



Test Report No.:
FCC2023-0055-RF2

TEST REPORT

FCC ID : 2AK43E25
Applicant : Guangzhou Rigal Electronics Co., Ltd.
Product Name : Multimedia projector /LCD INTELLIGENT PROJECTOR
Model No. : E25, B1, Exx, Exy, lxx, lxy, Bxy, Heyup Boxe Lite

CVC Testing Technology Co., Ltd.




Applicant		Name: Guangzhou Rigal Electronics Co., Ltd. Address: No.3-1, Ruixiang Road, Huadu District, Guangzhou	
Manufacturer		Name: Guangzhou Rigal Electronics Co., Ltd. Address: No.3-1, Ruixiang Road, Huadu District, Guangzhou	
Equipment Under Test		Product Name : Multimedia projector /LCD INTELLIGENT PROJECTOR Model No. : E25 Trade mark : N/A Serial no. : 000165233801001 Sampling : 1-1	
Date of Receipt.	2023.9.1	Date of Testing	2023.9.22
Test Specification		Test Result	
FCC CFR47 Part 15C (2020) Radio Frequency Devices ANSI C63.10 (2013) DA00-705 Filing and Frequency Measurement Guidelines For Frequency Hopping Spread Spectrum System (2000).		PASS	
Evaluation of Test Result		The equipment under test was found to comply with the requirements of the standards applied. Seal of CVC Issue Date: 2023.10.31	
Approved by: Chen Huawen 	Reviewed by: Xu Zhenfei 	Tested by: Lu Weiji 	
Other Aspects: NONE.			
Abbreviations:OK, Pass= passed Fail = failed N/A= not applicable EUT= equipment, sample(s) under tested			
Note: This test report relates only to the EUT, and shall not be reproduced except in full, without written approval of CVC .			

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1. General Product Information

1.1 General information

Product Name	Multimedia projector /LCD INTELLIGENT PROJECTOR
Model No.	E25
Additional model	B1, Heyup Boxe Lite, Exx(x represents the numbers 0-9), Exy(x represents numbers 0-9, y represents letters a-z or A-Z), lxx(x represents the numbers 0-9), lxy(x represents numbers 0-9, y represents letters a-z or A-Z), Bxy(x represents numbers 0-9, y represents letters a-z or A-Z)
Power Supply	AC100-240V, 50/60Hz
Serial Number(SN)	000165233801001
firmware	v1.0.0
software	v2.1.2
specific power settings	DH5: Default 2DH5: Default 3DH5: Default
Antenna Type	Internal antenna
Antenna Connector	A detachable antenna
Antenna Gain	1.97 dBi (provided by client)
Beamforming gain	Unsupported (provided by client)
Frequency Range	2402MHz~2480MHz
Bluetooth Version:	5.0
Channel Number	79
Type of Modulation	GFSK, π/4DQPSK, 8DPSK
Hopping Channel Type:	Adaptive Frequency Hopping systems
Max. Conducted Power	DH5: 7.96 dBm 2DH5: 7.95 dBm 3DH5: 7.90 dBm
Operate Temp.Range	5~30°C

Note:

- The information of the EUT is declared by the manufacturer.
- The laboratory is not responsible for the product technical specification provided by the client.
- The product model of this application are E25,B1,Heyup Boxe Lite, Exx(x represents the numbers 0-9), Exy(x represents numbers 0-9, y represents letters a-z or A-Z), lxx(x represents the numbers 0-9), lxy(x represents numbers 0-9, y represents letters a-z or A-Z), Bxy(x represents numbers 0-9, y represents letters a-z or A-Z). The material difference between the parts and the parts in the product model for inspection is shown in the table below:

No	Model	Difference	Remarks
1	E25	1. Only the appearance color difference is different. 2. All three nameplates can be sold on each model.	Inspection model
2	B1		Coverage model
3	Heyup Boxe Lite		Coverage model
4	Exx		Coverage model

5	Exy		Coverage model
6	lxy		Coverage model
7	lxx		Coverage model
8	Bxy		Coverage model

All the tests carried out on model E25.

Factory: Guangzhou Rigal Electronics Co., Ltd.

Address: No.3-1, Ruixiang Road, Huadu District, Guangzhou

2. Test Sites

2.1 Test Facilities

The tests and measurements refer to this report were performed by RF testing Lab. of CVC Testing Technology Co., Ltd.

Add.: No.3, Tiantaiyi Road, Kaitai Avenue, Science City, Guangzhou, Guangdong, 510663, People's Republic of China

Telephone : +86-20-32293888

Fax : +86-20-32293889

FCC(Test firm designation number: CN1282)

IC(Test firm CAB identifier number: CN0103)

2.2 Description of Non-standard Method and Deviations

The testing and measurement methods used in this report are applied by all standard methods. Not any non-standard method or deviation from the used standards was used.

2.3 List of Test and Measurement Instruments

Refer to **Appendix X**.

3. Test Configuration

3.1 Test Mode

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

Test Mode	Antenna Delivery	Test Channel
DH1/DH3/DH5 2DH1/2DH3/2DH5 3DH1/3DH3/3DH5	1TX / 1RX	0,39,78,hop

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate and different channels. Preliminary tests have been done on all the configuration for confirming worst case.

Data rate and channel below means worst-case rate of each test item.

Worst-case data rates and channels are shown as following table.

Test Items	Test Modes	Test Channels
Conducted Emissions	3DH5	0
Radiated Emissions	3DH5	0
Peak Power Output -Conducted	DH5/2DH5/3DH5	0,39,78
20dB Emission Bandwidth	DH5/2DH5/3DH5	0,39,78
Occupied Channel Bandwidth	DH5/2DH5/3DH5	0,39,78
Frequency Separation	DH5/2DH5/3DH5	hop
Time of Occupancy (Dwell Time)	DH1/DH3/DH5/ 2DH1/2DH3/2DH5/ 3DH1/3DH3/3DH5	hop
Band Edge Compliance	DH5/2DH5/3DH5	0,78
Number of Hopping Frequency	DH5/2DH5/3DH5	hop
Spurious RF Conducted Emissions	DH5/2DH5/3DH5	0,39,78

3.2 Duty cycle

TestMode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]	Limit	Verdict
DH5	Ant1	2402	2.87	3.74	76.74	---	---
	Ant1	2441	2.88	3.76	76.60	---	---
	Ant1	2480	2.88	3.76	76.60	---	---
2DH5	Ant1	2402	2.88	3.75	76.80	---	---
	Ant1	2441	2.88	3.76	76.60	---	---
	Ant1	2480	2.88	3.75	76.80	---	---
3DH5	Ant1	2402	2.89	3.75	77.07	---	---
	Ant1	2441	2.88	3.75	76.80	---	---
	Ant1	2480	2.89	3.76	76.86	---	---

4. Summary of measurement results

Summary of measurements of results	Clause in FCC rules	Verdict	Note
Conducted Emissions	15.207	PASS	/
Radiated Emissions	15.247(d),15.205,15.209	PASS	/
Peak Power Output -Conducted	15.247(b)(1)	PASS	Appendix C of BT_ diagram
20dB Emission Bandwidth	15.247(a)(1)	PASS	Appendix A of BT_ diagram
Occupied Channel Bandwidth	15.247(a)(1)	PASS	Appendix B of BT_ diagram
Frequency Separation	15.247(a)(1)	PASS	Appendix D of BT_ diagram
Time of Occupancy (Dwell Time)	15.247(a)(1)(iii)	PASS	Appendix E of BT_ diagram
Band Edge Compliance	15.247(d)	PASS	Appendix G of BT_ diagram
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS	Appendix F of BT_ diagram
Spurious RF Conducted Emissions	15.247(d)	PASS	Appendix H of BT_ diagram
Antenna Requirement	15.203	PASS	See note 1

Note 1: According to 15.203, it is considered sufficient to comply with the provisions of this section.

5. Measurement procedure

5.1 Conducted Emission

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

Method of Measurement:

The EUT was setup according to ANSI C63.10, 2013 for compliance to FCC 47CFR 15.207 requirements. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs) Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.

The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

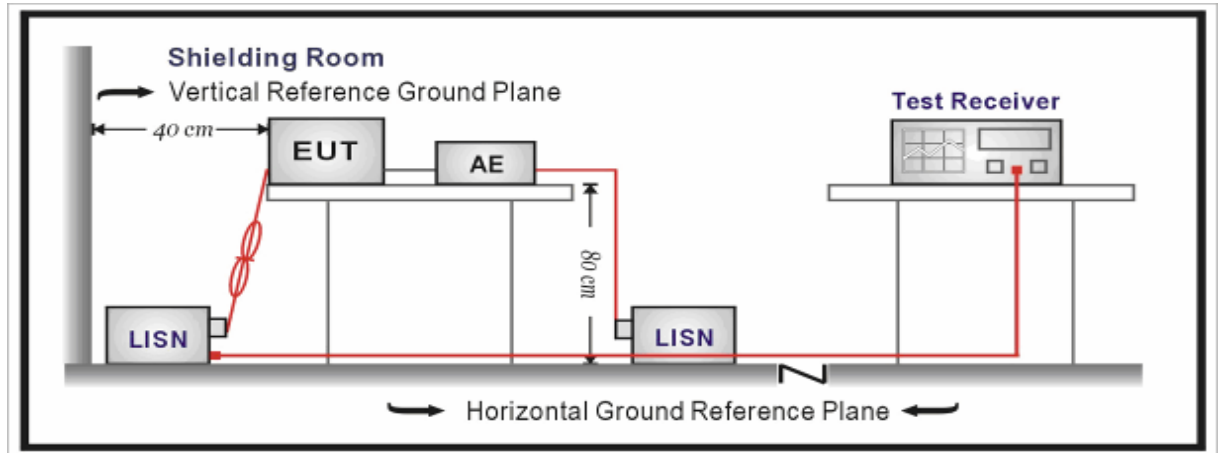
Limits:

Frequency (MHz)	Conducted Limits(dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46*
0.5 - 5	56	46
5 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

Test Setup:



Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Notes:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Level = Reading + Factor.

