



# FCC RADIO TEST REPORT

**FCC ID** : S9GR550  
**Equipment** : Wireless Access Point  
**Brand Name** : Ruckus  
**Model Name** : R550  
**Applicant** : Ruckus Wireless Inc.  
350 W. Java Dr., Sunnyvale CA 94089 USA  
**Manufacturer** : Ruckus Wireless Inc.  
350 W. Java Dr., Sunnyvale CA 94089 USA  
**Standard** : FCC Part 15 Subpart C §15.247

The product was received on Mar. 20, 2020 and testing was started from Mar. 25, 2020 and completed on Apr. 06, 2020. We, SPORTON INTERNATIONAL INC., EMC & Wireless Communications Laboratory, 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 report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this partial report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

*Louis Wu*

Approved by: Louis Wu

**SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory**

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



## Table of Contents

<b>History of this test report.....</b>	<b>3</b>
<b>Summary of Test Result.....</b>	<b>4</b>
<b>1 General Description.....</b>	<b>5</b>
1.1 Product Feature of Equipment Under Test.....	5
1.2 Modification of EUT .....	5
1.3 Testing Location .....	5
1.4 Applicable Standards.....	6
<b>2 Test Configuration of Equipment Under Test .....</b>	<b>7</b>
2.1 Carrier Frequency Channel .....	7
2.2 Test Mode.....	8
2.3 Connection Diagram of Test System.....	8
2.4 Support Unit used in test configuration and system .....	9
2.5 EUT Operation Test Setup .....	9
2.6 Measurement Results Explanation Example.....	9
<b>3 Test Result.....</b>	<b>10</b>
3.1 6dB and 99% Bandwidth Measurement .....	10
3.2 Output Power Measurement.....	14
3.3 Power Spectral Density Measurement .....	15
3.4 Conducted Band Edges and Spurious Emission Measurement .....	19
3.5 Radiated Band Edges and Spurious Emission Measurement .....	24
3.6 Antenna Requirements .....	28
<b>4 List of Measuring Equipment .....</b>	<b>29</b>
<b>5 Uncertainty of Evaluation.....</b>	<b>31</b>
<b>Appendix A. Conducted Test Results</b>	
<b>Appendix B. Conducted Spurious Emission</b>	
<b>Appendix C. Conducted Spurious Emission Plots</b>	
<b>Appendix D. Cabinet Radiated Spurious Emission</b>	
<b>Appendix E. Cabinet Radiated Spurious Emission Plots</b>	
<b>Appendix F. Duty Cycle Plots</b>	
<b>Appendix G. Setup Photographs</b>	



**History of this test report**

<b>Report No.</b>	<b>Version</b>	<b>Description</b>	<b>Issued Date</b>
FR021504A	01	Initial issue of report	Apr. 09, 2020
FR021504A	02	Revise Antenna information in section 1.1	Apr. 16, 2020



## Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)(3)	Peak Output Power	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	Pass	Under limit 2.69 dB at 7320.000 MHz
3.6	15.203 & 15.247(b)	Antenna Requirement	Pass	-

**Declaration of Conformity:**

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

**Comments and Explanations:**

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

**Reviewed by: Wii Chang**

**Report Producer: Yimin Ho**



# 1 General Description

## 1.1 Product Feature of Equipment Under Test

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

Product Specification subjective to this standard	
Antenna Type	WLAN: <Ant. 1> Internal Antenna <Ant. 2> Internal Antenna Bluetooth: Metal Antenna Zigbee: Metal Antenna

## 1.2 Modification of EUT

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

## 1.3 Testing Location

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	<b>Sporton Site No.</b> TH05-HY

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

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
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.	<b>Sporton Site No.</b> 03CH16-HY

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

FCC designation No.: TW1190 and TW0007



## **1.4 Applicable Standards**

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

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01
- ♦ ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



## 2 Test Configuration of Equipment Under Test

### 2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
20	2442	-	-	

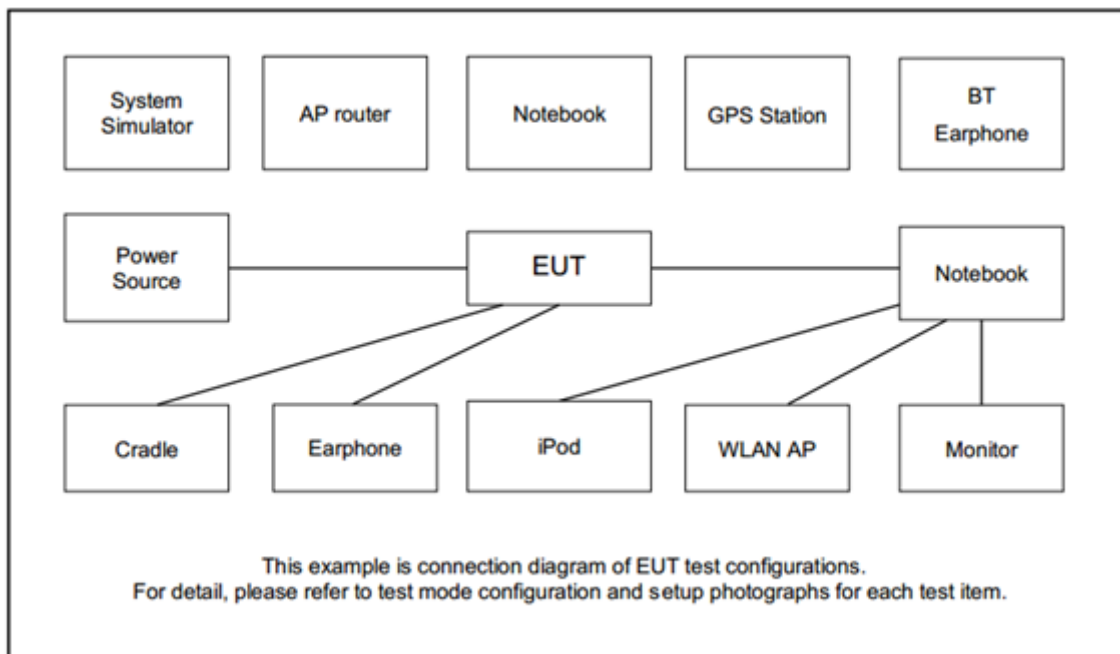
## 2.2 Test Mode

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: 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 (Z plane) were recorded in this report.

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

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth – LE / GFSK
<b>Conducted Test Cases</b>	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
<b>Radiated Test Cases</b>	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps

## 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.	POE Injector	Ruckus	740-64214-001	N/A	Unshielded, 1m	Unshielded, 0.5m

## 2.5 EUT Operation Test Setup

The RF test items, utility “Putty v0.6” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

## 2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

*Offset = RF cable loss + attenuator factor.*

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

$$\begin{aligned} \text{Offset}(dB) &= \text{RF cable loss}(dB) + \text{attenuator factor}(dB). \\ &= 4.2 + 10 = 14.2 \text{ (dB)} \end{aligned}$$

### 3 Test Result

#### 3.1 6dB and 99% Bandwidth Measurement

##### 3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

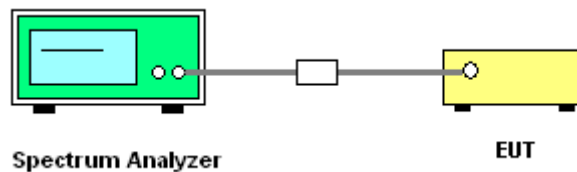
##### 3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

##### 3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW)  $\geq 3 * RBW$ .
6. Measure and record the results in the test report.

##### 3.1.4 Test Setup

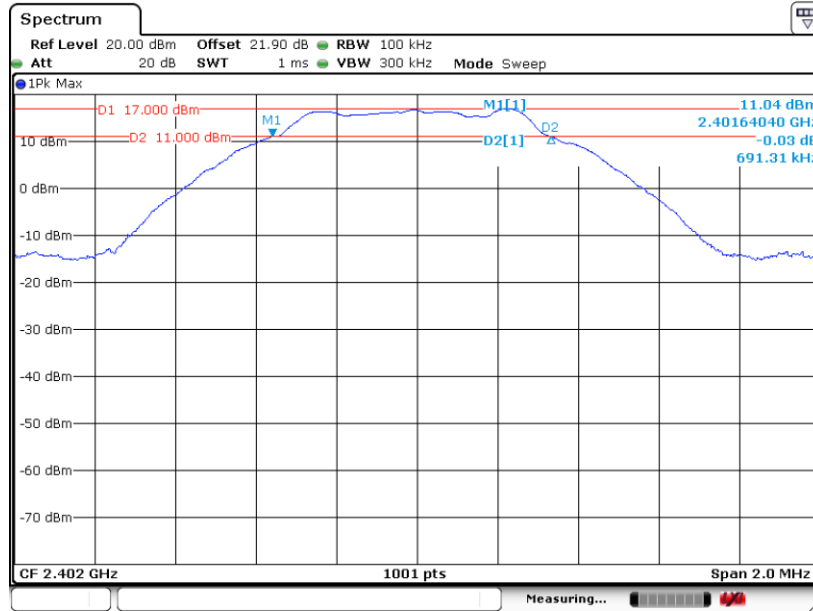




### 3.1.5 Test Result of 6dB Bandwidth

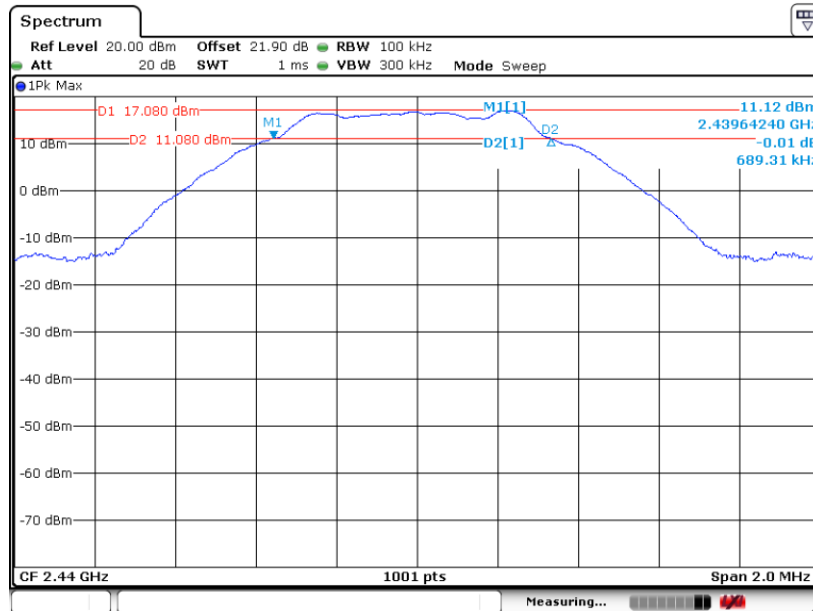
Please refer to Appendix A.

