

# FCC Test Report

**FCC ID** : IPH-B4224  
**Equipment** : Watch and Activity Monitor  
**Model No.** : AB4224  
**Brand Name** : GARMIN  
**Applicant** : Garmin International, Inc.  
**Address** : 1200 E. 151st Street Olathe, KS 66062 United States  
**Standard** : 47 CFR FCC Part 15.249  
**Received Date** : Apr. 16, 2021  
**Tested Date** : May 12 ~ Jul. 07, 2021

We, International Certification Corporation, would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:



Along Chen / Assistant Manager

Approved by:



Gary Chang / Manager



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## Release Record

Report No.	Version	Description	Issued Date
FR141603	Rev. 01	Initial issue	Sep. 09, 2021

## Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	AC Power Line Conducted Emissions	[dBuV]: 4.525MHz 33.38 (Margin -22.62dB) - QP	Pass
15.249(a)	Field Strength of Fundamental	Meet the requirement of limit	Pass
15.249(a)(d)	Field Strength of Harmonics and Emissions Radiated outside of the Specified Frequency Bands	Meet the requirement of limit	Pass
15.215(c)	20dB bandwidth	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	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.

# 1 General Description

## 1.1 Information

### 1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	Modulation	Ch. Freq. (MHz)	Channel Number	Data Rate
2402-2480	GFSK	2402-2480	1-79 [79]	1 Mbps

### 1.1.2 Antenna Details

Ant. No.	Brand	Model	Type	Connector	Gain (dBi)
1	Garmin	700-00157-00	PIFA	N/A	-5.42

### 1.1.3 Power Supply Type of Equipment under Test (EUT)

<b>Power Supply Type</b>	5Vdc from host 3.87Vdc from battery
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### 1.1.4 Accessories

Accessories		
No.	Equipment	Description
1	Battery	Brand: GARMIN Model: 361-00151-01 Power Rating: 3.87Vdc, 84mAh
2	USB cable	Brand: GARMIN Model: 320-01069-10 Power line: 0.52m non-shielded without core

### 1.1.5 Channel List

Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2402	21	2422	41	2442	61	2462
2	2403	22	2423	42	2443	62	2463
3	2404	23	2424	43	2444	63	2464
4	2405	24	2425	44	2445	64	2465
5	2406	25	2426	45	2446	65	2466
6	2407	26	2427	46	2447	66	2467
7	2408	27	2428	47	2448	67	2468
8	2409	28	2429	48	2449	68	2469
9	2410	29	2430	49	2450	69	2470
10	2411	30	2431	50	2451	70	2471
11	2412	31	2432	51	2452	71	2472
12	2413	32	2433	52	2453	72	2473
13	2414	33	2434	53	2454	73	2474
14	2415	34	2435	54	2455	74	2475
15	2416	35	2436	55	2456	75	2476
16	2417	36	2437	56	2457	76	2477
17	2418	37	2438	57	2458	77	2478
18	2419	38	2439	58	2459	78	2479
19	2420	39	2440	59	2460	79	2480
20	2421	40	2441	60	2461	---	---

### 1.1.6 Test Tool and Duty Cycle

<b>Test Tool</b>	ANT+ , Version: SW22.83	
<b>Duty Cycle and Duty Factor</b>	<b>Duty Cycle (%)</b>	<b>Duty Factor (dB)</b>
	64.06	1.93

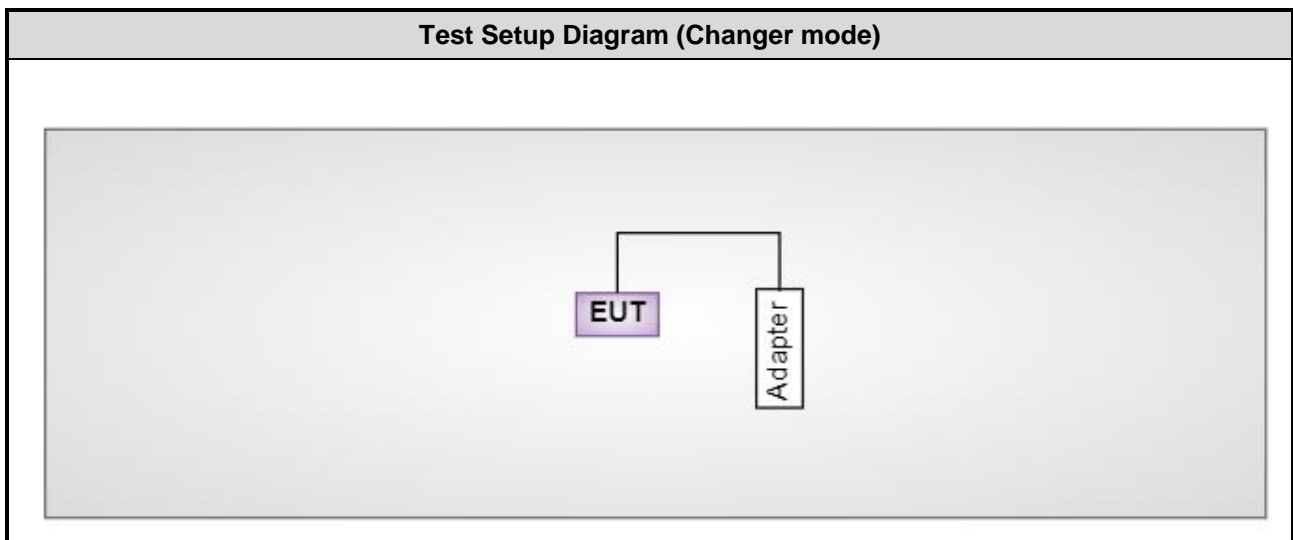
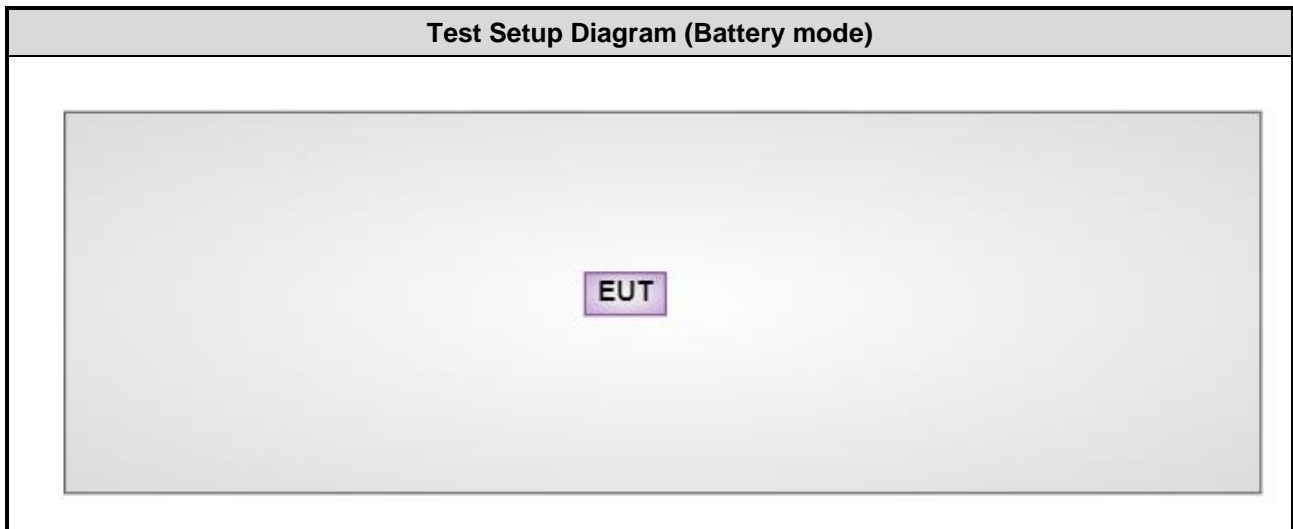
### 1.1.7 Power Index of Test Tool

Modulation Mode	Test Frequency (MHz)		
	2402	2442	2480
BT LE-1Mbps	default	default	default

## 1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	Adapter	Samsung	ETA-U90JWS	---	---

## 1.3 Test Setup Chart



## 1.4 The Equipment List

<b>Test Item</b>	Conducted Emission				
<b>Test Site</b>	Conduction room 1 / (CO01-WS)				
<b>Tested Date</b>	May 12, 2021				
<b>Instrument</b>	<b>Brand</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Until</b>
Receiver	R&S	ESR3	101658	Feb. 08, 2021	Feb. 07, 2022
LISN	R&S	ENV216	101579	Mar. 17, 2021	Mar. 16, 2022
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 21, 2020	Oct. 20, 2021
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

