

FCC TEST REPORT

FCC ID: 2AI63Z11

Product	:	Bluetooth speakers
Model Name	:	Z11
Brand	:	N/A
Report No.	:	PTC801483160708E-FC01
Prepared for		
Shenzhen tietou Industrial Co., Ltd.		
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Prepared by		
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Dongcheng District, Dongguan, Guangdong, China		

TEST RESULT CERTIFICATION

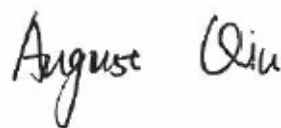
Applicant's name : Shenzhen tietou Industrial Co., Ltd.
Address : 3/F, Building B, Lisongyin Battery Road, Gongming Sub-District, Shenzhen, China
Manufacture's name : Shenzhen tietou Industrial Co., Ltd.
Address : 3/F, Building B, Lisongyin Battery Road, Gongming Sub-District, Shenzhen, China
Product name : Bluetooth speakers
Model name : Z11
Standards : FCC CFR47 Part 15 Section 15.247
Test procedure : ANSI C63.10:2013, DA 00-705
Test Date : Jul.18, 2016 ~Aug.14, 2016
Date of Issue : Aug.17, 2016
Test Result : Pass

This device described above has been tested by PTC, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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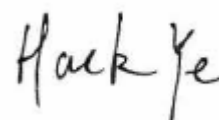
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2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Conducted Spurious emissions	15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
Conduct Emission	15.207	PASS
20dB Bandwidth	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Antenna Requirement	15.203	PASS

Remark:

N/A: Not Applicable

3 General Information

3.1 General Description of E.U.T.

Product Name	:	Bluetooth speakers
Model Name	:	Z11
Model Description	:	N/A
Bluetooth Version	:	BT3.0
Operating frequency	:	2402-2480MHz
Max. RF output power	:	1.44dBm
Type of Modulation	:	GFSK
Antenna installation:	:	PCB printed antenna
Antenna Gain:	:	0dBi
Power supply	:	DC 3.7V 1200mAh Power by battery, DC 5V charging by USB port



3.2 Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	/	/

3.3 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.

Test mode	Low channel	Middle channel	High channel
Transmitting	2402MHz	2441MHz	2480MHz
Hopping	2402-2480MHz		
Tests Carried Out Under FCC part 15.207			
Test Item		Test Mode	
Conduction Emission, 0.15MHz to 30MHz		BT Communication	

4 Equipment During Test

4.1 Equipments List

RF Conducted Test							
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	EMC Analyzer (9k~26.5GHz)	Agilent	E4407B	MY45109572	Aug.04, 2016	Aug.03, 2017	1 year
2	EXA Signal Analyzer	Keysight	N9010A	MY50520207 526B25MPB W7X	Aug.04, 2016	Aug.03, 2017	1 year
3	EMI Test Receiver	R&S	ESCI	101155	July 15, 2016	July 14, 2017	1 year
Radiated Emissions							
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	EMI Test Receiver	Rohde&Schwarz	ESCI	101417	July 15, 2016	July 14, 2017	1 year
2	Trilog Broadband Antenna	SCHWARZECK	VULB9160	9160-3355	July 15, 2016	July 14, 2017	1 year
3	Amplifier	EM	EM-30180	060538	July 15, 2016	July 14, 2017	1 year
4	Horn Antenna	SCHWARZECK	BBHA9120D	9120D-1246	July 15, 2016	July 14, 2017	1 year
5	Loop Antenna	SCHWARZECK	FMZB1516	9130D-1243	July 15, 2016	July 14, 2017	1 year
Conducted Emissions							
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	EMI Test Receiver	R&S	ESCI	101155	July 15, 2016	July 14, 2017	1 year
2	LISN	SCHWARZECK	NSLK 8128	8128-289	July 15, 2016	July 14, 2017	1 year
3	Cable	LARGE	RF300	-	July 15, 2016	July 14, 2017	1 year



4.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	$\pm 1.0\text{dB}$
Power Spectral Density, conducted	$\pm 2.2\text{dB}$
Radio Frequency	$\pm 1 \times 10^{-6}$
Bandwidth	$\pm 1.5 \times 10^{-6}$
Time	$\pm 2\%$
Duty Cycle	$\pm 2\%$
Temperature	$\pm 1^{\circ}\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 3\%$
Conducted Emissions (150kHz~30MHz)	$\pm 3.64\text{dB}$
Radiated Emission(30MHz~1GHz)	$\pm 5.03\text{dB}$
Radiated Emission(1GHz~25GHz)	$\pm 4.74\text{dB}$

5 Conducted Emission

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

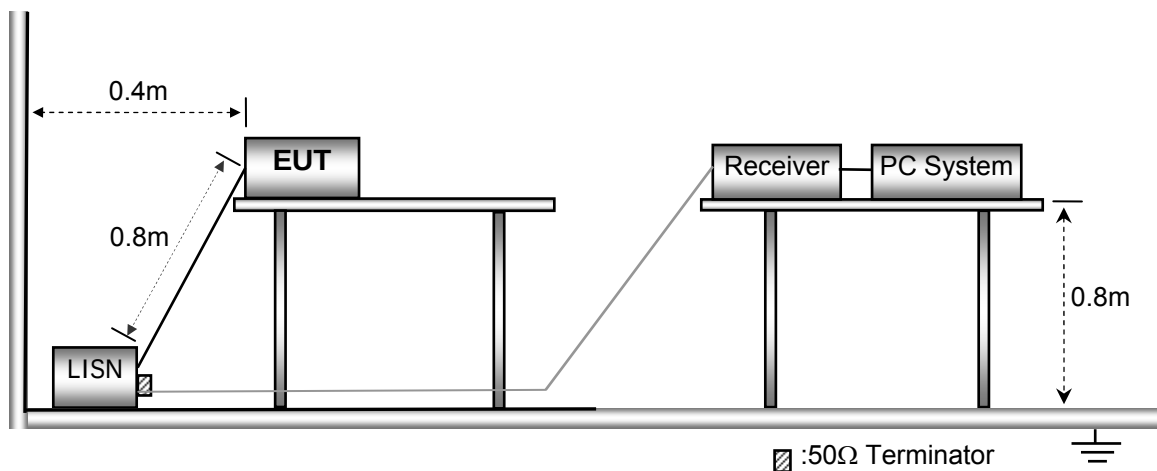
5.1 E.U.T. Operation

Operating Environment:

Temperature: : 25.5 °C
 Humidity: : 51 % RH
 Atmospheric Pressure: : 101.2kPa
 EUT Operation: : Refer to section 3.3

5.2 EUT Setup

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



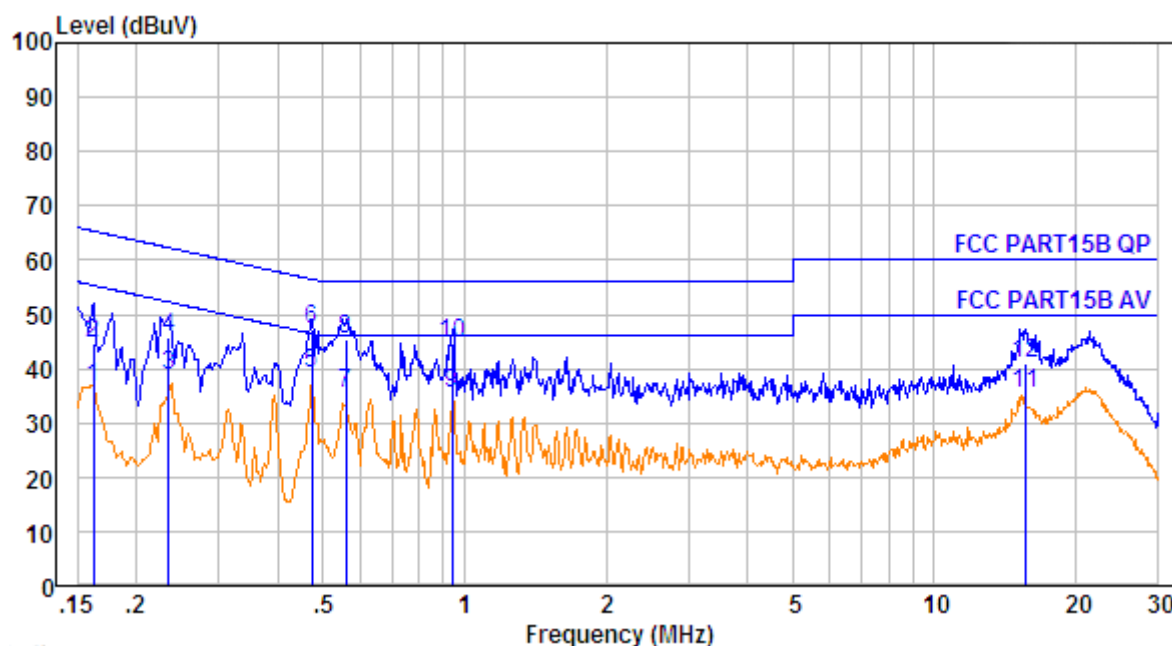
5.3 Measurement Description

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.

5.4 Conducted Emission Test Result

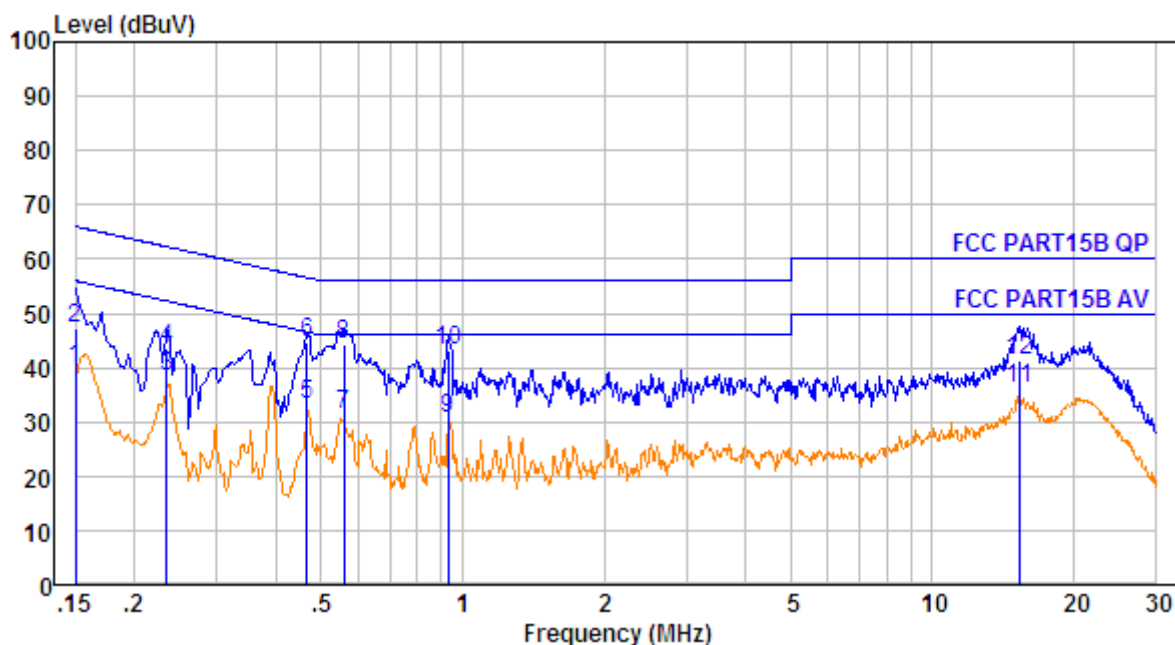
2402 channel TX Model have been tested and only the worst case

Live line:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	0.163	10.60	0.60	25.50	36.70	55.34	-18.64	Average
2.	0.163	10.60	0.60	33.30	44.50	65.34	-20.84	QP
3.	0.234	10.62	0.60	27.50	38.72	52.30	-13.58	Average
4.	0.234	10.62	0.60	34.70	45.92	62.30	-16.38	QP
5.	0.474	10.64	0.60	27.80	39.04	46.45	-7.41	Average
6.	0.474	10.64	0.60	36.00	47.24	56.45	-9.21	QP
7.	0.558	10.65	0.60	24.20	35.45	46.00	-10.55	Average
8.	0.558	10.65	0.60	34.30	45.55	56.00	-10.45	QP
9.	0.943	10.67	0.60	24.20	35.47	46.00	-10.53	Average
10.	0.943	10.67	0.60	33.30	44.57	56.00	-11.43	QP
11.	15.650	10.78	0.60	23.90	35.28	50.00	-14.72	Average
12.	15.650	10.78	0.60	29.40	40.78	60.00	-19.22	QP

Neutral line:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	0.150	10.60	0.60	28.50	39.70	56.00	-16.30	Average
2.	0.150	10.60	0.60	36.10	47.30	66.00	-18.70	QP
3.	0.234	10.62	0.60	27.20	38.42	52.30	-13.88	Average
4.	0.234	10.62	0.60	32.20	43.42	62.30	-18.88	QP
5.	0.466	10.64	0.60	22.00	33.24	46.58	-13.34	Average
6.	0.466	10.64	0.60	33.50	44.74	56.58	-11.84	QP
7.	0.558	10.65	0.60	20.20	31.45	46.00	-14.55	Average
8.	0.558	10.65	0.60	33.20	44.45	56.00	-11.55	QP
9.	0.933	10.67	0.60	19.30	30.57	46.00	-15.43	Average
10.	0.933	10.67	0.60	32.00	43.27	56.00	-12.73	QP
11.	15.400	10.77	0.60	24.70	36.07	50.00	-13.93	Average
12.	15.400	10.77	0.60	29.90	41.27	60.00	-18.73	QP

