TEST REPORT

Reference No.	:	WTS16S0756085E
FCC ID.....	:	2AD33IM210BLKBIG
Applicant	:	FLYBALL ELECTRONIC (SHENZHEN) CO. LTD
Address	:	5-6 Building, Zhiji Industrial Park, Shenzhen, China
Manufacturer	:	FLYBALL ELECTRONIC (SHENZHEN) CO. LTD
Address	:	5-6 Building, Zhiji Industrial Park, Shenzhen, China
Product Name	:	2.1 CH MULTIMEDIA SPEAKER SYSTEM
Model No.	:	IM210-BLK-BIG, C256KB-PQ,
Standards	:	FCC CFR47 Part 15 Section 15.247:2016
Date of Receipt sample	:	Jul.18, 2016
Date of Test	:	Jul.18 – Aug. 12, 2016
Date of Issue	:	Aug. 17, 2016
Test Result	:	**Pass**

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS16S0756085E	Jul. 18, 2016	Jul. 18 – Aug. 12, 2016	Aug. 17, 2016	original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product Name : 2.1 CH MULTIMEDIA SPEAKER SYSTEM

Model No. :IM210-BLK-BIG, C256KB-PQ

Model Description : The model IM210-BLK-BIG is the tested sample. Both models are same in all respects. Only the model names is different for different market requirement.

Operation Frequency : 2402-2480MHz, 79(EDR) Channels in total

The Lowest Oscillator : 24MHz

Antenna Gain : 0dBi

Type of Modulation : GFSK, Pi/4DQPSK

Antenna installation : PCB Printed Antenna

4.2 Details of E.U.T.

Technical Data : AC 110V, 60Hz

4.1 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2402	2	2403	3	2404	4	2405
5	2406	6	2407	7	2408	8	2409
9	2410	10	2411	11	2412	12	2413
13	2414	14	2415	15	2416	16	2417
17	2418	18	2419	19	2420	20	2421
21	2422	22	2423	23	2424	24	2425
25	2426	26	2427	27	2428	28	2429
29	2430	30	2431	31	2432	32	2433
33	2434	34	2435	35	2436	36	2437
37	2438	38	2439	39	2440	40	2441
41	2442	42	2443	43	2444	44	2445
45	2446	46	2447	47	2448	48	2449
49	2450	50	2451	51	2452	52	2453
53	2454	54	2455	55	2456	56	2457
57	2458	58	2459	59	2460	60	2461
61	2462	62	2463	63	2464	64	2465
65	2466	66	2467	67	2468	68	2469
69	2470	70	2471	71	2472	72	2473
73	2474	74	2475	75	2476	76	2477
77	2478	78	2479	79	2480	-	-

4.2 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Table 1 Tests Carried Out Under FCC part 15.247

Bluetooth mode	Test mode	Low channel	Middle channel	High channel
EDR	Transmitting	2402MHz	2441MHz	2480MHz

Table 2 Tests Carried Out Under FCC part 15.207 and 15.209

Test Item	Test Mode
Radiated Emissions	Transmitting
Conducted Emissions	Transmitting

4.3 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: 7760A-1**

  Waltek Services(Shenzhen) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration 7760A-1, October 15, 2015

- **FCC Test Site 1#– Registration No.: 880581**

  Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 880581, April 29, 2014.

- **FCC Test Site 2#– Registration No.: 328995**

  Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 328995, December 3, 2014.

5 Equipment Used during Test

5.1 Equipments List

3m Semi-anechoic Chamber for Radiation Emissions Test site 1#						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	EMC Analyzer	Agilent	E7405A	MY45114943	Sep.14,2015	Sep.13,2016
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Sep.14,2015	Sep.13,2016
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.18,2016	Apr.17,2017
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.14,2015	Sep.13,2016
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.18,2016	Apr.17,2017
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.18,2016	Apr.17,2017
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAM-840A	2004	Mar.16,2016	Mar.15,2017
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.09,2016	Apr.08,2017
3m Semi-anechoic Chamber for Radiation Emissions Test site 2#						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No**	**Last Calibration Date**	**Calibration Due Date**
1	Test Receiver	R&S	ESCI	101296	Sep.14,2015	Sep.13,2016
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	Sep.14,2015	Sep.13,2016
3	Amplifier	Compliance pirection systems inc	PAP-0203	22024	Sep.14,2015	Sep.13,2016
4	Cable	HUBER+SUHNER	CBL2	525178	Sep.14,2015	Sep.13,2016
RF Conducted Testing						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY45114943	Sep.14,2015	Sep.13,2016
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	Sep.14,2015	Sep.13,2016
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	Sep.14,2015	Sep.13,2016

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 1 x 10^{-6}
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (30M~1000MHz)
	± 5.47 dB (1000M~25000MHz)
Conducted Spurious Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)

5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

6 Test Summary

Test Items	Test Requirement	Result
Conduct Emission	15.207	C
Spurious Radiated Emissions	15.205(a) 15.209 15.247(d)	C
Band edge	15.247(d) 15.205(a)	C
20dB Bandwidth	15.247(a)(1)	C
Maximum Peak Output Power	15.247(b)(1)	C
Frequency Separation	15.247(a)(1)	C
Number of Hopping Frequency	15.247(a)(1)(iii)	C
Dwell time	15.247(a)(1)(iii)	C
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	C
Note: C=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable.		

7 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.10:2013;ANSI C63.4:2014
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class/Severity:	Class B
Limit:	66-56 dBμV between 0.15MHz & 0.5MHz
	56 dBμV between 0.5MHz & 5MHz
	60 dBμV between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)

7.1 E.U.T. Operation

Operating Environment **:**

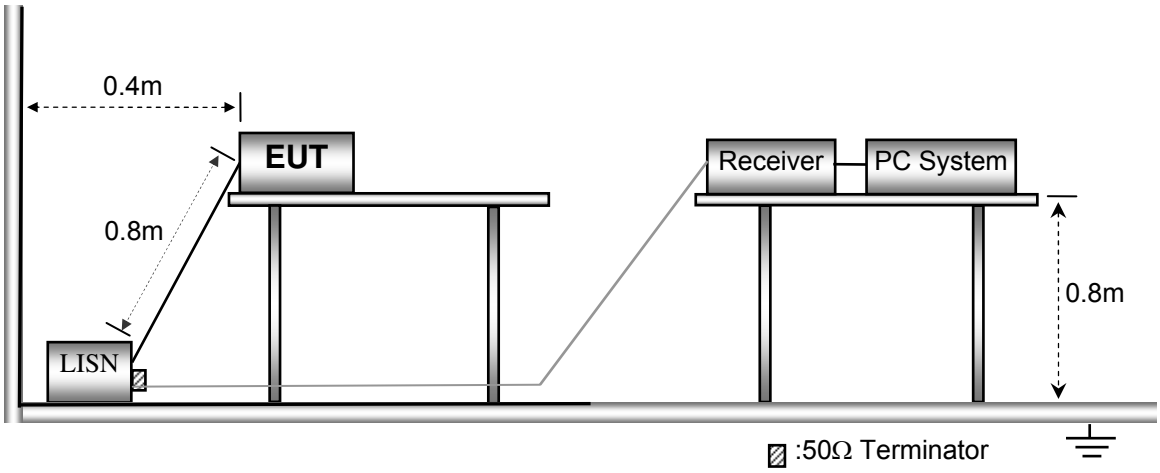
Temperature:	22.8 °C
Humidity:	52.6 % RH
Atmospheric Pressure:	101.2kPa

EUT Operation **:**

The test was performed in Transmitting mode, the test data were shown in the report.

7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



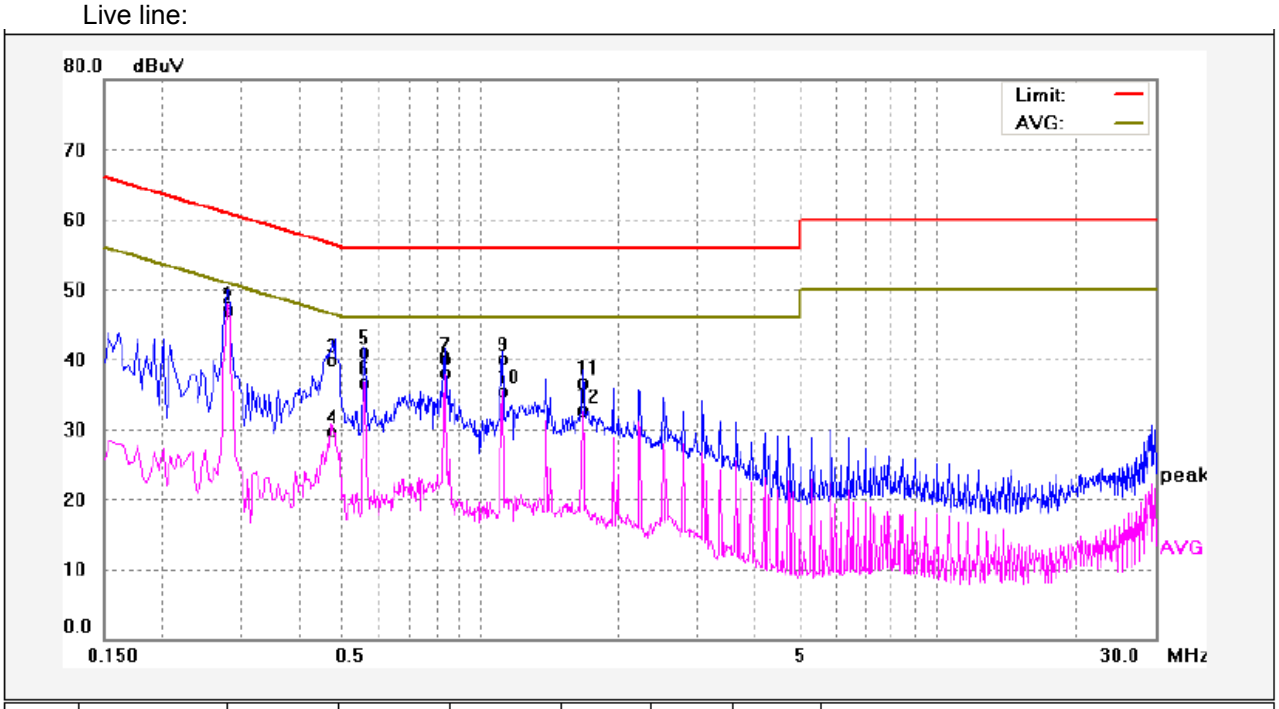
7.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

7.4 Conducted Emission Test Result

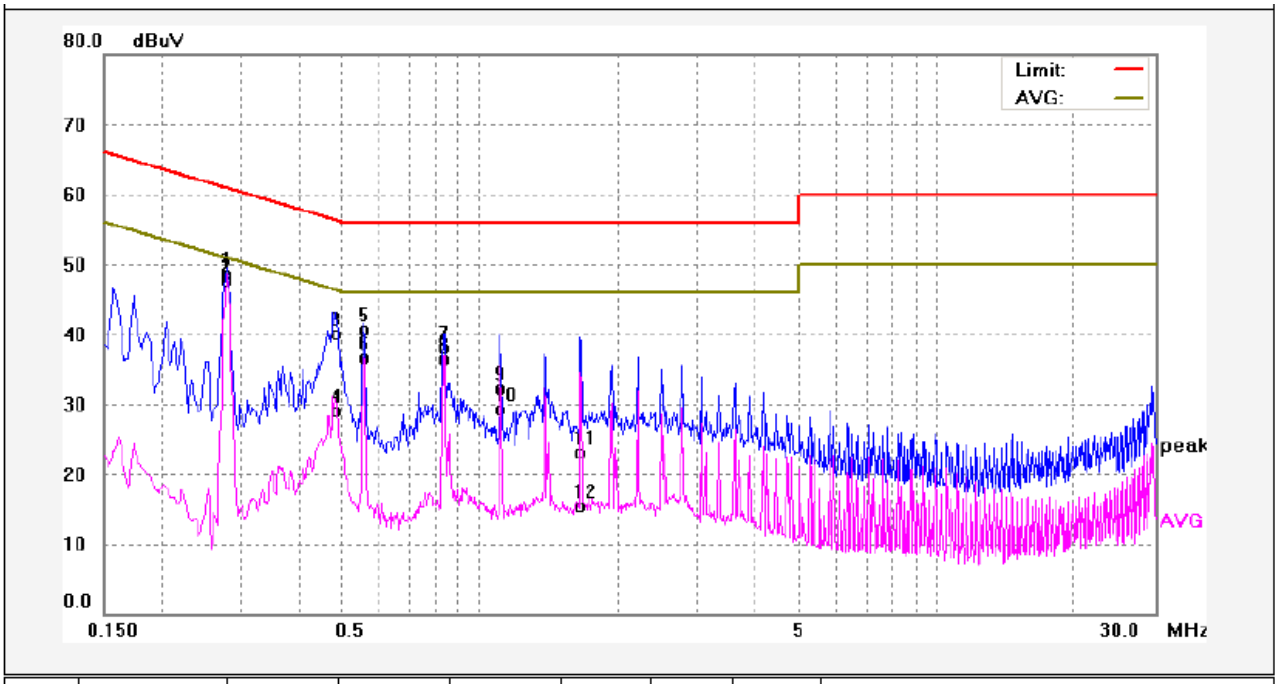
An initial pre-scan was performed on the live and neutral lines.

