

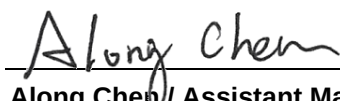
FCC C2PC Test Report

FCC ID : JVPEC2-CW
Equipment : Mouse for e-Sports
Model No. : EC2-CW
Brand Name : ZOWIE
Applicant : BENQ CORPORATION
Address : 16 Jihu Road, Neihu, Taipei 114, Taiwan
Standard : 47 CFR FCC Part 15.249
Received Date : Aug. 23, 2022
Tested Date : Aug. 24, 2022

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 shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:

Approved by:



Along Chen / Assistant Manager



Gary Chang / Manager

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Appendix A. Unwanted Emission

Appendix B. 20dB and Occupied Bandwidth

Release Record

Report No.	Version	Description	Issued Date
FR260608-01	Rev. 01	Initial issue	Sep. 06, 2022

Summary of Test Results

FCC Rules	Test Items	Measured	Result
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

This is a Class II Permissive Change report (C2PC).

This report is issued as a supplementary report to original report no. FR260608. The modifications are concerned with following items:

- Adding channels for 1Mbps data rate by software setting.
- To enable 2Mbps data rate by software setting.

In this report, only 2Mbps data was record in the following sections. No additional test results of 1Mbps data rate since L/M/H channel is not changed even if channels are adding.

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	Modulation	Ch. Freq. (MHz)	Channel Number	Data Rate
2400-2483.5	GFSK	2403-2475	1-73 [73]	1 Mbps
2400-2483.5	GFSK	2403-2475	1-73 [73]	2 Mbps

1.1.2 Antenna Details

Ant. No.	Brand	Model	Type	Connector	Gain (dBi)
1	BENQ Corporation	EC2-CW ANT	LDS Antenna	NA	3.94

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Type	3.7Vdc from battery 5Vdc from host
------------	---------------------------------------

1.1.4 Accessories

No.	Equipment	Description
1	Battery	Brand: Hangzhou Future Power Technology Co., Ltd Model: FT602030P/300mAh Rating: 300mAh, 3.7V
2	USB cable	Brand: Le Prestique Electronics Manufacturing Model: USB Type-C cable 2.05m non-shielded with one core

1.1.5 Channel List

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

1.1.6 Test Tool and Duty Cycle

Test Tool	Bus Hound, Version: 7.00	
Duty Cycle and Duty Factor	Duty Cycle (%)	Duty Factor (dB)
	19.82	7.03

1.1.7 Power Index of Test Tool

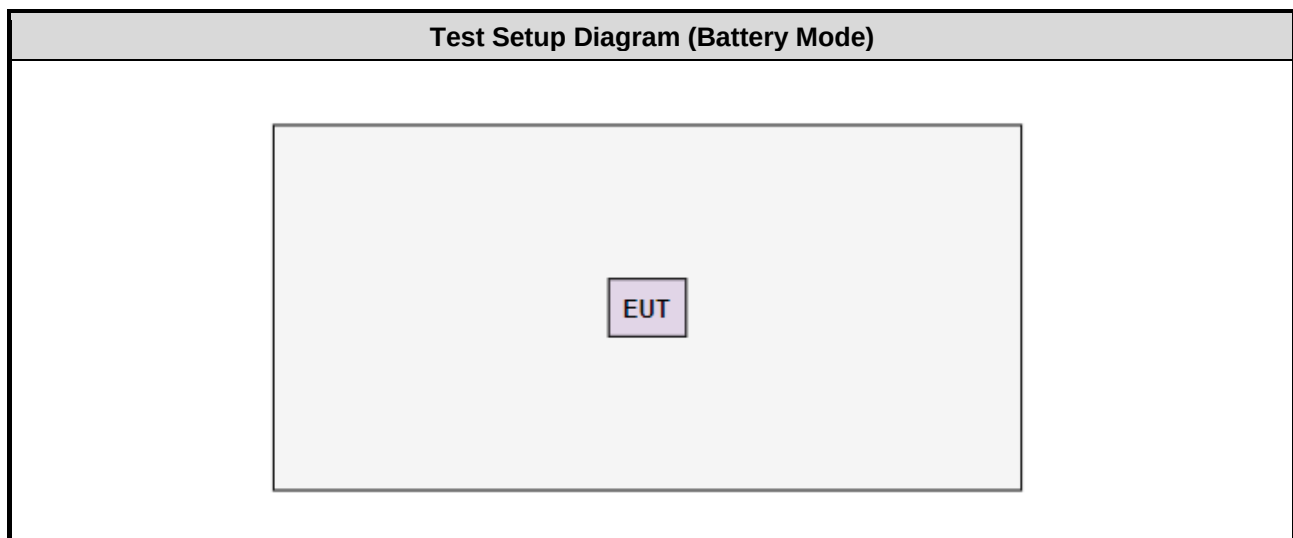
Modulation Mode	Test Frequency (MHz)		
	2403	2440	2475
GFSK	Default(04)	Default(04)	Default(04)

