TEST REPORT

Product Name	:	**ALTEC Kid Friendly 3n1 Headphone w/Learning MIC and Antimicrobial**
Model Number	:	**MZX4100, MZX4100-BLUB, MZX4100-PGRN, MZX4100-BPNK, MZX4100-APRD, MZX4100-BLKG, MZX4100-BLU, MZX4100-PNK, 20BF12**
FCC ID	:	**2AKI8-MZX4100**

Prepared for	:	TOPWAY EM ENTERPRISE LIMITED
Address	:	8F BLOCK B BUILDING 6 BAONENG S & T PARK LONG HUA SHENZHEN GD China

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Report Number	:	ES210121018W
Date(s) of Tests	:	January 21, 2021 to February 24, 2021
Date of issue	:	February 24, 2021

VERIFICATION OF COMPLIANCE

Applicant:	TOPWAY EM ENTERPRISE LIMITED
Manufacturer:	TOPWAY EM ENTERPRISE LIMITED
Factory:	Shenzhen Jia Hua Li Dian Zi You Xian Gong Si
Product Description:	ALTEC Kid Friendly 3n1 Headphone w/Learning MIC and Antimicrobial
Trade Mark:	N/A
Model Number:	MZX4100, MZX4100-BLUB, MZX4100-PGRN, MZX4100-BPNK, MZX4100-APRD, MZX4100-BLKG, MZX4100-BLU, MZX4100-PNK, 20BF12

We hereby certify that:

The above equipment was tested by EMTEK(SHENZHEN) CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10-2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247(2018).

Date of Test : January 21, 2021 to February 24, 2021

Prepared by : Loren Luo

Loren Luo /Editor

Reviewer : Tim Dong

Tim Dong /Supervisor

Approved & Authorized Signer :

Lisa Wang /Manager

Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	February 24, 2021	ES210121018W

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1. GENERAL INFORMATION

1.1 Product Description

Characteristics	Description
Product Name	ALTEC Kid Friendly 3n1 Headphone w/Learning MIC and Antimicrobial
Model number	MZX4100, MZX4100-BLUB, MZX4100-PGRN, MZX4100-BPNK, MZX4100-APRD, MZX4100-BLKG, MZX4100-BLU, MZX4100-PNK, 20BF12
Power Supply	DC 3.7V Battery
Kind of Device	Bluetooth Ver.5.0
Modulation	GFSK, π/4-DQPSK, 8DPSK
Operating Frequency Range	2402-2480MHz
Number of Channels	79
Transmit Power Max(PK)	-3.31dBm(0.000467W)
Antenna Type	Internal PCB antenna
Antenna Gain	0dBi

1.2 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10-2013. Radiated testing was performed at an antenna to EUT distance 3 meters.

1.3 Test Facility

Site Description

EMC Lab.	:	Accredited by CNAS, 2018.11.30 The certificate is valid until 2022.10.28 The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2006 (identical to ISO/IEC 17025:2017) The Certificate Registration Number is L2291. Accredited by FCC Designation Number: CN1204 Test Firm Registration Number: 882943 Accredited by A2LA, August 08, 2018 The Certificate Number is 4321.01. Accredited by Industry Canada, November 09, 2018 The Conformity Assessment Body Identifier is CN0008
Name of Firm	:	EMTEK(SHENZHEN) CO., LTD.
Site Location	:	Building 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China.

2. System Test Configuration

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The Transmitter was operated in the normal operating mode. The Tx frequency was fixed which was for the purpose of the measurements.

2.3. Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

2.3.2 Radiated Emissions

Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of EUT was fixed in a particular direction according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013.

2.4. Configuration of Tested System

Fig. 2-1 Configuration of Tested System

Table 2-1 Equipment Used in Tested System

Item	Equipment	Model No.	FCC ID	Note
1.	ALTEC Kid Friendly 3n1 Headphone w/Learning MIC and Antimicrobial	MZX4100	2AKI8-MZX4100	***EUT***

Note:

(1) Unless otherwise denoted as EUT in 『Remark』 column , device(s) used in tested system is a support equipment.

3. Summary of Test Results

FCC Rules	Description Of Test	Result
§15.207	AC Power Conducted Emission	N/A
§15.247(d),§15.209	Radiated Emission	Compliant
§15.247(a)(1)	Channel Separation test	Compliant
§15.247(a)(1)	20dB Bandwidth	Compliant
§15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§15.247(a)(1)(iii)	Time of Occupancy(Dwell Time)	Compliant
§15.247(b)	Max Peak output Power test	Compliant
§15.247(d)	Band edge test	Compliant
§15.203	Antenna Requirement	Compliant

4. Description of test modes

The EUT has been tested under its typical operating condition and fully-charged battery for EUT tested alone. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonics of the highest fundamental frequency or to 40 GHz, whichever is lower).

The EUT has been tested under TX operating condition.
This EUT is a FHSS system, were conducted to determine the final configuration from all possible combinations. We use software control the EUT, Let EUT hopping on and transmit with highest power, all the modes GFSK, Π/4-DQPSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	39	2441	…	…
1	2403	40	2442	76	2478
2	2404	41	2443	77	2479
…	…	…	…	78	2480
Note: fc=2402MHz+(k-1)×1MHz k=1 to 79					

Test Frequency and channe

Channel	Frequency(MHz)
0	2402
39	2441
78	2480

5. Frequency Hopping System Requirements

5.1. Standard Applicable

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

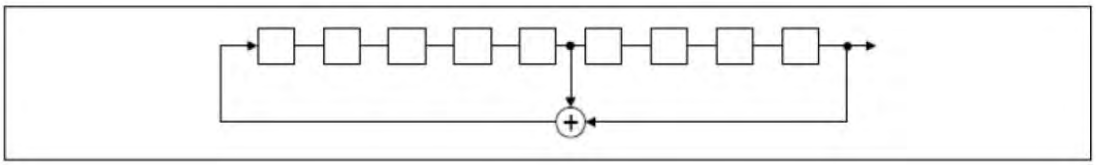
(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

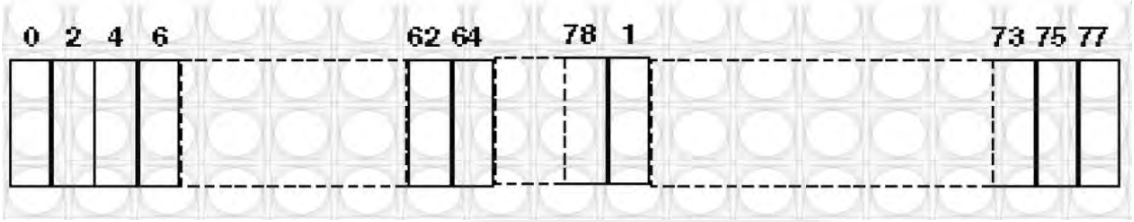
5.2. EUT Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels.
The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master.The channel is divide into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The normal hop is 1 600 hops/s.

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: 29-1 = 511 bits
Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence



Each frequency used equally on the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

5.3. Equal Hopping Frequency Use

All Bluetooth units participating in the piconet are time and hop-synchronized to the channel.

Example of a 79 hopping sequence in data mode:
35, 27, 6, 44, 14, 61, 74, 32, 1, 11, 23, 2, 55, 65, 29, 3, 9, 52, 78, 58, 40, 25, 0, 7, 18, 26, 76, 60, 47, 50, 2, 5, 16, 37, 70, 63, 66, 54, 20, 13, 4, 8, 15, 21, 26, 10, 73, 77, 67, 69, 43, 24, 57, 39, 46, 72, 48, 33, 17, 31, 75, 19, 41, 62, 68, 28, 51, 66, 30, 56, 34, 59, 71, 22, 49, 64, 38, 45, 36, 42, 53
Each Frequency used equally on the average by each transmitter

5.4. Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an

effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH- enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

6. TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Radio Frequency	±1x10^-5
Maximum Peak Output Power Test	±1.0dB
Conducted Emissions Test	±2.0dB
Radiated Emission Test	±2.0dB
Power Density	±2.0dB
Occupied Bandwidth Test	±1.0dB
Band Edge Test	±3dB
All emission, radiated	±3dB
Antenna Port Emission	±3dB
Temperature	±0.5℃
Humidity	±3%

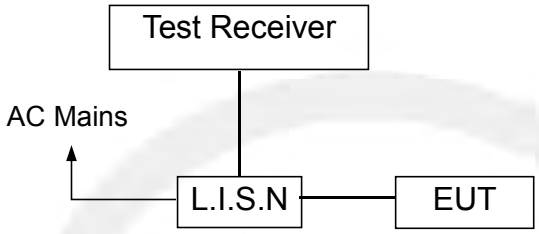
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%

7. Conducted Emissions Test

7.1. Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

7.2. Test SET-UP (Block Diagram of Configuration)



7.3. Measurement Equipment Used:

Conducted Emission Test Site						
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**Characteristics**	**Last Cal.**	**Due date**
Test Receiver	Rohde & Schwarz	ESCS30	100018	9kHz~3GHz	05/22/2020	05/21/2021
L.I.S.N	Rohde & Schwarz	ENV216	100017	9KHz-300MHz	05/22/2020	05/21/2021
RF Switching Unit	CDS	RSU-M2	38401	9KHz-300MHz	05/22/2020	05/21/2021
Coaxial Cable	CDS	79254	46107086	9kHz~3GHz	05/22/2020	05/21/2021

7.4. Measurement Result:

N/A.