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.2819	37.55	9.75	47.30	60.76	-13.46	QP	
2	0.2819	37.24	9.75	46.99	50.76	-3.77	AVG	
3	0.4820	30.23	9.76	39.99	56.30	-16.31	QP	
4	0.4820	20.02	9.76	29.78	46.30	-16.52	AVG	
5	0.5580	31.41	9.76	41.17	56.00	-14.83	QP	
6	0.5580	27.02	9.76	36.78	46.00	-9.22	AVG	
7	0.8380	30.30	9.79	40.09	56.00	-15.91	QP	
8	0.8380	28.24	9.79	38.03	46.00	-7.97	AVG	
9	1.1180	30.35	9.82	40.17	56.00	-15.83	QP	
10	1.1180	25.73	9.82	35.55	46.00	-10.45	AVG	
11	1.6780	26.86	9.85	36.71	56.00	-19.29	QP	
12	1.6780	22.94	9.85	32.79	46.00	-13.21	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.2779	38.88	9.75	48.63	60.88	-12.25	QP	
2	0.2779	37.94	9.75	47.69	50.88	-3.19	AVG	
3	0.4820	30.26	9.76	40.02	56.30	-16.28	QP	
4	0.4820	19.31	9.76	29.07	46.30	-17.23	AVG	
5	0.5580	31.01	9.76	40.77	56.00	-15.23	QP	
6	0.5580	26.97	9.76	36.73	46.00	-9.27	AVG	
7	0.8340	28.34	9.79	38.13	56.00	-17.87	QP	
8	0.8340	26.71	9.79	36.50	46.00	-9.50	AVG	
9	1.1100	22.41	9.82	32.23	56.00	-23.77	QP	
10	1.1100	19.54	9.82	29.36	46.00	-16.64	AVG	
11	1.6620	13.25	9.85	23.10	56.00	-32.90	QP	
12	1.6620	5.68	9.85	15.53	46.00	-30.47	AVG	

8 Radiated Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: ANSI C63.10:2013;ANSI C63.4:2014

Test Result: PASS

Measurement Distance: 3m

Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

8.1 EUT Operation

Operating Environment **:**

Temperature: 23.5 °C

Humidity: 52.1 % RH

Atmospheric Pressure: 101.2kPa

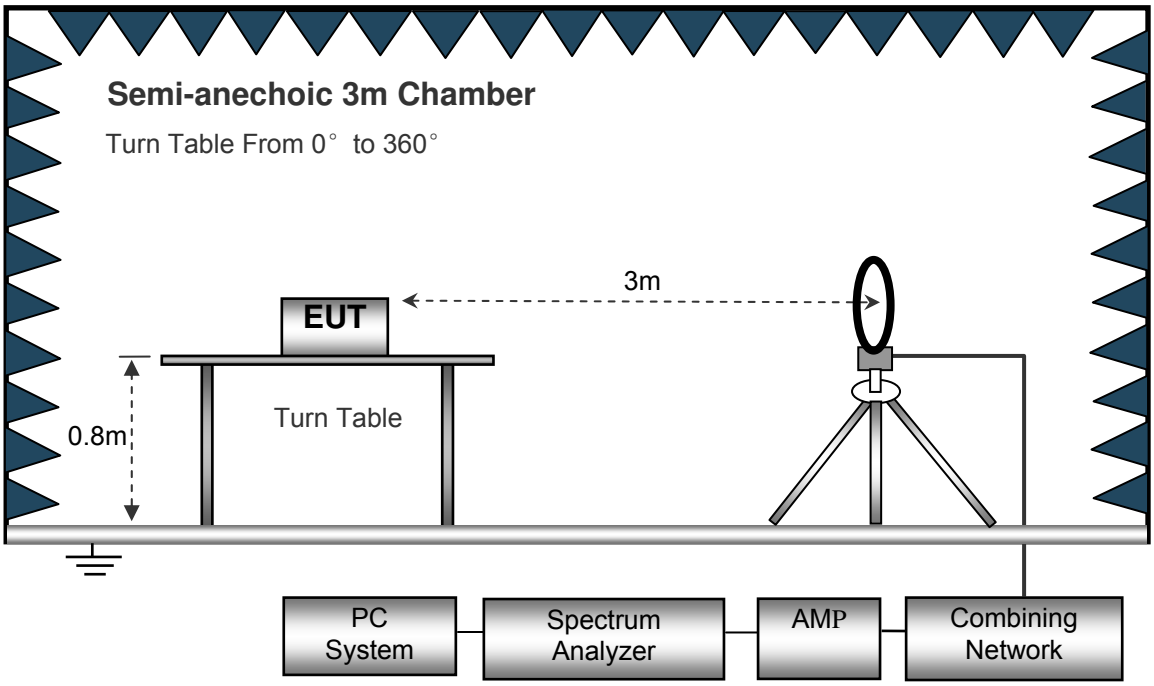
EUT Operation **:**

The test was performed in Transmitting mode, the test data were shown in the report.

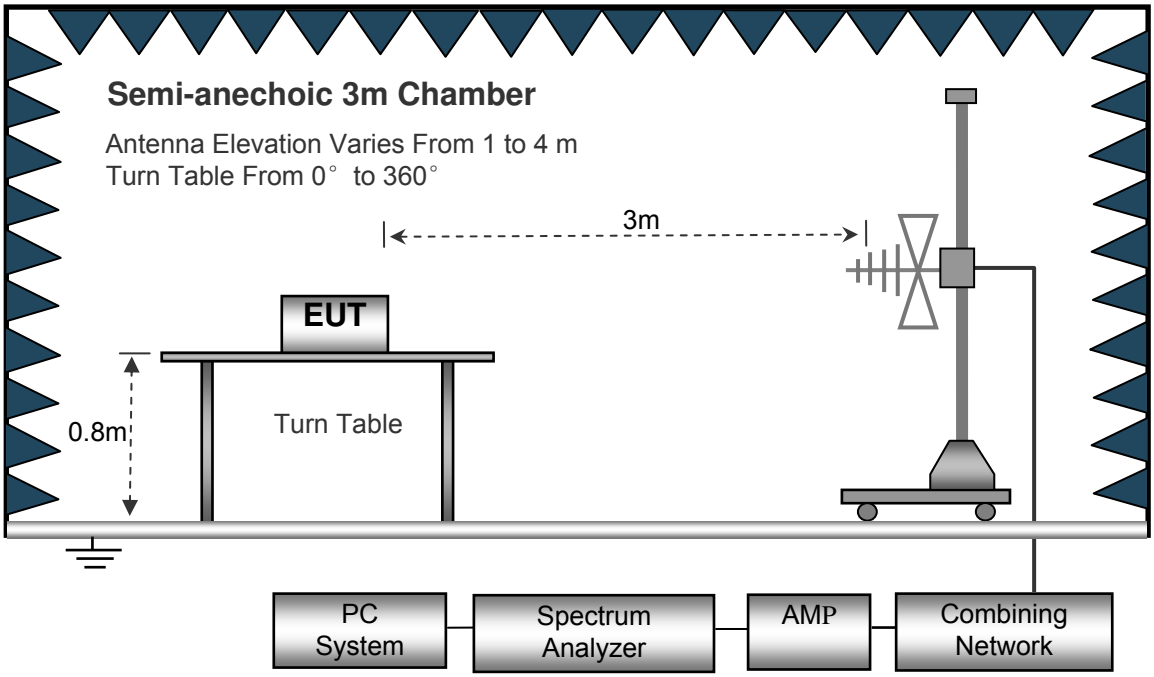
8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10.

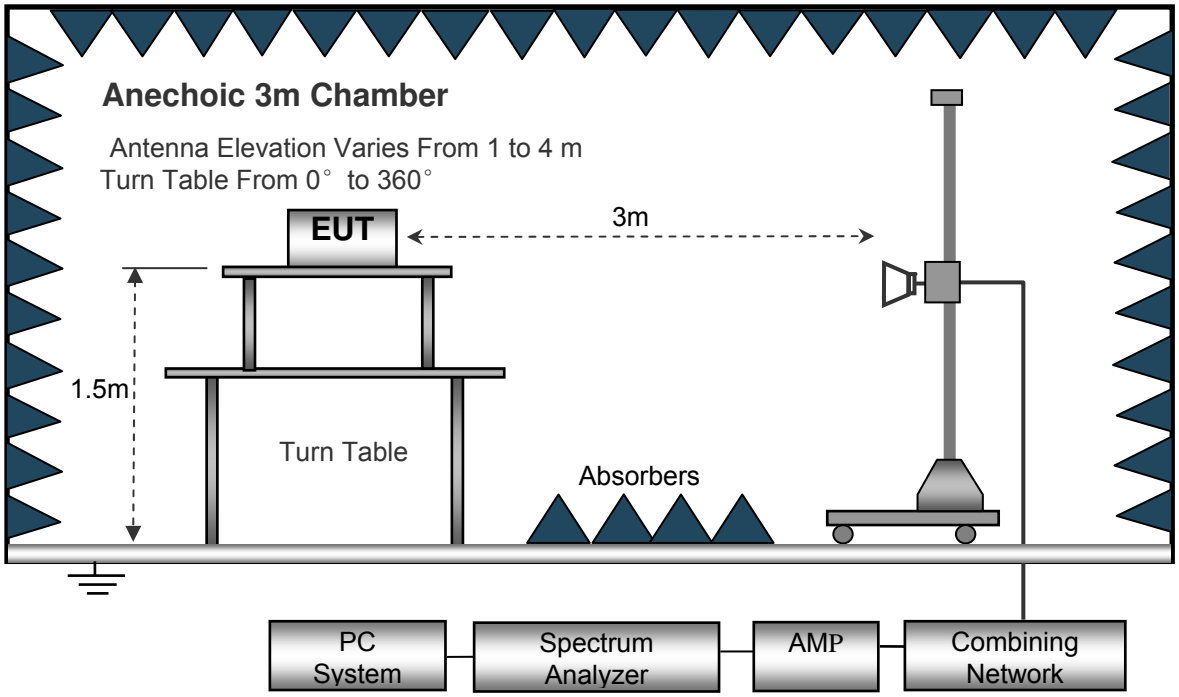
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed ..... Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz
Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 100kHz
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 3MHz
Detector ..... Ave.
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane; For above1GHz, the EUT is 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are performed in X,Y and Z axis positioning(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand),the worst condition was tested putting the eut in X axis,so the worst data were shown as follow.
8. A 2.4GHz high –pass filter is used druing radiated emissions above 1GHz measurement.

8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Limit

8.6 Summary of Test Results

Test Frequency: 24MHz ~ 30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~ 18GHz

Remark: only the worst data (GFSK modulation mode) were reported.

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel 2402MHz									
176.14	22.85	QP	78	1.1	H	11.02	33.87	43.53	-9.66
176.14	20.06	QP	149	1.2	V	11.02	31.08	43.53	-12.45
4804.00	52.58	PK	24	1.8	V	-1.11	51.47	74.00	-22.53
4804.00	41.59	Ave	24	1.8	V	-1.11	40.48	54.00	-13.52
7206.00	51.28	PK	223	1.1	H	1.51	52.79	74.00	-21.21
7206.00	42.86	Ave	223	1.1	H	1.51	44.37	54.00	-9.63
2324.19	46.48	PK	105	1.6	V	-14.24	32.24	74.00	-41.76
2324.19	39.80	Ave	105	1.6	V	-14.24	25.56	54.00	-28.44
2357.08	43.65	PK	147	1.4	H	-13.08	30.57	74.00	-43.43
2357.08	36.78	Ave	147	1.4	H	-13.08	23.70	54.00	-30.30
2492.53	42.52	PK	353	1.3	V	-13.12	29.40	74.00	-44.60
2492.53	36.12	Ave	353	1.3	V	-13.12	23.00	54.00	-31.00

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Middle Channel 2441MHz									
176.14	22.56	QP	133	1.6	H	11.12	33.68	43.53	-9.85
176.14	18.74	QP	253	1.8	V	11.02	29.76	43.53	-13.77
4882.00	53.74	PK	230	1.8	V	-0.64	53.10	74.00	-20.90
4882.00	41.78	Ave	230	1.8	V	-0.64	41.14	54.00	-12.86
7323.00	52.09	PK	258	1.5	H	2.14	54.23	74.00	-19.77
7323.00	43.21	Ave	258	1.5	H	2.14	45.35	54.00	-8.65
2329.05	45.57	PK	199	1.5	V	-13.27	32.30	74.00	-41.70
2329.05	39.66	Ave	199	1.5	V	-13.27	26.39	54.00	-27.61
2356.82	44.57	PK	273	1.5	H	-13.29	31.28	74.00	-42.72
2356.82	38.50	Ave	273	1.5	H	-13.29	25.21	54.00	-28.79
2494.55	43.88	PK	247	1.9	V	-13.16	30.72	74.00	-43.28
2494.55	38.07	Ave	247	1.9	V	-13.16	24.91	54.00	-29.09

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK High Channel 2480MHz									
176.14	21.85	QP	256	1.8	H	11.87	33.72	43.53	-9.81
176.14	19.30	QP	0	1.6	V	11.02	30.32	43.53	-13.21
4960.00	53.23	PK	354	1.4	V	-0.27	52.96	74.00	-21.04
4960.00	41.42	Ave	354	1.4	V	-0.27	41.15	54.00	-12.85
7440.00	52.01	PK	0	1.8	H	2.84	54.85	74.00	-19.15
7440.00	41.17	Ave	0	1.8	H	2.99	44.16	54.00	-9.84
2332.84	45.21	PK	141	1.7	V	-13.19	32.02	74.00	-41.98
2332.84	39.42	Ave	141	1.7	V	-13.54	25.88	54.00	-28.12
2375.39	43.71	PK	220	1.4	H	-13.52	30.19	74.00	-43.81
2375.39	38.37	Ave	220	1.4	H	-13.52	24.85	54.00	-29.15
2498.46	43.05	PK	303	1.8	V	-13.14	29.91	74.00	-44.09
2498.46	38.04	Ave	303	1.8	V	-13.14	24.90	54.00	-29.10

Test Frequency: 18GHz ~ 25GHz

The measurements were more than 20 dB below the limit and not reported.

9 Band Edge Measurement

Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	ANSI C63.10
Test Limit:	Regulation 15.247 (d), 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. If the transmitter complies 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
Test Mode:	Transmitting

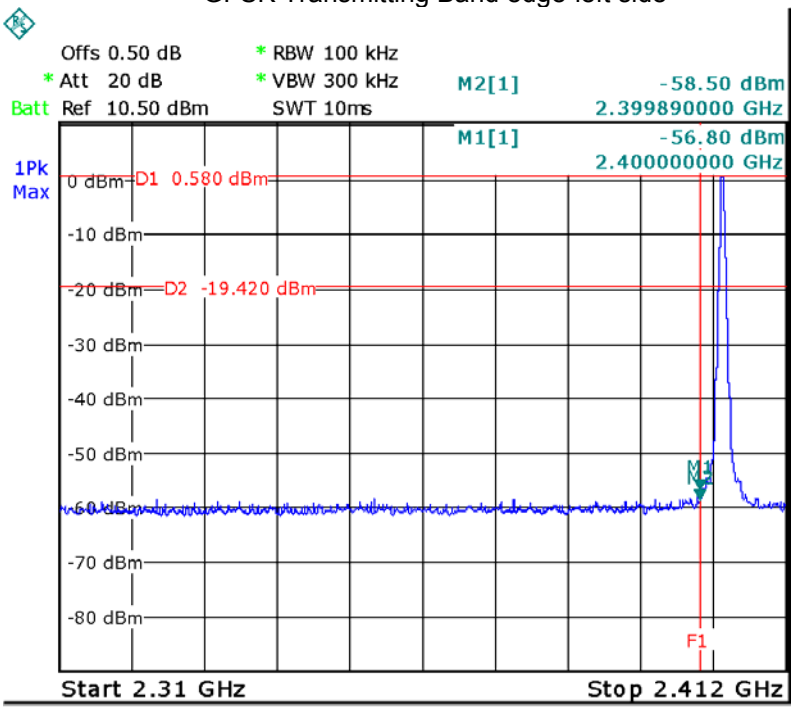
9.1 Test Procedure

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 = 100 kHz, VBW = 300 kHz, Sweep = auto
   Detector function = peak, Trace = max hold

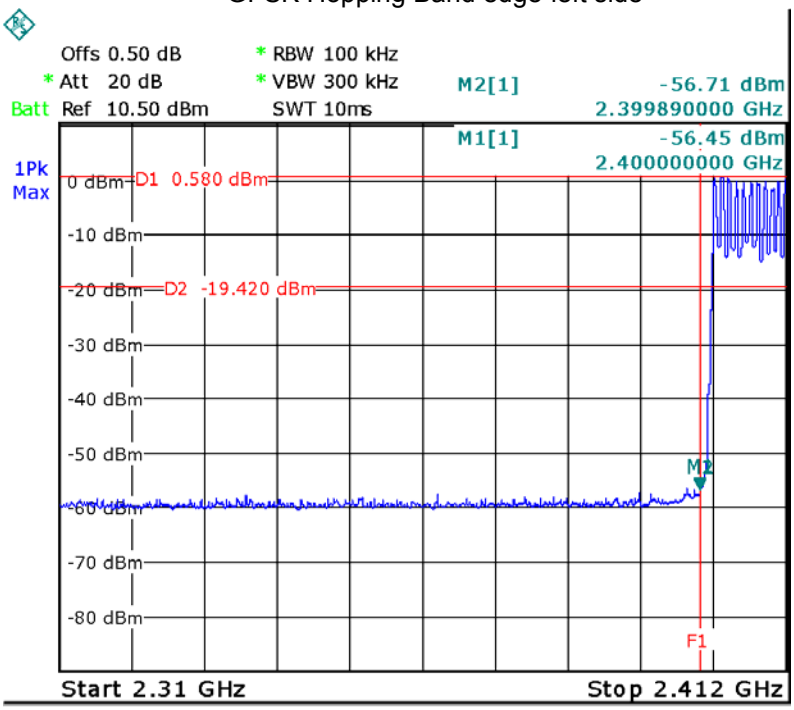
9.2 Test Result:

Test plots

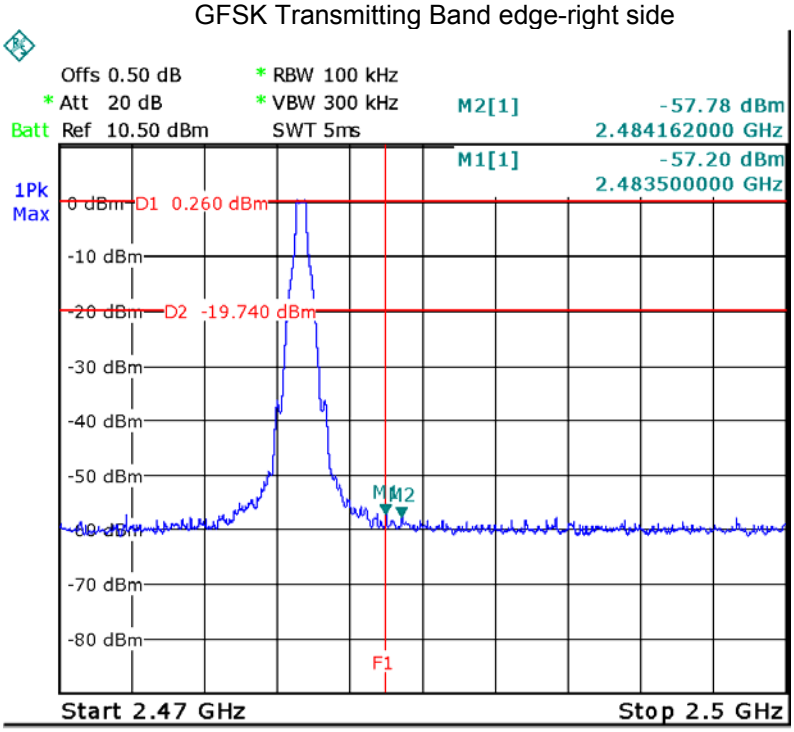
GFSK Transmitting Band edge-left side



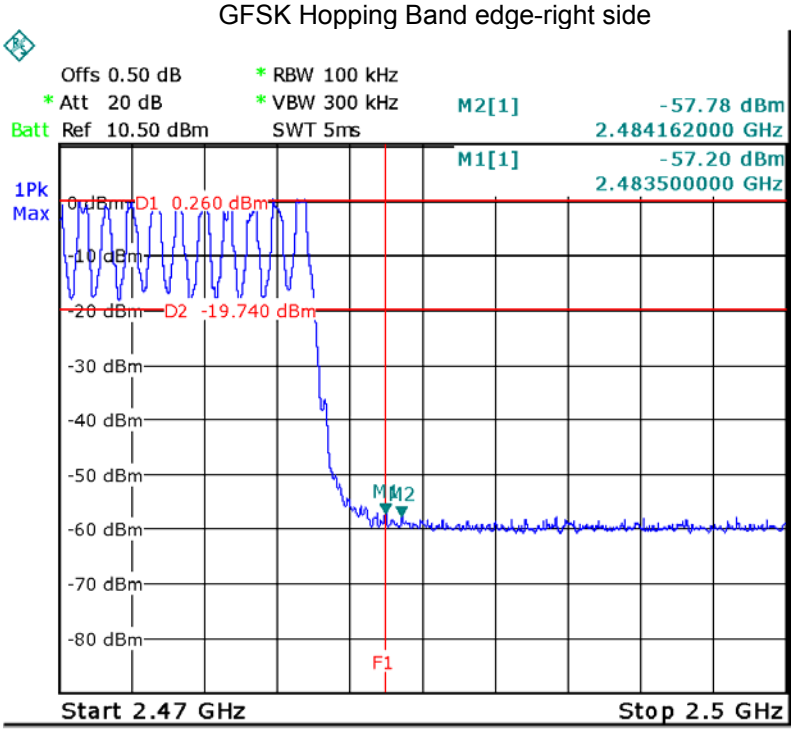
GFSK Hopping Band edge-left side



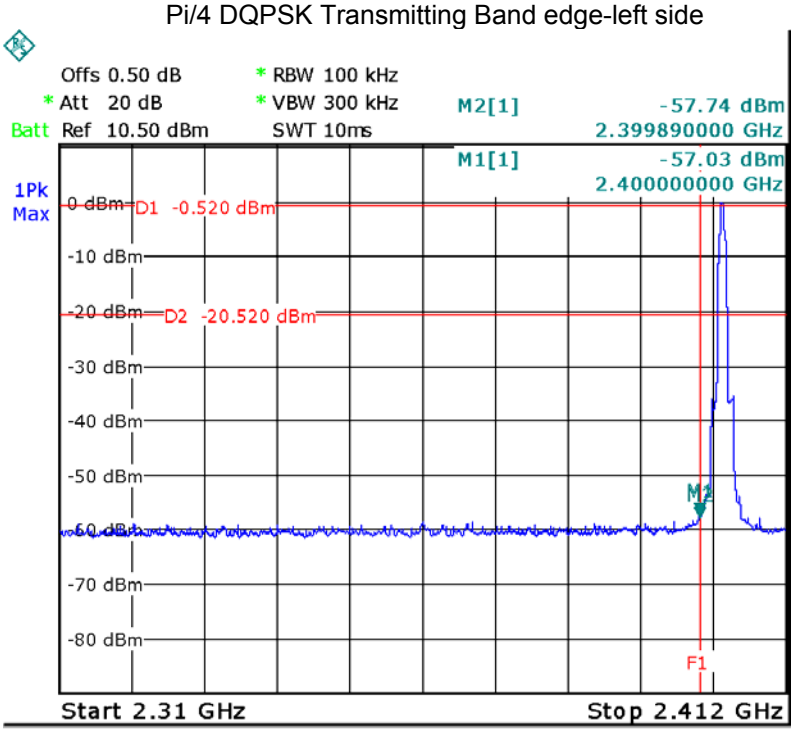
GFSK Transmitting Band edge-right side



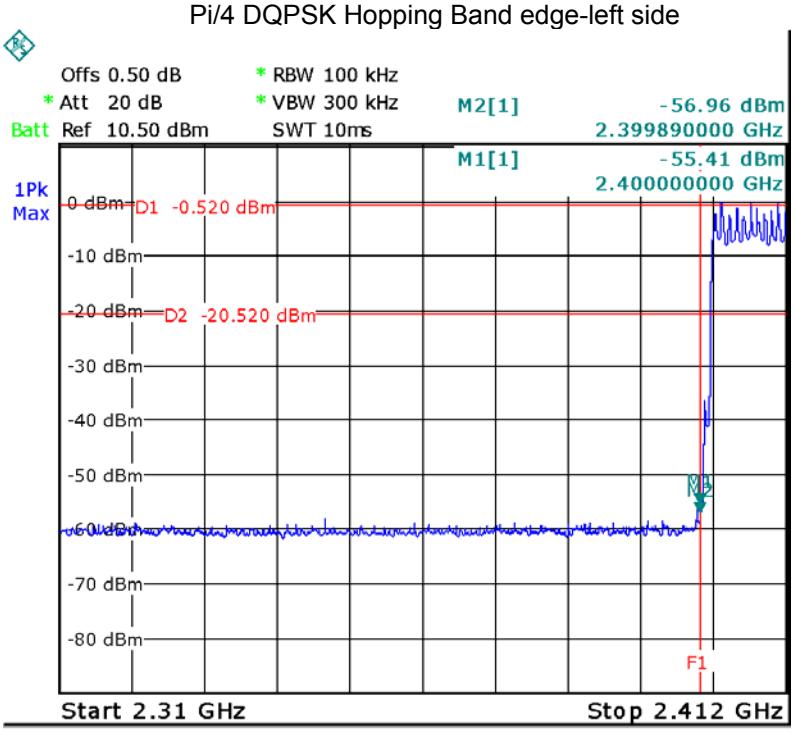
GFSK Hopping Band edge-right side



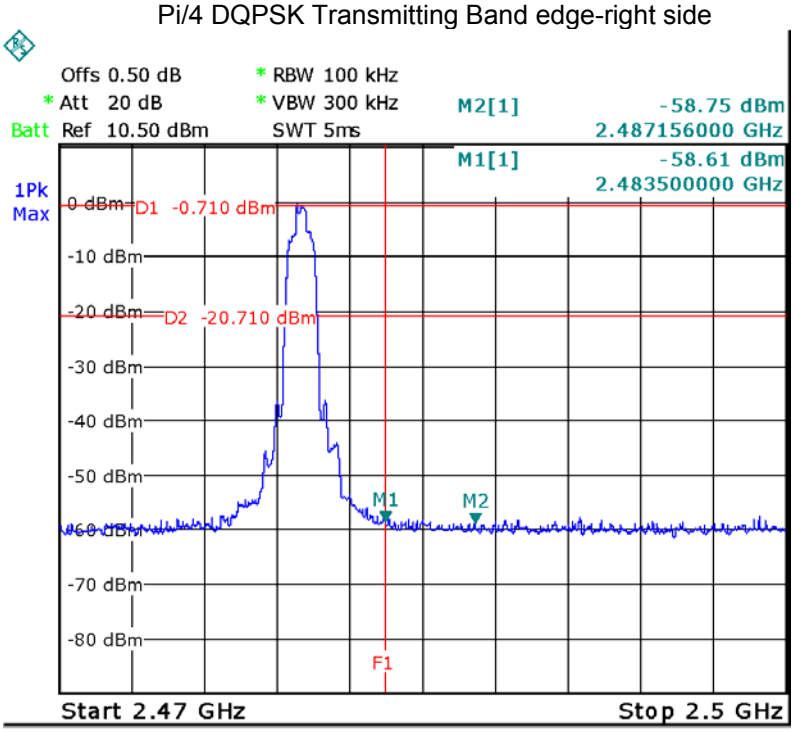
Pi/4 DQPSK Transmitting Band edge-left side



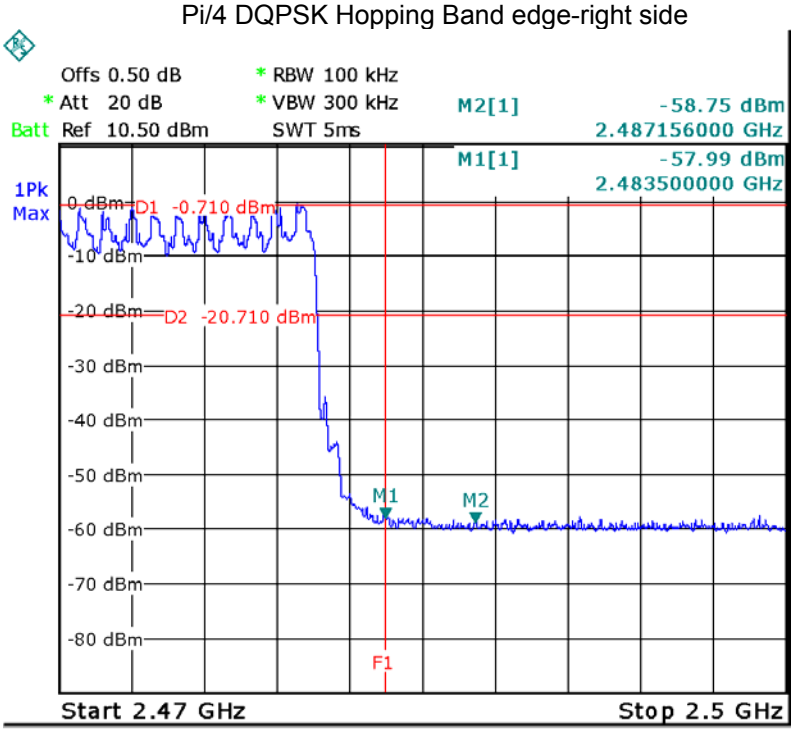
Pi/4 DQPSK Hopping Band edge-left side



Pi/4 DQPSK Transmitting Band edge-right side



Pi/4 DQPSK Hopping Band edge-right side



10 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI C63.10:2013

Test Mode: Test in fixing operating frequency at low, Middle, high channel.

10.1 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 = 30 kHz, VBW = 100 kHz

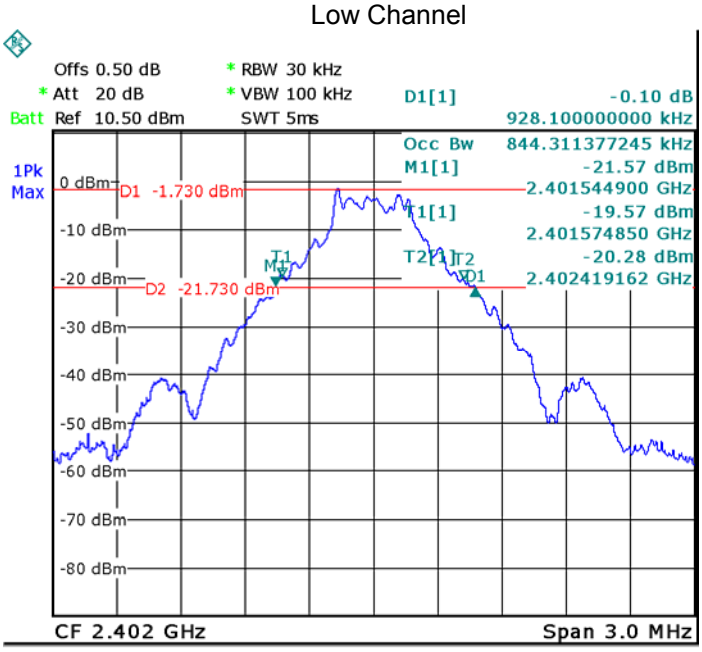
10.2 Test Result:

Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low	0.928
	Middle	0.928
	High	0.928
Pi/4DQPSK	Low	1.252
	Middle	1.252
	High	1.252

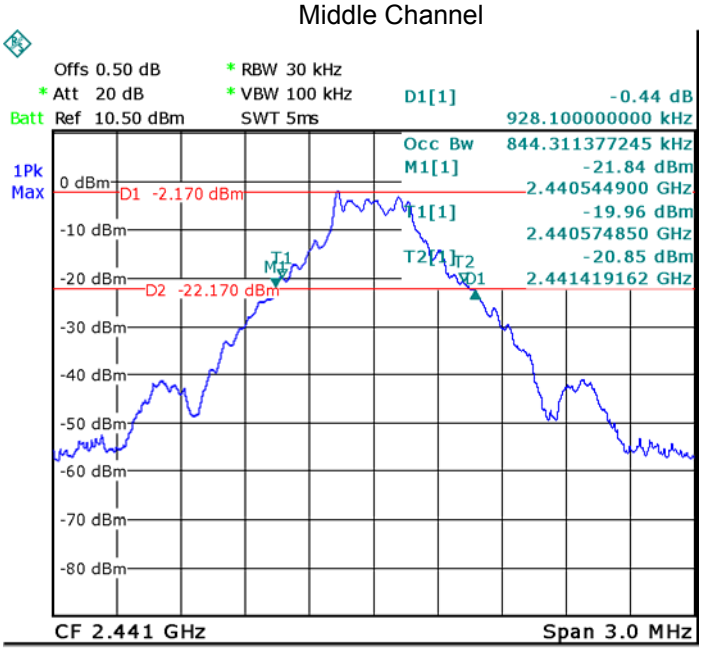
Test result plot as follows:

Modulation:GFSK

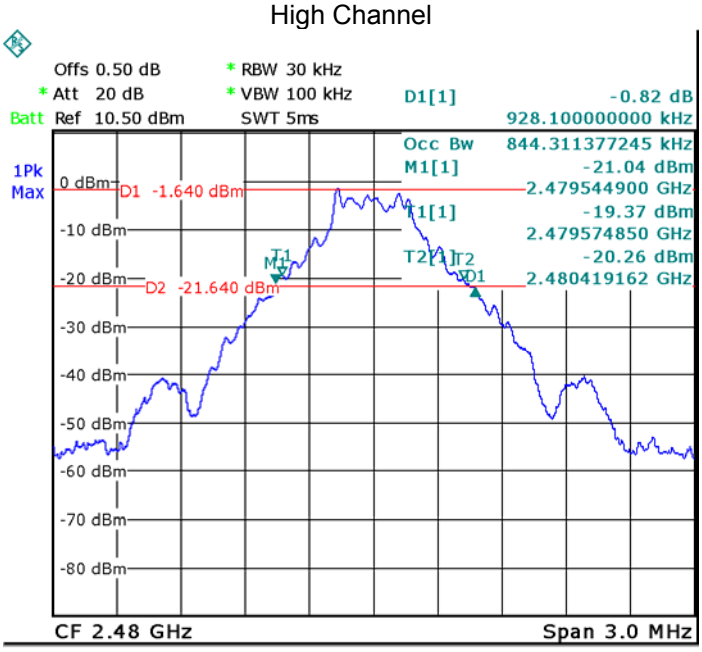
Low Channel



Middle Channel

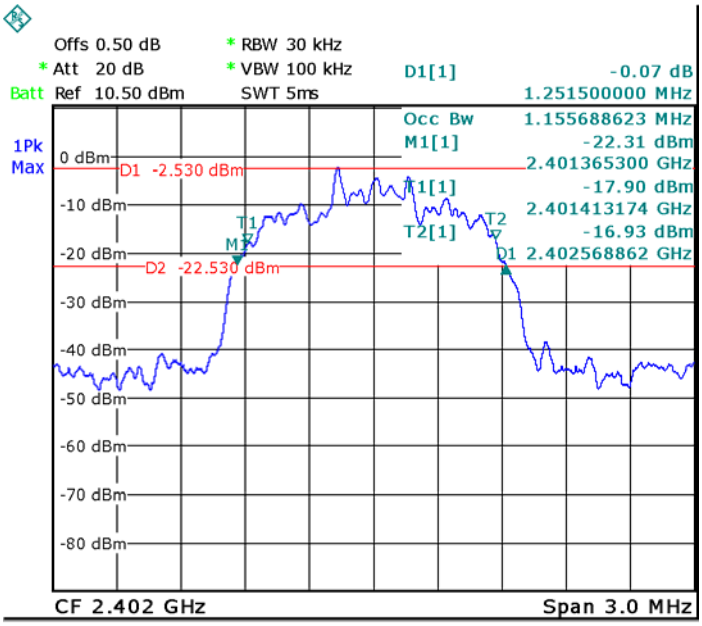


High Channel

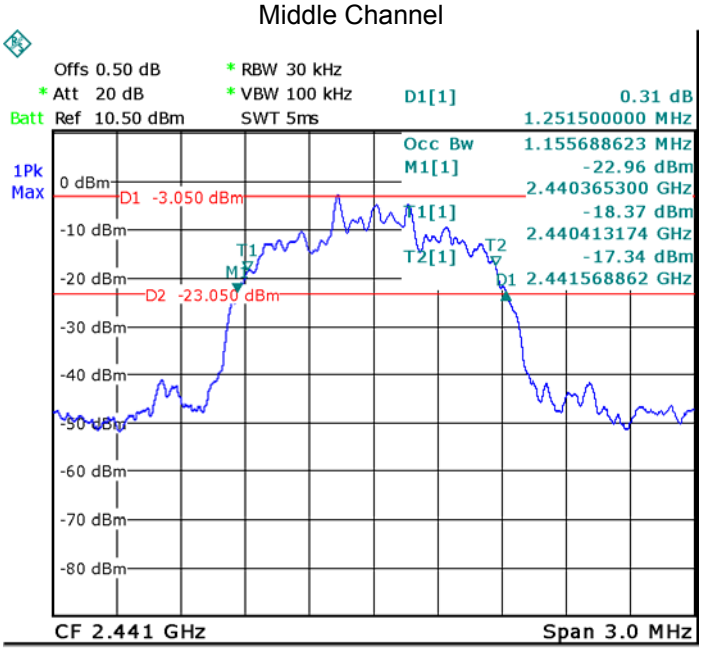


Modulation: Pi/4DQPSK

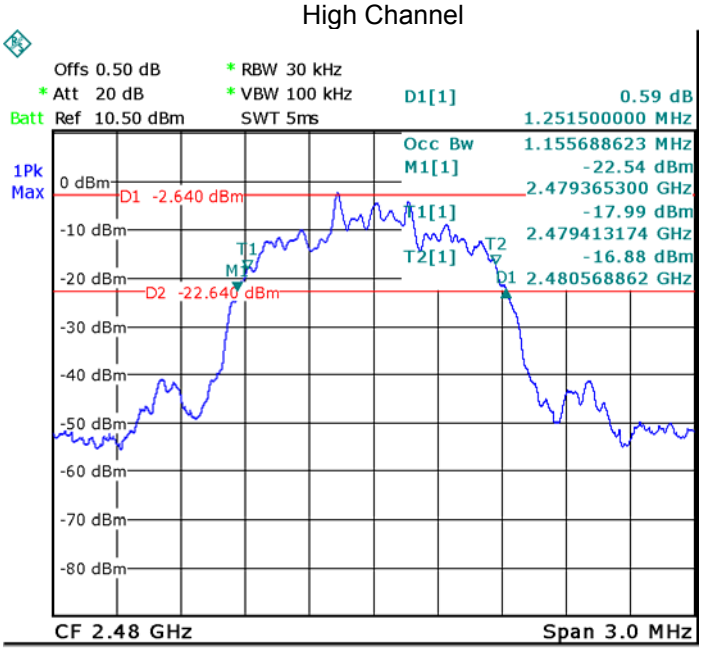
Low Channel



Middle Channel



High Channel



11 Maximum Peak Output Power

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI C63.10:2013

Test Limit: Regulation 15.247 (b)(1), 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.

Refer to the result "Number of Hopping Frequency" of this document. The 1watts (30 dBm) limit applies.

Test mode: Test in fixing frequency transmitting mode.

11.1 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 = 3 MHz. VBW =3 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

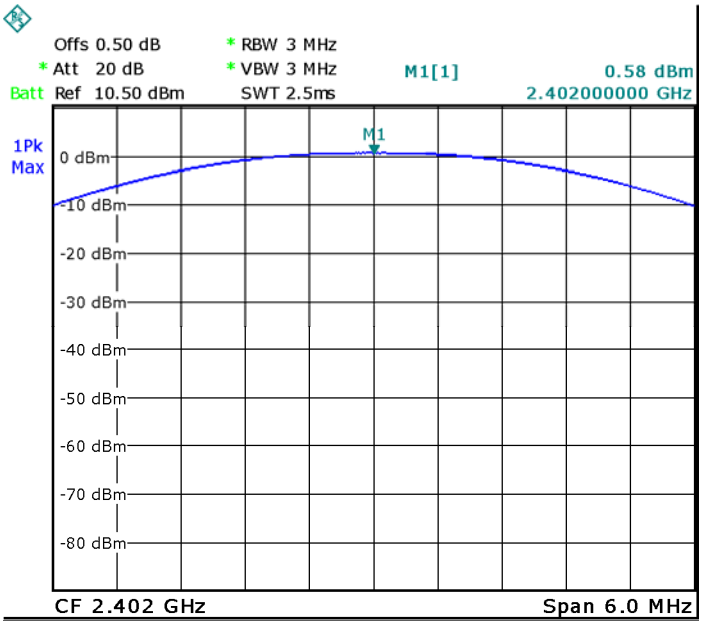
11.2 Test Result:

Test Mode	Data Rate	Peak Power(dBm)			Limit (dBm)
		Low Channel	Middle Channel	High Channel	
GFSK	1Mbps	0.58	-0.02	0.55	20.97
4*π4DQPSK	2Mbps	0.51	-0.23	0.36	20.97

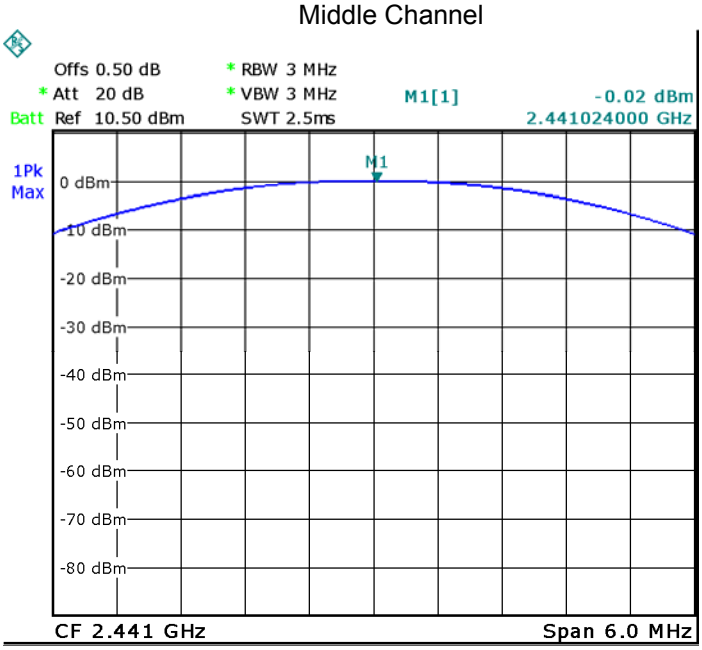
Test result plot as follows:

Modulation: GFSK

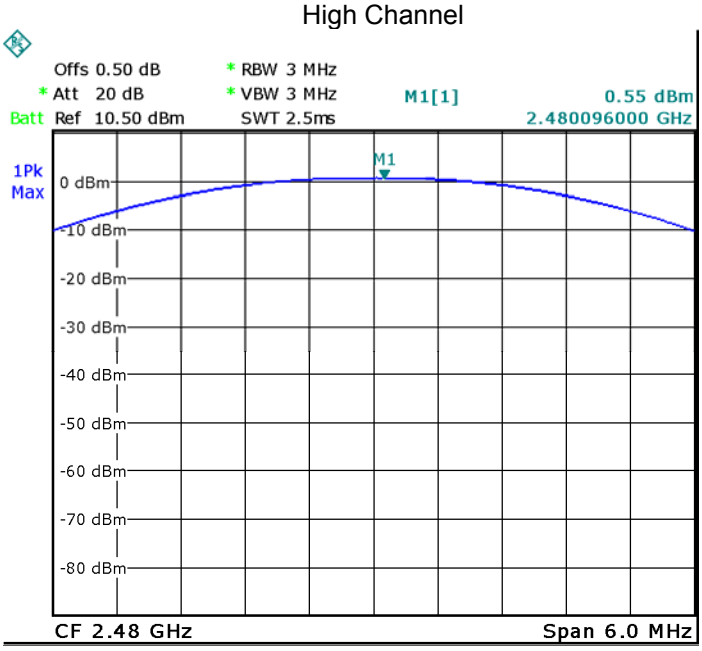
Low Channel



Middle Channel

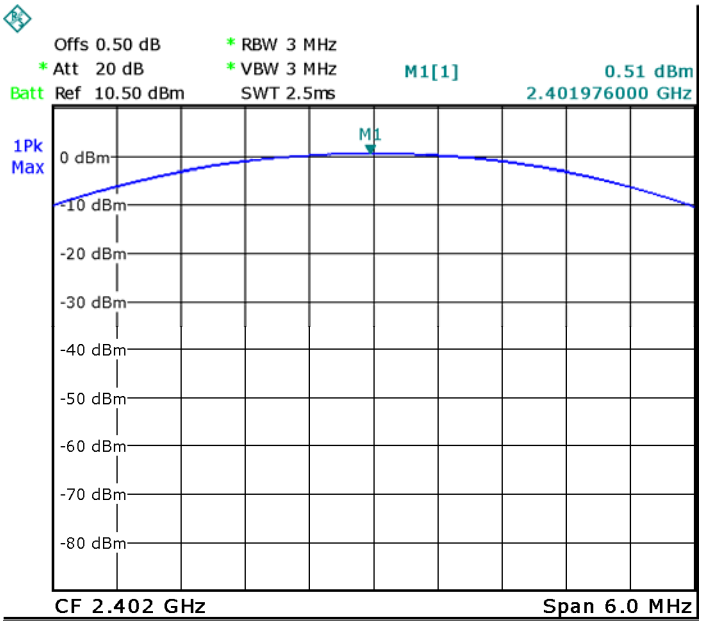


High Channel

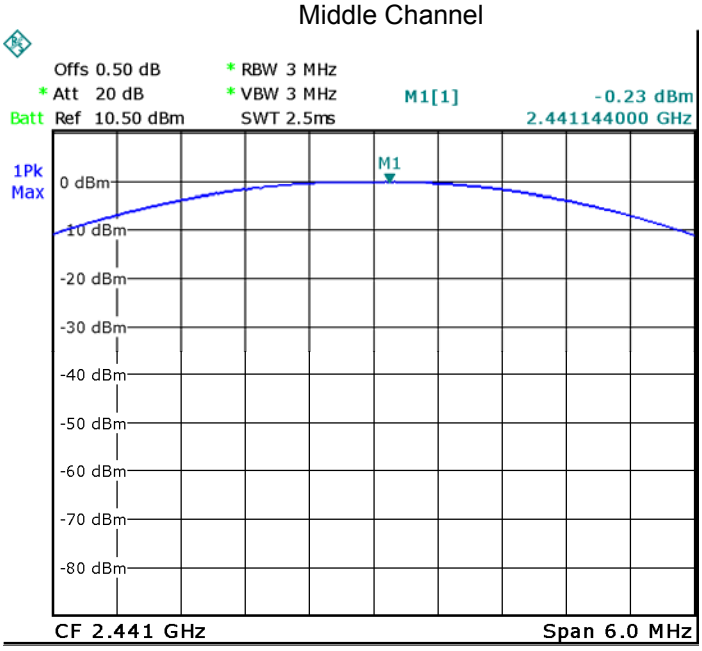


Modulation: Pi/4DQPSK

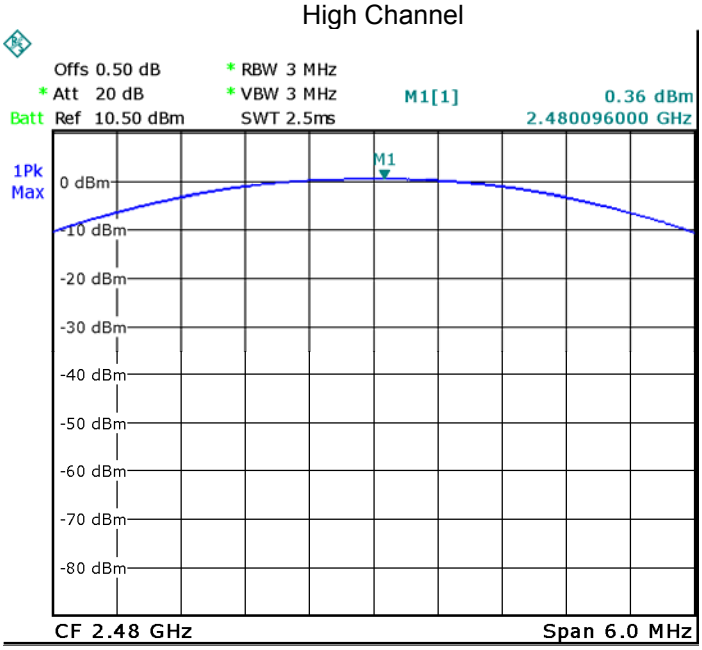
Low Channel



Middle Channel



High Channel



12 Hopping Channel Separation

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI C63.10:2013

Test Limit: Regulation 15.247(a)(1) 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 1W.