<b>Test Item</b>	Radiated Emission				
<b>Test Site</b>	966 chamber3 / (03CH03-WS)				
<b>Tested Date</b>	May. 12, 2021 ~ Jul. 07, 2021				
<b>Instrument</b>	<b>Brand</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Until</b>
Receiver	R&S	ESR3	101658	Feb. 08, 2021	Feb. 07, 2022
Spectrum Analyzer	R&S	FSV40	101499	Mar. 02, 2021	Mar. 01, 2022
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 17, 2020	Nov. 16, 2021
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-685	May 06, 2021	May 05, 2022
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Dec. 22, 2020	Dec. 21, 2021
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 06, 2020	Nov. 05, 2021
Preamplifier	EMC	EMC02325	980187	Aug. 05, 2020	Aug. 04, 2021
Preamplifier	Agilent	83017A	MY39501309	Sep. 02, 2020	Sep. 01, 2021
Preamplifier	EMC	EMC184045B	980192	Jul. 21, 2020	Jul. 20, 2021
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 06, 2020	Oct. 05, 2021
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800-001	Sep. 26, 2020	Sep. 25, 2021
LF cable-3M	EMC	EMC8D-NM-NM-3000	131103	Sep. 26, 2020	Sep. 25, 2021
LF cable-13M	EMC	EMC8D-NM-NM-13000	131104	Sep. 26, 2020	Sep. 25, 2021
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Sep. 26, 2020	Sep. 25, 2021
RF cable-8M	EMC	EMC104-SM-SM-8000	181107	Sep. 26, 2020	Sep. 25, 2021
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					



## 1.5 Test Standards

47 CFR FCC Part 15.249  
ANSI C63.10-2013

## 1.6 Deviation from Test Standard and Measurement Procedure

None

## 1.7 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor ( $k=2$ )).

Measurement Uncertainty	
Parameters	Uncertainty
Bandwidth	$\pm 34.130$ Hz
AC conducted emission	$\pm 2.92$ dB
Radiated emission $\leq 1$ GHz	$\pm 3.96$ dB
Radiated emission $> 1$ GHz	$\pm 4.51$ dB

## 2 Test Configuration

### 2.1 Testing Facility

<b>Test Laboratory</b>	International Certification Corporation
<b>Test Site</b>	CO01-WS, TH01-WS
<b>Address of Test Site</b>	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)
<b>Test Site</b>	03CH03-WS
<b>Address of Test Site</b>	No.14-1, Lane 19, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 333, Taiwan (R.O.C.)

- FCC Designation No.: TW0009
- FCC site registration No.: 207696
- ISED#: 10807A
- CAB identifier: TW2732

### 2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate	Test Configuration
AC Power Line Conducted Emissions	Charging	---	---	2
Field Strength of Fundamental	GFSK	2402, 2442, 2480	1 Mbps	1
Radiated Emissions $\leq$ 1GHz	GFSK	2480	1 Mbps	1
	Charging	---	---	2
Radiated Emissions $>$ 1GHz	GFSK	2402, 2442, 2480	1 Mbps	1
20dB bandwidth	GFSK	2402, 2442, 2480	1 Mbps	1
<b>NOTE:</b>				
1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The <b>Z-plane</b> results were found as the worst case and were shown in this report.				
2. The EUT had been tested by following test configurations.				
1) Configuration 1: Battery mode				
2) Configuration 2: Charging mode				

## 3 Transmitter Test Results

### 3.1 Conducted Emissions

#### 3.1.1 Limit of Conducted Emissions

Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: \* Decreases with the logarithm of the frequency.

#### 3.1.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50  $\Omega$  LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V / 60Hz.

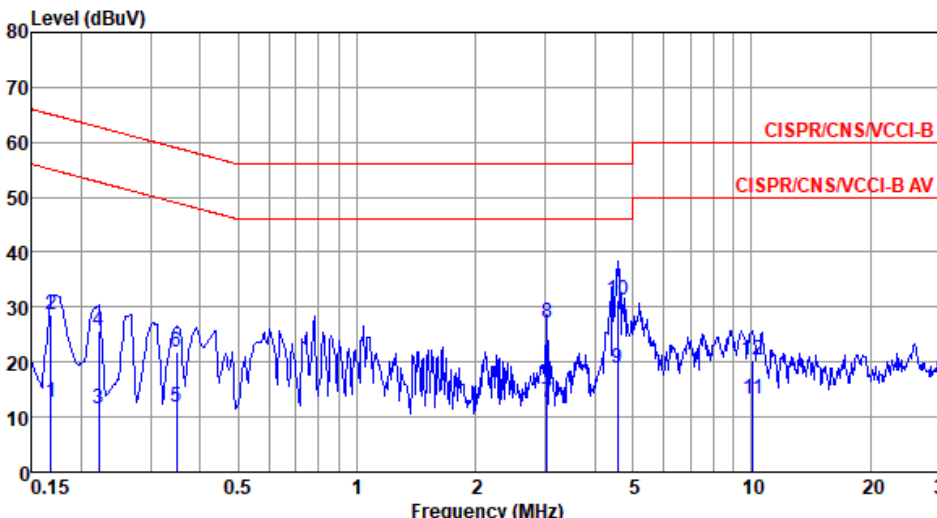
#### 3.1.3 Test Setup



Note: 1. Support units were connected to second LISN.

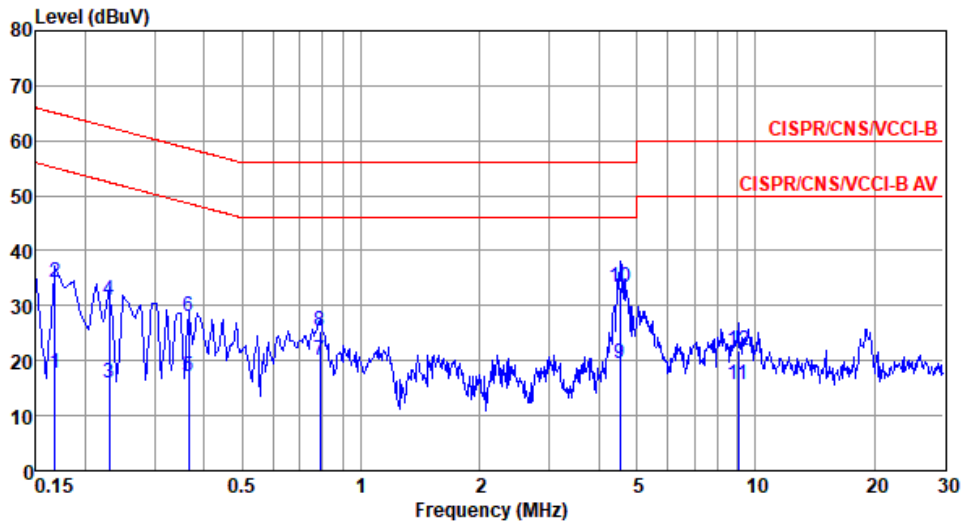
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

### 3.1.4 Test Result of Conducted Emissions

Modulation Mode	Charging	Test Freq. (MHz)	---																																																																																																																					
Power Phase	Line																																																																																																																							
<p>Test by : BRAD WU      Temperature: 24°C      Humidity: 64%</p>																																																																																																																								
																																																																																																																								
<table border="1"> <thead> <tr> <th></th> <th>Freq MHz</th> <th>Level dBuV</th> <th>Limit Line dBuV</th> <th>Over Limit dB</th> <th>Read Level dBuV</th> <th>Factor dB</th> <th>Cable loss dB</th> <th>Remark</th> </tr> </thead> <tbody> <tr><td>1</td><td>0.168</td><td>12.71</td><td>55.08</td><td>-42.37</td><td>2.83</td><td>9.83</td><td>0.05</td><td>Average</td></tr> <tr><td>2</td><td>0.168</td><td>28.64</td><td>65.08</td><td>-36.44</td><td>18.76</td><td>9.83</td><td>0.05</td><td>QP</td></tr> <tr><td>3</td><td>0.222</td><td>11.66</td><td>52.74</td><td>-41.08</td><td>1.75</td><td>9.85</td><td>0.06</td><td>Average</td></tr> <tr><td>4</td><td>0.222</td><td>25.82</td><td>62.74</td><td>-36.92</td><td>15.91</td><td>9.85</td><td>0.06</td><td>QP</td></tr> <tr><td>5</td><td>0.348</td><td>11.92</td><td>49.00</td><td>-37.08</td><td>1.96</td><td>9.88</td><td>0.08</td><td>Average</td></tr> <tr><td>6</td><td>0.348</td><td>21.75</td><td>59.00</td><td>-37.25</td><td>11.79</td><td>9.88</td><td>0.08</td><td>QP</td></tr> <tr><td>7</td><td>3.025</td><td>12.68</td><td>46.00</td><td>-33.32</td><td>2.41</td><td>10.02</td><td>0.25</td><td>Average</td></tr> <tr><td>8</td><td>3.025</td><td>27.25</td><td>56.00</td><td>-28.75</td><td>16.98</td><td>10.02</td><td>0.25</td><td>QP</td></tr> <tr><td>9</td><td>4.574</td><td>18.88</td><td>46.00</td><td>-27.12</td><td>8.52</td><td>10.05</td><td>0.31</td><td>Average</td></tr> <tr><td>10*</td><td>4.574</td><td>31.24</td><td>56.00</td><td>-24.76</td><td>20.88</td><td>10.05</td><td>0.31</td><td>QP</td></tr> <tr><td>11</td><td>10.072</td><td>13.30</td><td>50.00</td><td>-36.70</td><td>2.79</td><td>10.11</td><td>0.40</td><td>Average</td></tr> <tr><td>12</td><td>10.072</td><td>20.30</td><td>60.00</td><td>-39.70</td><td>9.79</td><td>10.11</td><td>0.40</td><td>QP</td></tr> </tbody> </table>					Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	Factor dB	Cable loss dB	Remark	1	0.168	12.71	55.08	-42.37	2.83	9.83	0.05	Average	2	0.168	28.64	65.08	-36.44	18.76	9.83	0.05	QP	3	0.222	11.66	52.74	-41.08	1.75	9.85	0.06	Average	4	0.222	25.82	62.74	-36.92	15.91	9.85	0.06	QP	5	0.348	11.92	49.00	-37.08	1.96	9.88	0.08	Average	6	0.348	21.75	59.00	-37.25	11.79	9.88	0.08	QP	7	3.025	12.68	46.00	-33.32	2.41	10.02	0.25	Average	8	3.025	27.25	56.00	-28.75	16.98	10.02	0.25	QP	9	4.574	18.88	46.00	-27.12	8.52	10.05	0.31	Average	10*	4.574	31.24	56.00	-24.76	20.88	10.05	0.31	QP	11	10.072	13.30	50.00	-36.70	2.79	10.11	0.40	Average	12	10.072	20.30	60.00	-39.70	9.79	10.11	0.40	QP
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<b>Modulation Mode</b>	Charging	<b>Test Freq. (MHz)</b>	---
<b>Power Phase</b>	Neutral		

