





FCC 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 : Jun. 06, 2022

Tested Date : Jun. 15 ~ Jun. 21, 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 / Manage

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Appendix A. Unwanted Emission

Appendix B. 20dB and Occupied Bandwidth

Appendix C. AC Power Line Conducted Emissions



Release Record

Report No.	Version	Description	Issued Date
FR260608	Rev. 01	Initial issue	Jul. 12, 2022

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Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	15.207 AC Power Line Conducted Emissions [dBuV]: 25.055MHz 24.73 (Margin -25.27dB) -		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.

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1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information							
Frequency Range (MHz)	· · · · WOOHIISTION CO FRON (WHZ) COSONOL WILMOOF LISTS RSTO						
2400-2483.5	GFSK	2403-2475	1-5 [5]	1 Mbps			

1.1.2 Antenna Details

Ant. No.	Brand	Model	Туре	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	
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1.1.4 Accessories

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

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1.1.5 Channel List

Channel No.	Frequency (MHz)
1	2403
2	2423
3	2440
4	2461
5	2475

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)	
Duty Cycle and Duty Factor	33.02	4.81	

1.1.7 Power Index of Test Tool

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

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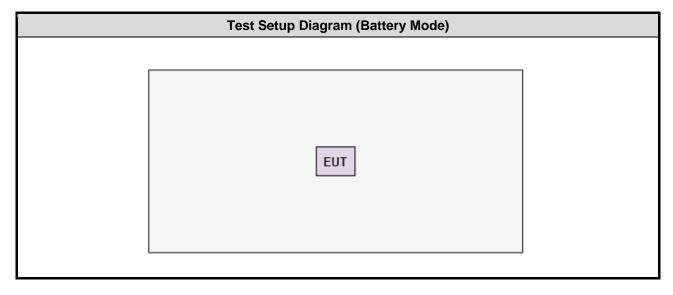


1.2 Local Support Equipment List

	Support Equipment List						
No.	Equipment	Brand	Model	FCC ID	Remarks		
1	Notebook	DELL	Latitude 5400	DoC			
For ch	For charging mode use only						
2	Enhance Wireless Receiver	BenQ	ER-80		Provided by applicant.		
3	USB cable	Le Prestique Electronics Manufacturing	USB Type-C cable		Provided by applicant.		
4	Adapter	Samsung	ETA-U90JWS				

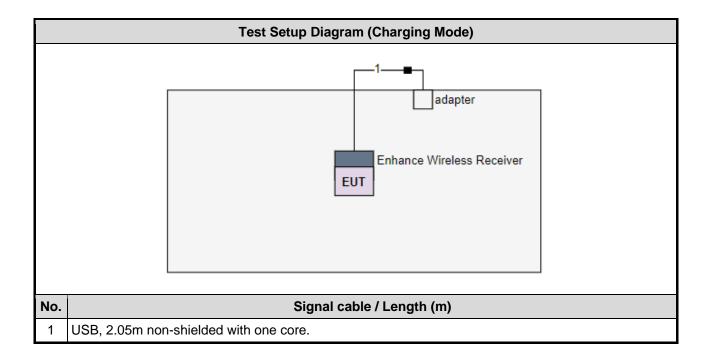
Note: The support notebook was removed from test table after sending command to control EUT to transmit continuously.

1.3 Test Setup Chart



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1.4 The Equipment List

Test Item Conducted Emission							
Test Site							
Tested Date							
Instrument Brand Model No. Serial No. Calibration Date Calibration Until							
Receiver	R&S	ESR3	101658	Feb. 16, 2022	Feb. 15, 2023		
LISN	R&S	ENV216	101579	Apr. 21, 2022	Apr. 20, 2023		
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127667	Jan .07, 2022	Jan .06, 2023		
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 19, 2021	Oct. 18, 2022		
50 ohm terminal (Support Unit)	NA	50	01	May 10, 2022	May 09, 2023		
Measurement Software AUDIX e3 6.120210k NA NA							

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Jun. 15, 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	Jun. 30, 2021	Jun. 29, 2022
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 9170508	Jan. 11, 2022	Jan. 10, 2023
Preamplifier	EMC	EMC02325	980225	Jun. 29, 2021	Jun. 28, 2022
Preamplifier	Agilent	83017A	MY39501308	Sep. 28, 2021	Sep. 27, 2022
Preamplifier	EMC	EMC184045B	980192	Jul. 14, 2021	Jul. 13, 2022
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