6 dB Bandwidth Plot on Channel 00



Date: 7.APR.2020 00:37:09

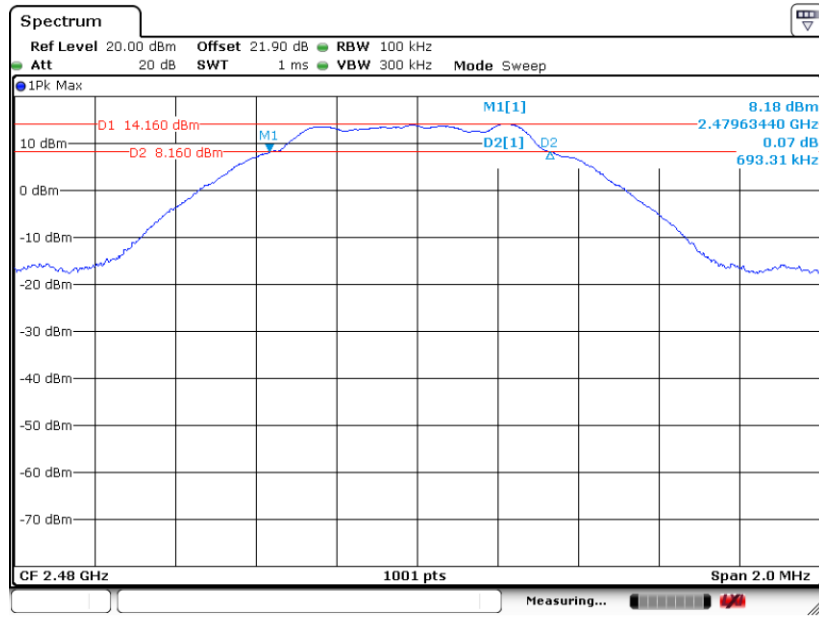
6 dB Bandwidth Plot on Channel 19



Date: 7.APR.2020 01:00:19



6 dB Bandwidth Plot on Channel 39

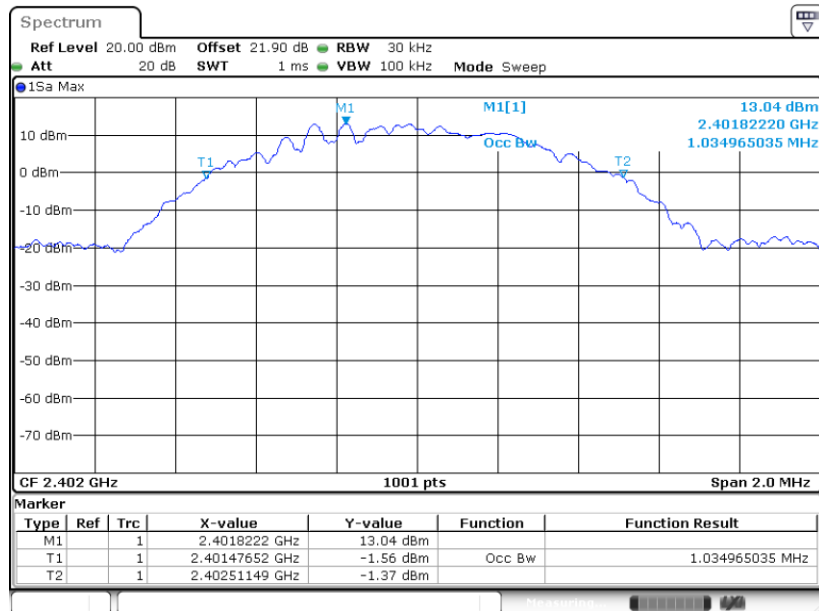


Date: 7.APR.2020 00:44:50

3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

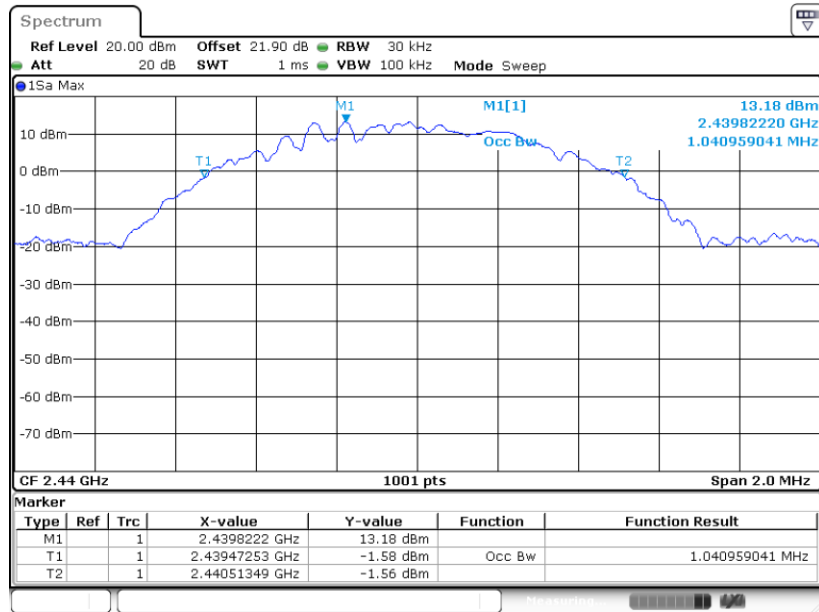
99% Bandwidth Plot on Channel 00



Date: 7.APR.2020 00:36:36

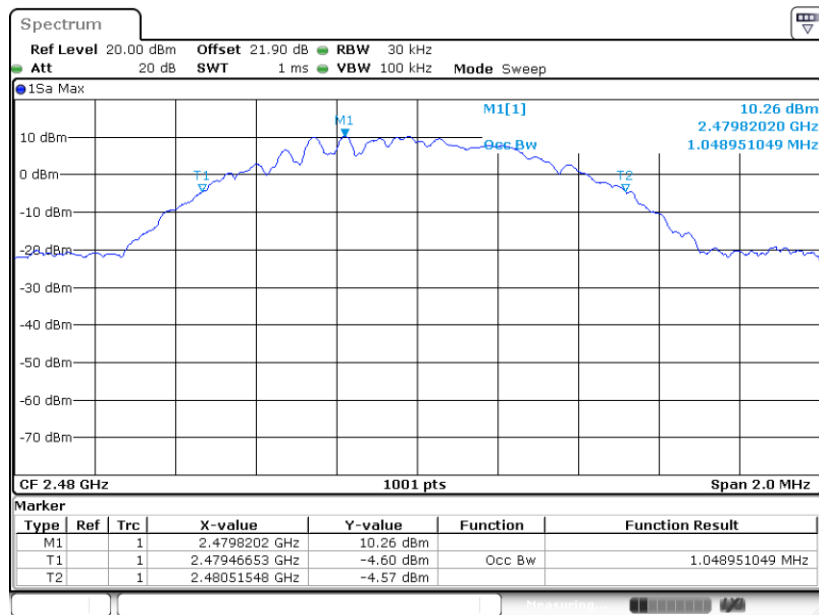


99% Occupied Bandwidth Plot on Channel 19



Date: 7.APR.2020 00:59:36

99% Occupied Bandwidth Plot on Channel 39



Date: 7.APR.2020 00:44:13

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

## 3.2 Output Power Measurement

### 3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for average output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the average output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

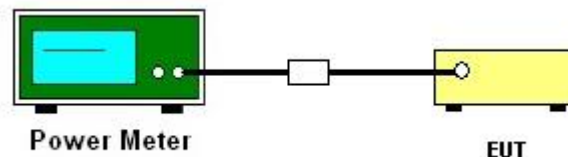
### 3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

### 3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGP-M-G
2. The RF output of EUT was connected to the power meter by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Measure the conducted output power and record the results in the test report.

### 3.2.4 Test Setup



### 3.2.5 Test Result of Average Output Power

Please refer to Appendix A.

### 3.3 Power Spectral Density Measurement

#### 3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

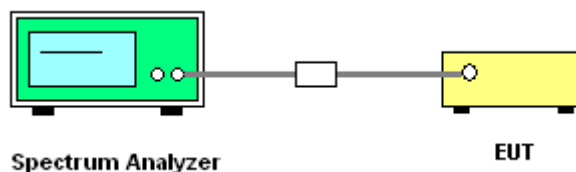
#### 3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

#### 3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 30dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

#### 3.3.4 Test Setup



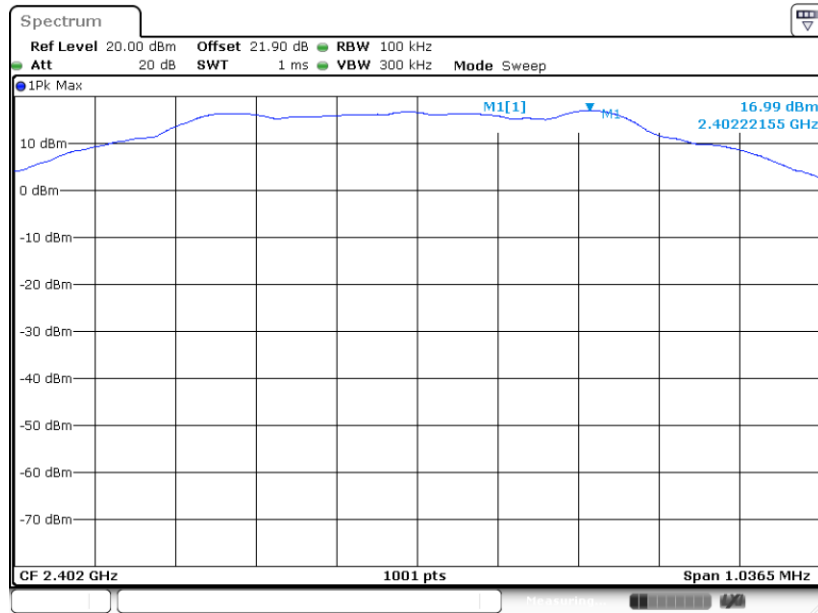
#### 3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.



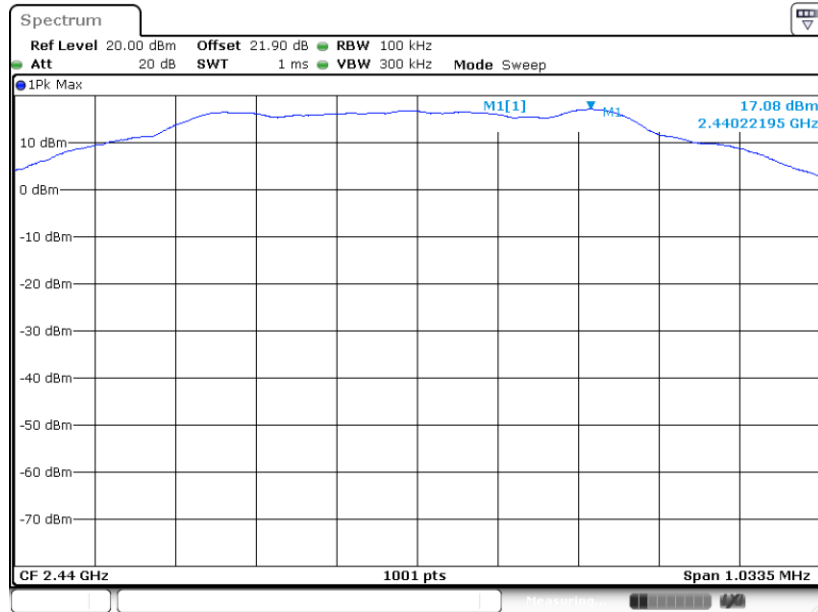
### 3.3.6 Test Result of Power Spectral Density Plots (100kHz)