Test Mode: Test in hopping transmitting operating mode.

12.1 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 = 30 KHz. VBW = 100 KHz , Span = 3 MHz Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

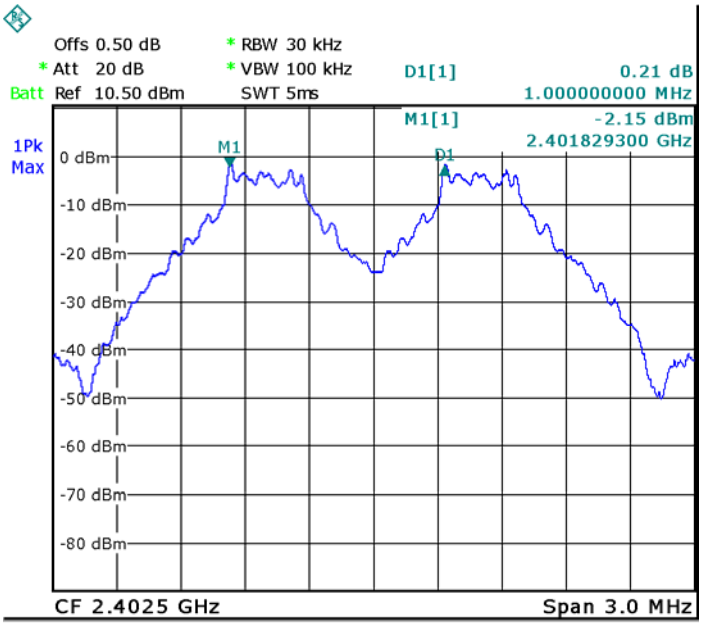
12.2 Test Result:

Modulation	Test Channel	Separation (MHz)
GFSK	Low	1.000
	Middle	1.000
	High	1.000
Pi/4DQPSK	Low	1.000
	Middle	1.000
	High	1.000

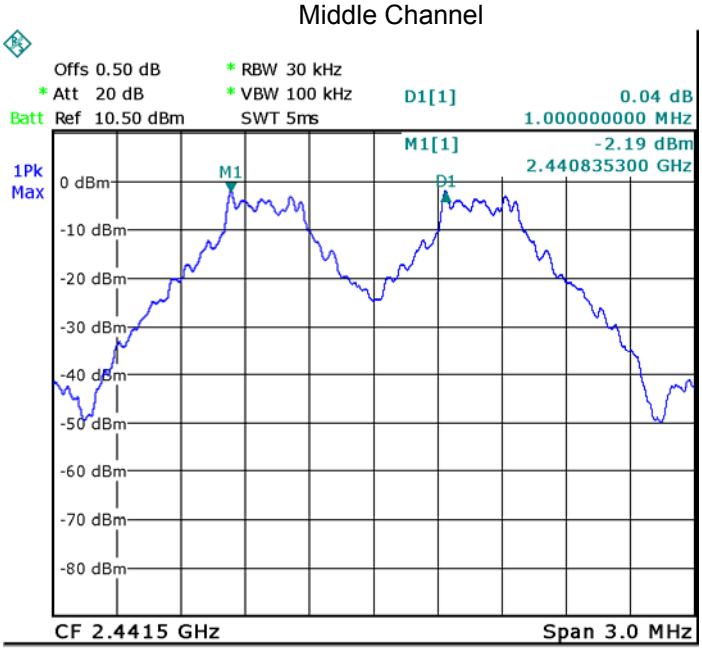
Test result plot as follows:

Modulation: GFSK

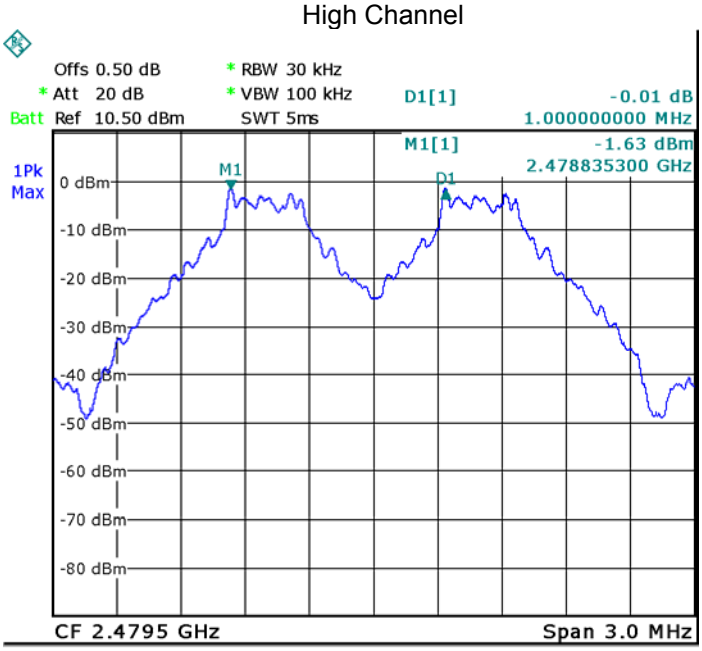
Low Channel



Middle Channel

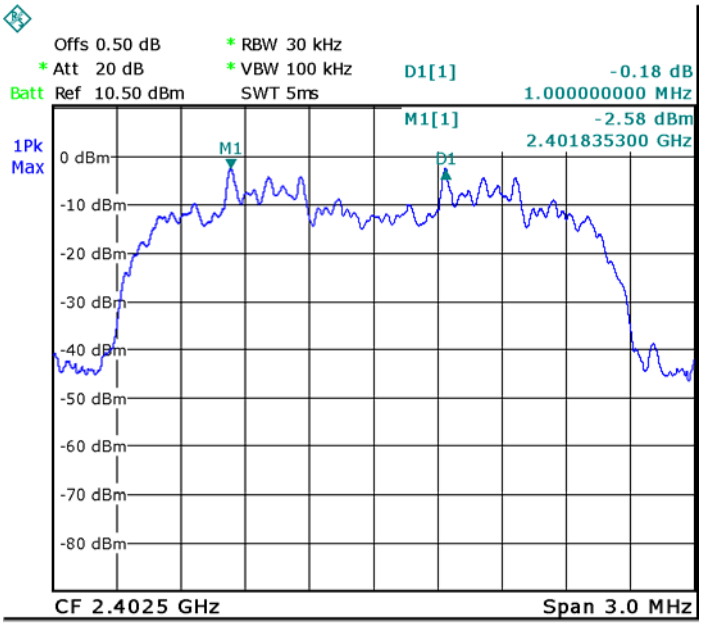


High Channel

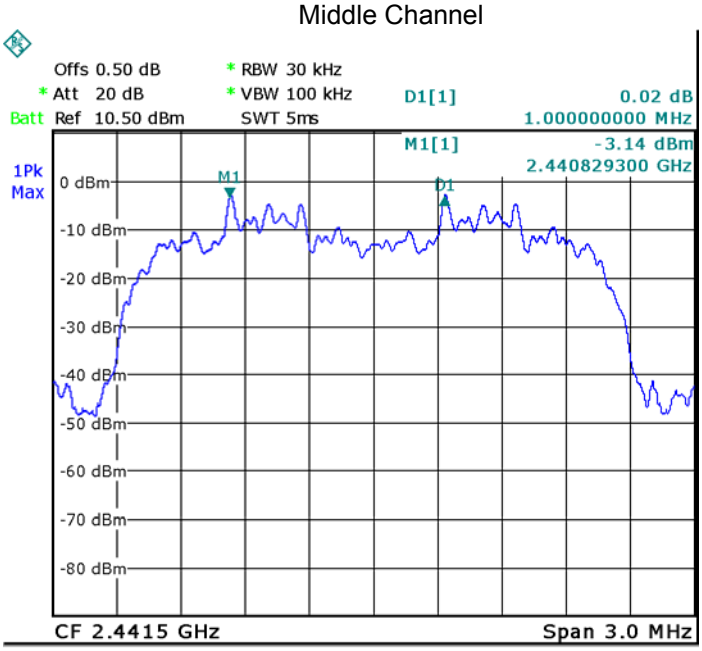


Modulation: Pi/4DQPSK

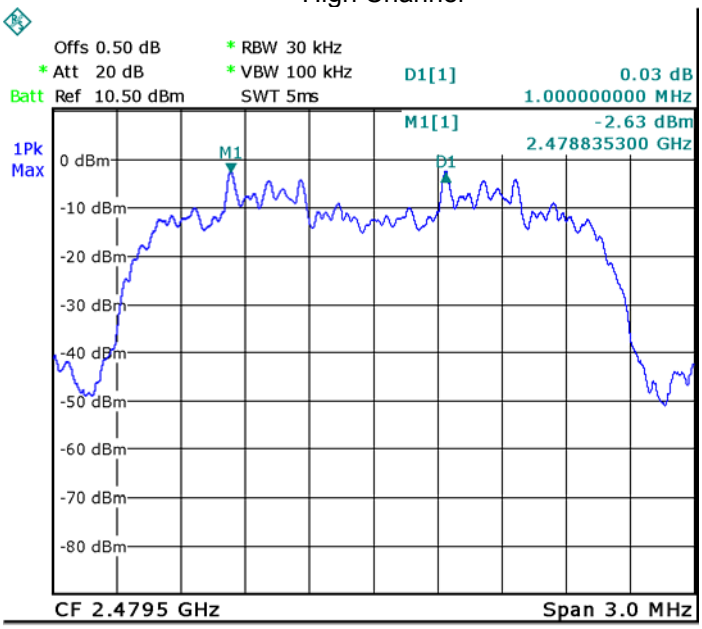
Low Channel



Middle Channel



High Channel



13 Number of Hopping Frequency

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
Test Limit:	Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode:	Test in hopping transmitting operating mode.

13.1 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 = 1MHz. VBW = 1MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

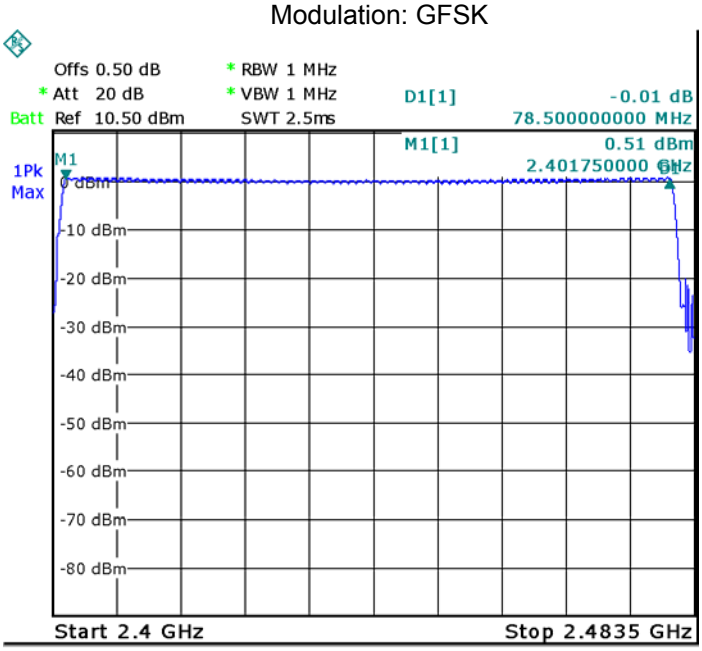
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.

4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

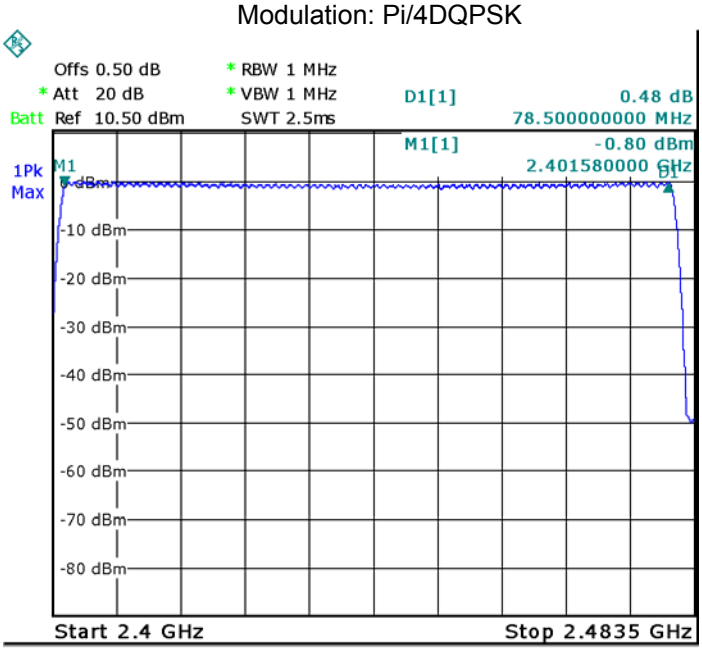
13.2 Test Result:

Total Channels are 79 Channels.

Modulation: GFSK



Modulation: Pi/4DQPSK



14 Dwell Time

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: ANSI C63.10:2013

Test Limit: Regulation 15.247(a)(1)(iii) 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Mode: Test in hopping transmitting operating mode.

14.1 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 spectrum analyzer span = 0. centred on a hopping channel;

3.Set RBW = 1MHz and VBW = 1MHz. Sweep = as necessary to capture the entire dwell time per hopping channel.

4.Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

14.2 Test Result:

Dwell time = Pulse wide x (Hopping rate / Number of channels) x Period
The test period: T= 0.4(s) * 79 = 31.6 (s)
DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).