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	Notebook	DELL	Latitude 5400	DoC	---

Note: The support notebook was removed from test table after sending command to control EUT to transmit continuously.

1.3 Test Setup Chart



1.4 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Aug. 24, 2022				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Mar. 15, 2022	Mar. 14, 2023
Spectrum Analyzer	R&S	FSV40	101498	Nov. 29, 2021	Nov. 28, 2022
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 08, 2021	Nov. 07, 2022
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Aug. 03, 2022	Aug. 02, 2023
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 03, 2021	Dec. 02, 2022
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 04, 2021	Nov. 03, 2022
Preamplifier	EMC	EMC02325	980225	Jun. 28, 2022	Jun. 27, 2023
Preamplifier	EMC	EMC118A45SE	980898	Jul. 16, 2022	Jul. 15, 2023
Preamplifier	EMC	EMC184045SE	980903	Jul. 16, 2022	Jul. 15, 2023
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 05, 2021	Oct. 04, 2022
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 05, 2021	Oct. 04, 2022
LF cable 11M	EMC	EMCCFD400-NW-N W-11000	200801	Oct. 05, 2021	Oct. 04, 2022
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	160502	Oct. 05, 2021	Oct. 04, 2022
RF Cable	EMC	EMC104-35M-35M- 8000	210920	Oct. 05, 2021	Oct. 04, 2022
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 05, 2021	Oct. 04, 2022
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	± 34.130 Hz
Unwanted Emission ≤ 1 GHz	± 3.41 dB
Unwanted Emission > 1 GHz	± 4.59 dB

2 Test Configuration

2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	03CH01-WS
Address of Test Site	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- ISED#: 10807A
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate	Test Configuration
Unwanted Emissions $\leq$ 1GHz	GFSK	2440	2 Mbps	-
Field Strength of Fundamental Unwanted Emissions > 1GHz 20dB bandwidth	GFSK	2403 / 2440 / 2475	2 Mbps	-

3 Transmitter Test Results

3.1 Unwanted Emission

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

3.1.1 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

3.1.2 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.

3.1.3 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:

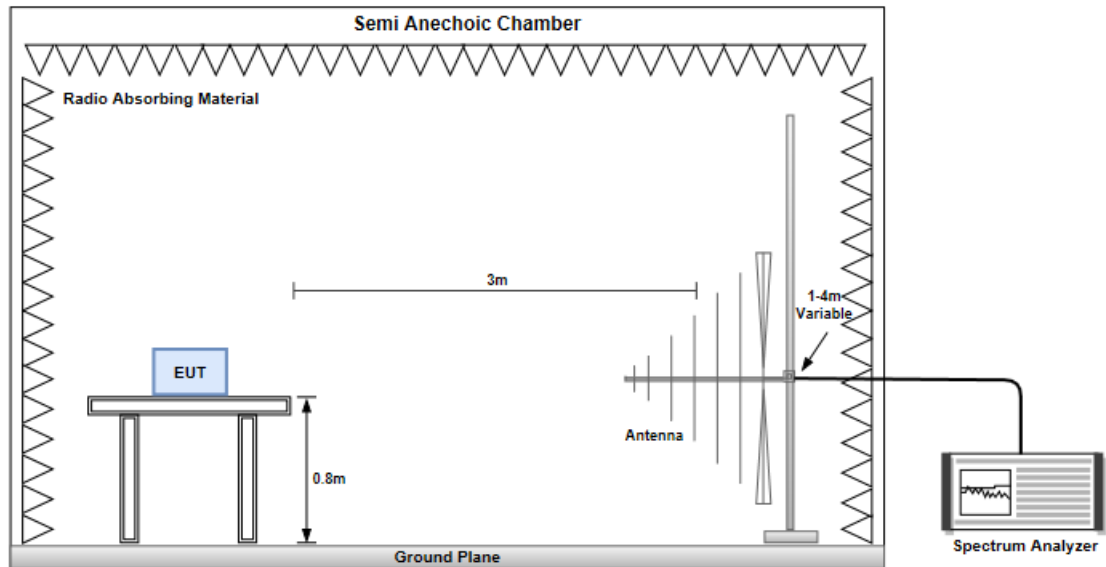
1. Radiated emission below 1GHz
120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission
2. Radiated emission above 1GHz / Peak value except fundamental
RBW=1MHz, VBW=3MHz and Peak detector
3. Radiated emission above 1GHz / Average value for field strength of fundamental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

$$20\log (\text{Duty cycle}) = 20\log \frac{0.126812 \times 13\text{ms}}{100 \text{ ms}} = -35.66\text{dB}$$

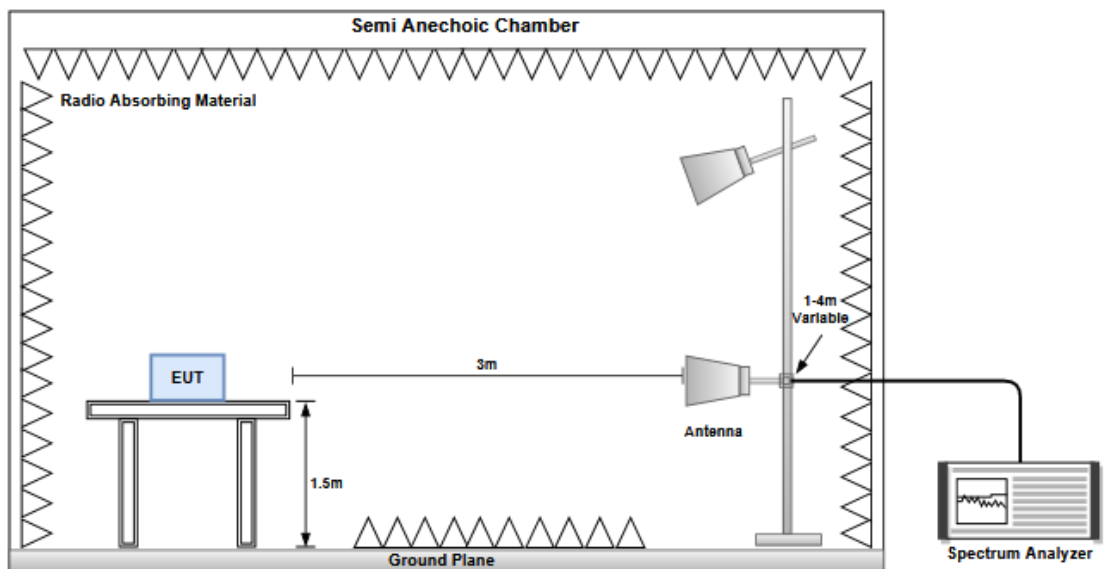
4. Radiated emission above 1GHz / Average value for other emissions
RBW=1MHz, VBW=1/T and Peak detector
5. Radiated emission Peak value for fundamental
RBW=2MHz, VBW=10MHz and Peak detector