PSD 100kHz Plot on Channel 00



Date: 7.APR.2020 00:40:06

PSD 100kHz Plot on Channel 19

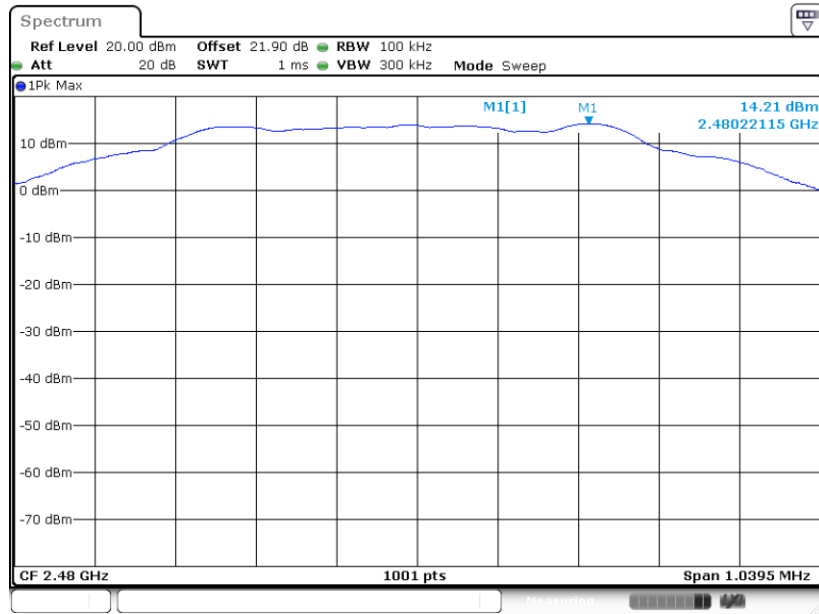


Date: 7.APR.2020 01:00:52





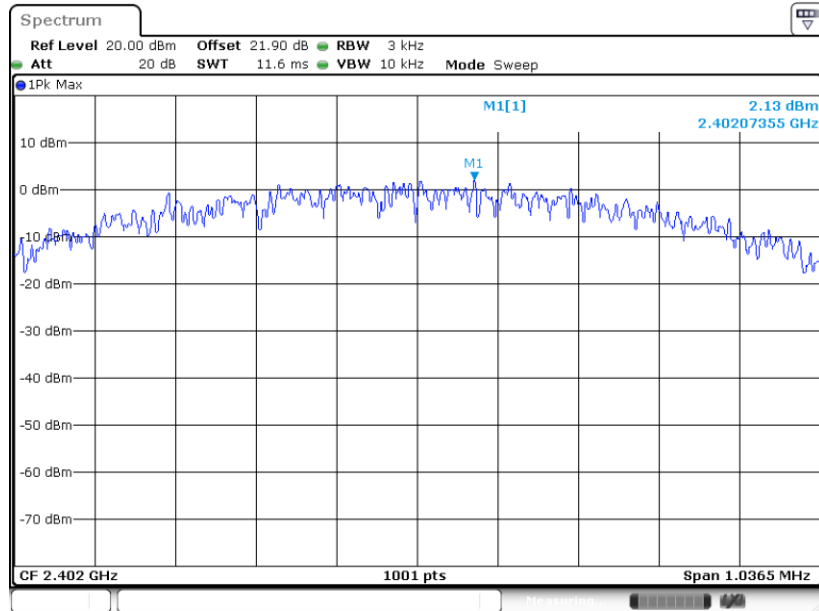
PSD 100kHz Plot on Channel 39



Date: 7.APR.2020 00:52:57

3.3.7 Test Result of Power Spectral Density Plots (3kHz)

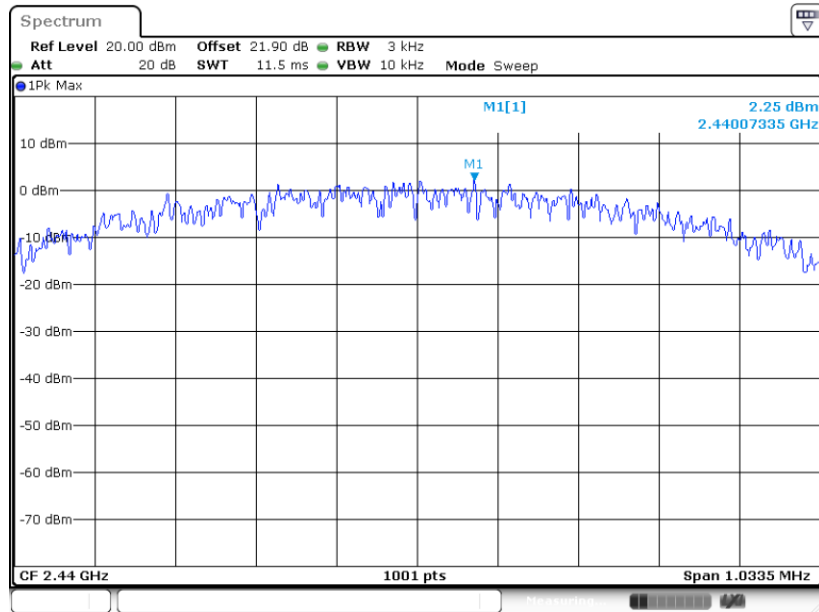
PSD 3kHz Plot on Channel 00



Date: 7.APR.2020 00:38:48

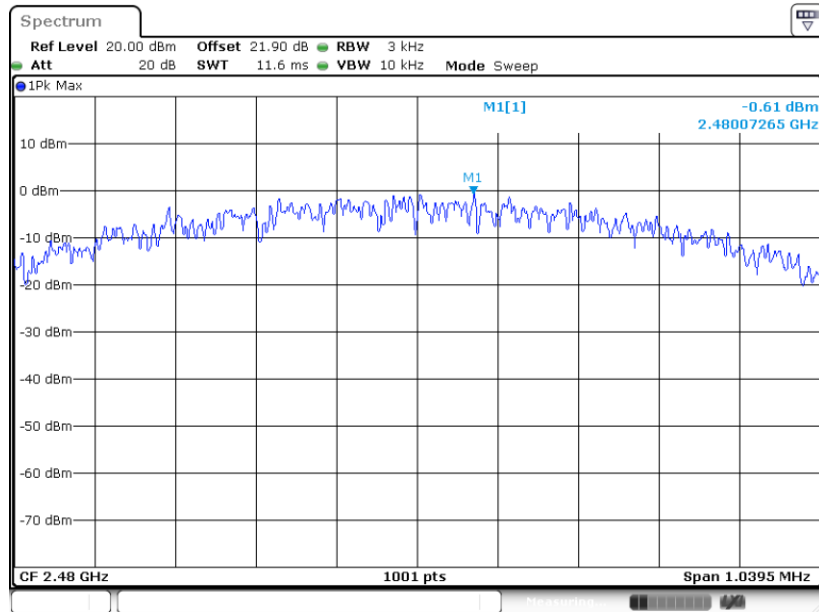


PSD 3kHz Plot on Channel 19



Date: 7.APR.2020 01:00:39

PSD 3kHz Plot on Channel 39



Date: 7.APR.2020 00:52:03

## 3.4 Conducted Band Edges and Spurious Emission Measurement

### 3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 30 dB down from the highest emission level within the authorized band.

