



# FCC RF Test Report

APPLICANT : IEI Integration Corp.  
EQUIPMENT : Tablet PC  
BRAND NAME : iEi  
MODEL NAME : TRN-3200T  
FCC ID : RFH-TRN3200T  
STANDARD : FCC Part 15 Subpart C §15.247  
CLASSIFICATION : (DSS) Spread Spectrum Transmitter

This is a variant report which is only valid together with the original test report. The product was received on Sep. 22, 2017 and testing was completed on Oct. 24, 2017. 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



## SPORTON INTERNATIONAL INC.

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

SPORTON INTERNATIONAL INC.

TEL : 886-3-327-3456

FAX : 886-3-328-4978

FCC ID : RFH-TRN3200T

Page Number : 1 of 19

Report Issued Date : Nov. 17, 2017

Report Version : Rev. 02

Report Template No.: BU5-FR15CBT Version 2.0



# 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 Modification of EUT ..... 5

    1.5 Testing Location ..... 5

    1.6 Applicable Standards..... 6

**2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST..... 7**

    2.1 Carrier Frequency Channel ..... 7

    2.2 Test Mode ..... 8

    2.3 Connection Diagram of Test System ..... 9

    2.4 Support Unit used in test configuration and system ..... 9

    2.5 EUT Operation Test Setup ..... 9

**3 TEST RESULT ..... 10**

    3.1 Peak Output Power Measurement ..... 10

    3.2 Radiated Band Edges and Spurious Emission Measurement ..... 11

    3.3 AC Conducted Emission Measurement..... 15

    3.4 Antenna Requirements ..... 17

**4 LIST OF MEASURING EQUIPMENT ..... 18**

**5 UNCERTAINTY OF EVALUATION..... 19**

**APPENDIX A. CONDUCTED TEST RESULTS**

**APPENDIX B. AC CONDUCTED EMISSION TEST RESULT**

**APPENDIX C. RADIATED SPURIOUS EMISSION**

**APPENDIX D. RADIATED SPURIOUS EMISSION PLOTS**

**APPENDIX E. DUTY CYCLE PLOTS**

**APPENDIX F. SETUP PHOTOGRAPHS**





## SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
-	15.247(a)(1)	Number of Channels	≥ 15Chs	Not required	-
-	15.247(a)(1)	Hopping Channel Separation	≥ 2/3 of 20dB BW	Not required	-
-	15.247(a)(1)	Dwell Time of Each Channel	≤ 0.4sec in 31.6sec period	Not required	-
-	15.247(a)(1)	20dB Bandwidth	NA	Not required	-
-	-	99% Bandwidth	-	Not required	-
3.1	15.247(b)(1)	Peak Output Power	≤ 125 mW	Pass	-
-	15.247(d)	Conducted Band Edges	≤ 20dBc	Not required	-
-	15.247(d)	Conducted Spurious Emission	≤ 20dBc	Not required	-
3.2	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 4.31 dB at 82.650 MHz
3.3	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 14.10 dB at 4.510 MHz
3.4	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-

**Remark :**

1. Not required means after assessing, test items are not necessary to carry out.
2. This is a variant report which can be referred Product Equality Declaration. All the test cases were performed on original report which can be referred to Sporton Report Number FR690221A. Based on the original report, the test cases were verified.



# 1 General Description

## 1.1 Applicant

IEI Integration Corp.

No. 29, Zhongxing Rd., Xizhi Dist., New Taipei City 221. Taiwan (R.O.C)

## 1.2 Manufacturer

IEI Integration Corp.

No. 29, Zhongxing Rd., Xizhi Dist., New Taipei City 221. Taiwan (R.O.C)

## 1.3 Product Feature of Equipment Under Test

Bluetooth, Wi-Fi 2.4GHz 802.11b/g/n, and Wi-Fi 5GHz 802.11a/n/ac

Product Specification subjective to this standard	
Antenna Type	WLAN: PCB Antenna Bluetooth: PCB Antenna

## 1.4 Modification of EUT

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

## 1.5 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1190 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 1 <sup>st</sup> 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.		
	TH05-HY	CO05-HY	03CH07-HY

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



## 1.6 Applicable Standards

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

- ♦ FCC Part 15 Subpart C §15.247
- ♦ 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 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	27	2429	54	2456
	1	2403	28	2430	55	2457
	2	2404	29	2431	56	2458
	3	2405	30	2432	57	2459
	4	2406	31	2433	58	2460
	5	2407	32	2434	59	2461
	6	2408	33	2435	60	2462
	7	2409	34	2436	61	2463
	8	2410	35	2437	62	2464
	9	2411	36	2438	63	2465
	10	2412	37	2439	64	2466
	11	2413	38	2440	65	2467
	12	2414	39	2441	66	2468
	13	2415	40	2442	67	2469
	14	2416	41	2443	68	2470
	15	2417	42	2444	69	2471
	16	2418	43	2445	70	2472
	17	2419	44	2446	71	2473
	18	2420	45	2447	72	2474
	19	2421	46	2448	73	2475
	20	2422	47	2449	74	2476
	21	2423	48	2450	75	2477
	22	2424	49	2451	76	2478
	23	2425	50	2452	77	2479
	24	2426	51	2453	78	2480
	25	2427	52	2454	-	-
	26	2428	53	2455	-	-