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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		
AC conducted emission	±2.92 dB		
Unwanted Emission ≤ 1GHz	±3.41 dB		
Unwanted Emission > 1GHz	±4.59 dB		

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2 Test Configuration

2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	CO01-WS, 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.: TW2732FCC 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
AC Power Line Conducted Emissions	Charging	•	-	-
Unwanted Emissions ≤ 1GHz	GFSK	2440	1 Mbps	-
	Charging	-	-	-
Field Strength of Fundamental				
Unwanted Emissions > 1GHz	GFSK	2403 / 2440 / 2475	1 Mbps	-
20dB bandwidth				

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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 Dista				
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.

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3.1.3 Test Procedures

- 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:

- Radiated emission below 1GHz
 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission
- Radiated emission above 1GHz / Peak value except fundamental RBW=1MHz, VBW=3MHz and Peak detector
- 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:

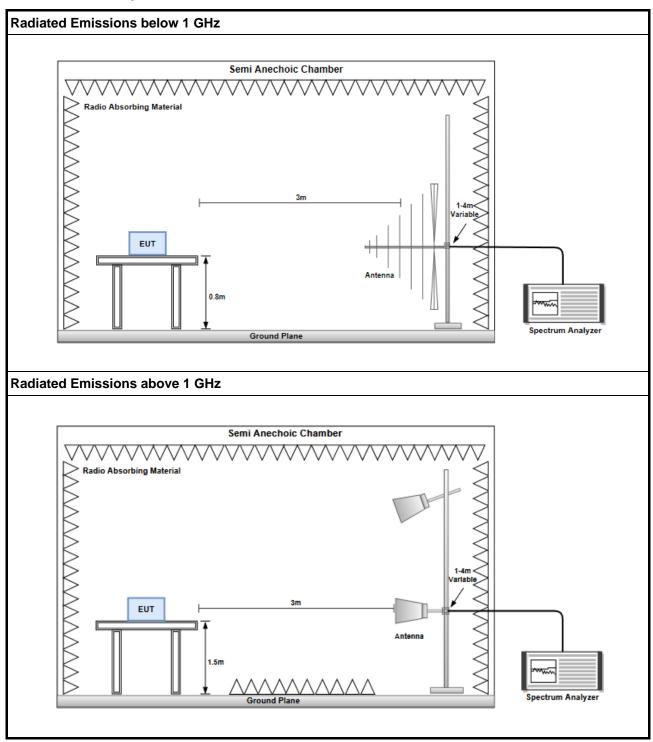
20log (Duty cycle) = 20log
$$\frac{0.125362 \times 13 \text{ms}}{100 \text{ ms}}$$
 = -35.76dB

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

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3.1.4 Test Setup



3.1.5 Test Results

Refer to Appendix A.

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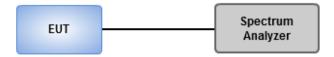


3.2 20dB and Occupied Bandwidth

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 specturm analyzer to measure 99% occupied bandwidth.

3.2.2 Test Setup



3.2.3 Test Results

Ambient Condition	23°C / 64%	Tested By	Roger Lu

Refer to Appendix B.

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3.3 AC Power Line Conducted Emissions

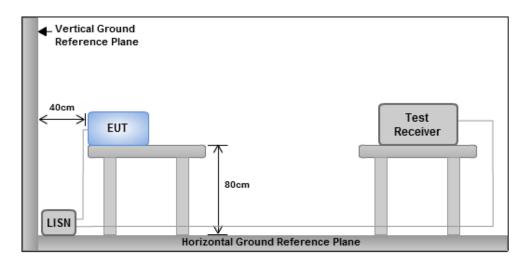
3.3.1 Limit of AC Power Line Conducted Emissions

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.				

3.3.2 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 Ω 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.

3.3.3 Test Setup



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

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

3.3.4 Test Results

Refer to Appendix C.

