FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No.	**CTA23052500101**
FCC ID	**2AYJK-RW2**
Compiled by (position+printed name+signature)	File administrators Kevin Liu
Supervised by (position+printed name+signature)	Project Engineer Kevin Liu
Approved by (position+printed name+signature)	RF Manager Eric Wang
Date of issue	May. 25, 2023
Testing Laboratory Name	**Shenzhen CTA Testing Technology Co., Ltd.**
Address	Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China
Applicant's name	**Shenzhen Warsong Technology Co., Ltd.**
Address	Floor 15, Building 1, Nanshan Zhiyuan Chongwen Park, No. 3370 Liuxian Avenue, Nanshan District, Shenzhen
Test specification	
Standard	**FCC Part 15.247**

Test item description	**Wireless Gaming Controller**
Trade Mark	BIGBIG WON
Manufacturer	Shenzhen Warsong Technology Co., Ltd.
Model/Type reference	Rainbow2 Pro
Listed Models	Rainbow2 lite,Rainbow2
Modulation	GFSK, Π/4DQPSK, 8DPSK
Frequency	From 2402MHz to 2480MHz
Rating	DC 3.7V From Battery and DC 5V From External circuit
Result	**PASS**

TEST REPORT

Equipment under Test	:	Wireless Gaming Controller
Model /Type	:	Rainbow2 Pro
Listed Models	:	Rainbow2 lite,Rainbow2
Model Declaration	:	PCB board, structure and internal of these model(s) are the same,So no additional models were tested.
Applicant	:	Shenzhen Warsong Technology Co., Ltd.
Address	:	Floor 15, Building 1, Nanshan Zhiyuan Chongwen Park, No. 3370 Liuxian Avenue, Nanshan District, Shenzhen
Manufacturer	:	Shenzhen Warsong Technology Co., Ltd.
Address	:	Floor 15, Building 1, Nanshan Zhiyuan Chongwen Park, No. 3370 Liuxian Avenue, Nanshan District, Shenzhen

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

2 SUMMARY

2.1 General Remarks

Date of receipt of test sample	:	May 05, 2023
Testing commenced on	:	May 05, 2023
Testing concluded on	:	May 23, 2023

2.2 Product Description

Product Name:	Wireless Gaming Controller
Model/Type reference:	Rainbow2 Pro
Power supply:	DC 3.7V From Battery and DC 5V From External circuit
Adapter information (Auxiliary test supplied by testing Lab）	N/A
Hardware version:	V1.0
Software version:	V1.0
Testing sample ID:	CTA23052500101-1# (Engineer sample) CTA23052500101-2# (Normal sample)
Bluetooth :	
Supported Type:	Bluetooth BR/EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	Ceramic antenna
Antenna gain:	1.8 dBi

2.3 Equipment Under Test

Power supply system utilised

Power supply voltage	:	○	230V / 50 Hz	○	120V / 60Hz
		○	12 V DC	○	24 V DC
		●	Other (specified in blank below)		

DC 3.7V From Battery and DC 5V From external circuit

2.4 Short description of the Equipment under Test (EUT)

This is a Wireless Gaming Controller.
For more details, refer to the user's manual of the EUT.

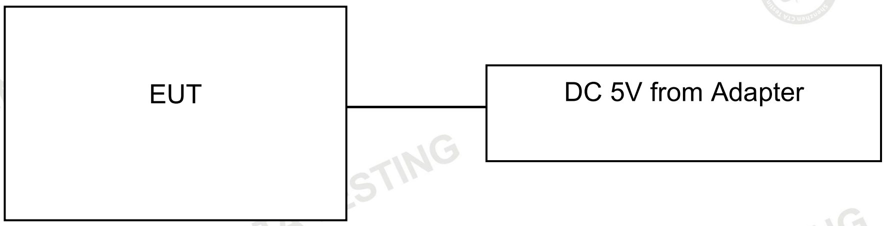
2.5 EUT operation mode

The Applicant provides communication tools software(Engineer mode) to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 79 channels provided to the EUT and Channel 00/39/78 were selected to test.

Operation Frequency:

Channel	Frequency (MHz)
00	2402
01	2403
⋮	⋮
38	2440
39	2441
40	2442
⋮	⋮
77	2479
78	2480

2.6 Block Diagram of Test Setup



2.7 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for the device filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8 Modifications

No modifications were implemented to meet testing criteria.

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

Shenzhen CTA Testing Technology Co., Ltd.
Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community,Fuhai Street, Bao ‘an District, Shenzhen, China

3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:
FCC-Registration No.: 517856 Designation Number: CN1318

Shenzhen CTA Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA-Lab Cert. No.: 6534.01

Shenzhen CTA Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

3.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:
Radiated Emission:

Temperature:	24 ° C
Humidity:	45 %
Atmospheric pressure:	950-1050mbar

AC Power Conducted Emission:

Temperature:	25 ° C
Humidity:	46 %
Atmospheric pressure:	950-1050mbar

Conducted testing:

Temperature:	25 ° C
Humidity:	44 %
Atmospheric pressure:	950-1050mbar

3.4 Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Test result
§15.247(a)(1)	Carrier Frequency separation	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Middle	Compliant
§15.247(a)(1)	Number of Hopping channels	GFSK Π/4DQPSK 8DPSK	☒ Full	GFSK	☒ Full	Compliant
§15.247(a)(1)	Time of Occupancy (dwell time)	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Middle	Compliant
§15.247(a)(1)	Spectrumbandwidth of aFHSS system20dB bandwidth	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(b)(1)	Maximum output peak power	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(d)	Band edgecompliance conducted	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	Compliant
§15.205	Band edgecompliance radiated	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Highest	Compliant
§15.247(d)	TX spuriousemissions conducted	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.247(d)	TX spuriousemissions radiated	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	Compliant
§15.209(a)	TX spurious Emissions radiated Below 1GHz	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Middle	Compliant
§15.107(a) §15.207	Conducted Emissions 9KHz-30 MHz	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Middle	Compliant

Remark:

1. The measurement uncertainty is not included in the test result.
2. We tested all test mode and recorded worst case in report

3.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the Shenzhen CTA Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen CTA Testing Technology Co., Ltd. :

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	9KHz~30MHz	3.82 dB	(1)
Radiated Emission	30~1000MHz	4.06 dB	(1)
Radiated Emission	1~18GHz	5.14 dB	(1)
Radiated Emission	18-40GHz	5.38 dB	(1)
Conducted Disturbance	0.15~30MHz	2.14 dB	(1)
Transmitter power conducted	1~40GHz	0.57 dB	(1)
Conducted spurious emission	1~40GHz	1.60 dB	(1)
OBW	1~40GHz	25 Hz	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

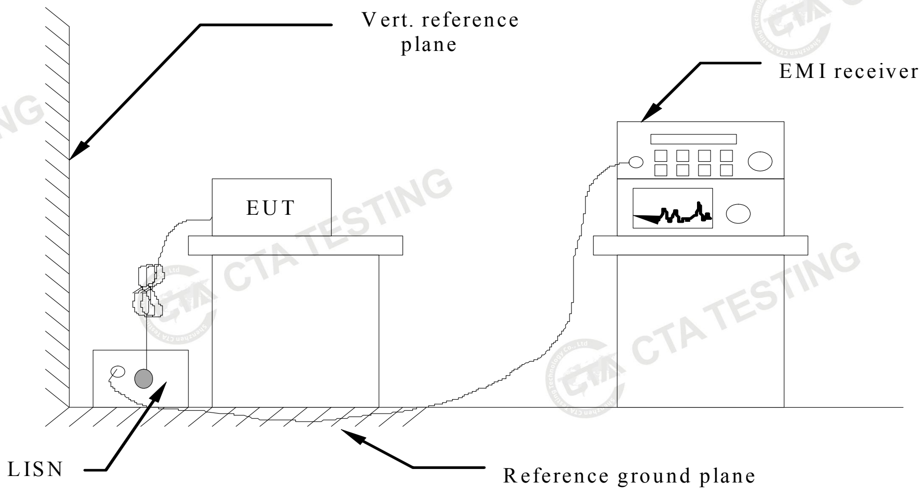
3.6 Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Equipment No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	CTA-308	2022/08/06	2023/08/05
LISN	R&S	ENV216	CTA-314	2022/08/06	2023/08/05
EMI Test Receiver	R&S	ESPI	CTA-307	2022/08/06	2023/08/05
EMI Test Receiver	R&S	ESCI	CTA-306	2022/08/06	2023/08/05
Spectrum Analyzer	Agilent	N9020A	CTA-301	2022/08/06	2023/08/05
Spectrum Analyzer	R&S	FSP	CTA-337	2022/08/06	2023/08/05
Vector Signal generator	Agilent	N5182A	CTA-305	2022/08/06	2023/08/05
Analog Signal Generator	R&S	SML03	CTA-304	2022/08/06	2023/08/05
Universal Radio Communication	CMW500	R&S	CTA-302	2022/08/06	2023/08/05
Temperature and humidity meter	Chigo	ZG-7020	CTA-326	2022/08/06	2023/08/05
Ultra-Broadband Antenna	Schwarzbeck	VULB9163	CTA-310	2022/08/06	2023/08/05
Horn Antenna	Schwarzbeck	BBHA 9120D	CTA-309	2022/08/06	2023/08/05
Loop Antenna	Zhinan	ZN30900C	CTA-311	2022/08/06	2023/08/05
Horn Antenna	Beijing Hangwei Dayang	OBH100400	CTA-336	2022/08/06	2023/08/05
Amplifier	Schwarzbeck	BBV 9745	CTA-312	2022/08/06	2023/08/05
Amplifier	Taiwan chengyi	EMC051845B	CTA-313	2022/08/06	2023/08/05
Directional coupler	NARDA	4226-10	CTA-303	2022/08/06	2023/08/05
High-Pass Filter	XingBo	XBLBQ-GTA18	CTA-402	2022/08/06	2023/08/05
High-Pass Filter	XingBo	XBLBQ-GTA27	CTA-403	2022/08/06	2023/08/05
Automated filter bank	Tonscend	JS0806-F	CTA-404	2022/08/06	2023/08/05
Power Sensor	Agilent	U2021XA	CTA-405	2022/08/06	2023/08/05
Amplifier	Schwarzbeck	BBV9719	CTA-406	2022/08/06	2023/08/05