## 2.2 Test Mode

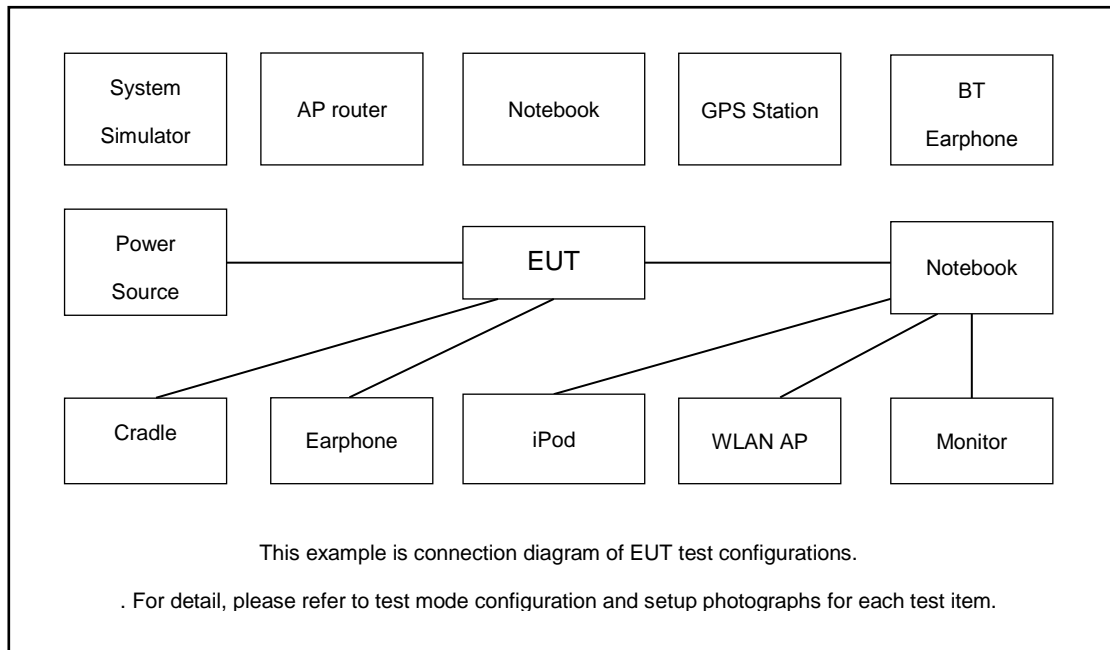
- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report, and the worst mode of radiated spurious emissions is Bluetooth 3Mbps mode, and recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

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

Summary table of Test Cases	
Radiated Test Cases	Bluetooth EDR 3Mbps 8-DPSK
	Mode 1: CH78_2480 MHz
AC Conducted Emission	Mode 1 :Bluetooth Link + WLAN (2.4GHz) Link + TC + TF
<b>Remark:</b> <ol style="list-style-type: none"> <li>1. For radiated test cases, the worst mode data rate 3Mbps 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 3Mbps, and no other significantly frequencies found in conducted spurious emission.</li> <li>2. TF stands for Test Function, and consists of H-Pattern, MPEG4, and Camera.</li> <li>3. TC stands for Test Configuration, and consists of SD Card, Earphone, LCD Monitor (Mini HDMI Out), USB HD, RJ-45 Link, Ultrasound Probe (Load), and Adapter 2.</li> </ol>	



### 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.	Bluetooth Base Station	R&S	CBT32	N/A	N/A	Unshielded, 1.8 m
2.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A
3.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
4.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded,1.8m
5.	Notebook	DELL	P20G	FCC DoC/ Contains FCC ID: QDS-BRCM1051	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
6.	LCD Monitor	DELL	U2410	FCC DoC	Shielded, 1.6 m	Unshielded, 1.8 m
7.	USB HD	WD	WDBAAR3200 ABK-PESN	FCC DoC	Unshielded, 0.5 m	N/A
8.	USB HD	DigiFusion	HD-326U3S	FCC DoC	Shielded, 0.5m	N/A
9.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A

### 2.5 EUT Operation Test Setup

The RF test items utility, “RTLBTAPP” was installed in EUT which was programmed in order to make the EUT get into the engineering modes to contact with base station for continuous transmitting and receiving signals.

### 3 Test Result

#### 3.1 Peak Output Power Measurement

##### 3.1.1 Limit of Peak Output Power

Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts. The power limit for 1Mbps, 2Mbps, 3Mbps and AFH modes are 0.125 watts.

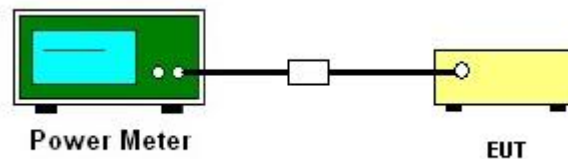
##### 3.1.2 Measuring Instruments

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

##### 3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
1. 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.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Measure the conducted output power with cable loss and record the results in the test report.
4. Measure and record the results in the test report.

##### 3.1.4 Test Setup



##### 3.1.5 Test Result of Peak Output Power

Please refer to Appendix A.