### 3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

### 3.4.3 Test Procedure

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

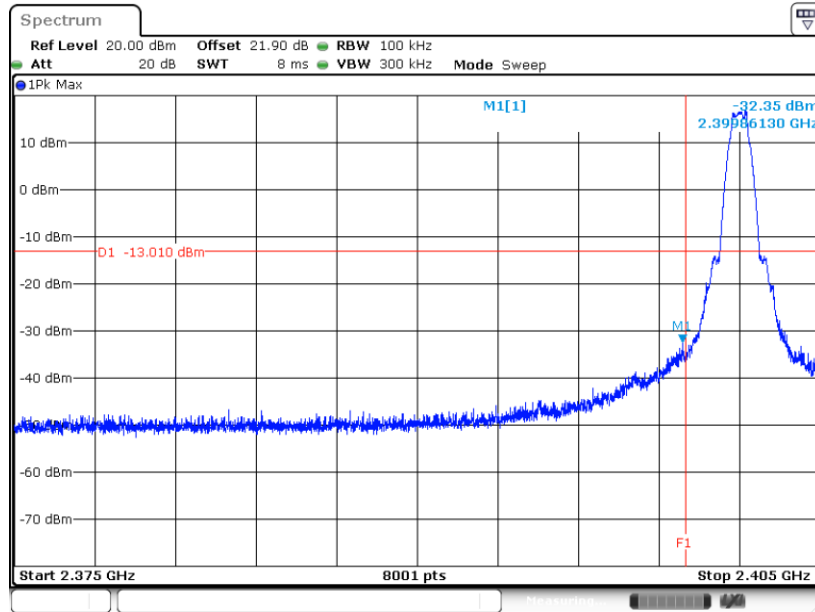
### 3.4.4 Test Setup



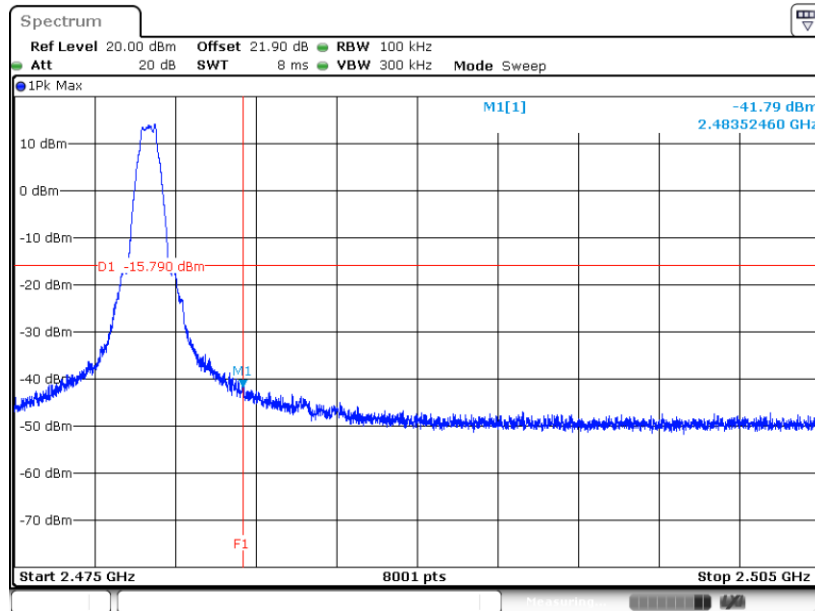


### 3.4.5 Test Result of Conducted Band Edges Plots

#### Low Band Edge Plot on Channel 00



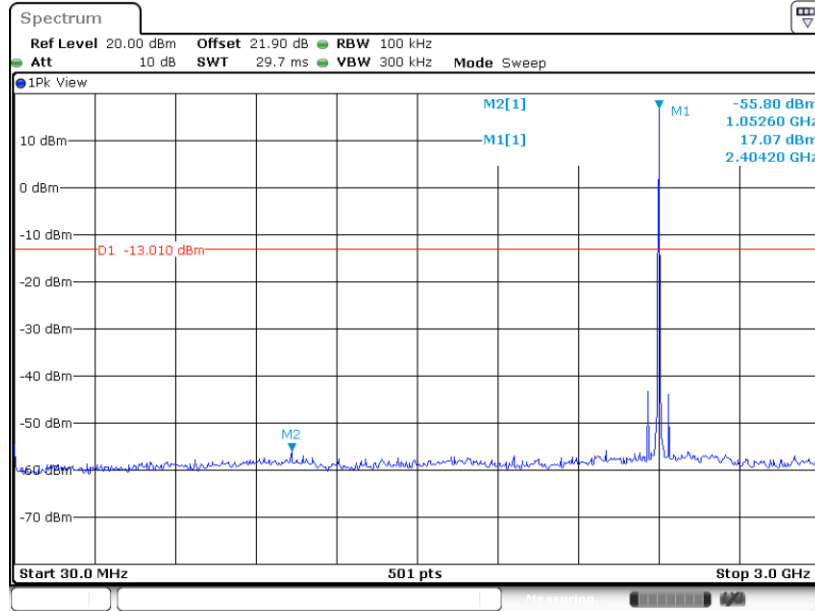
#### High Band Edge Plot on Channel 39



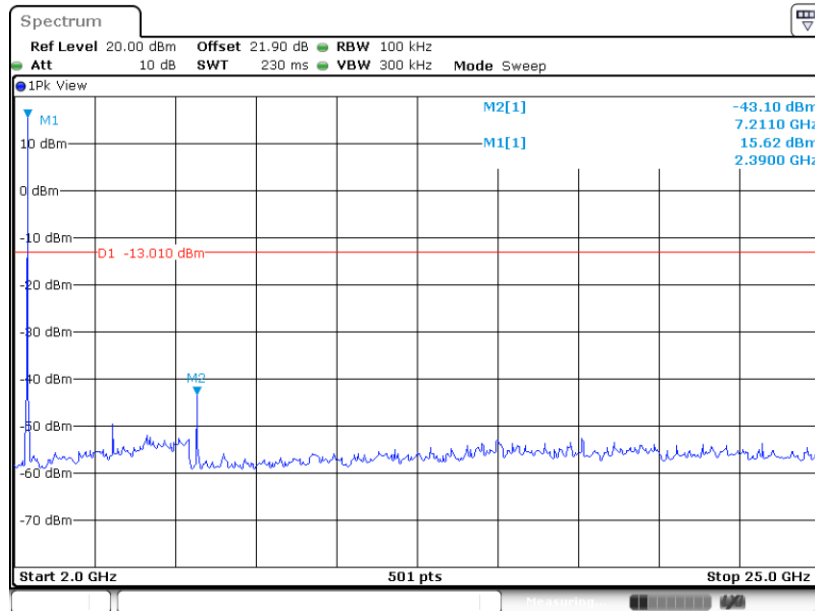


### 3.4.6 Test Result of Conducted Spurious Emission Plots

#### Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 00

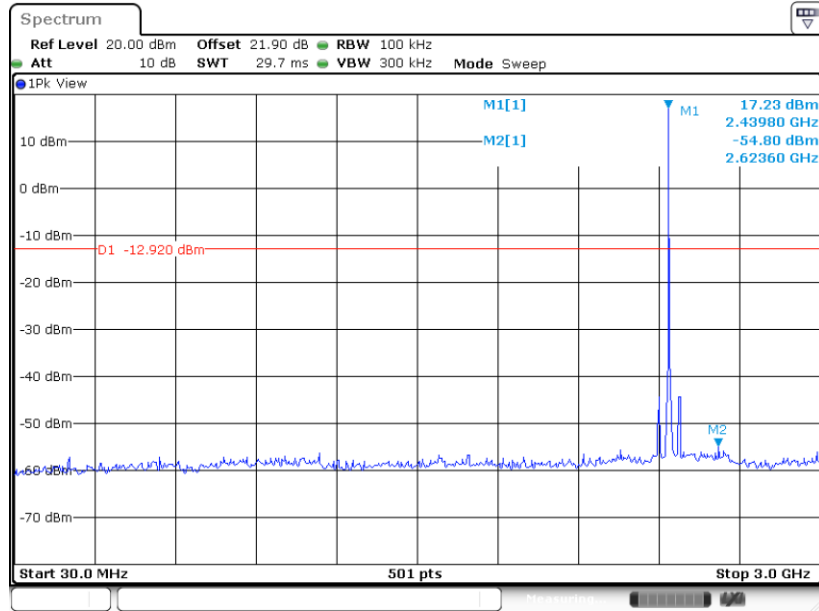


#### Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 00



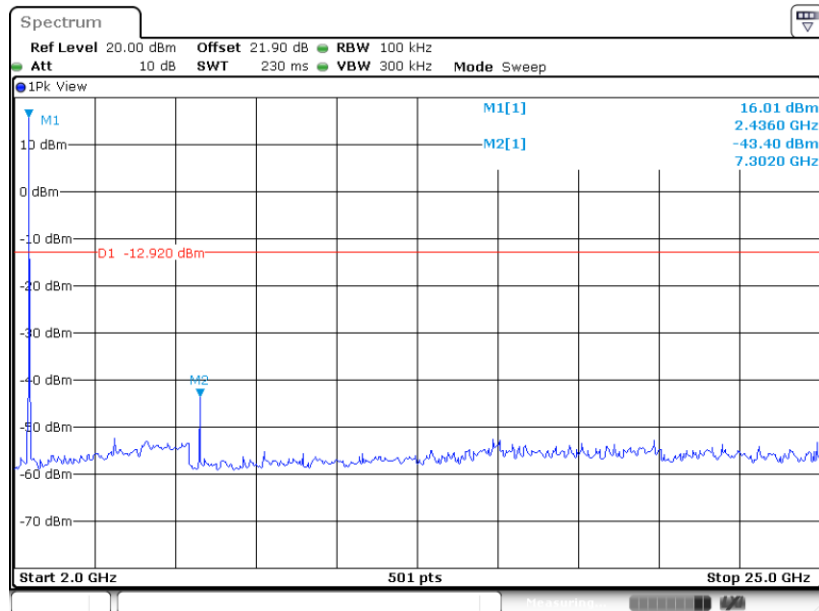


### Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



Date: 7.APR.2020 01:03:24

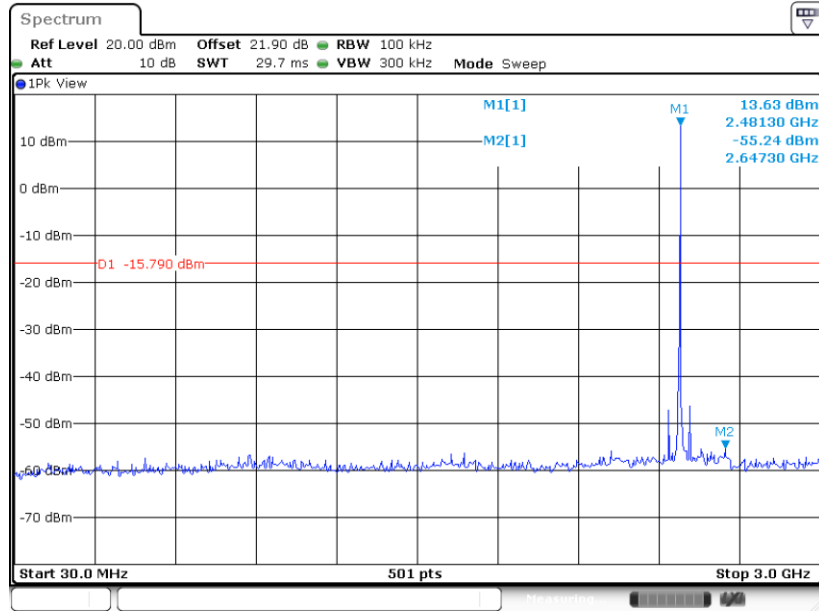
### Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



Date: 7.APR.2020 01:03:35

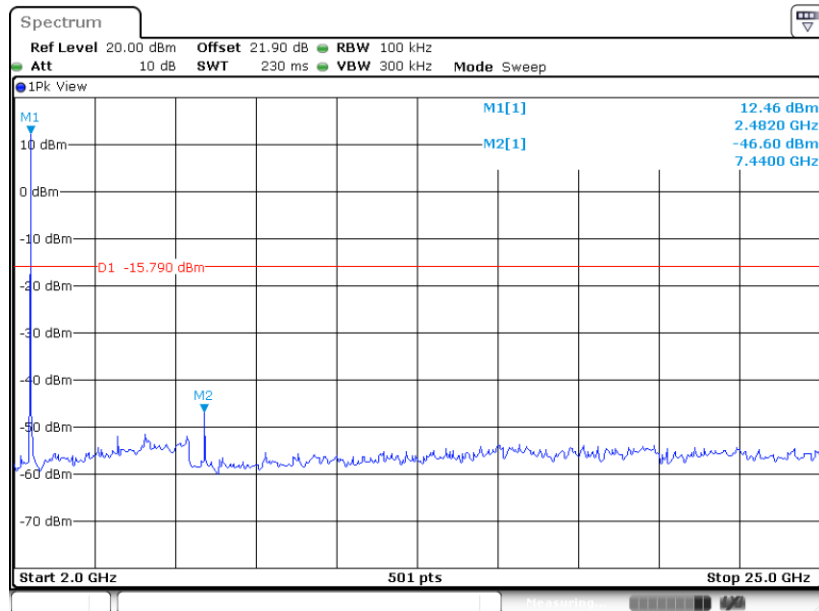


### Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39



Date: 7.APR.2020 00:56:57

### Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39



Date: 7.APR.2020 00:57:35



### 3.5 Radiated Band Edges and Spurious Emission Measurement

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

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

#### 3.5.2 Measuring Instruments

See list of measuring equipment of this test report.

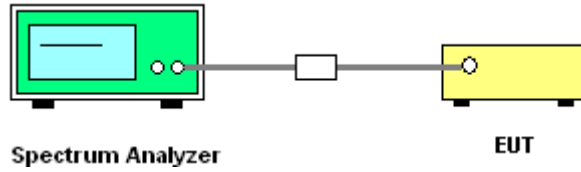


**3.5.3 Test Procedures**

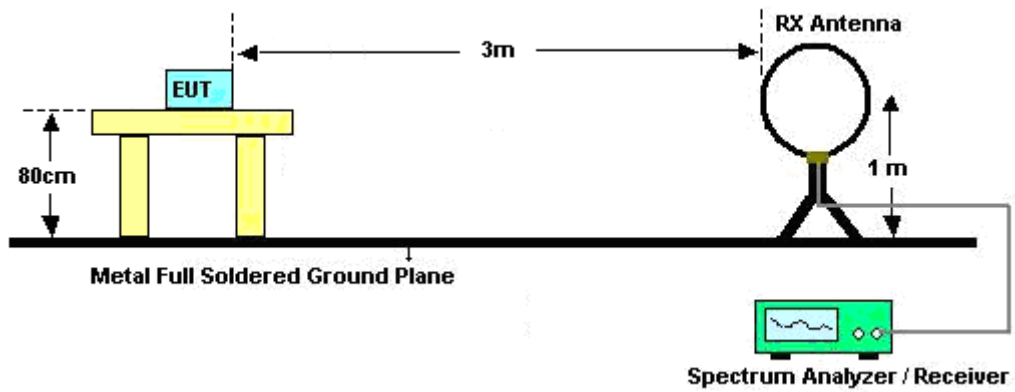
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for  $f < 1$  GHz;  $VBW \geq RBW$ ; Sweep = auto; Detector function = peak; Trace = max hold;
  - (3) Set RBW = 1 MHz, VBW= 3MHz for  $f \geq 1$  GHz for peak measurement.  
For average measurement:
    - $VBW = 10$  Hz, when duty cycle is no less than 98 percent.
    - $VBW \geq 1/T$ , when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

### 3.5.4 Test Setup

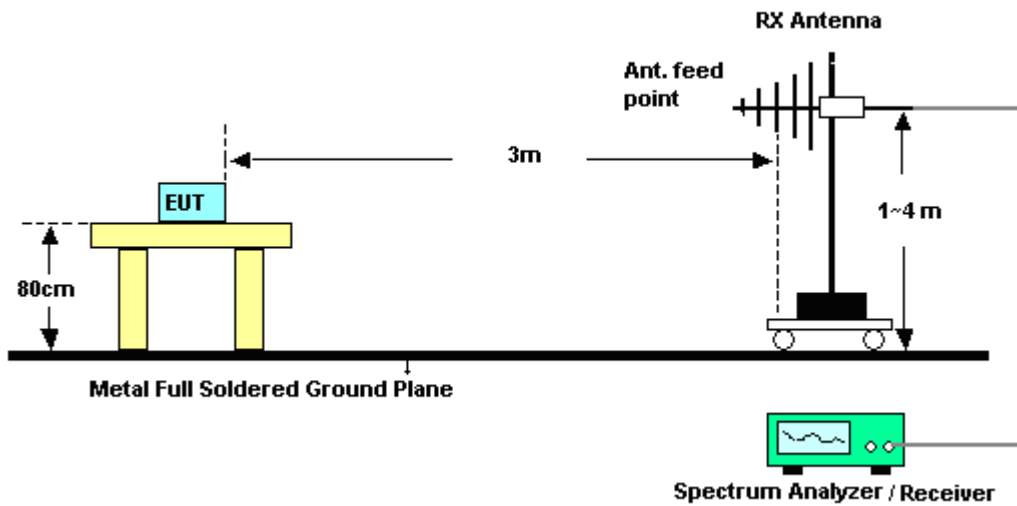
For Conducted Measurement Setup:



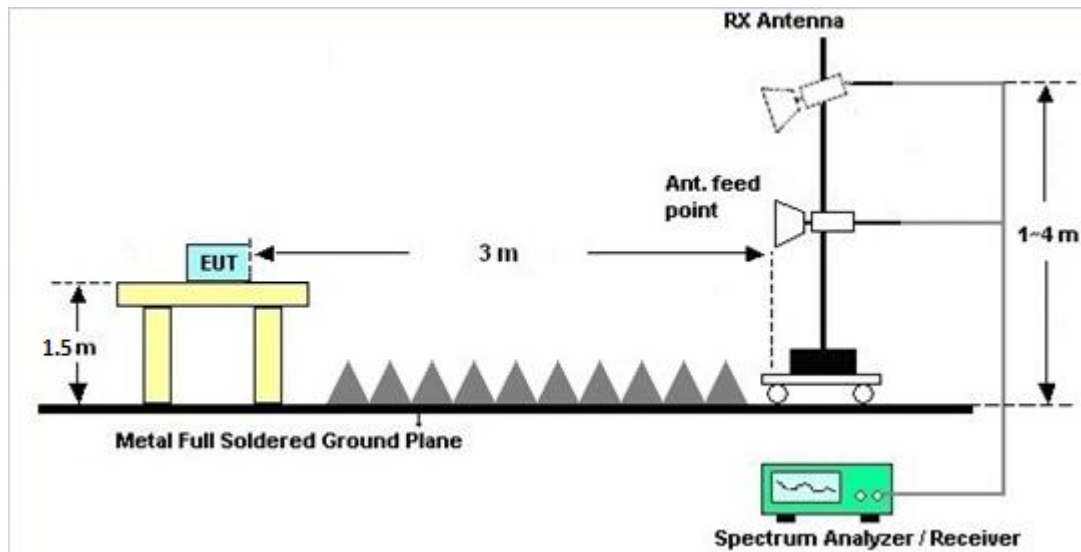
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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

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

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

### 3.5.6 Test Result of Conduced Spurious at Band Edges in the Restricted Band

Please refer to Appendix B and C.