Test by : BRAD WU      Temperature: 24°C      Humidity: 64%



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	Factor dB	Cable loss dB	Remark
1	0.168	17.79	55.08	-37.29	7.92	9.82	0.05	Average
2	0.168	34.13	65.08	-30.95	24.26	9.82	0.05	QP
3	0.230	15.85	52.44	-36.59	5.96	9.83	0.06	Average
4	0.230	31.00	62.44	-31.44	21.11	9.83	0.06	QP
5	0.365	17.13	48.61	-31.48	7.20	9.85	0.08	Average
6	0.365	27.98	58.61	-30.63	18.05	9.85	0.08	QP
7	0.788	20.06	46.00	-25.94	10.08	9.87	0.11	Average
8	0.788	25.52	56.00	-30.48	15.54	9.87	0.11	QP
9	4.525	19.53	46.00	-26.47	9.25	9.98	0.30	Average
10*	4.525	33.38	56.00	-22.62	23.10	9.98	0.30	QP
11	9.059	15.71	50.00	-34.29	5.24	10.08	0.39	Average
12	9.059	21.80	60.00	-38.20	11.33	10.08	0.39	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).  
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

## 3.2 Radiated Emission

This section includes field strength of fundamental, field strength of harmonics and emissions radiated outside of the operating frequency bands.

### 3.2.1 Limit of field strength of fundamental and field strength of harmonics

Fundamental Frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
2400–2483.5 MHz	50	500

### 3.2.2 Limit of Unwanted Emissions

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in below table, whichever is the lesser attenuation.

Radiated emission limits			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

**Note 1:**

Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

**Note 2:**

Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

### 3.2.3 Test Procedures

1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

1. Radiated emission below 1GHz  
120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission
2. Radiated emission above 1GHz / Peak value except fundamental  
RBW=2MHz, VBW=10MHz and Peak detector
3. Radiated emission above 1GHz / Average value for field strength of fundamental and harmonics  
The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula:

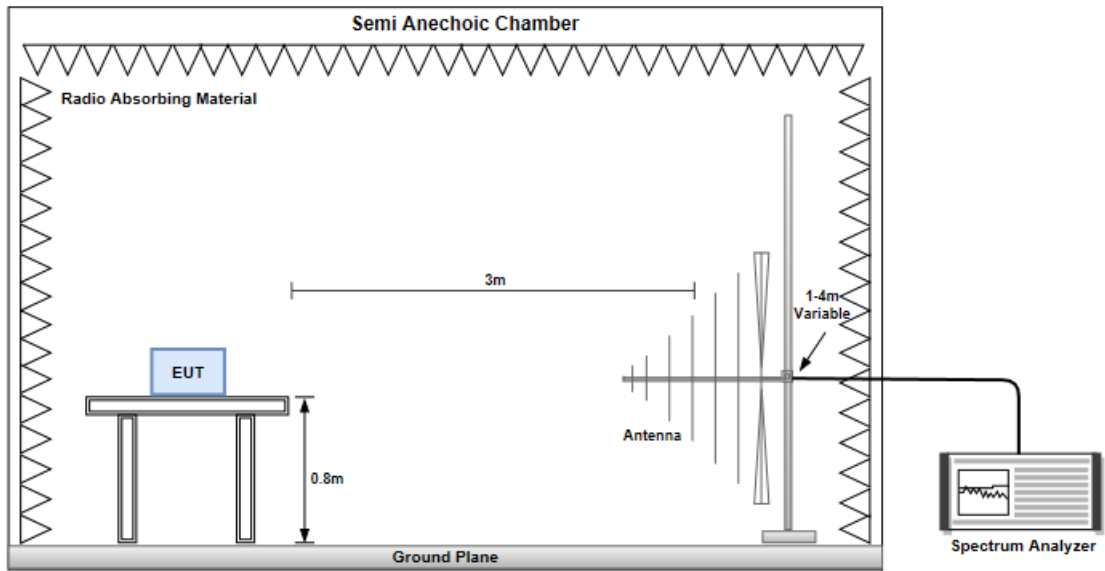
$$20\log(\text{Duty cycle}) = 20\log \frac{0.183188 * 1 \text{ ms}}{100 \text{ ms}} = -54.74\text{dB}$$

Please see page 27 for plotted duty

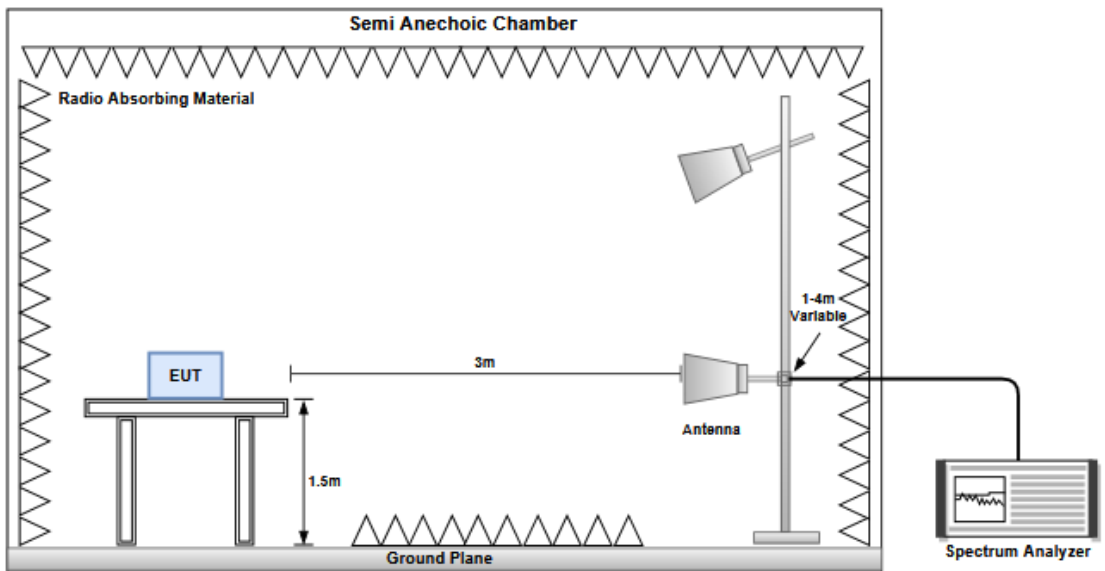
4. Radiated emission above 1GHz / Average value for other emissions  
RBW=1MHz, VBW=1/T and Peak detector
5. Radiated emission Peak value for fundamental  
RBW=3MHz, VBW=10MHz and Peak detector