### 3.2 Radiated Band Edges and Spurious Emission Measurement

#### 3.2.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. 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.



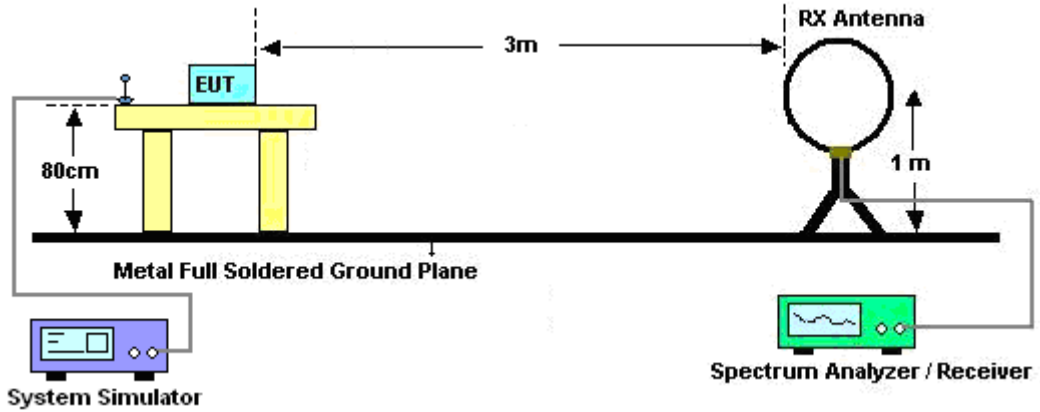
### 3.2.3 Test Procedures

1. The 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.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. 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.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for  $f < 1 \text{ GHz}$ , RBW=1MHz for  $f > 1\text{GHz}$  ; VBW  $\geq$  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 =  $N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$   
Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.  
Average Emission Level = Peak Emission Level +  $20 * \log(\text{Duty cycle})$
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

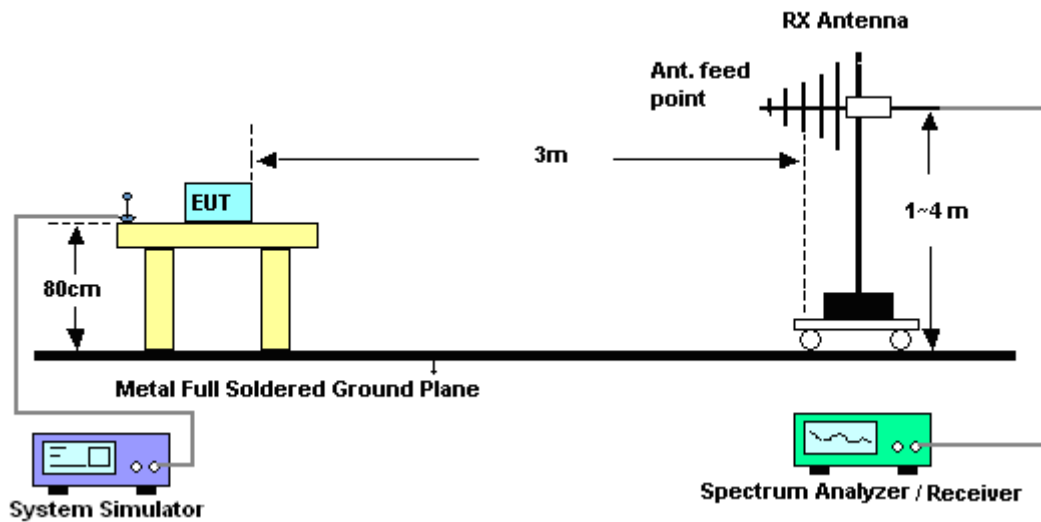
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.73dB) derived from  $20 \log(\text{dwell time}/100\text{ms})$ . This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

### 3.2.4 Test Setup

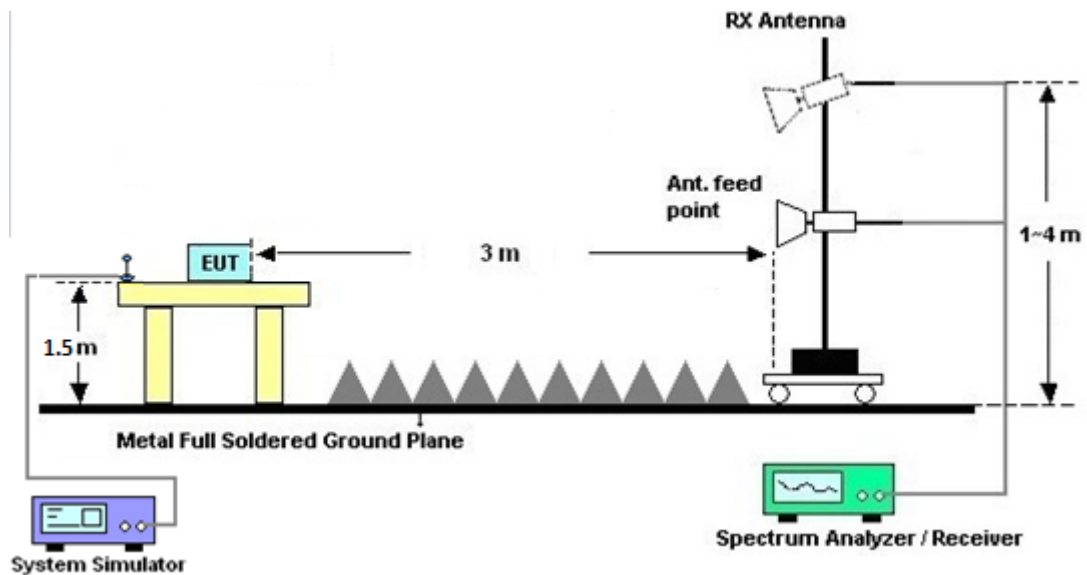
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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

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

### 3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

### 3.2.7 Duty Cycle

Please refer to Appendix E.