Measurement Uncertainty:

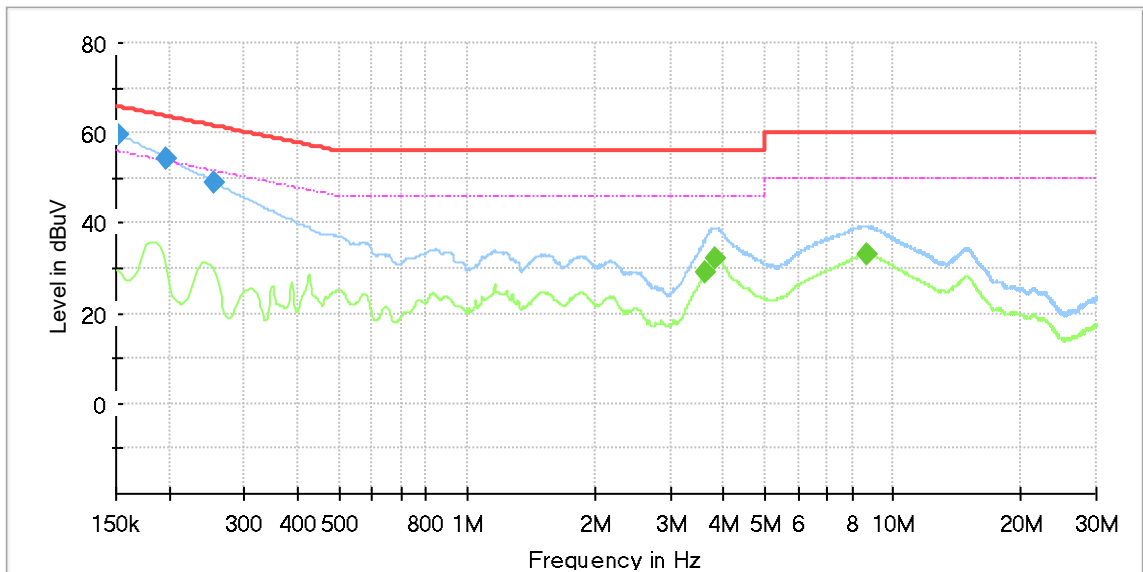
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$. $U = 3.12$ dB.

Test Results:

During the test, the Conducted Emission from 150kHz to 30MHz was performed in all modes with all channels, and all antennas. BT 8DPSK Channel 0, antenna 1 are selected as the worst condition. The test data of the worst-case condition was recorded in this report.

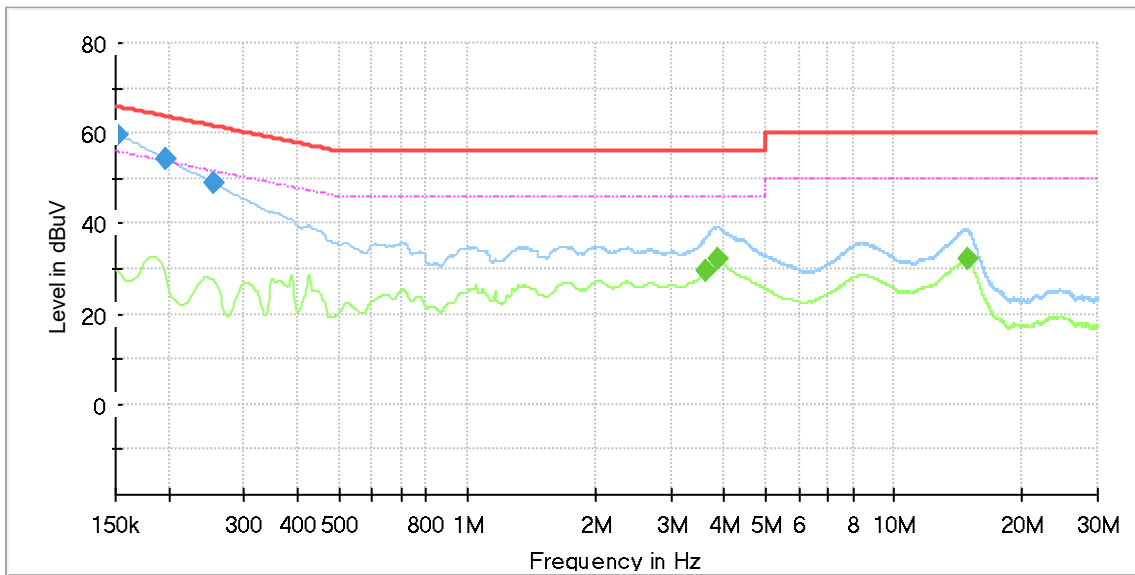
Power Line	L
Test channel	Worst-Case

Suspected List							
Freq. [MHz]	Factor [dB]	Reading [dBμV]	Level [dBμV]	Limit [dBμV]	Margin [dB]	Detector	Pass/Fail
0.152	19.5	40.1	59.6	65.9	6.2	QP	PASS
0.197	19.5	35.0	54.5	63.7	9.2	QP	PASS
0.256	19.4	29.7	49.1	61.6	12.5	QP	PASS
3.602	19.5	9.7	29.2	46.0	16.8	AV	PASS
3.831	19.5	12.8	32.3	46.0	13.7	AV	PASS
8.675	19.6	13.3	32.9	50.0	17.1	AV	PASS



Power Line	N
Test channel	Worst-Case

Suspected List							
Freq. [MHz]	Factor [dB]	Reading [dBμV]	Level [dBμV]	Limit [dBμV]	Margin [dB]	Detector	Pass/Fail
0.152	19.5	40.1	59.6	65.9	6.2	QP	PASS
0.197	19.5	34.9	54.4	63.7	9.3	QP	PASS
0.256	19.4	29.7	49.1	61.6	12.4	QP	PASS
3.602	19.6	10.2	29.8	46.0	16.2	AV	PASS
3.842	19.6	12.7	32.3	46.0	13.7	AV	PASS
14.836	20.1	12.2	32.3	50.0	17.7	AV	PASS



5.2 Radiated Emission

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

Method of Measurement:

The EUT was setup and tested according to ANSI C63.10, 2013.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from Antenna to the EUT was 3 meters.

The Antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the Antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.

The resolution bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.

The frequency range from 30MHz to 10th harmonic is checked.

Note: When doing emission measurement above 1GHz, the horn Antenna will be bended down a little (as horn

Antenna has the narrow beamwidth) in order to keeping the Antenna in the "cone of radiation" of EUT. The 3dB beamwidth is 10~60 degrees for H-plane and 10~90 degrees for E-plane.

Limits:

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part 15, must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Frequency	Limit ($\mu\text{V}/\text{m}$)	Limit ($\text{dB}\mu\text{V}/\text{m}$ @3m)	Remark
0.009MHz-0.490MHz	2400/F(kHz)@300m	20lg(240000/F(kHz))	Quasi-peak Level
0.490MHz~1.705MHz	24000/F(kHz)@30m	20lg(240000/F(kHz))	Quasi-peak Level
1.705MHz~30.0MHz	30@30m	49.54	Quasi-peak Level
30MHz-88MHz	100@3m	40.0	Quasi-peak Level
88MHz-216MHz	150@3m	43.5	Quasi-peak Level
216MHz-960MHz	200@3m	46.0	Quasi-peak Level
960MHz-1GHz	500@3m	54.0	Quasi-peak Level
Above 1GHz	500@3m	54.0	Average Level

