FCC RF Test Report

APPLICANT	:	**Wistron Corporation**
EQUIPMENT	:	**Notebook Computer**
BRAND NAME	:	**Lenovo**
MODEL NAME	:	**TP00076C**
FCC ID	:	**PU5-TP00076CUC**
STANDARD	:	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	:	**(DSS) Spread Spectrum Transmitter**

Equipment: Sierra Wireless EM7455 and Intel 8265NGW tested inside of Lenovo Notebook Computer

This is a partial report which is included the conducted emission and radiated emission test items. The product was received on Nov. 03, 2016 and testing was completed on Nov. 26, 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.
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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR6N0303-01A	Rev. 01	Initial issue of report	Dec. 19, 2016

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 12.08 dB at 197.130 MHz
3.2	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 17.07 dB at 0.170 MHz
3.3	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-

1 General Description

1.1 Applicant

Wistron Corporation
21F, No. 88, Sec. 1, Hsin Tai Wu Rd., Hsichih Dist, New Taipei City 221,Taiwan R.O.C.

1.2 Manufacturer

Wistron Corporation
21F, No. 88, Sec. 1, Hsin Tai Wu Rd., Hsichih Dist, New Taipei City 221,Taiwan R.O.C.

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Notebook Computer
Brand Name	Lenovo
Model Name	TP00076C
FCC ID	PU5-TP00076CUC
Integrated WWAN Module	Brand Name: Sierra Model Name: EM7455 FCC ID: N7NEM7455
Integrated WLAN Module	Brand Name: Intel Model Name: 8265NGW FCC ID: PD98265NG
EUT supports Radios application	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.**
	CO01-HY

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

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd Rd. Guishan Dist, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH10-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). Pre-scanned tests, X, Y, Z in three orthogonal panels, and different data rates were conducted to determine the final configuration (X plane as worst plane) from all possible combinations, and the worst mode of radiated spurious emissions is Bluetooth 1Mbps mode, and recorded in this report.

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.

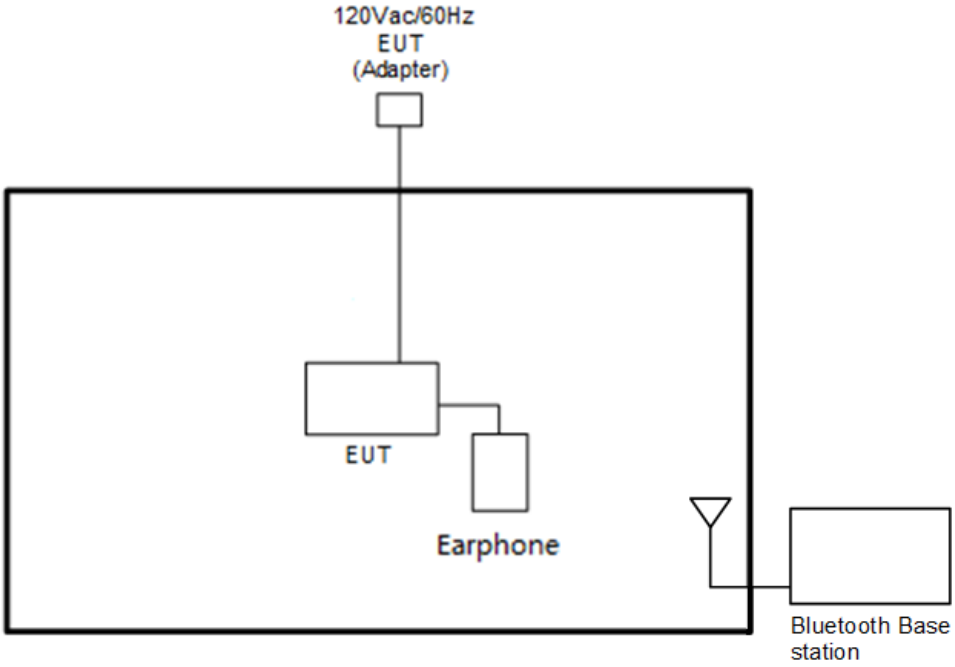
Summary table of Test Cases	
	Bluetooth BR 1Mbps GFSK
Radiated Test Cases	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz
AC Conducted Emission	Mode 1: Bluetooth Link + TF + TC Mode 2: WLAN Link + TF + TC

Remark:

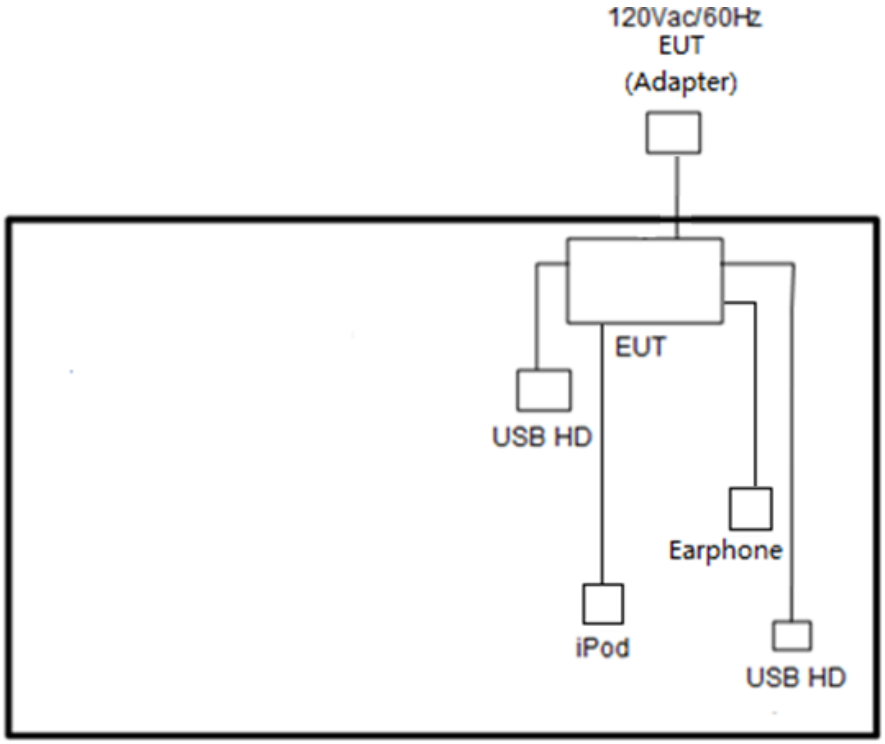
1. For radiated test cases, the worst mode data rate 1Mbps was reported only, because this data rate has the highest RF output power at preliminary tests, and the conducted spurious emissions and conducted band edge measurement for each data rate are no worse than 1Mbps, and no other significantly frequencies found in conducted spurious emission.
2. The worst case of conducted emission is mode 1; only the test data of it was reported.
3. All the radiated test cases were performance with Antenna 3.
4. TF stands for Test Function, and consists of MPEG4 and Camera.
5. TC stands for Test Configuration, and consists of Earphone, USB (HD and iPod), Adapter, SD Card, and DP Cable.

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.	iPod	Apple	A1285	DoC	Shielded, 1.0m	N/A
3.	Earphone	lenovo	TS300-01MS21-8S	FCC DoC	Unshielded,1.2m	N/A
4.	HD USB	lenovo	F310S	FCC DoC	Shielded, 0.5m	N/A
5.	HD USB	SONY	HD-E1	FCC DoC	Shielded, 0.5m	N/A
6.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A

2.5 EUT Operation Test Setup

For Bluetooth function, the RF utility, “DRTU” was installed in EUT which was programmed in order to make the EUT get into the engineering modes to contact with Bluetooth base station for continuous transmitting and receiving signals.

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.

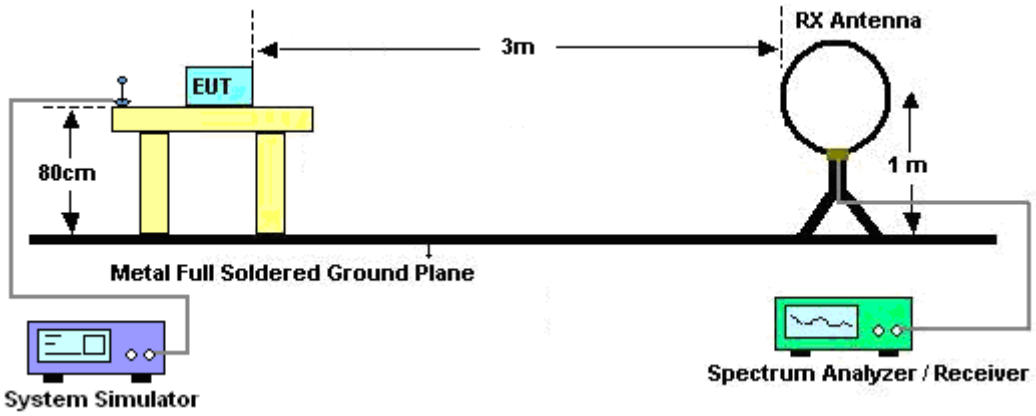
3.1.3 Test Procedures

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

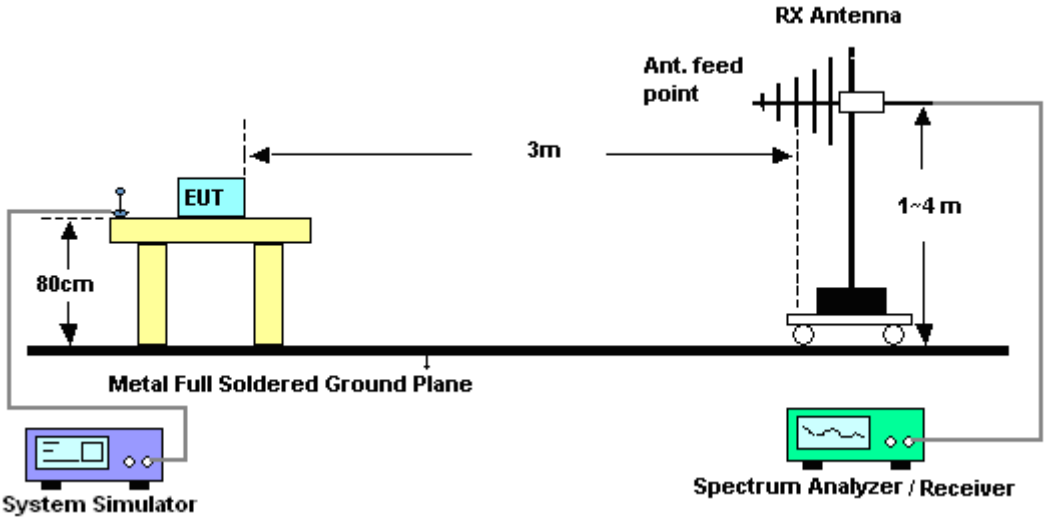
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.76dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent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

