FCC Report (Bluetooth)

Product Name	:	BTHS-TWS120
Trade mark	:	N/A
Model No.	:	BTHS-TWS120
FCC ID	:	2AITF-BTHS-TWS120
Report Number	:	BLA-EMC-202004-A56-01
Date of sample receipt	:	April 18, 2020
Date of Test	:	April 18, 2020–April 23, 2020
Date of Issue	:	April 23, 2020
Test standard	:	FCC CFR Title 47 Part 15 Subpart C Section 15.247
Test result	:	PASS

Prepared for:

Avantree Technology Co., Ltd.
The 4th Floor, Yuepeng Building, No.1019 Jiabin Rd, Luohu District,Shenzhen, China

Prepared by:

BlueAsia of Technical Services(Shenzhen) Co., Ltd.
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Compiled by: Jason

Review by: Sweet.Liang

Approved by: Tomen Li

Date: April 23, 2020

2 Version

Version No.	Date	Description
00	*April 23, 2020*	*Original*

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4 Test Summary

Test Item	Section in CFR 47	Result
Antenna Requirement	15.203/15.247 (c)	Pass
AC Power Line Conducted Emission	15.207	Pass
Conducted Peak Output Power	15.247 (b)(1)	Pass
20dB Occupied Bandwidth	15.247 (a)(1)	Pass
Carrier Frequencies Separation	15.247 (a)(1)	Pass
Hopping Channel Number	15.247 (a)(1)	Pass
Dwell Time	15.247 (a)(1)	Pass
Pseudorandom Frequency Hopping Sequence	15.247(b)(4)	Pass
Radiated Emission	15.205/15.209	Pass
Band Edge	15.247(d)	Pass

Pass: The EUT complies with the essential requirements in the standard.

Remark: Test according ANSI C63.10:2013

Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	9kHz ~ 30MHz	± 4.34dB	(1)
Radiated Emission	30MHz ~ 1000MHz	± 4.24dB	(1)
Radiated Emission	1GHz ~ 26.5GHz	± 4.68dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	± 3.45dB	(1)
Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.			

5 General Information

5.1 General Description of EUT

Product Name:	BTHS-TWS120
Model No.:	BTHS-TWS120
Test Model No:	BTHS-TWS120
Remark: All above models are identical in the same PCB layout, interior structure and electrical circuits. The differences are model name for commercial purpose.	
Serial No.:	HL-T3L
Sample(s) Status	Engineer sample
Hardware:	V5.0
Software:	V5.0
Operation Frequency:	2402MHz-2480MHz
Channel numbers:	79
Channel separation:	1MHz
Modulation type:	GFSK, π/4-DQPSK, 8DPSK
Antenna Type:	Internal Antenna
Antenna gain:	-5.1dBi
Power supply:	DC 3.7V
Remark:The Antenna Gain is supplied by the customer.BlueAsia is not responsible for this data	

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402MHz	21	2422MHz	41	2442MHz	61	2462MHz
2	2403MHz	22	2423MHz	42	2443MHz	62	2463MHz
3	2404MHz	23	2424MHz	43	2444MHz	63	2464MHz
4	2405MHz	24	2425MHz	44	2445MHz	64	2465MHz
5	2406MHz	25	2426MHz	45	2446MHz	65	2466MHz
6	2407MHz	26	2427MHz	46	2447MHz	66	2467MHz
7	2408MHz	27	2428MHz	47	2448MHz	67	2468MHz
8	2409MHz	28	2429MHz	48	2449MHz	68	2469MHz
9	2410MHz	29	2430MHz	49	2450MHz	69	2470MHz
10	2411MHz	30	2431MHz	50	2451MHz	70	2471MHz
11	2412MHz	31	2432MHz	51	2452MHz	71	2472MHz
12	2413MHz	32	2433MHz	52	2453MHz	72	2473MHz
13	2414MHz	33	2434MHz	53	2454MHz	73	2474MHz
14	2415MHz	34	2435MHz	54	2455MHz	74	2475MHz
15	2416MHz	35	2436MHz	55	2456MHz	75	2476MHz
16	2417MHz	36	2437MHz	56	2457MHz	76	2477MHz
17	2418MHz	37	2438MHz	57	2458MHz	77	2478MHz
18	2419MHz	38	2439MHz	58	2459MHz	78	2479MHz
19	2420MHz	39	2440MHz	59	2460MHz	79	2480MHz
20	2421MHz	40	2441MHz	60	2461MHz		

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The lowest channel	2402MHz
The middle channel	2441MHz
The Highest channel	2480MHz

5.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode with modulation. (hopping or no hopping mode) non hopping mode is worse case of radiated emission

Remark: During the test,the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.

Full battery is used during all test except ac conducted emission, DH1, DH3, DH5 all have been tested, during the test, GFSK, Pi/4QPSK, 8-DPSK modulation were all pre-scanned only worse case is reported.

5.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **FCC — Designation No.: CN1252**

BlueAsia of Technical Services(Shenzhen) Co., Ltd 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 files. Designation CN1252.

●**ISED — CAB identifier No.: CN0028**

BlueAsia of Technical Services(Shenzhen) Co., Ltd has been registered by Certification and Engineering Bureau of ISED for radio equipment testing with CAB identifier CN0028

5.4 Test Location

All tests were performed at:

All tests were performed at:
BlueAsia of Technical Services(Shenzhen) Co., Ltd.
IOT Test Centre of BlueAsia
No. 448 Bulong Road, Bantian Street, Longgang District, Shenzhen, China
*Telephone: TE*L: +86-755-28682673 FAX: +86-755-28682673
No tests were sub-contracted.Fax: 0755-27798960

5.5 Other Information Requested by the Customer

None.

5.6 Description of Support Units

Manufacturer	Description	Model	Serial Number
SAMSUNG	Adapter	ETAOU80EBE	N/A
Lenovo	Notebook computer	E470C	PF-10FB5C

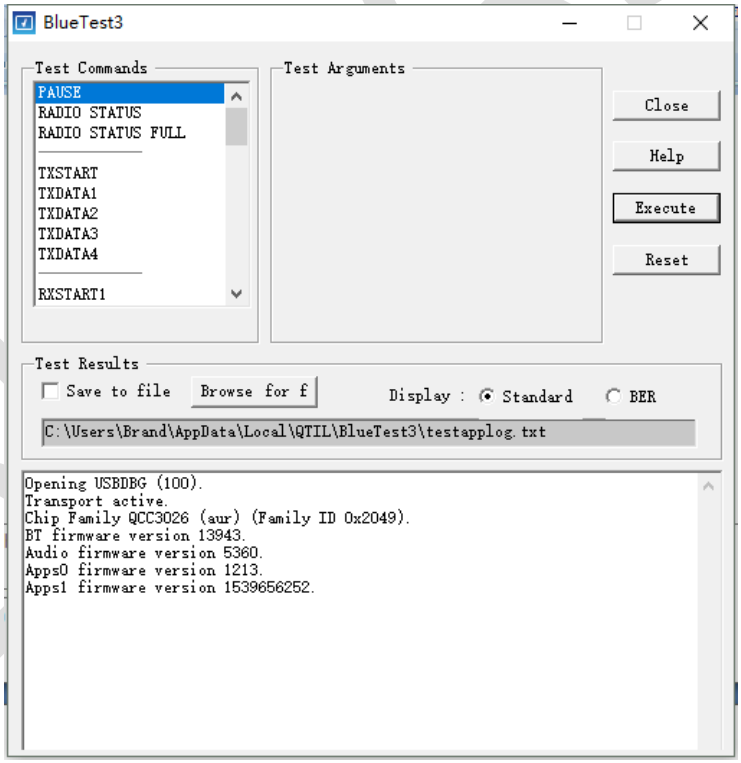
5.7 Additional Instructions

EUT Software Settings::

Mode	Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

Power level setup in software			
Test Software Name	Qualcomm BlueSuite 3.1.3		
Mode	Channel	Frequency (MHz)	Soft Set
GFSK, π/4-DQPSK, 8DPSK	CH01	2402	TX level : default
	CH40	2441	
	CH79	2480	

Run Software



6 Test Instruments list

Radiated Emission:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	3m SAC	SKET	9m*6 m*6m	966	06-10-2018	06-09-2023
2	Broadband Antenna	SCHWARZBECK	VULB9168	00836 P:00227	07-14-2019	07-13-2020
3	Horn Antenna	SCHWARZBECK	9120D	01892 P:00331	07-14-2019	07-13-2020
4	EMI Test Software	EZ	EZ	N/A	N/A	N/A
5	Pre-amplifier	SKET	N/A	N/A	07-19-2019	07-18-2020
6	Spectrum analyzer	Rohde & Schwarz	FSP40	100817	05-24-2019	05-23-2020
7	EMI Test Receiver	Rohde & Schwarz	ESR7	101199	03-21-2020	03-20-2021
8	Controller	SKET	N/A	N/A	N/A	N/A
9	Vector Signal Generator	Agilent	E4438C	MY45092582	05-24-2019	05-23-2020
10	Signal Generator	Agilent	E8257D	MY44320250	05-24-2019	05-23-2020
11	Coaxial Cable	BlueAsia	BLA-XC-02	N/A	N/A	N/A
12	Coaxial Cable	BlueAsia	BLA-XC-03	N/A	N/A	N/A
13	Coaxial Cable	BlueAsia	BLA-XC-01	N/A	N/A	N/A

Conducted Emission						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	EMI Test Receiver	Rohde & Schwarz	ESPI3	101082	06-10-2019	06-09-2020
2	LISN	CHASE	MN2050D	1447	12-18-2019	12-17-2020
3	LISN	Rohde & Schwarz	ENV216	3560.6550.15	07-19-2019	07-18-2020
4	EMI Test Software	EZ	EZ	N/A	N/A	N/A
5	Temperature Humidity Chamber	Mingle	TH101B	N/A	07-19-2019	07-18-2020
6	Coaxial Cable	BlueAsia	BLA-XC-05	N/A	N/A	N/A

RF Conducted Test:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Spectrum Analyzer	Agilent	N9030A	MY50510123	05-24-2019	05-23-2020
2	Spectrum analyzer	Rohde & Schwarz	FSP40	100817	05-24-2019	05-23-2020
3	Vector Signal Generator	Agilent	E4438C	MY45092582	05-24-2019	05-23-2020
4	Signal Generator	Agilent	E8257D	MY44320250	05-24-2019	05-23-2020
5	Power Sensor	D.A.R.E	RPR3006W	17I00015SNO27	05-24-2019	05-23-2020
6	Power Sensor	D.A.R.E	RPR3006W	17I00015SNO28	05-24-2019	05-23-2020
7	DC Power Supply	LODESTAR	LP305DE	N/A	07-19-2019	07-18-2020
8	Temperature Humidity Chamber	Mingle	TH101B	N/A	07-19-2019	07-18-2020

7 Test results and Measurement Data

7.1 Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)

15.203 requirement:

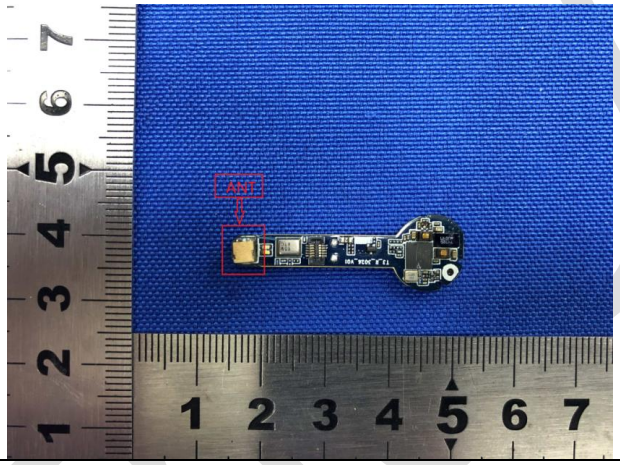
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

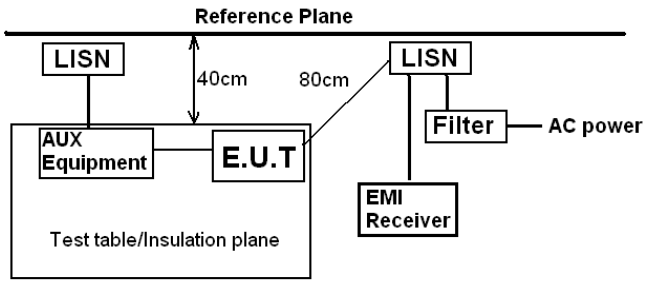
(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

E.U.T Antenna:

The antenna is Internal antenna, the best case gain of the antenna is -5.1dBi



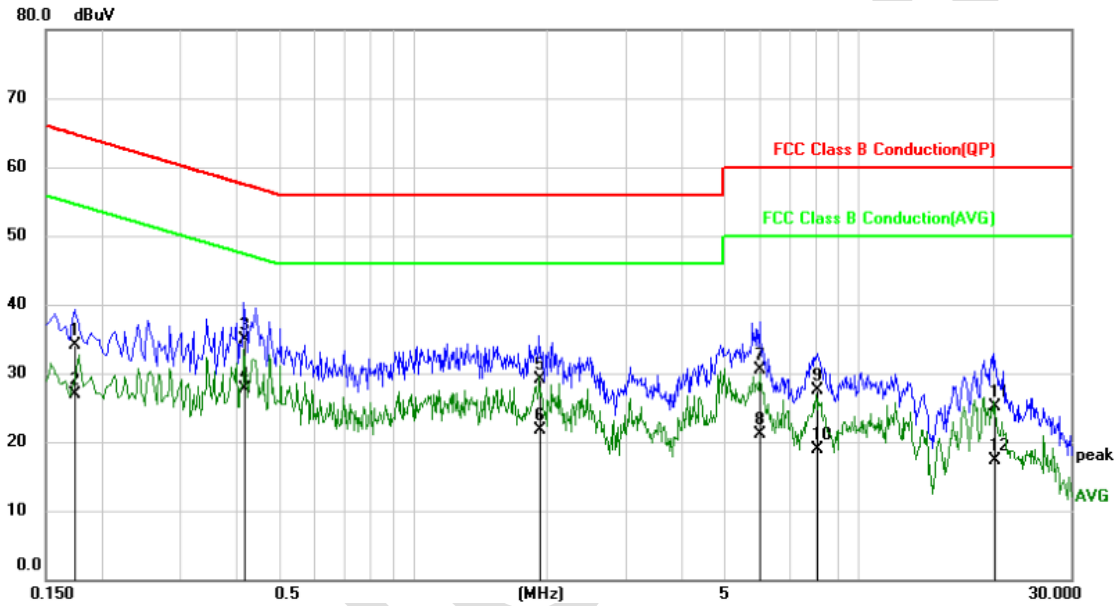
7.2 Conducted Emissions

Test Requirement:	FCC Part15 C Section 15.207
Test Method:	ANSI C63.10:2013
Test Frequency Range:	150KHz to 30MHz
Class / Severity:	Class B
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto
Limit:	Frequency range (MHz) / Limit (dBuV): Quasi-peak / Average 0.15-0.5: 66 to 56* / 56 to 46* 0.5-5: 56 / 46 5-30: 60 / 50 * Decreases with the logarithm of the frequency.
Test setup:	 *Remark:* *E.U.T: Equipment Under Test* *LISN: Line Impedence Stabilization Network* *Test table height=0.8m*
Test procedure:	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement data:

Line:

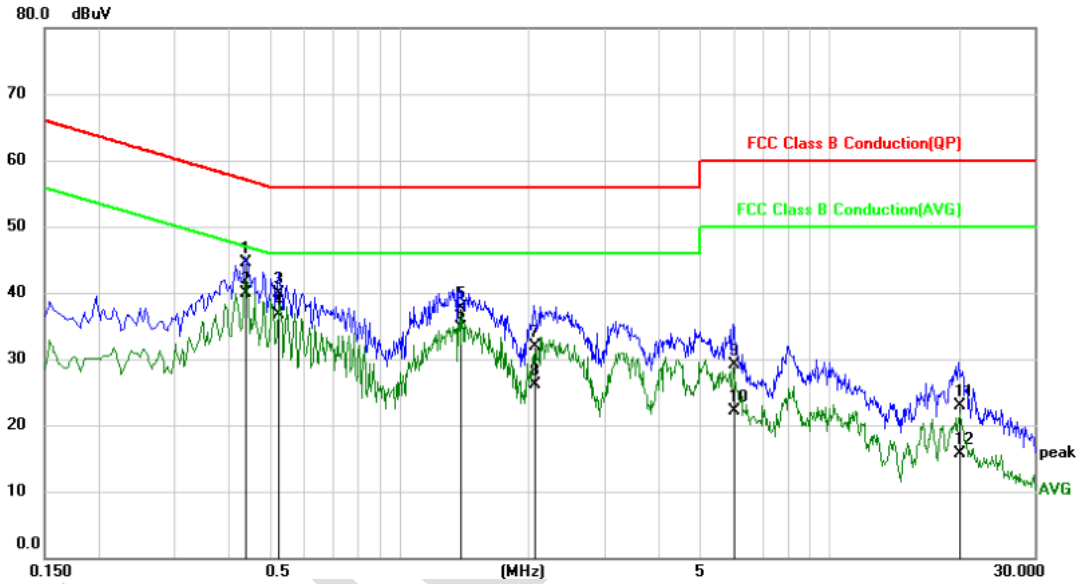
EUT:	BTHS-TWS120	**Probe:**	L1
Model:	BTHS-TWS120	**Power Source:**	AC120V/60Hz
Mode:	BT mode	**Test by:**	Eason
Temp./Hum.(%H):	26℃/60%RH		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1740	23.86	10.28	34.14	64.77	-30.63	QP
2		0.1740	16.63	10.28	26.91	54.77	-27.86	AVG
3		0.4180	24.72	10.14	34.86	57.49	-22.63	QP
4	*	0.4180	17.56	10.14	27.70	47.49	-19.79	AVG
5		1.9220	19.15	10.00	29.15	56.00	-26.85	QP
6		1.9220	11.76	10.00	21.76	46.00	-24.24	AVG
7		6.0060	20.63	9.95	30.58	60.00	-29.42	QP
8		6.0060	11.06	9.95	21.01	50.00	-28.99	AVG
9		8.0940	17.59	9.96	27.55	60.00	-32.45	QP
10		8.0940	8.86	9.96	18.82	50.00	-31.18	AVG
11		20.2380	15.04	10.05	25.09	60.00	-34.91	QP
12		20.2380	7.23	10.05	17.28	50.00	-32.72	AVG

Neutral:

EUT:	BTHS-TWS120	**Probe:**	N
Model:	BTHS-TWS120	**Power Source:**	AC120V/60Hz
Mode:	BT mode	**Test by:**	Eason
Temp./Hum.(%H):	26℃/60%RH		

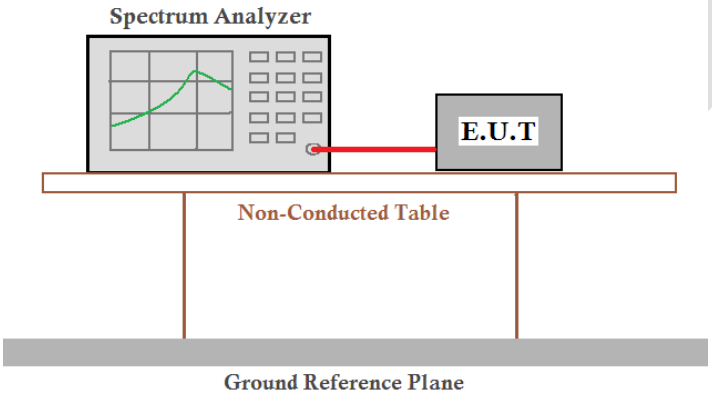


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.4380	34.33	10.16	44.49	57.10	-12.61	QP
2	*	0.4380	29.75	10.16	39.91	47.10	-7.19	AVG
3		0.5260	29.74	10.21	39.95	56.00	-16.05	QP
4		0.5260	26.47	10.21	36.68	46.00	-9.32	AVG
5		1.3820	27.73	10.01	37.74	56.00	-18.26	QP
6		1.3820	24.78	10.01	34.79	46.00	-11.21	AVG
7		2.0620	21.85	10.00	31.85	56.00	-24.15	QP
8		2.0620	16.01	10.00	26.01	46.00	-19.99	AVG
9		5.9660	19.20	9.95	29.15	60.00	-30.85	QP
10		5.9660	12.19	9.95	22.14	50.00	-27.86	AVG
11		19.9980	12.87	10.05	22.92	60.00	-37.08	QP
12		19.9980	5.75	10.05	15.80	50.00	-34.20	AVG

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level =Receiver Read level +Correct Factor
4. Correct Factor = LISN Factor + Cable Loss

Notes:

7.3 Conducted Peak Output Power

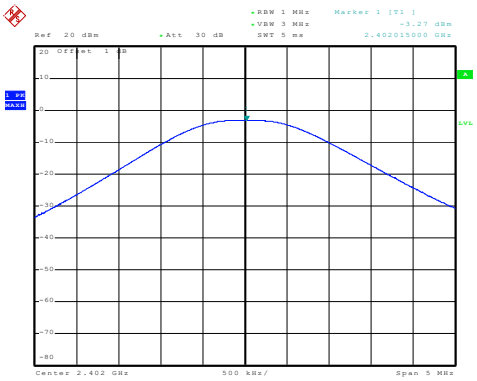
Test Requirement:	FCC Part15 C Section 15.247 (b)(3)
Test Method:	ANSI C63.10:2013
Limit:	30dBm(for GFSK),20.97dBm(for EDR)
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

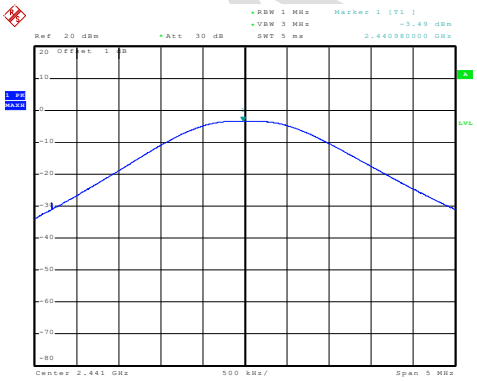
Mode	Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
GFSK	Lowest	-3.27	30.00	Pass
	Middle	-3.49		
	Highest	-3.66		
Pi/4QPSK	Lowest	-0.51	20.97	Pass
	Middle	-0.78		
	Highest	-1.18		
8DPSK	Lowest	0.16	20.97	Pass
	Middle	-0.05		
	Highest	-0.69		

Test plot as follows:

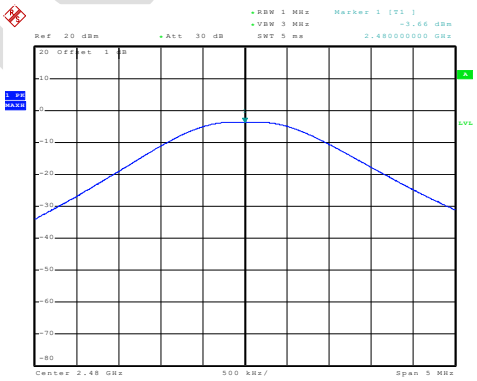
Test mode:	GFSK mode



Lowest channel

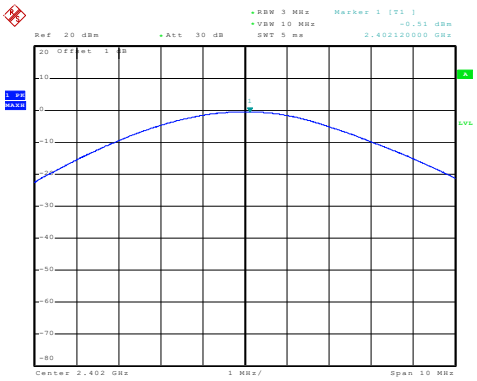


Middle channel

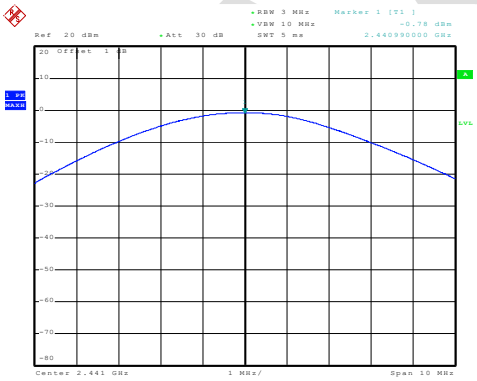


Highest channel

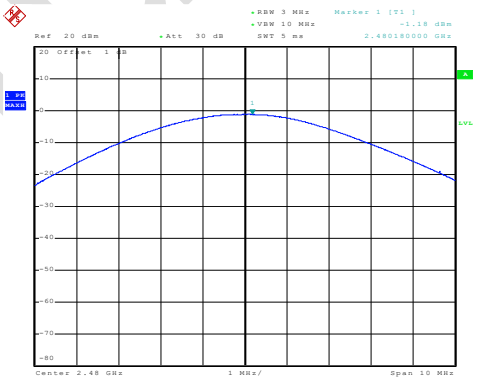
Test mode:	Pi/4QPSK mode



Lowest channel

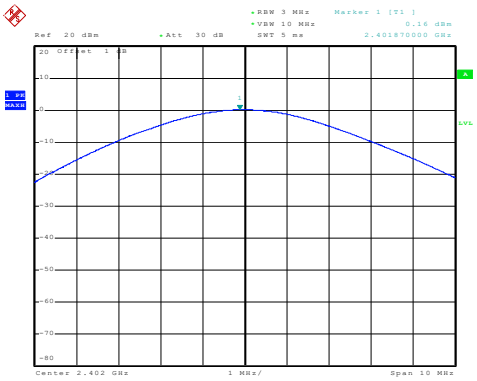


Middle channel

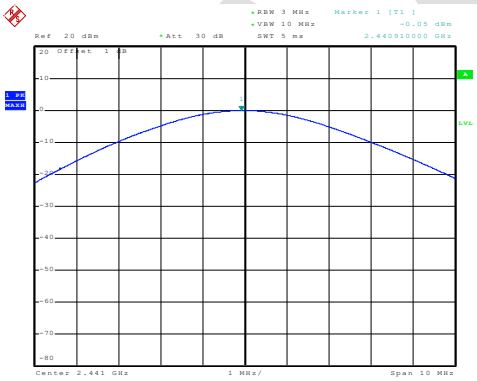


Highest channel

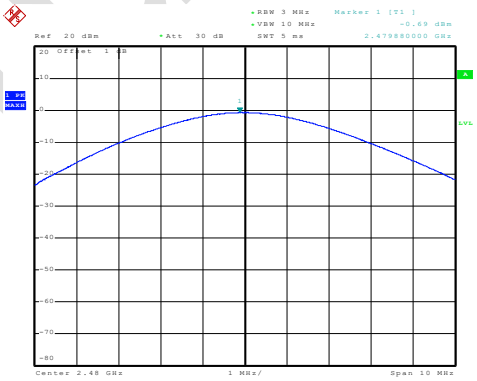
Test mode:	8DPSK mode



Lowest channel

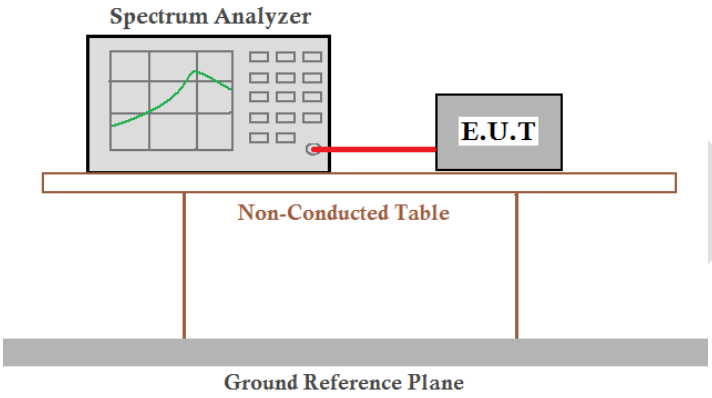


Middle channel



Highest channel

7.4 20dB Emission Bandwidth

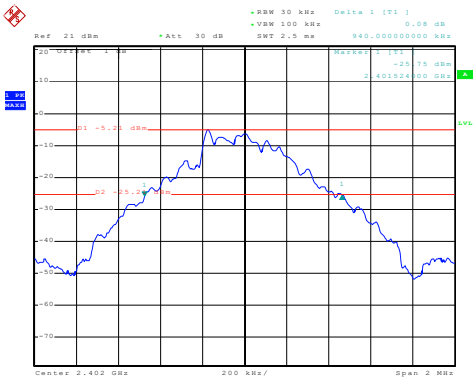
Test Requirement:	FCC Part15 C Section 15.247 (a)(2)
Test Method:	ANSI C63.10:2013
Limit:	N/A
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

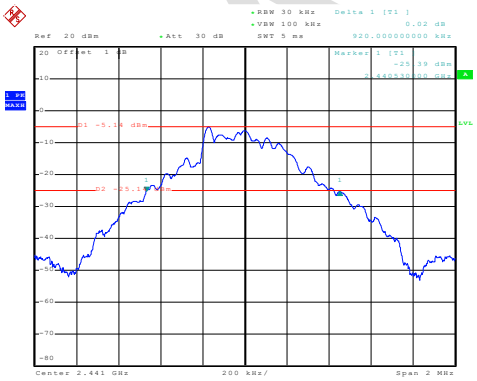
Mode	Test channel	20dB Emission Bandwidth (MHz)	Result
GFSK	Lowest	0.940	Pass
	Middle	0.920	
	Highest	0.924	
Pi/4QPSK	Lowest	1.332	Pass
	Middle	1.332	
	Highest	1.332	
8DPSK	Lowest	1.290	Pass
	Middle	1.284	
	Highest	1.290	

Test plot as follows:

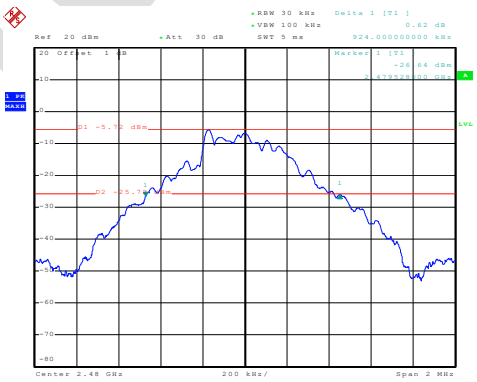
Test mode:	GFSK mode



Lowest channel

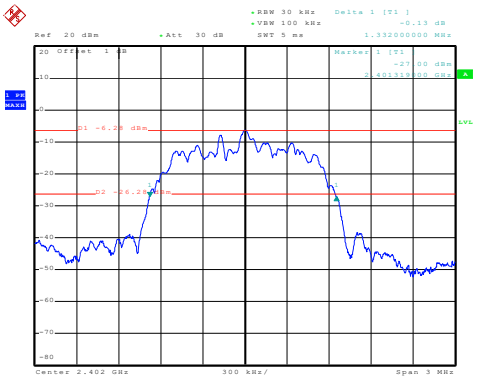


Middle channel

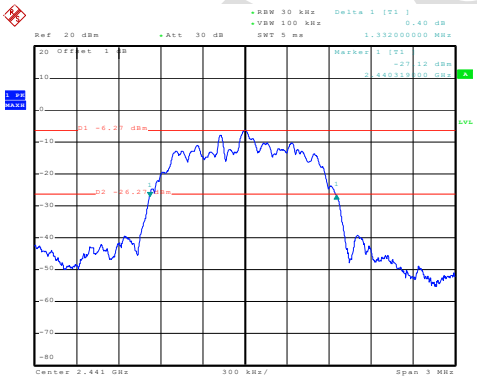


Highest channel

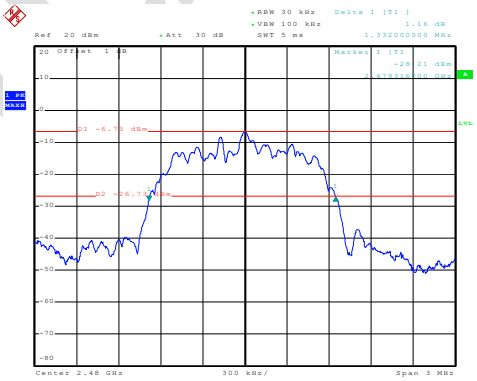
Test mode:	Pi/4QPSK mode



Lowest channel

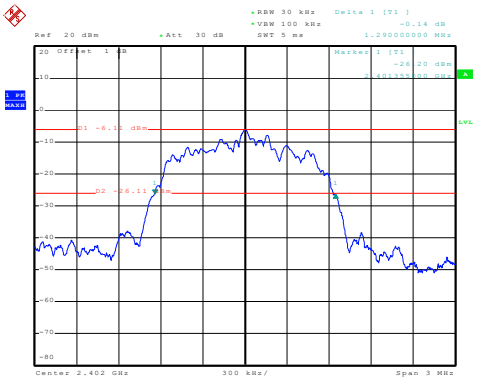


Middle channel

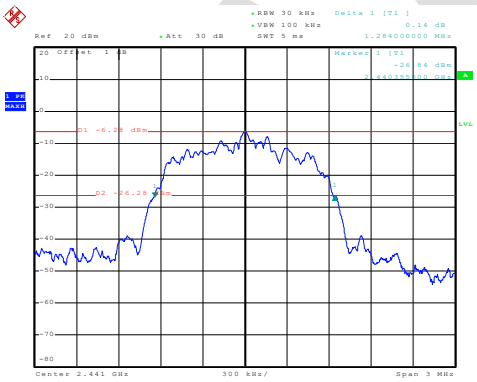


Highest channel

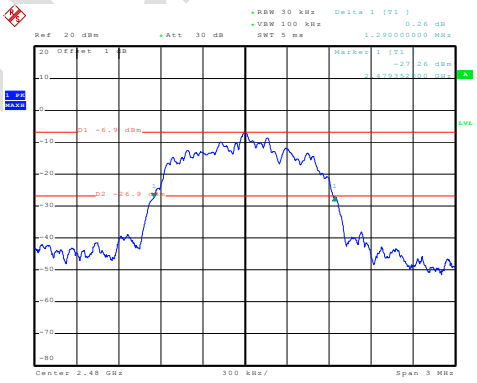
Test mode:	8DPSK mode



Lowest channel

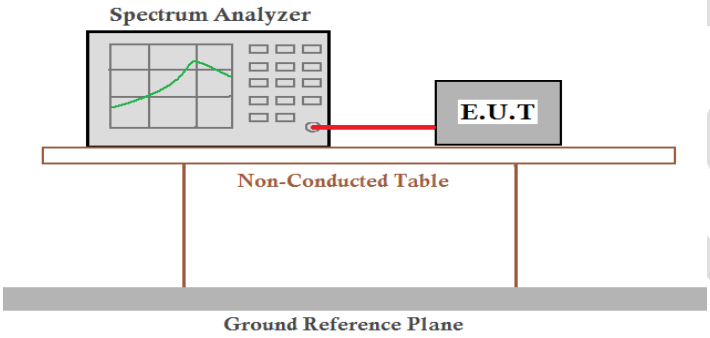


Middle channel



Highest channel

7.5 Carrier Frequencies Separation

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100KHz, VBW=300KHz, detector=Peak
Limit:	GFSK: 20dB bandwidth Pi/4QPSK & 8DSK: 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater)
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Mode	Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
GFSK	Lowest	1000	940	Pass
	Middle	1000	940	Pass
	Highest	1004	940	Pass
Pi/4QPSK	Lowest	1000	888	Pass
	Middle	1000	888	Pass
	Highest	1008	888	Pass
8DSK	Lowest	1004	860	Pass
	Middle	1000	860	Pass
	Highest	1004	860	Pass

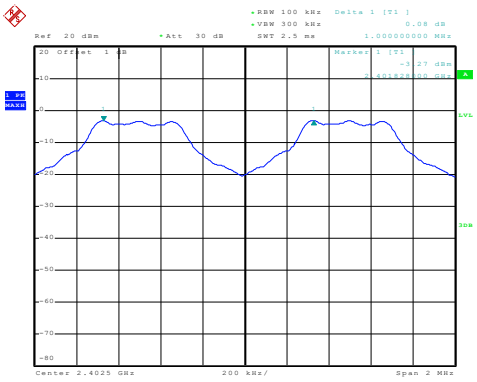
Note: According to section 7.4

Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
GFSK	940	940
Pi/4QPSK	1332	888

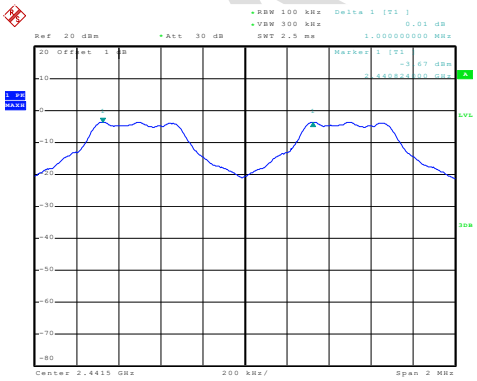
8DSK	1290	860

Test plot as follows:

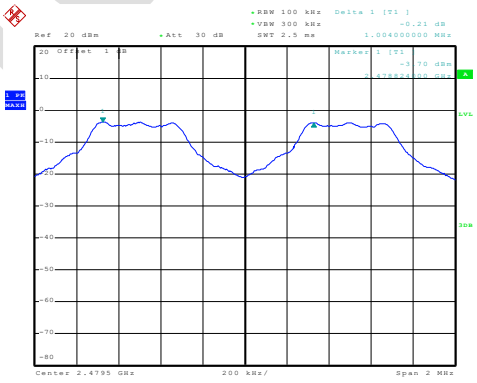
Modulation mode:	GFSK



Lowest channel

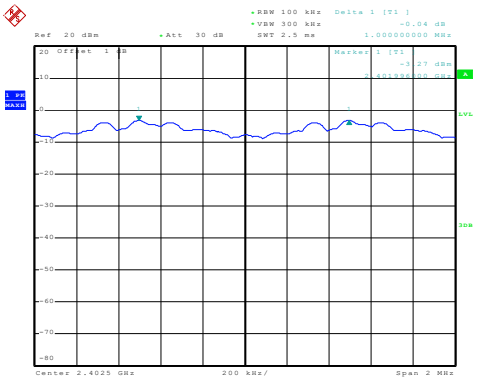


Middle channel

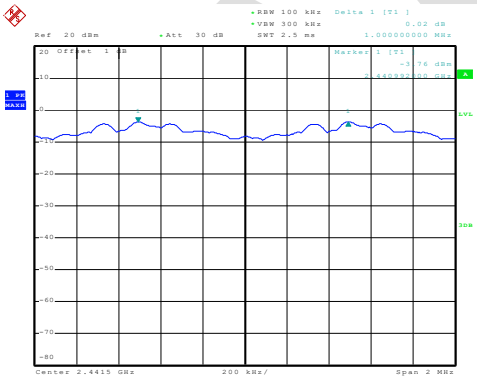


Highest channel

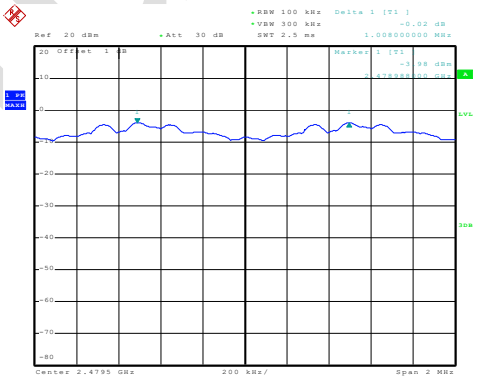
Test mode:	Pi/4QPSK mode



Lowest channel

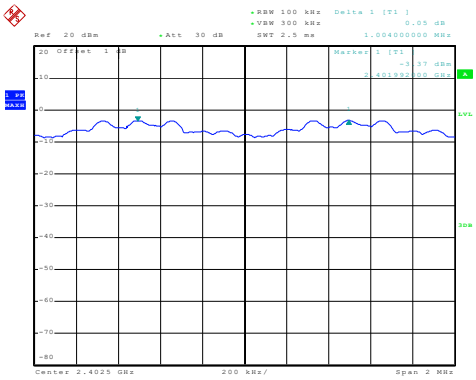


Middle channel

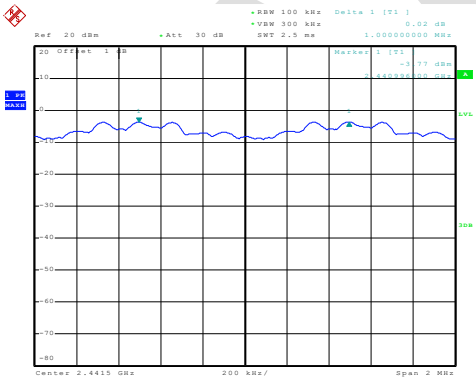


Highest channel

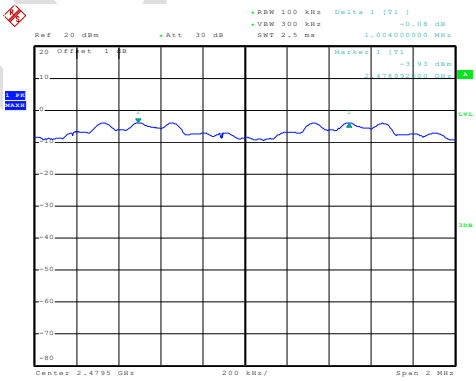
Test mode:	8DPSK mode



Lowest channel

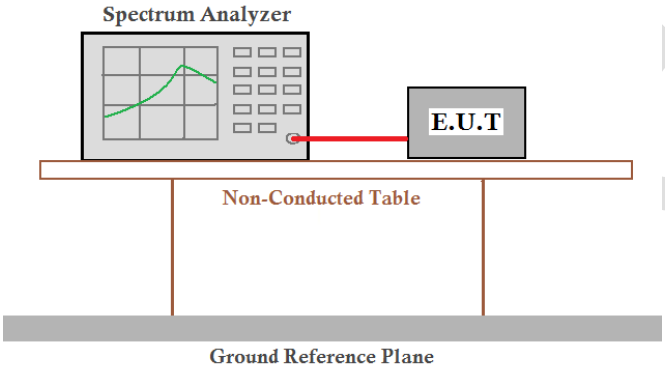


Middle channel



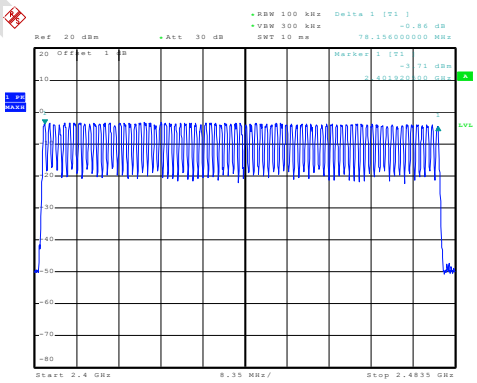
Highest channel

7.6 Hopping Channel Number

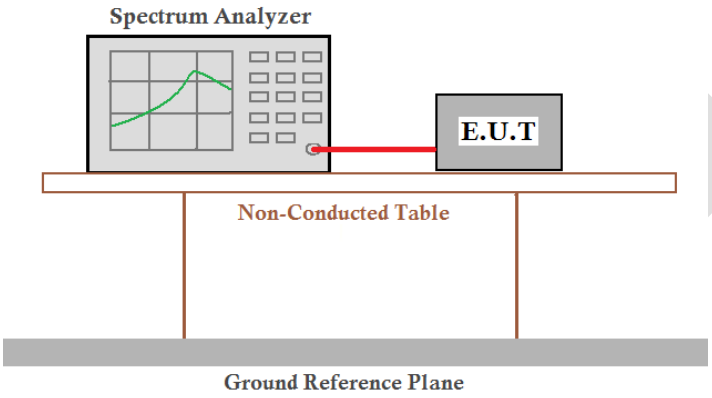
Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100kHz, VBW=300kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak
Limit:	15 channels
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data:

Mode	Hopping channel numbers	Limit	Result
GFSK	79	15	Pass
Pi/4QPSK	79	15	Pass
8DPSK	79	15	Pass



7.7 Dwell Time

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=1MHz, VBW=1MHz, Span=0Hz, Detector=Peak
Limit:	0.4 Second
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

Frequency	Packet	Dwell time(ms)	Limit(ms)	Result
2441MHz	DH1/2-DH1/3-DH1	127.36	400	Pass
2441MHz	DH3/2-DH3/3-DH3	266.88	400	Pass
2441MHz	DH5/2-DH5/3-DH5	310.61	400	Pass

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

Test channel: 2441MHz as blow

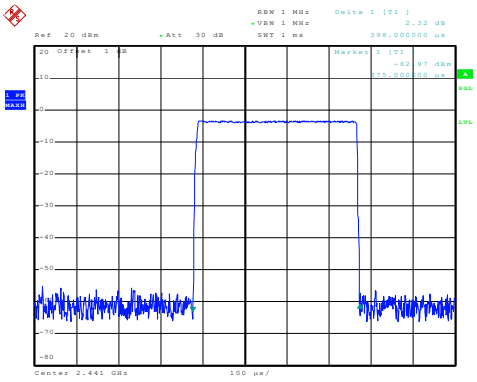
DH1/2-DH1/3-DH1 time slot=0.398(ms)*(1600/ (2*79))*31.6=127.36ms

DH3/2-DH3/3-DH3 time slot=1.668(ms)*(1600/ (4*79))*31.6=266.88ms

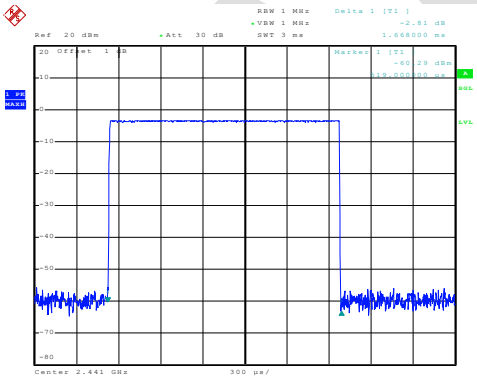
DH5/2-DH5/3-DH5 time slot=2.912(ms)*(1600/ (6*79))*31.6=310.61ms

Test plot as follows:

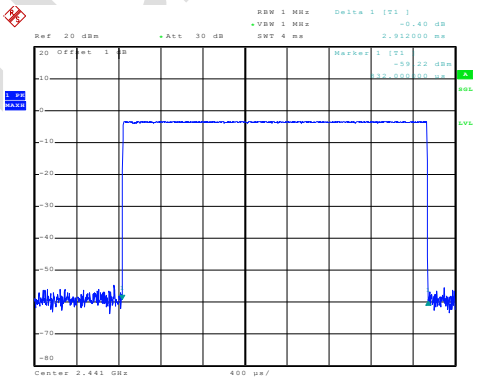
Test channel:	2441MHz



DH1/2-DH1/3-DH1



DH3/2-DH3/3-DH3



DH5/2-DH5/3-DH5

7.8 Pseudorandom Frequency Hopping Sequence

Test Requirement:	FCC Part15 C Section 15.247 (a)(1) requirement:

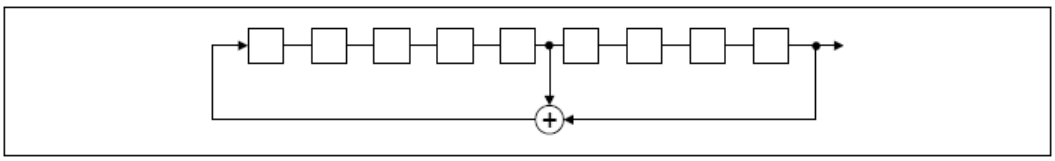
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence

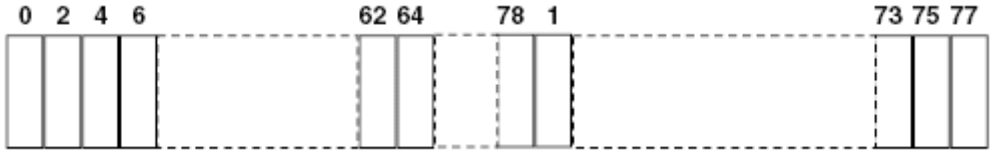
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

- *Number of shift register stages: 9*
- *Length of pseudo-random sequence: 2^9 -1 = 511 bits*
- *Longest sequence of zeros: 8 (non-inverted signal)*



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:

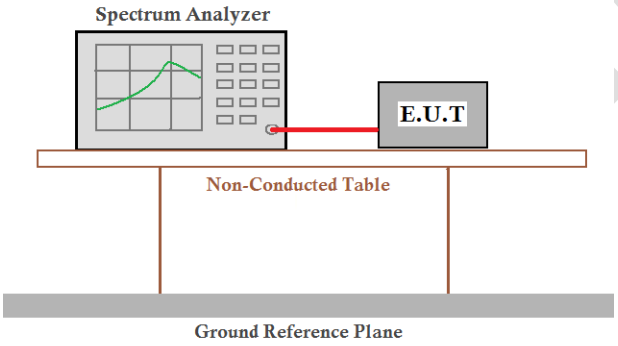


Each frequency used equally on the average by each transmitter.