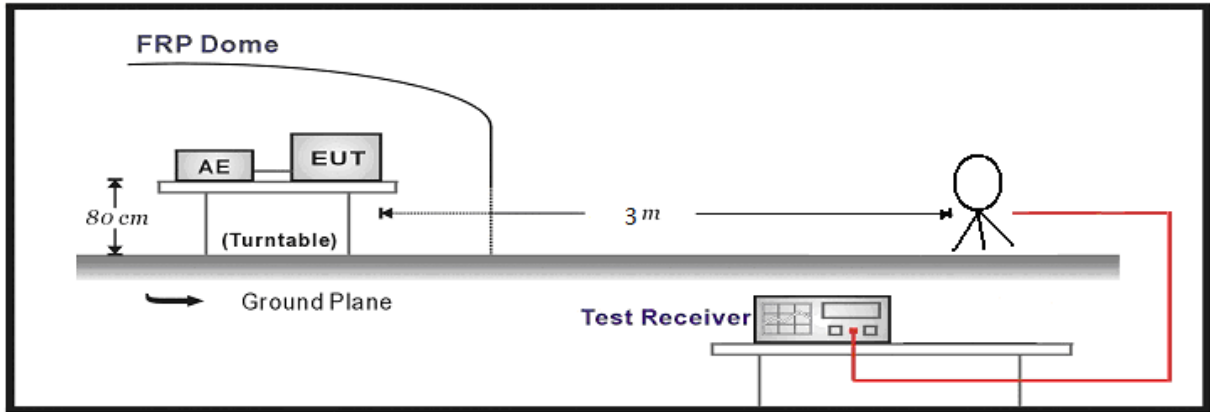
	5000@3m	74.0	Peak Level
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Spurious Radiated Emissions are permitted in any of the frequency bands listed below:

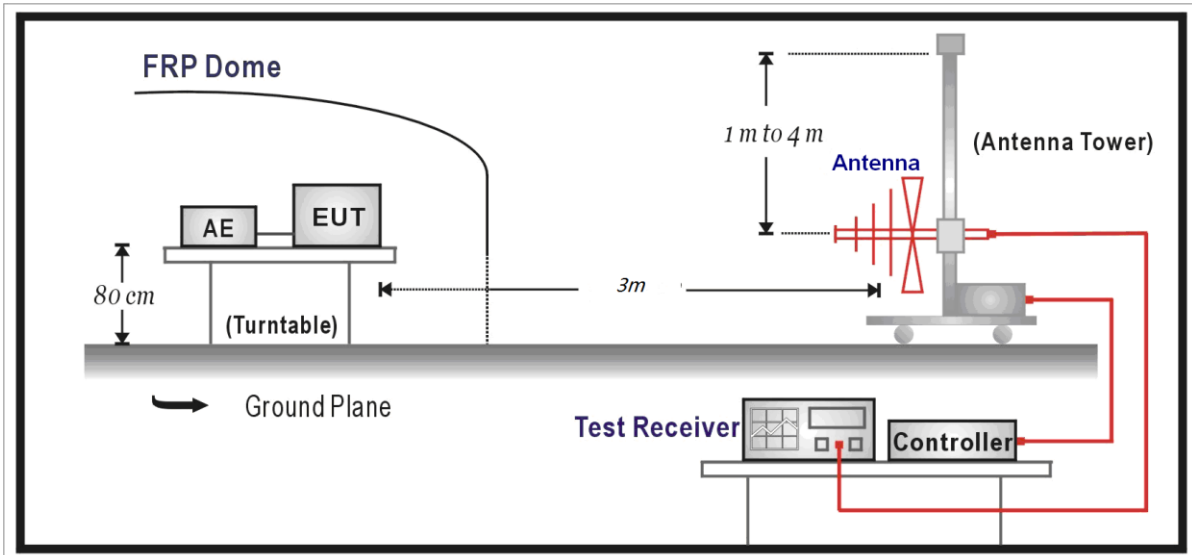
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.
12.57675-12.57725	322-335.4	3600-4400	/
13.36-13.41	/	/	/

Test Setup:

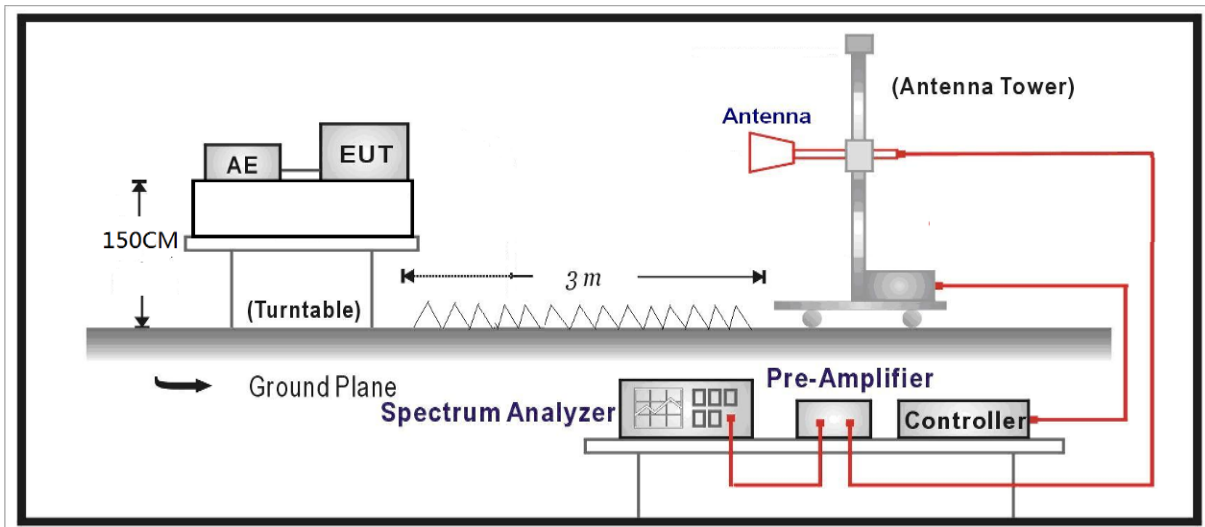
Below 30MHz Test Setup:



Below 1GHz Test Setup:



Above 1GHz Test Setup:



Measurement Data:

The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Level = Reading - Factor

Factor = Preamplifier Factor – Antenna Factor–Cable Loss

Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96.

Frequency	Uncertainty
9KHz-30MHz	3.55 dB
30MHz-200MHz	4.19 dB
200MHz-1GHz	3.63 dB
Above 1GHz	3.68 dB

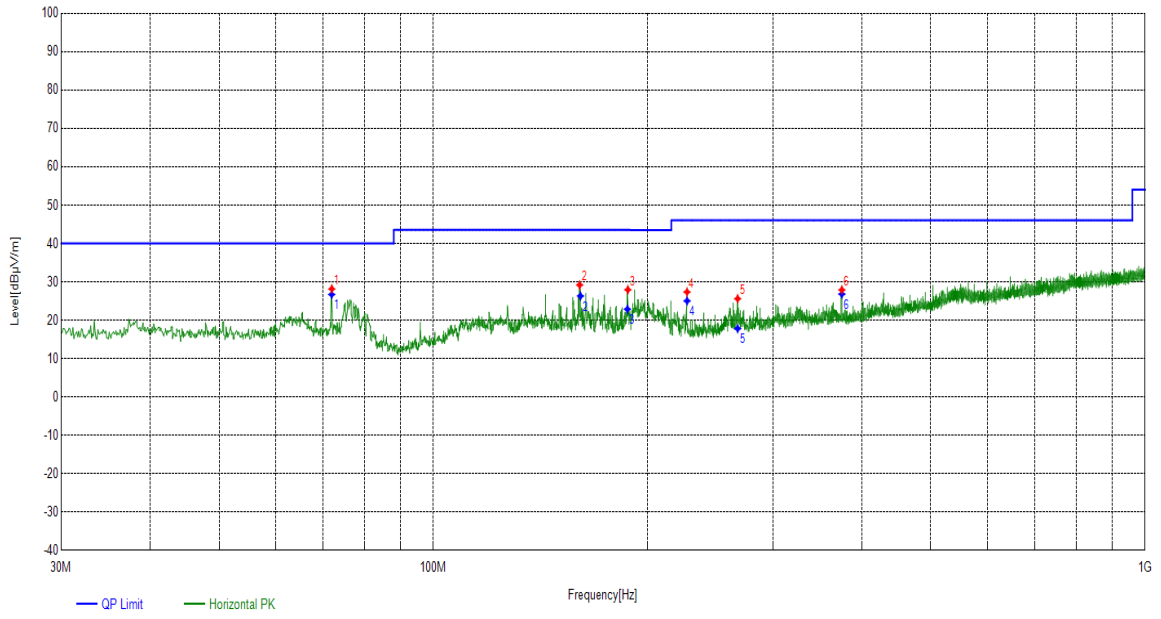
Test Results:

During the test, the Radiates Emission from 9kHz to 40GHz was performed in all modes with all channels and all antennas. BT 8DPSK Channel 0, antenna 1 are selected as the worst condition. The test data of the worst-case condition was recorded in this report.

Radiates Emission	9k~1G								
Test channel	Worst-Case								
Polarity	Horizontal								
Suspected List									
Frequency [MHz]	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
72.0052	17.84	10.30	28.14	40.00	11.86	PK	100	177	PASS
160.5751	20.85	8.32	29.17	43.50	14.33	PK	100	53	PASS
187.6408	18.21	9.72	27.93	43.50	15.57	PK	100	164	PASS
227.2207	18.45	8.88	27.33	46.00	18.67	PK	100	217	PASS
267.6738	20.10	5.49	25.59	46.00	20.41	PK	100	171	PASS
374.9665	23.31	4.59	27.90	46.00	18.10	PK	100	66	PASS

Note: 9kHz~30MHz have been test and test data more than 20dB margin.