6 Radiated Spurious Emissions

Test Requirement: : FCC CFR47 Part 15 Section 15.209 & 15.247
 Test Method: : ANSI C63.10:2013, DA 00-705
 Test Result: : PASS
 Measurement Distance: : 3m
 Limit: : See the follow table

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

6.1 EUT Operation

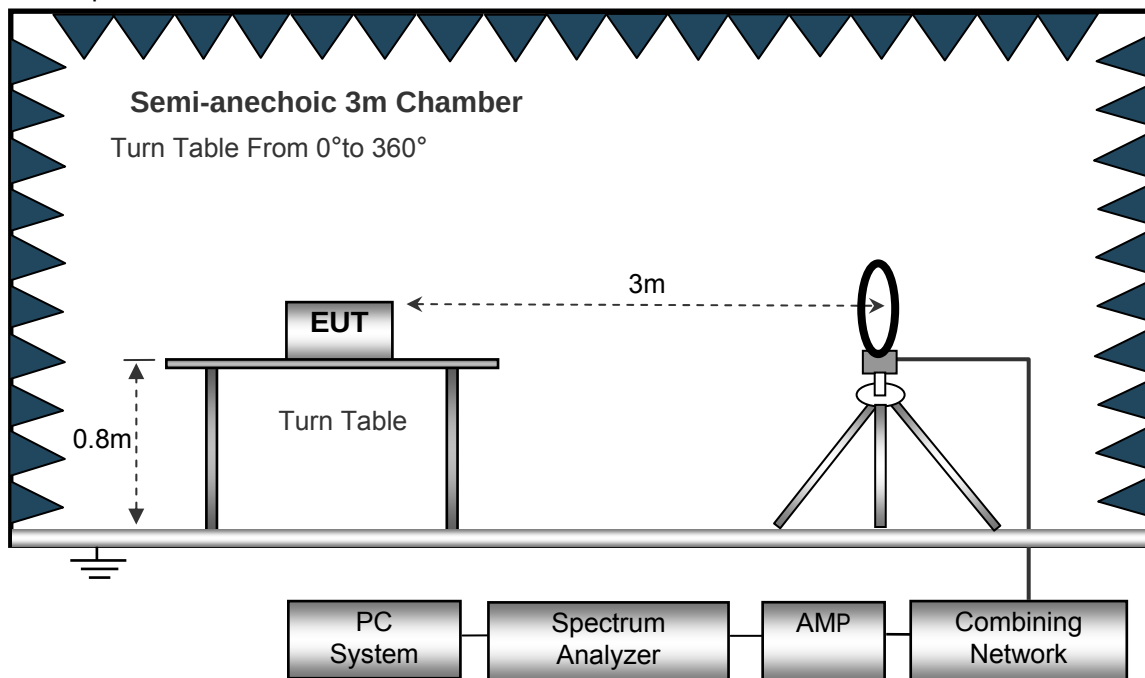
Operating Environment :

Temperature: : 23.5 °C
 Humidity: : 51.1 % RH
 Atmospheric Pressure: : 101.2kPa
 EUT Operation : : Refer to section 3.3

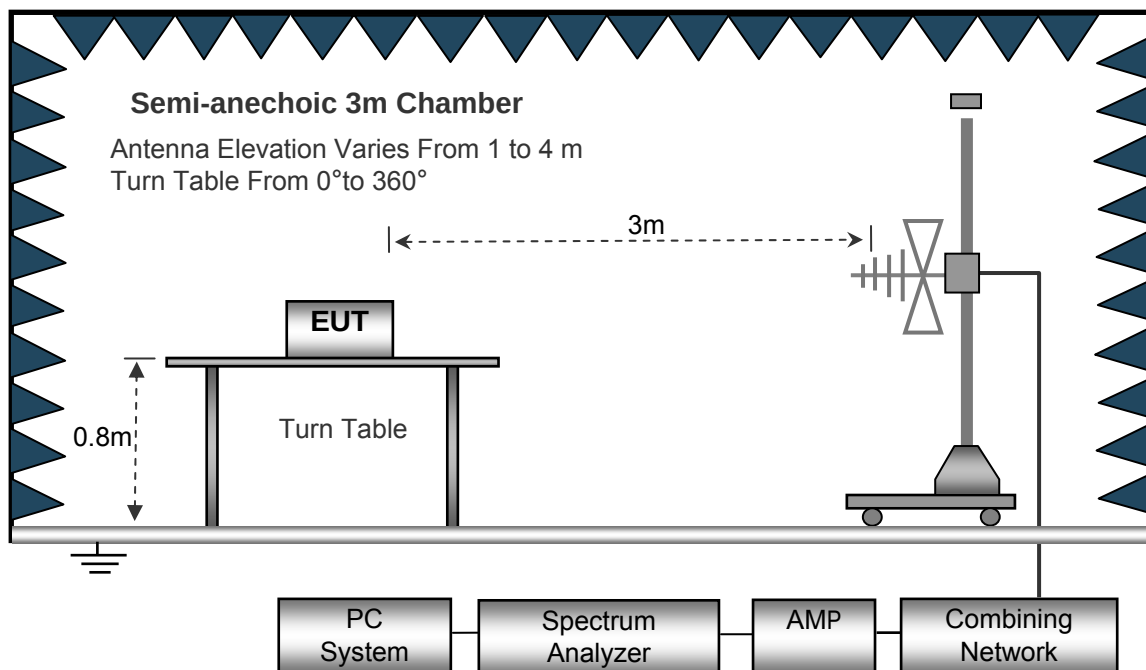
6.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

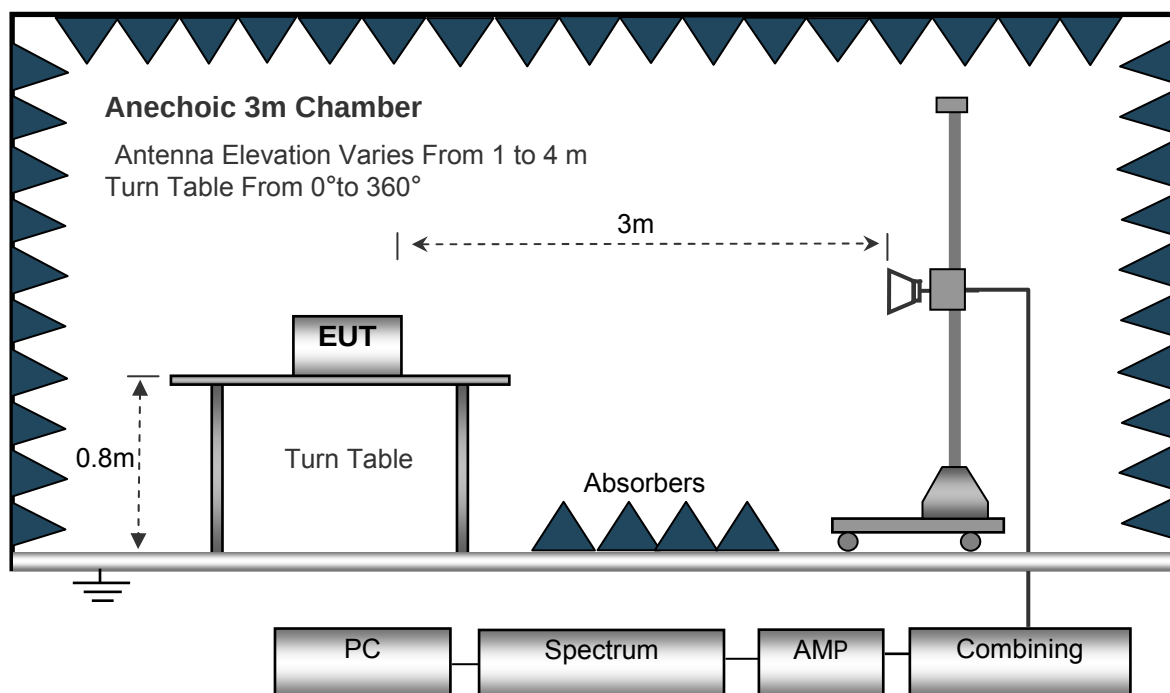
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



6.3 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

6.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m or 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. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
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 tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

6.5 Summary of Test Results

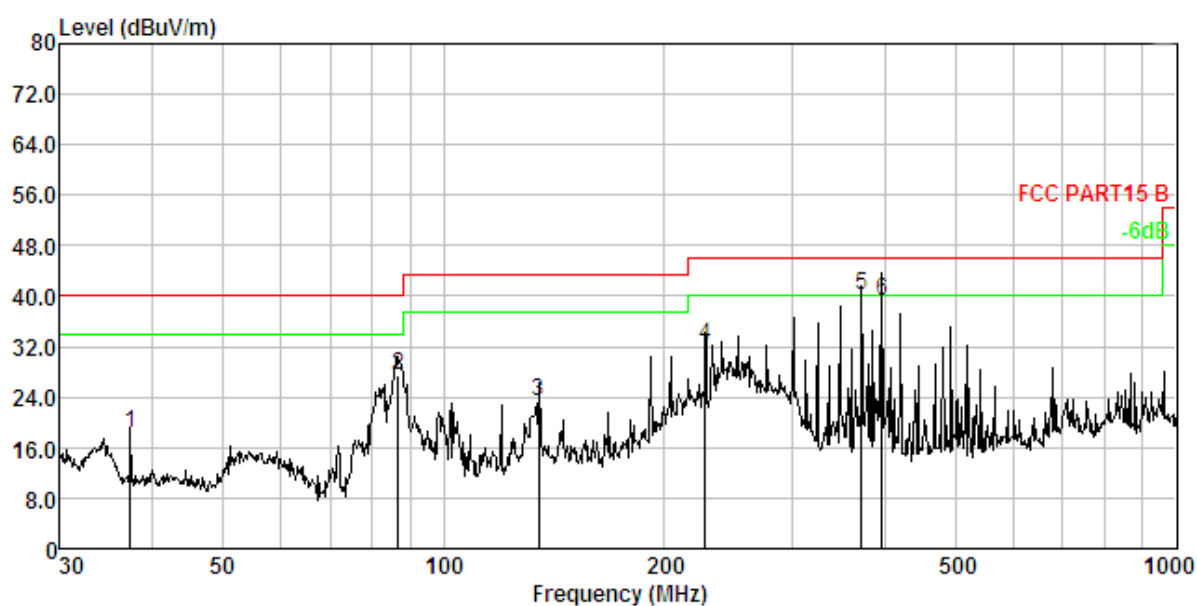
Test Frequency: Below 30MHz

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

Test Frequency: 30MHz ~ 1GHz

2402 channel TX Model have been tested and only the worst case

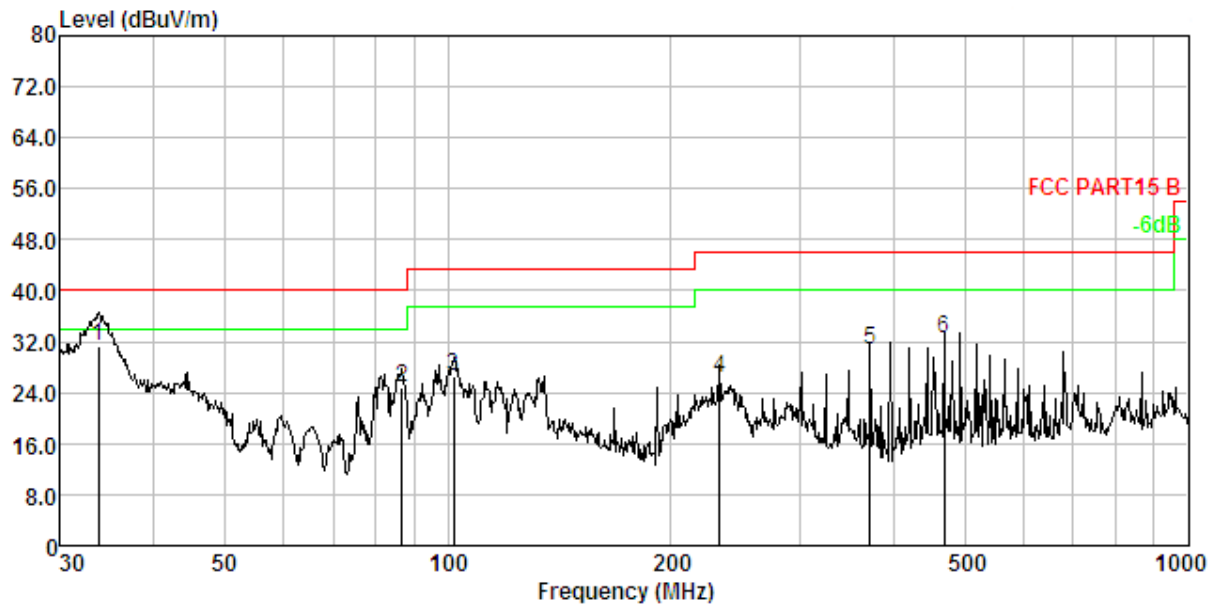
Antenna Polarization: Horizontal



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamplifier Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	37.416	1.26	13.51	33.53	30.05	18.25	40.00	-21.75	QP
2.	86.807	2.02	8.91	46.91	30.34	27.50	40.00	-12.50	QP
3.	135.032	2.42	13.00	38.31	30.49	23.24	43.50	-20.26	QP
4.	227.691	2.89	11.14	48.78	30.68	32.13	46.00	-13.87	QP
5.	372.005	3.33	14.69	53.01	30.85	40.18	46.00	-5.82	QP
6.	396.242	3.39	15.24	51.40	30.87	39.16	46.00	-6.84	QP