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

7.9 Band Edge

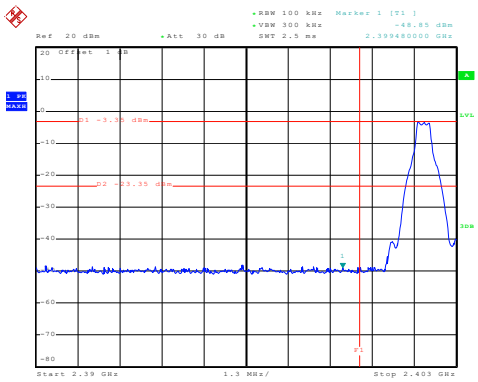
7.9.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100kHz, VBW=300kHz, Detector=Peak
Limit:	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, based on either an RF conducted or a radiated measurement.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

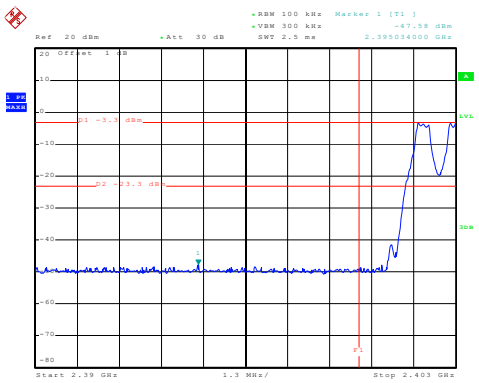
Test plot as follows:

GFSK Mode:

Test channel:	Lowest channel

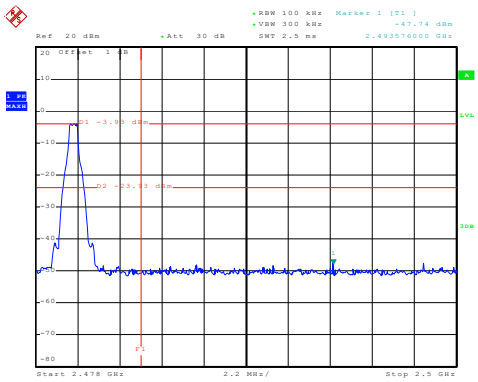


No-hopping mode

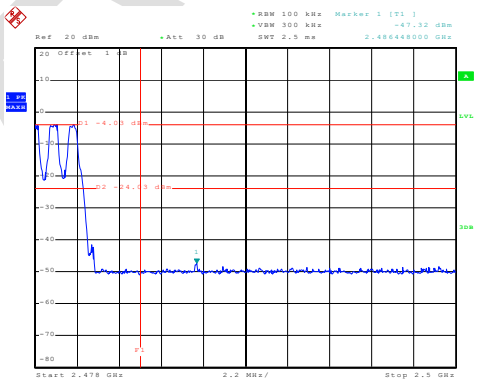


Hopping mode

Test channel:	Highest channel



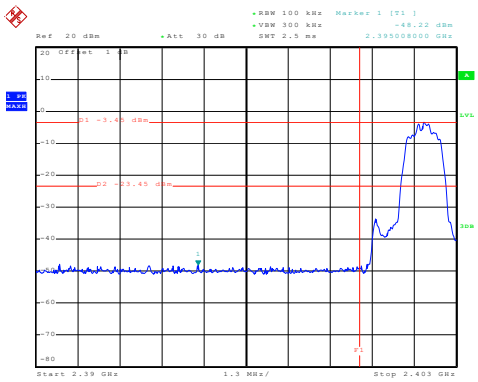
No-hopping mode



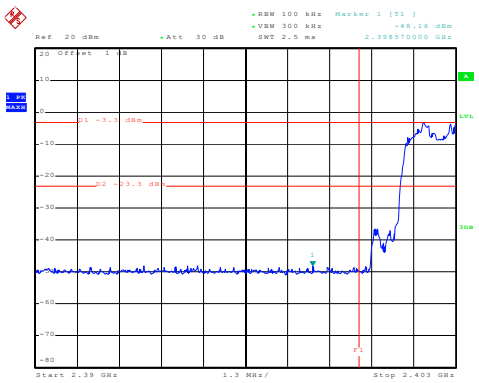
Hopping mode

Pi/4QPSK Mode:

Test channel:	Lowest channel

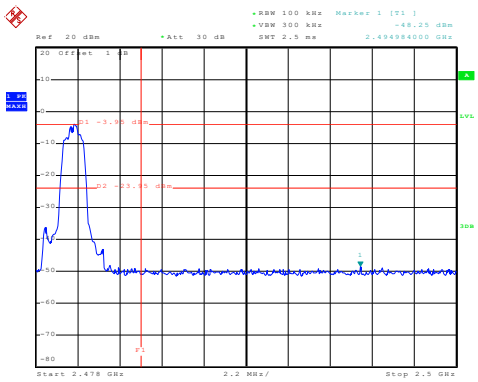


No-hopping mode

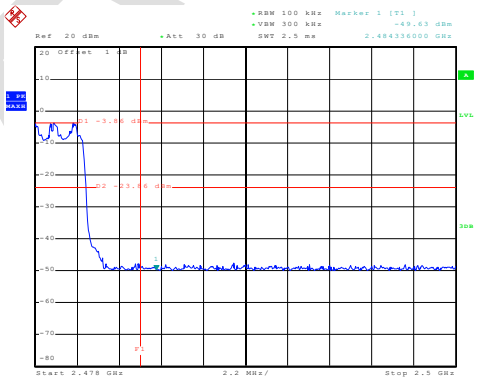


Hopping mode

Test channel:	Highest channel



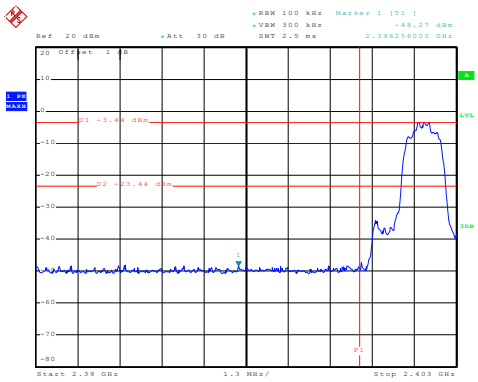
No-hopping mode



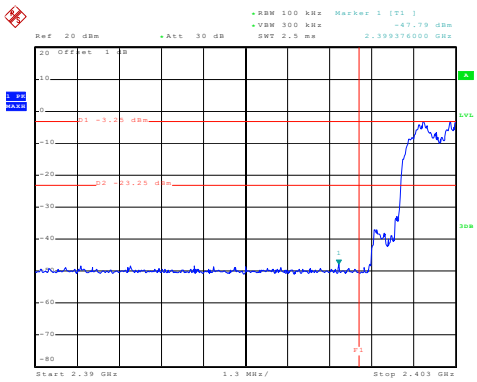
Hopping mode

8DPSK Mode:

Test channel:	Lowest channel

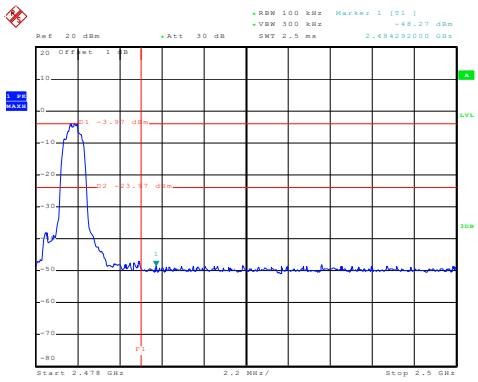


No-hopping mode

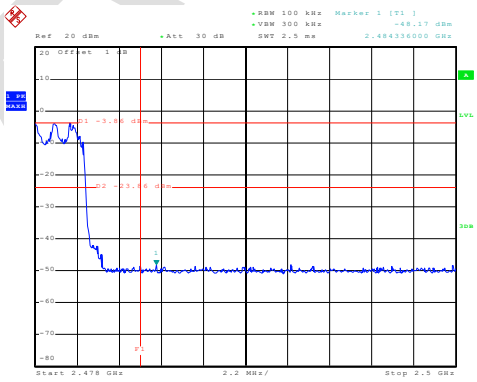


Hopping mode

Test channel:	Highest channel



No-hopping mode



Hopping mode

7.9.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209 and 15.205
Test Method:	ANSI C63.10:2013
Test Frequency Range:	All restriction band have been tested, and 2310MHz to 2390MHz, 2483.5MHz to 2500MHz band is the worse case
Test site:	Measurement Distance: 3m

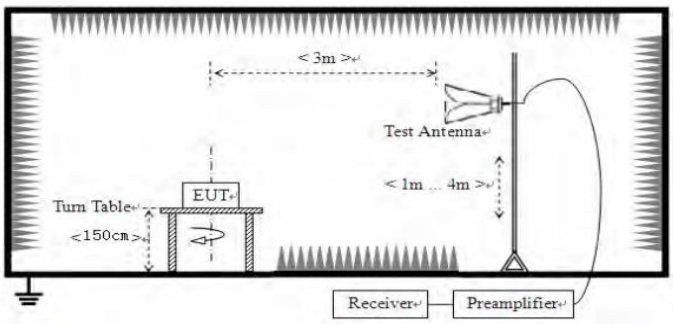
Receiver setup:

Frequency	Detector	RBW	VBW	Remark
Above 1GHz	Peak	1MHz	3MHz	Peak Value
	Peak	1MHz	10Hz	Average Value

Limit:

Frequency	Limit (dBuV/m @3m)	Remark
Above 1GHz	54.00	Average Value
	74.00	Peak Value

Test setup:



Test Procedure:

1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Test Instruments:	Refer to section 6.0 for details

Test mode:	Refer to section 5.2 for details
Test results:	Pass

Remark:

1. *During the test, pre-scan the GFSK, Pi/4QPSK, 8DPSK modulation, and found the 8DPSK modulation which it is worse case.*

Test channel:	Lowest

Peak value:

Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2310.00	56.03	-16.65	39.38	74.00	-34.62	Horizontal
2390.00	55.38	-16.24	39.14	74.00	-34.86	Horizontal
2310.00	68.85	-16.65	52.20	74.00	-21.80	Vertical
2390.00	56.03	-16.24	39.79	74.00	-34.21	Vertical

Average value:

Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2310.00	43.06	-16.65	26.41	54.00	-27.59	Horizontal
2390.00	44.81	-16.24	28.57	54.00	-25.43	Horizontal
2310.00	53.30	-16.65	36.56	54.00	-17.35	Vertical
2390.00	45.86	-16.24	29.62	54.00	-24.38	Vertical

Test channel:	Highest

Peak value:

Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	58.38	-15.71	42.67	74.00	-31.33	Horizontal
2500.00	57.76	-15.60	42.16	74.00	-31.84	Horizontal
2483.50	63.55	-15.71	47.84	74.00	-26.16	Vertical
2500.00	60.69	-15.60	45.09	74.00	-28.91	Vertical

Average value:

Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	40.98	-15.71	25.27	54.00	-28.73	Horizontal
2500.00	42.75	-15.60	27.15	54.00	-26.85	Horizontal
2483.50	47.62	-15.71	31.91	54.00	-22.09	Vertical
2500.00	46.37	-15.60	30.77	54.00	-23.23	Vertical

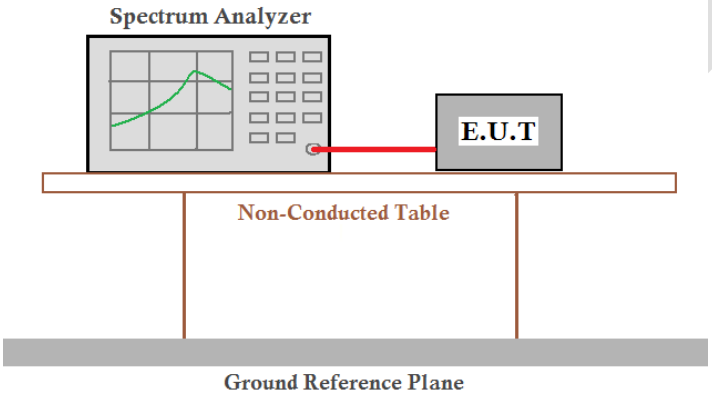
Remark:

1. *Final Level =Receiver Read level + Correct factor*

2. The emission levels of other frequencies are very lower than the limit and not show in test report.
3. Correct factor= Antenna Factor + Cable Loss – Preamplifier Factor

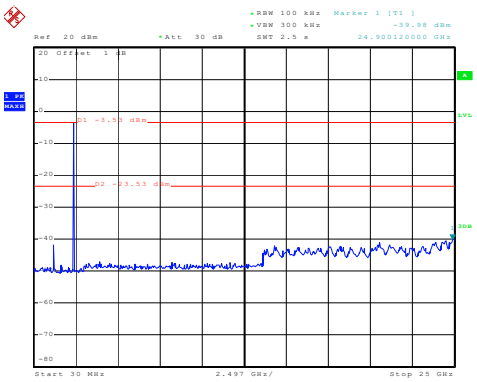
7.10 Spurious Emission

7.10.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Limit:	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, based on either an RF conducted or a radiated measurement.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

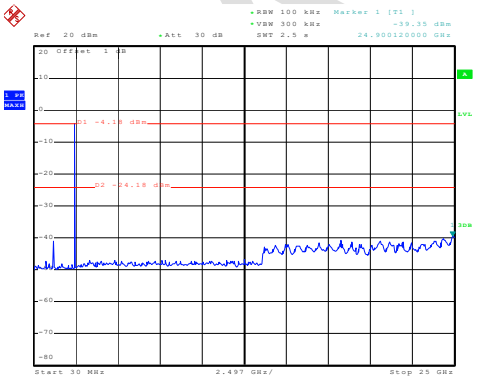
Remark:
During the test, pre-scan the GFSK, Pi/4QPSK, 8DPSK modulation, and found the 8DPSK modulation which it is worse case.