Note: Bluetooth does not work while charging

8. Radiated Emission Test

8.1. Measurement Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
7. Test Procedure of measurement (For Above 1GHz):
   1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
   2) Change the antenna polarization and repeat 1) with vertical polarization.
   3) Make a hardcopy of the spectrum.
   4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
   5) Change the analyser mode to Clear/ Write and found the cone of emission.
   6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
   7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
   8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

Use the following spectrum analyzer settings:

When spectrum scanned from 30MHz to 1GHz setting resolution bandwidth 120KHz and video bandwidth 300KHz:

EMI Test Receiver	Setting
Attenuation	Auto
RB	120KHz
VB	300KHz
Detector	QP
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

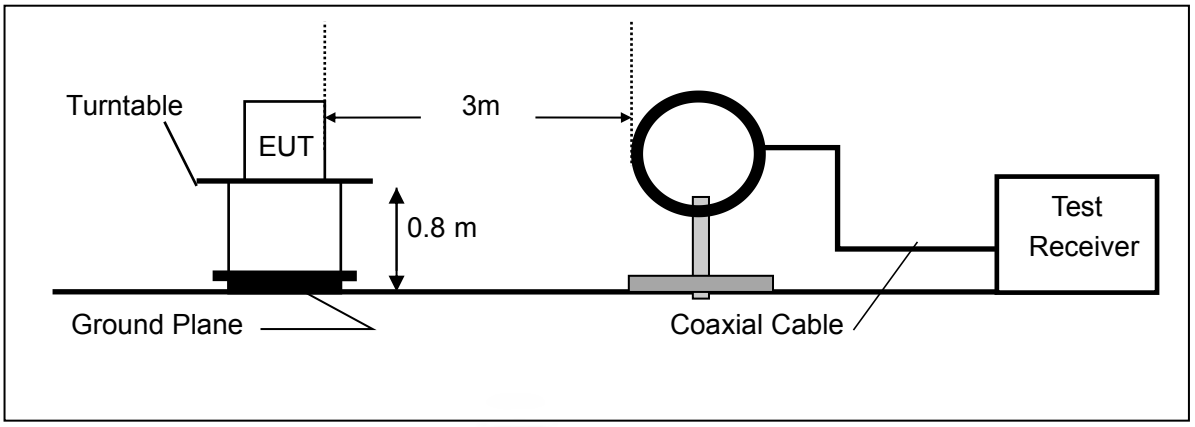
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 10Hz:

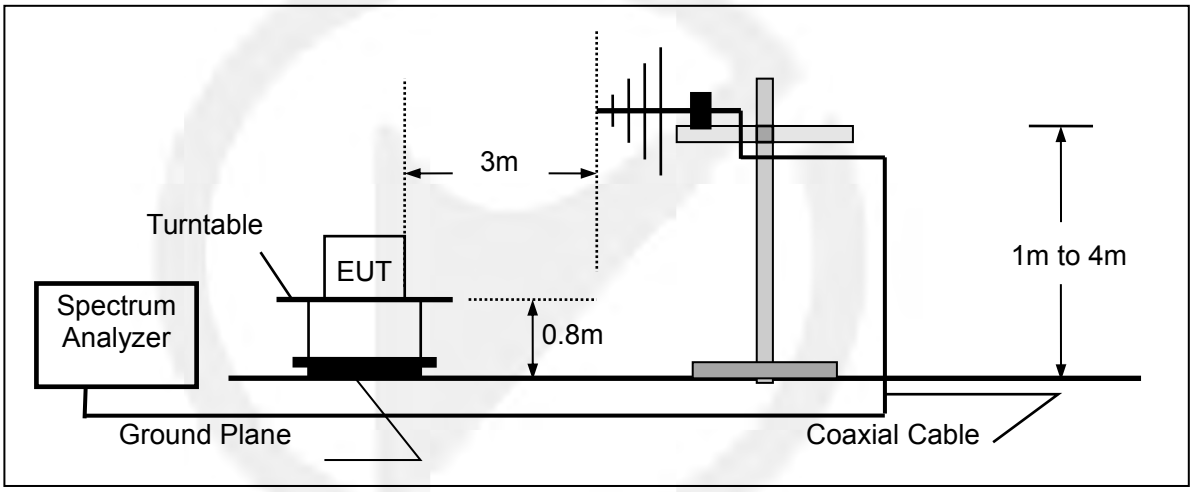
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Average
Trace	Max hold

8.2. Test SET-UP (Block Diagram of Configuration)

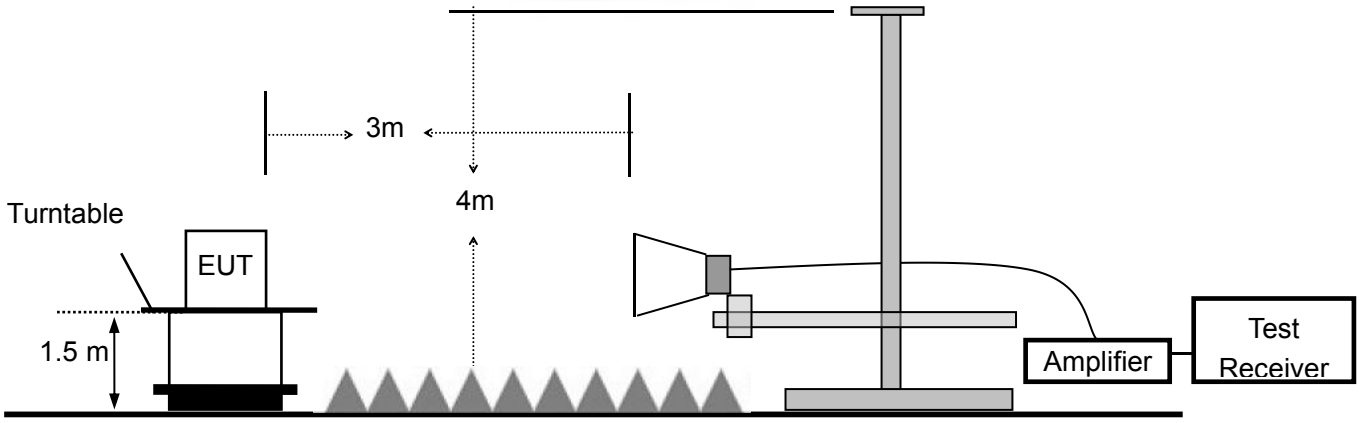
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



8.3. Measurement Equipment Used:

Item	Equipment	Manufacturer	Model No.	Serial No.	Characteristics	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI	1166.5950.03	9KHz-3GHz	05/22/2020	1 Year
2.	Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	05/22/2020	1 Year
3.	Bilog Antenna	Schwarzbeck	VULB9163	000141	25MHz-2GHz	05/22/2020	1 Year
4.	Power Amplifier	CDS	RSU-M352	818	1MHz-1GHz	05/22/2020	1 Year
5.	Power Amplifier	HP	8447F	OPT H64	1GHz-26.5GHz	05/22/2020	1 Year
6.	Color Monitor	SUNSPO	SP-140A	N/A	--	05/22/2020	1 Year
7.	Single Line Filter	JIANLI	XL-3	N/A	--	05/22/2020	1 Year
8.	Single Phase Power Line Filter	JIANLI	DL-2X100B	N/A	--	05/22/2020	1 Year
9.	3 Phase Power Line Filter	JIANLI	DL-4X100B	N/A	--	05/22/2020	1 Year
10.	DC Power Filter	JIANLI	DL-2X50B	N/A	--	05/22/2020	1 Year
11.	Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	05/22/2020	1 Year
12.	Cable	Rosenberger	CIL02	A0783566	9KHz-3GHz	05/22/2020	1 Year
13.	Cable	Rosenberger	RG 233/U	525178	9KHz-3GHz	05/22/2020	1 Year
14.	Signal Analyzer	Rohde & Schwarz	FSV30	103040	9KHz-40GHz	05/22/2020	1 Year
15.	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	1GHz-18GHz	05/22/2020	1 Year
16.	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	14GHz -26.5GHz	05/22/2020	1 Year
17.	Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	05/22/2020	1 Year
18.	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	05/22/2020	1 Year
19.	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	05/22/2020	1 Year
20.	Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	05/22/2020	1 Year

8.4. Radiated Emission Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table 15.209(a):

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

15.205 Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

Remark: 1. Emission level in dBuV/m=20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of ξ 15.205, and the emissions located in restricted bands also comply with 15.209 limit.

8.5. Measurement Result

Operation Mode:	TX	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	28℃
Test Result:	PASS	Humidity :	65 %
Measured Distance:	3m		

Below 30MHz:

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	--

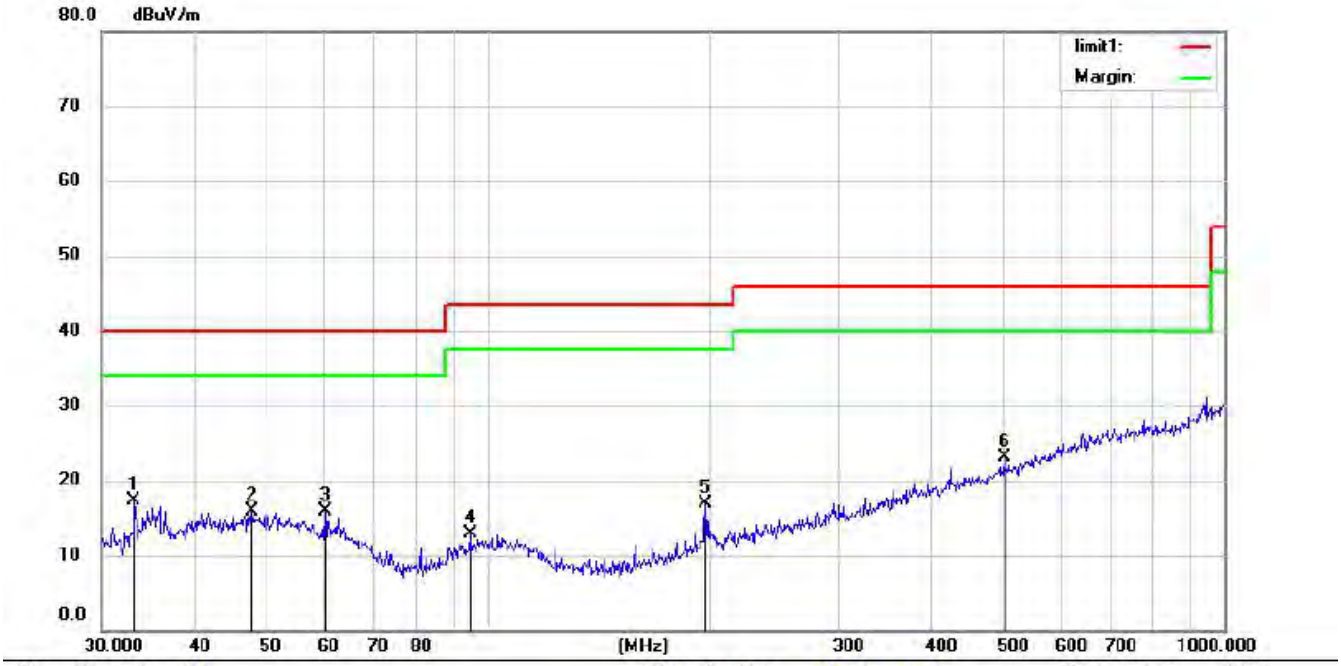
Note: The low frequency, which started from 9KHz-30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

Below 1000MHz:

Pass.

All modulation modes have been tested, the worst mode is (GFSK TX 2402MHz), the data is recorded on the following page, other modulation modes do not exceed this limit.

Please refer to the following data.