4 TEST CONDITIONS AND RESULTS

4.1 AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2 Support equipment, if needed, was placed as per ANSI C63.10-2013
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4 The EUT received power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT.The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

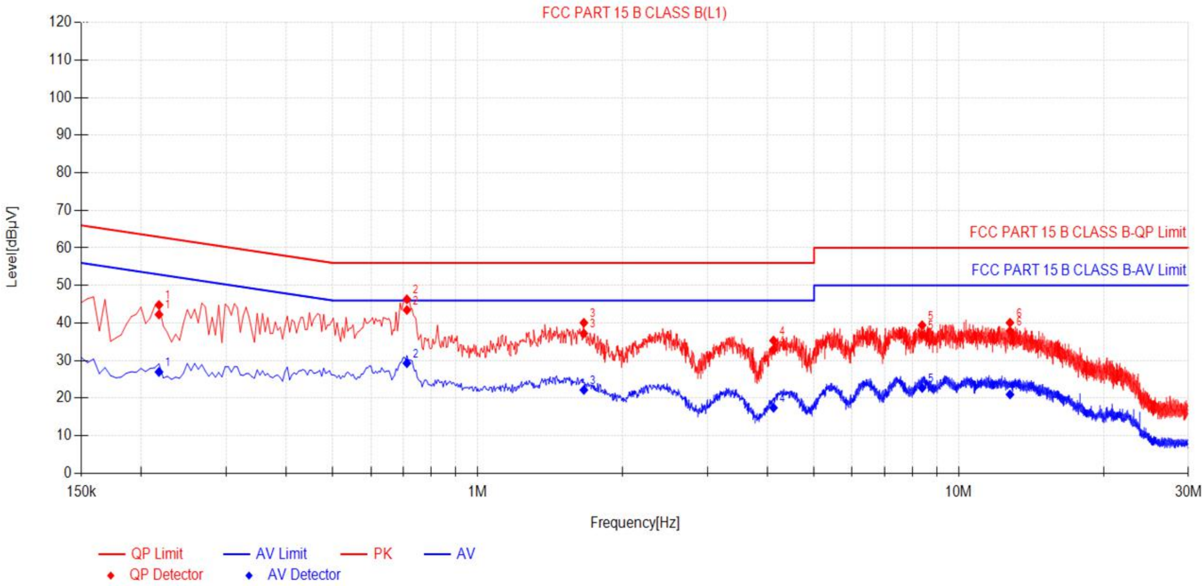
TEST RESULTS

Remark:

1. All modes of GFSK, Π/4 DQPSK and 8-DPSK were test at Low, Middle, and High channel; only the worst result of GFSK Middle Channel was reported as below:

2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:

Power supply:	DC 5V from Adapter AC 120V/60Hz	Polarization	L



Suspected List

NO.	Freq. [MHz]	Reading [dBµV]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Detector	Type	Verdict
1	0.2175	34.31	44.81	10.50	62.91	18.10	PK	L1	PASS
2	0.7125	35.82	46.32	10.50	56.00	9.68	PK	L1	PASS
3	1.662	29.56	40.06	10.50	56.00	15.94	PK	L1	PASS
4	4.119	24.83	35.33	10.50	56.00	20.67	PK	L1	PASS
5	8.3895	28.92	39.42	10.50	60.00	20.58	PK	L1	PASS
6	12.777	29.58	40.08	10.50	60.00	19.92	PK	L1	PASS

Final Data List

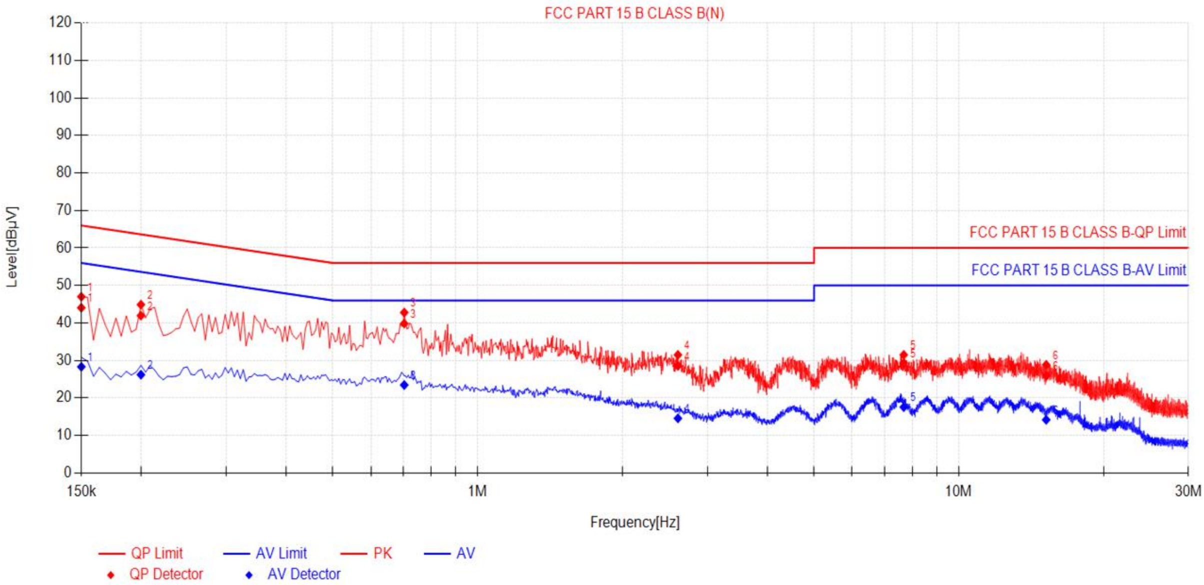
NO.	Freq. [MHz]	Factor [dB]	QP Reading[dBµV]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Reading [dBµV]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Verdict
1	0.2175	10.50	31.76	42.26	62.91	20.65	16.48	26.98	52.91	25.93	PASS
2	0.7125	10.50	32.97	43.47	56.00	12.53	18.81	29.31	46.00	16.69	PASS
3	1.662	10.50	26.71	37.21	56.00	18.79	11.67	22.17	46.00	23.83	PASS
4	4.119	10.50	22.38	32.88	56.00	23.12	6.93	17.43	46.00	28.57	PASS
5	8.3895	10.50	26.26	36.76	60.00	23.24	12.22	22.72	50.00	27.28	PASS
6	12.777	10.50	27.40	37.90	60.00	22.10	10.48	20.98	50.00	29.02	PASS

Note:1).Level (dBµV)= Reading (dBµV)+ Factor (dB)

2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)

3). Margin(dB) = Limit (dBµV) - Level (dBµV)

Power supply:	DC 5V from Adapter AC 120V/60Hz	Polarization	N



Suspected List

NO.	Freq. [MHz]	Reading [dBμV]	Level [dBμV]	Factor [dB]	Limit [dBμV]	Margin [dB]	Detector	Type	Verdict
1	0.15	36.49	46.99	10.50	66.00	19.01	PK	N	PASS
2	0.1995	34.39	44.89	10.50	63.63	18.74	PK	N	PASS
3	0.7035	32.28	42.78	10.50	56.00	13.22	PK	N	PASS
4	2.607	20.99	31.49	10.50	56.00	24.51	PK	N	PASS
5	7.683	21.01	31.51	10.50	60.00	28.49	PK	N	PASS
6	15.1935	18.35	28.85	10.50	60.00	31.15	PK	N	PASS

Final Data List

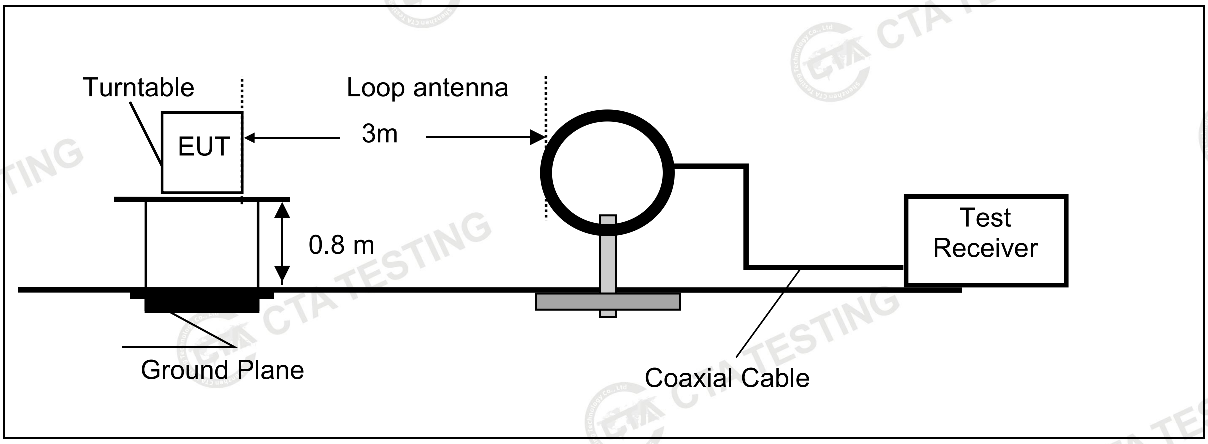
NO.	Freq. [MHz]	Factor [dB]	QP Reading[dBμV]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Reading [dBμV]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Verdict
1	0.15	10.50	33.56	44.06	66.00	21.94	17.82	28.32	56.00	27.68	PASS
2	0.1995	10.50	31.46	41.96	63.63	21.67	15.71	26.21	53.63	27.42	PASS
3	0.7035	10.50	29.35	39.85	56.00	16.15	12.96	23.46	46.00	22.54	PASS
4	2.607	10.50	18.06	28.56	56.00	27.44	4.08	14.58	46.00	31.42	PASS
5	7.683	10.50	18.87	29.37	60.00	30.63	7.06	17.56	50.00	32.44	PASS
6	15.1935	10.50	15.41	25.91	60.00	34.09	3.69	14.19	50.00	35.81	PASS