### 3.2.4 Test Setup

#### Radiated Emissions below 1 GHz



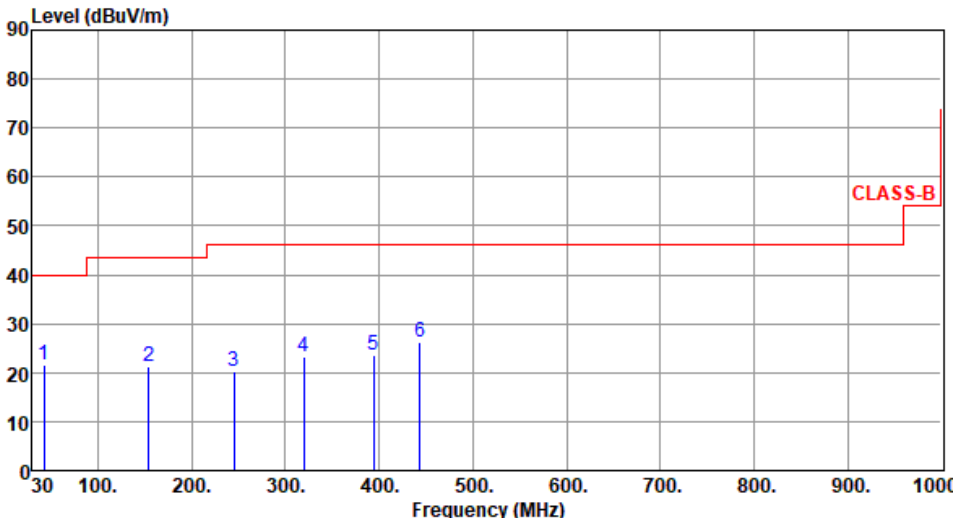
#### Radiated Emissions above 1 GHz





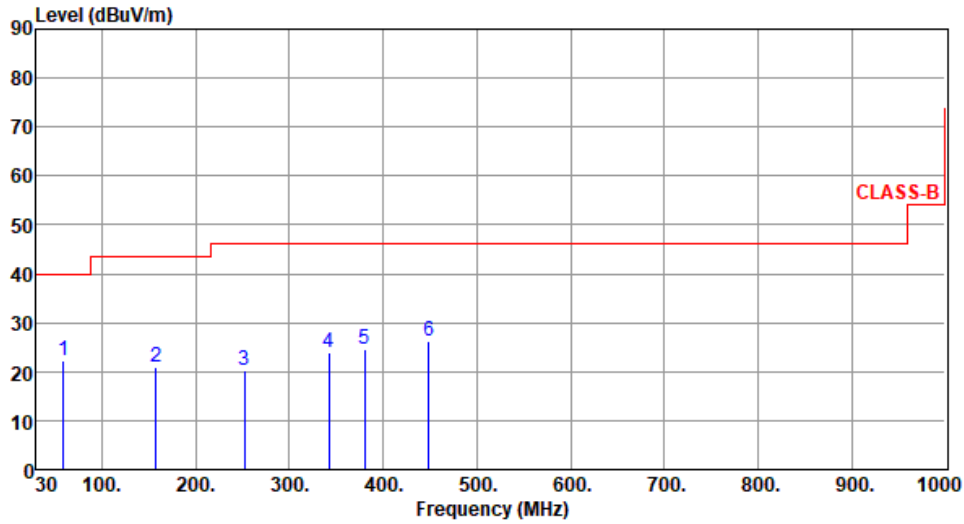
### Configuration 1: Battery mode

#### 3.2.5 Transmitter Radiated Unwanted Emissions (Below 1GHz)

<b>Modulation</b>	GFSK	<b>Test Freq. (MHz)</b>	2480						
<b>Polarization</b>	Horizontal								
Test By :Roger Lu      Temperature(°C):25      Humidity(%):62									
 <p>The graph plots Level (dBuV/m) on the y-axis (0 to 90) against Frequency (MHz) on the x-axis (30 to 1000). A red line represents the CLASS-B limit, which is constant at 40 dBuV/m from 30 MHz to 100 MHz, then steps up to 45 dBuV/m from 100 MHz to 1000 MHz. Six blue vertical lines represent emission peaks at 42.61, 154.16, 245.34, 320.03, 393.75, and 443.22 MHz. The peak levels are 21.55, 21.20, 20.23, 23.21, 23.69, and 26.11 dBuV/m respectively.</p>									
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	42.61	21.55	40.00	-18.45	30.27	-8.72	Peak	---	---
2	154.16	21.20	43.50	-22.30	29.93	-8.73	Peak	---	---
3	245.34	20.23	46.00	-25.77	30.39	-10.16	Peak	---	---
4	320.03	23.21	46.00	-22.79	30.94	-7.73	Peak	---	---
5	393.75	23.69	46.00	-22.31	29.45	-5.76	Peak	---	---
6	443.22	26.11	46.00	-19.89	30.19	-4.08	Peak	---	---
<p>Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB/m)  *Factor includes antenna factor , cable loss and amplifier gain  Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).  Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.</p>									

<b>Modulation</b>	GFSK	<b>Test Freq. (MHz)</b>	2480
<b>Polarization</b>	Vertical		

Test By :Roger Lu      Temperature(°C):25      Humidity(%):62



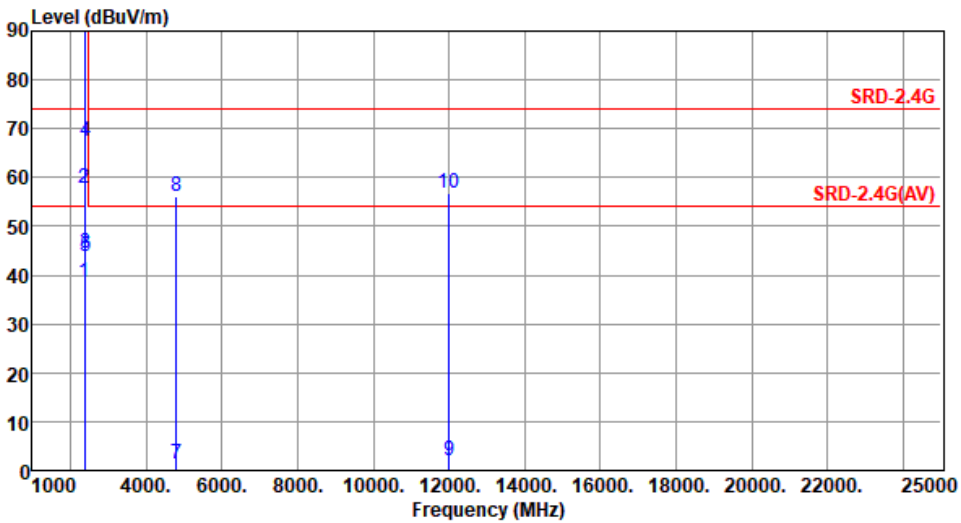
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	59.10	22.35	40.00	-17.65	31.82	-9.47	Peak	---	---
2	158.04	20.98	43.50	-22.52	29.62	-8.64	Peak	---	---
3	252.13	20.22	46.00	-25.78	30.14	-9.92	Peak	---	---
4	342.34	23.96	46.00	-22.04	31.10	-7.14	Peak	---	---
5	380.17	24.42	46.00	-21.58	30.60	-6.18	Peak	---	---
6	449.04	26.23	46.00	-19.77	30.14	-3.91	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB/m)

\*Factor includes antenna factor , cable loss and amplifier gain

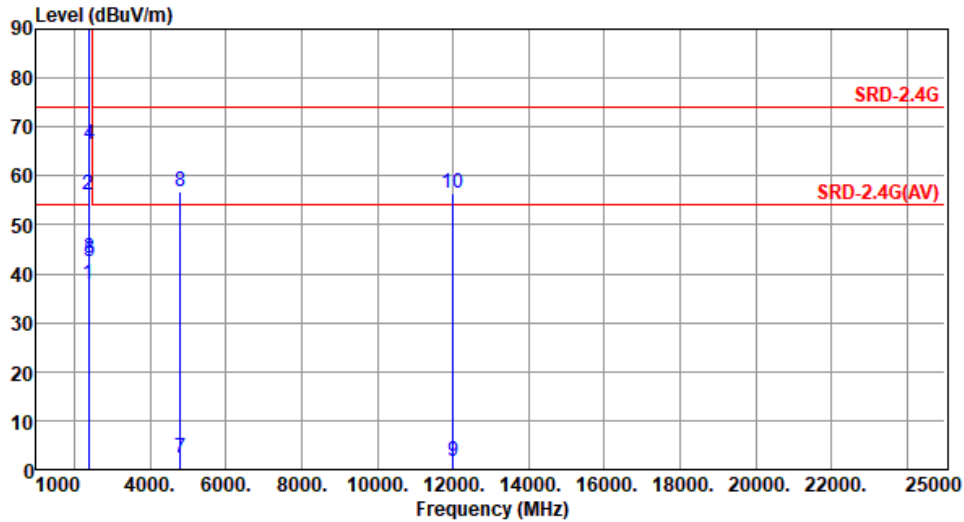
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

### 3.2.6 Transmitter Radiated Unwanted Emissions (Above 1GHz)

<b>Modulation</b>	GFSK	<b>Test Freq. (MHz)</b>	2402																																																																																																																																									
<b>Polarization</b>	Horizontal																																																																																																																																											
Test By : Roger Lu      Temperature(°C):25      Humidity(%):62																																																																																																																																												
																																																																																																																																												