3.1.4 Test Setup

Radiated Emissions below 1 GHz



Radiated Emissions above 1 GHz



3.1.5 Test Results

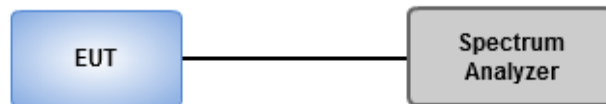
Refer to Appendix A.

3.2 20dB and Occupied Bandwidth

3.2.1 Test Procedures

1. Set resolution bandwidth (RBW) = 20 kHz, 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.

3.2.2 Test Setup



3.2.3 Test Results

Ambient Condition	24°C / 65%	Tested By	Brad Wu
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Refer to Appendix B.

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

==END==



Unwanted Emissions (Below 1GHz)

Modulation	GFSK	Test Freq. (MHz)	2440																																																																						
Polarization	Horizontal																																																																								
Test By :Akun Chung Temperature(°C):24 Humidity(%):65																																																																									
Level (dBuV/m) Frequency (MHz) <table><tr><th></th><th>Freq. MHz</th><th>Emission level dBuV/m</th><th>Limit dBuV/m</th><th>Margin dB</th><th>SA reading dBuV</th><th>Factor dB/m</th><th>Remark</th><th>ANT High cm</th><th>Turn Table deg</th></tr><tr><td>1</td><td>43.58</td><td>24.55</td><td>40.00</td><td>-15.45</td><td>33.06</td><td>-8.51</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>2</td><td>161.92</td><td>25.79</td><td>43.50</td><td>-17.71</td><td>34.98</td><td>-9.19</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>3</td><td>215.27</td><td>27.31</td><td>43.50</td><td>-16.19</td><td>39.30</td><td>-11.99</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>4</td><td>257.95</td><td>27.16</td><td>46.00</td><td>-18.84</td><td>36.84</td><td>-9.68</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>5</td><td>437.40</td><td>29.60</td><td>46.00</td><td>-16.40</td><td>34.15</td><td>-4.55</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>6</td><td>509.18</td><td>31.11</td><td>46.00</td><td>-14.89</td><td>34.17</td><td>-3.06</td><td>Peak</td><td>---</td><td>---</td></tr></table>					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	43.58	24.55	40.00	-15.45	33.06	-8.51	Peak	---	---	2	161.92	25.79	43.50	-17.71	34.98	-9.19	Peak	---	---	3	215.27	27.31	43.50	-16.19	39.30	-11.99	Peak	---	---	4	257.95	27.16	46.00	-18.84	36.84	-9.68	Peak	---	---	5	437.40	29.60	46.00	-16.40	34.15	-4.55	Peak	---	---	6	509.18	31.11	46.00	-14.89	34.17	-3.06	Peak	---	---
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Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + 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.																																																																									



Modulation	GFSK	Test Freq. (MHz)	2440
Polarization	Vertical		
Test By :Akun Chung Temperature(°C):24 Humidity(%):65			
Level (dBUV/m)			



Unwanted Emissions (Above 1GHz)

Modulation	GFSK	Test Freq. (MHz)	2403
Polarization	Horizontal		
Test By :Brad Wu Temperature(°C):24 Humidity(%):65			
Level (dBuV/m) <			



Modulation	GFSK	Test Freq. (MHz)	2403
Polarization	Vertical		
Test By :Brad Wu Temperature(°C):24 Humidity(%):65			
Level (dBuV/m)			



Modulation	GFSK	Test Freq. (MHz)	2440
Polarization	Horizontal		
Test By :Brad Wu Temperature(°C):24 Humidity(%):65			
Level (dBUV/m)			