DH1 Packet permit maximum 1600 / 79 / 2 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

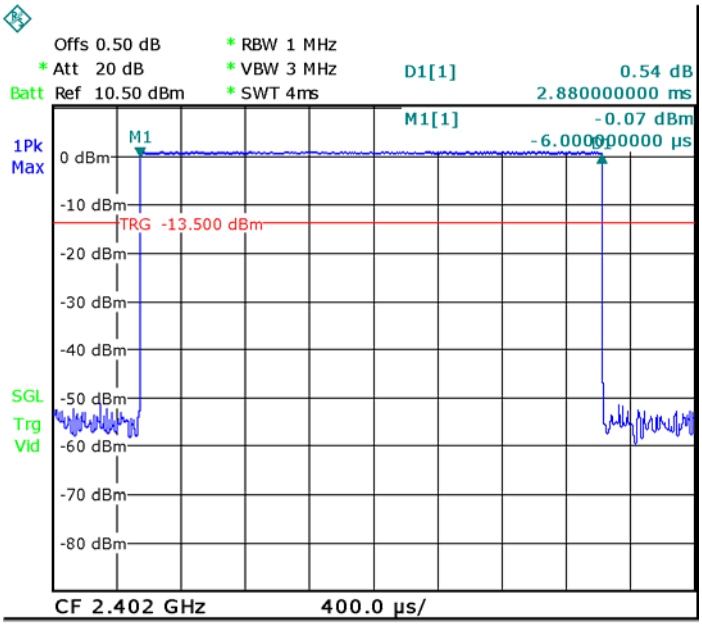
Data Packet	Dwell Time(s)
DH5	1600/79/6*31.6*(MkrDelta)/1000
DH3	1600/79/4*31.6*(MkrDelta)/1000
DH1	1600/79/2*31.6*(MkrDelta)/1000
Remark	Mkr Delta is single pulse time.

Modulation	Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	DH5	Low	2.880	0.307	0.4
		middle	2.880	0.307	0.4
		High	2.880	0.307	0.4
Pi/4DQPSK	DH5	Low	2.880	0.307	0.4
		middle	2.880	0.307	0.4
		High	2.880	0.307	0.4

Modulation: GFSK

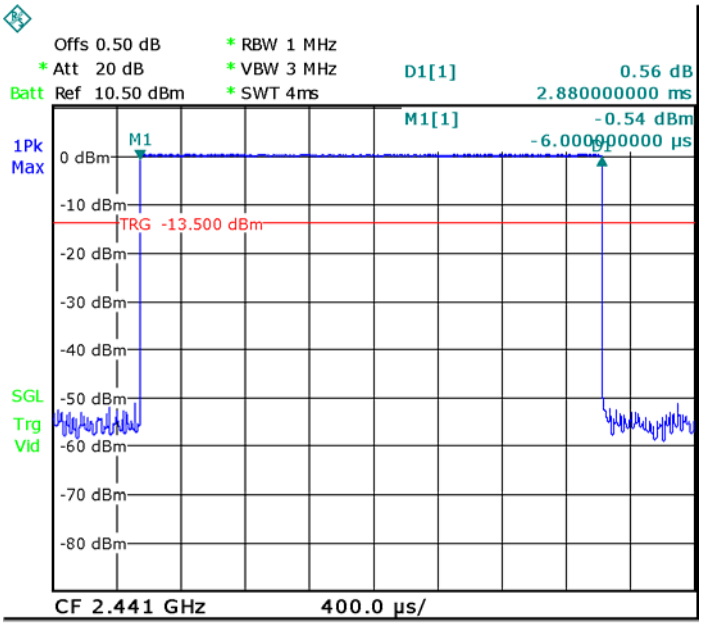
Data Packet:

DH5.Low channel



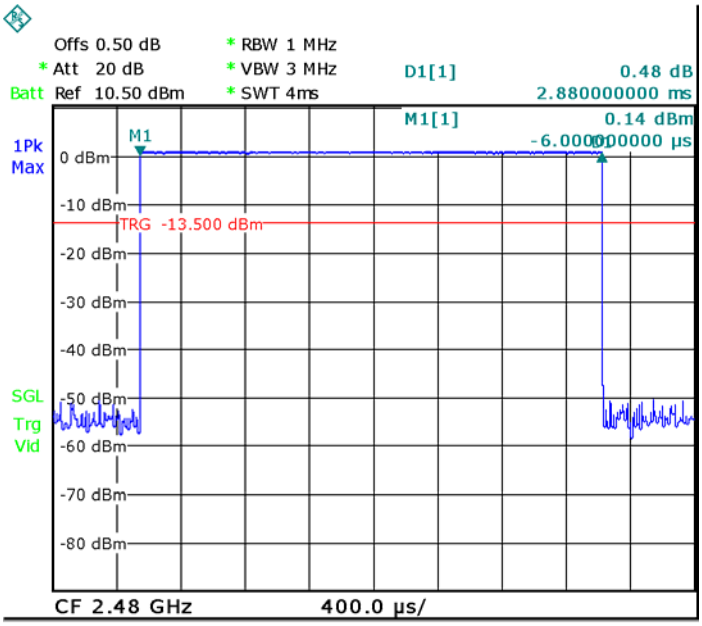
Data Packet:

DH5.Middle channel



Data Packet:

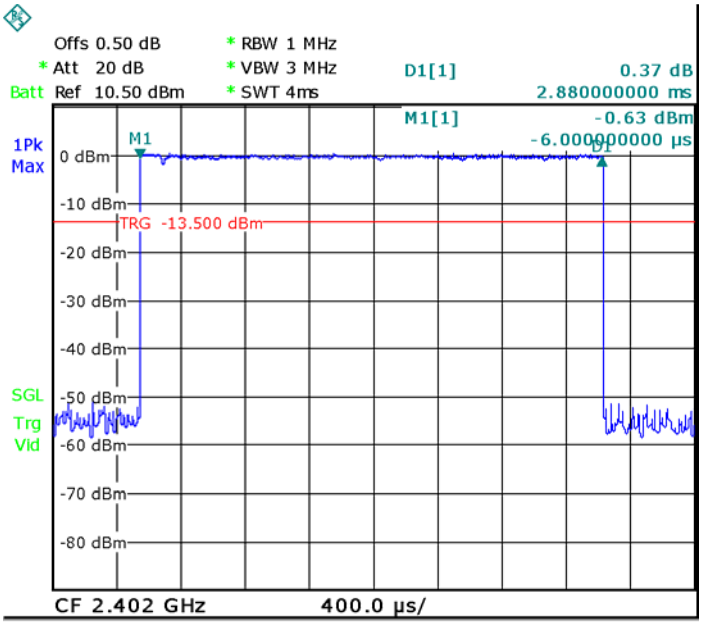
DH5, High channel



Pi/4DQPSK

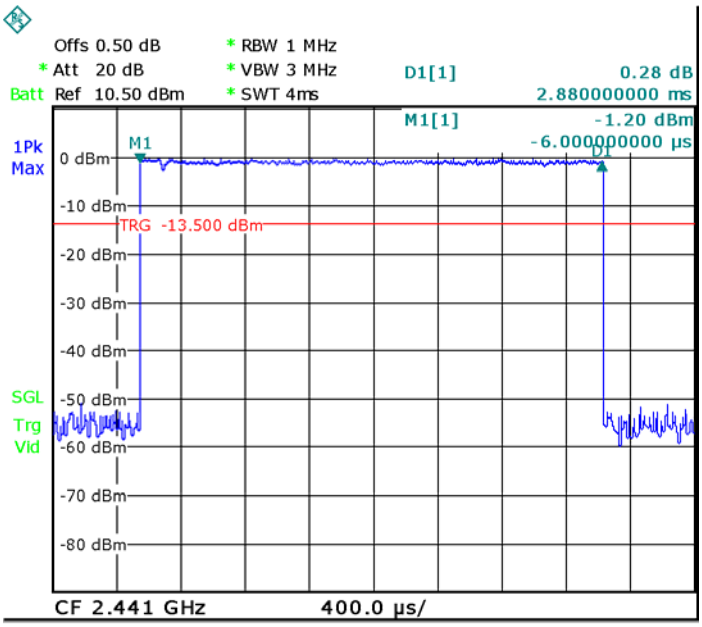
Data Packet:

DH5, Low channel



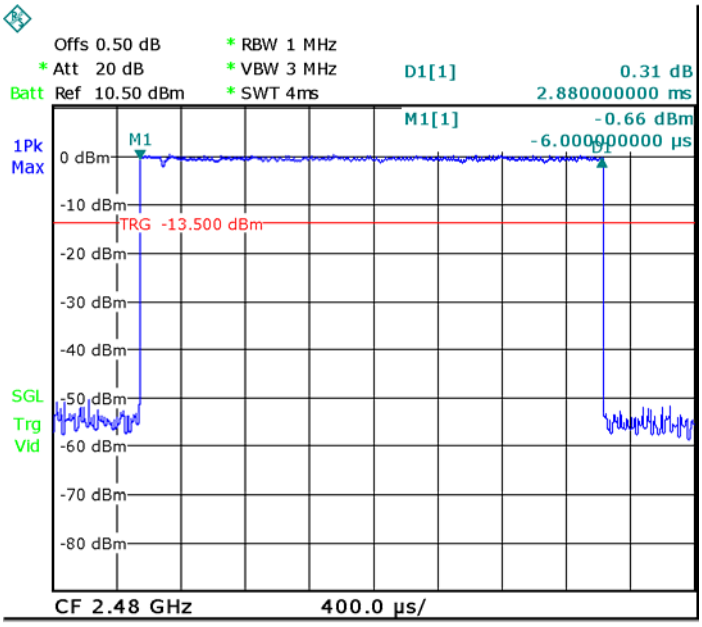
Data Packet:

DH5, Middle channel



Data Packet:

DH5, High channel



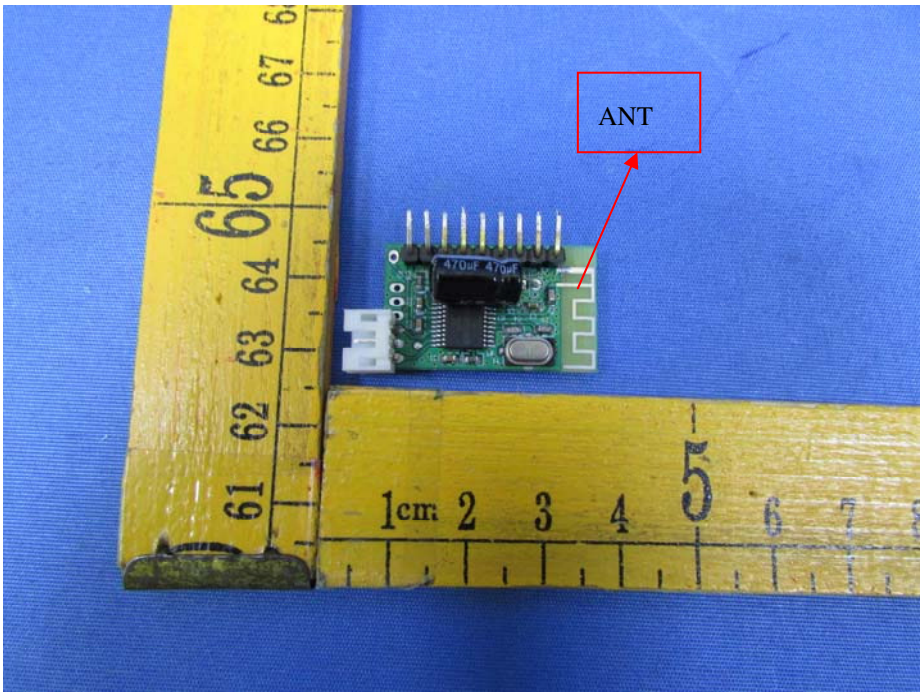
15 Antenna Requirement

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

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.

Result:

The EUT has one PCB printed antenna, the gain is 0dBi. Meets the requirements of FCC 15.203.



16 RF Exposure

Test Requirement: FCC Part 1.1307

Evaluation Method: FCC Part 2.1091& KDB 447498 D01 General RF Exposure Guidance v06

16.1 Requirements

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

16.2 The procedures / limit

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm^2)	Averaging Time $\|E\|^2$,$\|H\|^2$or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm^2)	Averaging Time $\|E\|^2$,$\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

16.3 MPE Calculation Method

$$S = \frac{P \times G}{4 \times \pi \times R^2}$$

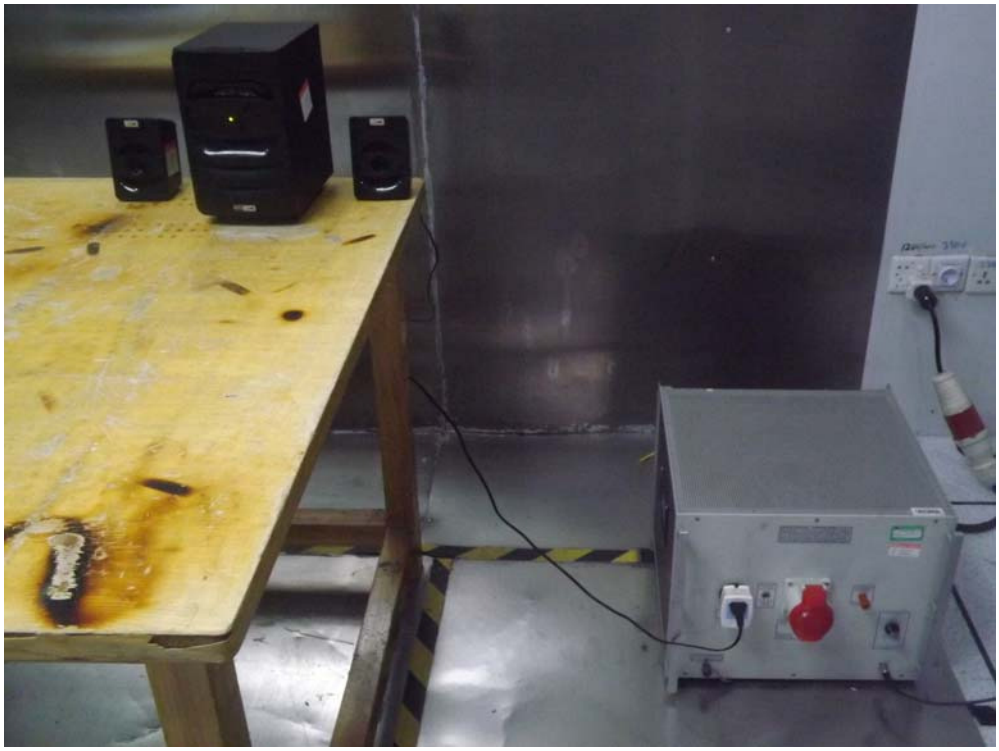
S = power density (in appropriate units, e.g. mW/cm^2)
P = output power to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

From the peak EUT RF output power, the minimum mobile separation distance, R=20cm, as well as the gain of the used antenna, the RF power density can be obtained

Antenna Gain (dBi)	Antenna Gain (numeric)	Max. Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (mW/cm2)	Limit of Power Density (mW/cm2)
0.00	1.000	0.58	1.143	0.000227	1