3.1.4 Test Setup

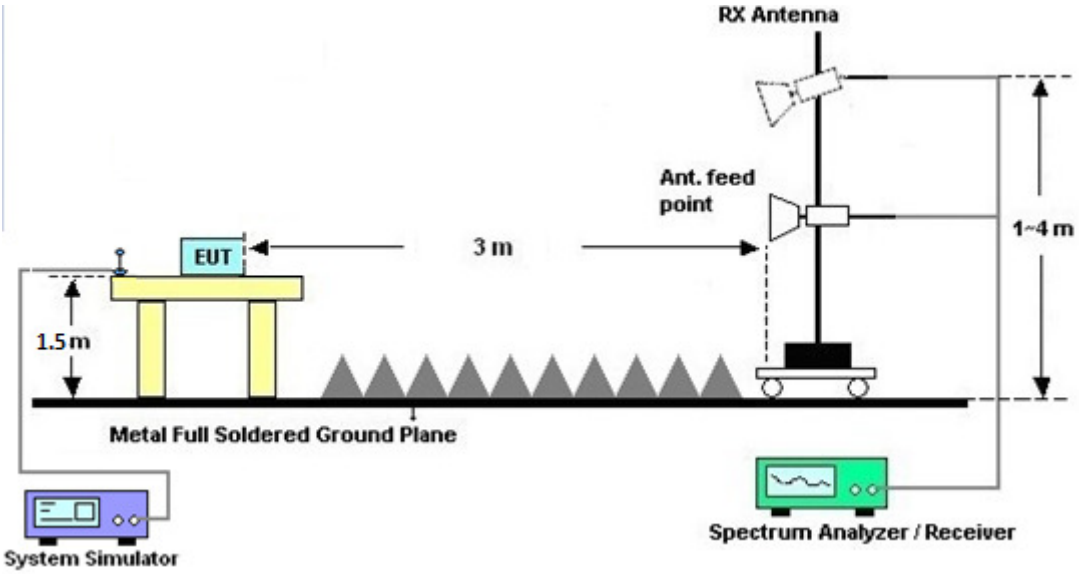
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz

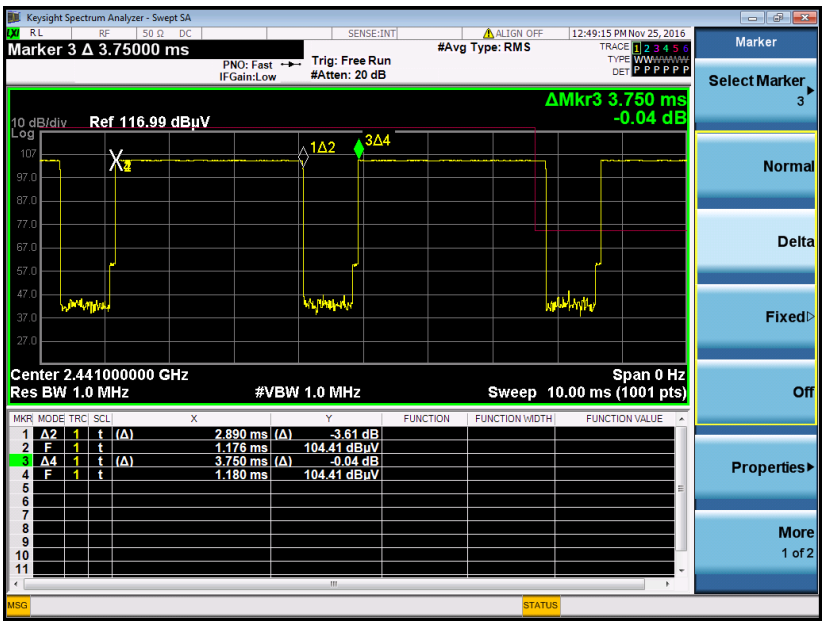


3.1.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

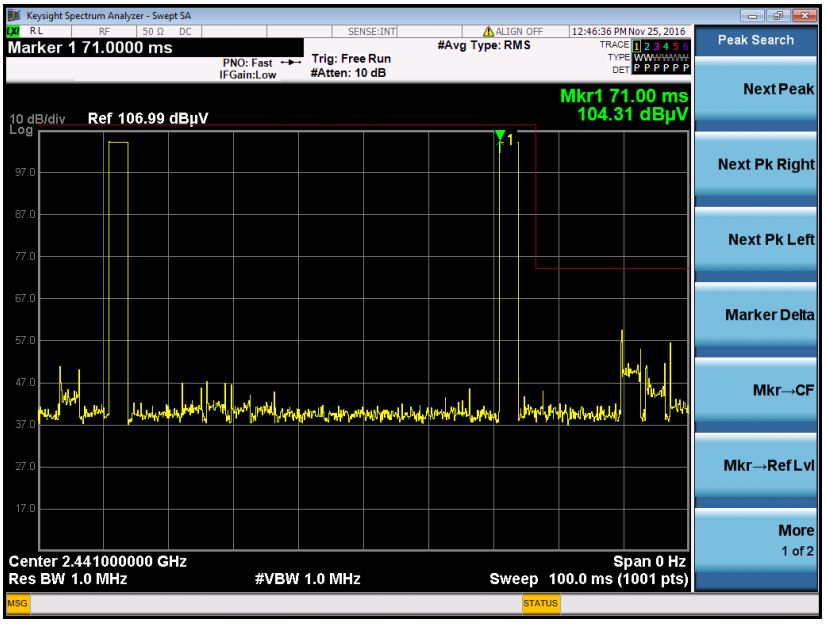
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

3.1.6 Duty cycle correction factor for average measurement

DH5 on time (One Pulse) Plot on Channel 39



DH5 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. DH5 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.