	<table border="1"> <thead> <tr> <th>10</th> <th>20</th> <th>30</th> <th>40</th> <th>50</th> <th>60</th> <th>70</th> <th>80</th> <th>90</th> </tr> </thead> <tbody> <tr> <td>1000</td> <td>4000</td> <td>6000</td> <td>8000</td> <td>10000</td> <td>12000</td> <td>14000</td> <td>16000</td> <td>18000</td> </tr> <tr> <td>20000</td> <td>22000</td> <td>25000</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	10	20	30	40	50	60	70	80	90	1000	4000	6000	8000	10000	12000	14000	16000	18000	20000	22000	25000							<table border="1"> <thead> <tr> <th>Level (dBuV/m)</th> <th>Frequency (MHz)</th> <th>SA reading (dBuV)</th> <th>Factor (dB/m)</th> <th>Emission level (dBuV/m)</th> <th>Limit (dBuV/m)</th> <th>Margin (dB)</th> </tr> </thead> <tbody> <tr> <td>40.02</td> <td>2390.00</td> <td>40.02</td> <td>-1.66</td> <td>38.36</td> <td>54.00</td> <td>-15.64</td> </tr> <tr> <td>59.56</td> <td>2390.00</td> <td>59.56</td> <td>-1.66</td> <td>57.90</td> <td>74.00</td> <td>-16.10</td> </tr> <tr> <td>46.10</td> <td>2400.00</td> <td>46.10</td> <td>-1.68</td> <td>44.42</td> <td>54.00</td> <td>-9.58</td> </tr> <tr> <td>69.21</td> <td>2400.00</td> <td>69.21</td> <td>-1.68</td> <td>67.53</td> <td>74.00</td> <td>-6.47</td> </tr> <tr> <td>45.42</td> <td>2402.00</td> <td>45.42</td> <td>-1.68</td> <td>43.74</td> <td>94.00</td> <td>-50.26</td> </tr> <tr> <td>100.16</td> <td>2402.00</td> <td>100.16</td> <td>-1.68</td> <td>98.48</td> <td>114.00</td> <td>-15.52</td> </tr> <tr> <td>-3.62</td> <td>4804.00</td> <td>-3.62</td> <td>5.00</td> <td>1.38</td> <td>54.00</td> <td>-52.62</td> </tr> <tr> <td>51.12</td> <td>4804.00</td> <td>51.12</td> <td>5.00</td> <td>56.12</td> <td>74.00</td> <td>-17.88</td> </tr> <tr> <td>-12.56</td> <td>12010.00</td> <td>-12.56</td> <td>14.68</td> <td>2.12</td> <td>54.00</td> <td>-51.88</td> </tr> <tr> <td>42.18</td> <td>12010.00</td> <td>42.18</td> <td>14.68</td> <td>56.86</td> <td>74.00</td> <td>-17.14</td> </tr> </tbody> </table>	Level (dBuV/m)	Frequency (MHz)	SA reading (dBuV)	Factor (dB/m)	Emission level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	40.02	2390.00	40.02	-1.66	38.36	54.00	-15.64	59.56	2390.00	59.56	-1.66	57.90	74.00	-16.10	46.10	2400.00	46.10	-1.68	44.42	54.00	-9.58	69.21	2400.00	69.21	-1.68	67.53	74.00	-6.47	45.42	2402.00	45.42	-1.68	43.74	94.00	-50.26	100.16	2402.00	100.16	-1.68	98.48	114.00	-15.52	-3.62	4804.00	-3.62	5.00	1.38	54.00	-52.62	51.12	4804.00	51.12	5.00	56.12	74.00	-17.88	-12.56	12010.00	-12.56	14.68	2.12	54.00	-51.88	42.18	12010.00	42.18	14.68	56.86	74.00	-17.14	<table border="1"> <thead> <tr> <th>Remark</th> <th>ANT High cm</th> <th>Turn Table deg</th> </tr> </thead> <tbody> <tr> <td>Average</td> <td>265</td> <td>1</td> </tr> <tr> <td>Peak</td> <td>265</td> <td>1</td> </tr> <tr> <td>Average</td> <td>265</td> <td>1</td> </tr> <tr> <td>Peak</td> <td>265</td> <td>1</td> </tr> <tr> <td>Average</td> <td>265</td> <td>1</td> </tr> <tr> <td>Peak</td> <td>265</td> <td>1</td> </tr> <tr> <td>Average</td> <td>100</td> <td>40</td> </tr> <tr> <td>Peak</td> <td>100</td> <td>40</td> </tr> <tr> <td>Average</td> <td>100</td> <td>50</td> </tr> <tr> <td>Peak</td> <td>100</td> <td>50</td> </tr> </tbody> </table>	Remark	ANT High cm	Turn Table deg	Average	265	1	Peak	265	1	Average	265	1	Peak	265	1	Average	265	1	Peak	265	1	Average	100	40	Peak	100	40	Average	100	50	Peak	100	50
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46.10	2400.00	46.10	-1.68	44.42	54.00	-9.58																																																																																																																																						
69.21	2400.00	69.21	-1.68	67.53	74.00	-6.47																																																																																																																																						
45.42	2402.00	45.42	-1.68	43.74	94.00	-50.26																																																																																																																																						
100.16	2402.00	100.16	-1.68	98.48	114.00	-15.52																																																																																																																																						
-3.62	4804.00	-3.62	5.00	1.38	54.00	-52.62																																																																																																																																						
51.12	4804.00	51.12	5.00	56.12	74.00	-17.88																																																																																																																																						
-12.56	12010.00	-12.56	14.68	2.12	54.00	-51.88																																																																																																																																						
42.18	12010.00	42.18	14.68	56.86	74.00	-17.14																																																																																																																																						
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<b>Modulation</b>	GFSK	<b>Test Freq. (MHz)</b>	2402
<b>Polarization</b>	Vertical		

Test By :Roger Lu      Temperature(°C):25      Humidity(%):62



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2390.00	37.77	54.00	-16.23	39.43	-1.66	Average	355	279
2	2390.00	55.97	74.00	-18.03	57.63	-1.66	Peak	355	279
3	2400.00	43.24	54.00	-10.76	44.92	-1.68	Average	355	279
4	2400.00	66.49	74.00	-7.51	68.17	-1.68	Peak	355	279
5	2402.00	42.66	94.00	-51.34	44.34	-1.68	Average	355	279
6	2402.00	97.40	114.00	-16.60	99.08	-1.68	Peak	355	279
7	4804.00	2.20	54.00	-51.80	-2.80	5.00	Average	100	81
8	4804.00	56.94	74.00	-17.06	51.94	5.00	Peak	100	81
9	12010.00	1.79	54.00	-52.21	-12.89	14.68	Average	100	81
10	12010.00	56.53	74.00	-17.47	41.85	14.68	Peak	100	20

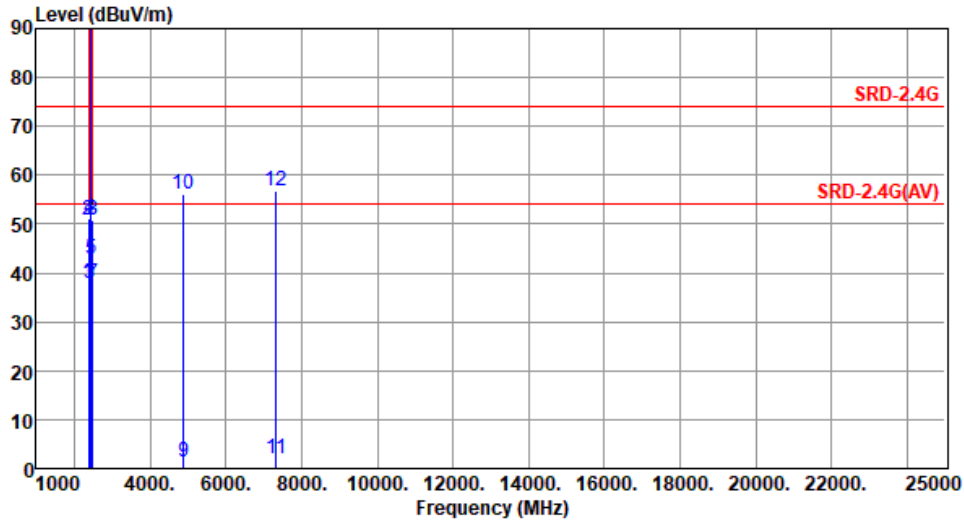
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB/m)

\*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

<b>Modulation</b>	GFSK	<b>Test Freq. (MHz)</b>	2442
<b>Polarization</b>	Horizontal		

Test By : Roger Lu      Temperature(°C): 25      Humidity(%): 62



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2390.00	37.80	54.00	-16.20	39.46	-1.66	Average	294	1
2	2390.00	50.77	74.00	-23.23	52.43	-1.66	Peak	294	1
3	2400.00	37.91	54.00	-16.09	39.59	-1.68	Average	294	1
4	2400.00	51.09	74.00	-22.91	52.77	-1.68	Peak	294	1
5	2442.00	42.73	94.00	-51.27	44.50	-1.77	Average	294	1
6	2442.00	97.47	114.00	-16.53	99.24	-1.77	Peak	294	1
7	2483.50	37.94	54.00	-16.06	39.80	-1.86	Average	294	1
8	2483.50	50.72	74.00	-23.28	52.58	-1.86	Peak	294	1
9	4884.00	1.40	54.00	-52.60	-3.69	5.09	Average	100	50
10	4884.00	56.14	74.00	-17.86	51.05	5.09	Peak	100	50
11	7326.00	1.96	54.00	-52.04	-8.44	10.40	Average	100	9
12	7326.00	56.70	74.00	-17.30	46.30	10.40	Peak	100	9