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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

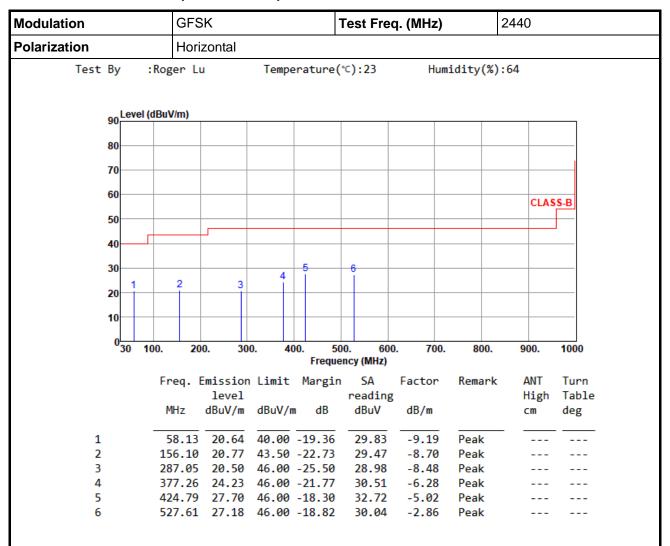
Email: ICC Service@icertifi.com.tw

==END==

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Unwanted Emissions (Below 1GHz)



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

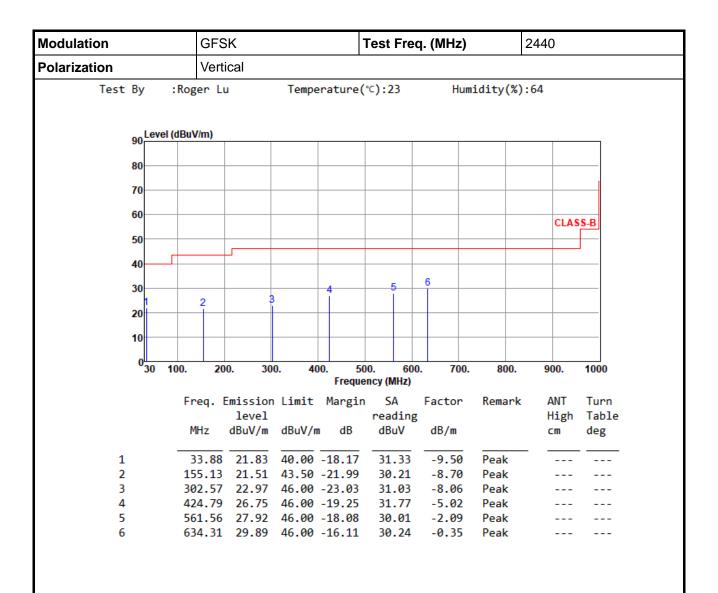
*Factor includes antenna factor, cable loss and amplifier gain

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.

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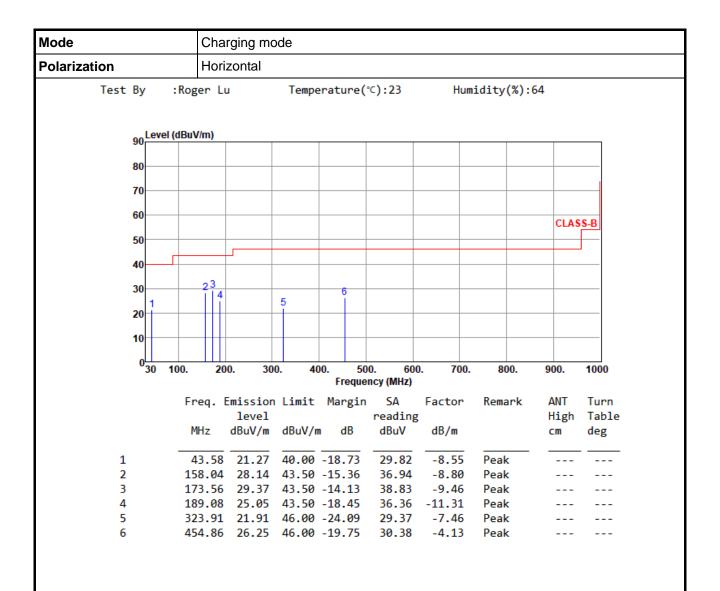


*Factor includes antenna factor, cable loss and amplifier gain

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.