### 3.5.7 Test Result of Conduced Spurious Emission in the Restricted Band

Please refer to Appendix B and C.

### 3.5.8 Test Result of Cabinet Radiated Spurious at Band Edges

Please refer to Appendix D and E.

### 3.5.9 Test Result of Cabinet Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix D and E.

### 3.5.10 Duty Cycle

Please refer to Appendix F.



## **3.6 Antenna Requirements**

### **3.6.1 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.

### **3.6.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

### **3.6.3 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
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Dec. 26, 2019	Mar. 27, 2020~ Mar. 28, 2020	Dec. 25, 2020	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL6111D&0 0802N1D01N- 06	47020&06	30MHz to 1GHz	Oct. 13, 2019	Mar. 27, 2020~ Mar. 28, 2020	Oct. 12, 2020	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-152 2	1G~18GHz	Sep. 19, 2019	Mar. 27, 2020~ Mar. 28, 2020	Sep. 18, 2020	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA9170 576	18GHz~40GHz	May 14, 2019	Mar. 27, 2020~ Mar. 28, 2020	May 13, 2020	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1000MHz	Oct. 01, 2019	Mar. 27, 2020~ Mar. 28, 2020	Sep. 30, 2020	Radiation (03CH16-HY)
Preamplifier	Jet-Power	JPA0118-55-3 03	171000180 0055007	1GHz~18GHz	Apr. 01, 2019	Mar. 27, 2020~ Mar. 28, 2020	Mar. 31, 2020	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY532702 64	1GHz~26.5GHz	Dec. 11, 2019	Mar. 27, 2020~ Mar. 28, 2020	Dec.10, 2020	Radiation (03CH16-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz~40GHz	Dec.13, 2019	Mar. 27, 2020~ Mar. 28, 2020	Dec.12, 2020	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A (MXE)	MY572901 11	3Hz~26.5GHz	Dec. 05, 2019	Mar. 27, 2020~ Mar. 28, 2020	Dec. 04, 2020	Radiation (03CH16-HY)
Spectrum Analyzer	Agilent	E4446A	MY501801 36	3Hz~44GHz	Apr. 29, 2019	Mar. 27, 2020~ Mar. 28, 2020	Apr. 28, 2020	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11680/ 4PE	NA	Aug. 30, 2019	Mar. 27, 2020~ Mar. 28, 2020	Aug. 29, 2020	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11688/ 4PE	NA	Aug. 30, 2019	Mar. 27, 2020~ Mar. 28, 2020	Aug. 29, 2020	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300 -5757	NA	Aug. 30, 2019	Mar. 27, 2020~ Mar. 28, 2020	Aug. 29, 2020	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30MHz~40GHz	Feb. 25, 2020	Mar. 27, 2020~ Mar. 28, 2020	Feb. 24, 2021	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30MHz~40GHz	Feb. 25, 2020	Mar. 27, 2020~ Mar. 28, 2020	Feb. 24, 2021	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Mar. 27, 2020~ Mar. 28, 2020	N/A	Radiation (03CH16-HY)
Hygrometer	Testo	608-H2	41410069	N/A	Jun. 17, 2019	Apr. 06, 2020	Jun. 16, 2020	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16I00054S NO10	10MHz~6GHz	Dec. 23, 2019	Apr. 06, 2020	Dec. 22, 2020	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Jul. 15, 2019	Apr. 06, 2020	Jul. 14, 2020	Conducted (TH05-HY)
Switch Control Manframe	E-IUSTRUME NT	ETF-1405-0	EC190006 7	N/A	Aug. 15, 2019	Apr. 06, 2020	Aug. 14, 2020	Conducted (TH05-HY)



Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Test Receiver	Keysight	N9038A (MXE)	MY541300 85	20Hz ~ 8.4GHz	Nov. 01, 2019	Mar. 25, 2020~ Apr. 01, 2020	Oct. 31, 2020	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Jul. 15, 2019	Mar. 25, 2020~ Apr. 01, 2020	Jul. 14, 2020	Conducted (TH05-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9838/4 PE	30M-18G	Apr. 15, 2019	Mar. 25, 2020~ Apr. 01, 2020	Apr. 14, 2020	Conducted (TH05-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY802430 /4	30M~18GHz	May 13, 2019	Mar. 25, 2020~ Apr. 01, 2020	May 12, 2020	Conducted (TH05-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2859/2	30MHz-40GHz	Mar. 12, 2020	Mar. 25, 2020~ Apr. 01, 2020	Mar. 11, 2021	Conducted (TH05-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY4274/2	30MHz-40GHz	Mar. 12, 2020	Mar. 25, 2020~ Apr. 01, 2020	Mar. 11, 2021	Conducted (TH05-HY)
Filter	Wainwright	WLK4-1000-1 530-8000-40S S	SN11	1G Low Pass	Sep. 15, 2019	Mar. 25, 2020~ Apr. 01, 2020	Sep. 14, 2020	Conducted (TH05-HY)
Filter	Wainwright	WHKX12-270 0-3000-18000 -60ST	SN1	3 GHz Highpass	Sep. 15, 2019	Mar. 25, 2020~ Apr. 01, 2020	Sep. 14, 2020	Conducted (TH05-HY)



## 5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.9
---	-----

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	6.7
---	-----

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	3.9
---	-----

**Appendix A. Test Result of Conducted Test Items**

Test Engineer:	Kai Liao	Temperature:	21~25	°C
Test Date:	2020/4/6	Relative Humidity:	51~54	%

**TEST RESULTS DATA**  
**6dB and 99% Occupied Bandwidth**

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.035	691.310	0.50	Pass
BLE	1Mbps	1	19	2440	1.041	689.310	0.50	Pass
BLE	1Mbps	1	39	2480	1.049	693.310	0.50	Pass

**TEST RESULTS DATA**  
**Average Power Table**

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	18.20	30.00	1.00	19.20	36.00	Pass
BLE	1Mbps	1	19	2440	18.60	30.00	1.00	19.60	36.00	Pass
BLE	1Mbps	1	39	2480	15.40	30.00	1.00	16.40	36.00	Pass

**TEST RESULTS DATA**  
**Peak Power Density**

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	1Mbps	1	0	2402	16.99	2.13	1.00	8.00	Pass
BLE	1Mbps	1	19	2440	17.08	2.25	1.00	8.00	Pass
BLE	1Mbps	1	39	2480	14.21	-0.61	1.00	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.





## Appendix B. Conducted Spurious Emission

Test Engineer :	Kai Liao	Temperature :	21~25°C
		Relative Humidity :	51~54%

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ Conducted)

BLE	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Aux Factor	Aux2 Factor	Peak Avg.
		( MHz )	( dBm )	( dB )	( dBm )	( dBm )	( dBi )	( dB )	( dB )	( dB )	( P/A )
BLE CH 00 2402MHz		2363.445	-37.57	-16.37	-21.2	-42.24	2	2.04	0.63	0	P
		2363.55	-42.19	-0.99	-41.2	-46.86	2	2.04	0.63	0	A
	*	2402	20.40	-	-	15.72	2	2.06	0.64	0	P
	*	2402	19.63	-	-	14.93	2	2.06	0.64	0	A
BLE CH 19 2440MHz		2374.54	-43.26	-22.06	-21.2	-47.96	2	2.06	0.64	0	P
		2363.06	-56.57	-15.37	-41.2	-61.24	2	2.04	0.63	0	A
	*	2440	20.19	-	-	15.46	2	2.08	0.65	0	P
	*	2440	19.69	-	-	14.96	2	2.08	0.65	0	A
		2499.65	-42.52	-21.32	-21.2	-47.3	2	2.11	0.67	0	P
		2483.48	-56.42	-15.22	-41.2	-61.19	2	2.1	0.67	0	A
BLE CH 39 2480MHz	*	2480	18.45	-	-	13.69	2	2.1	0.66	0	P
	*	2480	17.52	-	-	12.76	2	2.1	0.66	0	A
		2483.5	-29.73	-8.53	-21.2	-34.5	2	2.1	0.67	0	P
		2483.5	-41.48	-0.28	-41.2	-46.25	2	2.1	0.67	0	A
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.										



**2.4GHz 2400~2483.5MHz**

**BLE (Harmonic @ Conducted)**

BLE	Note	Frequency ( MHz )	Level ( dBm )	Over Limit ( dB )	Limit Line ( dBm )	Read Level ( dBm )	Antenna Factor ( dBi )	Cable Loss ( dB )	Aux Factor ( dB )	Aux2 Factor ( dB )	Peak Avg. (P/A)
<b>BLE CH 00 2402MHz</b>		4804	-44.94	-23.74	-21.2	-51.52	2	3.03	0.53	1.02	P
		4804	-47.4	-6.2	-41.2	-53.98	2	3.03	0.53	1.02	A
		7206	-37.4	-16.2	-21.2	-44.84	2	3.97	0.39	1.08	P
		7206	-41.81	-0.61	-41.2	-49.25	2	3.97	0.39	1.08	A
<b>BLE CH 19 2440MHz</b>		4880	-40.96	-19.76	-21.2	-47.6	2	3.07	0.52	1.05	P
		4880	-43.13	-1.93	-41.2	-49.77	2	3.07	0.52	1.05	A
		7320	-37.95	-16.75	-21.2	-45.5	2	4.01	0.45	1.09	P
		7320	-42.17	-0.97	-41.2	-49.72	2	4.01	0.45	1.09	A
<b>BLE CH 39 2480MHz</b>		4960	-47.52	-26.32	-21.2	-54.21	2	3.1	0.5	1.09	P
		4960	-50.63	-9.43	-41.2	-57.32	2	3.1	0.5	1.09	A
		7440	-40.68	-19.48	-21.2	-48.33	2	4.07	0.48	1.1	P
		7440	-44.98	-3.78	-41.2	-52.63	2	4.07	0.48	1.1	A
<b>Remark</b>	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.										



Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Aux	Grounding	Peak
				Limit	Line	Level	Factor	Loss	Factor	Factor	Avg.
		( MHz )	( dBm )	( dB )	( dBm )	( dBm )	( dBi )	( dB )	( dB )	( dB )	(P/A)
2.4GHz BLE LF		38.37	-65.67	-10.47	-55.2	-72.76	2	0.24	0.15	4.7	P
		193.89	-78.78	-27.08	-51.7	-86.43	2	0.52	0.43	4.7	P
		298.92	-76.29	-27.09	-49.2	-84.08	2	0.65	0.44	4.7	P
		515.6	-72.01	-22.81	-49.2	-80.13	2	0.86	0.56	4.7	P
		748.7	-69.35	-20.15	-49.2	-77.76	2	1.07	0.64	4.7	P
		974.1	-65.93	-24.73	-41.2	-74.74	2	1.26	0.85	4.7	P
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

- 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 C. Conducted Spurious Emission Plots

Test Engineer :	Kai Liao	Temperature :	21~25°C
		Relative Humidity :	51~54%

Note symbol

-L	Low channel location
-R	High channel location



2.4GHz 2400~2483.5MHz

BLE (Band Edge @ Conducted)

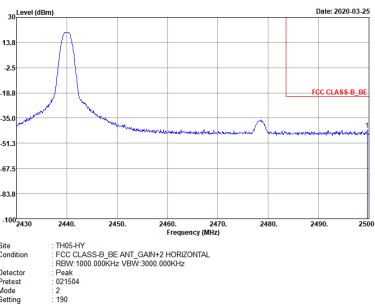
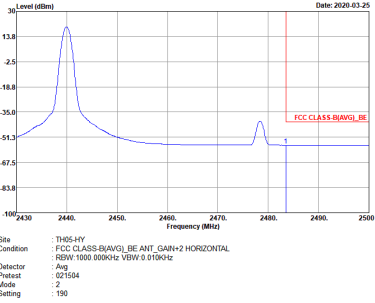
BLE	2.4GHz 2400~2483.5MHz Band Edge @ Conducted	
BLE CH00 2402MHz		
Band Edge - L		Fundamental
<b>Peak</b>	<p>Date: 2020-03-25</p> <p>Site : TH05-HY            Condition : FCC CLASS-B_BE_ANT_GAIN+2 HORIZONTAL            Detector : Peak            Pretest : 021504            Mode : 1            Setting : 190</p>	<p>Date: 2020-03-31</p> <p>Site : TH05-HY            Condition : FCC CLASS-B_CON_ANT_GAIN+2 HORIZONTAL            Detector : Peak            Pretest : 021504            Mode : 1            Setting : 190</p>
<b>Avg.</b>	<p>Date: 2020-03-25</p> <p>Site : TH05-HY            Condition : FCC CLASS-B_AVG_BE_ANT_GAIN+2 HORIZONTAL            Detector : Avg            Pretest : 021504            Mode : 1            Setting : 190</p>	<p>Date: 2020-03-31</p> <p>Site : TH05-HY            Condition : FCC CLASS-B_AVG_CON_ANT_GAIN+2 HORIZONTAL            Detector : Peak            Pretest : 021504            Mode : 1            Setting : 190</p>



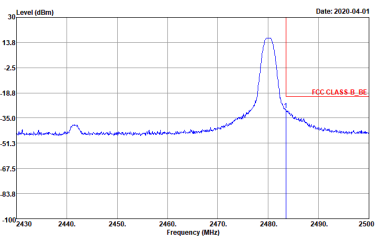
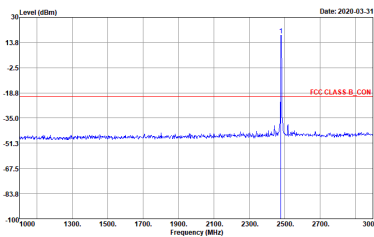
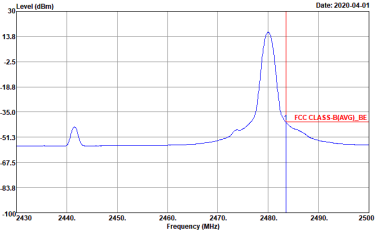
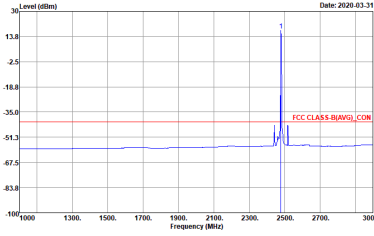
BLE		2.4GHz 2400~2483.5MHz Band Edge @ Conducted	
		BLE CH19 2440MHz	
		Band Edge - L	Fundamental
Peak	<p>Site: TH05-HY            Condition: FCC CLASS-B_BE_ANT_GAIN+2 HORIZONTAL            RBW: 1000 000kHz VSW: 3000 000kHz            Detector: Peak            Pretest: 021504            Mode: 2            Setting: 190</p>	<p>Site: TH05-HY            Condition: FCC CLASS-B_CON_ANT_GAIN+2 HORIZONTAL            RBW: 1000 000kHz VSW: 3000 000kHz            Detector: Peak            Pretest: 021504            Mode: 2            Setting: 190</p>	
Avg.	<p>Site: TH05-HY            Condition: FCC CLASS-B_AVG_BE_ANT_GAIN+2 HORIZONTAL            RBW: 1000 000kHz VSW: 0 010kHz            Detector: Avg            Pretest: 021504            Mode: 2            Setting: 190</p>	<p>Site: TH05-HY            Condition: FCC CLASS-B_AVG_CON_ANT_GAIN+2 HORIZONTAL            RBW: 1000 000kHz VSW: 0 010kHz            Detector: Avg            Pretest: 021504            Mode: 2            Setting: 190</p>	





BLE	2.4GHz 2400~2483.5MHz Band Edge @ Conducted	
BLE CH19 2440MHz - R		
	Band Edge - R	Fundamental
<b>Peak</b>	 <p>Site : TH05-HY Condition : FCC CLASS-B_BE_ANT_GAIN+2 HORIZONTAL Detector : Peak Pretest : 021504 Mode : 2 Setting : 190</p>	Left blank
<b>Avg.</b>	 <p>Site : TH05-HY Condition : FCC CLASS-B(AVG)_BE_ANT_GAIN+2 HORIZONTAL Detector : Avg Pretest : 021504 Mode : 2 Setting : 190</p>	Left blank



BLE	2.4GHz 2400~2483.5MHz Band Edge @ Conducted	
BLE CH39 2480MHz		
Band Edge - R		Fundamental
Peak	 <p>Date: 2020-04-01</p> <p>Site : TH05-HY            Condition : FCC CLASS-B_BE ANT_GAIN+2 HORIZONTAL            Detector : Peak            Pretest : 021504            Mode : 3            Setting : 170</p>	 <p>Date: 2020-03-31</p> <p>Site : TH05-HY            Condition : FCC CLASS-B_CON ANT_GAIN+2 HORIZONTAL            Detector : Peak            Pretest : 021504            Mode : 3            Setting : 170</p>
Avg.	 <p>Date: 2020-04-01</p> <p>Site : TH05-HY            Condition : FCC CLASS-B(AVG)_BE ANT_GAIN+2 HORIZONTAL            Detector : Avg            Pretest : 021504            Mode : 3            Setting : 170</p>	 <p>Date: 2020-03-31</p> <p>Site : TH05-HY            Condition : FCC CLASS-B(AVG)_CON ANT_GAIN+2 HORIZONTAL            Detector : Avg            Pretest : 021504            Mode : 3            Setting : 170</p>

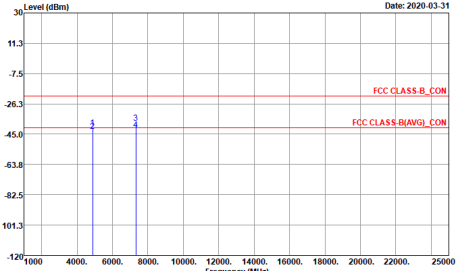


2.4GHz 2400~2483.5MHz

BLE (Harmonic @ Conducted)

BLE	2.4GHz 2400~2483.5MHz Harmonic @ Conducted
	BLE CH00 2402MHz
Peak Avg.	<p>Date: 2020-03-25</p> <p>Site : TH02-HY Condition : FCC CLASS-B_CON ANT_GAIN+2 HORIZONTAL Detector : Peak Pretest : 021504 Mode : 1 Setting : 150</p>



BLE	2.4GHz 2400~2483.5MHz Harmonic @ Conducted
	BLE CH19 2440MHz
Peak Avg.	 <p data-bbox="635 712 901 784">Date: 2020-03-31 Site : TH3C-HY Condition : FCC CLASS-B_CON ANT_GAIN+2 HORIZONTAL Detector : Peak Pretest : 021504 Mode : 2 Setting : 150</p>



BLE	2.4GHz 2400~2483.5MHz Harmonic @ Conducted
	BLE CH39 2480MHz
Peak	<p>The figure is a spectrum plot titled 'Date: 2020-03-25'. The vertical axis is labeled 'Level (dBm)' and ranges from -120 to 36 in increments of 17.3. The horizontal axis is labeled 'Frequency (MHz)' and ranges from 1000 to 25000 in increments of 2000. Two horizontal red lines represent FCC limits: 'FCC CLASS-B_COM' at -26.3 dBm and 'FCC CLASS-BI/WGL_COM' at -45.0 dBm. Two vertical blue lines with arrows point to peaks at approximately 5000 MHz and 7500 MHz, both of which are below the -45.0 dBm limit. A legend at the bottom left of the plot area contains the following text: Site : TH3C-HY Condition : FCC CLASS-B_CON ANT_GAIN+2 HORIZONTAL Detector : Peak Pretest : 021504 Mode : 3 Setting : 170</p>



Emission below 1GHz

2.4GHz BLE (LF)

BLE	2.4GHz 2400~2483.5MHz
	BLE LF
QP / Peak	<p>Level (dBm)</p> <p>Date: 2020-04-01</p> <p>FCC CLASS-B_CON</p> <p>Frequency (MHz)</p> <p>Site : TH05-HY Condition : FCC CLASS-B_CON ANT_GAIN+2 HORIZONTAL Detector : Peak Pretest : 021504 Mode : 4 Setting : 170</p>



## Appendix D. Cabinet Radiated Spurious Emission

Test Engineer :	Andy Yang	Temperature :	20~25°C
		Relative Humidity :	50~60%

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	Limit	Level	Factor	Loss	Factor	Pos	Pos	Avg.		
					Line	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
BLE CH 00 2402MHz		2368.905	56.97	-17.03	74	40.96	27.72	18.06	29.77	172	26	P	H	
		2316.615	44.51	-9.49	54	28.36	27.93	17.97	29.75	172	26	A	H	
	*	2402	89.41	-	-	73.49	27.6	18.11	29.79	172	26	P	H	
	*	2402	88.81	-	-	72.89	27.6	18.11	29.79	172	26	A	H	
													H	
														H
			2356.62	57.88	-16.12	74	41.84	27.77	18.04	29.77	217	312	P	V
			2312.73	44.49	-9.51	54	28.32	27.95	17.97	29.75	217	312	A	V
	*		2402	86.97	-	-	71.05	27.6	18.11	29.79	217	312	P	V
	*		2402	86.3	-	-	70.38	27.6	18.11	29.79	217	312	A	V
														V
													V	
BLE CH 19 2440MHz		2376.64	56.96	-17.04	74	40.98	27.69	18.07	29.78	143	26	P	H	
		2311.54	44.49	-9.51	54	28.33	27.95	17.96	29.75	143	26	A	H	
	*	2440	90.17	-	-	74.2	27.6	18.17	29.8	143	26	P	H	
	*	2440	89.6	-	-	73.63	27.6	18.17	29.8	143	26	A	H	
			2490.34	56.36	-17.64	74	40.42	27.52	18.25	29.83	143	26	P	H
			2487.82	44.56	-9.44	54	28.61	27.52	18.25	29.82	143	26	A	H
			2320.36	57.32	-16.68	74	41.17	27.92	17.98	29.75	211	318	P	V
			2317	44.5	-9.5	54	28.35	27.93	17.97	29.75	211	318	A	V
	*		2440	87.48	-	-	71.51	27.6	18.17	29.8	211	318	P	V
	*		2440	86.83	-	-	70.86	27.6	18.17	29.8	211	318	A	V
			2494.19	56.25	-17.75	74	40.31	27.51	18.26	29.83	211	318	P	V
		2490.97	44.61	-9.39	54	28.66	27.52	18.26	29.83	211	318	A	V	



<b>BLE CH 39 2480MHz</b>	*	2480	87.62	-	-	71.66	27.54	18.24	29.82	157	19	P	H
	*	2480	86.9	-	-	70.94	27.54	18.24	29.82	157	19	A	H
		2489.64	57.4	-16.6	74	41.46	27.52	18.25	29.83	157	19	P	H
		2483.56	44.62	-9.38	54	28.67	27.53	18.24	29.82	157	19	A	H
													H
													H
	*	2480	85.88	-	-	69.92	27.54	18.24	29.82	231	300	P	V
	*	2480	85.18	-	-	69.22	27.54	18.24	29.82	231	300	A	V
		2499.76	57.45	-16.55	74	41.51	27.5	18.27	29.83	231	300	P	V
		2483.56	44.57	-9.43	54	28.62	27.53	18.24	29.82	231	300	A	V
													V
													V
<b>Remark</b>	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												