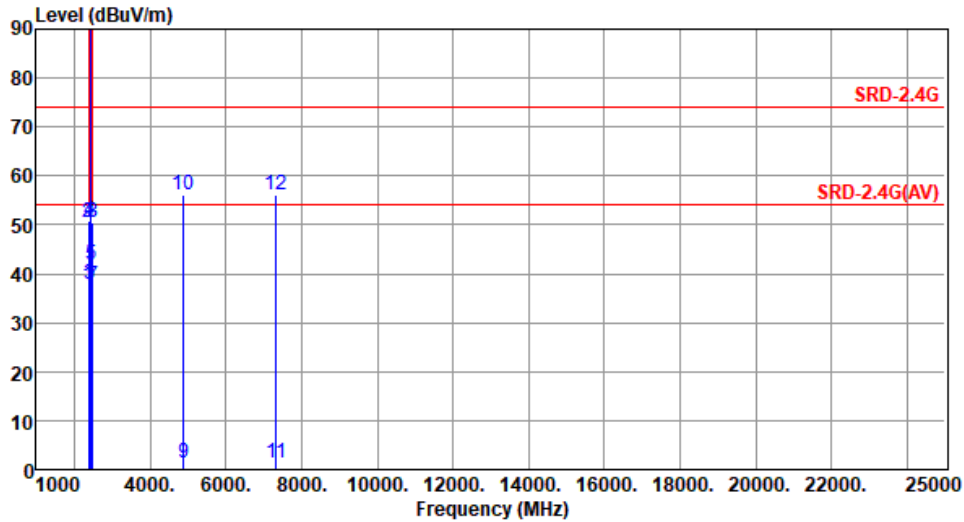
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB/m)

\*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

<b>Modulation</b>	GFSK	<b>Test Freq. (MHz)</b>	2442
<b>Polarization</b>	Vertical		

Test By : Roger Lu      Temperature(°C): 25      Humidity(%): 62



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2390.00	37.63	54.00	-16.37	39.29	-1.66	Average	351	275
2	2390.00	50.63	74.00	-23.37	52.29	-1.66	Peak	351	275
3	2400.00	37.87	54.00	-16.13	39.55	-1.68	Average	351	275
4	2400.00	50.90	74.00	-23.10	52.58	-1.68	Peak	351	275
5	2442.00	41.91	94.00	-52.09	43.68	-1.77	Average	351	275
6	2442.00	96.65	114.00	-17.35	98.42	-1.77	Peak	351	275
7	2483.50	37.69	54.00	-16.31	39.55	-1.86	Average	351	275
8	2483.50	50.63	74.00	-23.37	52.49	-1.86	Peak	351	275
9	4884.00	1.29	54.00	-52.71	-3.80	5.09	Average	100	83
10	4884.00	56.03	74.00	-17.97	50.94	5.09	Peak	100	83
11	7326.00	1.26	54.00	-52.74	-9.14	10.40	Average	314	208
12	7326.00	56.00	74.00	-18.00	45.60	10.40	Peak	314	208

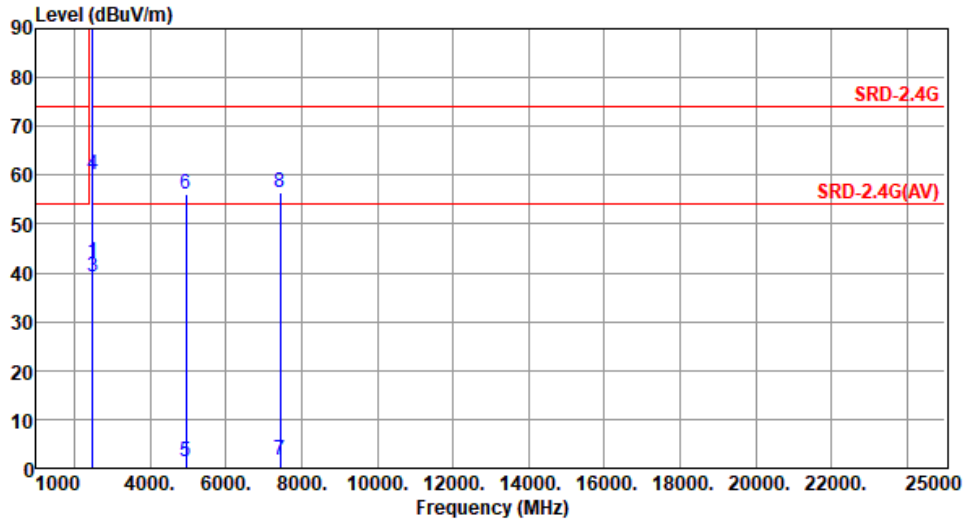
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB/m)

\*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

<b>Modulation</b>	GFSK	<b>Test Freq. (MHz)</b>	2480
<b>Polarization</b>	Horizontal		

Test By :Roger Lu      Temperature(°C):25      Humidity(%):62



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2480.00	42.18	94.00	-51.82	44.03	-1.85	Average	284	359
2	2480.00	96.92	114.00	-17.08	98.77	-1.85	Peak	284	359
3	2483.50	39.23	54.00	-14.77	41.09	-1.86	Average	284	359
4	2483.50	60.24	74.00	-13.76	62.10	-1.86	Peak	284	359
5	4960.00	1.39	54.00	-52.61	-3.91	5.30	Average	100	40
6	4960.00	56.13	74.00	-17.87	50.83	5.30	Peak	100	40
7	7440.00	1.69	54.00	-52.31	-8.46	10.15	Average	100	11
8	7440.00	56.43	74.00	-17.57	46.28	10.15	Peak	100	11

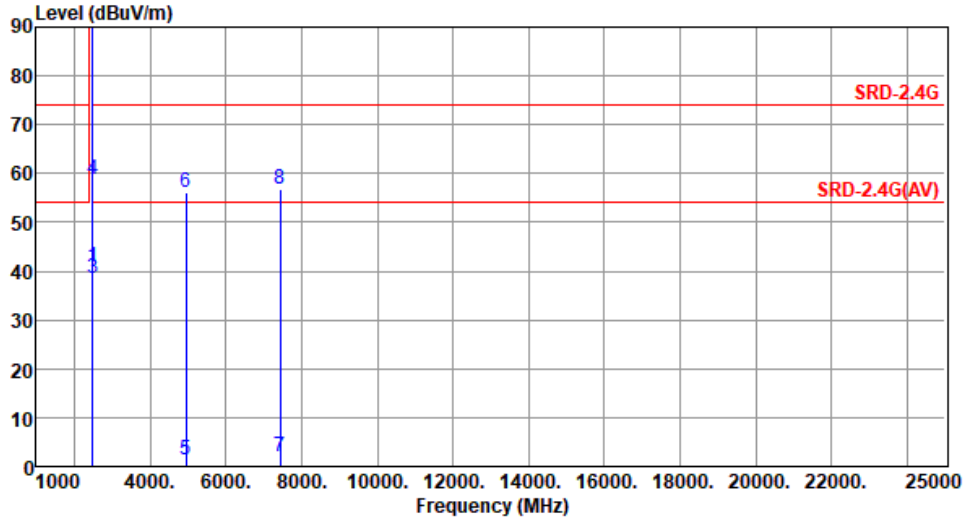
Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor\* (dB/m)

\*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

<b>Modulation</b>	GFSK	<b>Test Freq. (MHz)</b>	2480
<b>Polarization</b>	Vertical		

Test By :Roger Lu      Temperature(°C):25      Humidity(%):62



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2480.00	40.99	94.00	-53.01	42.84	-1.85	Average	354	281
2	2480.00	95.73	114.00	-18.27	97.58	-1.85	Peak	354	281
3	2483.50	38.42	54.00	-15.58	40.28	-1.86	Average	354	281
4	2483.50	58.84	74.00	-15.16	60.70	-1.86	Peak	354	281
5	4960.00	1.37	54.00	-52.63	-3.93	5.30	Average	100	79
6	4960.00	56.11	74.00	-17.89	50.81	5.30	Peak	100	79
7	7440.00	2.02	54.00	-51.98	-8.13	10.15	Average	316	205
8	7440.00	56.76	74.00	-17.24	46.61	10.15	Peak	316	205

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB/m)

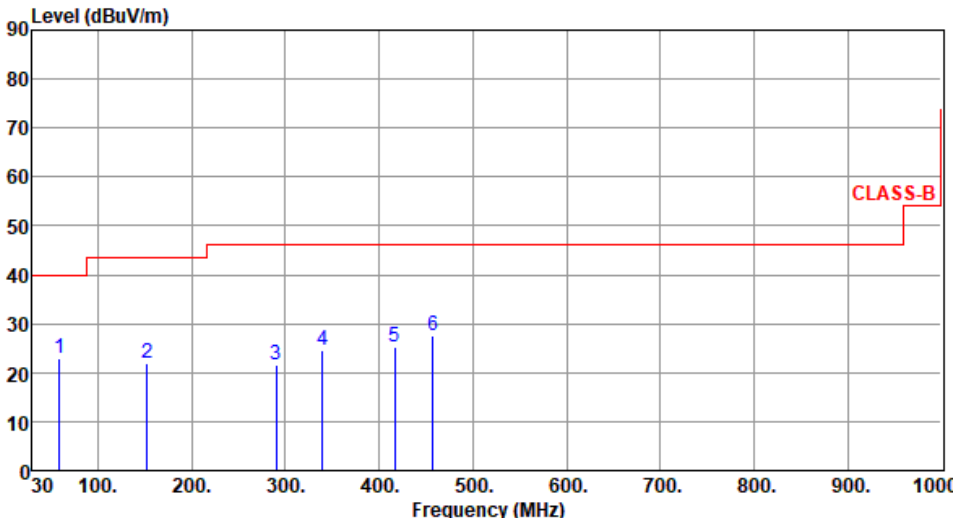
\*Factor includes antenna factor , cable loss and amplifier gain