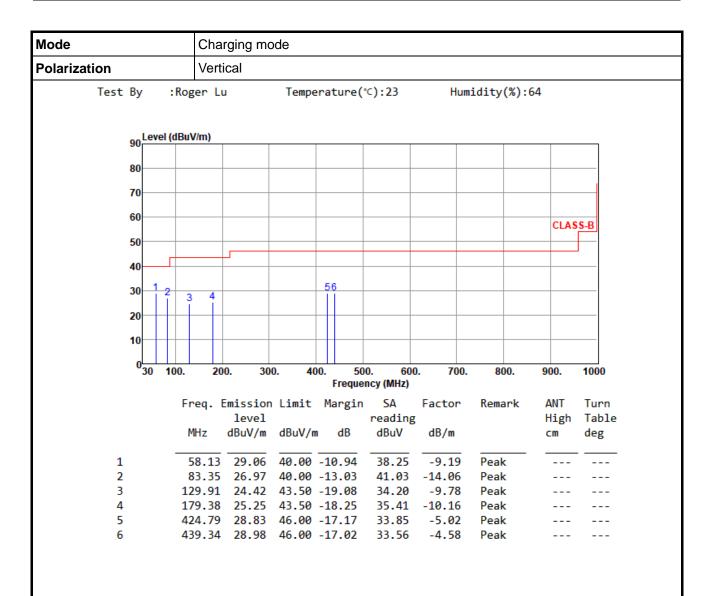


*Factor includes antenna factor, cable loss and amplifier gain

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.





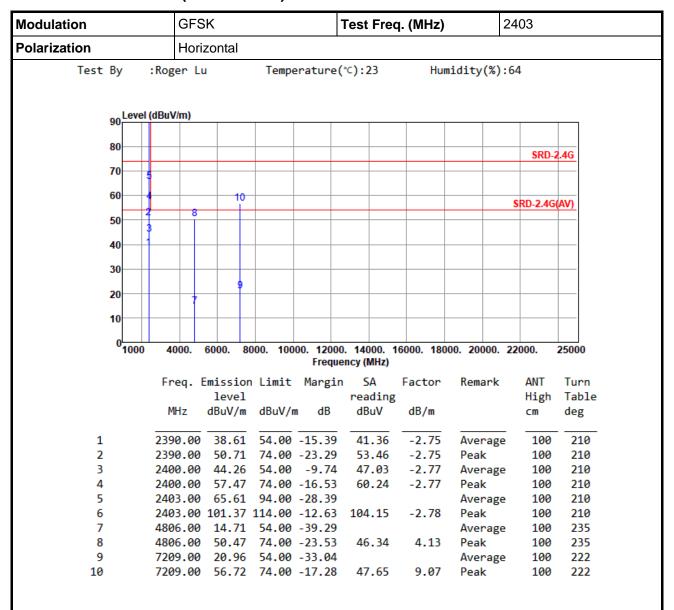
*Factor includes antenna factor, cable loss and amplifier gain

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.



Unwanted Emissions (Above 1GHz)



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

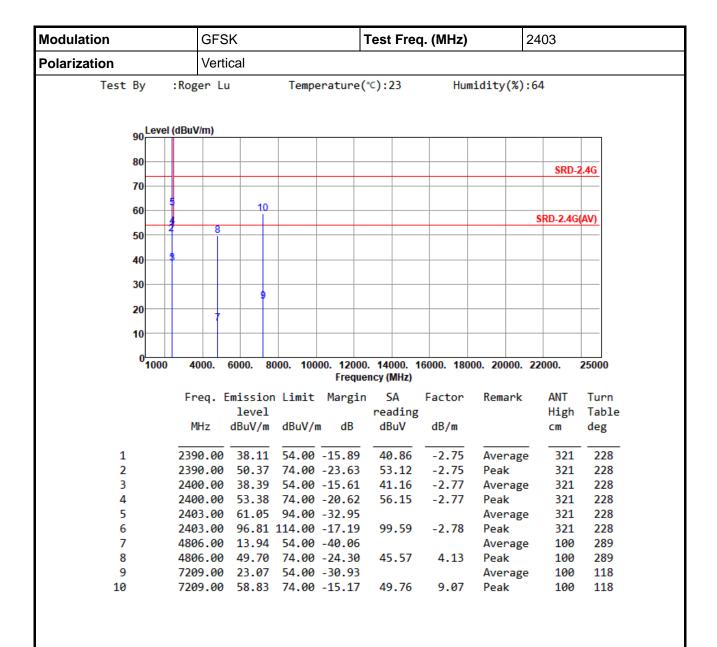
*Factor includes antenna factor, cable loss and amplifier gain

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.