Note:1).Level (dBμV)= Reading (dBμV)+ Factor (dB)
2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)
3). Margin(dB) = Limit (dBμV) - Level (dBμV)

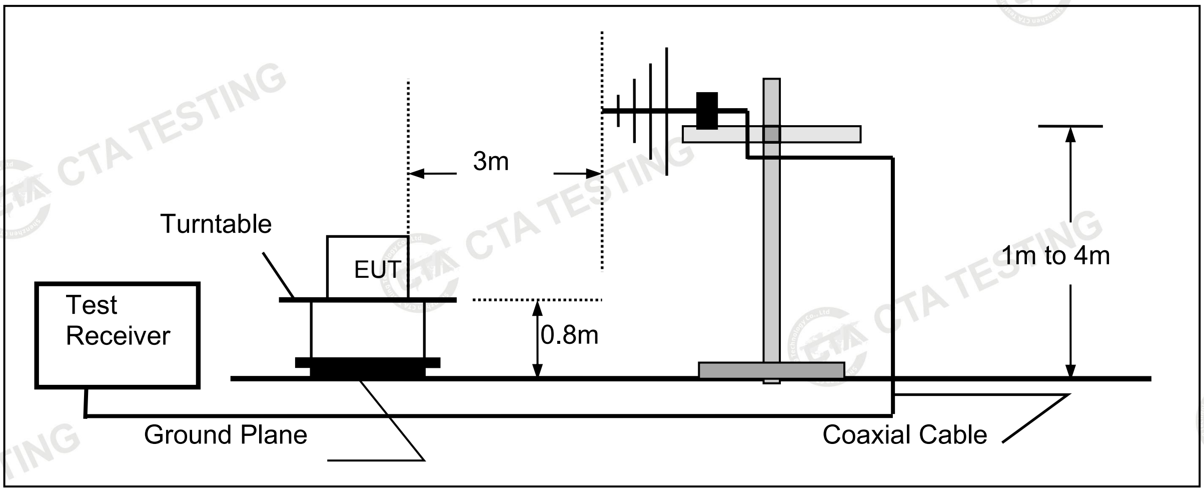
4.2 Radiated Emission

TEST CONFIGURATION

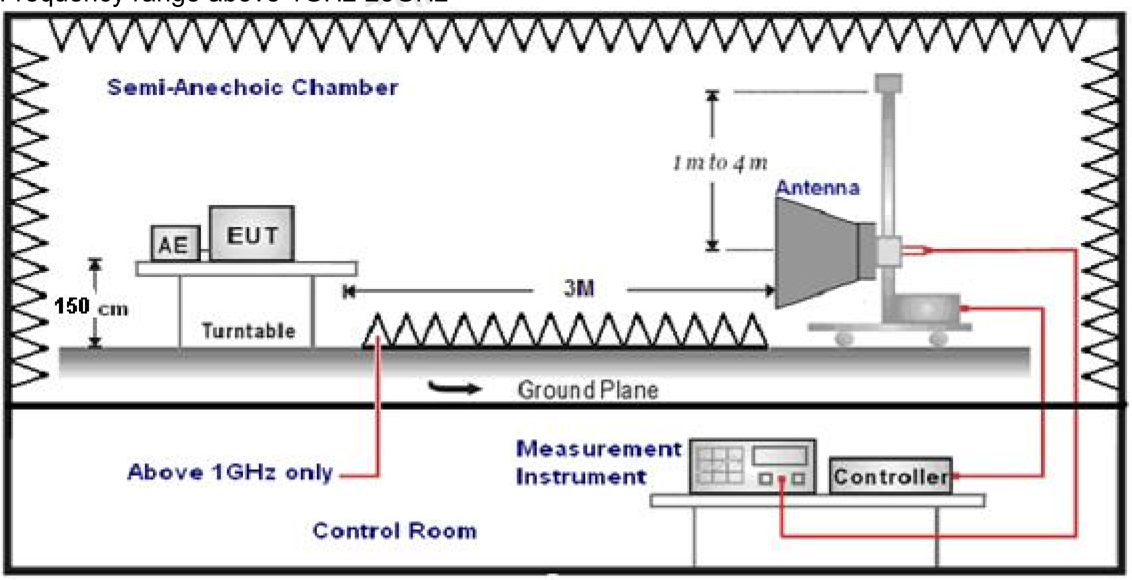
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

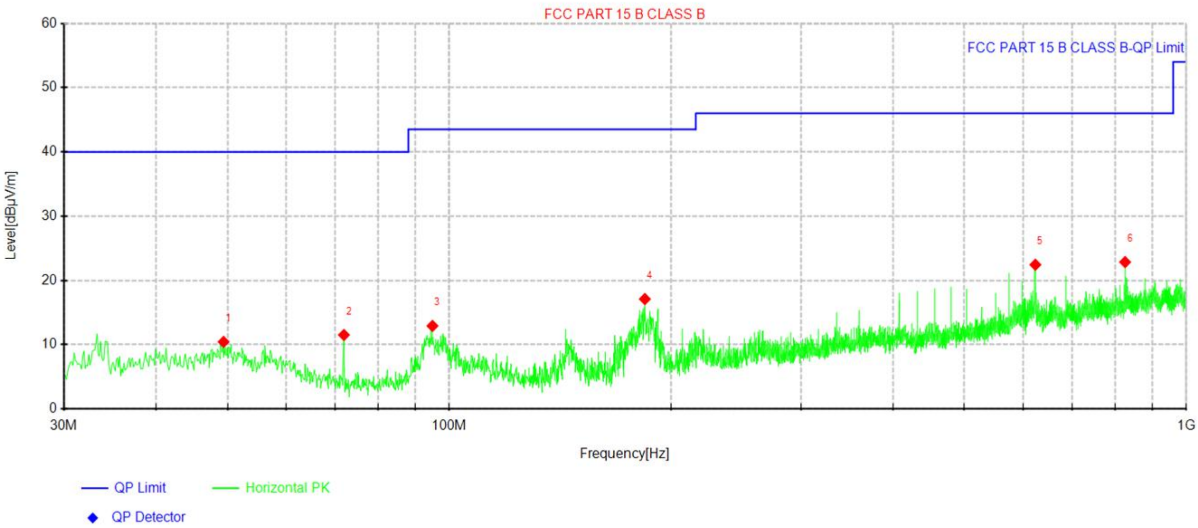
TEST RESULTS

Remark:

1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
2. We measured Radiated Emission at GFSK, π/4 *DQPSK and 8-DPSK* mode from 9 KHz to 25GHz and recorded worst case at GFSK DH5 mode.
3. For below 1GHz testing recorded worst at GFSK DH5 middle channel.
4. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

Horizontal



Suspected Data List

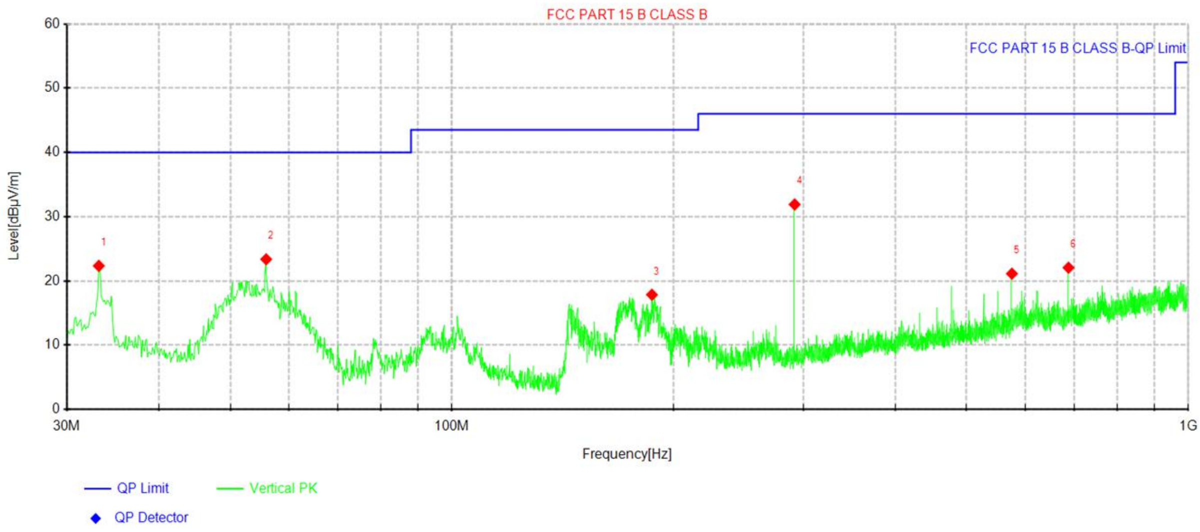
NO.	Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	49.4	26.55	10.44	-16.11	40.00	29.56	100	360	Horizontal
2	71.9525	32.49	11.52	-20.97	40.00	28.48	100	199	Horizontal
3	94.8688	32.09	12.92	-19.17	43.50	30.58	100	360	Horizontal
4	184.23	37.38	17.10	-20.28	43.50	26.40	100	88	Horizontal
5	624.003	34.62	22.44	-12.18	46.00	23.56	100	63	Horizontal
6	825.885	33.18	22.86	-10.32	46.00	23.14	100	260	Horizontal

Note:1).Level (dBµV/m)= Reading (dBµV/m)+ Factor (dB/m)

2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin(dB) = Limit (dBµV/m) - Level (dBµV/m)

Vertical



Suspected Data List									
NO.	Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	33.1525	40.52	22.34	-18.18	40.00	17.66	100	112	Vertical
2	55.9475	40.71	23.37	-17.34	40.00	16.63	100	355	Vertical
3	186.897	37.95	17.85	-20.10	43.50	25.65	100	18	Vertical
4	292.021	49.36	31.90	-17.46	46.00	14.10	100	69	Vertical
5	575.988	34.00	21.13	-12.87	46.00	24.87	100	337	Vertical
6	687.538	33.80	22.06	-11.74	46.00	23.94	100	103	Vertical

Note:1).Level (dBµV/m)= Reading (dBµV/m)+ Factor (dB/m)
2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)
3). Margin(dB) = Limit (dBµV/m) - Level (dBµV/m)

For 1GHz to 25GHz

Note: GFSK, π/4 DQPSK and 8-DPSK all have been tested, only worse case GFSK is reported.