Site Chamber #1 Polarization: *Horizontal* Temperature: 21.6

Limit: FCC PART 15 C 3m(RE) Power: DC 3.7V Humidity: 60 %

Mode: TX 2402MHz

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	33.2112	36.29	-18.98	17.31	40.00	-22.69	QP			
2		47.9940	31.60	-15.67	15.93	40.00	-24.07	QP			
3		60.2801	33.07	-17.11	15.96	40.00	-24.04	QP			
4		94.7601	31.90	-19.02	12.88	43.50	-30.62	QP			
5		197.8928	34.30	-17.45	16.85	43.50	-26.65	QP			
6		502.9395	31.90	-8.78	23.12	46.00	-22.88	QP			

*:Maximum data x:Over limit !:over margin Operator: XIA

Site Chamber #1 Polarization: *Vertical* Temperature: 21.6

Limit: FCC PART 15 C 3m(RE) Power: DC 3.7V Humidity: 60 %

Mode:TX 2402MHz

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		31.0706	35.79	-18.89	16.90	40.00	-23.10	QP			
2	*	44.9006	33.19	-15.87	17.32	40.00	-22.68	QP			
3		54.8348	32.66	-15.93	16.73	40.00	-23.27	QP			
4		107.8877	33.46	-18.30	15.16	43.50	-28.34	QP			
5		138.8735	35.82	-21.50	14.32	43.50	-29.18	QP			
6		338.4001	30.90	-12.37	18.53	46.00	-27.47	QP			

*:Maximum data x:Over limit !:over margin Operator: XIA

Above 1000MHz~10th Harmonics:

All modulation modes have been tested, the worst mode is (GFSK), the data is recorded on the following page, other modulation modes do not exceed this limit.Please refer to the following data.

Operation Mode: GFSK (CH0: 2402MHz) Test Date : January 25, 2021

Freq.	Ant. Pol.	Reading Level(dBuV/m)		Correct Factor	Emission Level(dBuV/m)		Limit 3m(dBuV/m		Margin(dB)	
(MHz)	H/V	PK	AV	dB	PK	AV	PK	AV	PK	AV
4804	V	91.99	75.06	-32.3	59.69	42.76	74	54	-14.31	-11.24
7206	V	97.38	70.93	-37.2	60.18	33.73	74	54	-13.82	-20.27
9608	V	96.29	76.42	-39.8	56.49	36.62	74	54	-17.51	-17.38
12010	V	95.93	75.80	-40.5	55.43	35.30	74	54	-18.57	-18.70
14412	V	98.58	70.60	-41.7	56.88	28.90	74	54	-17.12	-25.10
16814	V	98.83	72.19	-40.0	58.83	32.19	74	54	-15.17	-21.81
4804	H	98.89	71.98	-31.6	67.29	40.38	74	54	-6.71	-13.62
7206	H	95.60	73.71	-35.5	60.10	38.21	74	54	-13.90	-15.79
9608	H	92.58	74.27	-38.3	54.28	35.97	74	54	-19.72	-18.03
12010	H	93.14	74.93	-39.0	54.14	35.93	74	54	-19.86	-18.07
14412	H	94.03	72.42	-42.0	52.03	30.42	74	54	-21.97	-23.58
16814	H	97.15	72.87	-39.3	57.85	33.57	74	54	-16.15	-20.43

Operation Mode: GFSK (CH39: 2441MHz) Test Date : January 25, 2021

Freq.	Ant. Pol.	Reading Level(dBuV/m)		Correct Factor	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
(MHz)	H/V	PK	AV	dB	PK	AV	PK	AV	PK	AV
4882	V	91.90	76.71	-32.3	59.6	44.41	74	54	-14.40	-9.59
7323	V	93.74	70.31	-37.2	56.54	33.11	74	54	-17.46	-20.89
9764	V	92.12	70.19	-39.8	52.32	30.39	74	54	-21.68	-23.61
12205	V	97.59	75.36	-40.5	57.09	34.86	74	54	-16.91	-19.14
14646	V	94.14	70.58	-41.0	53.14	29.58	74	54	-20.86	-24.42
17087	V	91.05	74.68	-41.1	49.95	33.58	74	54	-24.05	-20.42
4882	H	98.13	74.97	-31.6	66.53	43.37	74	54	-7.47	-10.63
7323	H	91.17	76.68	-35.5	55.67	41.18	74	54	-18.33	-12.82
9764	H	93.52	70.04	-38.3	55.22	31.74	74	54	-18.78	-22.26
12205	H	96.43	73.53	-39.0	57.43	34.53	74	54	-16.57	-19.47
14646	H	97.07	75.38	-42.0	55.07	33.38	74	54	-18.93	-20.62
17087	H	97.49	70.67	-41.5	55.99	29.17	74	54	-18.01	-24.83

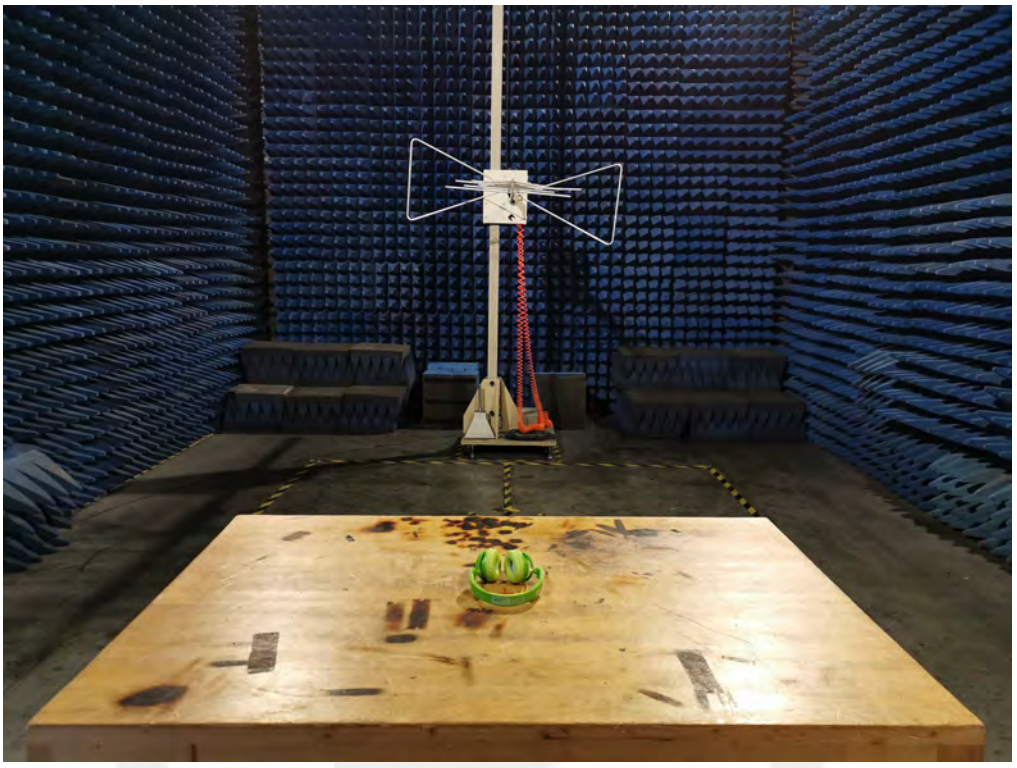
Operation Mode: GFSK (CH78: 2480MHz) Test Date : January 25, 2021

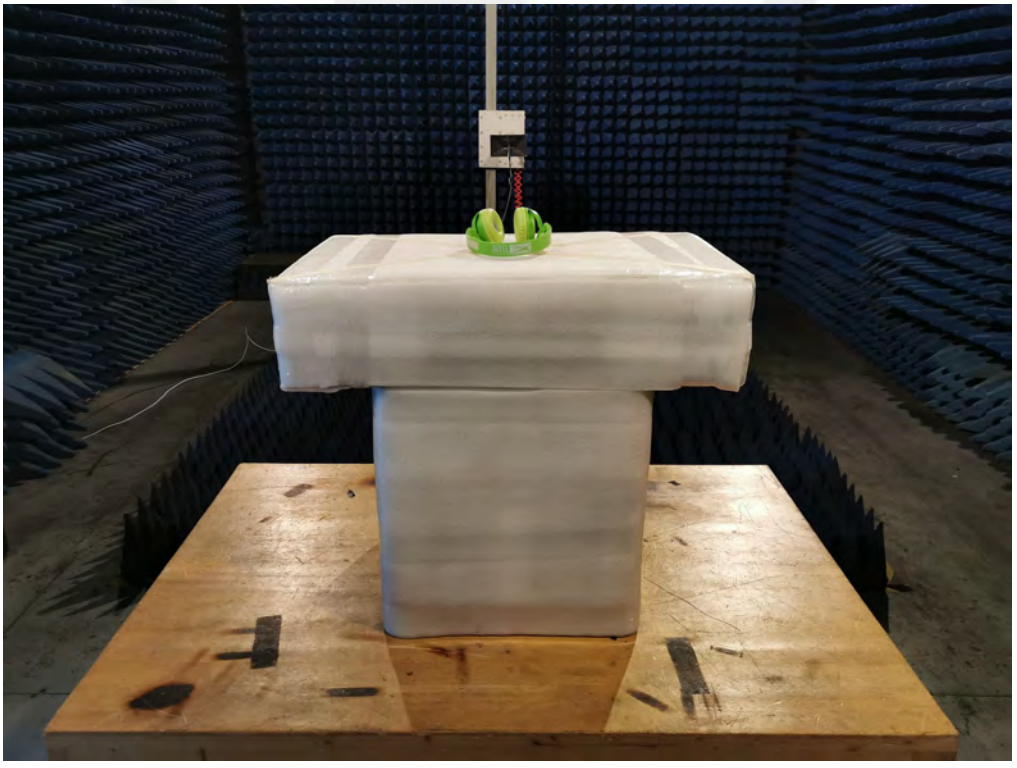
Freq.	Ant. Pol.	Reading Level(dBuV/m)		Correct Factor	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
(MHz)	H/V	PK	AV	dB	PK	AV	PK	AV	PK	AV
4960	V	91.30	74.27	-32.3	59	41.97	74	54	-15.00	-12.03
7440	V	98.84	73.57	-37.2	61.64	36.37	74	54	-12.36	-17.63
9920	V	97.04	72.13	-39.8	57.24	32.33	74	54	-16.76	-21.67
12400	V	97.73	72.12	-40.5	57.23	31.62	74	54	-16.77	-22.38
14880	V	94.01	71.51	-41.0	53.01	30.51	74	54	-20.99	-23.49
17360	V	91.10	74.75	-41.1	50	33.65	74	54	-24.00	-20.35
4960	H	91.60	73.98	-31.6	60	42.38	74	54	-14.00	-11.62
7440	H	94.87	73.15	-35.5	59.37	37.65	74	54	-14.63	-16.35
9920	H	98.57	71.60	-38.3	60.27	33.3	74	54	-13.73	-20.70
12400	H	92.75	73.66	-39.0	53.75	34.66	74	54	-20.25	-19.34
14880	H	97.14	71.61	-42.0	55.14	29.61	74	54	-18.86	-24.39
17360	H	97.12	73.16	-41.5	55.62	31.66	74	54	-18.38	-22.34

Other harmonics emissions are lower than 20dB below the allowable limit.

Note: (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
(3) The average measurement was not performed when the peak measured data under the limit of average detection.
(4) Measuring frequencies from 1GHz to 25GHz.