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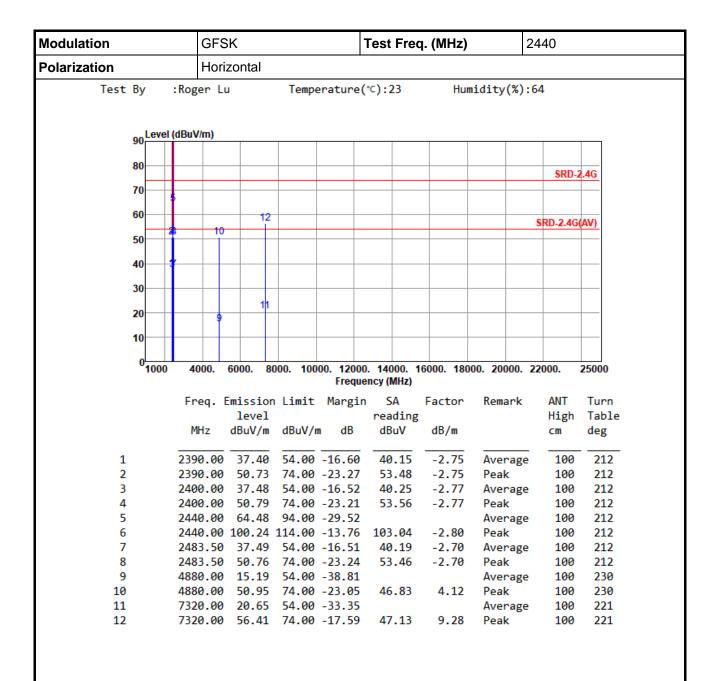