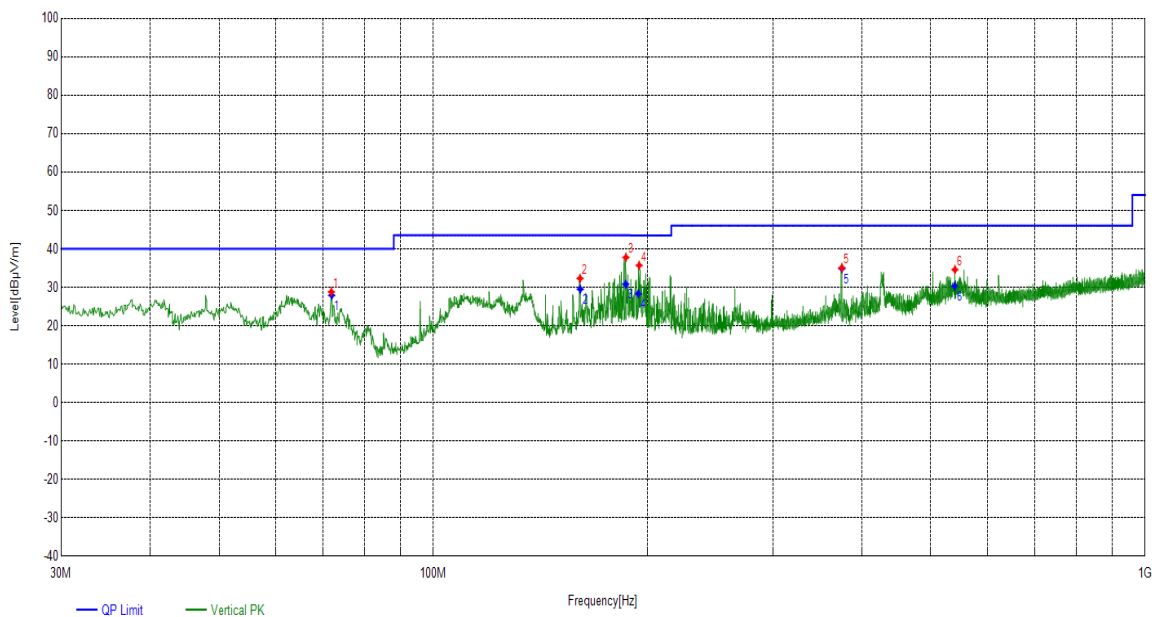
Final Data List							
Frequency [MHz]	Factor [dB]	QP Value [dB μ V/m]	QP Limit [dB μ V/m]	QP Margin [dB]	Height [cm]	Angle [°]	Pass/Fail
71.9833	17.84	26.69	40.00	13.31	260	177	PASS
160.9887	20.85	26.29	43.50	17.21	360	53	PASS
187.3665	18.21	22.86	43.50	20.64	130	164	PASS
227.27	18.45	25.02	46.00	20.98	280	217	PASS
267.6776	20.10	17.81	46.00	28.19	130	171	PASS
374.9937	23.31	26.80	46.00	19.20	260	66	PASS



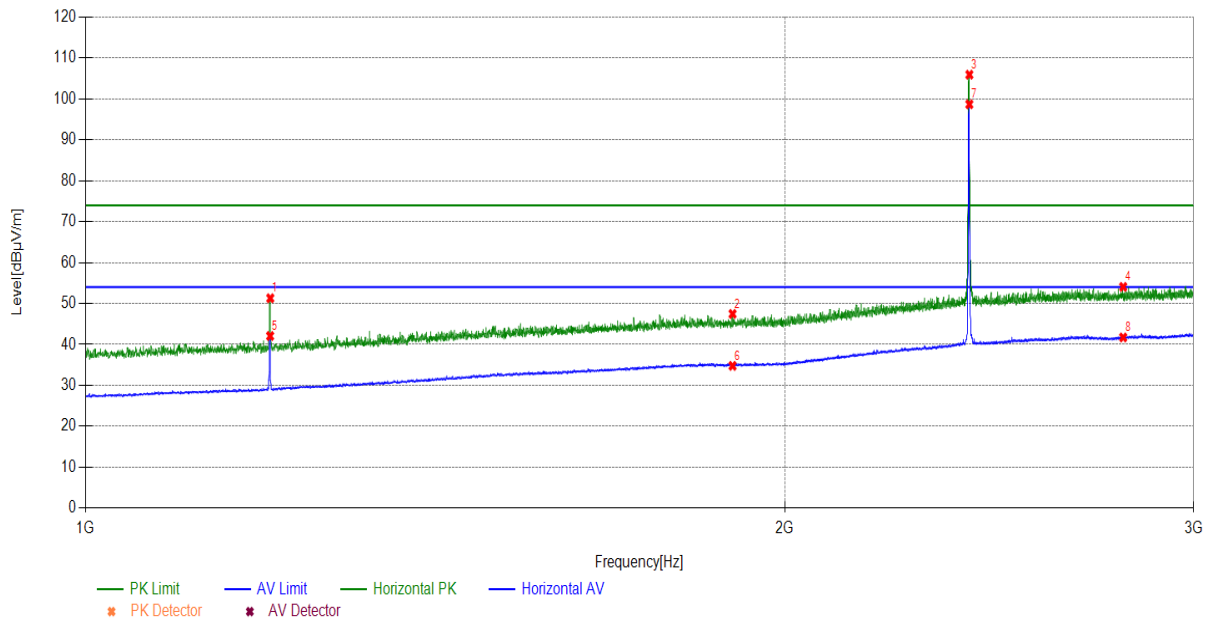
Radiates Emission	9k~1G								
Test channel	Worst-Case								
Polarity	Vertical								
Suspected List									
Frequency [MHz]	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
71.9082	17.86	10.93	28.79	40.00	11.21	PK	100	14	PASS
160.7691	20.84	11.46	32.30	43.50	11.20	PK	100	125	PASS
186.4766	18.37	19.40	37.77	43.50	5.73	PK	100	145	PASS
194.6255	17.61	18.09	35.70	43.50	7.80	PK	100	139	PASS
374.9665	23.31	11.77	35.08	46.00	10.92	PK	100	53	PASS
540.6591	27.49	7.09	34.58	46.00	11.42	PK	100	152	PASS

Note: 9kHz~30MHz have been test and test data more than 20dB margin.

Final Data List							
Frequency [MHz]	Factor [dB]	QP Value [dB μ V/m]	QP Limit [dB μ V/m]	QP Margin [dB]	Height [cm]	Angle [°]	Pass/Fail
71.9894	17.86	27.89	40.00	12.11	100	14	PASS
160.8855	20.84	29.48	43.50	14.02	100	125	PASS
186.3524	18.37	30.79	43.50	12.71	100	145	PASS
194.1523	17.61	28.31	43.50	15.19	100	139	PASS
375.0099	23.31	34.86	46.00	11.14	100	53	PASS
539.9471	27.49	30.33	46.00	15.67	100	152	PASS

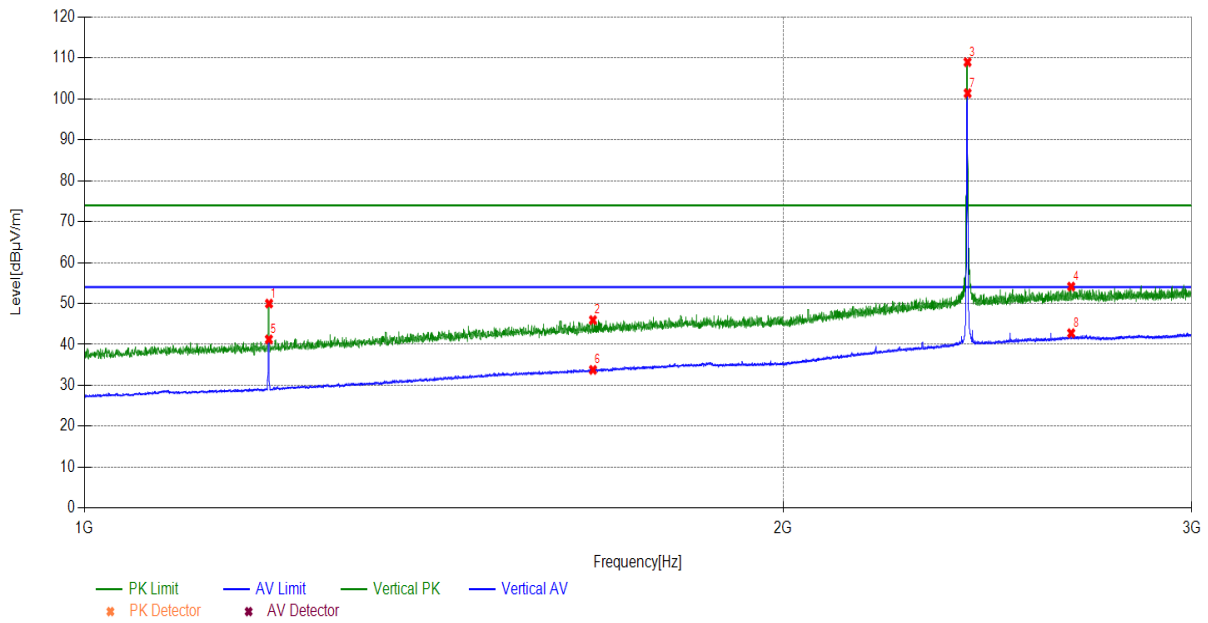


Radiates Emission		1G~3G							
Test channel		Worst-Case							
polarization		Horizontal							
Suspected List									
Frequency [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
1201.0201	27.92	23.39	51.31	74.00	22.69	PK	150	61	PASS
1899.2899	33.06	14.41	47.47	74.00	26.53	PK	150	0	PASS
2401.9402	37.34	68.57	105.91	74.00	-31.91	PK	150	75	---
2797.5798	38.78	15.30	54.08	74.00	19.92	PK	150	33	PASS
1200.8201	27.92	14.15	42.07	54.00	11.93	AV	150	47	PASS
1899.2899	33.06	1.72	34.78	54.00	19.22	AV	150	33	PASS
2401.9402	37.34	61.33	98.67	54.00	-44.67	AV	150	75	---
2797.5798	38.78	2.94	41.72	54.00	12.28	AV	150	188	PASS