### 3.2.8 Test Result of Radiated Spurious Emission (30MHz ~ 10<sup>th</sup> Harmonic)

Please refer to Appendix C and D.



### 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.

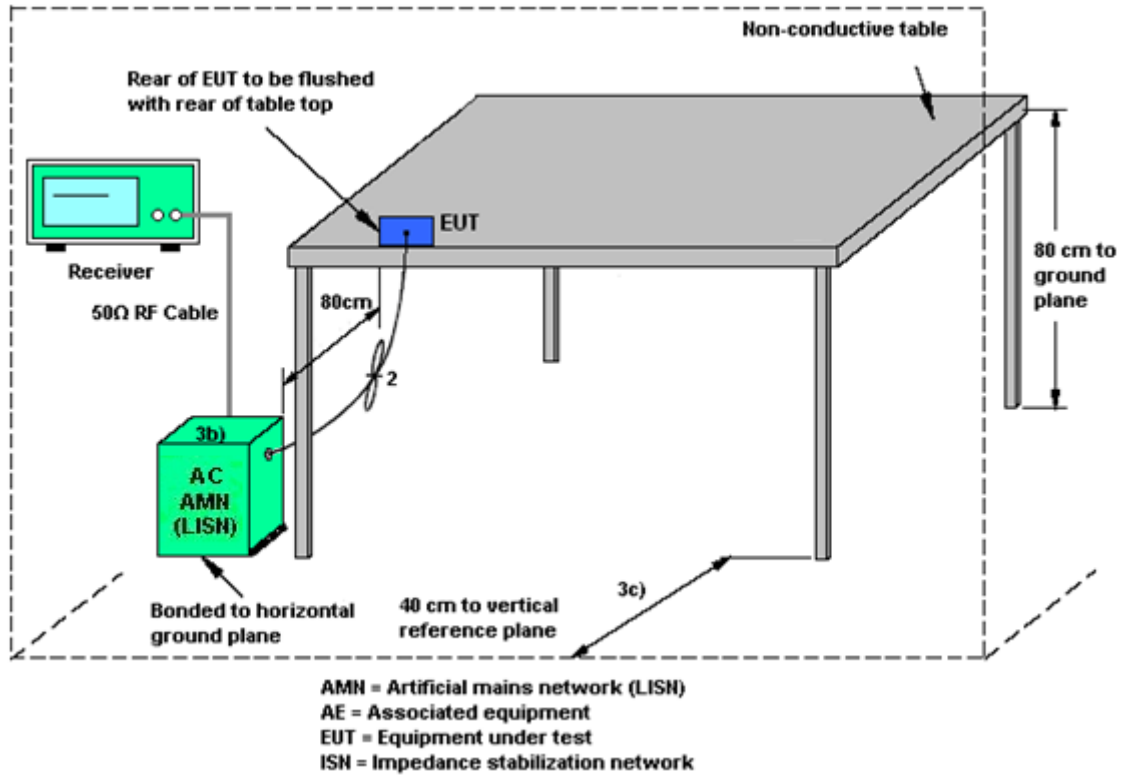
#### 3.3.2 Measuring Instruments

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

### 3.3.4 Test Setup



### 3.3.5 Test Result of AC Conducted Emission

Please refer to Appendix B.





## **3.4 Antenna Requirements**

### **3.4.1 Standard Applicable**

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

### **3.4.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

### **3.4.3 Antenna Gain**

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



## 4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Power Meter	Agilent	E4416A	GB412923 44	N/A	Dec. 26, 2016	Oct.15.2017~ Nov.15.2017	Dec. 25, 2017	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US404415 48	50MHz~18GHz	Dec. 26, 2016	Oct.15.2017~ Nov.15.2017	Dec. 25, 2017	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP30	101067	9kHz ~ 30GHz	Nov. 17, 2016	Oct.15.2017~ Nov.15.2017	Nov. 16, 2017	Conducted (TH05-HY)
BT Base Station(Measure)	Rohde & Schwarz	CBT	101136	BT 3.0	Sep. 20, 2017	Oct.15.2017~ Nov.15.2017	Sep. 19, 2018	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Oct. 23, 2017	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9kHz~7GHz	Sep. 20, 2017	Oct. 23, 2017	Sep. 19, 2018	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Nov. 29, 2016	Oct. 23, 2017	Nov. 28, 2017	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Dec. 06, 2016	Oct. 23, 2017	Dec. 05, 2017	Conduction (CO05-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	35419&03	30MHz to 1GHz	Jan. 07, 2017	Oct. 24, 2017	Jan. 06, 2018	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Aug. 23, 2017	Oct. 24, 2017	Aug. 22, 2018	Radiation (03CH07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	May 15, 2017	Oct. 24, 2017	May 14, 2019	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	1GHz ~ 18GHz	Apr. 25, 2017	Oct. 24, 2017	Apr. 24, 2018	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz-1GHz	Mar. 14, 2017	Oct. 24, 2017	Mar. 13, 2018	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A023 62	1GHz~ 26.5GHz	Oct. 13, 2017	Oct. 24, 2017	Oct. 12, 2018	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9010A	MY534701 18	10Hz~44GHz	Apr. 17, 2017	Oct. 24, 2017	Apr. 16, 2018	Radiation (03CH07-HY)
Antenna Mast	Max-Full	MFA520BS	N/A	1m~4m	N/A	Oct. 24, 2017	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Oct. 24, 2017	N/A	Radiation (03CH07-HY)
Amplifier	MITEQ	TTA1840-35- HG	1871923	18GHz~40GHz, VSWR : 2.5:1 max	Jul. 18, 2017	Oct. 24, 2017	Jul. 17, 2018	Radiation (03CH07-HY)
EMI Test Receiver	Agilent	N9038A (MXE)	MY532900 53	20Hz to 26.5GHz	Jan. 12, 2017	Oct. 24, 2017	Jan. 11, 2018	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA9170 584	18GHz- 40GHz	Nov. 08, 2016	Oct. 24, 2017	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% ( $U = 2Uc(y)$ )	5.7
---	-----