Test channel:	Lowest channel



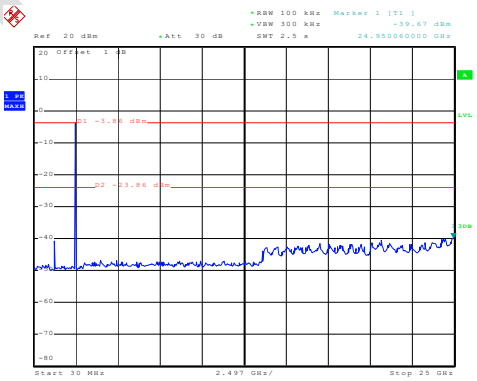
30MHz~25GHz

Test channel:	Middle channel



30MHz~25GHz

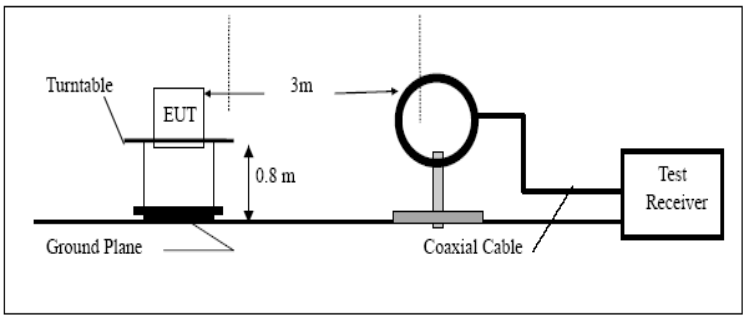
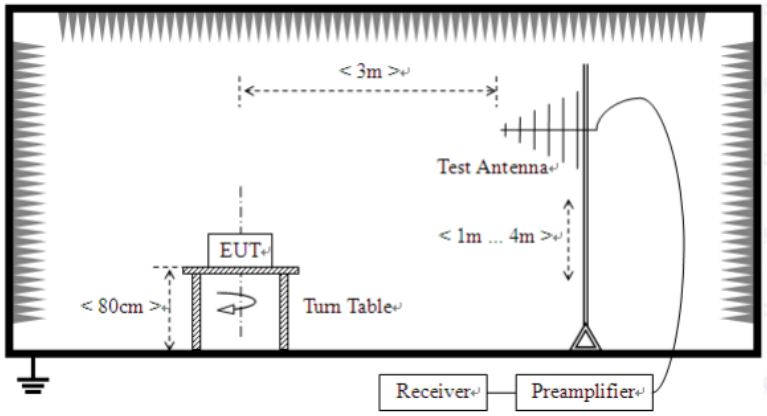
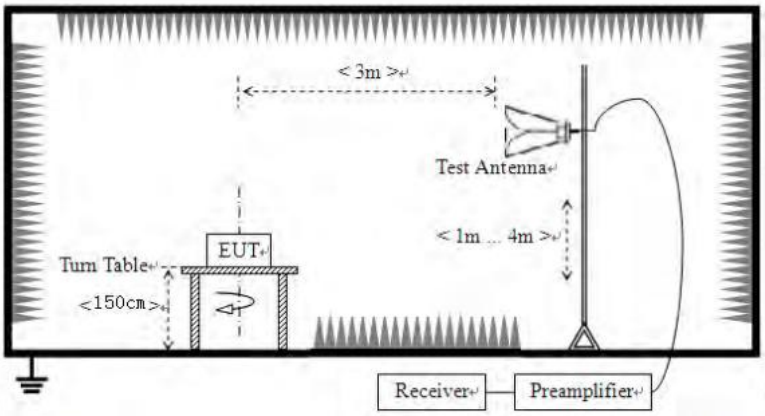
Test channel:	Highest channel



30MHz~25GHz

7.10.2 Radiated Emission Method

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.209</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10:2013</td></tr>
<tr><td>Test Frequency Range:</td><td>9kHz to 25GHz</td></tr>
<tr><td>Test site:</td><td>Measurement Distance: 3m</td></tr>
<tr><td>Receiver setup:</td><td>
<table>
<tr><th>Frequency</th><th>Detector</th><th>RBW</th><th>VBW</th><th>Value</th></tr>
<tr><td>9KHz-150KHz</td><td>Quasi-peak</td><td>200Hz</td><td>600Hz</td><td>Quasi-peak</td></tr>
<tr><td>150KHz-30MHz</td><td>Quasi-peak</td><td>9KHz</td><td>30KHz</td><td>Quasi-peak</td></tr>
<tr><td>30MHz-1GHz</td><td>Quasi-peak</td><td>120KHz</td><td>300KHz</td><td>Quasi-peak</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>Peak</td><td>1MHz</td><td>3MHz</td><td>Peak</td></tr>
<tr><td>Peak</td><td>1MHz</td><td>10Hz</td><td>Average</td></tr>
</table>
</td></tr>
<tr><td>Limit:
(Spurious Emissions)</td><td>
<table>
<tr><th>Frequency</th><th>Limit (uV/m)</th><th>Value</th><th>Measurement Distance</th></tr>
<tr><td>0.009MHz-0.490MHz</td><td>2400/F(KHz)</td><td>QP</td><td>300m</td></tr>
<tr><td>0.490MHz-1.705MHz</td><td>24000/F(KHz)</td><td>QP</td><td>30m</td></tr>
<tr><td>1.705MHz-30MHz</td><td>30</td><td>QP</td><td>30m</td></tr>
<tr><td>30MHz-88MHz</td><td>100</td><td>QP</td><td rowspan="6">3m</td></tr>
<tr><td>88MHz-216MHz</td><td>150</td><td>QP</td></tr>
<tr><td>216MHz-960MHz</td><td>200</td><td>QP</td></tr>
<tr><td>960MHz-1GHz</td><td>500</td><td>QP</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>500</td><td>Average</td></tr>
<tr><td>5000</td><td>Peak</td></tr>
</table>
</td></tr>
<tr><td>Limit:
(band edge)</td><td>Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.</td></tr>
</table>

Test setup:	Below 30MHz  Below 1GHz  Above 1GHz 
Test Procedure:	1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.

	2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement data:

Remark:

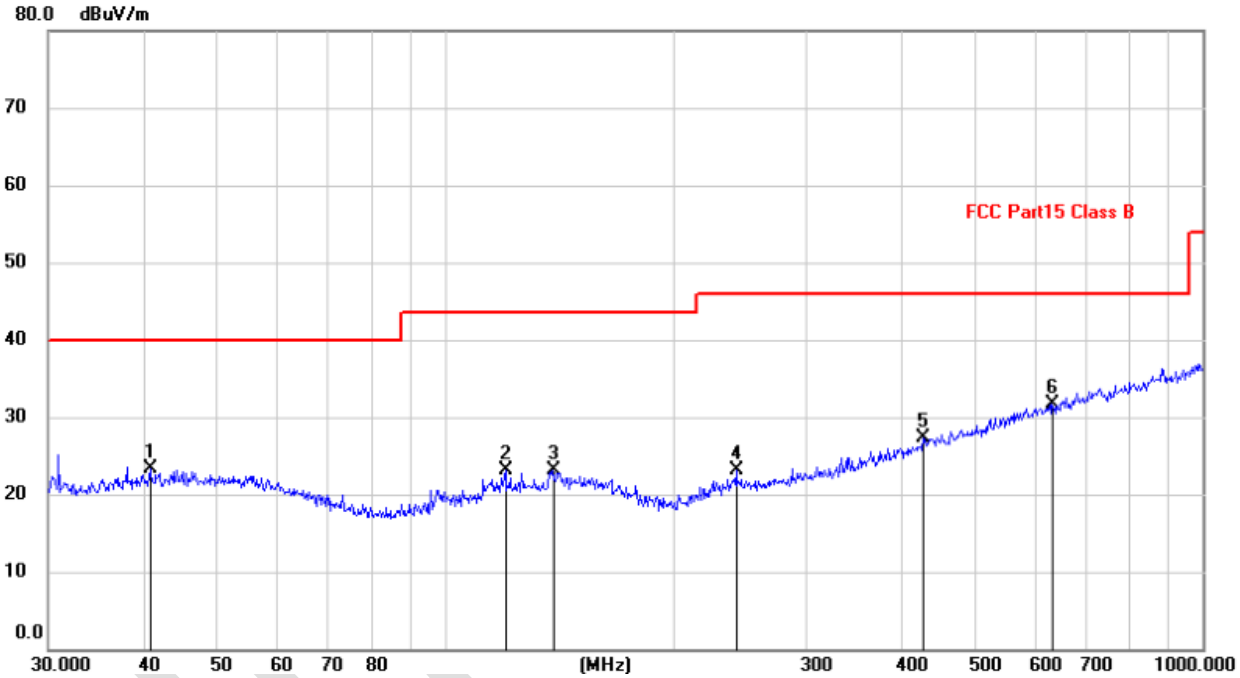
1. *During the test, pre-scan the GFSK, Pi/4QPSK, 8DPSK modulation, and found the 8DPSK modulation which it is worse case.*
2. *Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.*

■ **9 kHz ~ 30 MHz**

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

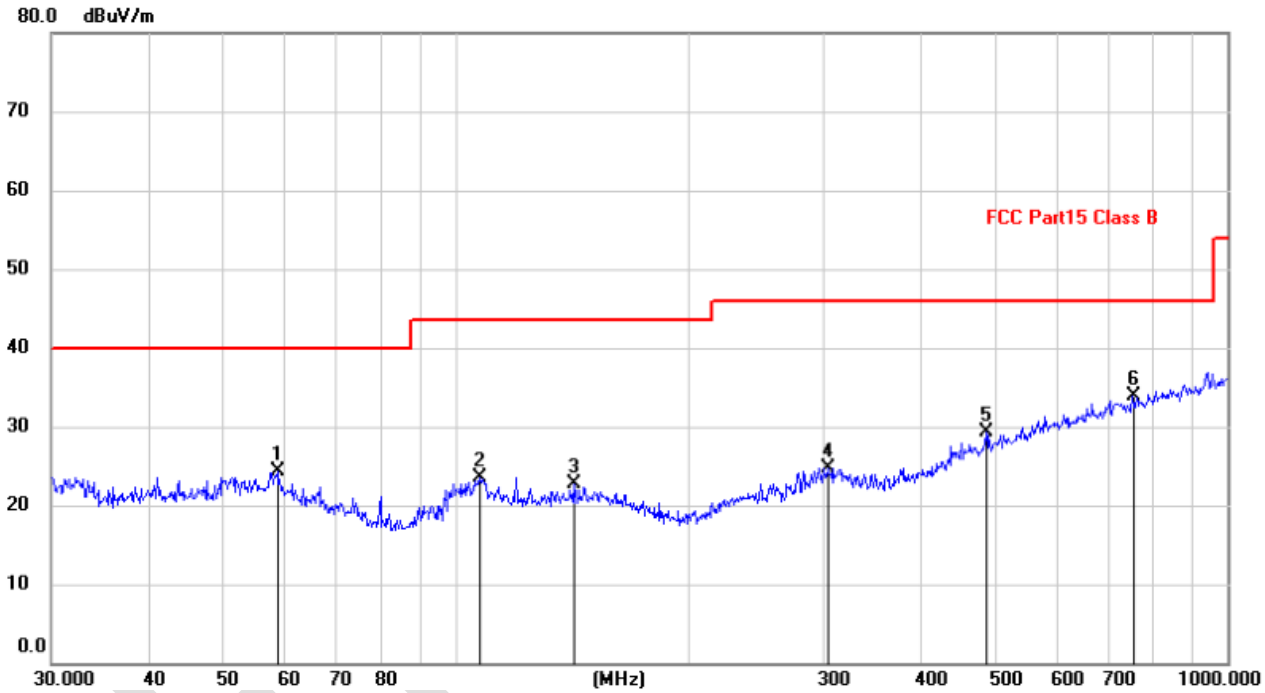
■ **Below 1GHz**

EUT:	BTHS-TWS120	**Polarziation:**	Horizontal
Model:	BTHS-TWS120	**Power Source:**	AC120V/60Hz
Mode:	BT mode	**Test by:**	Eason
Temp./Hum.(%H):	26℃/60%RH		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		40.8444	9.66	13.74	23.40	40.00	-16.60	QP
2		120.2766	10.63	12.39	23.02	43.50	-20.48	QP
3		138.8735	10.03	13.02	23.05	43.50	-20.45	QP
4		242.5252	10.37	12.72	23.09	46.00	-22.91	QP
5		428.0192	10.09	17.17	27.26	46.00	-18.74	QP
6	*	631.6884	10.35	21.40	31.75	46.00	-14.25	QP