*Factor includes antenna factor, cable loss and amplifier gain

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

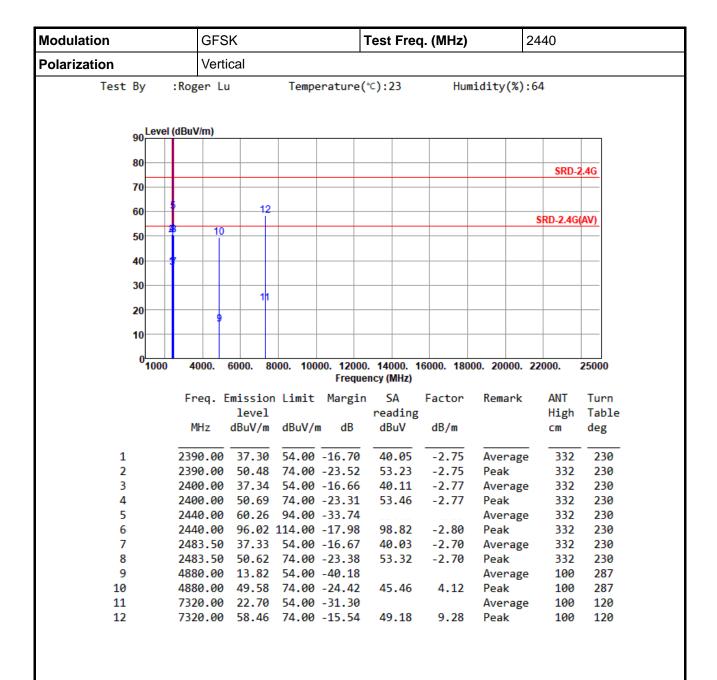




*Factor includes antenna factor, cable loss and amplifier gain

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

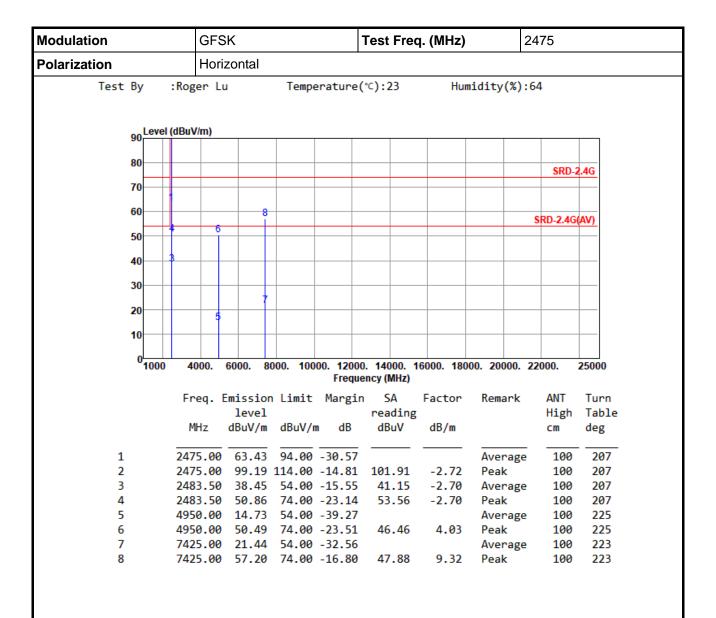




*Factor includes antenna factor, cable loss and amplifier gain

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

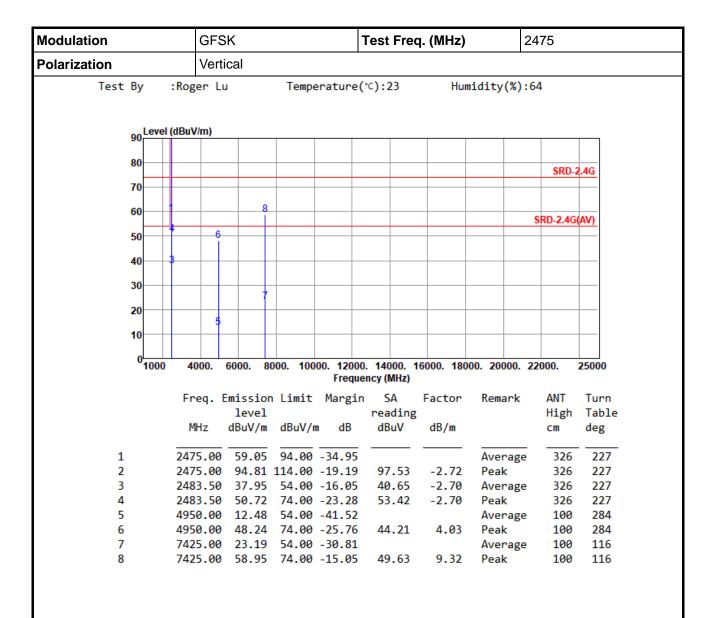




*Factor includes antenna factor, cable loss and amplifier gain