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.5
---	-----

### 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. Test Result of Conducted Test Items**

Test Engineer:	Aking Chang	Temperature:	21~25	°C
Test Date:	2017/11/15	Relative Humidity:	51~54	%

**TEST RESULTS DATA****Peak Power Table**

DH	channel		Peak Power (dBm)	Power Limit (dBm)	Test Result
DH1	0	1	<b>5.71</b>	20.97	Pass
	39	1	5.18	20.97	Pass
	78	1	4.55	20.97	Pass

2DH	channel		Peak Power (dBm)	Power Limit (dBm)	Test Result
2DH1	0	1	<b>6.60</b>	20.97	Pass
	39	1	6.45	20.97	Pass
	78	1	5.80	20.97	Pass

3DH	channel		Peak Power (dBm)	Power Limit (dBm)	Test Result
3DH1	0	1	<b>7.25</b>	20.97	Pass
	39	1	7.01	20.97	Pass
	78	1	6.40	20.97	Pass



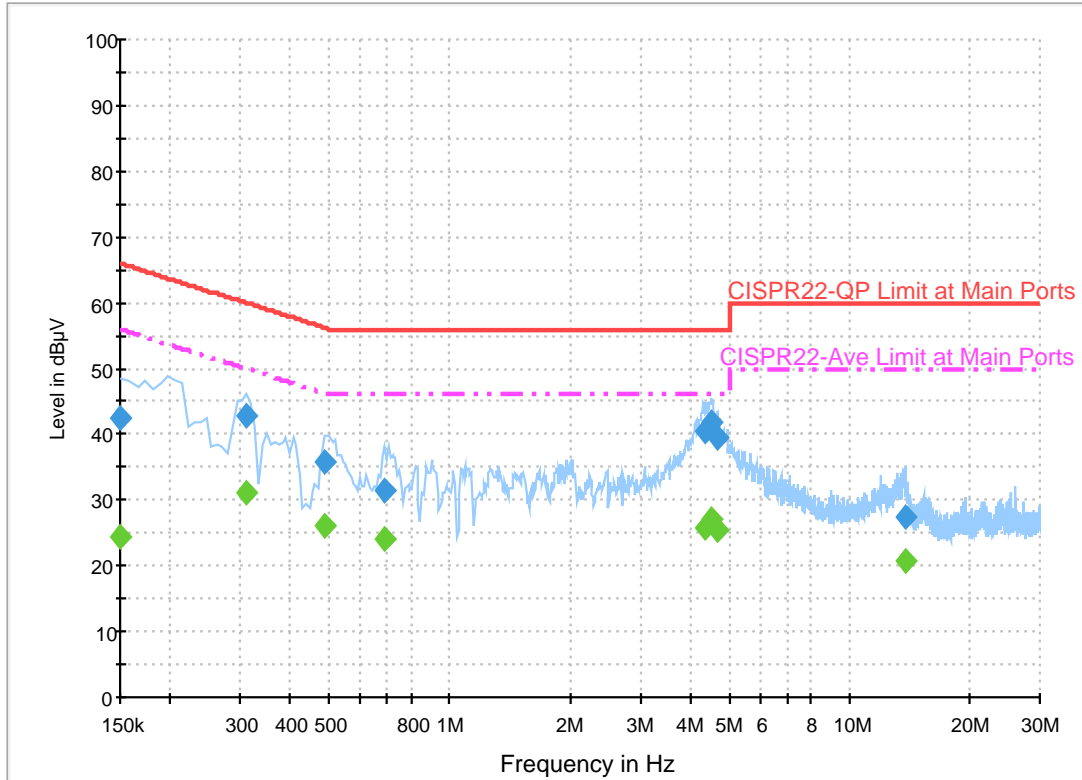
## Appendix B. AC Conducted Emission Test Results

Test Engineer :	Blue Lan	Temperature :	23~24°C
		Relative Humidity :	37~38%

# EUT Information

Report NO : 690221-01  
 Test Mode : Mode 1  
 Test Voltage : 120Vac/60Hz  
 Phase : Line