2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

BLE	Note	Frequency ( MHz )	Level ( dBµV/m )	Over Limit ( dB )	Limit Line ( dBµV/m )	Read Level ( dBµV )	Antenna Factor ( dB/m )	Path Loss ( dB )	Preamp Factor ( dB )	Ant Pos ( cm )	Table Pos ( deg )	Peak Avg. ( P/A )	Pol. ( H/V )
BLE CH 00 2402MHz		4804	37.81	-36.19	74	53.43	31.11	12.43	59.16	400	0	P	H
		7206	52.27	-21.73	74	59.78	36.12	15.59	59.22	400	0	P	H
													H
													H
		4804	38.27	-35.73	74	53.89	31.11	12.43	59.16	100	0	P	V
		7206	50.85	-23.15	74	58.36	36.12	15.59	59.22	100	0	P	V
													V
													V
BLE CH 19 2440MHz		4880	36.37	-37.63	74	51.97	31.08	12.5	59.18	400	0	P	H
		7320	59.58	-14.42	74	66.67	36.48	15.6	59.17	284	72	P	H
		7320	51.31	-2.69	54	58.4	36.48	15.6	59.17	284	72	A	H
													H
		4880	37.87	-36.13	74	53.47	31.08	12.5	59.18	100	0	P	V
		7320	57.82	-16.18	74	64.91	36.48	15.6	59.17	150	324	P	V
		7320	49.51	-4.49	54	56.6	36.48	15.6	59.17	150	324	A	V
													V
BLE CH 39 2480MHz		4960	38.31	-35.69	74	53.68	31.26	12.56	59.19	100	0	P	H
		7440	57.92	-16.08	74	64.74	36.58	15.72	59.12	321	73	P	H
		7440	49.61	-4.39	54	56.43	36.58	15.72	59.12	321	73	A	H
													H
		4960	39.01	-34.99	74	54.38	31.26	12.56	59.19	100	0	P	V
		7440	57.3	-16.7	74	64.12	36.58	15.72	59.12	150	322	P	V
		7440	48.13	-5.87	54	54.95	36.58	15.72	59.12	150	322	A	V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Emission below 1GHz

2.4GHz BLE (LF)

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
2.4GHz BLE LF		137.67	28.78	-14.72	43.5	41.63	17.38	2.05	32.28	-	-	P	H	
		160.95	28.12	-15.38	43.5	41.85	16.31	2.25	32.29	-	-	P	H	
		418	28.95	-17.05	46	35.06	22.57	3.5	32.18	-	-	P	H	
		727.43	30.7	-15.3	46	30.87	27.41	4.63	32.21	-	-	P	H	
		804.06	30.98	-15.02	46	30.52	27.93	4.88	32.35	-	-	P	H	
		953.44	34.32	-11.68	46	29.46	30.83	5.32	31.29	100	0	P	H	
														H
														H
														H
														H
														H
														H
			32.91	36.92	-3.08	40	45.2	22.99	0.96	32.23	100	101	QP	V
			42.61	31.03	-8.97	40	44.34	17.95	1.08	32.34	-	-	P	V
			125.06	29.7	-13.8	43.5	42.54	17.48	1.95	32.27	-	-	P	V
			416.06	30.54	-15.46	46	36.76	22.47	3.49	32.18	-	-	P	V
			768.17	31.12	-14.88	46	30.53	28.12	4.77	32.3	-	-	P	V
			931.13	34.01	-11.99	46	30.44	29.87	5.25	31.55	-	-	P	V
														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.
QP/P/A	<b>Quasi-Peak</b> or <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:

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		( MHz )	( dBµV/m )	( dB )	( dBµV/m )	( dBµV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
BLE CH 00 2402MHz		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. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBµV/m) =  
Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBµV/m) – Limit Line(dBµV/m)

**For Peak Limit @ 2390MHz:**

1. Level(dBµV/m)  
= Antenna Factor(dB/m) + Path 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) + Path 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 E. Cabinet Radiated Spurious Emission Plots

Test Engineer :	Andy Yang	Temperature :	20~25°C
		Relative Humidity :	50~60%

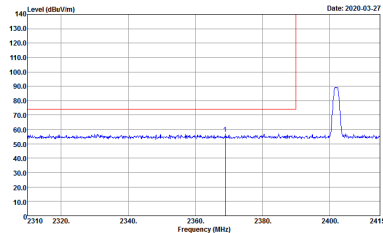
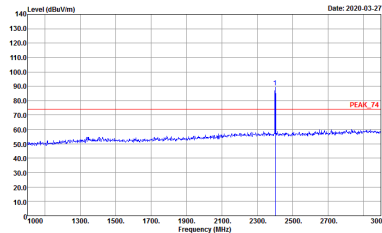
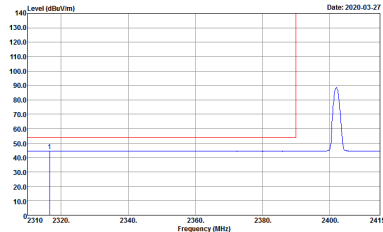
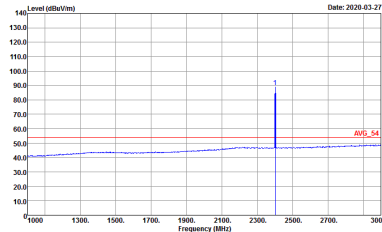
### Note symbol

-L	Low channel location
-R	High channel location

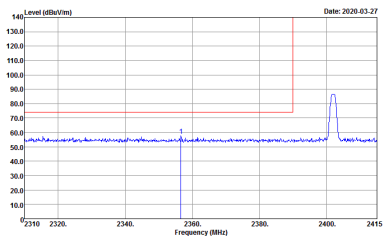
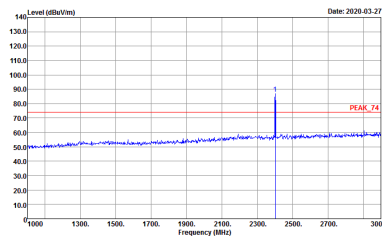
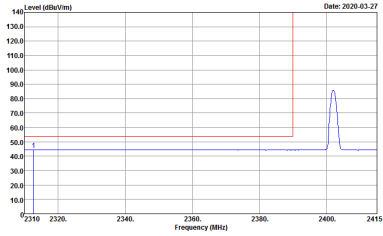
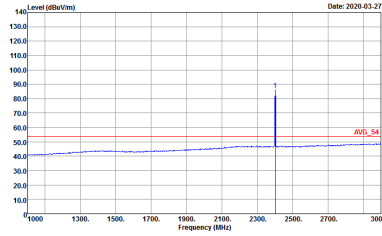


2.4GHz 2400~2483.5MHz

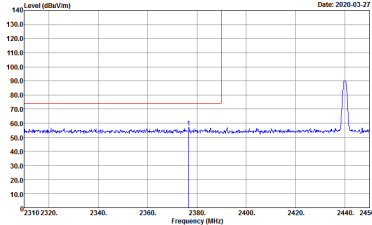
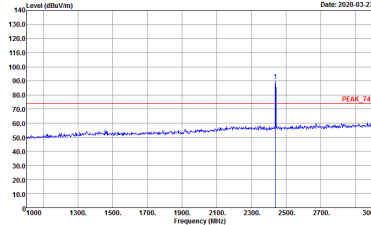
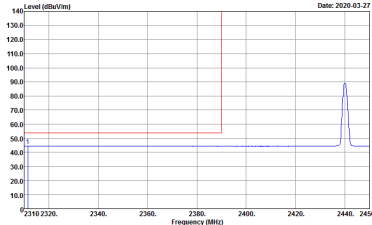
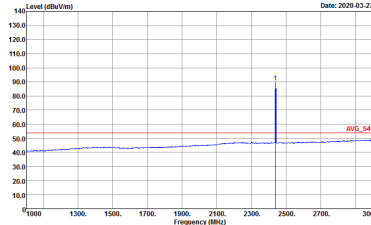
BLE (Band Edge @ 3m)

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Fundamental
Peak	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY  Condition : PEAK_BE_74 3m 91200_1522 HORIZONTAL  Condition : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto  Detector : Peak  Project : 021504</p>	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY  Condition : PEAK_74 3m 91200_1522 HORIZONTAL  Condition : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto  Detector : Peak  Project : 021504</p>
Avg.	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY  Condition : AV6_BE_54 3m 91200_1522 HORIZONTAL  Condition : RBW:1000.000KHz VBW:0.010KHz SWT:Auto  Detector : Peak  Project : 021504</p>	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY  Condition : AV6_54 3m 91200_1522 HORIZONTAL  Condition : RBW:1000.000KHz VBW:0.010KHz SWT:Auto  Detector : Peak  Project : 021504</p>



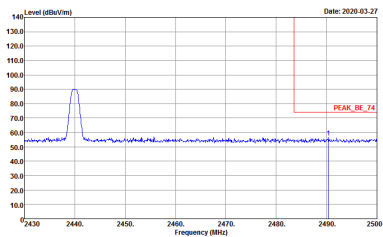
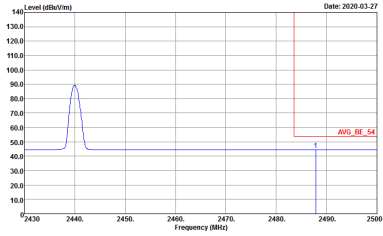
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH00 2402MHz		
Vertical		Fundamental
Peak	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY            Condition : PEAK_BE_74 3m 91200_1522 VERTICAL            : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY            Condition : PEAK_74 3m 91200_1522 VERTICAL            : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>
Avg	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY            Condition : AVG_BE_54 3m 91200_1522 VERTICAL            : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY            Condition : AVG_54 3m 91200_1522 VERTICAL            : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>



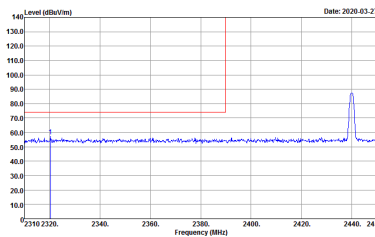
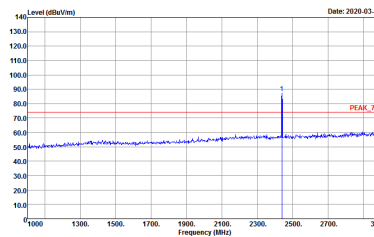
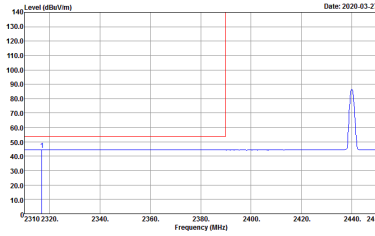
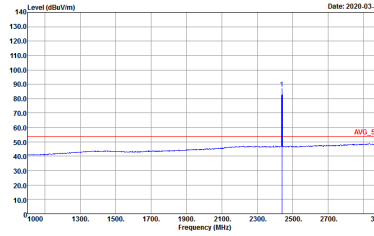
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - L		
Horizontal		Fundamental
Peak	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY  Condition : PEAK_BE_74 3m 91200_1522 HORIZONTAL  RBW:1000.000KHz VBW:3000.000KHz SWT:Auto  Detector : Peak  Project : 021504</p>	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY  Condition : PEAK_74 3m 91200_1522 HORIZONTAL  RBW:1000.000KHz VBW:3000.000KHz SWT:Auto  Detector : Peak  Project : 021504</p>
Avg.	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY  Condition : AVG_BE_54 3m 91200_1522 HORIZONTAL  RBW:1000.000KHz VBW:0.010KHz SWT:Auto  Detector : Peak  Project : 021504</p>	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY  Condition : AVG_54 3m 91200_1522 HORIZONTAL  RBW:1000.000KHz VBW:0.010KHz SWT:Auto  Detector : Peak  Project : 021504</p>



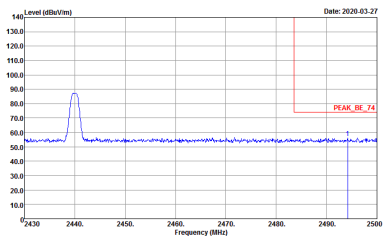
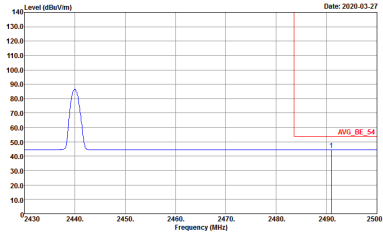


BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - R		
	Horizontal	Fundamental
<b>Peak</b>	 <p>Site : 03CH16-HY Condition : PEAK_BE_74 3m 91200_1522 HORIZONTAL Detector : Peak Project : 021504</p>	Left blank
<b>Avg.</b>	 <p>Site : 03CH16-HY Condition : AVG_BE_54 3m 91200_1522 HORIZONTAL Detector : Peak Project : 021504</p>	Left blank

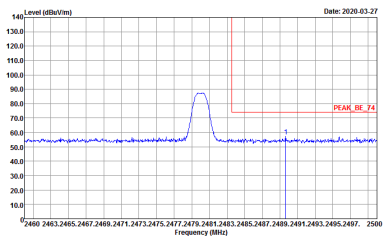
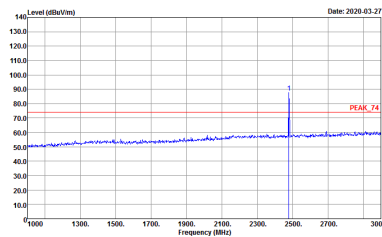
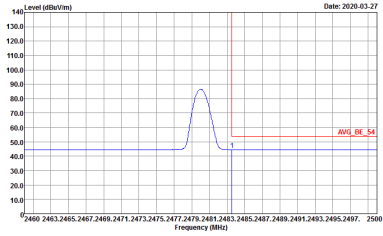
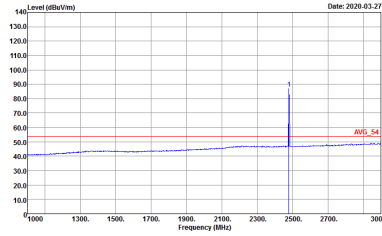


BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - L		
Vertical		Fundamental
Peak	 <p>Site : 03CH16-HY            Condition : PEAK_BE_74 3m 91200_1522 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>	 <p>Site : 03CH16-HY            Condition : PEAK_74 3m 91200_1522 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>
Avg.	 <p>Site : 03CH16-HY            Condition : AVG_BE_54 3m 91200_1522 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>	 <p>Site : 03CH16-HY            Condition : AVG_54 3m 91200_1522 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>

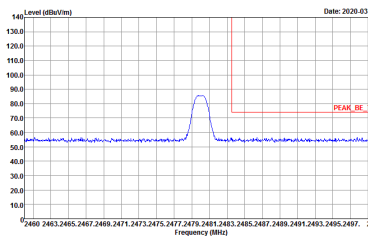
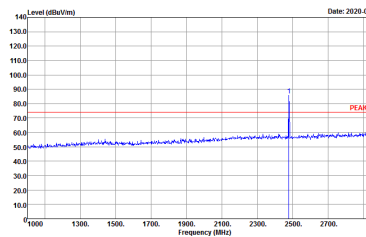
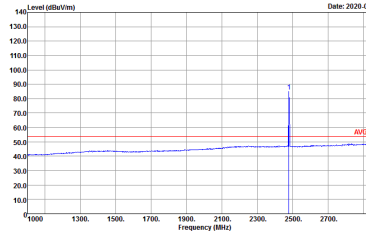


BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH19 2440MHz - R		
	Vertical	Fundamental
<b>Peak</b>	 <p>Site : 03CH16-HY Condition : PEAK_BE_74 3m 91200_1522 VERTICAL Detector : Peak Project : 021504</p>	Left blank
<b>Avg.</b>	 <p>Site : 03CH16-HY Condition : AVG_BE_54 3m 91200_1522 VERTICAL Detector : Peak Project : 021504</p>	Left blank



BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH39 2480MHz		
Horizontal		Fundamental
Peak	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY            Condition : PEAK_BE_74 3m 91200_1522 HORIZONTAL            : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY            Condition : PEAK_74 3m 91200_1522 HORIZONTAL            : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>
Avg.	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY            Condition : AVG_BE_54 3m 91200_1522 HORIZONTAL            : RBW:1000.000KHz VBW:0.010KHz SWT:Auto            Detector : Peak            Project : 021504</p>	 <p>Date: 2020-03-27</p> <p>Site : 03CH16-HY            Condition : AVG_54 3m 91200_1522 HORIZONTAL            : RBW:1000.000KHz VBW:0.010KHz SWT:Auto            Detector : Peak            Project : 021504</p>

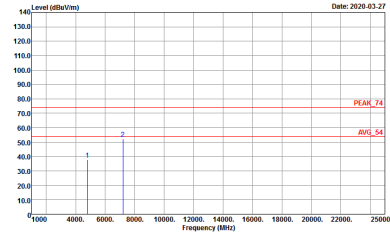
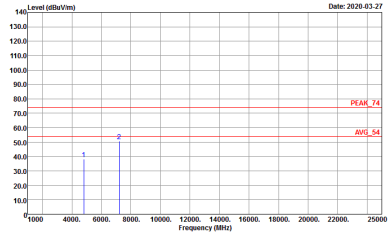


BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BLE CH39 2480MHz		
Vertical		Fundamental
Peak	 <p>Level (dBm/100kHz) vs Frequency (MHz) plot showing a peak at 2480 MHz. The peak level is approximately 85 dBm/100kHz. The plot is labeled 'PEAK_BE_74'.</p> <p>Site : 03CH16-HY            Condition : PEAK_BE_74 3m 91200_1522 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>	 <p>Level (dBm/100kHz) vs Frequency (MHz) plot showing a peak at 2480 MHz. The peak level is approximately 85 dBm/100kHz. The plot is labeled 'PEAK_74'.</p> <p>Site : 03CH16-HY            Condition : PEAK_74 3m 91200_1522 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>
Avg.	 <p>Level (dBm/100kHz) vs Frequency (MHz) plot showing an average level at 2480 MHz. The average level is approximately 55 dBm/100kHz. The plot is labeled 'AVG_BE_54'.</p> <p>Site : 03CH16-HY            Condition : AVG_BE_54 3m 91200_1522 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>	 <p>Level (dBm/100kHz) vs Frequency (MHz) plot showing an average level at 2480 MHz. The average level is approximately 55 dBm/100kHz. The plot is labeled 'AVG_54'.</p> <p>Site : 03CH16-HY            Condition : AVG_54 3m 91200_1522 VERTICAL            RBW:1000.000KHz VBW:3000.000KHz SWT:Auto            Detector : Peak            Project : 021504</p>

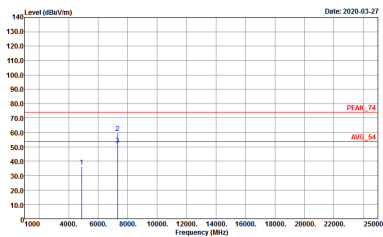
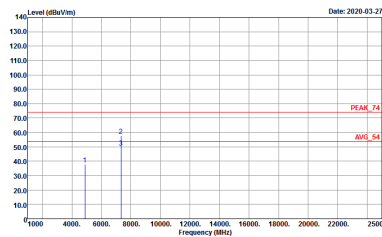


2.4GHz 2400~2483.5MHz

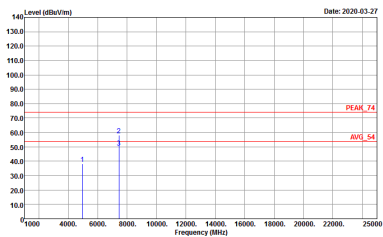
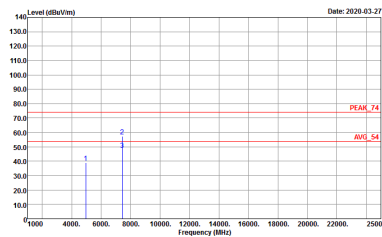
BLE (Harmonic @ 3m)

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH00 2402MHz	
	Horizontal	Vertical
<p><b>Peak</b></p> <p><b>Avg.</b></p>	 <p>Site : 03CH16-HY            Condition : PEAK_74 3m 9120D_1522 HORIZONTAL            Detector : Peak            Project : 021504</p>	 <p>Site : 03CH16-HY            Condition : PEAK_74 3m 9120D_1522 VERTICAL            Detector : Peak            Project : 021504</p>



BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH19 2440MHz	
	Horizontal	Vertical
<p><b>Peak</b></p> <p><b>Avg.</b></p>	 <p>Site : 03CH16-11Y Condition : PEAK_74 3m 9120D_1522 HORIZONTAL Detector : Peak Project : 021504</p>	 <p>Site : 03CH16-11Y Condition : PEAK_74 3m 9120D_1522 VERTICAL Detector : Peak Project : 021504</p>



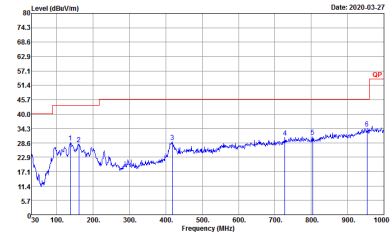
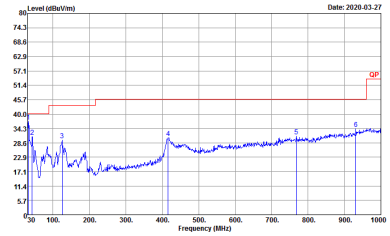
BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BLE CH39 2480MHz	
	Horizontal	Vertical
<p><b>Peak</b></p> <p><b>Avg.</b></p>	 <p>Site : 03CH16-11Y Condition : PEAK_74 3m 91200_1522 HORIZONTAL Detector : Peak Project : 021504</p>	 <p>Site : 03CH16-11Y Condition : PEAK_74 3m 91200_1522 VERTICAL Detector : Peak Project : 021504</p>





Emission below 1GHz

2.4GHz BLE (LF)

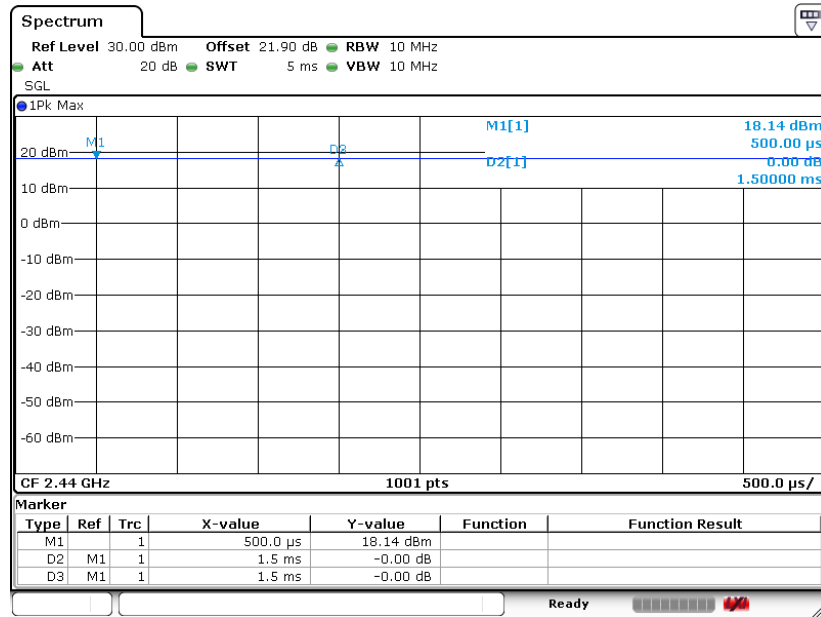
BLE	2.4GHz 2400~2483.5MHz	
	BLE LF	
	Horizontal	Vertical
QP / Peak	 <p>Site : 03CH16-HY          Condition : QP 3m BIL06_47020406 HORIZONTAL          Detector : Peak          Project : 021504</p>	 <p>Site : 03CH16-HY          Condition : QP 3m BIL06_47020406 VERTICAL          Detector : Peak          Project : 021504</p>



### Appendix F. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
Bluetooth -LE	100	-	-	10Hz	0.00

#### Bluetooth - LE



Date: 6.APR.2020 21:47:36