8.6. Radiated Measurement Photos:



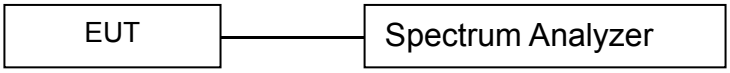


9. Channel Separation test

9.1. Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

9.2. Test SET-UP (Block Diagram of Configuration)



9.3. Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/22/2020	05/21/2021
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/22/2020	05/21/2021
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/22/2020	05/21/2021

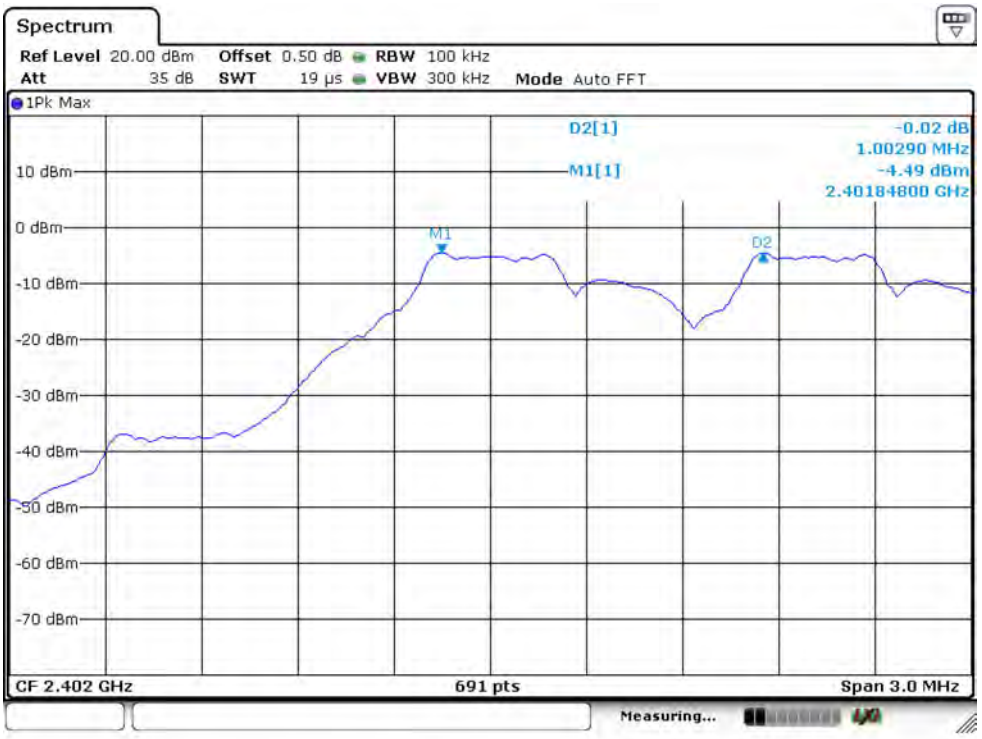
Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

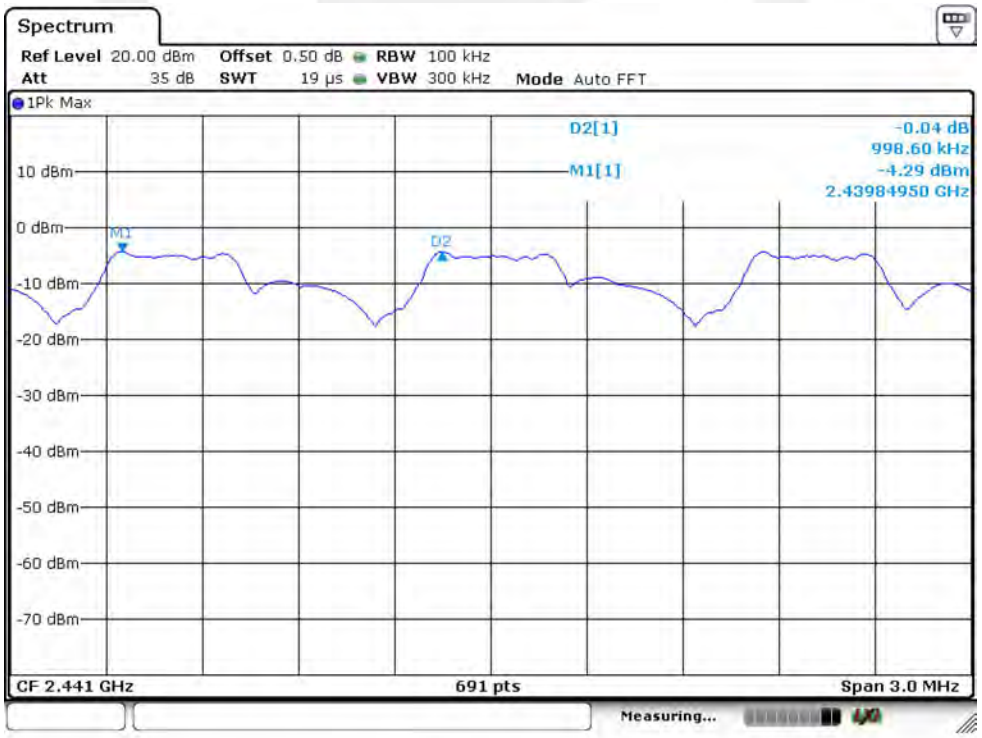
9.4. Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
0	2402	1003	>634
39	2441	999	>602
78	2480	999	>634

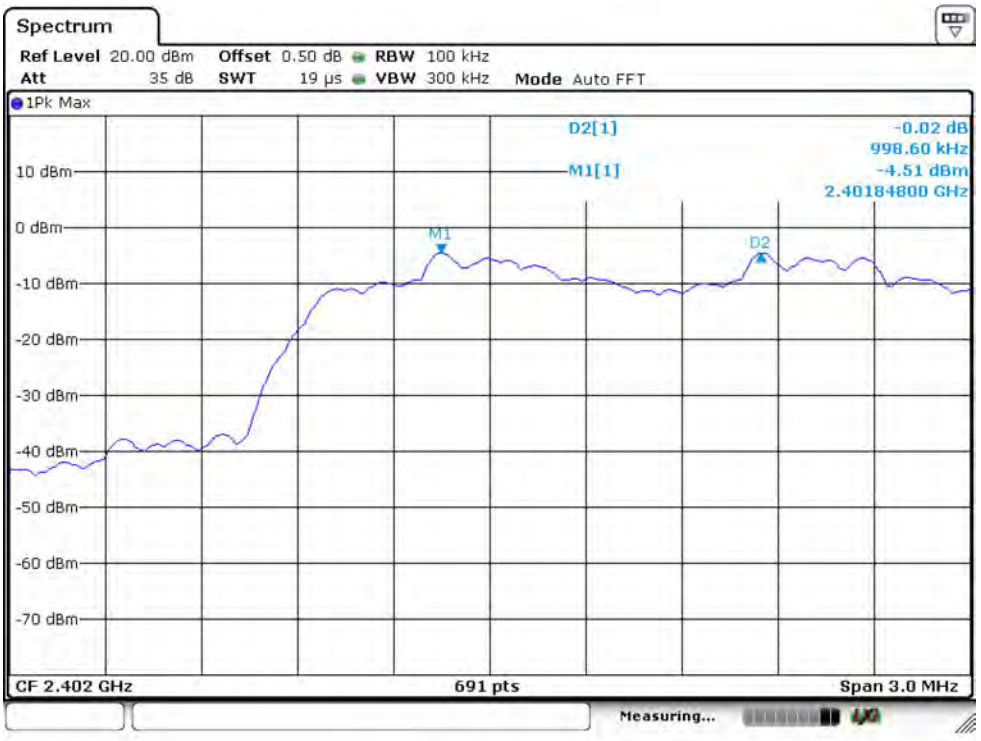

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 100 kHz
Att 35 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D2[1] -0.02 dB
1.00290 MHz
M1[1] -4.49 dBm
2.40184800 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D2
CF 2.402 GHz
691 pts
Span 3.0 MHz
Measuring...

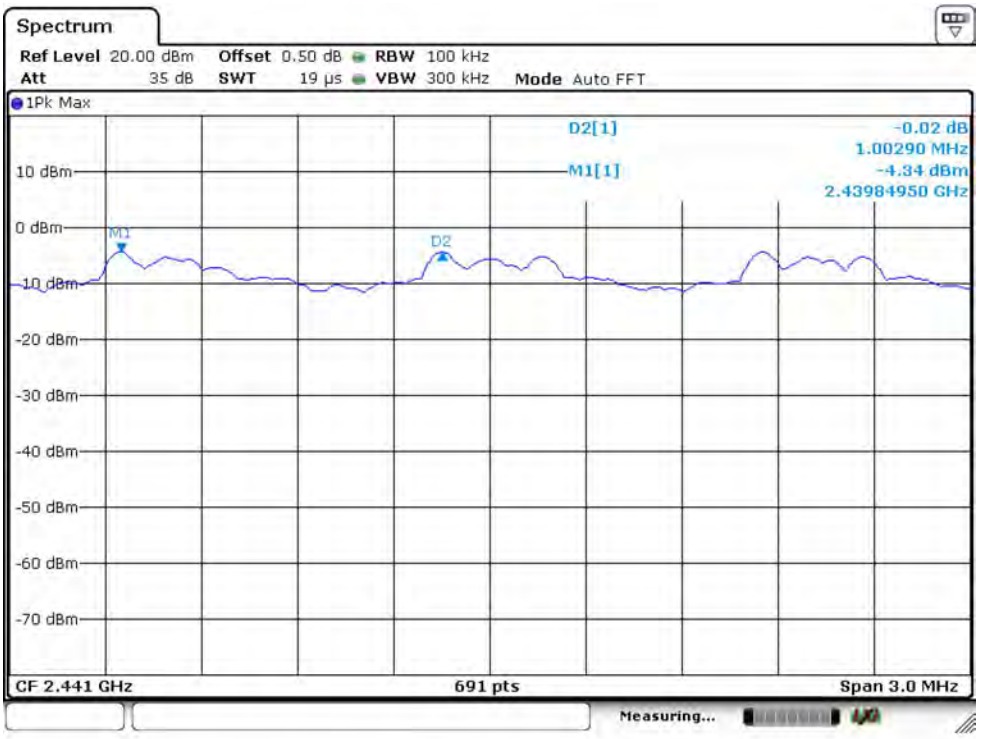

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 100 kHz
Att 35 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D2[1] -0.04 dB
998.60 kHz
M1[1] -4.29 dBm
2.43984950 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D2
CF 2.441 GHz
691 pts
Span 3.0 MHz
Measuring...