EUT:	BTHS-TWS120	**Polarziation:**	Vertical
Model:	BTHS-TWS120	**Power Source:**	AC120V/60Hz
Mode:	BT mode	**Test by:**	Eason
Temp./Hum.(%H):	26℃/60%RH		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		58.8185	11.30	13.07	24.37	40.00	-15.63	QP
2		107.5100	12.48	11.08	23.56	43.50	-19.94	QP
3		142.3241	9.68	13.05	22.73	43.50	-20.77	QP
4		303.5437	11.21	13.55	24.76	46.00	-21.24	QP
5		487.3149	10.69	18.56	29.25	46.00	-16.75	QP
6	*	752.7432	10.54	23.28	33.82	46.00	-12.18	QP

■ **Above 1GHz**

Test channel:	Lowest

Peak value:

Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4804.00	55.19	-7.43	47.76	74.00	-26.24	Vertical
7206.00	57.65	-2.42	55.23	74.00	-18.77	Vertical
9608.00	59.17	-2.38	56.79	74.00	-17.21	Vertical
12010.00	*			74.00		Vertical
14412.00	*			74.00		Vertical
4804.00	58.03	-7.43	50.60	74.00	-23.40	Horizontal
7206.00	58.71	-2.42	56.29	74.00	-17.71	Horizontal
9608.00	59.05	-2.38	56.67	74.00	-17.33	Horizontal
12010.00	*			74.00		Horizontal
14412.00	*			74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4804.00	43.61	-7.43	36.18	54.00	-17.82	Vertical
7206.00	44.07	-2.42	41.65	54.00	-12.35	Vertical
9608.00	45.18	-2.38	42.80	54.00	-11.20	Vertical
12010.00	*			54.00		Vertical
14412.00	*			54.00		Vertical
4804.00	46.94	-7.43	39.51	54.00	-14.49	Horizontal
7206.00	47.47	-2.42	45.05	54.00	-8.95	Horizontal
9608.00	48.05	-2.38	45.67	54.00	-8.33	Horizontal
12010.00	*			54.00		Horizontal
14412.00	*			54.00		Horizontal

Remark:

1. *Final Level =Receiver Read level + Correct factor*
2. *Correct factor = Antenna Factor + Cable Loss – Preamplifier Factor*
3. *"*", means this data is the too weak instrument of signal is unable to test.*
4. *The emission levels of other frequencies are very lower than the limit and not show in test report.*

Test channel:	Middle

Peak value:

Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4882.00	57.76	-7.49	50.27	74.00	-23.73	Vertical
7323.00	54.36	-2.40	51.96	74.00	-22.04	Vertical
9764.00	58.17	-2.38	55.79	74.00	-18.21	Vertical
12205.00	*			74.00		Vertical
14646.00	*			74.00		Vertical
4882.00	59.31	-7.49	51.82	74.00	-22.18	Horizontal
7323.00	57.69	-2.40	55.29	74.00	-18.71	Horizontal
9764.00	59.31	-2.38	56.93	74.00	-17.07	Horizontal
12205.00	*			74.00		Horizontal
14646.00	*			74.00		Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4882.00	46.48	-7.49	38.99	54.00	-15.01	Vertical
7323.00	43.36	-2.40	40.96	54.00	-13.04	Vertical
9764.00	44.79	-2.38	42.41	54.00	-11.59	Vertical
12205.00	*			54.00		Vertical
14646.00	*			54.00		Vertical
4882.00	47.61	-7.49	40.12	54.00	-13.88	Horizontal
7323.00	45.03	-2.40	42.63	54.00	-11.37	Horizontal
9764.00	47.14	-2.38	44.76	54.00	-9.24	Horizontal
12205.00	*			54.00		Horizontal
14646.00	*			54.00		Horizontal

Remark:

1. *Final Level =Receiver Read level + Correct facto*
2. *Correct factor = Antenna Factor + Cable Loss – Preamplifier Factor*
3. *"*", means this data is the too weak instrument of signal is unable to test.*
4. *The emission levels of other frequencies are very lower than the limit and not show in test report.*

Test channel:	Highest

Peak value:

Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4960.00	56.31	-7.47	48.84	74.00	-25.16	Vertical
7440.00	55.54	-2.45	53.09	74.00	-20.91	Vertical
9920.00	57.96	-2.37	55.59	74.00	-18.41	Vertical
12400.00	*			74.00		Vertical
14880.00	*			74.00		Vertical
4960.00	59.98	-7.47	52.51	74.00	-21.49	Horizontal
7440.00	54.69	-2.45	52.24	74.00	-21.76	Horizontal
9920.00	59.76	-2.37	57.39	74.00	-16.61	Horizontal
12400.00	*			74.00		Horizontal
14880.00	*			74.00		Horizontal

Average value:

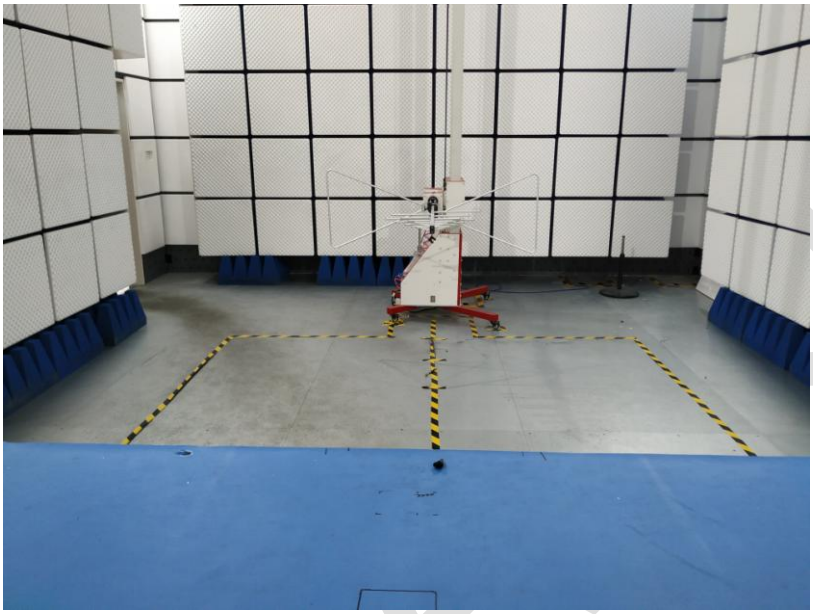
Frequency (MHz)	Read Level (dBuV)	Correct factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4960.00	44.33	-7.47	36.86	54.00	-17.14	Vertical
7440.00	43.06	-2.45	40.61	54.00	-13.39	Vertical
9920.00	43.71	-2.37	41.34	54.00	-12.66	Vertical
12400.00	*			54.00		Vertical
14880.00	*			54.00		Vertical
4960.00	47.54	-7.47	40.07	54.00	-13.93	Horizontal
7440.00	45.06	-2.45	42.61	54.00	-11.39	Horizontal
9920.00	46.67	-2.37	44.30	54.00	-9.70	Horizontal
12400.00	*			54.00		Horizontal
14880.00	*			54.00		Horizontal

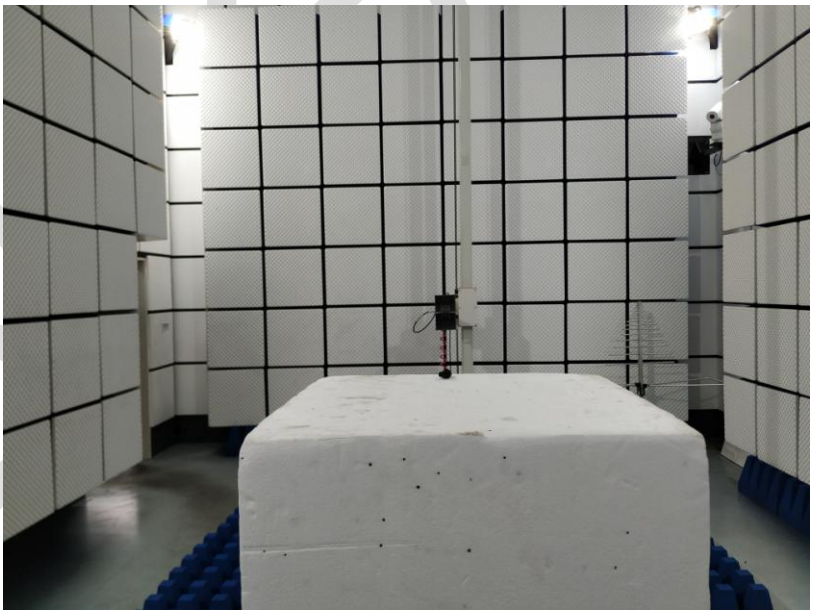
Remark:

1. *Final Level =Receiver Read level + Correct factor*
2. *Correct factor = Antenna Factor + Cable Loss – Preamplifier Factor*
3. *"*", means this data is the too weak instrument of signal is unable to test.*
4. *The emission levels of other frequencies are very lower than the limit and not show in test report.*