GFSK (above 1GHz)

Frequency(MHz):			2402		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	62.06	PK	74	11.94	66.42	32.40	5.11	41.87	-4.36
4804.00	48.88	AV	54	5.12	53.24	32.40	5.11	41.87	-4.36
7206.00	61.54	PK	74	12.46	62.17	36.58	6.43	43.64	-0.63
7206.00	50.60	AV	54	3.40	51.23	36.58	6.43	43.64	-0.63

Frequency(MHz):			2402		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	59.88	PK	74	14.12	64.24	32.40	5.11	41.87	-4.36
4804.00	46.87	AV	54	7.13	51.23	32.40	5.11	41.87	-4.36
7206.00	60.62	PK	74	13.38	61.25	36.58	6.43	43.64	-0.63
7206.00	50.62	AV	54	3.38	51.25	36.58	6.43	43.64	-0.63

Frequency(MHz):			2441		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4882.00	60.27	PK	74	13.73	64.22	32.56	5.34	41.85	-3.95
4882.00	49.21	AV	54	4.79	53.16	32.56	5.34	41.85	-3.95
7323.00	60.90	PK	74	13.10	61.26	36.54	6.81	43.71	-0.36
7323.00	51.21	AV	54	2.79	51.57	36.54	6.81	43.71	-0.36

Frequency(MHz):			2441		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4880.00	59.62	PK	74	14.38	63.57	32.56	5.34	41.85	-3.95
4880.00	49.32	AV	54	4.68	53.27	32.56	5.34	41.85	-3.95
7320.00	61.02	PK	74	12.98	61.38	36.54	6.81	43.71	-0.36
7320.00	51.22	AV	54	2.78	51.58	36.54	6.81	43.71	-0.36

Frequency(MHz):			2480		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	60.76	PK	74	13.24	64.22	32.73	5.64	41.83	-3.46
4960.00	49.90	AV	54	4.10	53.36	32.73	5.64	41.83	-3.46
7440.00	61.09	PK	74	12.91	61.15	36.50	7.23	43.79	-0.06
7440.00	51.30	PK	54	2.70	51.36	36.50	7.23	43.79	-0.06

Frequency(MHz):			2480		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	59.37	PK	74	14.63	62.83	32.73	5.64	41.83	-3.46
4960.00	49.78	AV	54	4.22	53.24	32.73	5.64	41.83	-3.46
7440.00	62.23	PK	74	11.77	62.29	36.50	7.23	43.79	-0.06
7440.00	49.26	PK	54	4.74	49.32	36.50	7.23	43.79	-0.06

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

Results of Band Edges Test (Radiated)

Note: GFSK, Pi/4 DQPSK and 8-DPSK all have been tested, only worse case GFSK is reported.

GFSK

Frequency(MHz):			**2402**		**Polarity:**		**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	51.82	PK	74	22.18	62.24	27.42	4.31	42.15	-10.42
2390.00	49.70	AV	54	4.30	60.12	27.42	4.31	42.15	-10.42
Frequency(MHz):			**2402**		**Polarity:**		**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	53.10	PK	74	20.90	63.52	27.42	4.31	42.15	-10.42
2390.00	49.93	AV	54	4.07	60.35	27.42	4.31	42.15	-10.42
Frequency(MHz):			**2480**		**Polarity:**		**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	47.42	PK	74	26.58	57.53	27.70	4.47	42.28	-10.11
2483.50	45.71	AV	54	8.29	55.82	27.70	4.47	42.28	-10.11
Frequency(MHz):			**2480**		**Polarity:**		**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	43.13	PK	74	30.87	53.24	27.70	4.47	42.28	-10.11
2483.50	41.13	AV	54	12.87	51.24	27.70	4.47	42.28	-10.11

REMARKS:
1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

4.3 Maximum Peak Output Power

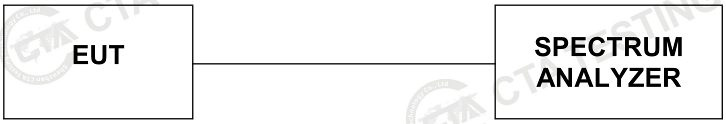
Limit

The Maximum Peak Output Power Measurement is 30dBm(for GFSK)/20.97dBm(for EDR)

Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 8MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

Test Configuration



Test Results

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	-4.43	30.00	Pass
	39	-4.21		
	78	-4.85		
π/4DQPSK	00	-2.25	20.97	Pass
	39	-2.08		
	78	-2.75		
8-DPSK	00	-2.45	20.97	Pass
	39	-2.25		
	78	-2.93		

Note: 1.The test results including the cable lose.

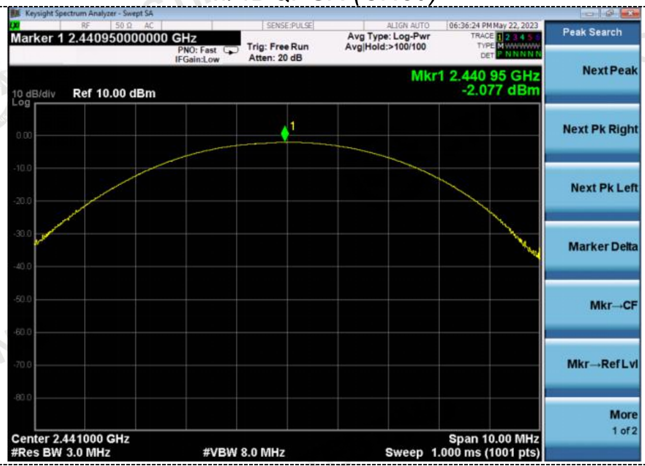
Test plots

GFSK(CH00)

π/4DQPSK (CH00)

GFSK(CH39)

π/4DQPSK (CH39)



GFSK(CH78)

π/4DQPSK (CH78)

8-DPSK(CH00)

8-DPSK(CH39)

8-DPSK(CH78)


4.4 20dB Bandwidth

Limit

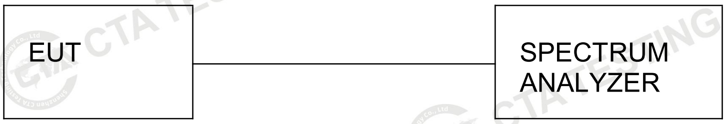
For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100 KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

Test Configuration



Test Results

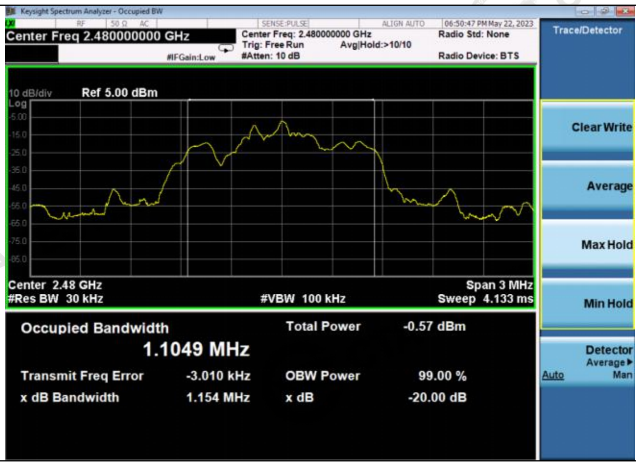
Modulation	Channel	20dB bandwidth (MHz)	Result
GFSK	CH00	0.709	Pass
	CH39	0.702	
	CH78	0.670	
π/4DQPSK	CH00	1.107	
	CH39	1.105	
	CH78	1.106	
8-DPSK	CH00	1.146	
	CH39	1.150	
	CH78	1.154	

Test plot as follows:

GFSK Modulation	*π/4DQPSK Modulation*
	
CH00	*CH00*
	
CH39	*CH39*
	
CH78	*CH78*

8-DPSK Modulation

CH00

CH39

CH78

4.5 Frequency Separation

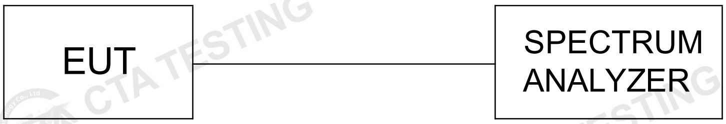
LIMIT

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with100 KHz RBW and 300 KHz VBW.