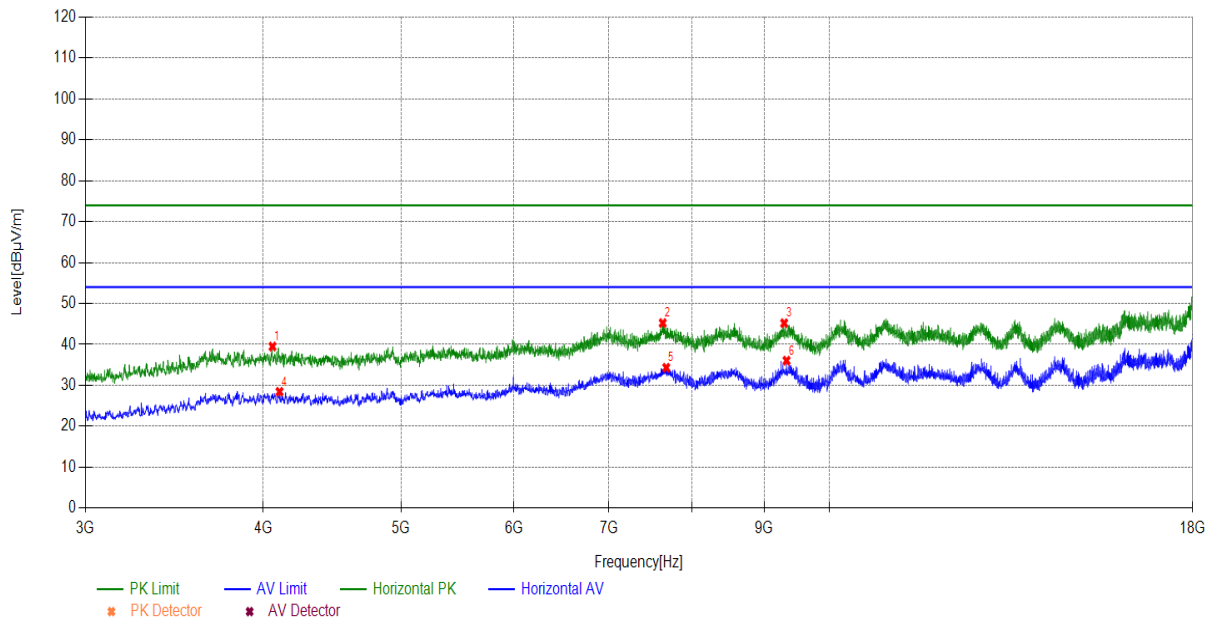
Note: The signal beyond the limit is carrier

Radiates Emission	1G~3G								
Test channel	Worst-Case								
polarization	Vertical								
Suspected List									
Frequency [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/ Fail
1201.0201	27.92	22.08	50.00	74.00	24.00	PK	150	179	PASS
1656.2656	31.92	14.05	45.97	74.00	28.03	PK	150	66	PASS
2401.7402	37.34	71.63	108.97	74.00	-34.97	PK	150	122	---
2661.9662	38.38	15.76	54.14	74.00	19.86	PK	150	151	PASS
1200.8201	27.92	13.32	41.24	54.00	12.76	AV	150	179	PASS
1656.2656	31.92	1.88	33.80	54.00	20.20	AV	150	165	PASS
2401.9402	37.34	64.03	101.37	54.00	-47.37	AV	150	236	---
2661.9662	38.38	4.39	42.77	54.00	11.23	AV	150	122	PASS

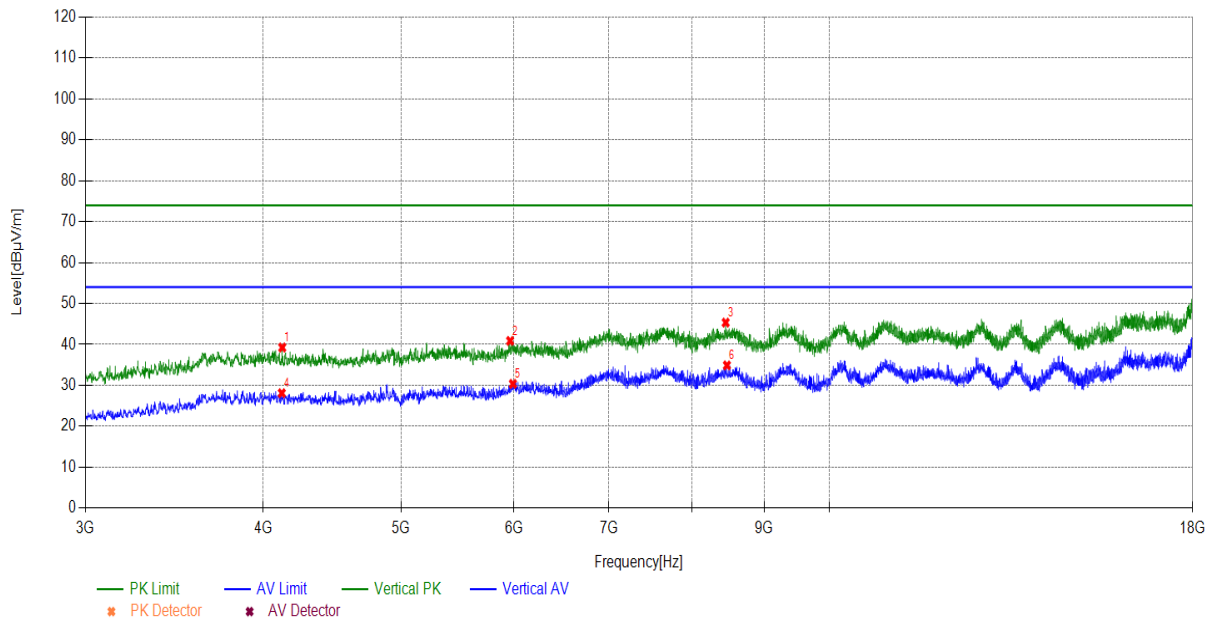


Note: The signal beyond the limit is carrier

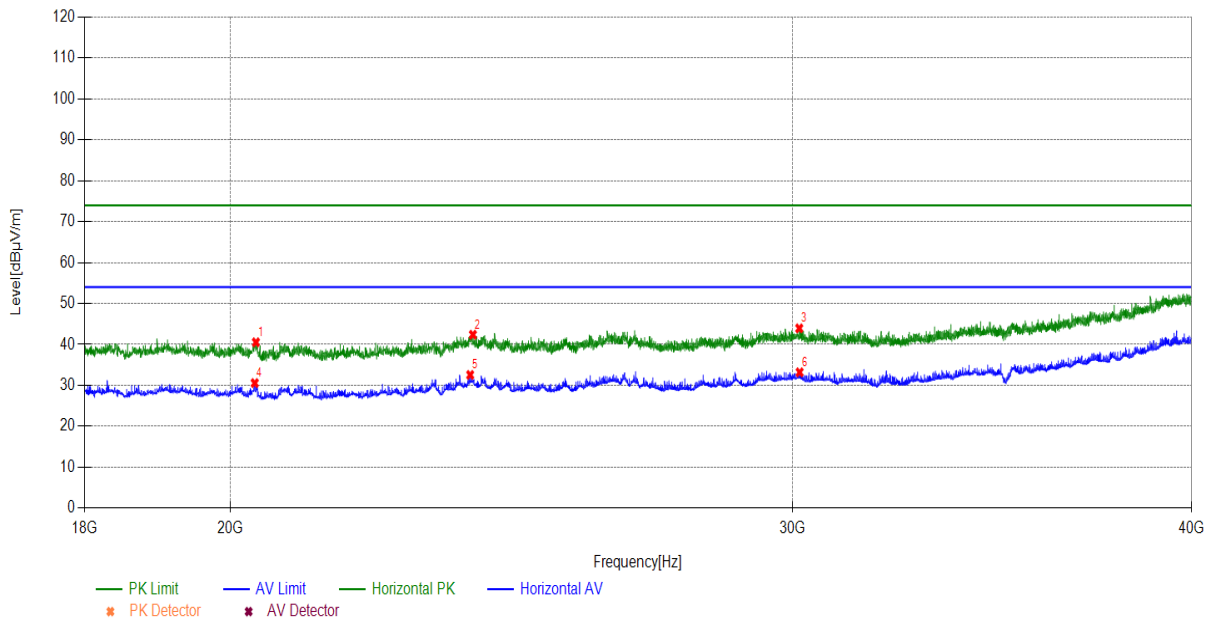
Radiates Emission	3G~18G								
Test channel	Worst-Case								
polarization	Horizontal								
Suspected List									
Frequency [MHz]	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/ Fail
4060.6061	-0.20	39.70	39.50	74.00	34.50	PK	150	260	PASS
7635.4635	8.36	36.89	45.25	74.00	28.75	PK	150	130	PASS
9293.1293	10.64	34.57	45.21	74.00	28.79	PK	150	70	PASS
4107.1107	-0.25	28.69	28.44	54.00	25.56	AV	150	90	PASS
7678.9679	8.38	25.95	34.33	54.00	19.67	AV	150	210	PASS
9329.1329	10.76	25.30	36.06	54.00	17.94	AV	150	10	PASS