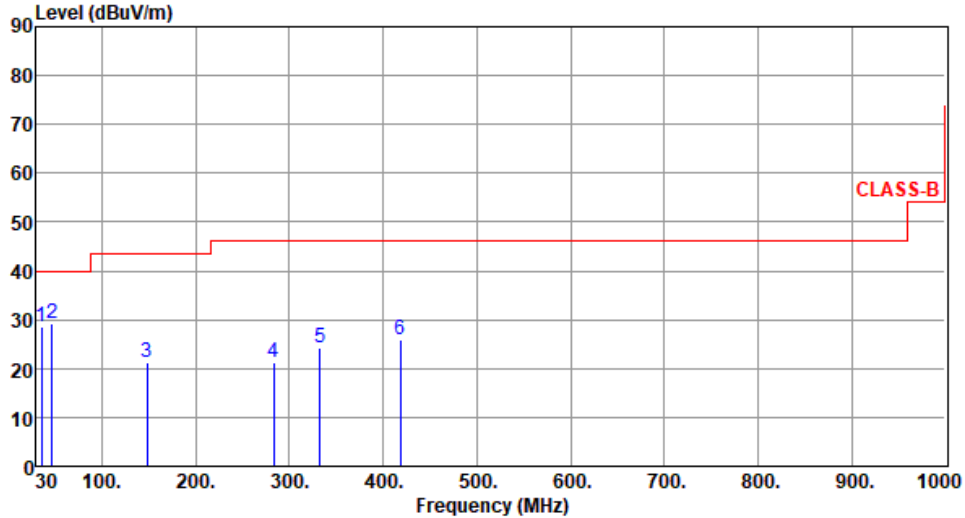
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).



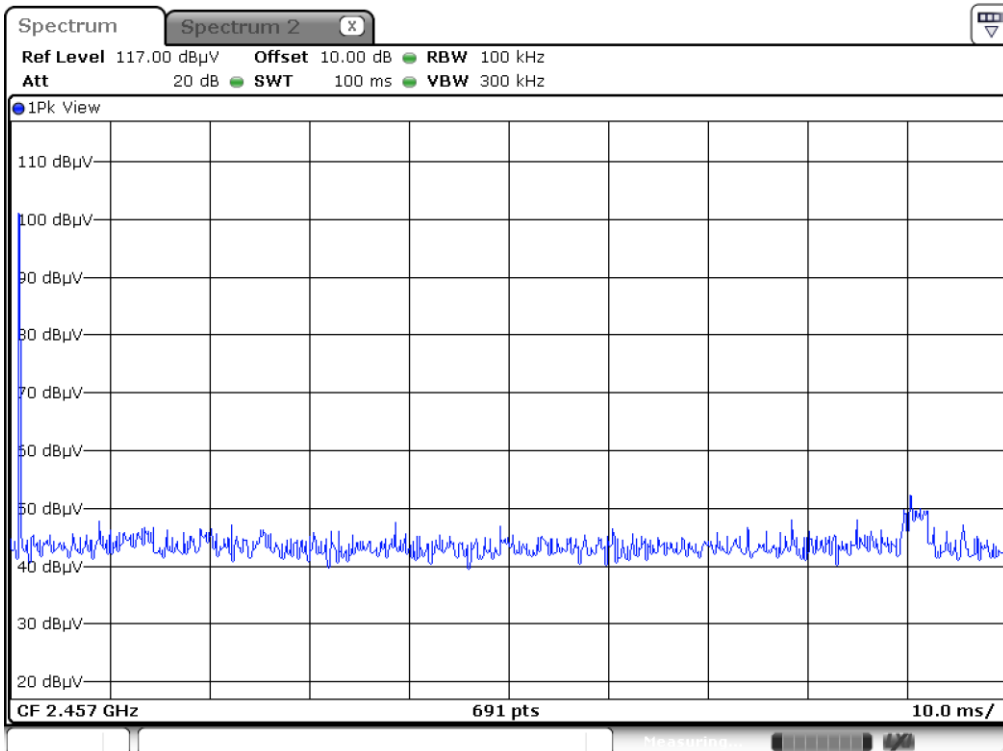
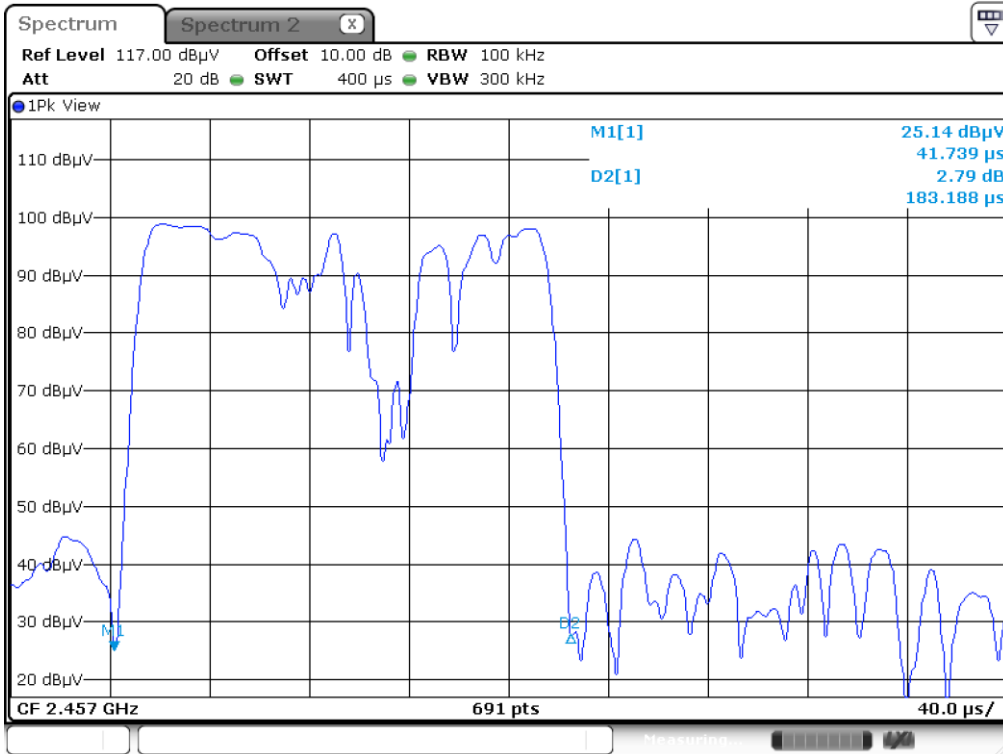
## Configuration 2: Charging mode

### 3.2.7 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation	Charging	Test Freq. (MHz)	---						
Polarization	Horizontal								
Test By :Roger Lu      Temperature(°C):25      Humidity(%):63									
 <p>The graph displays the radiated unwanted emissions for a charging mode transmitter. The y-axis represents the emission level in dBuV/m, ranging from 0 to 90. The x-axis represents the frequency in MHz, ranging from 30 to 1000. A red line indicates the CLASS-B limit, which is constant at 40 dBuV/m from 30 MHz to 100 MHz, then steps up to 45 dBuV/m from 100 MHz to 1000 MHz. Six blue vertical lines represent measured emission peaks, labeled 1 through 6, with their respective frequencies and levels indicated in the table below.</p>									
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	59.10	23.01	40.00	-16.99	32.48	-9.47	Peak	---	---
2	152.22	21.99	43.50	-21.51	30.67	-8.68	Peak	---	---
3	289.96	21.74	46.00	-24.26	30.36	-8.62	Peak	---	---
4	339.43	24.63	46.00	-21.37	31.79	-7.16	Peak	---	---
5	417.03	25.29	46.00	-20.71	30.36	-5.07	Peak	---	---
6	457.77	27.64	46.00	-18.36	31.35	-3.71	Peak	---	---
<p>Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB/m)            *Factor includes antenna factor , cable loss and amplifier gain            Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).            Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.</p>									

<b>Modulation</b>	Charging	<b>Test Freq. (MHz)</b>	---						
<b>Polarization</b>	Vertical								
Test By : Roger Lu		Temperature(°C): 25			Humidity(%): 63				
									
	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		cm	deg
1	35.82	28.49	40.00	-11.51	38.27	-9.78	Peak	---	---
2	46.49	29.14	40.00	-10.86	37.79	-8.65	Peak	---	---
3	148.34	21.25	43.50	-22.25	30.04	-8.79	Peak	---	---
4	283.17	21.09	46.00	-24.91	29.86	-8.77	Peak	---	---
5	332.64	24.20	46.00	-21.80	31.47	-7.27	Peak	---	---
6	418.00	25.82	46.00	-20.18	30.86	-5.04	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB/m)  
\*Factor includes antenna factor , cable loss and amplifier gain  
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).