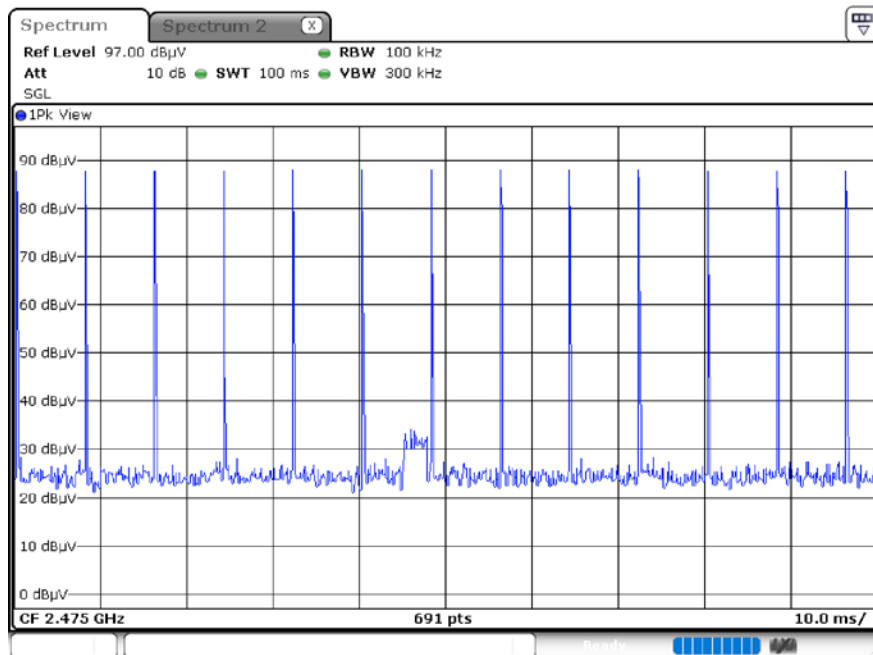
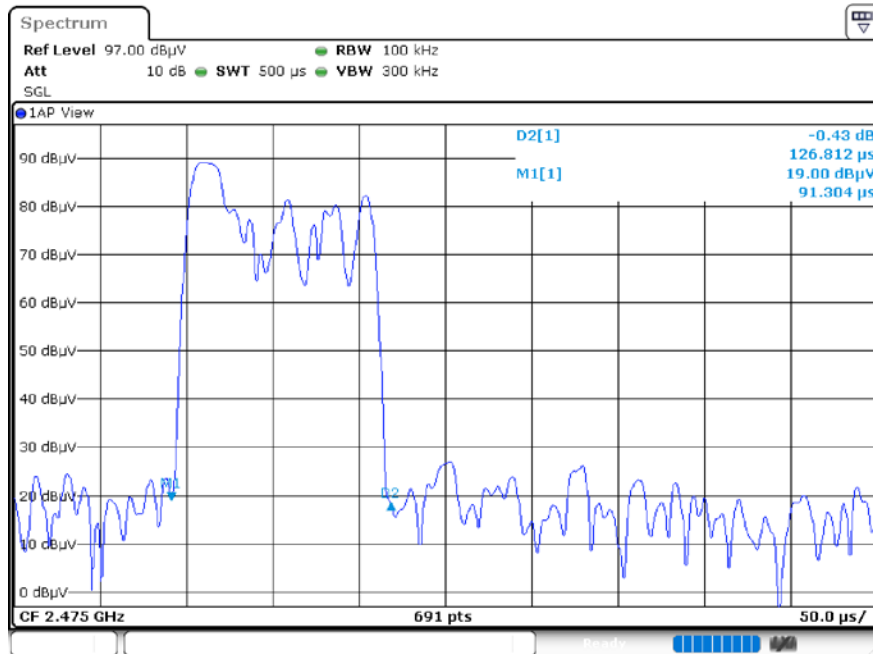
Modulation	GFSK	Test Freq. (MHz)	2440
Polarization	Vertical		
Test By :Brad Wu Temperature(°C):24 Humidity(%):65			
Level (dBUV/m)			