ENV216 Auto Test-L



## Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	42.4	Off	L1	19.6	23.6	66.0
0.310000	42.7	Off	L1	19.5	17.3	60.0
0.486000	35.8	Off	L1	19.5	20.4	56.2
0.686000	31.5	Off	L1	19.5	24.5	56.0
4.350000	40.5	Off	L1	19.6	15.5	56.0
4.510000	41.9	Off	L1	19.6	14.1	56.0
4.694000	39.4	Off	L1	19.6	16.6	56.0
13.814000	27.5	Off	L1	19.7	32.5	60.0

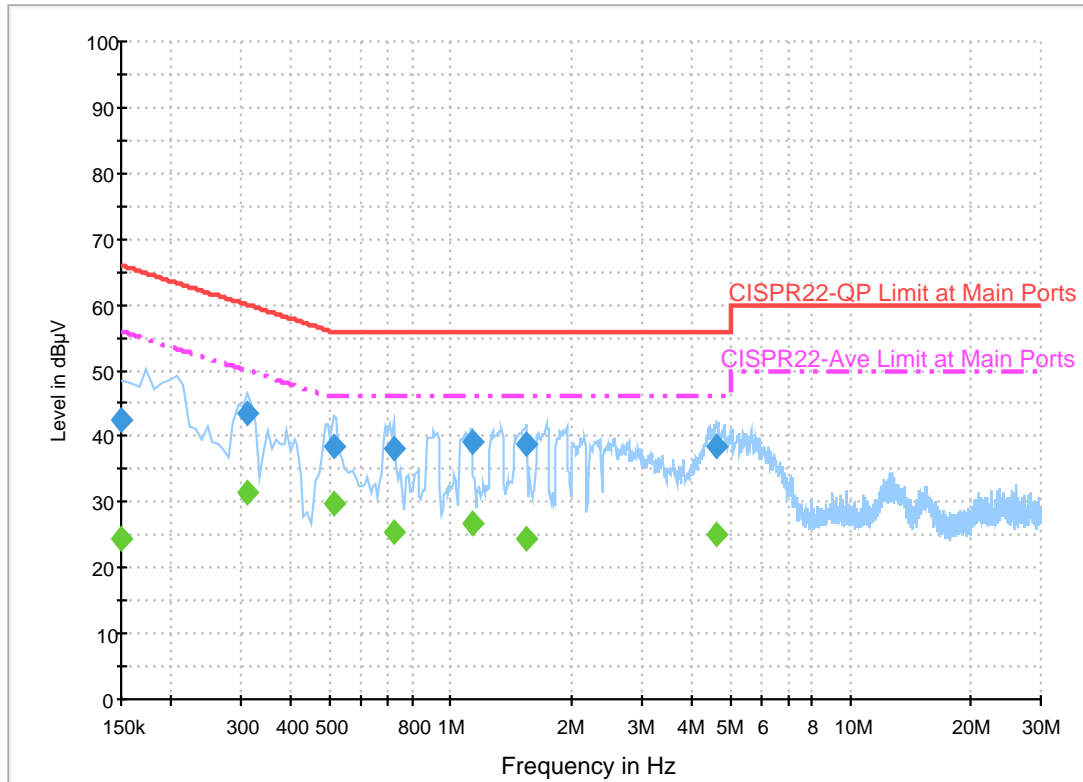
## Final Result 2

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	24.4	Off	L1	19.6	31.6	56.0
0.310000	31.1	Off	L1	19.5	18.9	50.0
0.486000	25.9	Off	L1	19.5	20.3	46.2
0.686000	24.0	Off	L1	19.5	22.0	46.0
4.350000	25.8	Off	L1	19.6	20.2	46.0
4.510000	27.1	Off	L1	19.6	18.9	46.0
4.694000	25.6	Off	L1	19.6	20.4	46.0
13.814000	20.6	Off	L1	19.7	29.4	50.0

# EUT Information

Report NO : 690221-01  
 Test Mode : Mode 1  
 Test Voltage : 120Vac/60Hz  
 Phase : Neutral

ENV216 Auto Test-N



## Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	42.5	Off	N	19.5	23.5	66.0
0.310000	43.6	Off	N	19.5	16.4	60.0
0.510000	38.4	Off	N	19.5	17.6	56.0
0.726000	38.0	Off	N	19.5	18.0	56.0
1.134000	39.1	Off	N	19.5	16.9	56.0
1.550000	38.8	Off	N	19.5	17.2	56.0
4.654000	38.5	Off	N	19.6	17.5	56.0

## Final Result 2

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	24.4	Off	N	19.5	31.6	56.0
0.310000	31.5	Off	N	19.5	18.5	50.0
0.510000	29.7	Off	N	19.5	16.3	46.0
0.726000	25.4	Off	N	19.5	20.6	46.0
1.134000	26.9	Off	N	19.5	19.1	46.0
1.550000	24.3	Off	N	19.5	21.7	46.0
4.654000	25.2	Off	N	19.6	20.8	46.0



## Appendix C. Radiated Spurious Emission

Test Engineer :	Jesse Wang and James Chiu	Temperature :	23~24°C
		Relative Humidity :	54~55%

### 2.4GHz 2400~2483.5MHz

#### BT (Band Edge @ 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 78 2480MHz	*	2480	95.22	-	-	89.03	32.16	8.3	34.27	200	138	P	H	
	*	2480	70.49	-	-	-	-	-	-	-	-	A	H	
		2483.52	47.98	-26.02	74	41.79	32.16	8.3	34.27	200	138	P	H	
		2483.52	23.25	-30.75	54	-	-	-	-	-	-	A	H	
													H	
													H	
	*	2480	97.28	-	-	91.09	32.16	8.3	34.27	310	274	P	V	
	*	2480	72.55	-	-	-	-	-	-	-	-	-	A	V
		2499.76	47.7	-26.3	74	41.5	32.2	8.3	34.3	310	274	P	V	
		2499.76	22.97	-31.03	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)

Table with 14 columns: 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). Rows include data for BT CH 78 2480MHz and a Remark section.