Antenna Polarization: Vertical



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBUV	Preamp Factor dB	Emission Level dBUV/m	Limit dBUV/m	Over Limit dB	Remark
1.	33.799	1.16	13.32	46.80	30.01	31.27	40.00	-8.73	QP
2.	86.807	2.02	8.91	44.12	30.34	24.71	40.00	-15.29	QP
3.	102.001	2.16	10.41	44.36	30.40	26.53	43.50	-16.97	QP
4.	233.349	2.91	11.40	42.66	30.68	26.29	46.00	-19.71	QP
5.	372.005	3.33	14.69	43.60	30.85	30.77	46.00	-15.23	QP
6.	468.876	3.54	16.68	43.05	30.93	32.34	46.00	-13.66	QP



Test Frequency: 1GHz ~ 18GHz

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

Frequency	Receiver Reading	Detector	Corrected Factor	Corrected Amplitude	Limit	Margin	Polar (H/V)
(MHz)	(dBμV)	(PK/QP/Ave)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
GFSK Low Channel							
1184.32	44.05	PK	-18.92	25.13	74.00	-48.87	Horizontal
1184.32	36.71	Ave	-18.92	17.79	54.00	-36.21	Horizontal
4804.00	47.87	PK	-1.06	46.81	74.00	-27.19	Horizontal
4804.00	43.36	Ave	-1.06	42.3	54.00	-11.7	Horizontal
7206.00	49.29	PK	1.33	50.62	74.00	-23.38	Horizontal
7206.00	41.31	Ave	1.33	42.64	54.00	-11.36	Horizontal
1183.53	43.26	PK	-16.32	26.94	74.00	-47.06	Vertical
1183.53	35.27	Ave	-16.32	18.95	54.00	-35.05	Vertical
4804.00	46.53	PK	-2.69	43.84	74.00	-30.16	Vertical
4804.00	42.98	Ave	-2.69	40.29	54.00	-13.71	Vertical
7206.00	48.62	PK	-3.63	44.99	74.00	-29.01	Vertical
7206.00	40.39	Ave	-3.63	36.76	54.00	-17.24	Vertical
Restricted bands Emission							
2331.63	44.71	PK	-13.19	31.52	74.00	-42.48	Horizontal
2331.63	37.95	Ave	-13.19	24.76	54.00	-29.24	Horizontal
2766.60	39.86	PK	-13.14	26.72	74.00	-47.28	Horizontal
2766.60	37.11	Ave	-13.14	23.97	54.00	-30.03	Horizontal
3334.34	41.41	PK	-13.08	28.33	74.00	-45.67	Horizontal
3334.34	40.05	Ave	-13.08	26.97	54.00	-27.03	Horizontal
2230.59	42.87	PK	-13.26	29.61	74.00	-44.39	Vertical
2230.59	35.14	Ave	-13.26	21.88	54.00	-32.12	Vertical
2594.83	37.23	PK	-13.45	23.78	74.00	-50.22	Vertical
2594.83	35.26	Ave	-13.45	21.81	54.00	-32.19	Vertical
3224.32	40.92	PK	-13.23	27.69	74.00	-46.31	Vertical
3224.32	39.86	Ave	-13.23	26.63	54.00	-27.37	Vertical
Remark: Corrected Factor=ANT Factor + Cable Loss – Amp Gain							



Frequency	Receiver Reading	Detector	Corrected Factor	Corrected Amplitude	Limit	Margin	Polar (H/V)
(MHz)	(dBμV)	(PK/QP/Ave)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
GFSK Middle Channel							
1184.32	44.14	PK	-18.92	25.22	74.00	-48.78	Horizontal
1184.32	36.61	Ave	-18.92	17.69	54.00	-36.31	Horizontal
4882.00	48.7	PK	-0.93	47.77	74.00	-26.23	Horizontal
4882.00	43.52	Ave	-0.93	42.59	54.00	-11.41	Horizontal
7324.00	48.41	PK	1.67	50.08	74.00	-23.92	Horizontal
7324.00	41.66	Ave	1.67	43.33	54.00	-10.67	Horizontal
1184.32	43.21	PK	-17.36	25.85	74.00	-48.15	Vertical
1184.32	25.23	Ave	-17.36	7.87	54.00	-46.13	Vertical
4882.00	46.91	PK	-1.29	45.62	74.00	-28.38	Vertical
4882.00	40.36	Ave	-1.29	39.07	54.00	-14.93	Vertical
7324.00	46.29	PK	-0.36	45.93	74.00	-28.07	Vertical
7324.00	40.30	Ave	-0.36	39.94	54.00	-14.06	Vertical
Restricted bands Emission							
2314.09	43.85	PK	-13.19	30.66	74.00	-43.34	Horizontal
2314.09	37.75	Ave	-13.19	24.56	54.00	-29.44	Horizontal
2670.38	39.6	PK	-13.14	26.46	74.00	-47.54	Horizontal
2670.38	36.29	Ave	-13.14	23.15	54.00	-30.85	Horizontal
3349.48	42.32	PK	-13.08	29.24	74.00	-44.76	Horizontal
3349.48	39.45	Ave	-13.08	26.37	54.00	-27.63	Horizontal
2369.21	42.69	PK	-12.97	29.72	74.00	-44.28	Vertical
2369.21	36.43	Ave	-12.97	23.46	54.00	-30.54	Vertical
2653.28	38.29	PK	-13.05	25.24	74.00	-48.76	Vertical
2653.28	35.32	Ave	-13.05	22.27	54.00	-31.73	Vertical
3332.09	40.63	PK	-12.98	27.65	74.00	-46.35	Vertical
3332.09	38.59	Ave	-12.98	25.61	54.00	-28.39	Vertical
Remark: Corrected Factor=ANT Factor + Cable Loss – Amp Gain							



Frequency	Receiver Reading	Detector	Corrected Factor	Corrected Amplitude	Limit	Margin	Polar (H/V)
(MHz)	(dBμV)	(PK/QP/Ave)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
GFSK High Channel							
1184.32	44.37	PK	-18.92	25.45	74.00	-48.55	Horizontal
1184.32	35.69	Ave	-18.92	16.77	54.00	-37.23	Horizontal
4960.00	48.09	PK	-0.87	47.22	74.00	-26.78	Horizontal
4960.00	43	Ave	-0.87	42.13	54.00	-11.87	Horizontal
7440.00	48.19	PK	1.84	50.03	74.00	-23.97	Horizontal
7440.00	42.64	Ave	1.84	44.48	54.00	-9.52	Horizontal
1184.32	43.29	PK	-17.86	25.43	74.00	-48.57	Vertical
1184.32	34.26	Ave	-17.86	16.4	54.00	-37.6	Vertical
4960.00	46.32	PK	-1.69	44.63	74.00	-29.37	Vertical
4960.00	42.47	Ave	-1.69	40.78	54.00	-13.22	Vertical
7440.00	46.58	PK	-0.93	45.65	74.00	-28.35	Vertical
7440.00	40.98	Ave	-0.93	40.05	54.00	-13.95	Vertical
Restricted bands Emission							
2313.86	43.48	PK	-13.19	30.29	74.00	-43.71	Horizontal
2313.86	36.79	Ave	-13.19	23.6	54.00	-30.4	Horizontal
2687.21	39.02	PK	-13.14	25.88	74.00	-48.12	Horizontal
2687.21	36.65	Ave	-13.14	23.51	54.00	-30.49	Horizontal
3355.95	42.32	PK	-13.08	29.24	74.00	-44.76	Horizontal
3355.95	40.1	Ave	-13.08	27.02	54.00	-26.98	Horizontal
2364.17	42.93	PK	-13.26	29.67	74.00	-44.33	Vertical
2364.17	35.82	Ave	-13.26	22.56	54.00	-31.44	Vertical
2688.92	39.59	PK	-13.45	26.14	74.00	-47.86	Vertical
2688.92	35.42	Ave	-13.45	21.97	54.00	-32.03	Vertical
3356.46	41.39	PK	-13.20	28.19	74.00	-45.81	Vertical
3356.46	40.23	Ave	-13.20	27.03	54.00	-26.97	Vertical
Remark: Corrected Factor=ANT Factor + Cable Loss – Amp Gain							

Test Frequency :Above 18GHz

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

Remark1.The testing has been conformed to $10 \times 2480 = 24800\text{MHz}$.

2.All other emissions more than 30dB below the limit.

Radiated band edge:

Frequency	Receiver Reading	Detector	Corrected Factor	Corrected Amplitude	Limit	Margin	Polar (H/V)
(MHz)	(dBμV)	(PK/QP/Ave)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
GFSK							
2390.00	60.36	PK	-13.06	47.3	74.00	-26.7	Horizontal
2390.00	59.38	Ave	-13.06	46.32	54.00	-7.68	Horizontal
2483.50	59.19	PK	-12.78	46.41	74.00	-27.59	Horizontal
2483.50	58.84	Ave	-12.78	46.06	54.00	-7.94	Horizontal
2390.00	60.23	PK	-13.08	47.15	74.00	-26.85	Vertical
2390.00	59.18	Ave	-13.08	46.1	54.00	-7.9	Vertical
2483.50	59.09	PK	-12.93	46.16	74.00	-27.84	Vertical
2483.50	58.47	Ave	-12.93	45.54	54.00	-8.46	Vertical
Remark: The PK value is below the AV limit, The AV value was not recorded.							

Test Frequency :Above 18GHz

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

Remark1.The testing has been conformed to $10 \times 2480 = 24800\text{MHz}$.

2.All other emissions more than 30dB below the limit.

7 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 C63.10:2013, DA 00-705
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	: Refer to section 3.3

7.1 Test Procedure

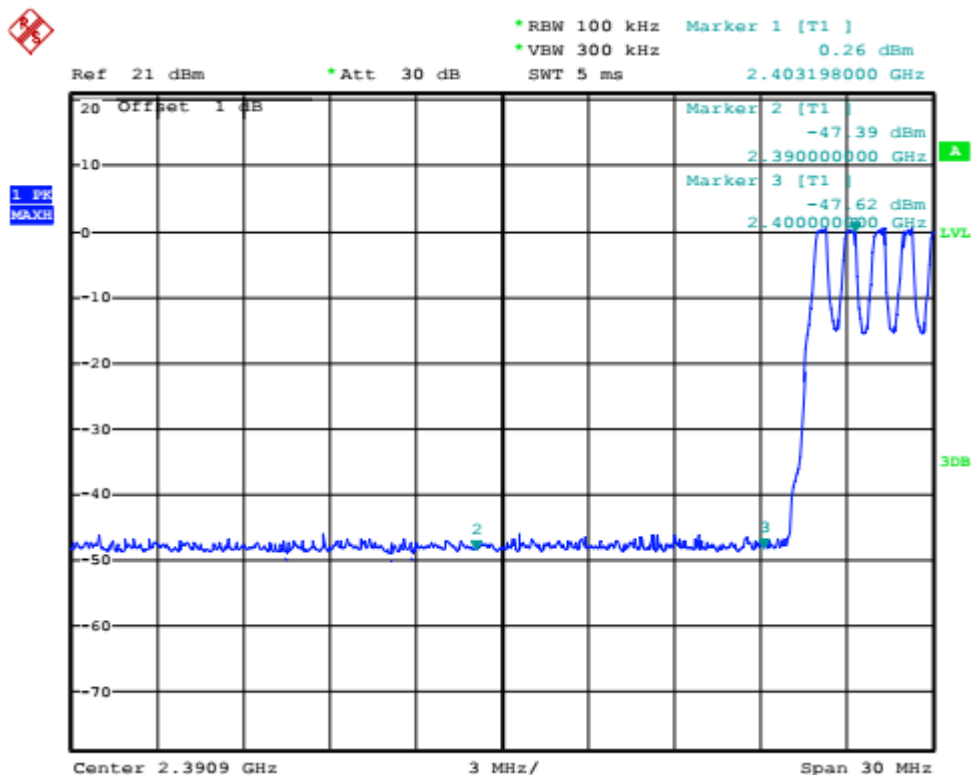
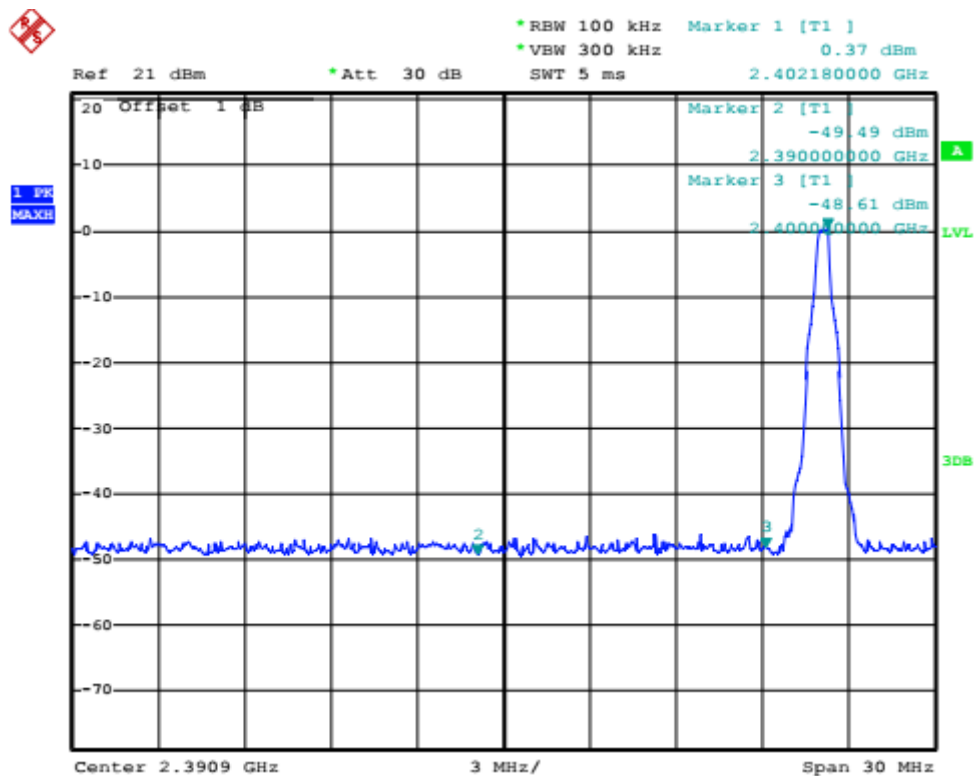
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto

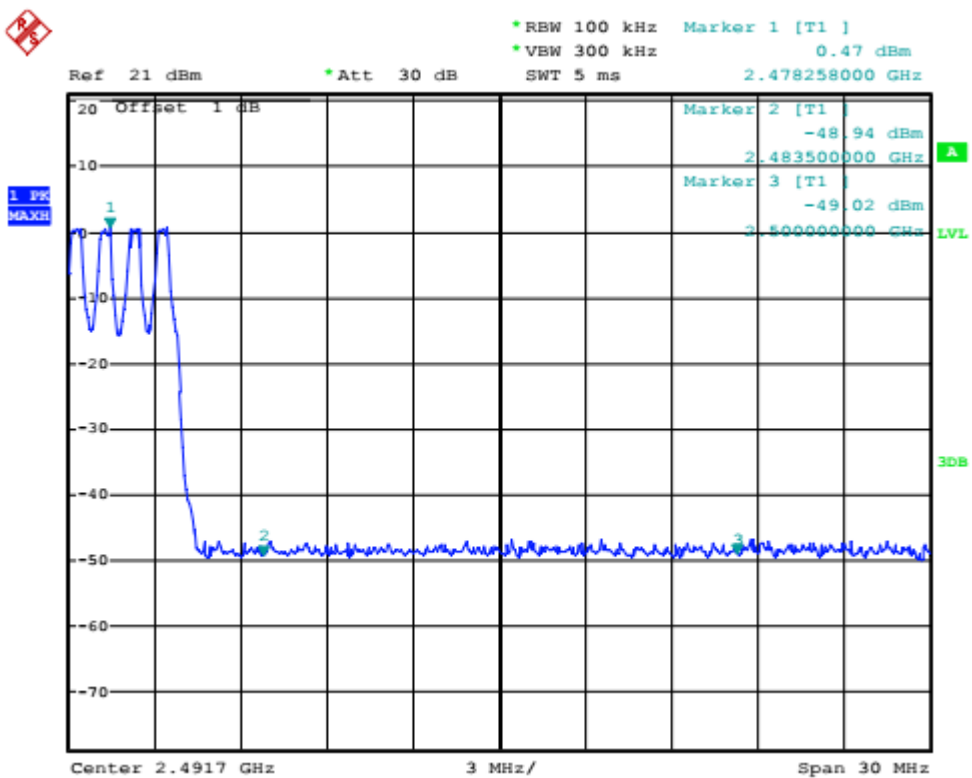
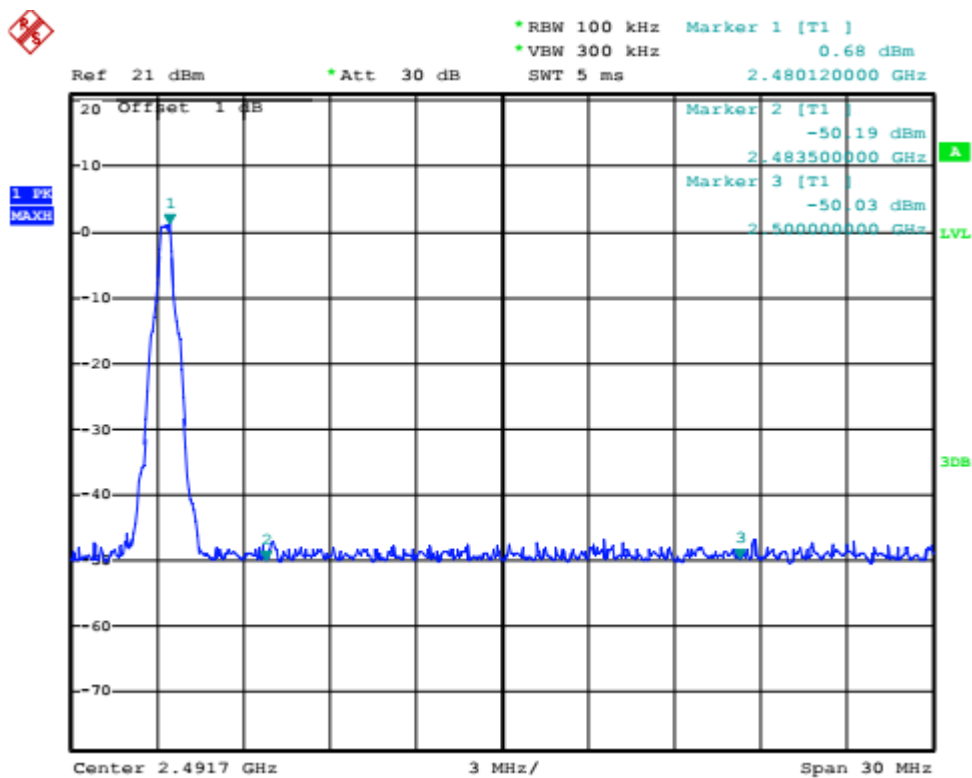
Detector function = peak, Trace = max hold

7.2 Test Result

GFSK Band edge-left side



GFSK Band edge-left side



8 20 dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247
 Test Method : ANSI C63.10:2013, DA 00-705
 Test Mode : Refer to section 3.3

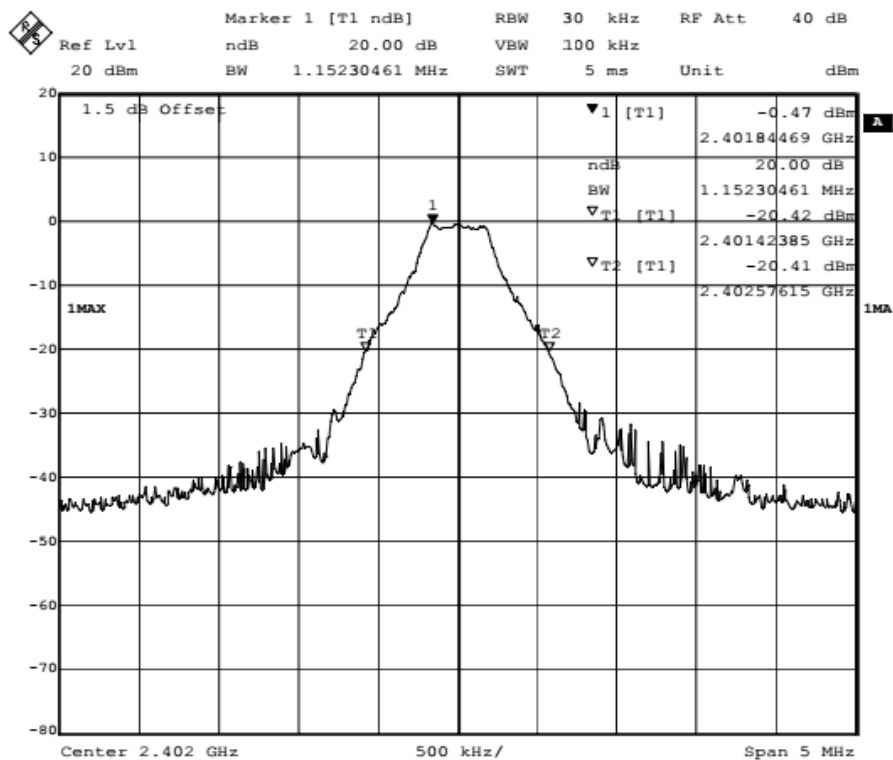
8.1 Test Procedure

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 = 30kHz, VBW = 100kHz

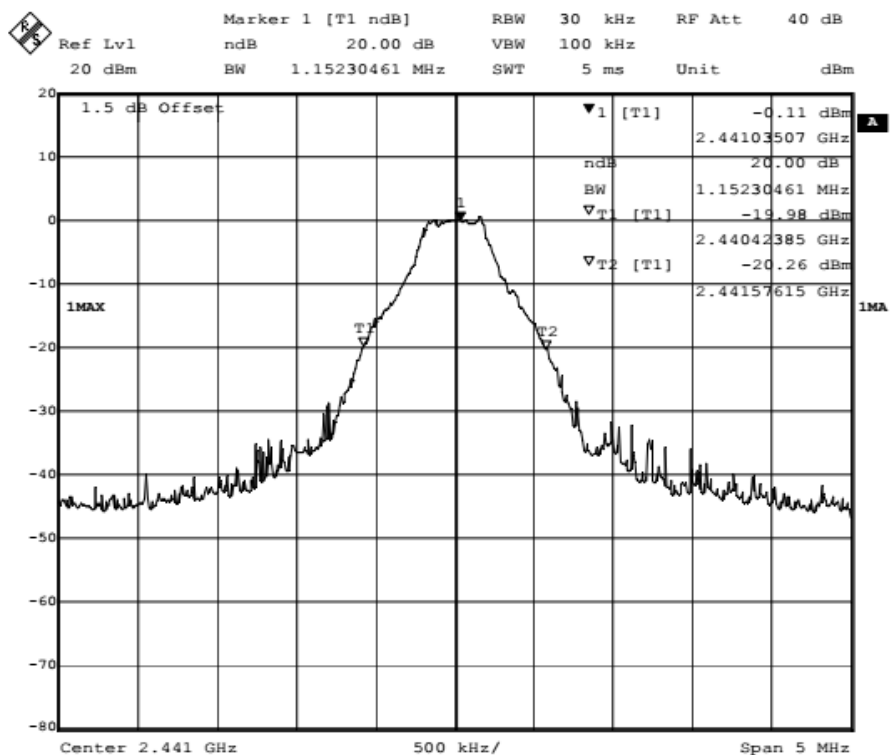
8.2 Test Result

Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low(2402MHz)	1.152
GFSK	Middle(2441MHz)	1.152
GFSK	High(2480MHz)	1.122

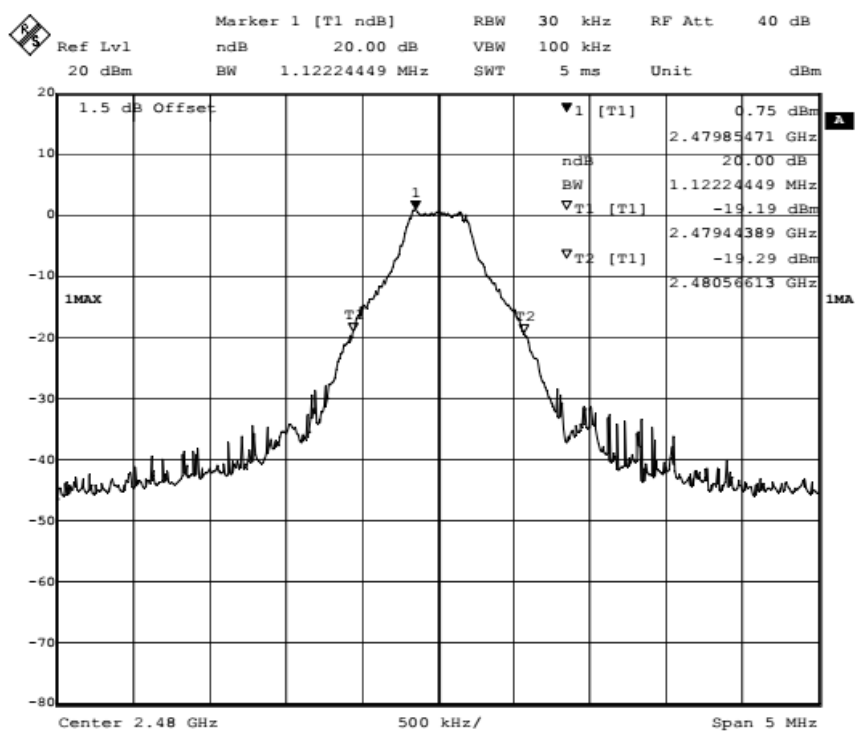
GFSK Low Channel



GFSK Middle Channel



GFSKHigh Channel



9 Maximum Peak Output Power

Test Requirement	: FCC CFR47 Part 15 Section 15.247
Test Method	: ANSI C63.10:2013,DA 00-705
Test Limit	: 0.125W (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.)
Test Mode	: Refer to section 3.3

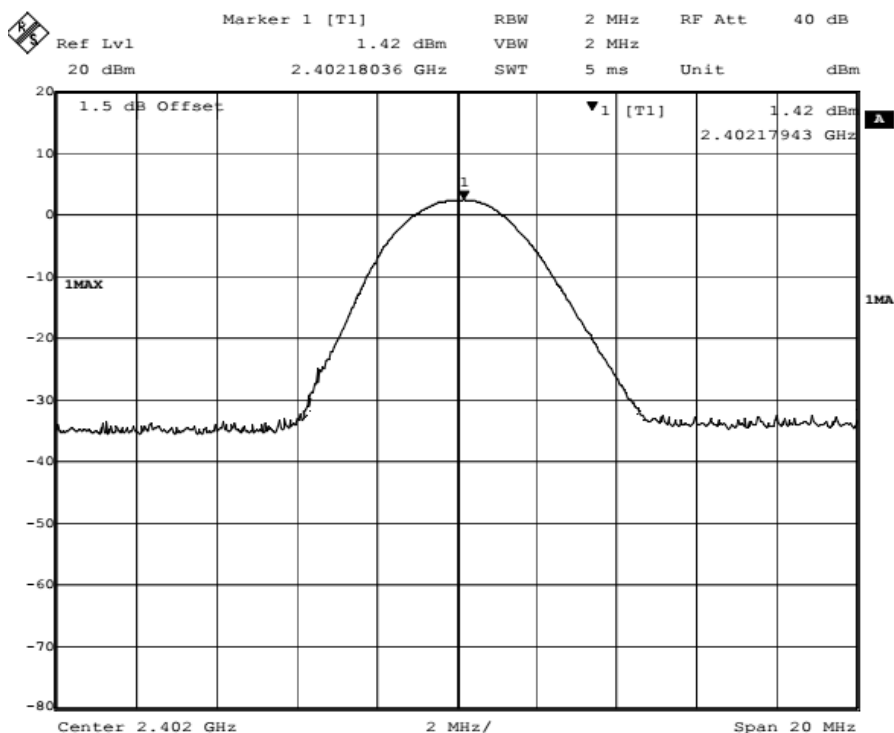
9.1 Test Procedure

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel; RBW > the 20 dB bandwidth of the emission being measured; VBW ≥ RBW; VBW = 2MHz, RBW=2MHz; Sweep = auto; Detector function = peak; Trace = max hold
3. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
4. Repeat above procedures until all frequencies measured were complete.