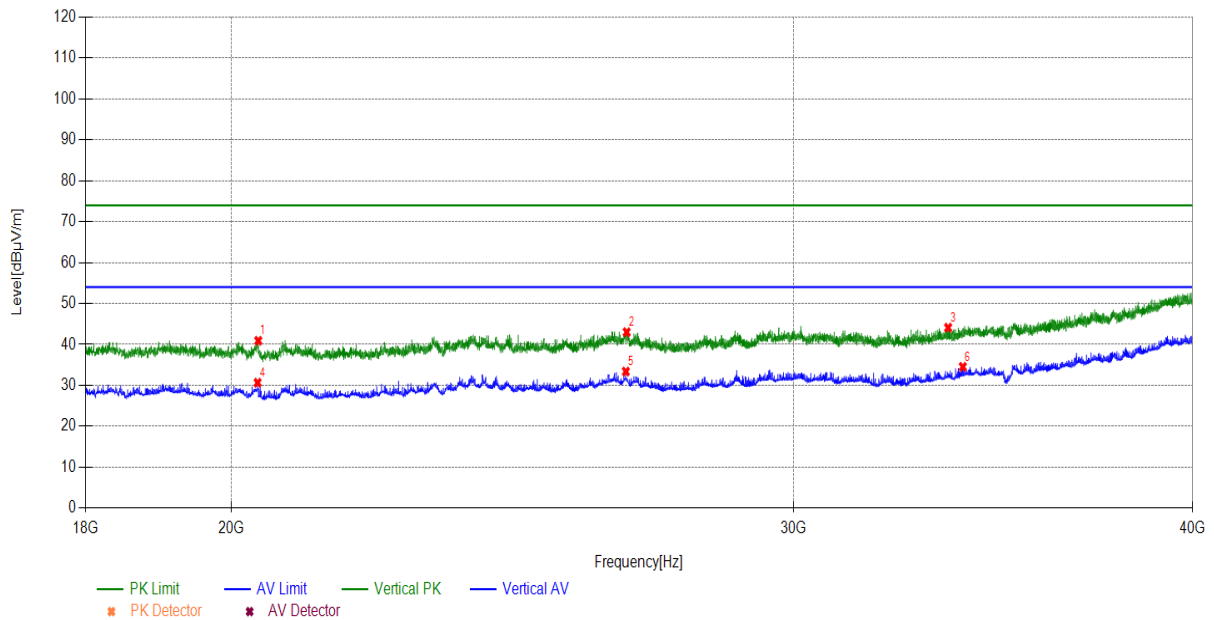
Radiates Emission	3G~18G								
Test channel	Worst-Case								
polarization	Vertical								
Suspected List									
Frequency[MHz]	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
4125.1125	-0.27	39.53	39.26	74.00	34.74	PK	150	150	PASS
5964.2964	4.81	36.07	40.88	74.00	33.12	PK	150	250	PASS
8454.5455	9.08	36.27	45.35	74.00	28.65	PK	150	330	PASS
4122.1122	-0.27	28.38	28.11	54.00	25.89	AV	150	110	PASS
5991.2991	4.92	25.46	30.38	54.00	23.62	AV	150	310	PASS
8471.0471	9.10	25.81	34.91	54.00	19.09	AV	150	10	PASS



Radiates Emission	18G~40G								
Test channel	Worst-Case								
polarization	Horizontal								
Suspected List									
Frequency [MHz]	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/ Fail
20369.637	1.43	39.11	40.54	74.00	33.46	PK	150	170	PASS
23819.582	3.56	38.83	42.39	74.00	31.61	PK	150	200	PASS
30140.8141	6.64	37.31	43.95	74.00	30.05	PK	150	10	PASS
20352.0352	1.42	29.16	30.58	54.00	23.42	AV	150	160	PASS
23773.3773	3.52	29.05	32.57	54.00	21.43	AV	150	330	PASS
30149.615	6.63	26.58	33.21	54.00	20.79	AV	150	180	PASS



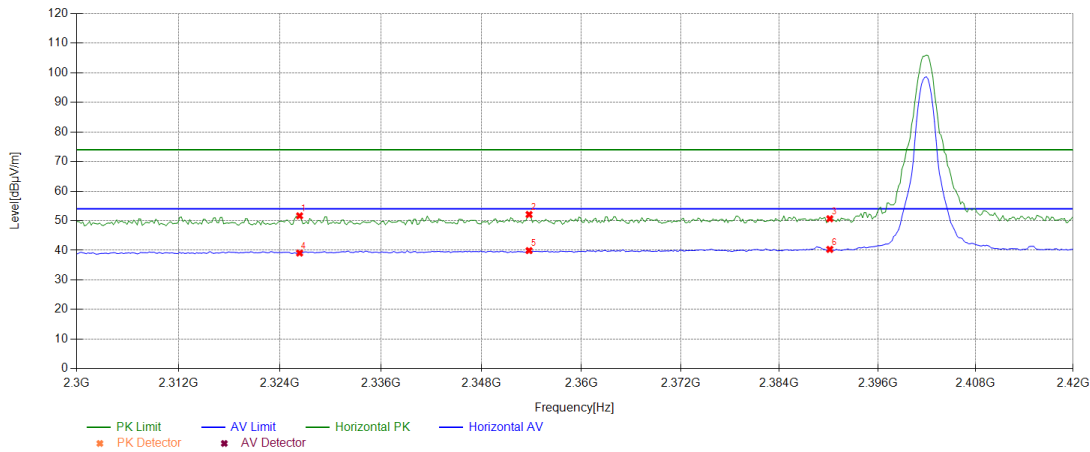
Radiates Emission	18G~40G								
Test channel	Worst-Case								
polarization	Vertical								
Suspected List									
Frequency [MHz]	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/ Fail
20389.4389	1.44	39.48	40.92	74.00	33.08	PK	150	70	PASS
26594.0594	4.74	38.27	43.01	74.00	30.99	PK	150	60	PASS
33533.5534	6.46	37.65	44.11	74.00	29.89	PK	150	360	PASS
20380.6381	1.43	29.24	30.67	54.00	23.33	AV	150	110	PASS
26578.6579	4.73	28.66	33.39	54.00	20.61	AV	150	70	PASS
33889.989	6.57	27.98	34.55	54.00	19.45	AV	150	350	PASS



Band Edge:

During the test, the Band Edge was performed in BT all modes with all channels and all antennas. BT 8DPSK, antenna 1 are selected as the worst condition. The test data of the worst-case condition was recorded in this report.

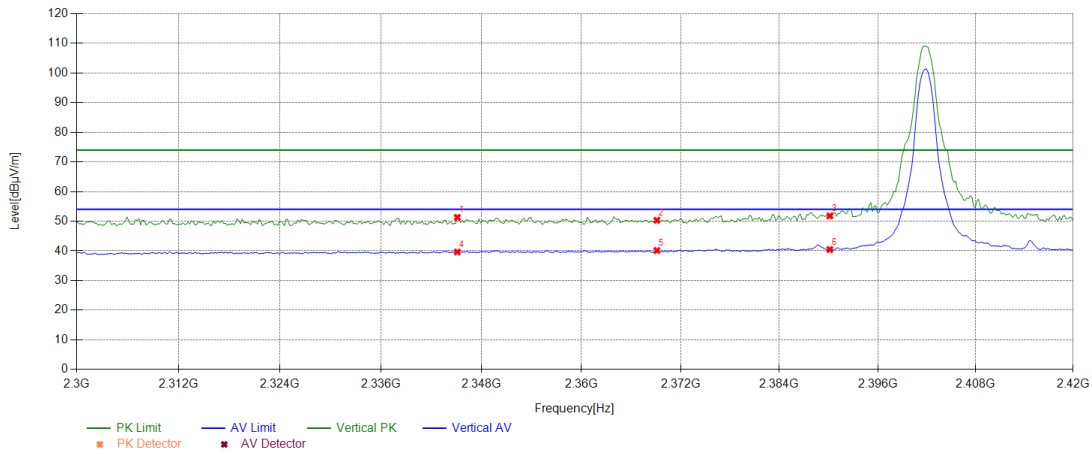
Test mode	8DPSK								
Test channel	Lowest channel								
polarization	Horizontal								
Suspected List									
Frequency [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
2326.3326	36.67	14.98	51.65	74.00	22.35	PK	150	174	PASS
2353.7354	36.92	15.19	52.11	74.00	21.89	PK	150	131	PASS
2390.139	37.24	13.43	50.67	74.00	23.33	PK	150	33	PASS
2326.3326	36.67	2.43	39.10	54.00	14.90	AV	150	89	PASS
2353.7354	36.92	3.00	39.92	54.00	14.08	AV	150	47	PASS
2390.139	37.24	3.08	40.32	54.00	13.68	AV	150	61	PASS