Emission below 1GHz

2.4GHz BT (LF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
2.4GHz BT LF		82.65	35.69	-4.31	40	51.63	13.53	2.11	31.58	100	77	P	H	
		185.79	34.8	-8.7	43.5	48.84	14.71	2.72	31.47	-	-	P	H	
		291.9	40.72	-5.28	46	49.72	19.03	3.28	31.31	-	-	P	H	
		323.8	39.09	-6.91	46	47.43	19.49	3.43	31.26	-	-	P	H	
		579.3	38.45	-7.55	46	39.62	25.49	4.2	30.86	-	-	P	H	
		815.2	35.39	-10.61	46	33.07	27.92	4.98	30.58	-	-	P	H	
														H
														H
														H
														H
														H
														H
			82.38	30.79	-9.21	40	46.73	13.53	2.11	31.58	-	-	P	V
			186.33	25.64	-17.86	43.5	39.68	14.71	2.72	31.47	-	-	P	V
			298.92	27.74	-18.26	46	36.56	19.2	3.28	31.3	-	-	P	V
			454	35.49	-10.51	46	39.59	23.07	3.88	31.05	-	-	P	V
			575.8	36.92	-9.08	46	38.02	25.57	4.2	30.87	100	114	P	V
			952.4	35.17	-10.83	46	29.66	30.62	5.4	30.51	-	-	P	V
														V
														V
													V	
													V	
													V	
Remark	1. No other spurious found. 2. All results are PASS against limit line.													



**Note symbol**

*	<b>Fundamental Frequency</b> which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is <b>over limit</b> line.
P/A	<b>Peak</b> or <b>Average</b>
H/V	<b>Horizontal</b> or <b>Vertical</b>



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

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

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

**For Peak Limit @ 2390MHz:**

- 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)
- Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 55.45(dBμV/m) – 74(dBμV/m)  
= -18.55(dB)

**For Average Limit @ 2390MHz:**

- 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)
- 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 D. Radiated Spurious Emission Plots

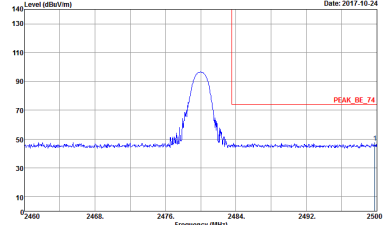
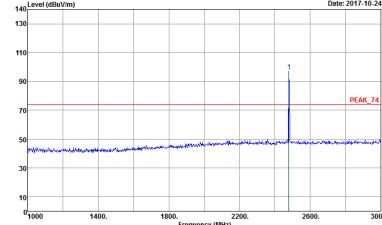
Test Engineer :	Jesse Wang and James Chiu	Temperature :	23~24°C
		Relative Humidity :	54~55%

### 2.4GHz 2400~2483.5MHz

### BT (Band Edge @ 3m)

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
1	Horizontal	Fundamental
Peak	<p>Site : 03CH07-HY            Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 690221-01            Mode : 1</p>	<p>Site : 03CH07-HY            Condition : PEAK_74 3m HF_ANT_00075962 HORIZONTAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 690221-01            Mode : 1</p>

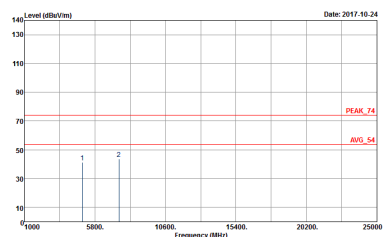
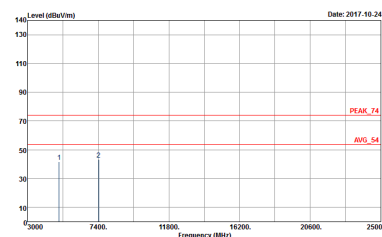


BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
1	Vertical	Fundamental
Peak	 <p>           Site : 03CH07-HY            Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 690221-01            Mode : 1         </p>	 <p>           Site : 03CH07-HY            Condition : PEAK_74 3m HF_ANT_00075962 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 690221-01            Mode : 1         </p>



2.4GHz 2400~2483.5MHz

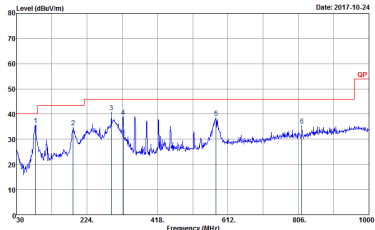
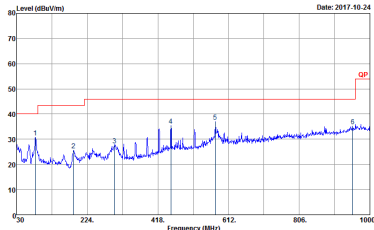
BT (Harmonic @ 3m)