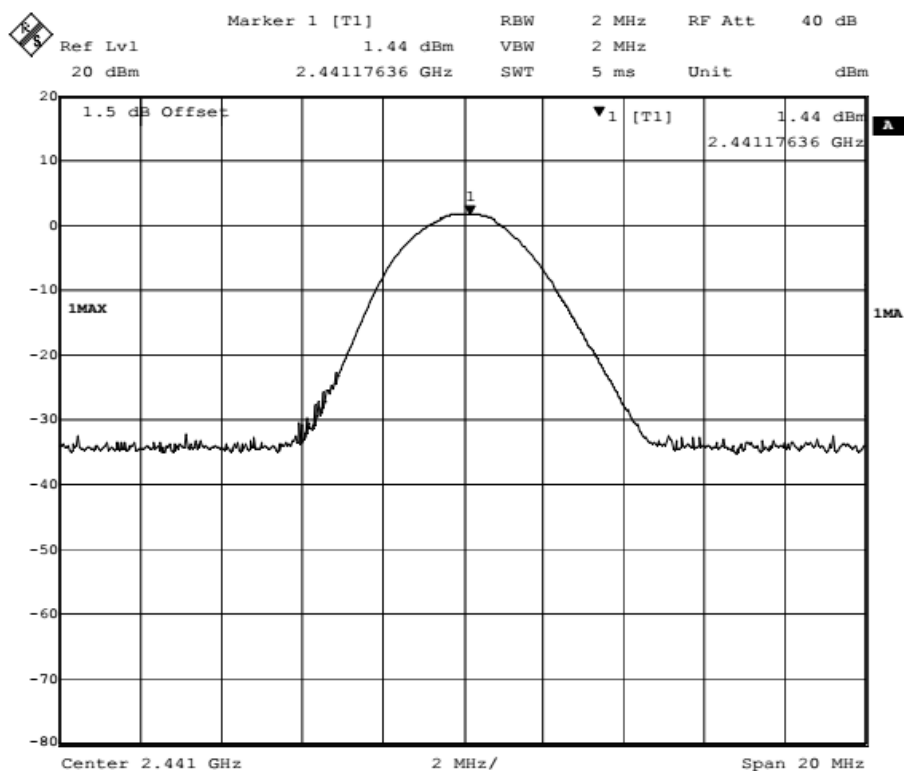
9.2 Test Result

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low(2402MHz)	1.42	20.97
GFSK	Middle(2441MHz)	1.44	20.97
GFSK	High(2480MHz)	1.42	20.97

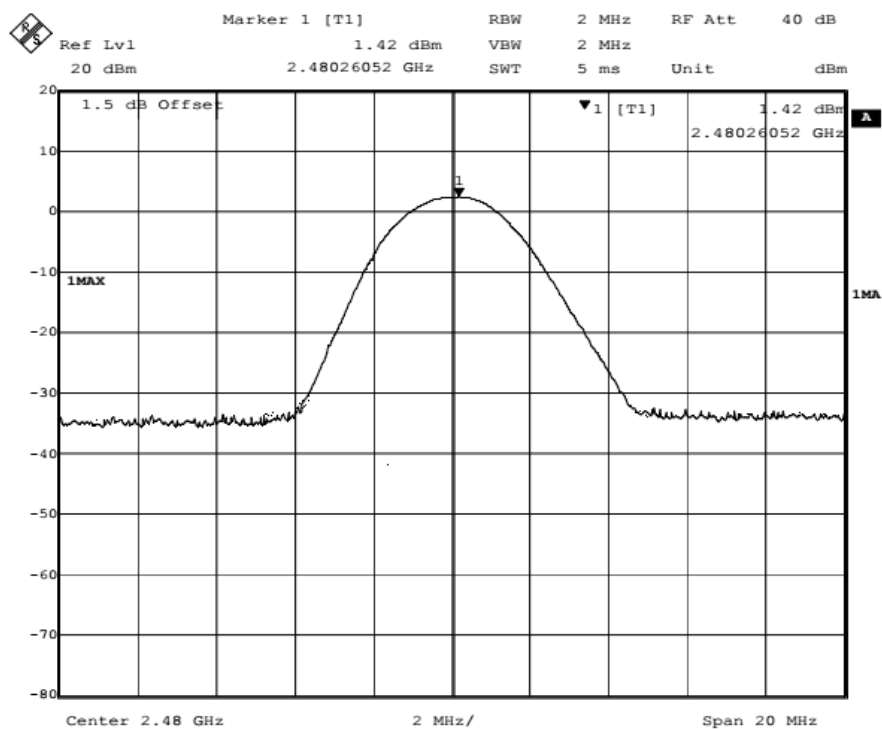
GFSK Low Channel



GFSK Middle Channel



GFSK High Channel



10 Hopping Channel Separation

Test Requirement	: FCC CFR47 Part 15 Section 15.247
Test Method	: ANSI C63.10:2013,DA 00-705
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 2400-2483.5MHz 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	: Hopping

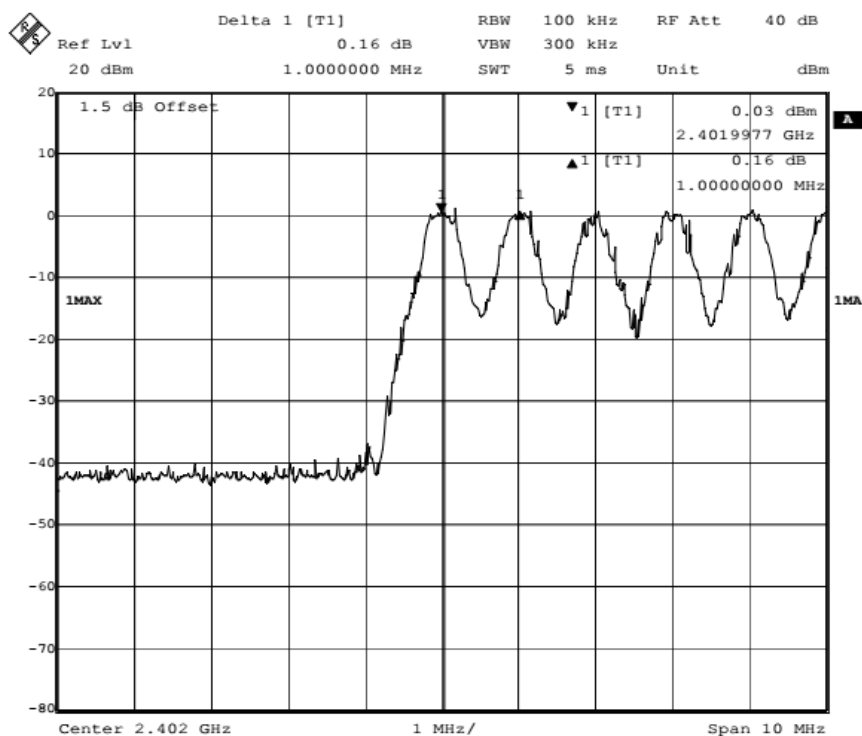
10.1 Test Procedure

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 = 100KHz. VBW = 300KHz , Span = 10MHz. 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.

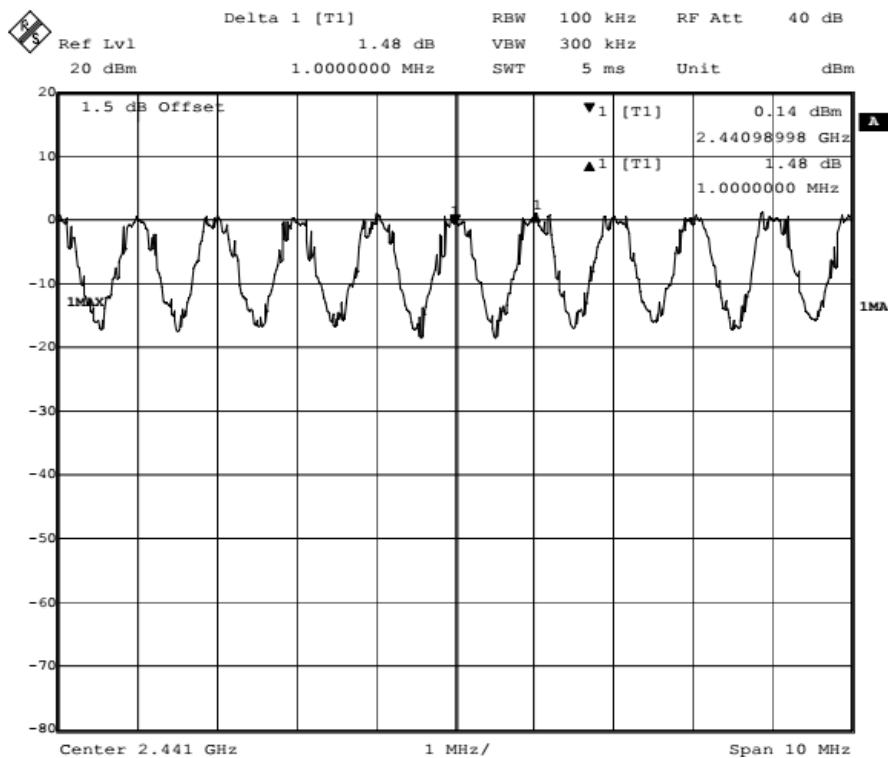
10.2 Test Result

Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	1.000	0.768	PASS
GFSK	Middle	1.000	0.768	PASS
GFSK	High	1.000	0.748	PASS