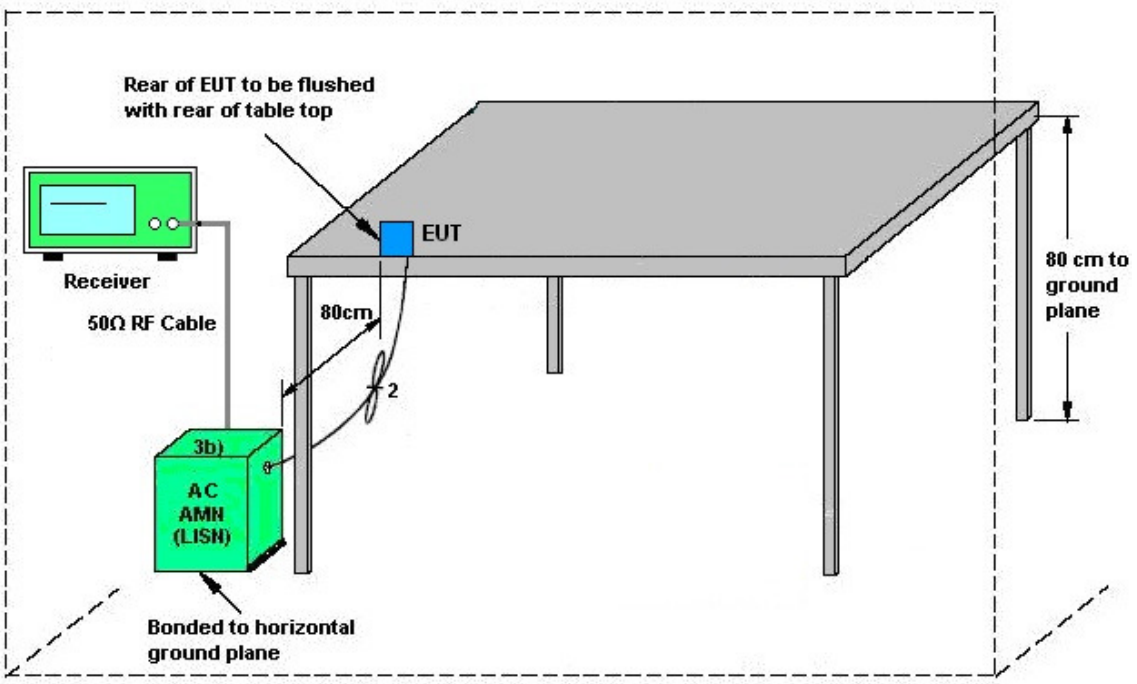
3.2.2 Measuring Instruments

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.

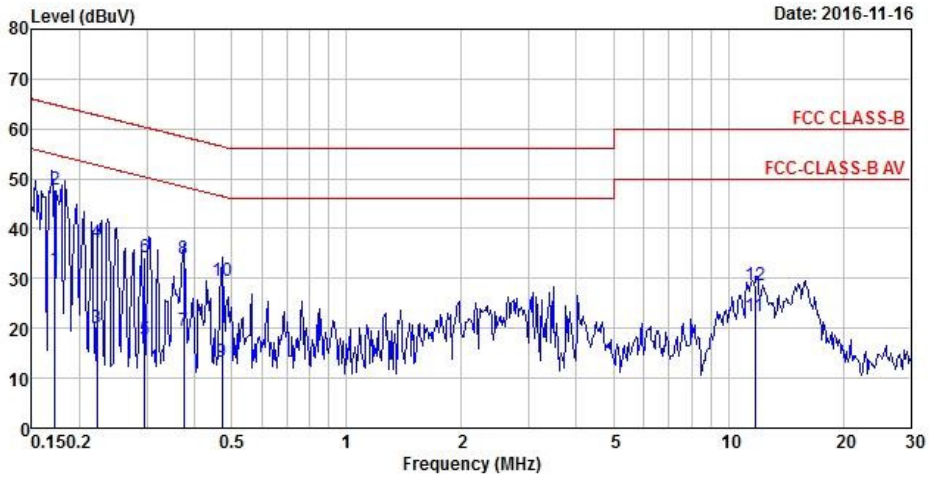
3.2.4 Test Setup



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

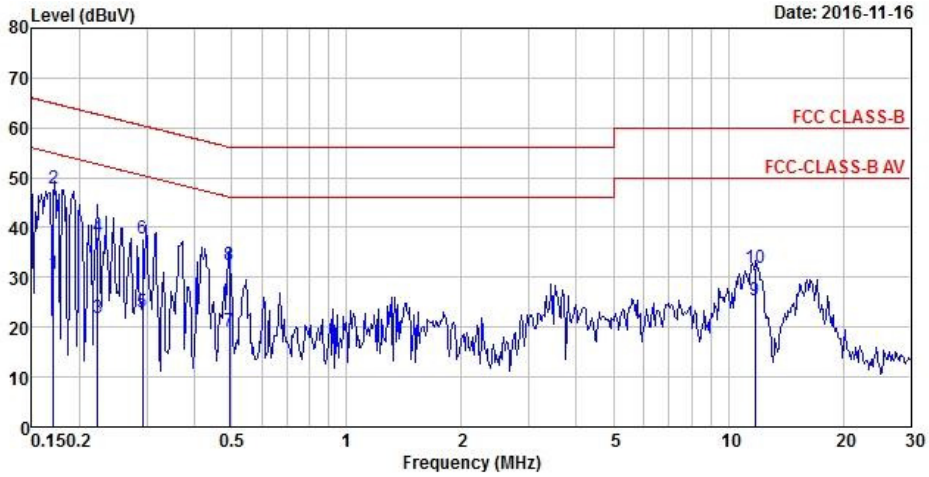
Test Mode :	Mode 1	Temperature :	22~25℃
Test Engineer :	James Chiu	Relative Humidity :	50~54%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	Bluetooth Link + TF + TC		