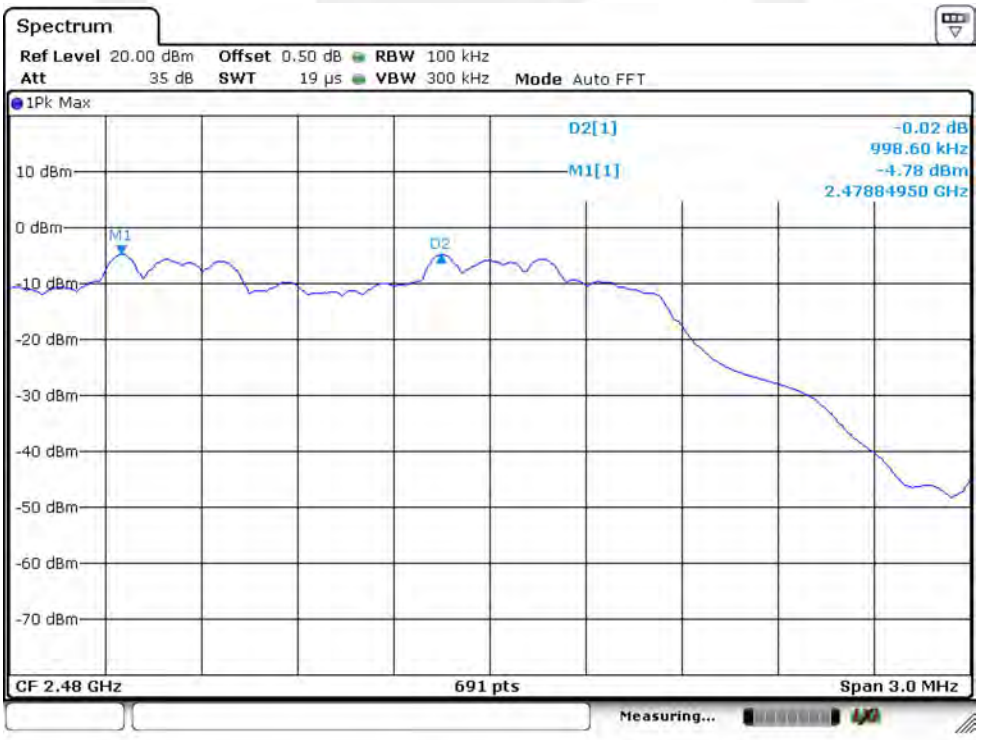

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 100 kHz
Att 35 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D2[1] -0.06 dB
998.60 kHz
M1[1] -4.72 dBm
2.47884950 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D2
CF 2.48 GHz
691 pts
Span 3.0 MHz
Measuring...

Spectrum Detector:	PK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	Π/4-DQPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
0	2402	999	>831
39	2441	1003	>831
78	2480	999	>831

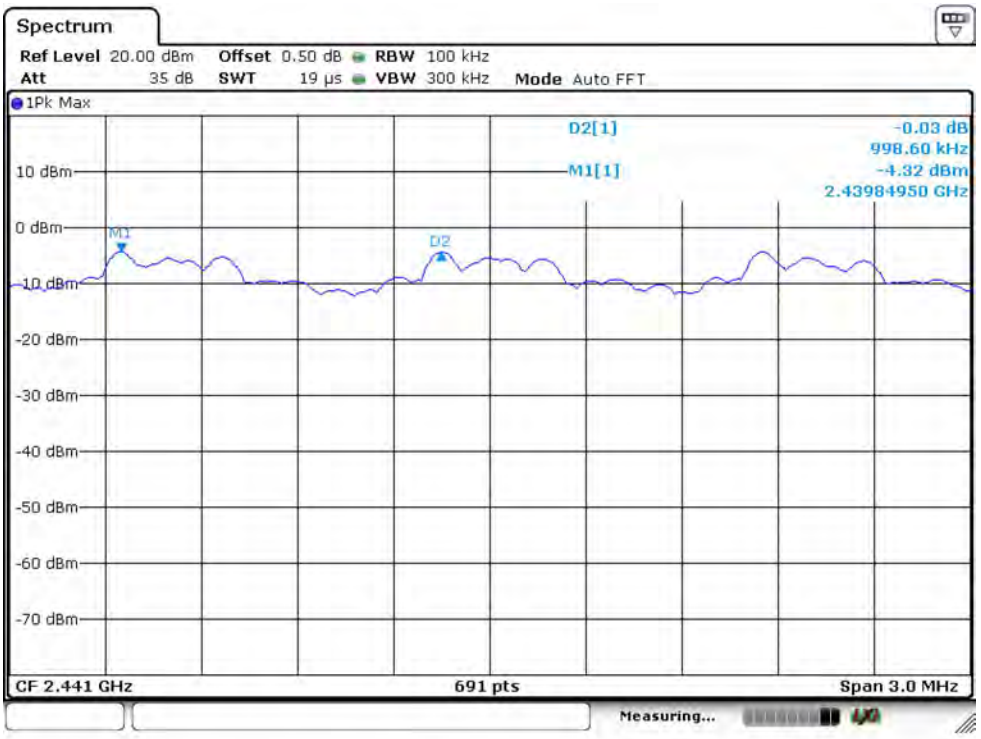



Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 100 kHz
Att 35 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D2[1] -0.02 dB
1.00290 MHz
M1[1] -4.34 dBm
2.43984950 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D2
CF 2.441 GHz
691 pts
Span 3.0 MHz
Measuring...


Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 100 kHz
Att 35 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D2[1] -0.02 dB
998.60 kHz
M1[1] -4.78 dBm
2.47884950 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D2
CF 2.48 GHz
691 pts
Span 3.0 MHz
Measuring...

Spectrum Detector:	PK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	Separation Read Value (kHz)	Separation Limit 2/3 20dB Down BW(kHz)
0	2402	1003	>811
39	2441	999	>811
78	2480	1003	>811


Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 100 kHz
Att 35 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D2[1] -0.03 dB
998.60 kHz
M1[1] -4.32 dBm
2.43984950 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D2
CF 2.441 GHz
691 pts
Span 3.0 MHz
Measuring...

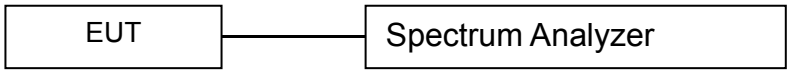

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 100 kHz
Att 35 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D2[1] -0.01 dB
1.00290 MHz
M1[1] -4.79 dBm
2.47884950 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D2
CF 2.48 GHz
691 pts
Span 3.0 MHz
Measuring...

10. 20dB Bandwidth test

10.1.Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

10.2.Test SET-UP (Block Diagram of Configuration)



10.3. Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/22/2020	05/21/2021
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/22/2020	05/21/2021
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/22/2020	05/21/2021

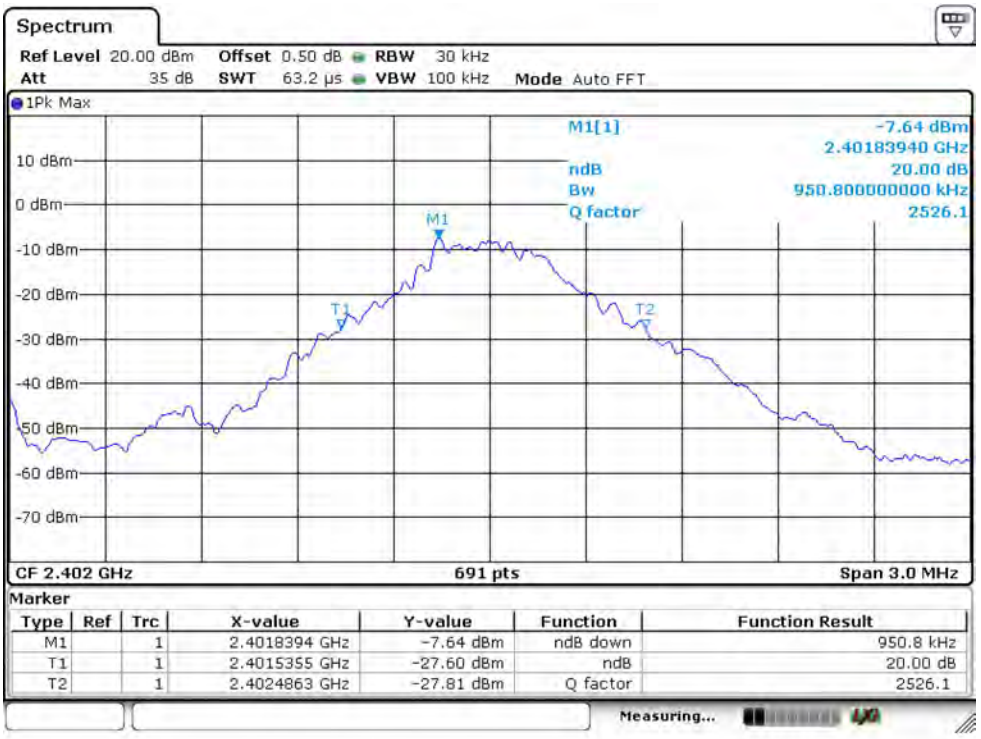
Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

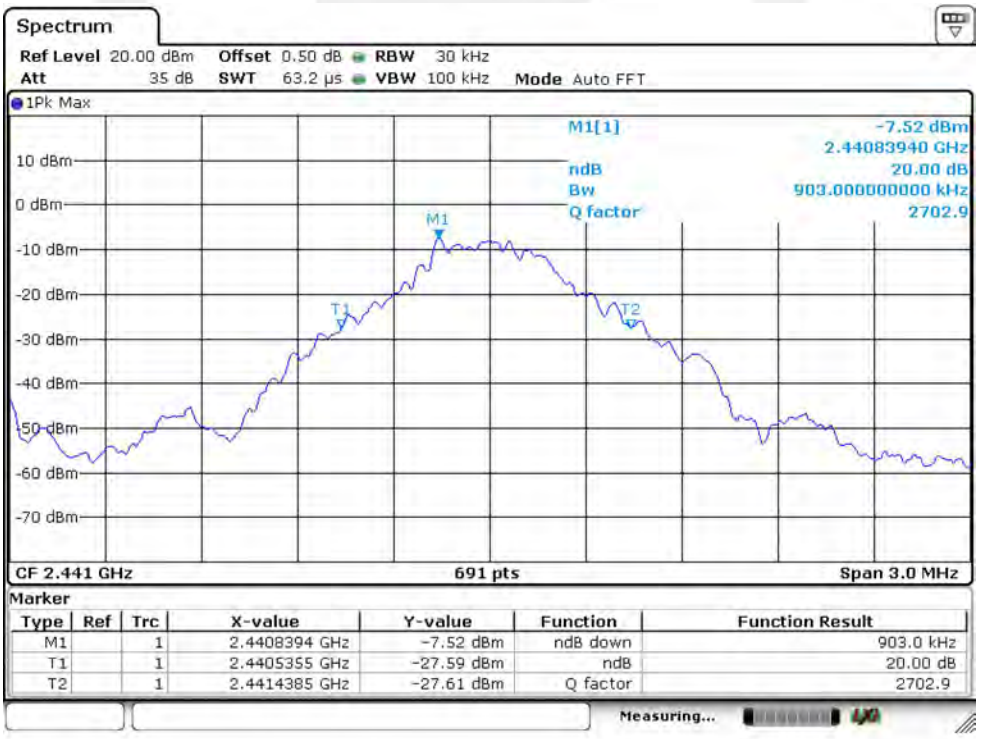
10.4. Measurement Results:

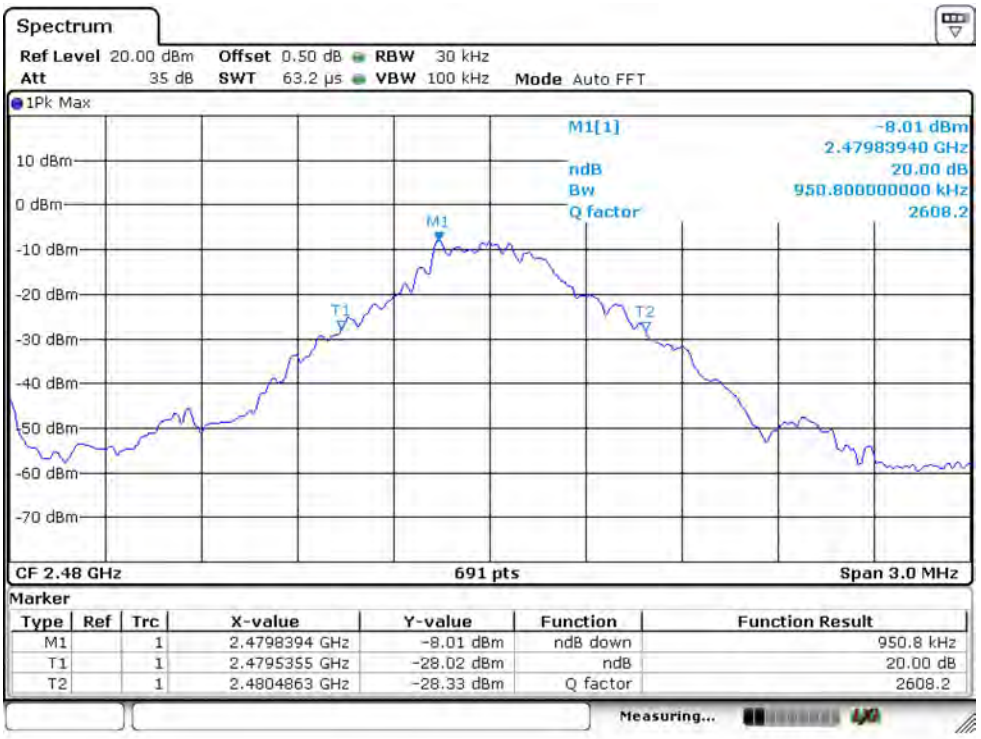
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
0	2402	951
39	2441	903
78	2480	951

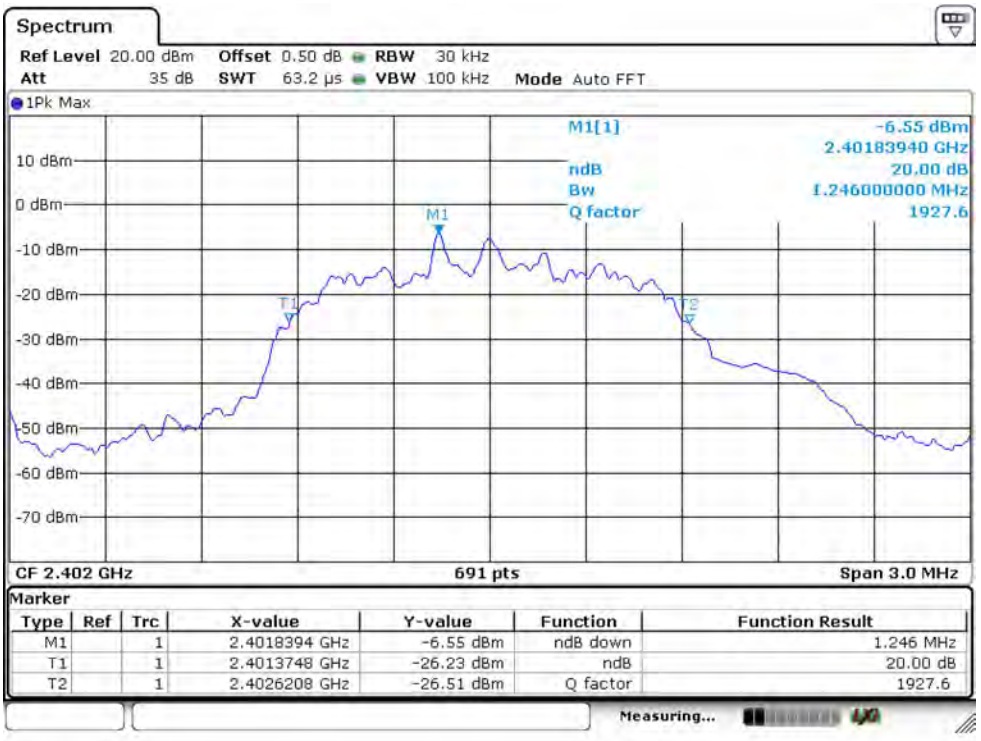

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 30 kHz
Att 35 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT
1Pk Max
M1[1] -7.64 dBm
2.40183940 GHz
ndB 20.00 dB
Bw 950.800000000 kHz
Q factor 2526.1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 2.402 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4018394 GHz -7.64 dBm ndB down 950.8 kHz
T1 1 2.4015355 GHz -27.60 dBm ndB 20.00 dB
T2 1 2.4024863 GHz -27.81 dBm Q factor 2526.1
Measuring...

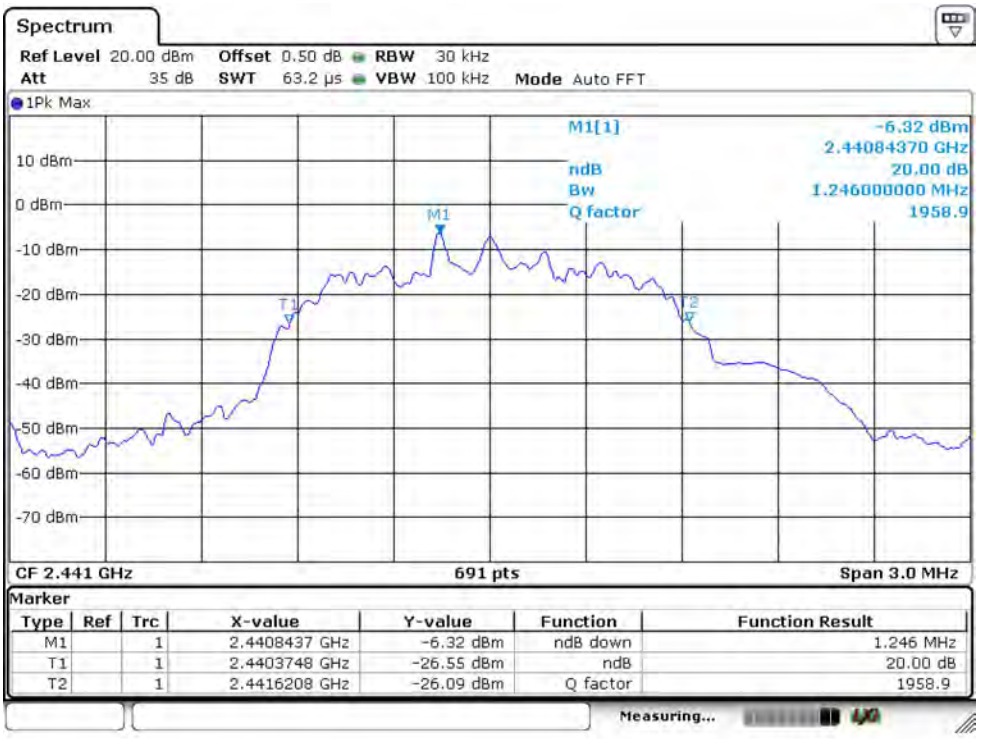

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 30 kHz
Att 35 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT
1Pk Max
M1[1] -7.52 dBm
2.44083940 GHz
ndB 20.00 dB
Bw 903.000000000 kHz
Q factor 2702.9
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 2.441 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4408394 GHz -7.52 dBm ndB down 903.0 kHz
T1 1 2.4405355 GHz -27.59 dBm ndB 20.00 dB
T2 1 2.4414385 GHz -27.61 dBm Q factor 2702.9
Measuring...

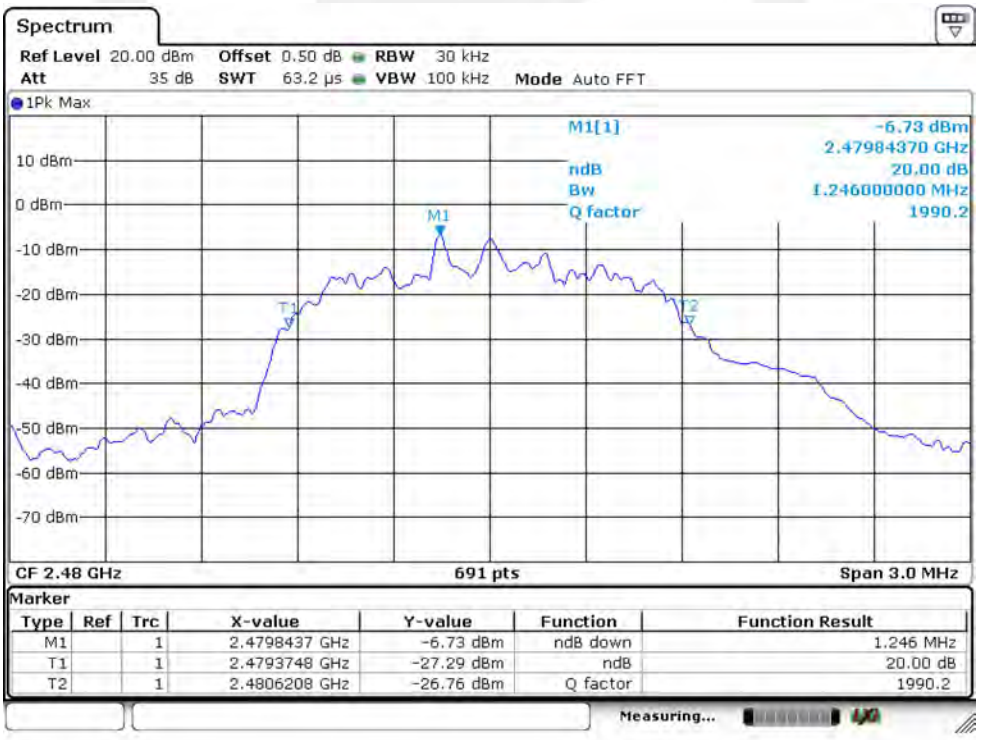

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 30 kHz
Att 35 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT
1Pk Max
M1[1] -8.01 dBm
2.47983940 GHz
ndB 20.00 dB
Bw 950.800000000 kHz
Q factor 2608.2
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 2.48 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4798394 GHz -8.01 dBm ndB down 950.8 kHz
T1 1 2.4795355 GHz -28.02 dBm ndB 20.00 dB
T2 1 2.4804863 GHz -28.33 dBm Q factor 2608.2
Measuring...