8 Test Setup Photo

Radiated Emission



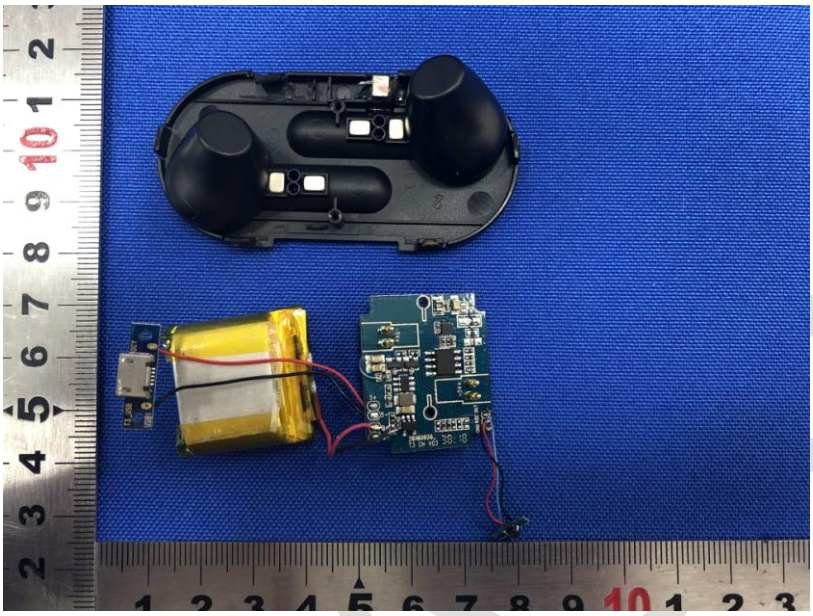


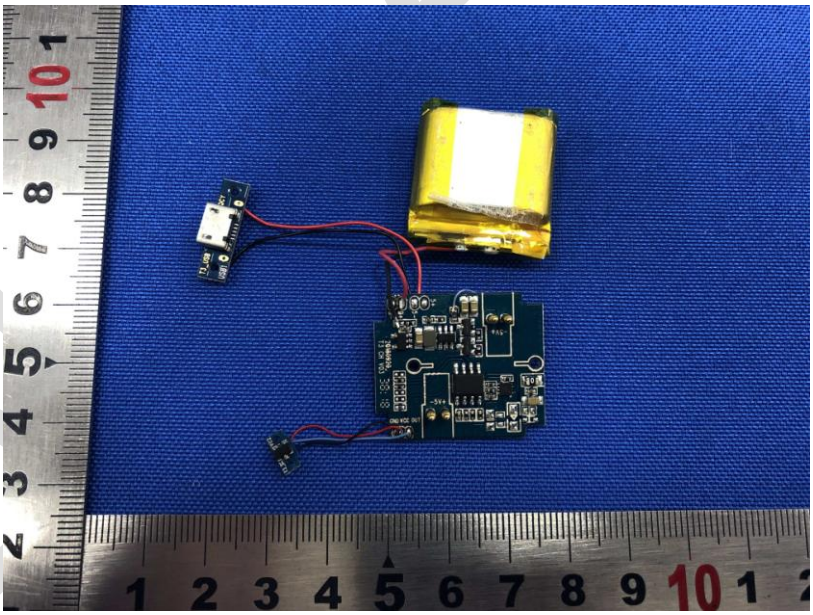
Conducted Emission

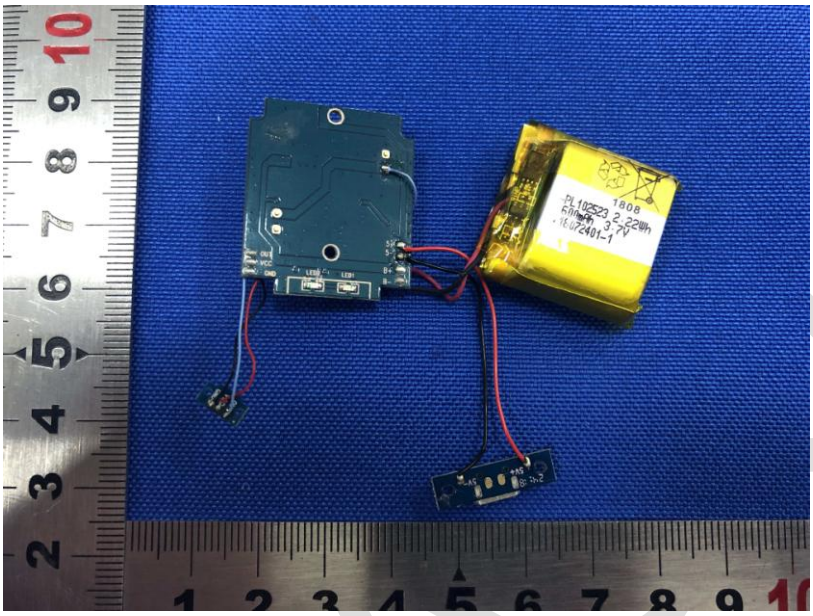
9 EUT Constructional Details

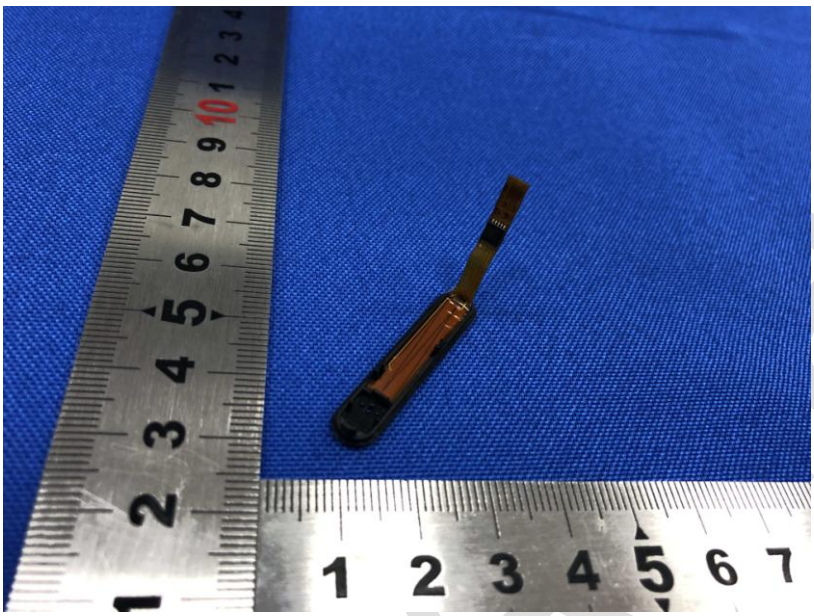

QCY

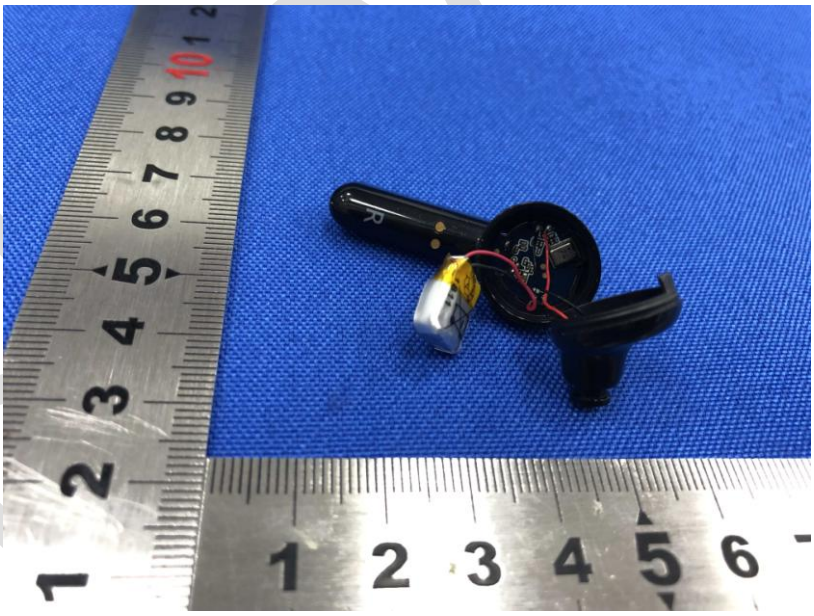

QCY

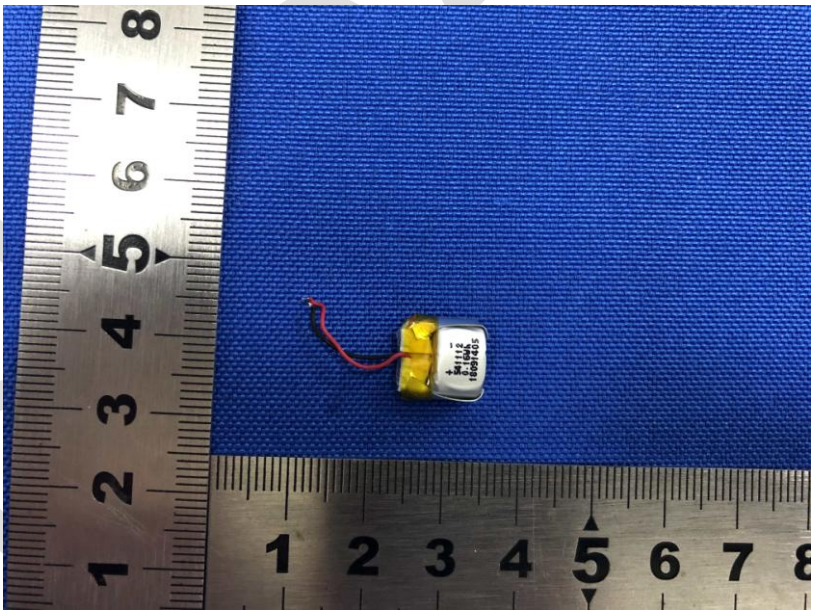


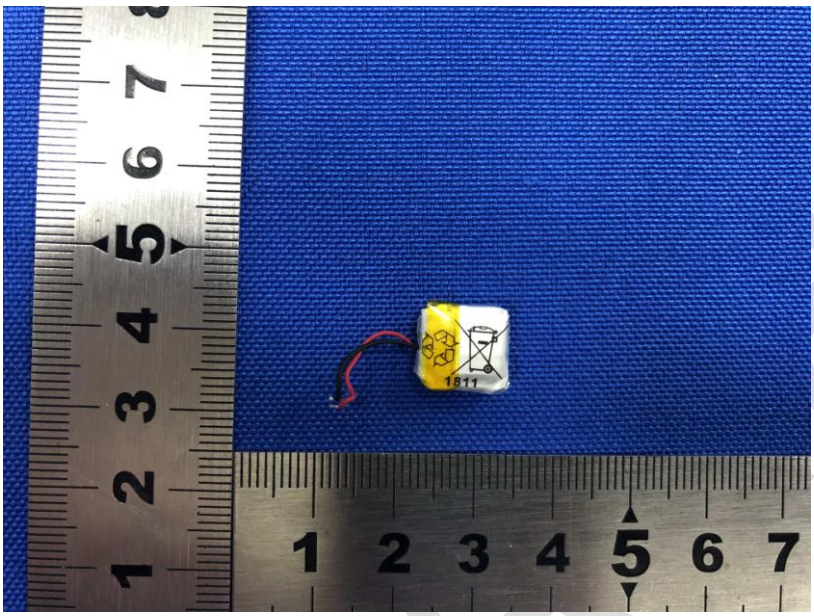


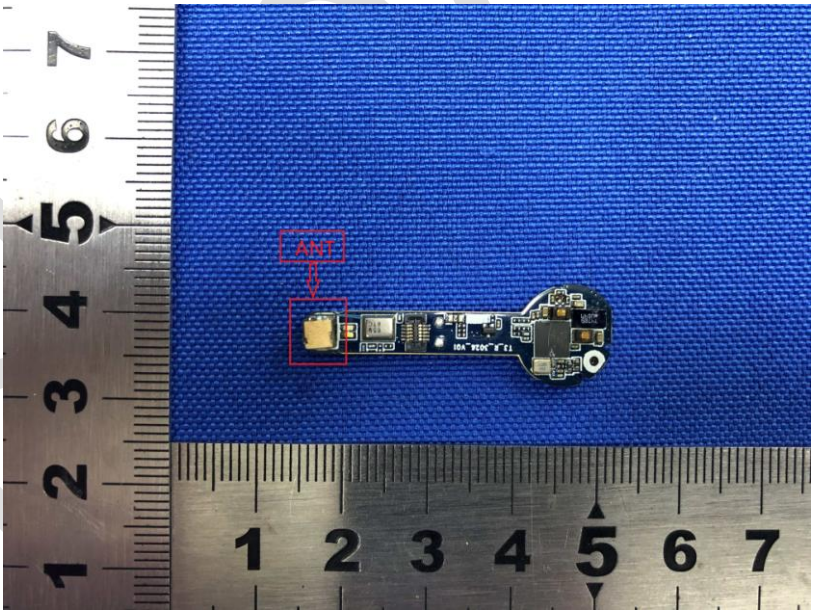








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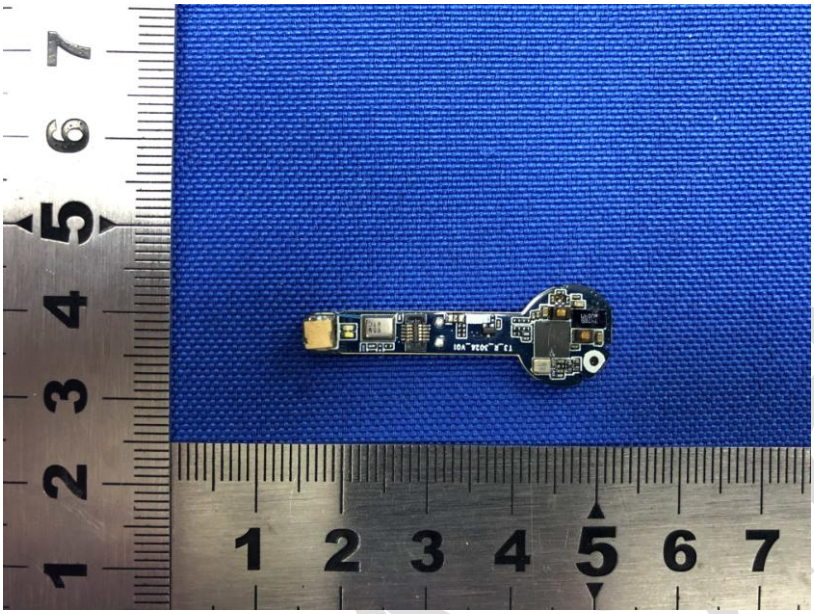

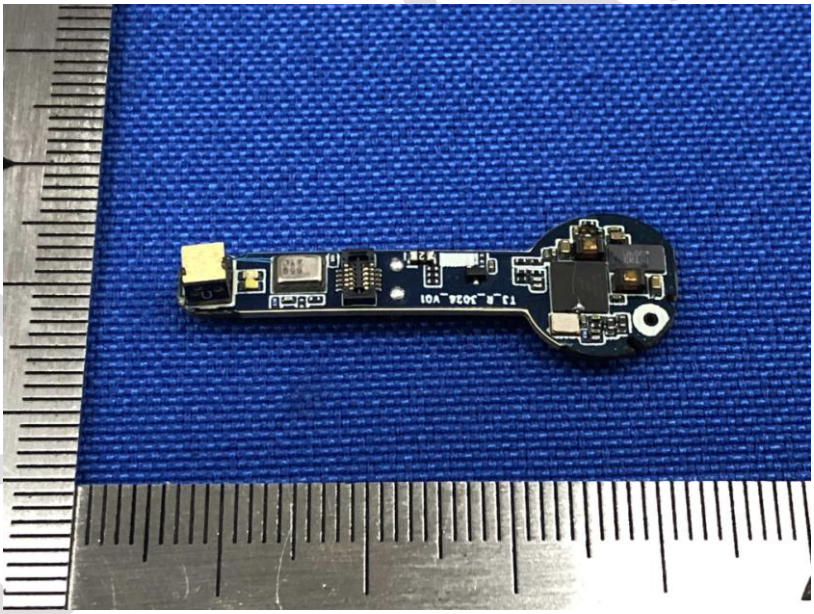

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