Site : CO01-HY
Condition: FCC CLASS-B LISN 2001/009-106-A LINE
EUT : NB (Convertible) (Sierra EM7455) FCC
Model : ThinkPad X1 Yoga 2nd(Raven 2
Power : 120V/60Hz
Memo : Mode 1-L
Memo : BT Link + TF + TC
Project : 6N0303-01

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.17	31.89	-22.96	54.85	31.63	0.16	0.10	Average
2 MAX	0.17	47.78	-17.07	64.85	47.52	0.16	0.10	QP
3	0.22	20.01	-32.74	52.75	19.77	0.14	0.10	Average
4	0.22	37.14	-25.61	62.75	36.90	0.14	0.10	QP
5	0.30	17.68	-32.65	50.33	17.43	0.15	0.10	Average
6	0.30	34.17	-26.16	60.33	33.92	0.15	0.10	QP
7	0.38	19.46	-28.93	48.39	19.19	0.17	0.10	Average
8	0.38	34.06	-24.33	58.39	33.79	0.17	0.10	QP
9	0.47	13.23	-33.26	46.49	12.96	0.17	0.10	Average
10	0.47	29.46	-27.03	56.49	29.19	0.17	0.10	QP
11	11.74	22.44	-27.56	50.00	21.90	0.44	0.10	Average
12	11.74	28.52	-31.48	60.00	27.98	0.44	0.10	QP

Test Mode :	Mode 1	Temperature :	22~25℃
Test Engineer :	James Chiu	Relative Humidity :	50~54%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Link + TF + TC		



Site : CO01-HY
Condition: FCC CLASS-B LISN 2001/009-106-A NEUTRAL
EUT : NB (Convertible) (Sierra EM7455) FCC
Model : ThinkPad X1 Yoga 2nd(Raven 2
Power : 120V/60Hz
Memo : Mode 1-N
Memo : BT Link + TF + TC
Project : 6N0303-01

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.17	30.71	-24.20	54.91	30.53	0.08	0.10	Average
2 MAX	0.17	47.70	-17.21	64.91	47.52	0.08	0.10	QP
3	0.22	21.85	-30.85	52.70	21.62	0.13	0.10	Average
4	0.22	37.96	-24.74	62.70	37.73	0.13	0.10	QP
5	0.29	22.99	-27.46	50.45	22.75	0.14	0.10	Average
6	0.29	37.71	-22.74	60.45	37.47	0.14	0.10	QP
7	0.49	19.30	-26.80	46.10	19.05	0.15	0.10	Average
8	0.49	32.39	-23.71	56.10	32.14	0.15	0.10	QP
9	11.75	25.51	-24.49	50.00	25.01	0.40	0.10	Average
10	11.75	31.76	-28.24	60.00	31.26	0.40	0.10	QP

3.3 Antenna Requirements

3.3.1 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 FCC rule.

3.3.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.3.3 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
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Nov. 16, 2016	N/A	Conduction (CO01-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9kHz~7GHz	Aug. 30, 2016	Nov. 16, 2016	Aug. 29, 2017	Conduction (CO01-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Dec. 02, 2015	Nov. 16, 2016	Dec. 01, 2016	Conduction (CO01-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Sep. 02, 2015	Nov. 25, 2016 ~ Nov. 26, 2016	Sep. 01, 2017	Radiation (03CH10-HY)
Amplifier	SONOMA	310N	187311	9kHz~1GHz	Oct. 26, 2016	Nov. 25, 2016 ~ Nov. 26, 2016	Oct. 25, 2017	Radiation (03CH10-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	35413&02	30MHz~1GHz	Jan. 13, 2016	Nov. 25, 2016 ~ Nov. 26, 2016	Jan. 12, 2017	Radiation (03CH10-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1325	1GHz ~ 18GHz	Sep. 30, 2016	Nov. 25, 2016 ~ Nov. 26, 2016	Sep. 29, 2017	Radiation (03CH10-HY)
Preamplifier	Keysight	83017A	MY53270078	1GHz~26.5GHz	Oct. 26, 2016	Nov. 25, 2016 ~ Nov. 26, 2016	Oct. 25, 2017	Radiation (03CH10-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz ~ 44GHz	Oct. 17, 2016	Nov. 25, 2016 ~ Nov. 26, 2016	Oct. 16, 2017	Radiation (03CH10-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Nov. 25, 2016 ~ Nov. 26, 2016	N/A	Radiation (03CH10-HY)
Turn Table	EMEC	TT 2200	N/A	0~360 Degree	N/A	Nov. 25, 2016 ~ Nov. 26, 2016	N/A	Radiation (03CH10-HY)
Preamplifier	MITEQ	TTA0204	1872107	2GHz~40GHz	Feb. 15, 2016	Nov. 25, 2016 ~ Nov. 26, 2016	Feb. 14, 2017	Radiation (03CH10-HY)
Preamplifier	MITEQ	JS44-18004000-33-8P	1840917	18GHz ~ 40GHz	Jun. 14, 2016	Nov. 25, 2016 ~ Nov. 26, 2016	Jun. 13, 2017	Radiation (03CH10-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 08, 2016	Nov. 25, 2016 ~ Nov. 26, 2016	Nov. 07, 2017	Radiation (03CH10-HY)
EMI Test Receiver	Agilent	N9038A(MXE)	MY53290053	20Hz to 26.5GHz	Jan. 20, 2016	Nov. 25, 2016 ~ Nov. 26, 2016	Jan. 19, 2017	Radiation (03CH10-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))	**2.2**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.6**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.9**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.2**