TEST CONFIGURATION



TEST RESULTS

Modulation	Channel	Channel Separation (MHz)	Limit(MHz)	Result
GFSK	CH38	1.004	25KHz or 2/3*20dB bandwidth	Pass
GFSK	CH39	1.004	25KHz or 2/3*20dB bandwidth	Pass
π/4DQPSK	CH38	1.002	25KHz or 2/3*20dB bandwidth	Pass
π/4DQPSK	CH39	1.002	25KHz or 2/3*20dB bandwidth	Pass
8-DPSK	CH38	1.002	25KHz or 2/3*20dB bandwidth	Pass
8-DPSK	CH39	1.002	25KHz or 2/3*20dB bandwidth	Pass

Note:
We have tested all mode at high, middle and low channel, and recorded worst case at middle

Test plot as follows:

GFSK

π/4DQPSK

8-DPSK

4.6 Number of hopping frequency

Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

Test Procedure

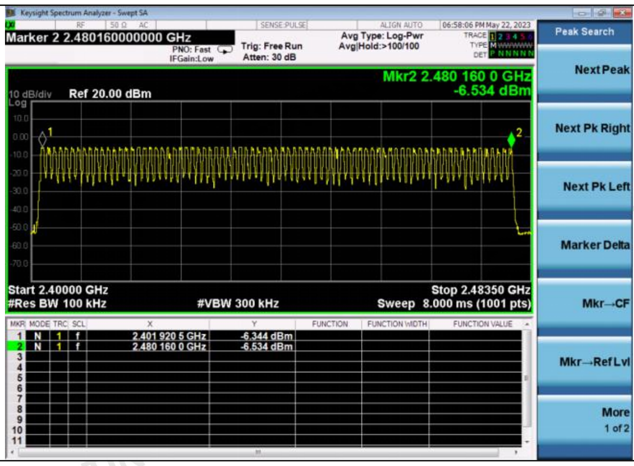
The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz with 100 KHz RBW and 300 KHz VBW.

Test Configuration

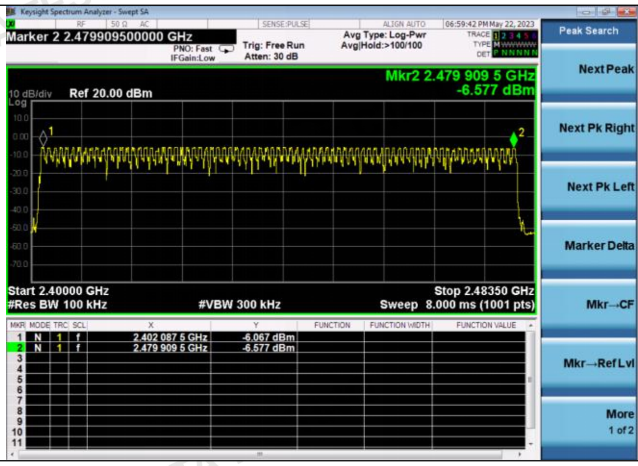
Test Results

Modulation	Number of Hopping Channel	Limit	Result
GFSK	79	≥15	Pass
π/4DQPSK	79		
8-DPSK	79		

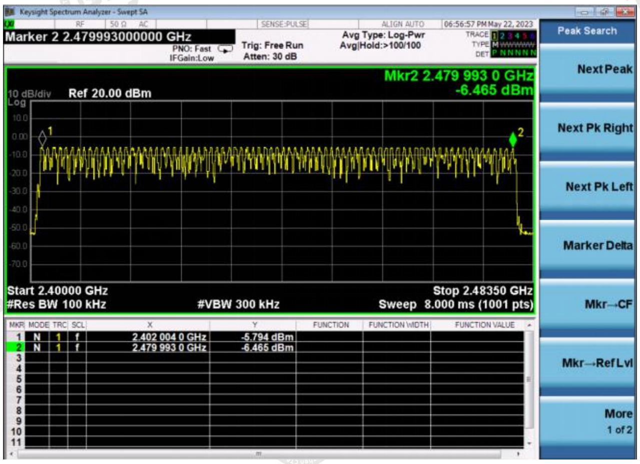
Test plot as follows:



GFSK Modulation



π/4DQPSK Modulation



8-DPSK Modulation

4.7 Time of Occupancy (Dwell Time)

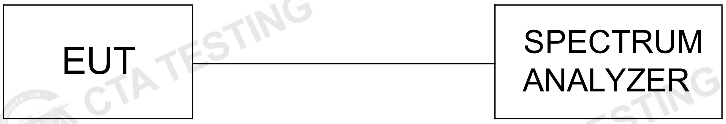
Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 1MHz RBW and 3MHz VBW, Span 0Hz.

Test Configuration

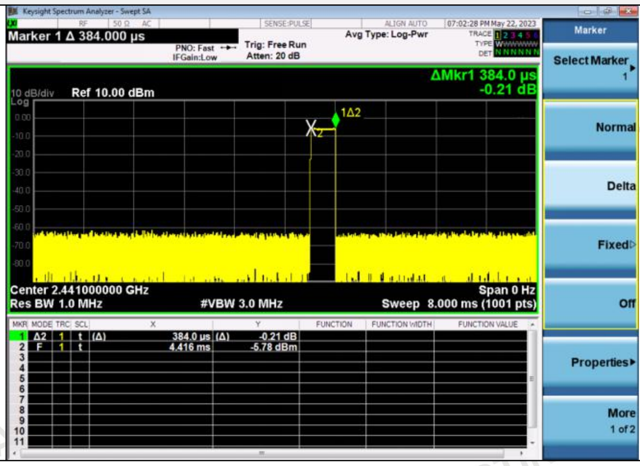
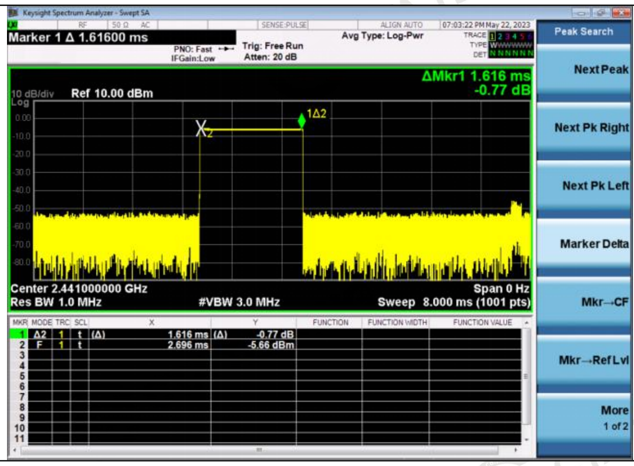
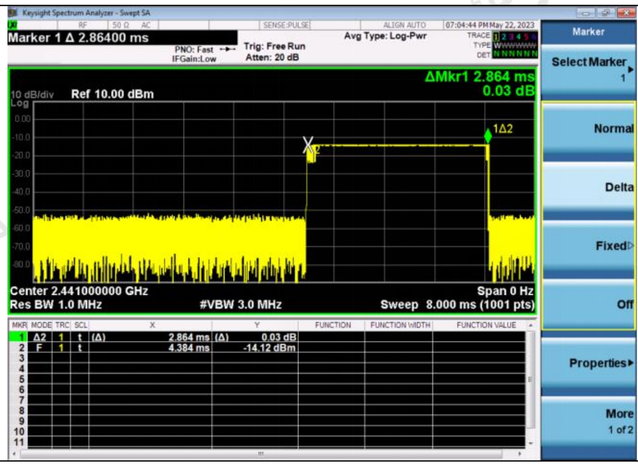


Test Results

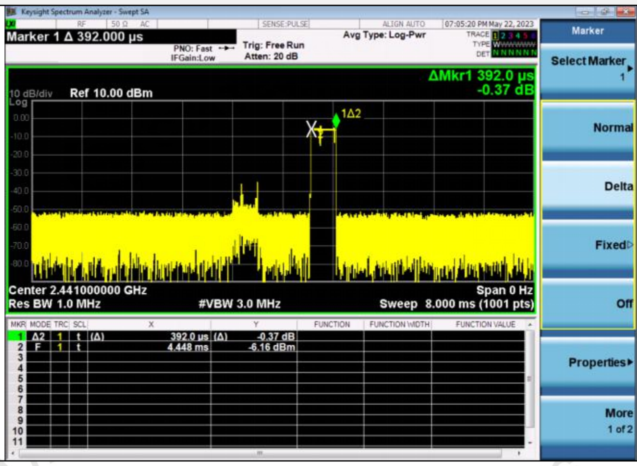
Modulation	Packet	Burst time (ms)	Dwell time (s)	Limit (s)	Result
GFSK	DH1	0.384	0.123	0.40	Pass
	DH3	1.616	0.259		
	DH5	2.864	0.305		
π/4DQPSK	2-DH1	0.392	0.125	0.40	Pass
	2-DH3	1.616	0.259		
	2-DH5	2.864	0.305		
8-DPSK	3-DH1	0.376	0.120	0.40	Pass
	3-DH3	1.648	0.264		
	3-DH5	2.880	0.307		

Note:We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1, 3-DH1
Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3, 3-DH2
Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5, 3-DH3

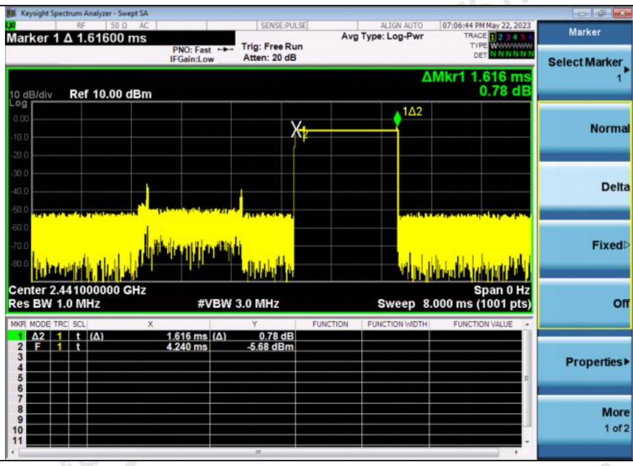
Test plot as follows:

GFSK Modulation

DH1 burst time

DH3 burst time

DH5 burst time

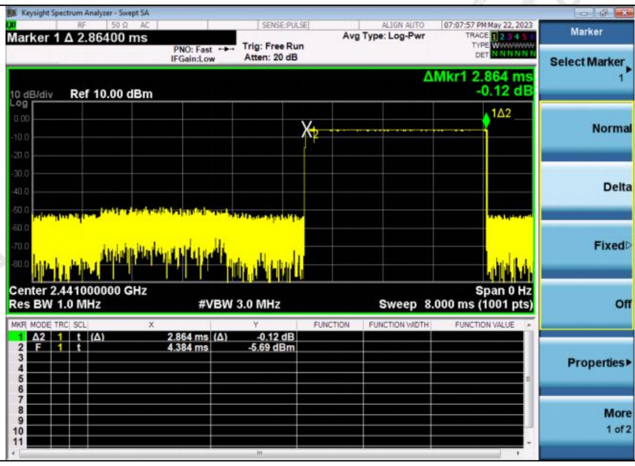
π/4DQPSK Modulation



2-DH1 burst time

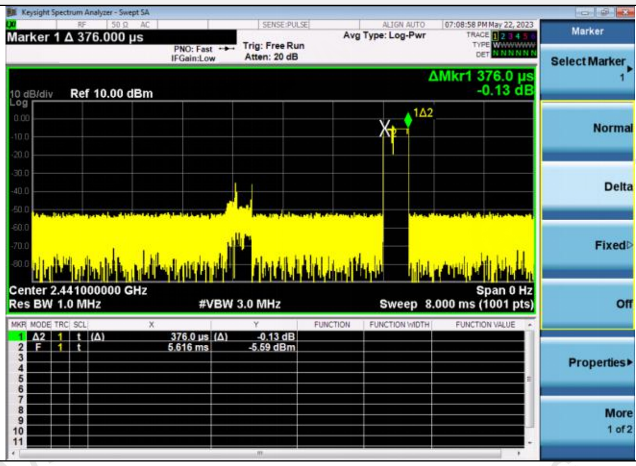


2-DH3 burst time

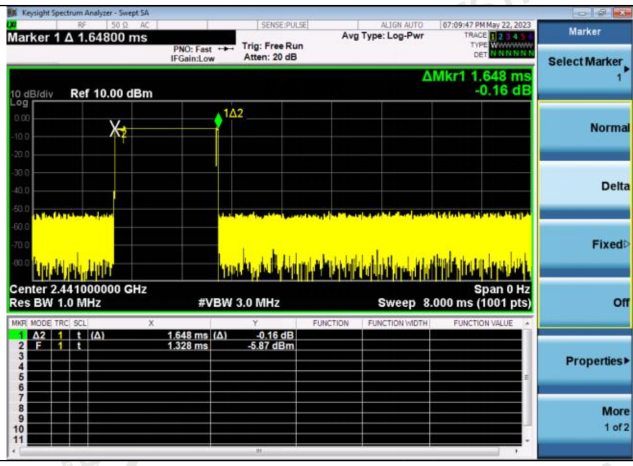


2-DH5 burst time

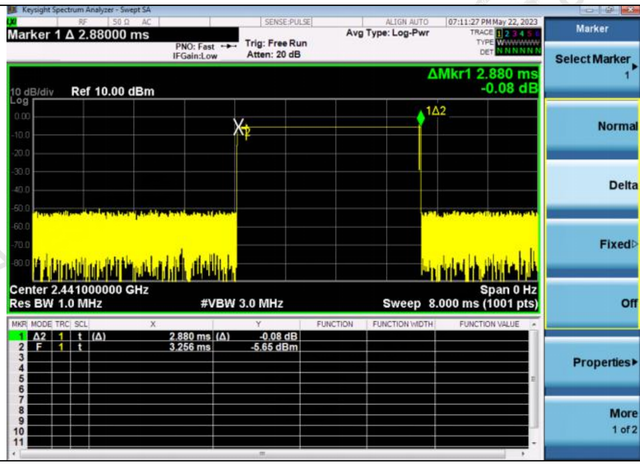
8-DPSK Modulation



3-DH1 burst time



3-DH3 burst time



3-DH5 burst time

4.8 Out-of-band Emissions

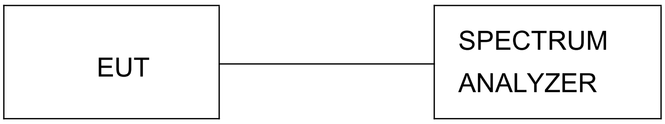
Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

Test Configuration

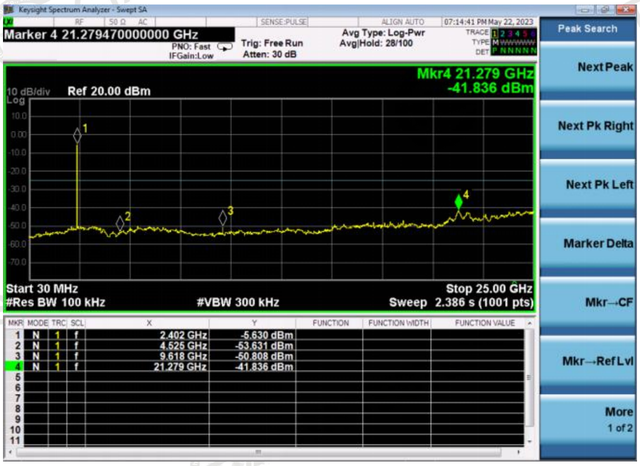


Test Results

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.
We measured all conditions (DH1, DH3, DH5) and recorded worst case at DH5

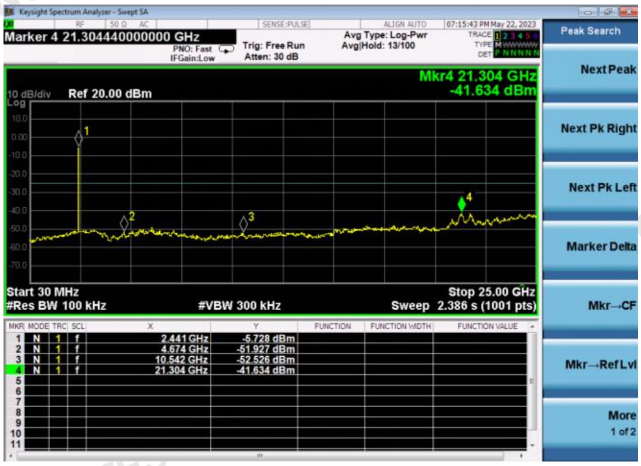
Test plot as follows:

GFSK(CH00)



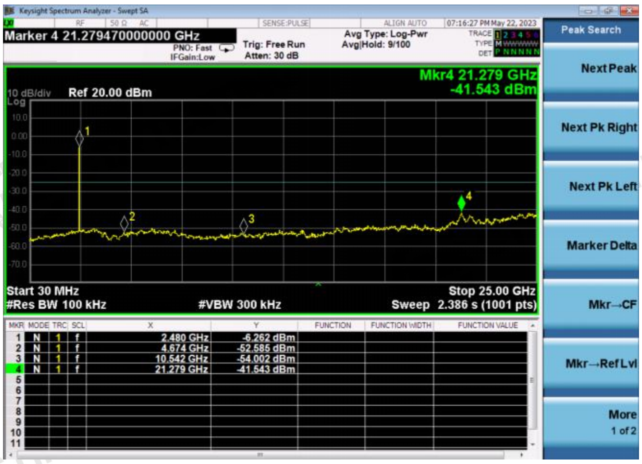
30MHz-25G

GFSK(CH39)



30MHz-25G

GFSK(CH78)



30MHz-25G

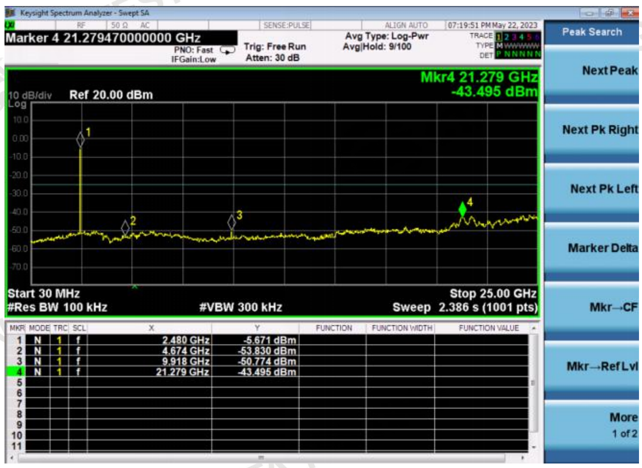
π/4DQPSK (CH00)

30MHz-25G

π/4DQPSK (CH39)

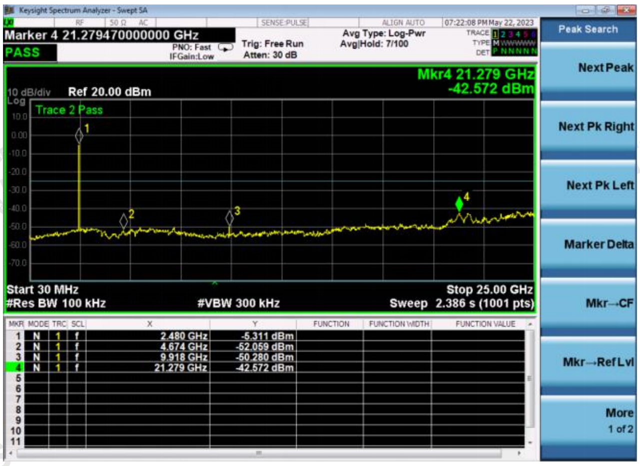
30MHz-25G

π/4DQPSK (CH78)