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BT CH78 2480MHz	
1	Horizontal	Vertical
<p>Peak Avg.</p>	 <p>Site : 03CH07-11Y Condition : PEAK_74 3m SHF-EHF_131029 HORIZONTAL Detector : Peak Project : 690221-01 Mode : 1</p>	 <p>Site : 03CH07-11Y Condition : PEAK_74 3m SHF-EHF_131029 VERTICAL Detector : Peak Project : 690221-01 Mode : 1</p>



Emission below 1GHz

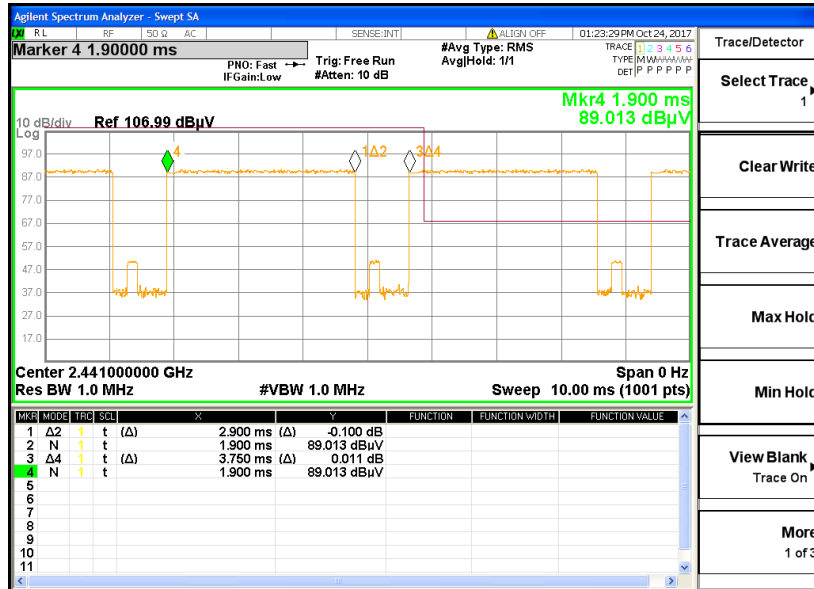
2.4GHz BT (LF)

BT	2.4GHz 2400~2483.5MHz	
ANT	BT LF	
1	Horizontal	Vertical
QP / Peak	 <p>Site : 03CH07-4#Y Condition : QP 3m LF-ANT-35419(6) HORIZONTAL Detector : Peak Project : 690221-01 Mode : 2</p>	 <p>Site : 03CH07-4#Y Condition : QP 3m LF-ANT-35419(6) VERTICAL Detector : Peak Project : 690221-01 Mode : 2</p>

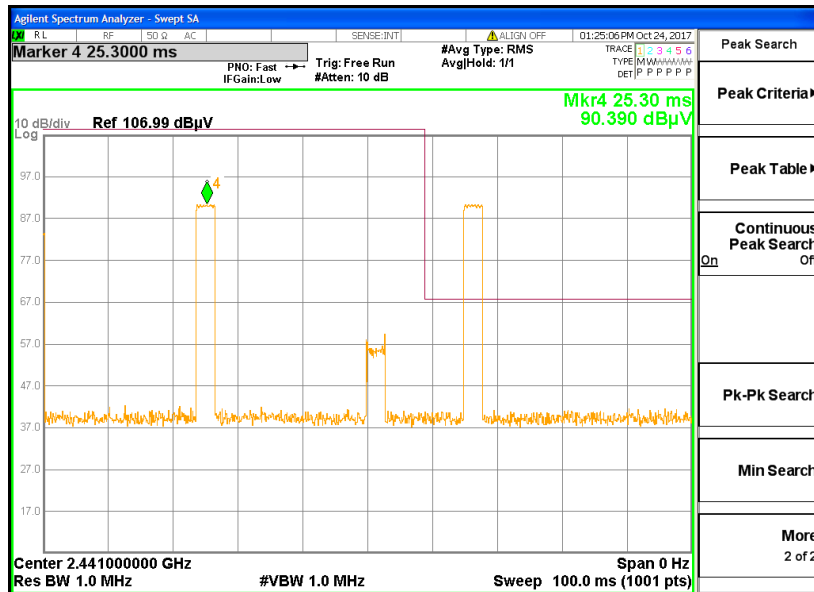


# Appendix E. Duty Cycle Plots

DH5 on time (One Pulse) Plot on Channel 39



on time (Count Pulses) Plot on Channel 39



**Note:**

1. Worst case Duty cycle = on time/100 milliseconds =  $2 * 2.90 / 100 = 5.8 \%$
2. Worst case Duty cycle correction factor =  $20 * \log(\text{Duty cycle}) = -24.73 \text{ dB}$
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

$$2.90 \text{ ms} \times 20 \text{ channels} = 58 \text{ ms}$$

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.  $[100\text{ms} / 57.6\text{ms}] = 2$  hops

Thus, the maximum possible ON time:

$$2.90 \text{ ms} \times 2 = 5.8 \text{ ms}$$

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

$$20 \times \log(5.8 \text{ ms}/100\text{ms}) = -24.73 \text{ dB}$$