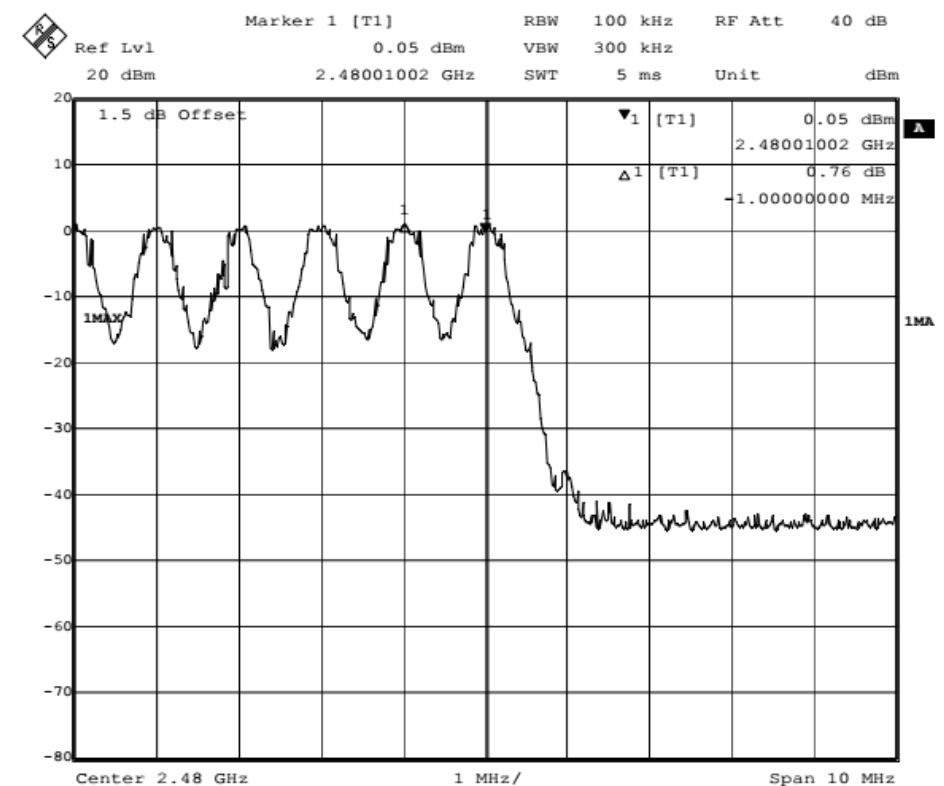
GFSK Low Channel



GFSK Middle Channel



GFSK High Channel



11 Number of Hopping Frequency

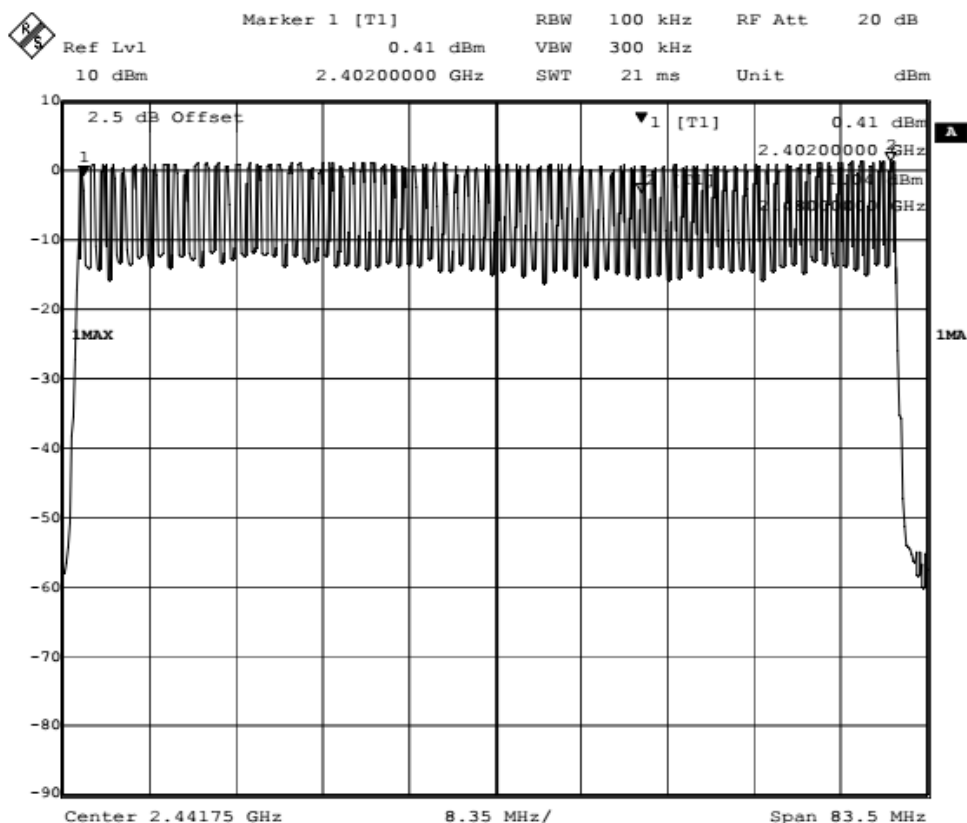
Test Requirement : FCC CFR47 Part 15 Section 15.247
 Test Method : ANSI C63.10:2013,DA 00-705
 Test Limit : Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
 Test Mode : Hopping(GFSK)

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 = 100KHz. VBW = 300KHz. 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 = 2.483GHz. Sweep=auto;

11.2 Test Result

Channel Number	Limit
79	≥ 15



12 Dwell Time

Test Requirement	: FCC CFR47 Part 15 Section 15.247
Test Method	: ANSI C63.10:2013,DA 00-705
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.
Test Mode	: Hopping
Remark	: The worst case(DH5) was recorded

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 spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
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).

12.2 Test Result

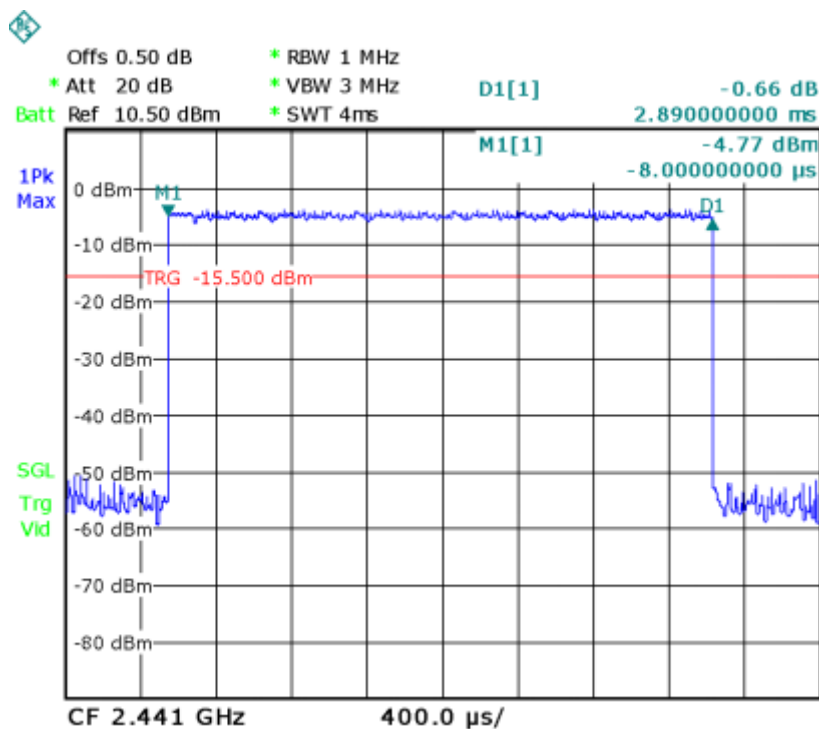
DH5 Packet permit maximum $1600 / 79 / 6$ hops per second in each channel (5 time slots RX, 1 time slot TX).

DH3 Packet permit maximum $1600 / 79 / 4$ hops per second in each channel (3 time slots RX, 1 time slot TX).

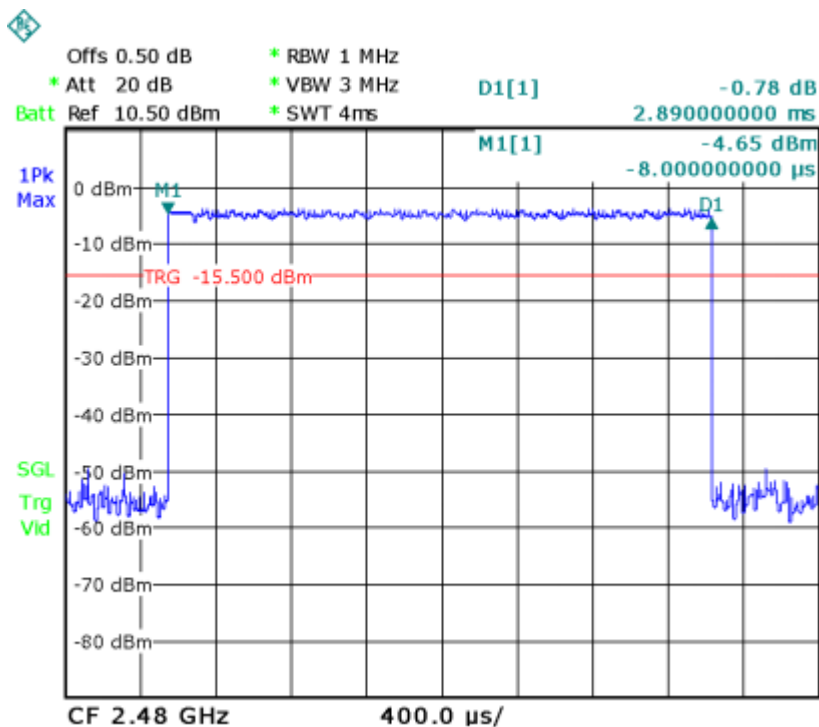
DH1 Packet permit maximum $1600 / 79 / 2$ hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

Data Packet	Dwell Time(s)
DH5	$1600/79/6*0.4*79*(MkrDelta)/1000$
DH3	$1600/79/4*0.4*79*(MkrDelta)/1000$
DH1	$1600/79/2*0.4*79*(MkrDelta)/1000$
Remark: Mkr Delta is once pulse time. Only the worst data(DH5) were show as follow.	

GFSK Middle Channel



GFSK High Channel



13 Conducted Spurious Emissions

Test Requirement	: FCC CFR47 Part 15 Section 15.247
Test Method	: DA 00-705
Test 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 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 Section 15.209(a) is not required. 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 Result	: PASS

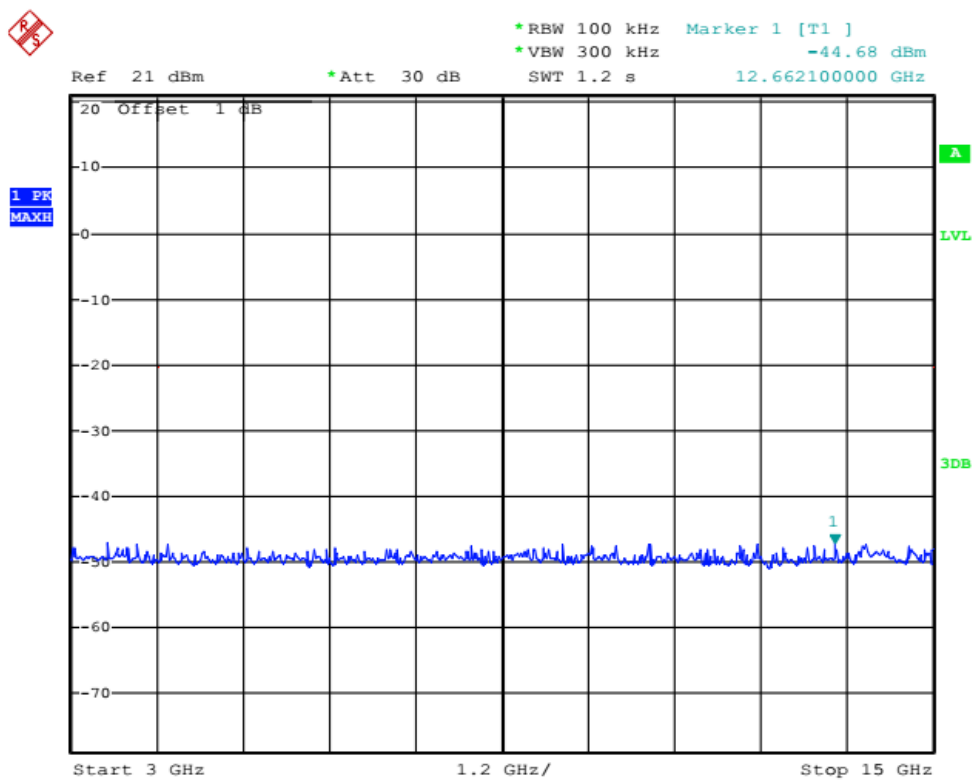
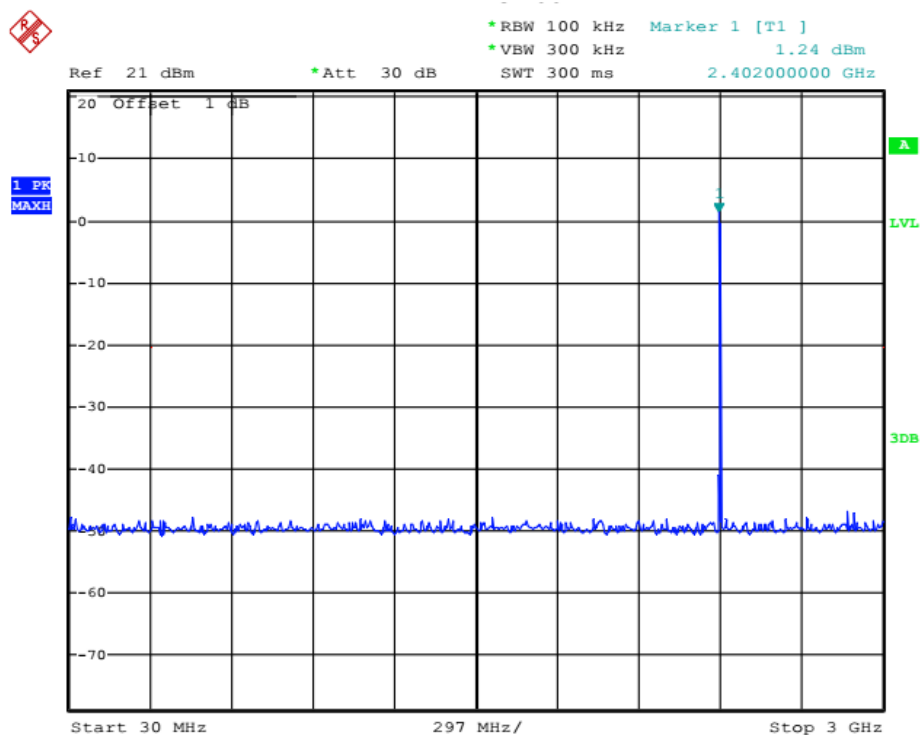
13.1 Test Procedure

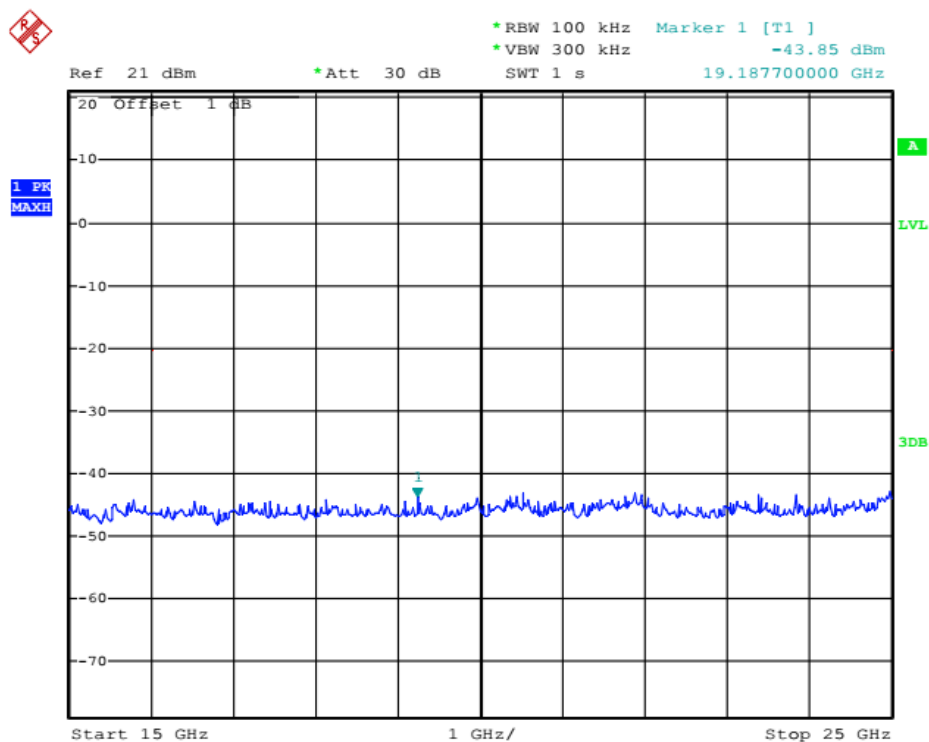
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer:
RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