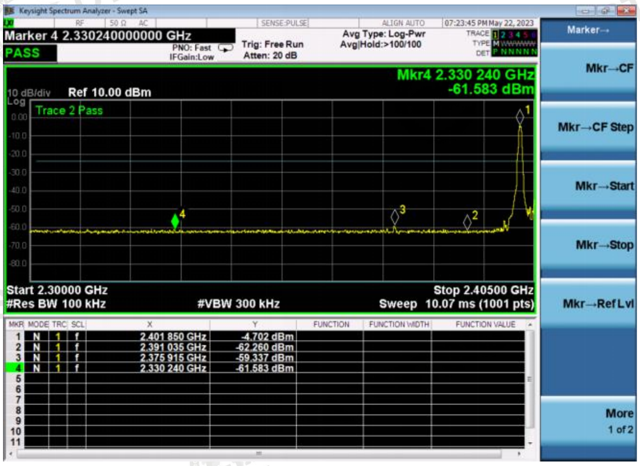
30MHz-25G

8-DPSK(CH00)	8-DPSK(CH39)
	
30MHz-25G	30MHz-25G

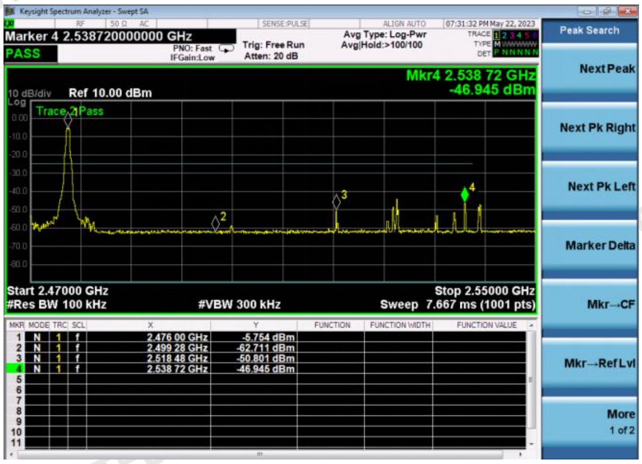
8-DPSK(CH78)	
	
30MHz-25G	

Band-edge Measurements for RF Conducted Emissions:

GFSK

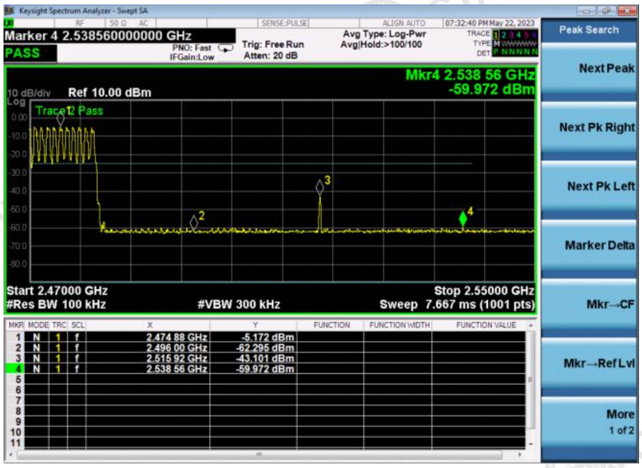


Left Band edge hoping off



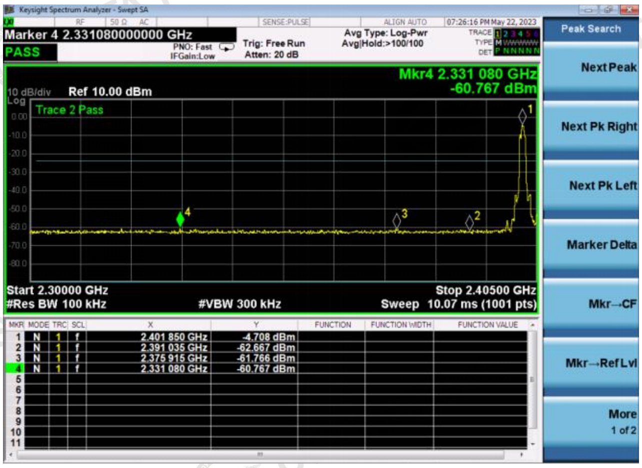
Right Band edge hoping off

Left Band edge hoping on

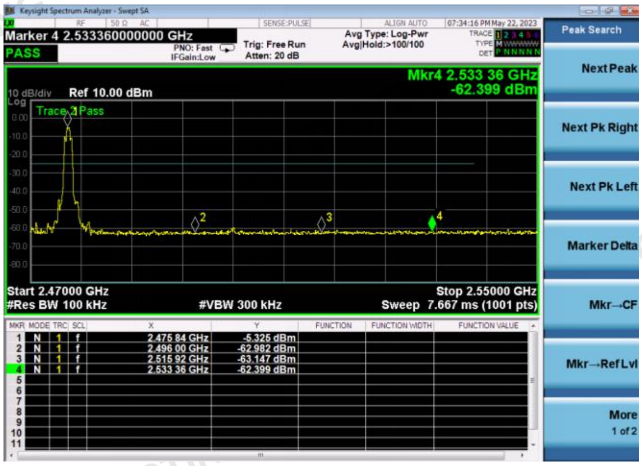


Right Band edge hoping on

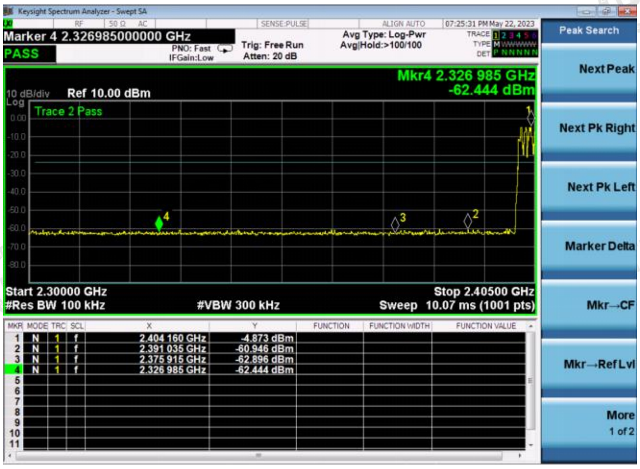
π/4DQPSK



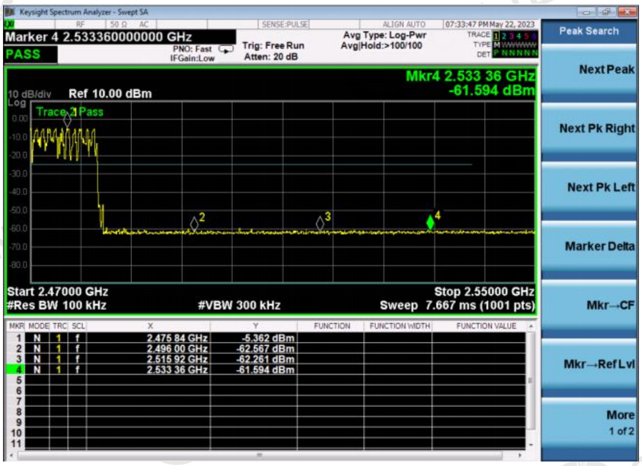
Left Band edge hoping off



Right Band edge hoping off

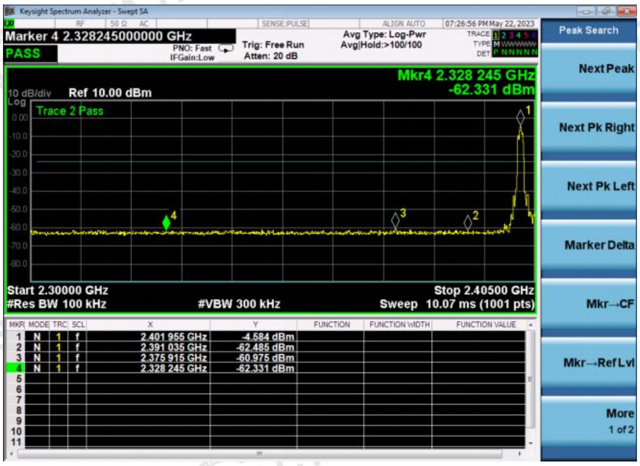


Left Band edge hoping on



Right Band edge hoping on

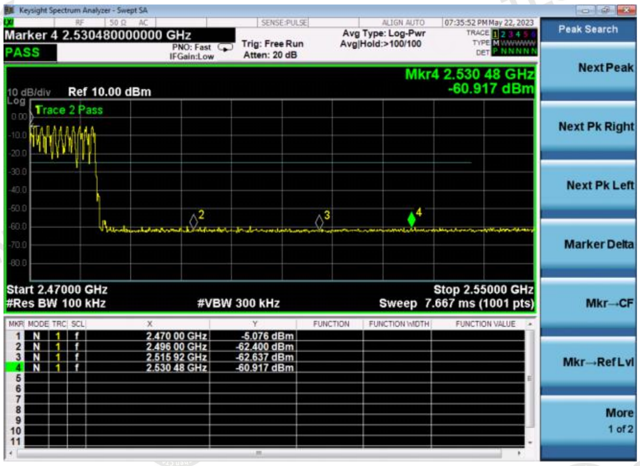
8-DPSK



Left Band edge hoping off

Right Band edge hoping off

Left Band edge hoping on



Right Band edge hoping on

4.9 Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

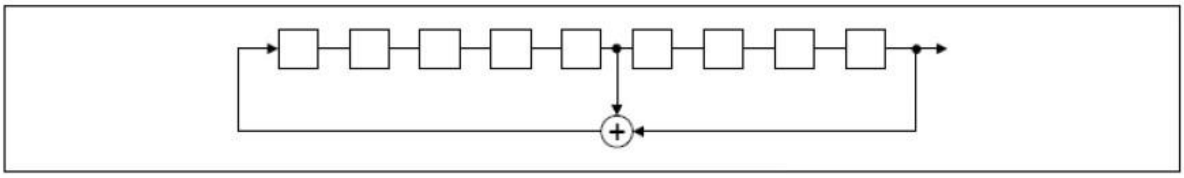
For 47 CFR Part 15C section 15.247 (a) (1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