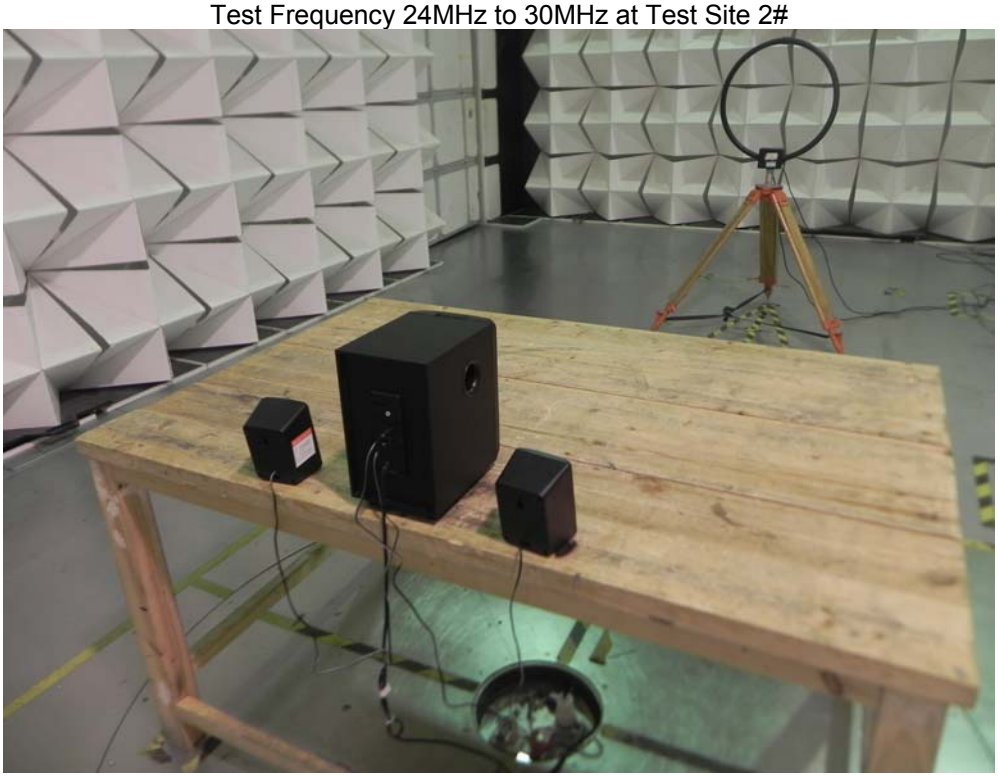
17 Photographs – Model IM210-BLK-BIG Test Setup

17.1 Photograph-Conducted Emissions Test Setup at Test Site 2#

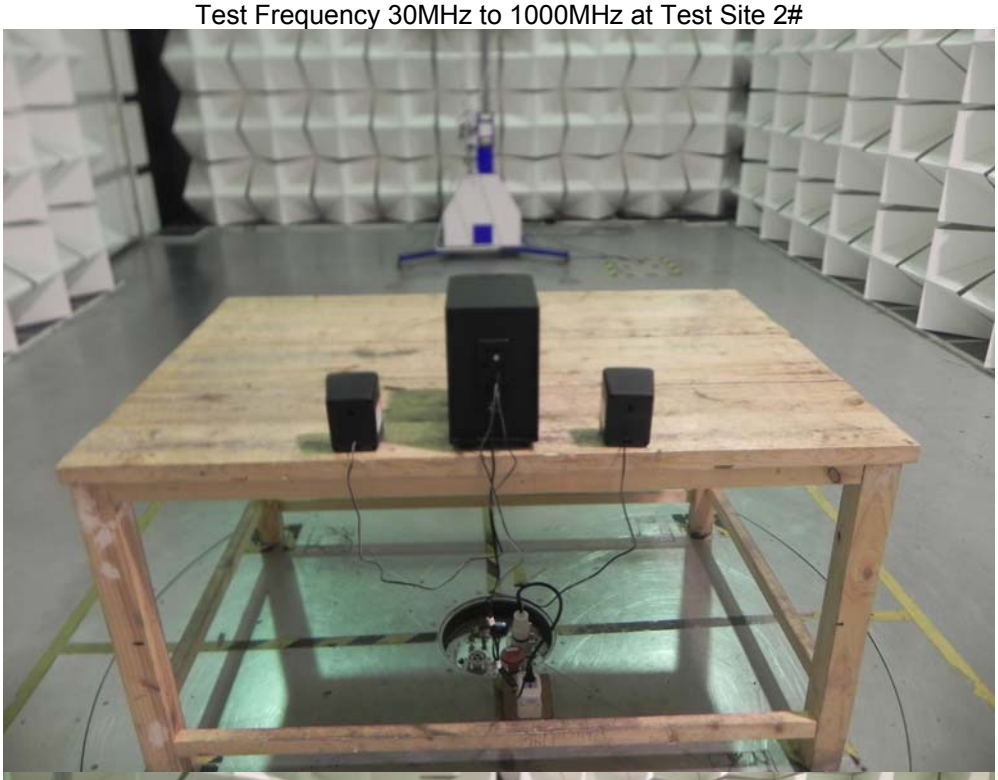


17.2 Photograph-Radiated Emissions

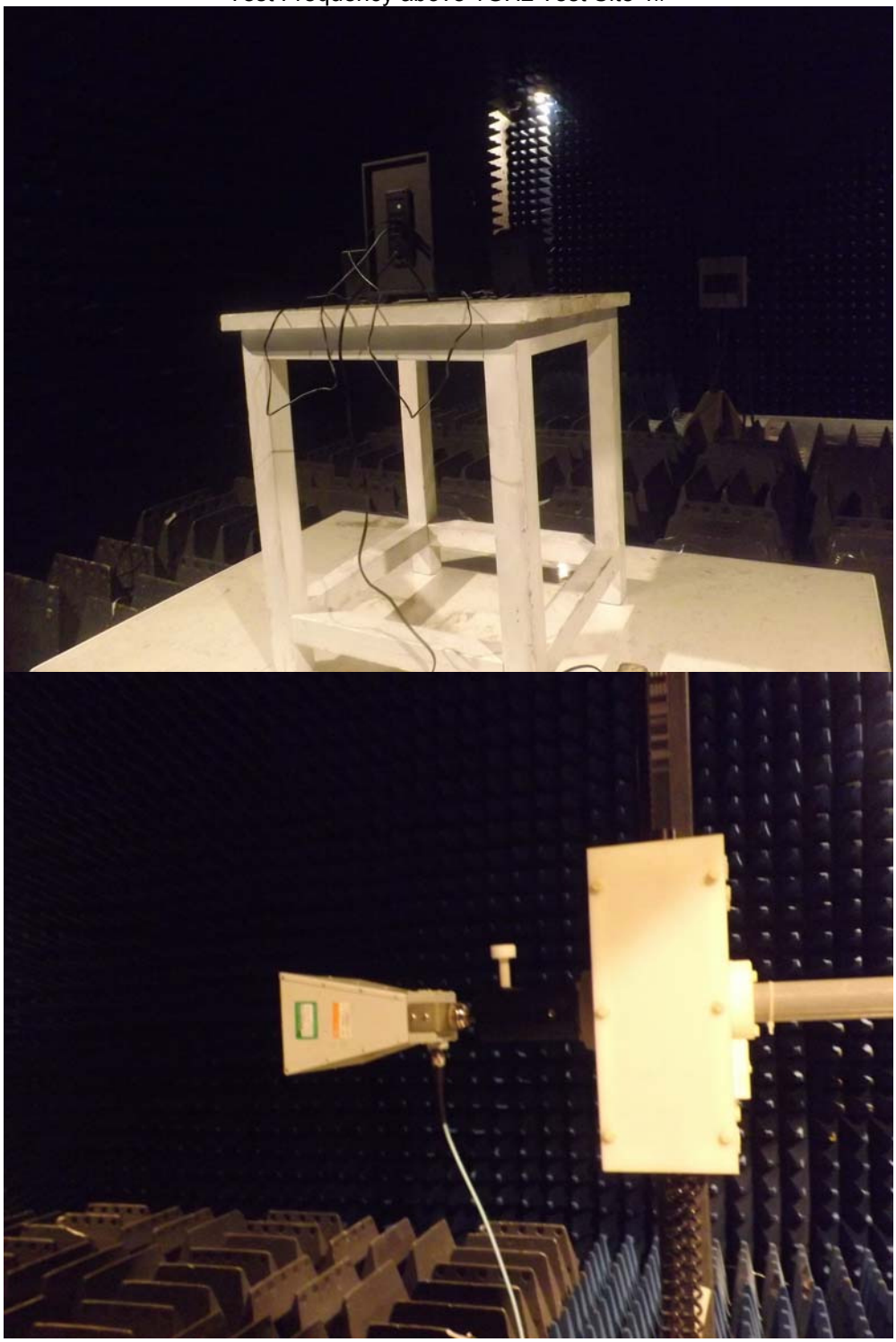
Test Frequency 24MHz to 30MHz at Test Site 2#



Test Frequency 30MHz to 1000MHz at Test Site 2#

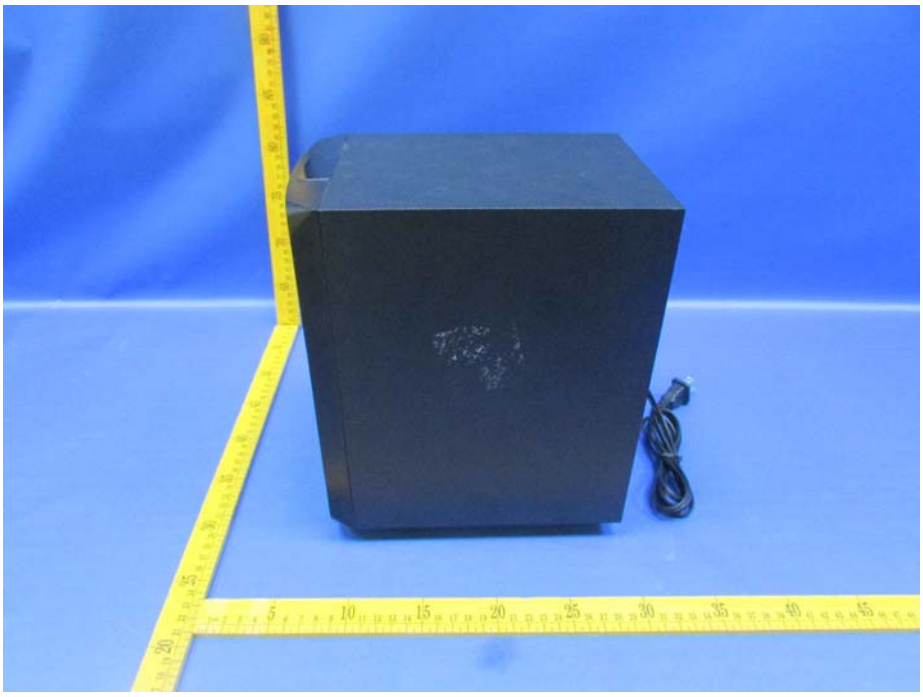


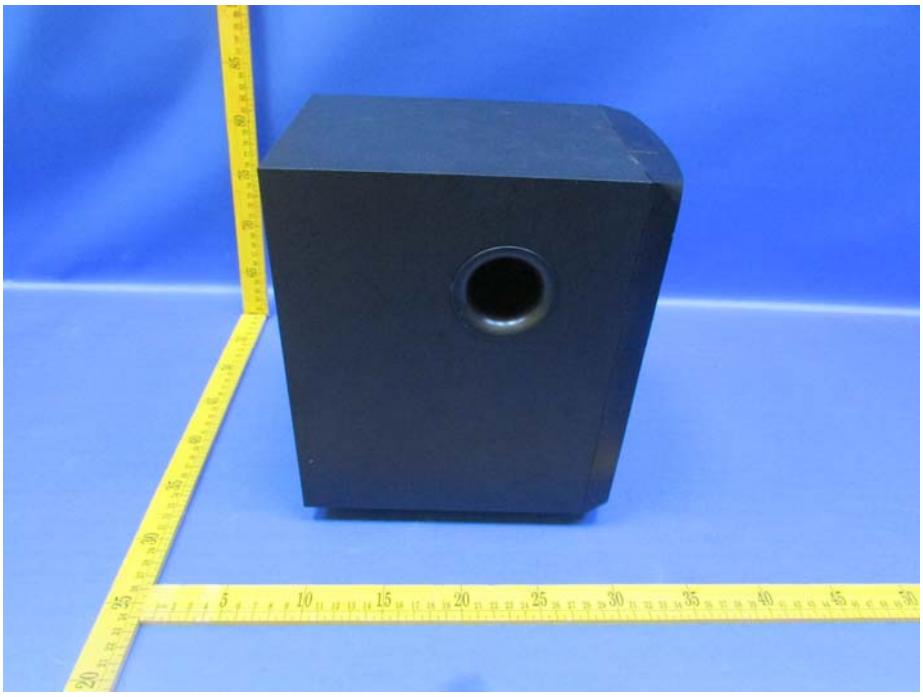
Test Frequency above 1GHz Test Site 1#

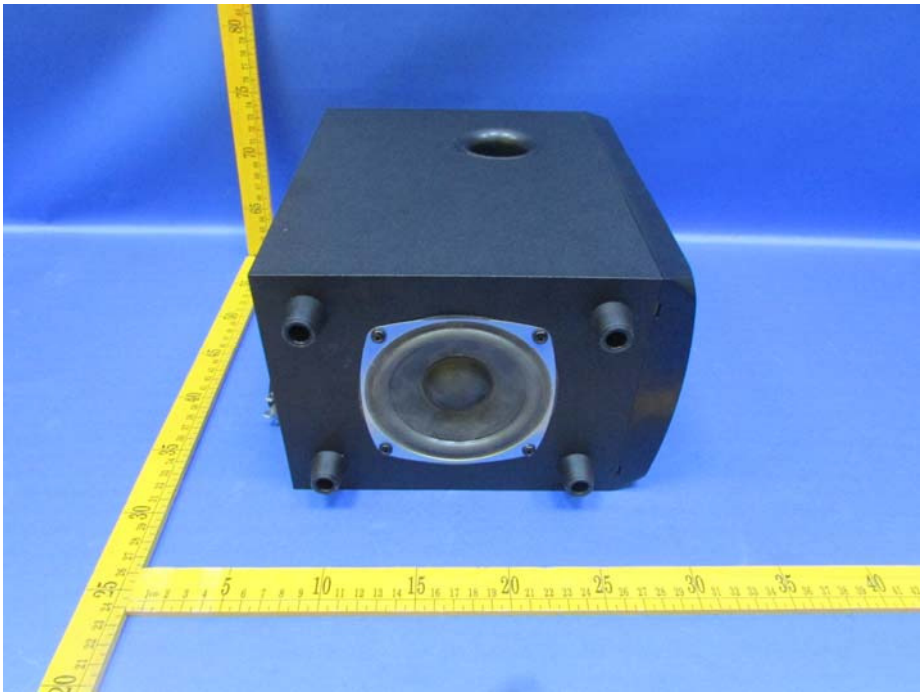


18 Photographs – Constructional Details

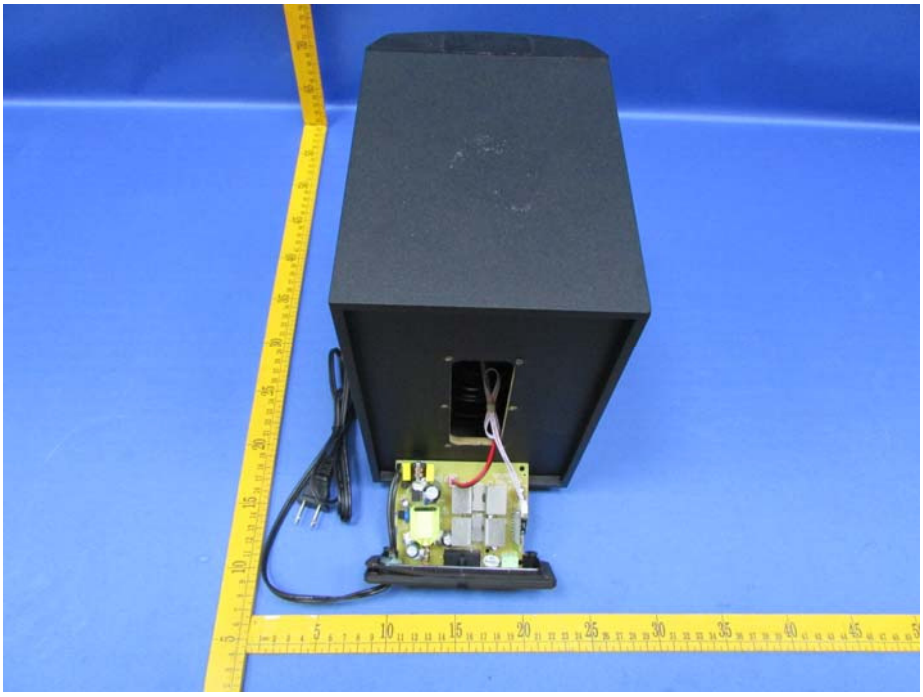
18.1 Model IM210-BLK-BIG– External Photos