Appendix A. Radiated Spurious Emission

Test Engineer :	Tsung Lee, Stan Hsieh, and Kyle Chuang	Temperature :	21~23°C
		Relative Humidity :	45~49%

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		2322.18	47.99	-26.01	74	48.91	27.05	5.27	33.24	113	212	P	H
		2322.18	23.23	-30.77	54	-	-	-	-	-	-	A	H
	*	2402	102.7	-	-	103.29	27.23	5.39	33.21	113	212	P	H
	*	2402	77.94	-	-	-	-	-	-	-	-	A	H
													H
													H
		2322.18	49.13	-24.87	74	50.05	27.05	5.27	33.24	351	156	P	V
		2322.18	24.37	-29.63	54	-	-	-	-	-	-	A	V
	*	2402	103.69	-	-	104.28	27.23	5.39	33.21	351	156	P	V
	*	2402	78.93	-	-	-	-	-	-	-	-	A	V
													V
													V
BT CH 39 2441MHz		2361.1	48.8	-25.2	74	49.56	27.14	5.33	33.23	121	210	P	H
		2361.1	24.04	-29.96	54	-	-	-	-	-	-	A	H
	*	2441	103.68	-	-	104.07	27.37	5.42	33.18	121	210	P	H
	*	2441	78.92	-	-	-	-	-	-	-	-	A	H
		2496.57	40.92	-33.08	74	41.12	27.5	5.46	33.16	121	210	P	H
		2496.57	16.16	-37.84	54	-	-	-	-	-	-	A	H
		2361.1	50.37	-23.63	74	51.13	27.14	5.33	33.23	344	152	P	V
		2361.1	25.61	-28.39	54	-	-	-	-	-	-	A	V
	*	2441	104.09	-	-	104.48	27.37	5.42	33.18	344	152	P	V
	*	2441	79.33	-	-	-	-	-	-	-	-	A	V
		2489.57	41.4	-32.6	74	41.61	27.5	5.46	33.17	344	152	P	V
		2489.57	16.64	-37.36	54	-	-	-	-	-	-	A	V

BT CH 78 2480MHz	*	2480	103.22	-	-	103.49	27.46	5.44	33.17	111	210	P	H
	*	2480	78.46	-	-	-	-	-	-	-	-	A	H
		2490.04	57.57	-16.43	74	57.78	27.5	5.46	33.17	111	210	P	H
		2490.04	32.81	-21.19	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	104.3	-	-	104.57	27.46	5.44	33.17	290	156	P	V
	*	2480	79.54	-	-	-	-	-	-	-	-	A	V
		2490.04	58.91	-15.09	74	59.12	27.5	5.46	33.17	290	156	P	V
		2490.04	34.15	-19.85	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		4804	35.07	-38.93	74	47.25	31.42	7.58	51.18	100	0	P	H
		4804	10.31	-43.69	54	-	-	-	-	-	-	A	H
													H
													H
		4804	34.49	-39.51	74	46.67	31.42	7.58	51.18	100	0	P	V
		4804	9.73	-44.27	54	-	-	-	-	-	-	A	V
													V
													V
BT CH 39 2441MHz		4882	35.49	-38.51	74	47.26	31.56	7.82	51.15	100	0	P	H
		4882	10.73	-43.27	54	-	-	-	-	-	-	A	H
		7323	44.94	-29.06	74	50.01	36.22	9.51	50.8	100	0	P	H
		7323	20.18	-33.82	54	-	-	-	-	-	-	A	H
		4882	35.89	-38.11	74	47.66	31.56	7.82	51.15	100	0	P	V
		4882	11.13	-42.87	54	-	-	-	-	-	-	A	V
		7323	44.74	-29.26	74	49.81	36.22	9.51	50.8	100	0	P	V
		7323	19.98	-34.02	54	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		4960	35.24	-38.76	74	46.7	31.73	7.93	51.12	100	0	P	H
		4960	10.48	-43.52	54	-	-	-	-	-	-	A	H
		7440	45.98	-28.02	74	50.68	36.49	9.61	50.8	100	0	P	H
		7440	21.22	-32.78	54	-	-	-	-	-	-	A	H
		4960	35.04	-38.96	74	46.5	31.73	7.93	51.12	100	0	P	V
		4960	10.28	-43.72	54	-	-	-	-	-	-	A	V
		7440	43.98	-30.02	74	48.68	36.49	9.61	50.8	100	0	P	V
		7440	19.22	-34.78	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		48.9	24.34	-15.66	40	40.12	16.03	0.93	32.74			P	H
		197.13	31.42	-12.08	43.5	46.81	15.88	1.48	32.75	100	0	P	H
		269.22	32.37	-13.63	46	43.93	19.4	1.76	32.72			P	H
		342	33.04	-12.96	46	42.86	20.97	1.94	32.73			P	H
		402.2	31.89	-14.11	46	40.07	22.45	2.13	32.76			P	H
		867	30.57	-15.43	46	31.2	28.7	3.16	32.49			P	H
													H
													H
													H
													H
													H
													H
		48.9	27.19	-12.81	40	42.97	16.03	0.93	32.74	100	0	P	V
		196.32	25.28	-18.22	43.5	40.71	15.84	1.48	32.75			P	V
		270.84	25.12	-20.88	46	36.69	19.39	1.76	32.72			P	V
		381.9	30.24	-15.76	46	38.88	21.98	2.13	32.75			P	V
		855.8	29.88	-16.12	46	30.58	28.7	3.16	32.56			P	V
		955.2	30.99	-15.01	46	29.4	30	3.29	31.7			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)