Spectrum Detector:	PK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	Π/4-DQPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
0	2402	1246
39	2441	1246
78	2480	1246

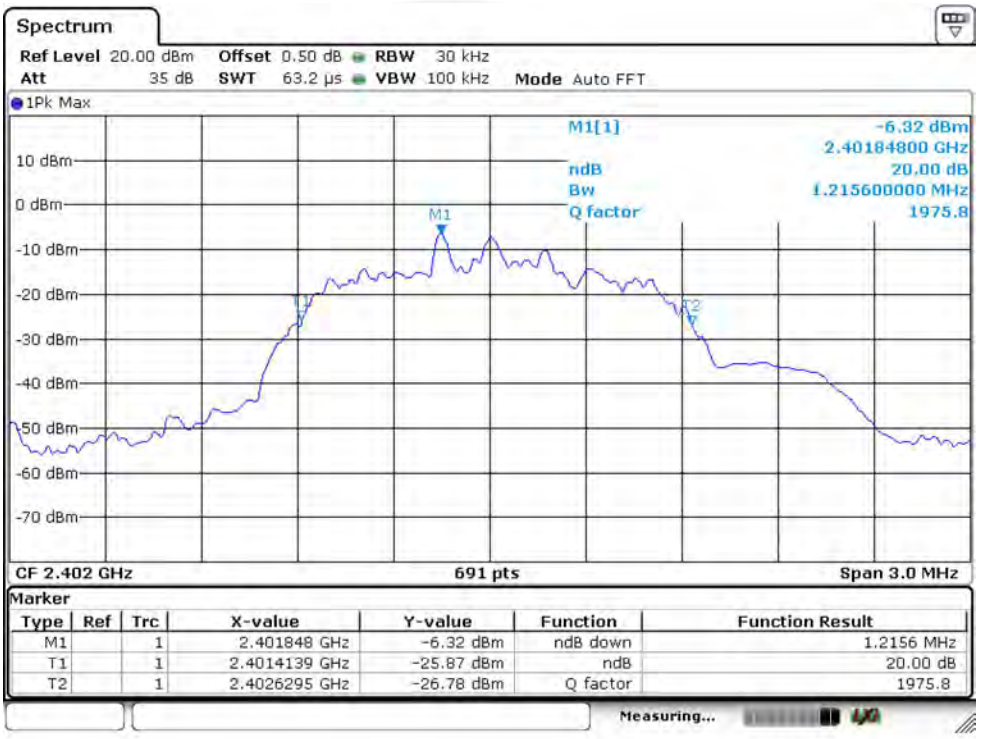


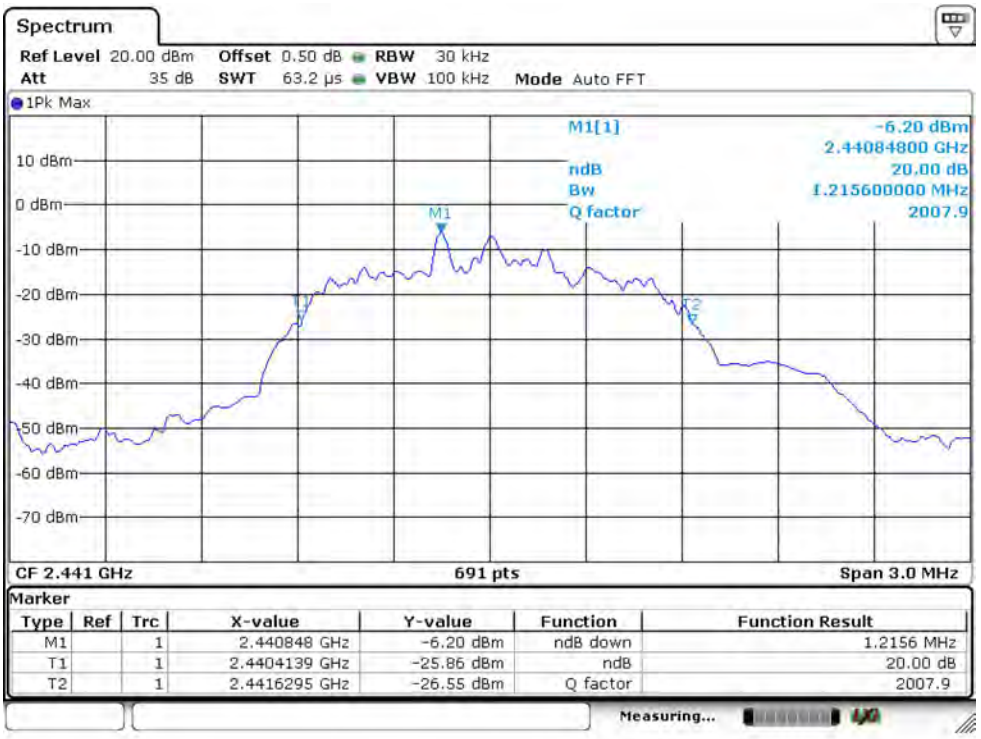

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 30 kHz
Att 35 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT
1Pk Max
M1[1] -6.32 dBm
2.44084370 GHz
ndB 20.00 dB
Bw 1.246000000 MHz
Q factor 1958.9
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 2.441 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4408437 GHz -6.32 dBm ndB down 1.246 MHz
T1 1 2.4403748 GHz -26.55 dBm ndB 20.00 dB
T2 1 2.4416208 GHz -26.09 dBm Q factor 1958.9
Measuring...

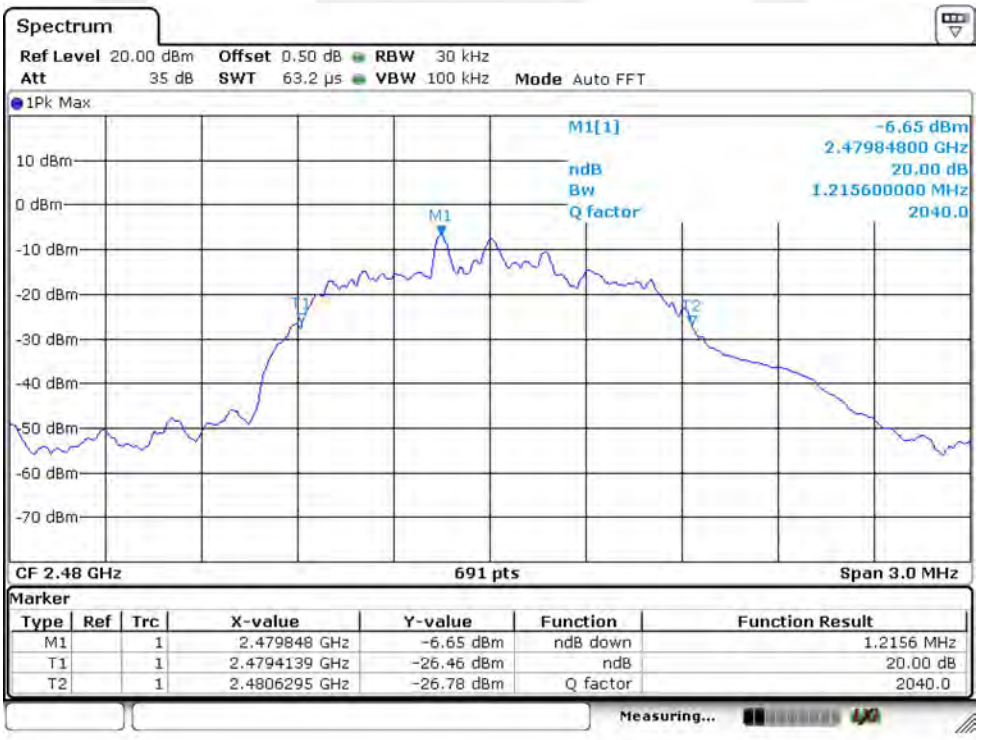

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 30 kHz
Att 35 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT
1Pk Max
M1[1] -6.73 dBm
2.47984370 GHz
ndB 20.00 dB
Bw 1.246000000 MHz
Q factor 1990.2
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 2.48 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4798437 GHz -6.73 dBm ndB down 1.246 MHz
T1 1 2.4793748 GHz -27.29 dBm ndB 20.00 dB
T2 1 2.4806208 GHz -26.76 dBm Q factor 1990.2
Measuring...

Spectrum Detector:	PK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Modulation:	8DPSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
0	2402	1216
39	2441	1216
78	2480	1216




Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 30 kHz
Att 35 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT
1Pk Max
M1[1] -6.20 dBm
2.44084800 GHz
ndB 20.00 dB
Bw 1.215600000 MHz
Q factor 2007.9
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 2.441 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.440848 GHz -6.20 dBm ndB down 1.2156 MHz
T1 1 2.4404139 GHz -25.86 dBm ndB 20.00 dB
T2 1 2.4416295 GHz -26.55 dBm Q factor 2007.9
Measuring...


Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 30 kHz
Att 35 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT
1Pk Max
M1[1] -6.65 dBm
2.47984800 GHz
ndB 20.00 dB
Bw 1.215600000 MHz
Q factor 2040.0
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
T1
T2
CF 2.48 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.479848 GHz -6.65 dBm ndB down 1.2156 MHz
T1 1 2.4794139 GHz -26.46 dBm ndB 20.00 dB
T2 1 2.4806295 GHz -26.78 dBm Q factor 2040.0
Measuring...

11. Quantity of Hopping Channel Test

11.1.Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

11.2.Test SET-UP (Block Diagram of Configuration)

EUT —— Spectrum Analyzer

11.3.Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/22/2020	05/21/2021
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/22/2020	05/21/2021
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/22/2020	05/21/2021

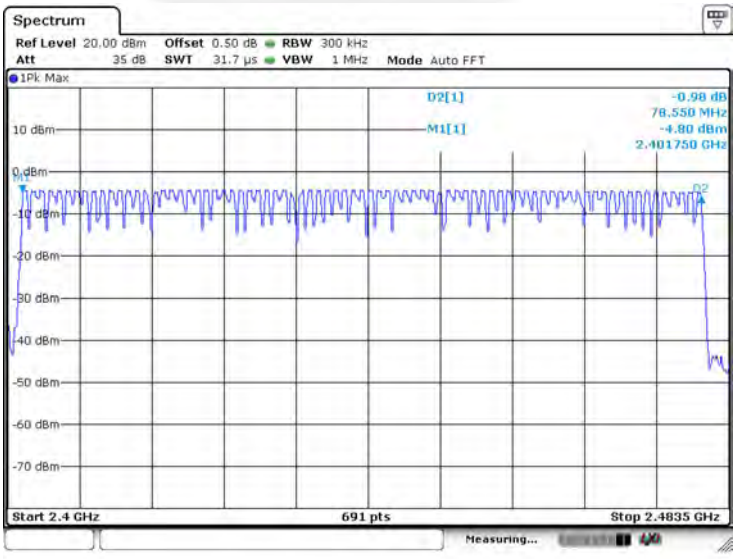
Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

11.4.Measurement Results:

Refer to attached data chart.