Test mode	8DPSK
Test channel	Lowest channel
polarization	Vertical

Suspected List

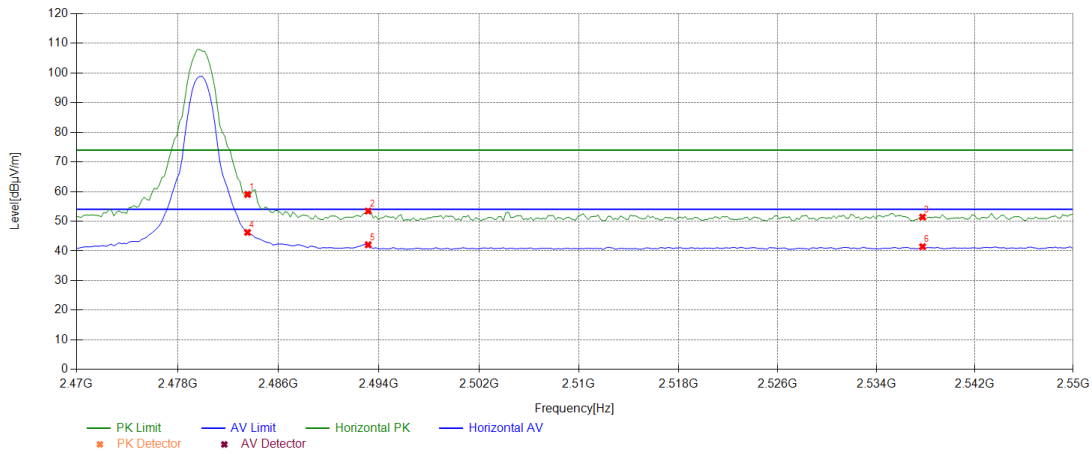
Frequency [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
2345.1345	36.84	14.46	51.30	74.00	22.70	PK	150	122	PASS
2369.1369	37.06	13.26	50.32	74.00	23.68	PK	150	136	PASS
2390.139	37.24	14.55	51.79	74.00	22.21	PK	150	122	PASS
2345.1345	36.84	2.79	39.63	54.00	14.37	AV	150	108	PASS
2369.1369	37.06	3.07	40.13	54.00	13.87	AV	150	122	PASS
2390.139	37.24	3.22	40.46	54.00	13.54	AV	150	122	PASS



Test mode	8DPSK
Test channel	Highest channel
polarization	Horizontal

Suspected List

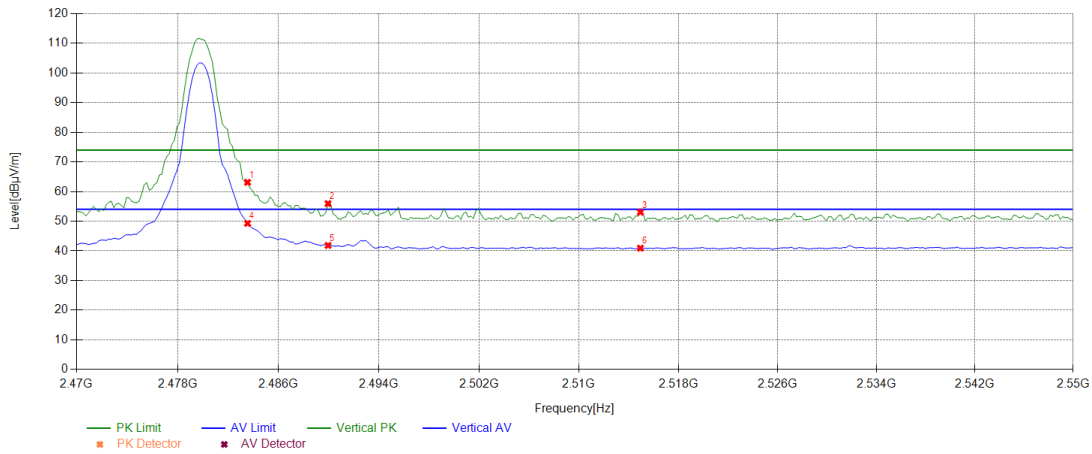
Frequency [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
2483.5484	37.72	21.32	59.04	74.00	14.96	PK	150	313	PASS
2493.1493	37.76	15.66	53.42	74.00	20.58	PK	150	85	PASS
2537.7538	37.94	13.46	51.40	74.00	22.60	PK	150	327	PASS
2483.5484	37.72	8.51	46.23	54.00	7.77	AV	150	327	PASS
2493.1493	37.76	4.31	42.07	54.00	11.93	AV	150	85	PASS
2537.7538	37.94	3.49	41.43	54.00	12.57	AV	150	228	PASS



Test mode	8DPSK
Test channel	Highest channel
polarization	Vertical

Suspected List

Frequency [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Detect or	Height [cm]	Angle deg	Pass/Fail
2483.5484	37.72	25.40	63.12	74.00	10.88	PK	150	106	PASS
2489.949	37.75	18.19	55.94	74.00	18.06	PK	150	120	PASS
2514.9515	37.85	15.18	53.03	74.00	20.97	PK	150	64	PASS
2483.5484	37.72	11.55	49.27	54.00	4.73	AV	150	120	PASS
2489.949	37.75	4.11	41.86	54.00	12.14	AV	150	120	PASS
2514.9515	37.85	3.06	40.91	54.00	13.09	AV	150	234	PASS



5.3 Peak Power Output -Conducted

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

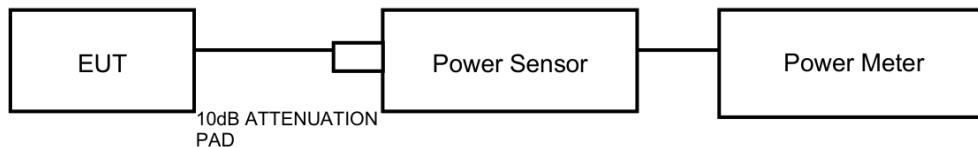
Method of Measurement:

During the process of the testing, The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. The EUT is controlled by the Bluetooth test set to ensure max power transmission with proper modulation. The peak detector is used.

Limits:

Rule Part 15.247 (b) (1)specifies that " For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts."

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.44$ dB.

Test Results:

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH5	Ant1	2402	7.96	≤30.00	PASS
	Ant1	2441	7.08	≤30.00	PASS
	Ant1	2480	6.79	≤30.00	PASS
2DH5	Ant1	2402	7.95	≤20.97	PASS
	Ant1	2441	7.07	≤20.97	PASS
	Ant1	2480	6.77	≤20.97	PASS
3DH5	Ant1	2402	7.90	≤20.97	PASS
	Ant1	2441	7.22	≤20.97	PASS
	Ant1	2480	6.93	≤20.97	PASS

5.4 20dB Emission Bandwidth

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable. RBW is set to 20 kHz; VBW is set to 100 kHz on spectrum analyzer.

Detector=Peak, Trace mode=Max hold.

Limits:

No specific occupied bandwidth requirements in part 15.247(a) (1).

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 936$ Hz.

Test Results:

TestMode	Antenna	Channel	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.94	2401.526	2402.465	---	---
	Ant1	2441	0.94	2440.523	2441.462	---	---
	Ant1	2480	0.94	2479.526	2480.465	---	---
2DH5	Ant1	2402	1.25	2401.361	2402.609	---	---
	Ant1	2441	1.25	2440.361	2441.606	---	---
	Ant1	2480	1.25	2479.358	2480.609	---	---
3DH5	Ant1	2402	1.26	2401.349	2402.606	---	---
	Ant1	2441	1.25	2440.349	2441.603	---	---
	Ant1	2480	1.26	2479.349	2480.606	---	---

5.5 Occupied Channel Bandwidth

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable. RBW is set to 20 kHz; VBW is set to 100 kHz on spectrum analyzer.

Detector=Peak, Trace mode=Max hold.

Limits:

No specific occupied bandwidth requirements in part 15.247(a) (1).

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 936$ Hz.

Test Results:

TestMode	Antenna	Channel	OCB [MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.857	---	---
	Ant1	2441	0.857	---	---
	Ant1	2480	0.851	---	---
2DH5	Ant1	2402	1.157	---	---
	Ant1	2441	1.151	---	---
	Ant1	2480	1.160	---	---
3DH5	Ant1	2402	1.160	---	---
	Ant1	2441	1.154	---	---
	Ant1	2480	1.163	---	---

5.6 Frequency Separation

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer.