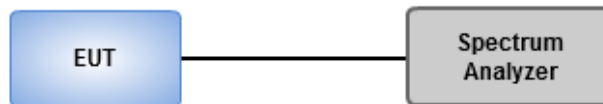
$$20\log(\text{Duty cycle}) = 20\log \frac{0.183188 * 1 \text{ ms}}{100 \text{ ms}} = -54.74\text{dB}$$

### 3.3 20dB and Occupied Bandwidth

#### 3.3.1 Test Procedures

1. Set resolution bandwidth (RBW) = 20kHz, Video bandwidth = 100 kHz.
2. Detector = Peak(20 dB bandwidth) / Sample(Occupied bandwidth), Trace mode = max hold
3. Sweep = auto couple, Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20dB relative to the maximum level measured in the fundamental emission.
5. Use the occupied measurement function of spectrum analyzer to measure 99% occupied bandwidth.

#### 3.3.2 Test Setup

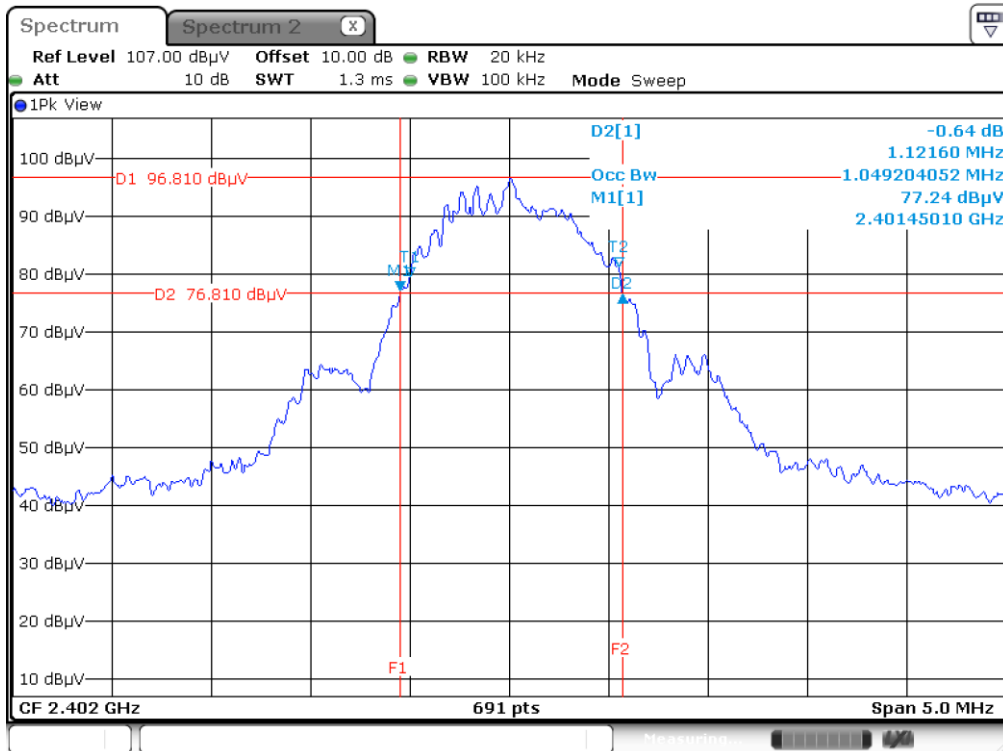


#### 3.3.3 20dB and Occupied Bandwidth

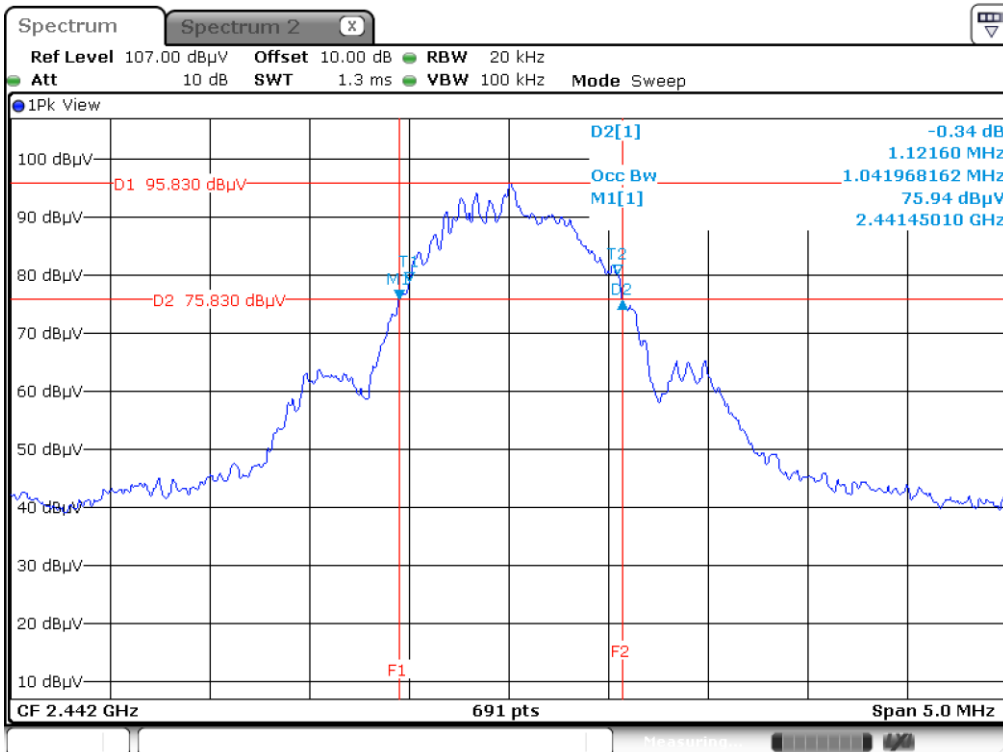
<b>Ambient Condition</b>	25°C / 62%	<b>Tested By</b>	Roger Lu
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Frequency (MHz)	20dB Bandwidth (MHz)	99% Occupied BW
2402	1.122	1.049
2442	1.122	1.042
2480	1.129	1.056

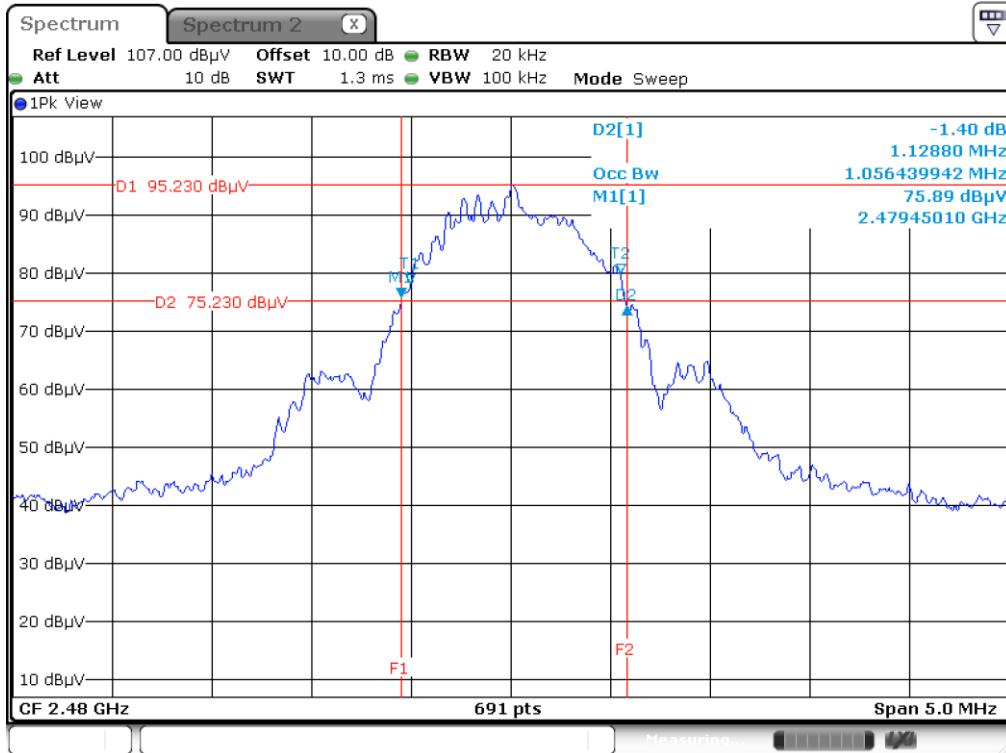
### 2402MHz



### 2442MHz



### 2480MHz



## 4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corporation (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

### **Linkou**

Tel: 886-2-2601-1640

No.30-2, Ding Fwu Tsuen, Lin Kou  
District, New Taipei City, Taiwan  
(R.O.C.)

### **Kwei Shan**

Tel: 886-3-271-8666

No.3-1, Lane 6, Wen San 3rd  
St., Kwei Shan Dist., Tao Yuan  
City 33381, Taiwan (R.O.C.)  
No.2-1, Lane 6, Wen San 3rd  
St., Kwei Shan Dist., Tao Yuan  
City 33381, Taiwan (R.O.C.)

### **Kwei Shan Site II**

Tel: 886-3-271-8640

No.14-1, Lane 19, Wen San 3rd  
St., Kwei Shan Dist., Tao Yuan  
City 333, Taiwan (R.O.C.)

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666

Fax: 886-3-318-0345

Email: ICC\_Service@icertifi.com.tw

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