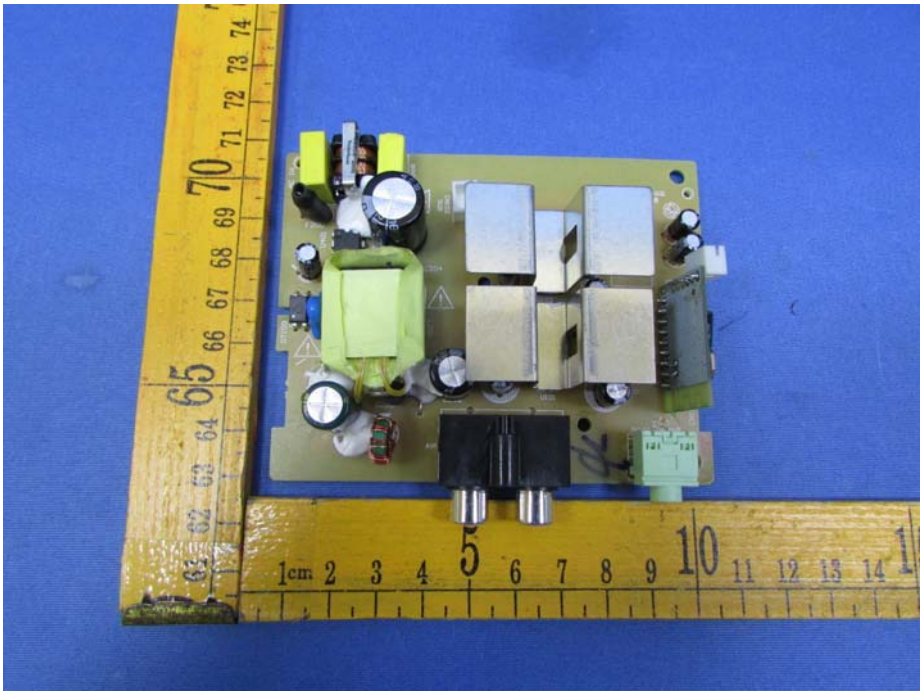


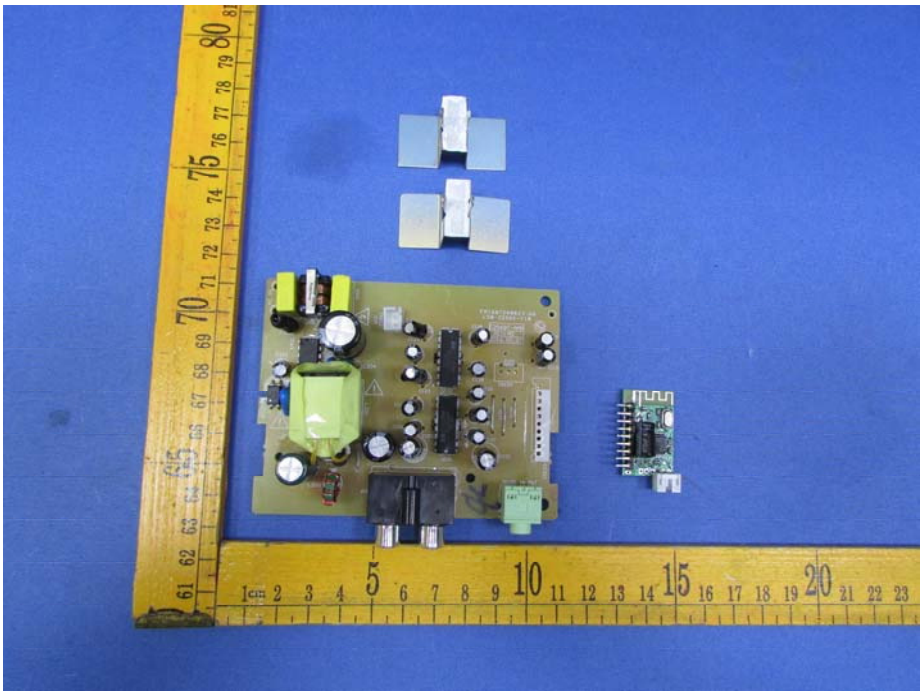


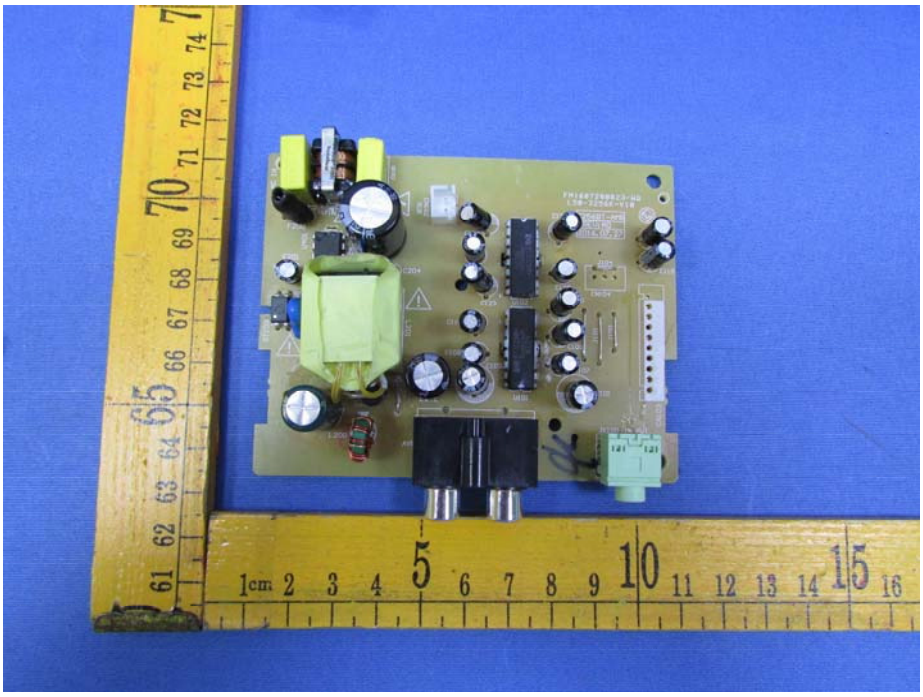


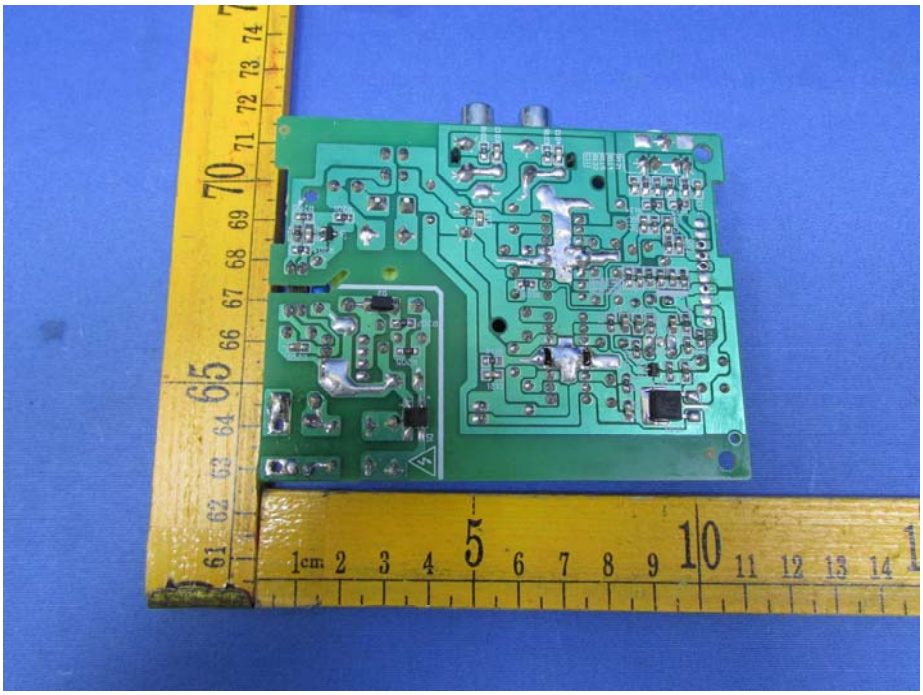
18.2 Model IM210-BLK-BIG – Internal Photos

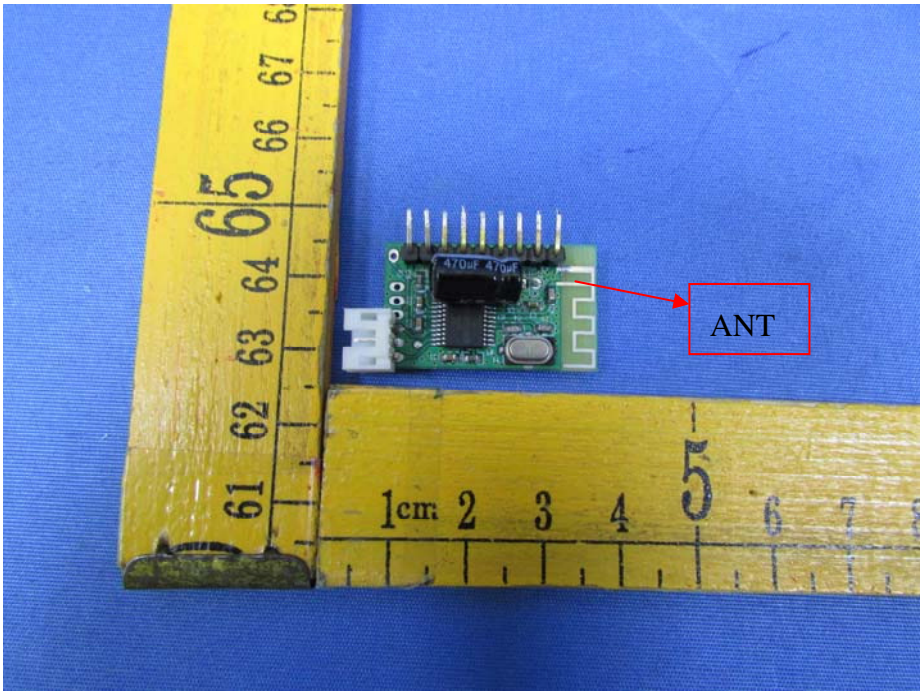








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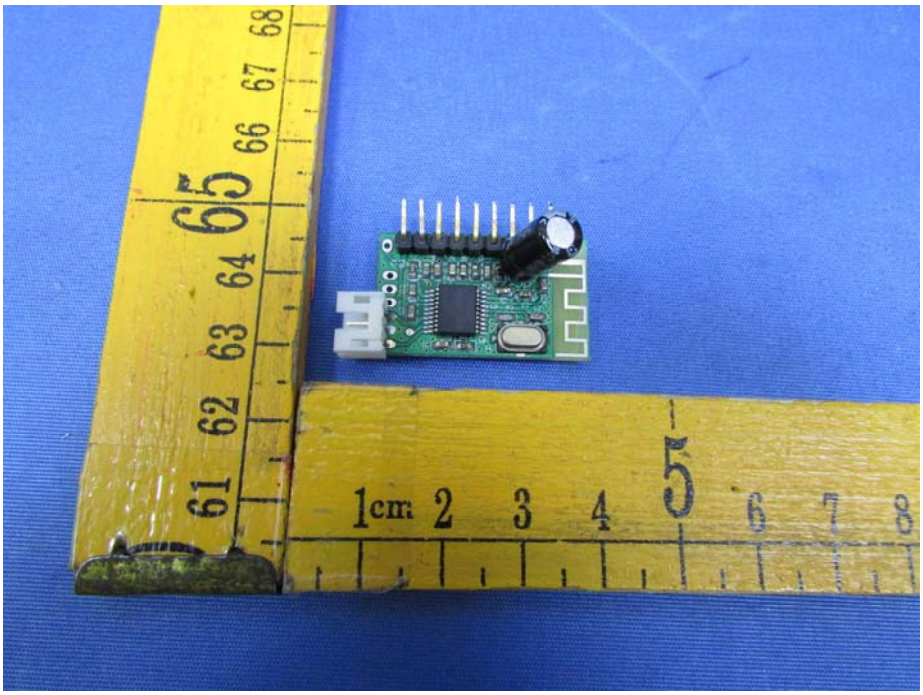

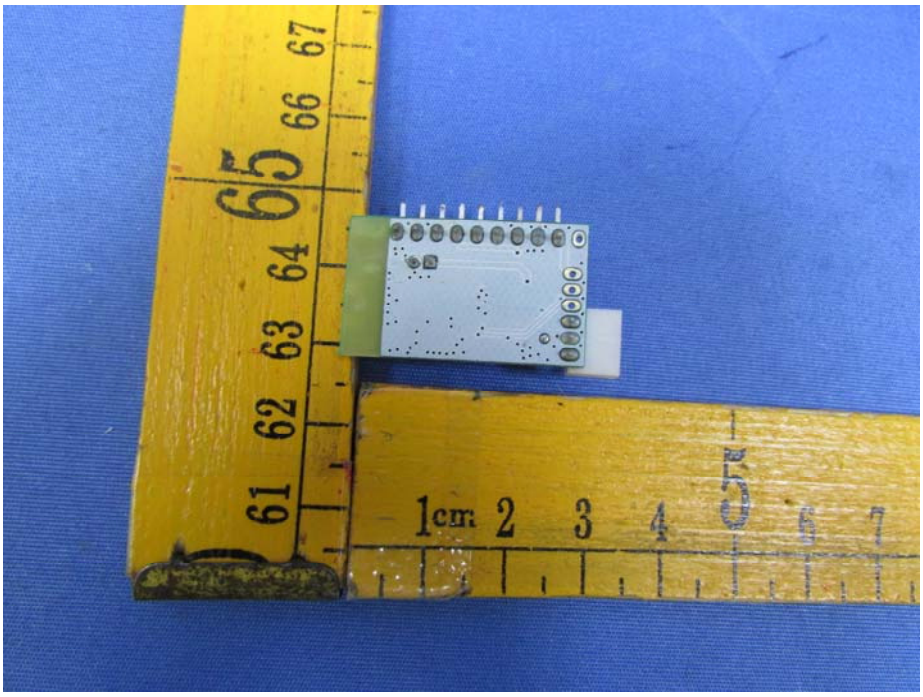

======End of Report======