13.2 Test Result

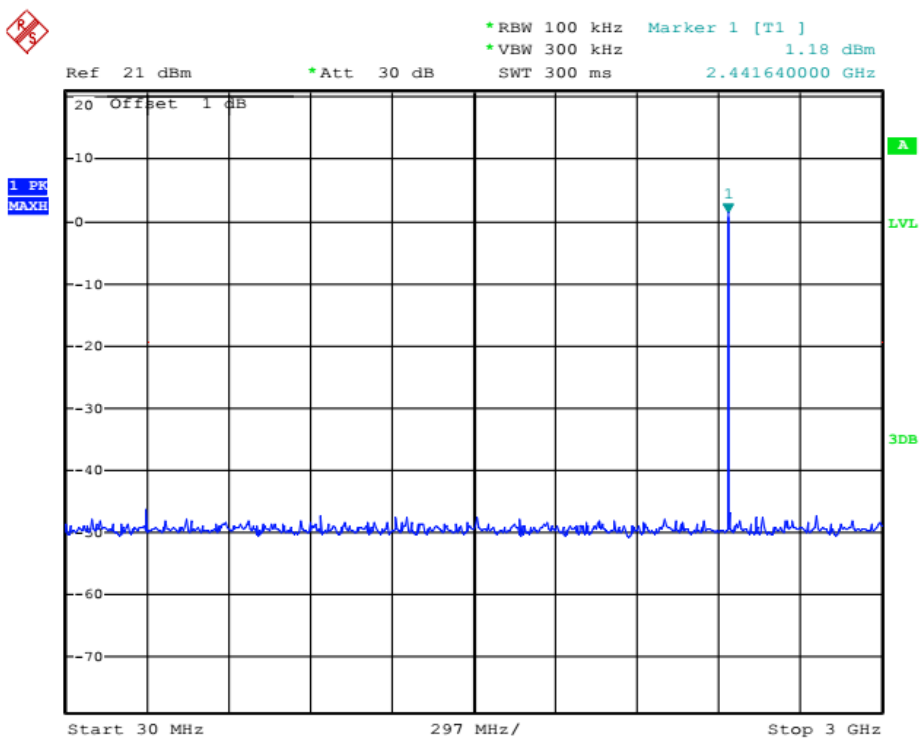
Remark: only the worst data(GFSK modulation mode) were reported.

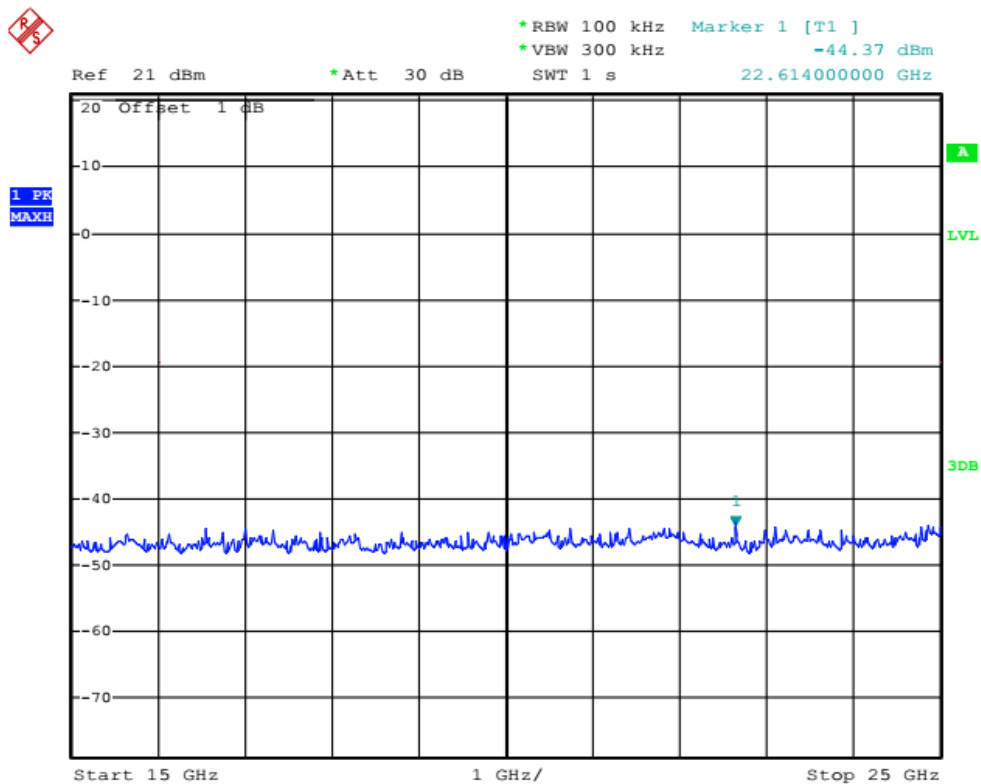
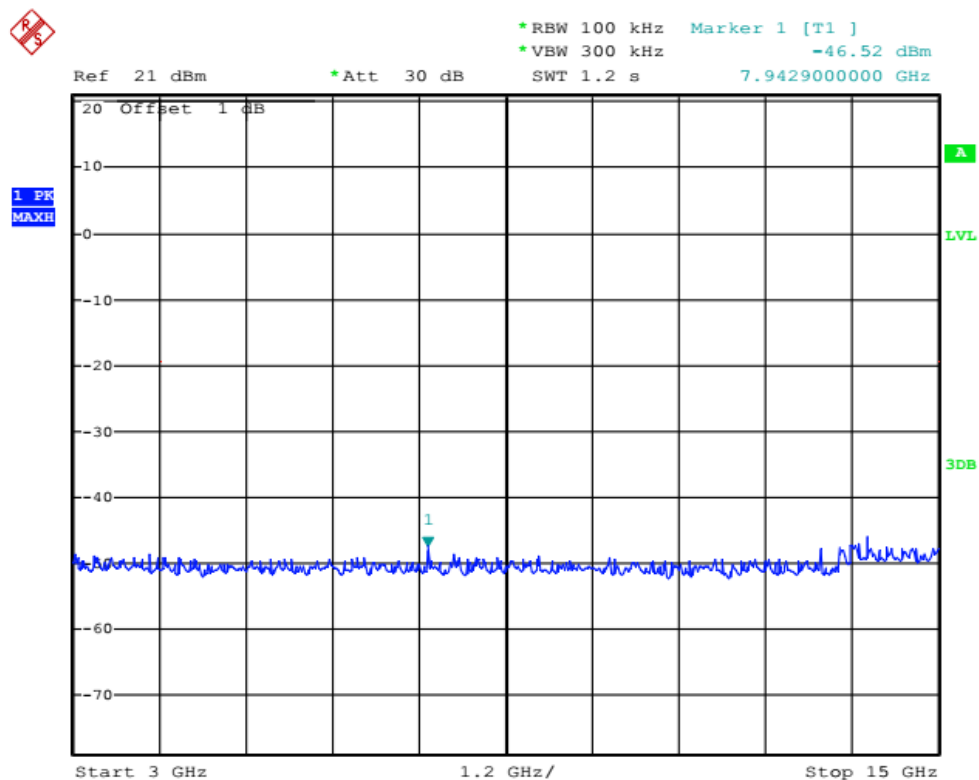
Low Channel



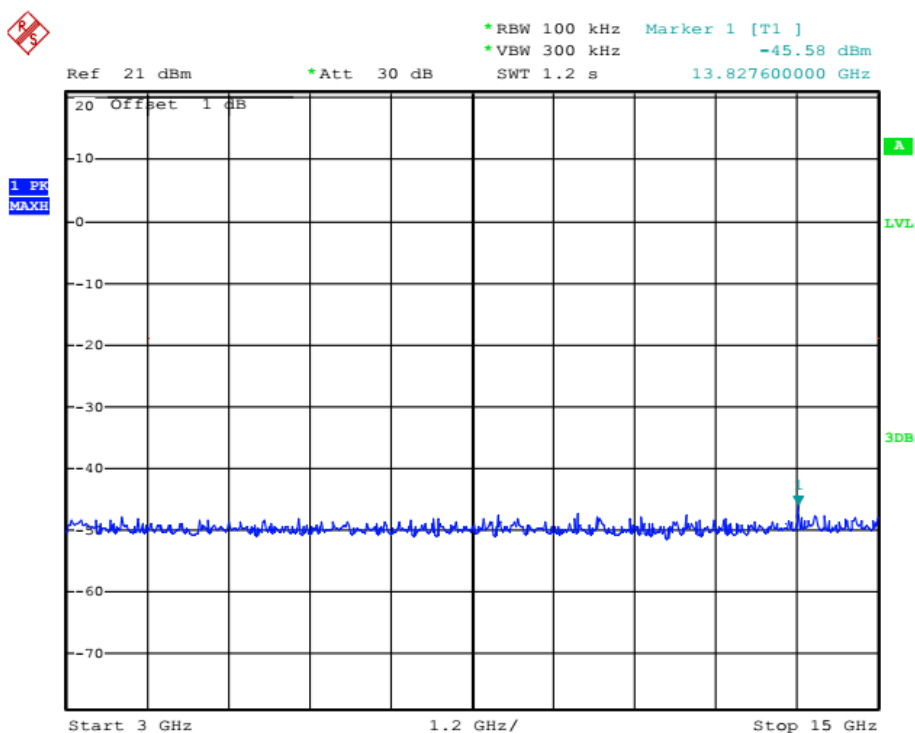
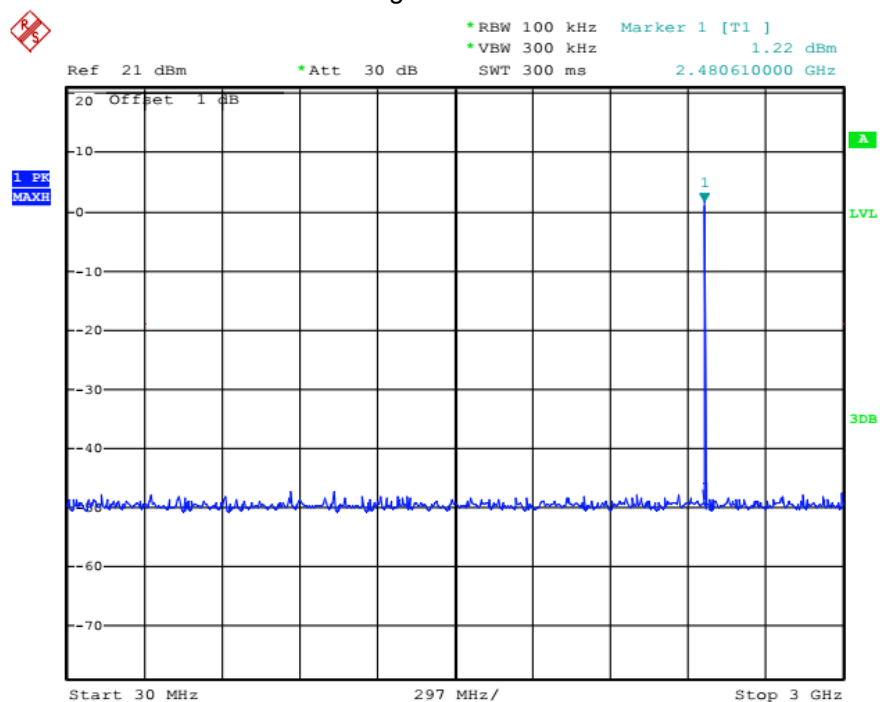