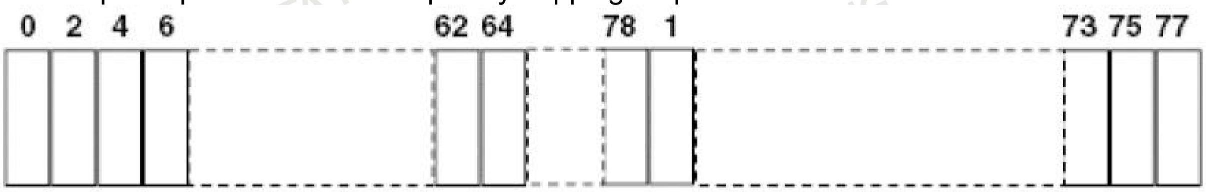
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

4.10 Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Refer to statement below for compliance

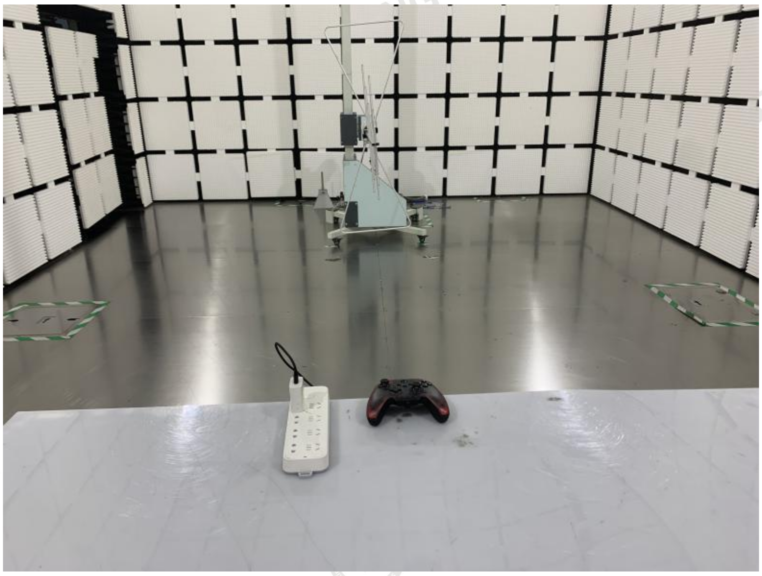
The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

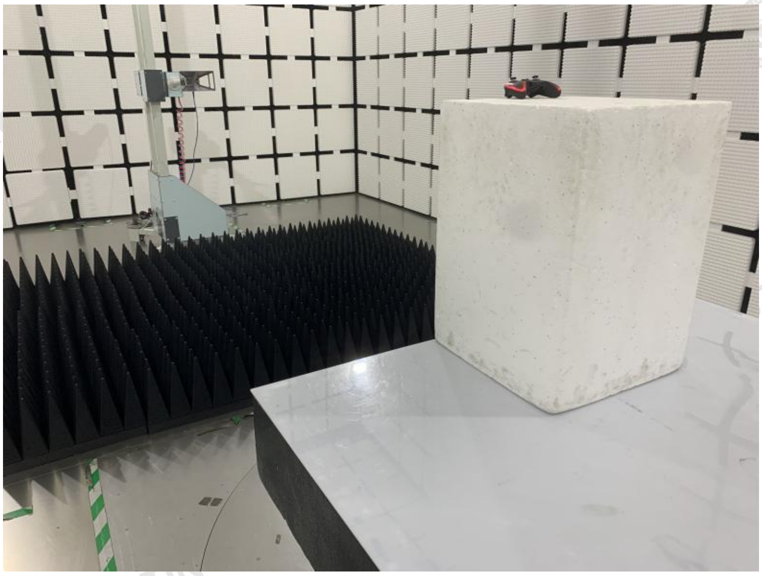
Antenna Connected Construction

The maximum gain of antenna was 1.8 dBi.

Remark:The antenna gain is provided by the customer , if the data provided by the customer is not accurate, Shenzhen CTA Testing Technology Co., Ltd. does not assume any responsibility.

5 Test Setup Photos of the EUT





Photos of the EUT

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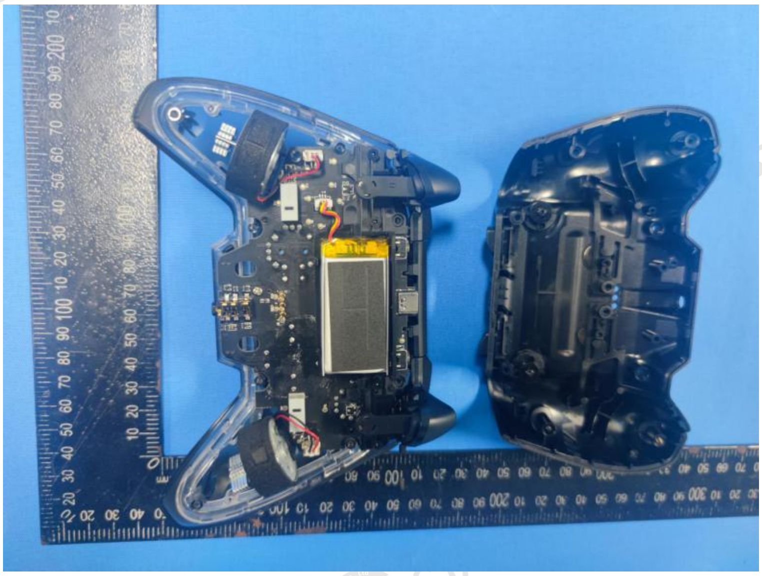
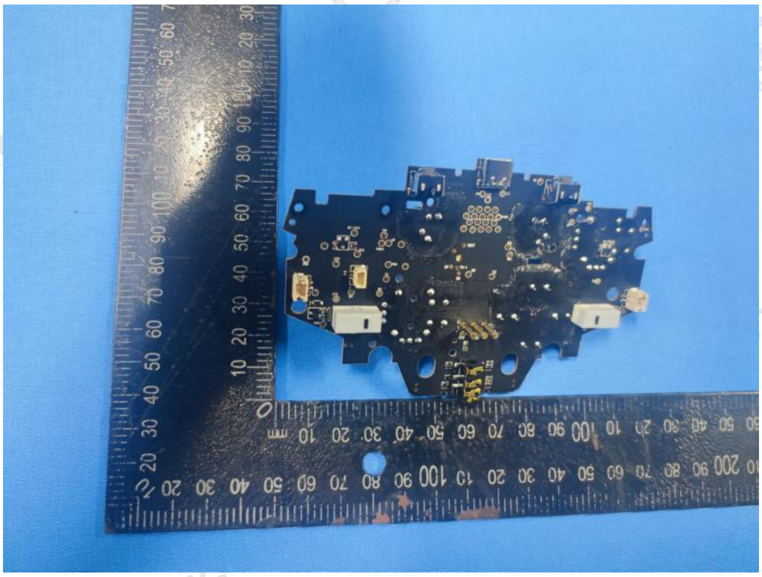
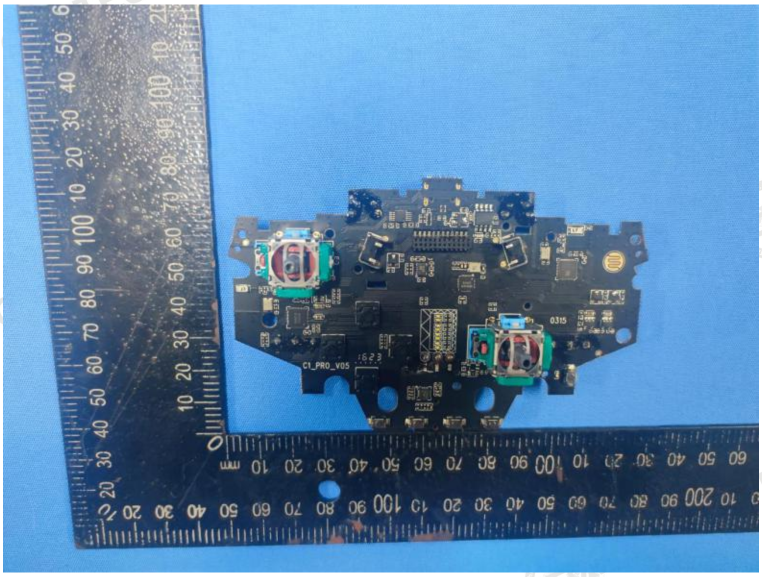
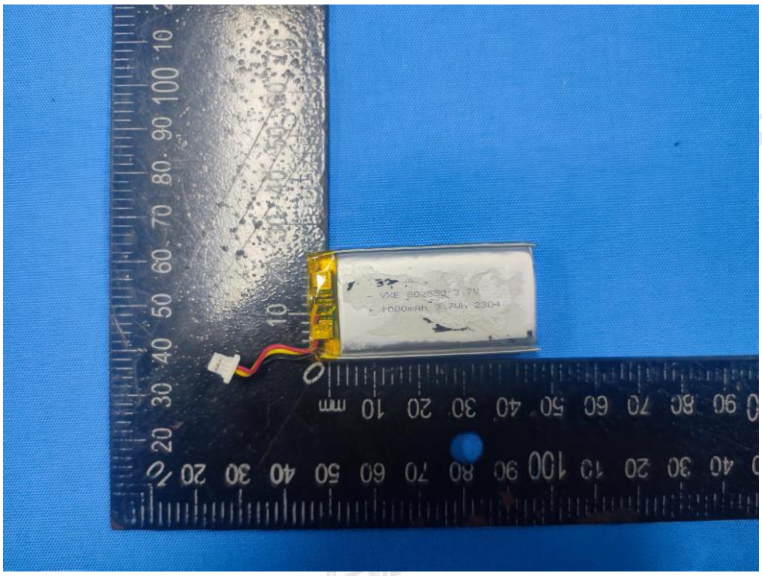
Tel:+86-755 2322 5875 E-mail:cta@cta-test.cn Web:http://www.cta-test.cn









********************** End of Report **********************