	LX7847-16-000-C	LX7848-16-000-C
	Peak gain	Main Antenna : WLAN(2.4GHz):-6.76 WLAN(5GHz):-1.84	Aux Antenna : WLAN(2.4GHz):-6.52 Bluetooth :-6.52 WLAN(5GHz):0.14
Antenna 2	Manufacturer	Speedwire	
	Antenna Type	Main:PIFA Antenna	Aux:PIFA Antenna
	Part number	F.0G.ZV-0006-003-00	F.0G.ZV-0006-004-00
	Peak gain	Main Antenna : WLAN(2.4GHz):1.5 WLAN(5GHz):-1.97	Aux Antenna : WLAN(2.4GHz):1.68 Bluetooth :1.68 WLAN(5GHz):-0.3