Modulation	GFSK	Test Freq. (MHz)	2475																																																																																										
Polarization	Horizontal																																																																																												
Test By :Brad Wu Temperature(°C):24 Humidity(%):65																																																																																													
Level (dBuV/m) Frequency (MHz) <table><tr><th></th><th>Freq. MHz</th><th>Emission level dBuV/m</th><th>Limit dBuV/m</th><th>Margin dB</th><th>SA reading dBuV</th><th>Factor dB/m</th><th>Remark</th><th>ANT High cm</th><th>Turn Table deg</th></tr><tr><td>1</td><td>2475.00</td><td>64.66</td><td>94.00</td><td>-29.34</td><td></td><td></td><td>Average</td><td>100</td><td>209</td></tr><tr><td>2</td><td>2475.00</td><td>100.32</td><td>114.00</td><td>-13.68</td><td>105.64</td><td>-5.32</td><td>Peak</td><td>100</td><td>209</td></tr><tr><td>3</td><td>2483.50</td><td>39.96</td><td>54.00</td><td>-14.04</td><td>45.27</td><td>-5.31</td><td>Average</td><td>100</td><td>209</td></tr><tr><td>4</td><td>2483.50</td><td>50.68</td><td>74.00</td><td>-23.32</td><td>55.99</td><td>-5.31</td><td>Peak</td><td>100</td><td>209</td></tr><tr><td>5</td><td>4950.00</td><td>12.76</td><td>54.00</td><td>-41.24</td><td></td><td></td><td>Average</td><td>100</td><td>245</td></tr><tr><td>6</td><td>4950.00</td><td>48.42</td><td>74.00</td><td>-25.58</td><td>49.53</td><td>-1.11</td><td>Peak</td><td>100</td><td>245</td></tr><tr><td>7</td><td>7425.00</td><td>23.18</td><td>54.00</td><td>-30.82</td><td></td><td></td><td>Average</td><td>100</td><td>36</td></tr><tr><td>8</td><td>7425.00</td><td>58.84</td><td>74.00</td><td>-15.16</td><td>54.53</td><td>4.31</td><td>Peak</td><td>100</td><td>36</td></tr></table>					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	2475.00	64.66	94.00	-29.34			Average	100	209	2	2475.00	100.32	114.00	-13.68	105.64	-5.32	Peak	100	209	3	2483.50	39.96	54.00	-14.04	45.27	-5.31	Average	100	209	4	2483.50	50.68	74.00	-23.32	55.99	-5.31	Peak	100	209	5	4950.00	12.76	54.00	-41.24			Average	100	245	6	4950.00	48.42	74.00	-25.58	49.53	-1.11	Peak	100	245	7	7425.00	23.18	54.00	-30.82			Average	100	36	8	7425.00	58.84	74.00	-15.16	54.53	4.31	Peak	100	36
	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	2475.00	64.66	94.00	-29.34			Average	100	209																																																																																				
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5	4950.00	12.76	54.00	-41.24			Average	100	245																																																																																				
6	4950.00	48.42	74.00	-25.58	49.53	-1.11	Peak	100	245																																																																																				
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Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + 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: When average value is calculated not measured, no SA reading and factor value are listed.																																																																																													



Modulation	GFSK	Test Freq. (MHz)	2475
Polarization	Vertical		
Test By :Brad Wu Temperature(°C):24 Humidity(%):65			
Level (dBUV/m)			



$$20\log (\text{Duty cycle}) = 20\log \frac{0.126812 \times 13\text{ms}}{100 \text{ ms}} = -35.66\text{dB}$$



Frequency (MHz)	20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2403.0	2.048	1.975
2440.0	2.048	1.983
2475.0	2.048	1.983