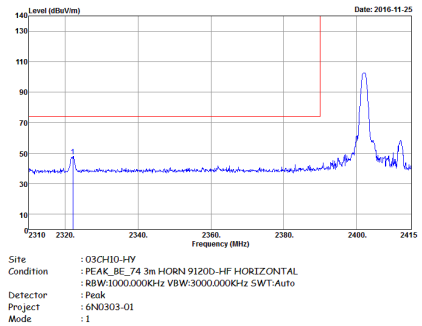
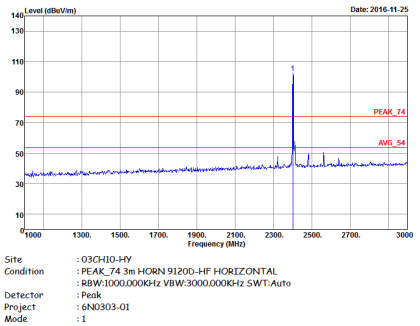
Both peak and average measured complies with the limit line, so test result is "PASS".

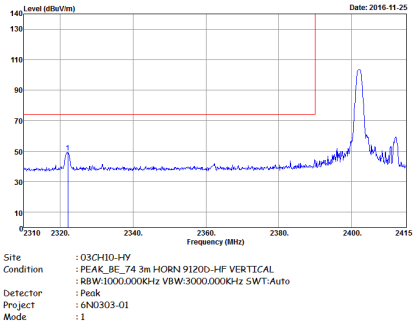
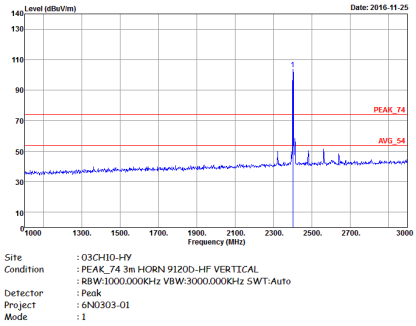
Appendix B. Radiated Spurious Emission Plots

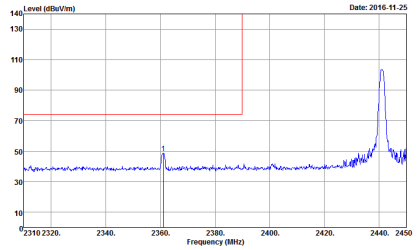
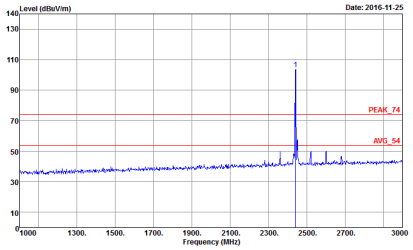
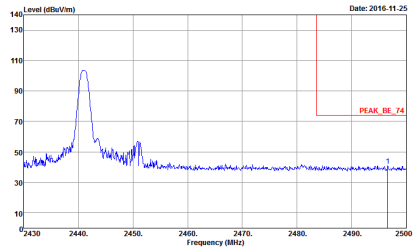
Test Engineer :	Tsung Lee, Stan Hsieh, and Kyle Chuang	Temperature :	21~23°C
		Relative Humidity :	45~49%

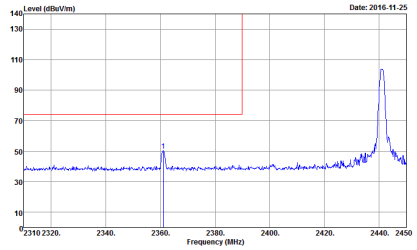
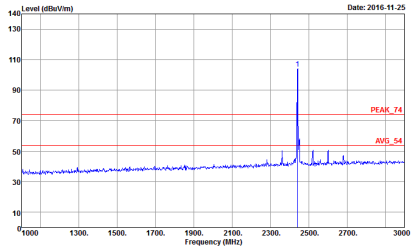
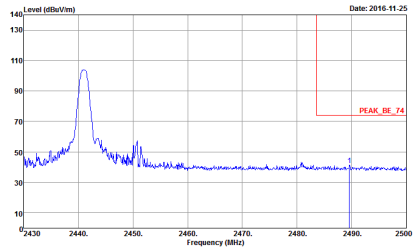
2.4GHz 2400~2483.5MHz