Limits:

Rule Part 15.247(a)(1) specifies that “Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping 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. ”

Note: The value of two-thirds of 20 dB bandwidth is always greater than 25 kHz.

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U=936$ Hz.

Test Results:

TestMode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	0.696	≥ 0.627	PASS
2DH5	Ant1	Hop	1.136	≥ 0.833	PASS
3DH5	Ant1	Hop	0.922	≥ 0.840	PASS

5.7 Time of Occupancy (Dwell Time)

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 1MHz and VBW is set to 3MHz on spectrum analyzer. The dwell time is calculated by:

Dwell time = time slot length * hop rate * 0.4s with:

The selected EUT Packet type uses a slot type of 5-Tx&1-Rx and a hopping rate of 1600(ch*hop/s) for all channels. So the final hopping rate for all channel is $1600/6=266.67(ch*hop/s)$

Limits:

Rule Part15.247(a) specifies that " Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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."

Dwell time	$\leq 400ms$
------------	--------------

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$.

Requirements	Uncertainty					
Dwell Time	DH5	U=0.70ms	2DH5	U=0.70ms	3DH5	U=0.70ms

Test Results:

TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.37	320	0.118	≤0.4	PASS
DH3	Ant1	Hop	1.61	160	0.258	≤0.4	PASS
DH5	Ant1	Hop	2.85	106.67	0.304	≤0.4	PASS
2DH1	Ant1	Hop	0.38	320	0.122	≤0.4	PASS
2DH3	Ant1	Hop	1.62	160	0.259	≤0.4	PASS
2DH5	Ant1	Hop	2.86	106.67	0.305	≤0.4	PASS
3DH1	Ant1	Hop	0.38	320	0.122	≤0.4	PASS
3DH3	Ant1	Hop	1.62	160	0.259	≤0.4	PASS
3DH5	Ant1	Hop	2.86	106.67	0.305	≤0.4	PASS

5.8 Band Edge Measurement

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer.

Limits:

Rule Part 15.247(d) specifies that “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 conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$, $U = 936 \text{ Hz}$, $2 \text{ GHz} - 3 \text{ GHz} = 1.407 \text{ dB}$.

Test Result:

TestMode	Antenna	ChName	Channel	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	Low	2402	7.32	-32.84	≤-12.68	PASS
		High	2480	6.60	-45.57	≤-13.4	PASS
		Low	Hop_2402	7.33	-49.98	≤-12.67	PASS
		High	Hop_2480	6.46	-49.04	≤-13.54	PASS
2DH5	Ant1	Low	2402	7.77	-35.61	≤-12.23	PASS
		High	2480	6.58	-48.09	≤-13.42	PASS
		Low	Hop_2402	7.10	-50.03	≤-12.9	PASS
		High	Hop_2480	6.42	-48.29	≤-13.58	PASS
3DH5	Ant1	Low	2402	7.86	-35.03	≤-12.14	PASS
		High	2480	6.65	-47.79	≤-13.35	PASS
		Low	Hop_2402	6.83	-49.42	≤-13.17	PASS
		High	Hop_2480	6.11	-48.74	≤-13.89	PASS

5.9 Number of hopping Frequency

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 100KHz and VBW is set to 300KHz on spectrum analyzer. Set EUT on Hopping on mode.

Limits:

Rule Part 15.247(a) (1) (iii) specifies that” Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.”

Limits	≥ 15 channels

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.75\text{dB}$.

Test Results:

TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS
3DH5	Ant1	Hop	79	≥15	PASS

5.10 Spurious RF Conducted Emissions

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.2kPa

Method of Measurement:

The EUT was connected to the spectrum analyzer with a known loss. The spectrum analyzer scans from 30MHz to the 10th harmonic of the carrier. The peak detector is used. Set RBW to 100kHz and VBW to 300 kHz, Sweep is set to AUTO .The test is in transmitting mode.

Limits:

Rule Part 15.247(d) pacifies that “In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

Test Setup:



Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

Frequency	Uncertainty
100kHz-2GHz	0.684 dB
2GHz-26GHz	1.407 dB

Test Results:

TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	Reference	7.90	7.90	---	PASS
			30~1000	7.90	-44.76	≤-12.1	PASS
			1000~26500	7.90	-45.38	≤-12.1	PASS
		2441	Reference	6.99	6.99	---	PASS
			30~1000	6.99	-60.94	≤-13.01	PASS
			1000~26500	6.99	-45.21	≤-13.01	PASS
		2480	Reference	6.70	6.70	---	PASS
			30~1000	6.70	-49.49	≤-13.3	PASS
			1000~26500	6.70	-44.4	≤-13.3	PASS
2DH5	Ant1	2402	Reference	7.83	7.83	---	PASS
			30~1000	7.83	-61.41	≤-12.17	PASS
			1000~26500	7.83	-47.2	≤-12.17	PASS
		2441	Reference	6.94	6.94	---	PASS
			30~1000	6.94	-60.66	≤-13.06	PASS
			1000~26500	6.94	-48.57	≤-13.06	PASS
		2480	Reference	6.63	6.63	---	PASS
			30~1000	6.63	-60.29	≤-13.37	PASS
			1000~26500	6.63	-45.35	≤-13.37	PASS
3DH5	Ant1	2402	Reference	7.91	7.91	---	PASS
			30~1000	7.91	-60.97	≤-12.09	PASS
			1000~26500	7.91	-48.17	≤-12.09	PASS
		2441	Reference	7.02	7.02	---	PASS
			30~1000	7.02	-59.82	≤-12.98	PASS
			1000~26500	7.02	-45.9	≤-12.98	PASS
		2480	Reference	6.73	6.73	---	PASS
			30~1000	6.73	-60.77	≤-13.27	PASS
			1000~26500	6.73	-47.06	≤-13.27	PASS

6. Appendix X

Test Equipment	Type/Mode	SERIAL NO.	Equipment No.	Manufacturer	Cal. Due
Spectrum Analyzer	FSV40	101580	DZ-000238-3	R&S	2024/04/22
Comprehensive Test Instrument	CMW270	100304	DZ-000240-1	R&S	2023/12/06
Analog Signal Generator	SMB100A	181858	DZ-000238-2	R&S	2024/05/29
Vector Signal Generator	SGT100A	111661	DZ-000238-1	R&S	2024/05/29
RF Radio Frequency Switch	JS0806-2	19H9080187	DZ-000241	Tonscend	2024/05/29
Programmable DC Power Supply	E3644A	MY58036222	DZ-000178	KEYSIGHT	2024/04/12
3m Semi-Anechoic Chamber	FACT-4	ST08035	WKNA-0024	ETS	2024/12/12
5m Semi-Anechoic Chamber	SAC-5	SAC-5-2.0	EM-000557	COMTEST	2024/11/02
Spectrum Analyzer	N9010B	MY57470323	DZ-000174	KEYSIGHT	2024/02/22
EMI Test Receiver	N9038A-508	MY532290079	EM-000397	Agilent	2024/02/22
EMI Test Receiver	ESR7	102235	VG DY-0956	R&S	2024/02/22
loop antenna	HLA 6121	540046	EM-000546	TESEQ	2024/06/05
Broadband Antenna	VULB 9168	01537	EM-000736-1	SCHWAR ZBECK	2024/04/24
Broadband Antenna	VULB 9163	9163-530	EM-000342	SCHWAR ZBECK	2024/06/10
Waveguide Horn Antenna	HF906	360306/008	EM-000093	R&S	2024/02/24
Waveguide Horn Antenna	BBHA9170	00949	DZ-000209-2	SCHWAR ZBECK	2024/08/05
Bandstop Filters	SW-BSF-2400-100-7-A1	/	EM-000495	/	2024/08/29
5G Bandstop Filters	WRCJV12-4900-5100-5900-6100-50EE	1	DZ-000186	WI	2023/12/06
Preamplifier	BBV 9721	9721-050	DZ-000209-1	SCHWAR ZBECK	2024/06/04
EMI Test Receiver	ESR3	102394	VG DY-0705	R&S	2024/04/22
LISN	NSLK 8127	8127644	EM-000370	SCHWAR ZBECK	2024/07/27
Plus Limiter (#2)	VTSD 9561	9561-F017	EM-000367	SCHWAR ZBECK	2024/09/03
Shielding Room(#2)	GP1A	001	WKNF-0006	LEINING	2024/08/07
Temperature and humidity meter	MHO-C201	/	DZ-000249-2	Seconds test	2024/09/23

The End

Important

1. The test report is invalid without the official stamp of CVC;
2. Any part photocopies of the test report are forbidden without the written permission from CVC;
3. The test report is invalid without the signatures of Author and Reviewer;
4. The test report is invalid if altered;
5. Objections to the test report must be submitted to CVC within 15 days;
6. Generally, commission test is responsible for the tested samples only;
7. As for the test result, “—” or “N/A” means “not applicable”, “ / ”means “not testing”, “P” means “pass” and “F” means “fail”.

***The test data and test results given in this test report should only be used for purposes of scientific research, teaching and internal quality control when the CMA symbol is not presented. ***

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