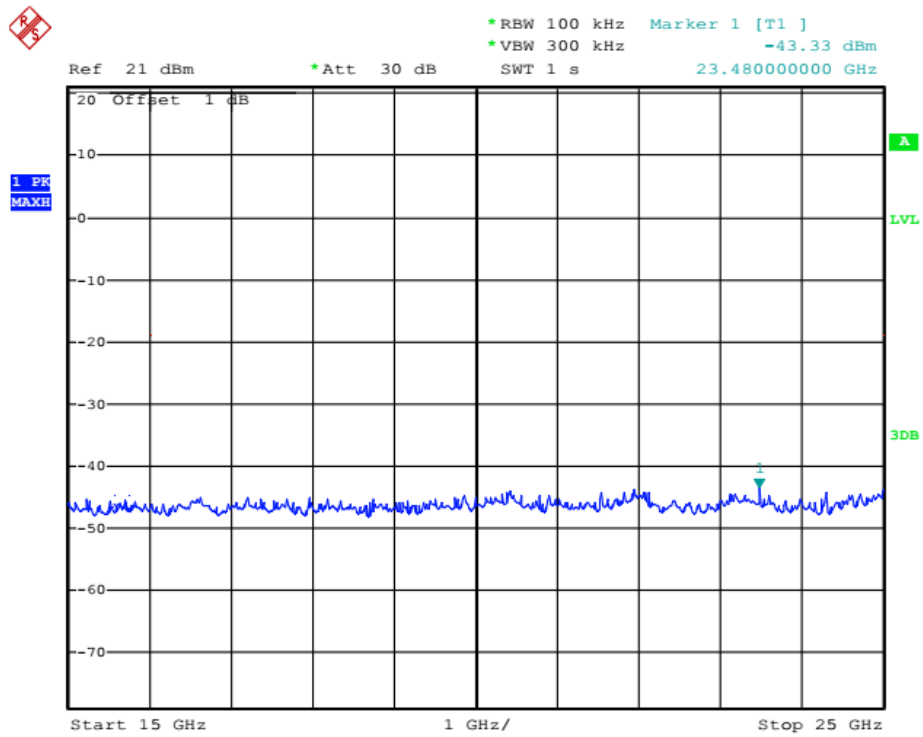
Middle Channel





High Channel





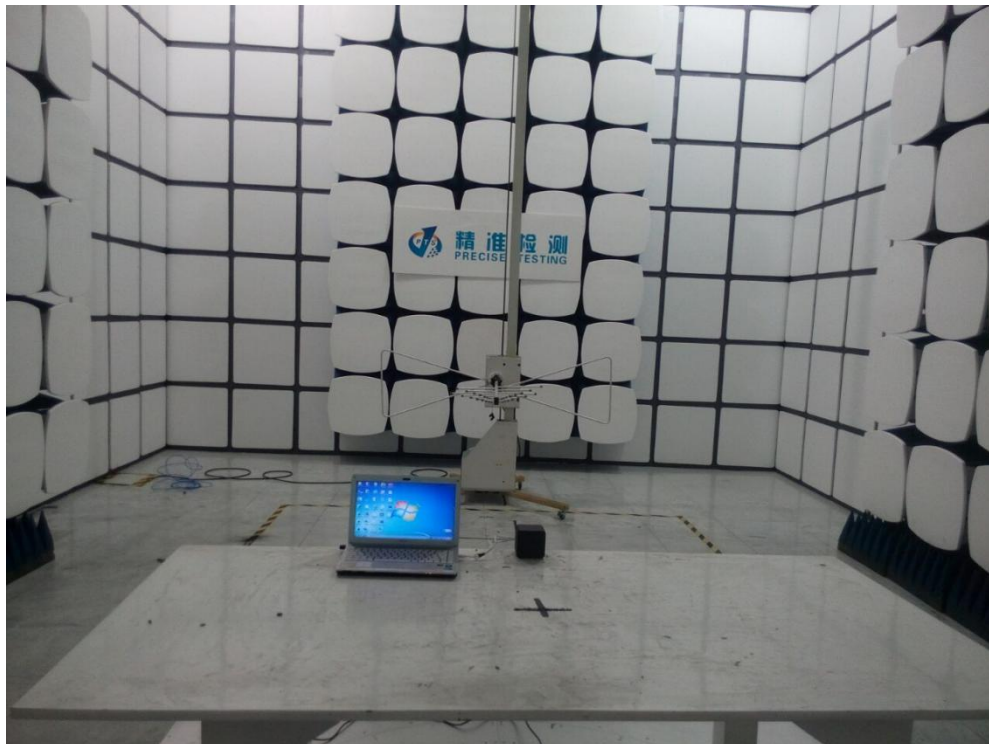


14 Antenna Requirement

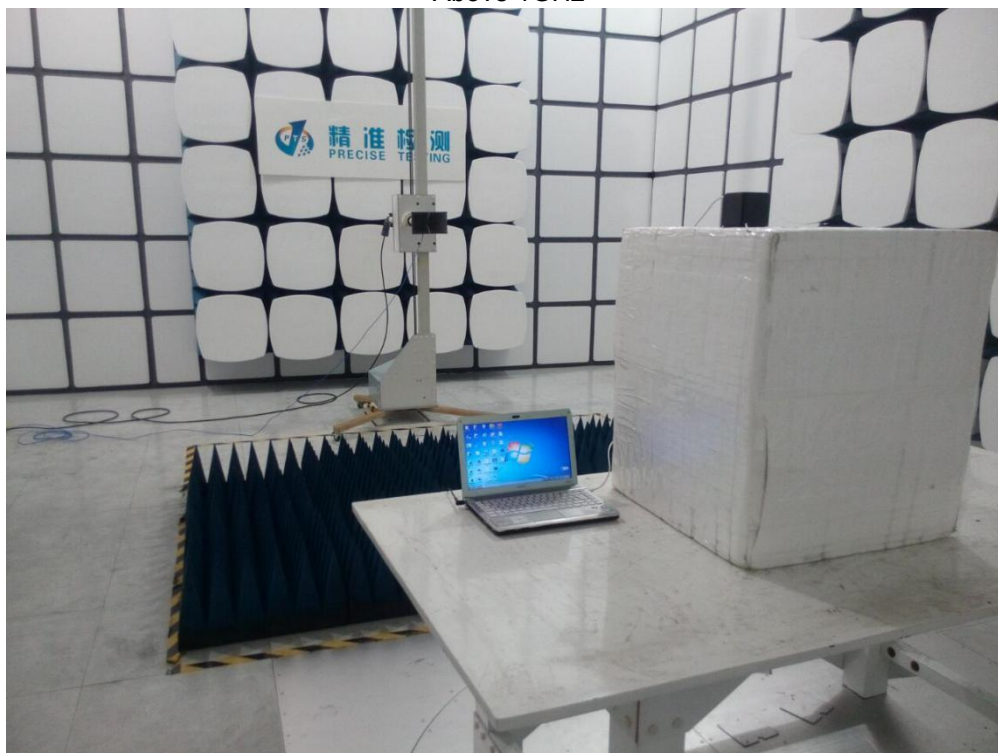
According to the FCC part15.203, a transmitter can only be sold or operated with antennas with which it was approved. This product has anPCB printed antenna, it meet the requirement of this section.

15 Test Setup

Spurious Emissions
From 30MHz-1000MHz



Above 1GHz



Conducted Emissions



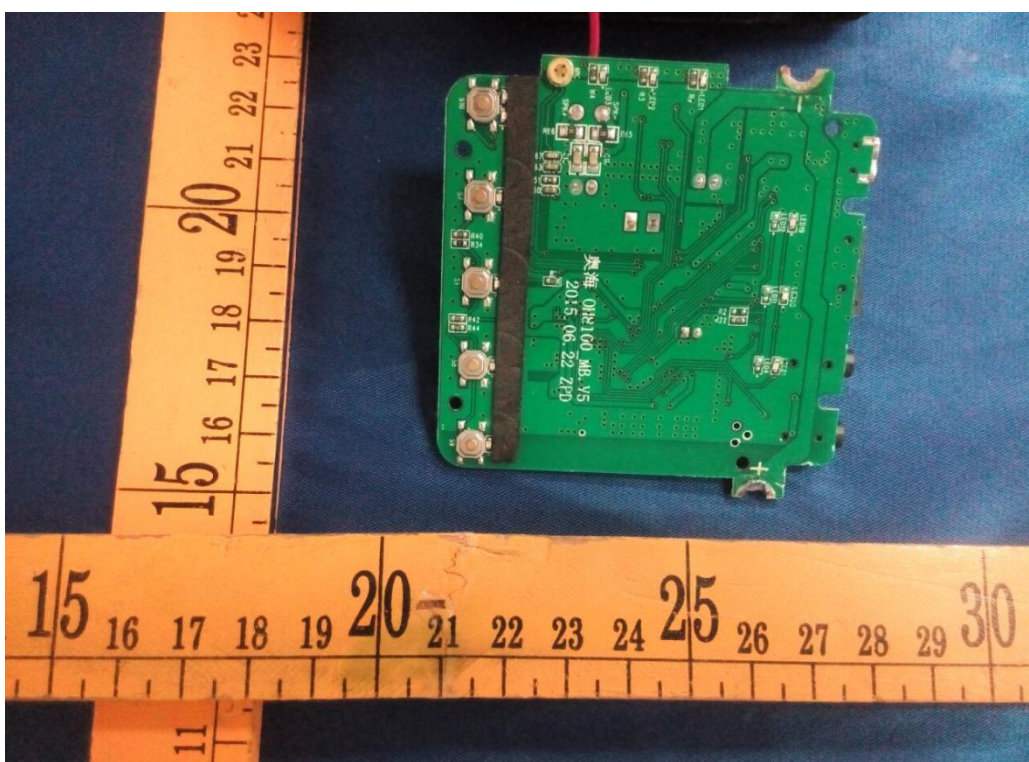
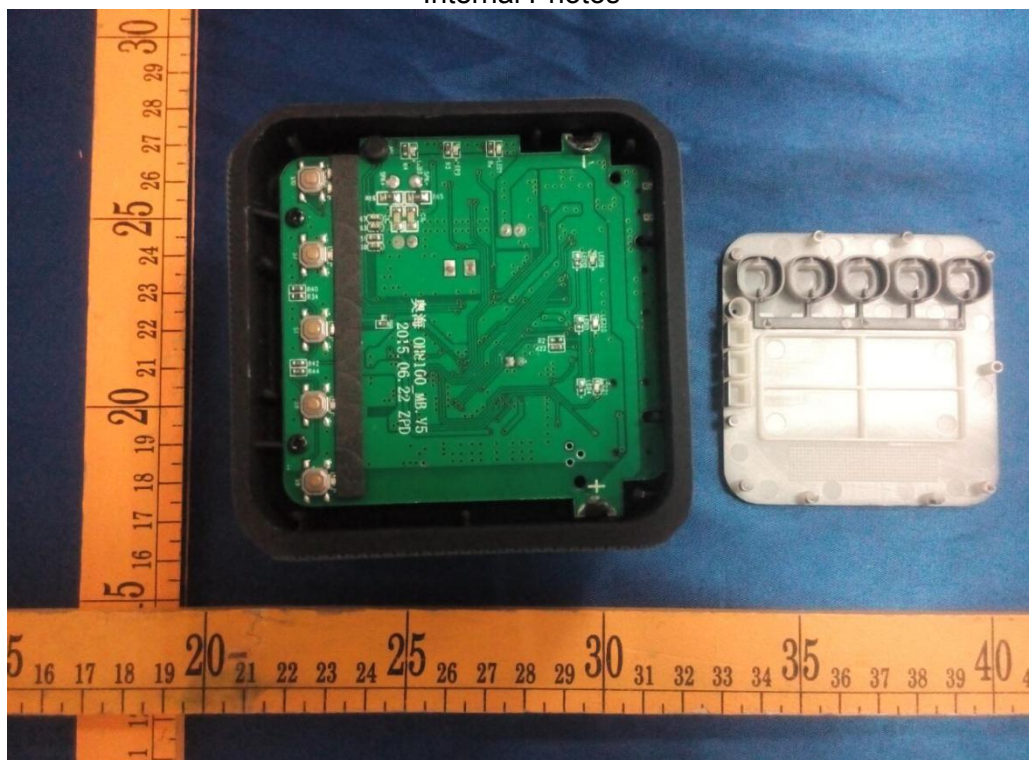
16 EUT Photos

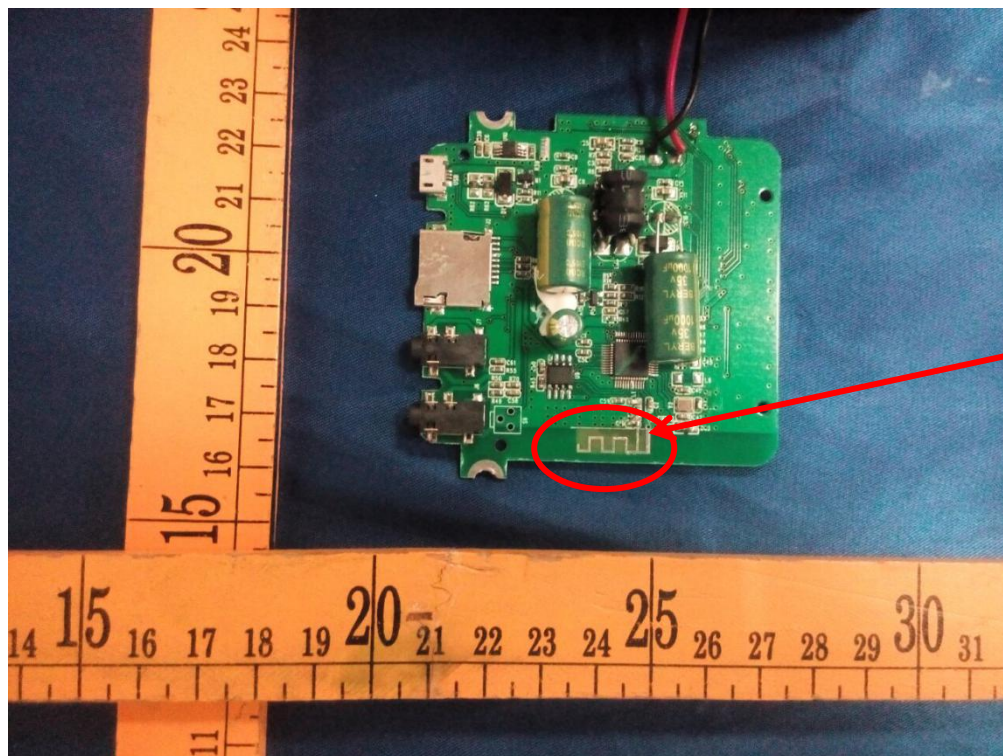
External Photos





Internal Photos





Antenna

*****THE END REPORT*****