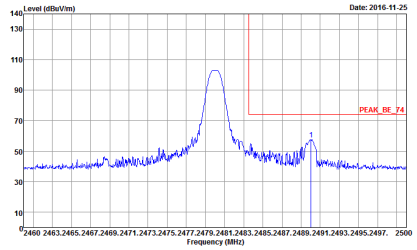
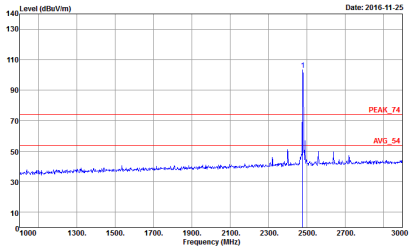
BT (Band Edge @ 3m)

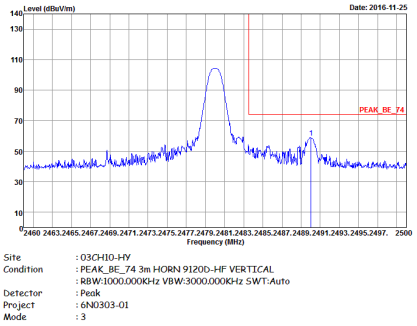
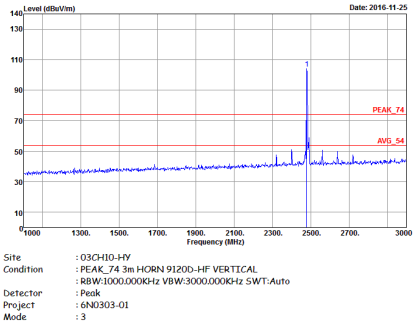
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH00 2402MHz	
1	Horizontal	Fundamental
Peak		

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

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH39 2441MHz	
1	Horizontal	Fundamental
Peak	 Site : 03CH10-HY Condition : PEAK_BE_74 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0303-01 Mode : 2	 Site : 03CH10-HY Condition : PEAK_74 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0303-01 Mode : 2
Peak	 Site : 03CH10-HY Condition : PEAK_BE_74 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0303-01 Mode : 2	Left blank

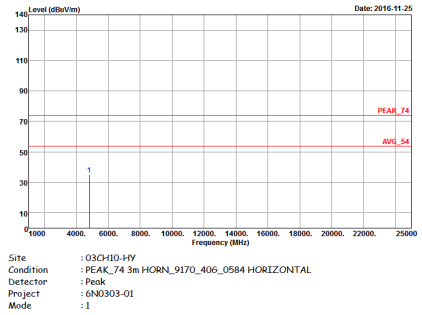
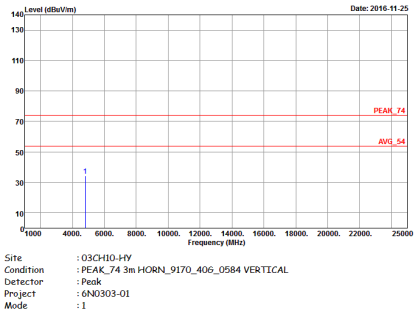
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH39 2441MHz	
1	Vertical	Fundamental
Peak	 Site : 03CH10-HY Condition : PEAK_BE_74 3m HORN 9120D-HF VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0303-01 Mode : 2	 Site : 03CH10-HY Condition : PEAK_74 3m HORN 9120D-HF VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0303-01 Mode : 2
Peak	 Site : 03CH10-HY Condition : PEAK_BE_74 3m HORN 9120D-HF VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0303-01 Mode : 2	Left blank

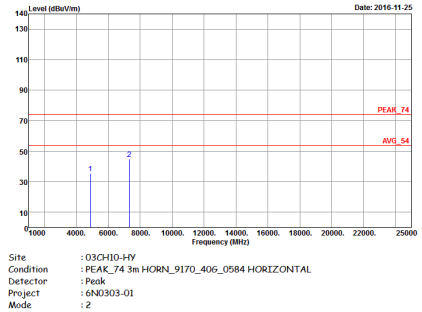
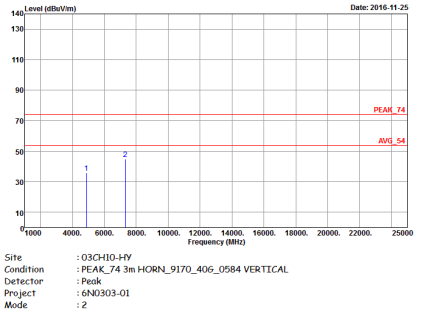
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
1	Horizontal	Fundamental
Peak	 Site : 03CH10-HY Condition : PEAK_BE_74 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0303-01 Mode : 3	 Site : 03CH10-HY Condition : PEAK_74 3m HORN 9120D-HF HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto Detector : Peak Project : 6N0303-01 Mode : 3

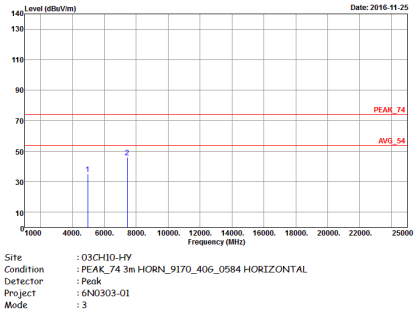
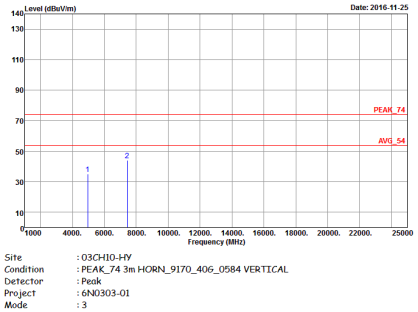
BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
1	Vertical	Fundamental
Peak		

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

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

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

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

Emission below 1GHz

2.4GHz BT (LF)

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