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

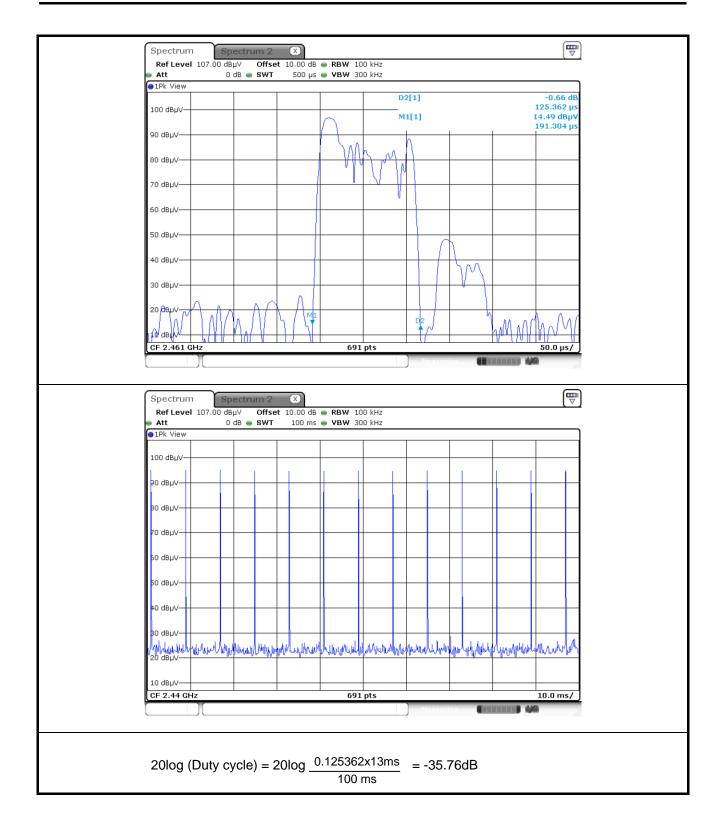




*Factor includes antenna factor, cable loss and amplifier gain

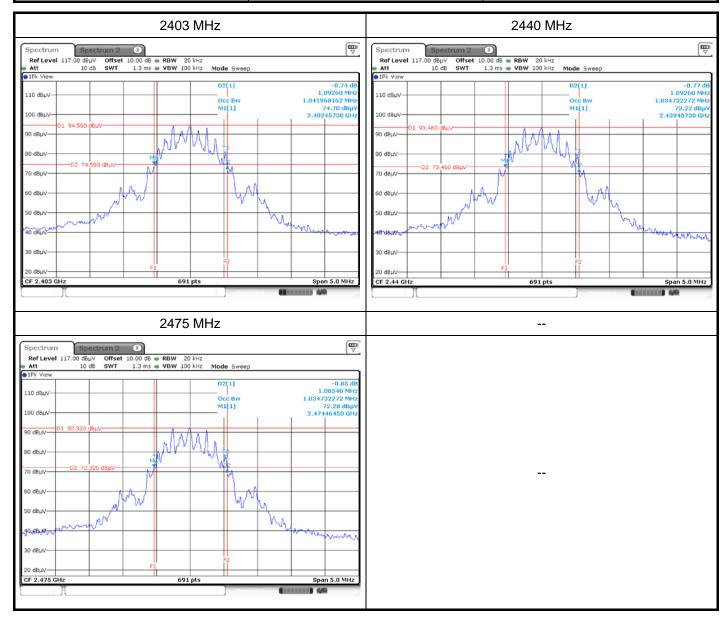
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).



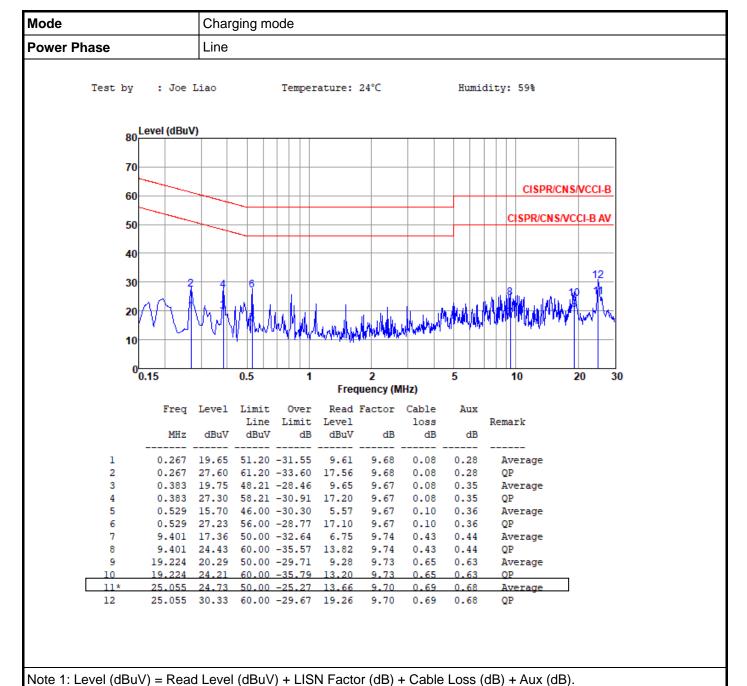




Frequency (MHz)	20dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2403.0	1.093	1.042
2440.0	1.093	1.035
2475.0	1.085	1.035







Note 1. Level (ubuv) = Nead Level (ubuv) + Lishi Factor (ub) + Cable Loss (ub) + Aux (ub)

2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).