Worst Test Mode	GFSK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %

Hopping Channel Frequency Range	Quantity of Hopping Channel	Quantity of Hopping Channel
2402-2480	79	＞15



12. Time of Occupancy (Dwell Time) test

12.1.Test Description

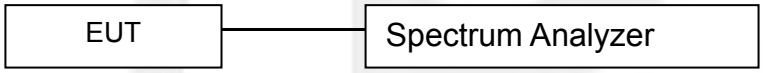
The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

Dwell time = time slot length * hop rate / number of hopping channels * 31.6s

with:
- hop rate = 1600 * 1/s for DH1 packets = 1600 s^{-1}
- hop rate = 1600/3 * 1/s for DH3 packets = 533.33 s^{-1}
- number of hopping channels = 79
- 31.6 s = 0.4 seconds multiplied by the number of hopping channels = 0.4 s * 79

The highest value of the dwell time is reported.

12.2.Test SET-UP (Block Diagram of Configuration)



12.3.Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/22/2020	05/21/2021
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/22/2020	05/21/2021
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/22/2020	05/21/2021

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

12.4.Test Requirements / Limits

FCC Part 15, Subpart C, §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. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6seconds. Refer to attached data chart

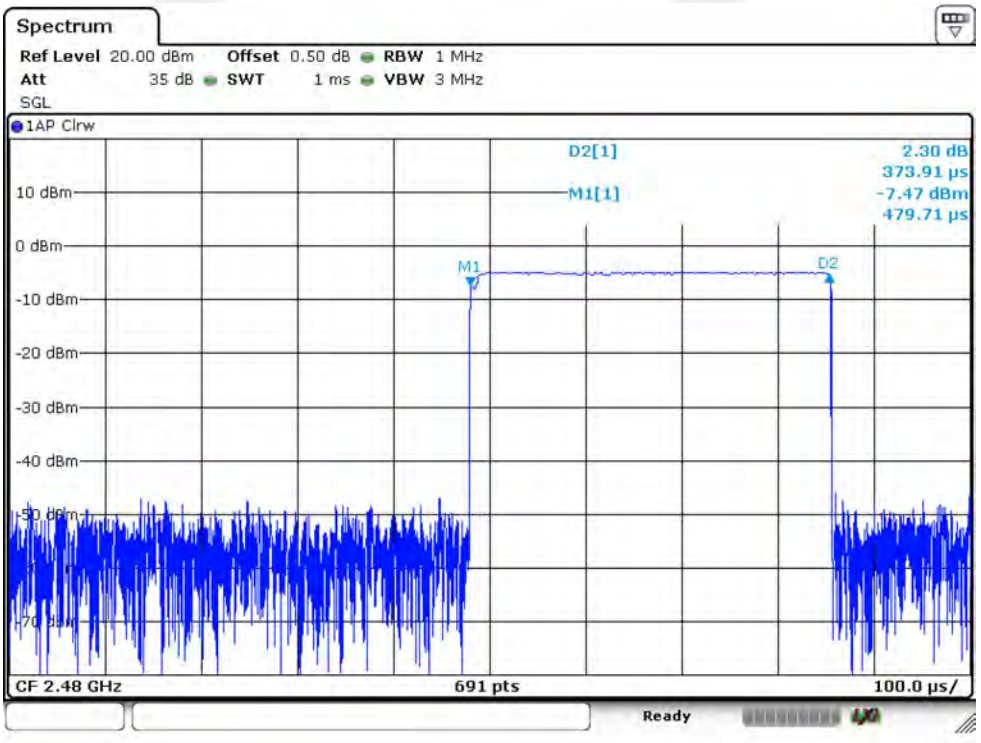
Modulation:	GFSK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %

12.5.Test result

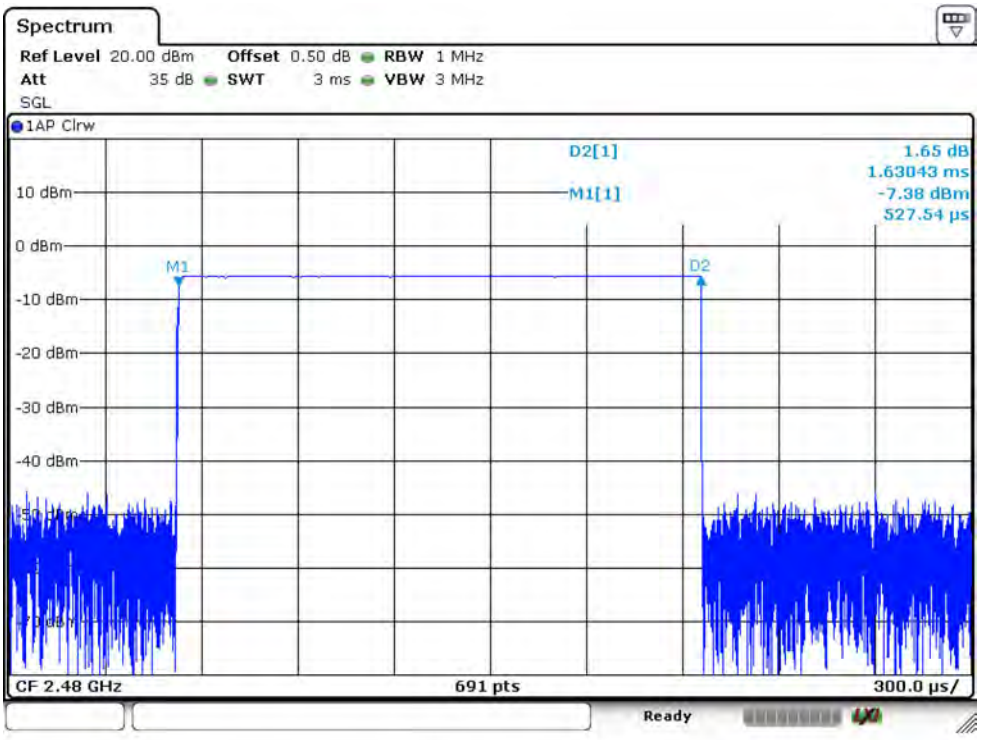
Mode	Number of transmission in a 31.6(79 Hopping*0.4)	Length of transmissions time(msec)	Result (msec)	Limit (msec)
DH1	1600/(2*79) x 31.6 = 320	0.374	119.68	400
DH3	1600/(4*79) x 31.6 =160	1.630	260.8	400
DH5	1600/(6*79) x 31.6 =106.67	2.870	306.143	400

Remark: The results of worst cased was recorded.

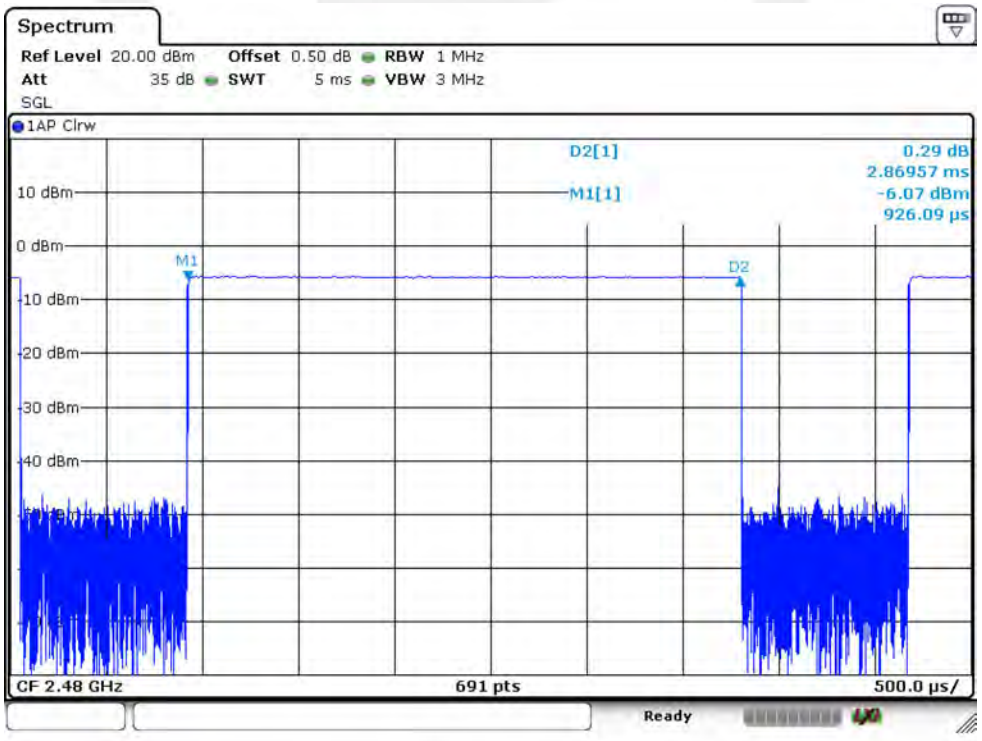
DH1:



DH3:


Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 1 MHz
Att 35 dB SWT 3 ms VBW 3 MHz
SGL
1AP Clrw
D2[1] 1.65 dB
1.63043 ms
M1[1] -7.38 dBm
527.54 µs
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
M1
D2
CF 2.48 GHz
691 pts
300.0 µs/
Ready

DH5:

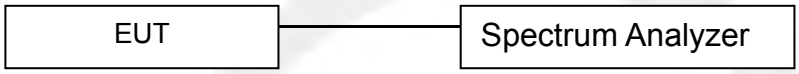

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 1 MHz
Att 35 dB SWT 5 ms VBW 3 MHz
SGL
1AP Clrw
D2[1] 0.29 dB
2.86957 ms
M1[1] -6.07 dBm
926.09 µs
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
M1
D2
CF 2.48 GHz
691 pts
500.0 µs/
Ready

13. MAXIMUM PEAK OUTPUT POWER TEST

13.1.Measurement Procedure

a. Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.
d. Measure the captured power within the band and recording the plot.
e. Repeat above procedures until all frequencies required were complete.

13.2.Test SET-UP (Block Diagram of Configuration)



13.3.Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	Characteristics	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSV30	1321.3008K	10Hz-30GHz	05/22/2020	05/21/2021
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	05/22/2020	05/21/2021
Antenna Connector	ARTHUR-YANG	2244-N1TG1	N/A	10Hz-30GHz	05/22/2020	05/21/2021

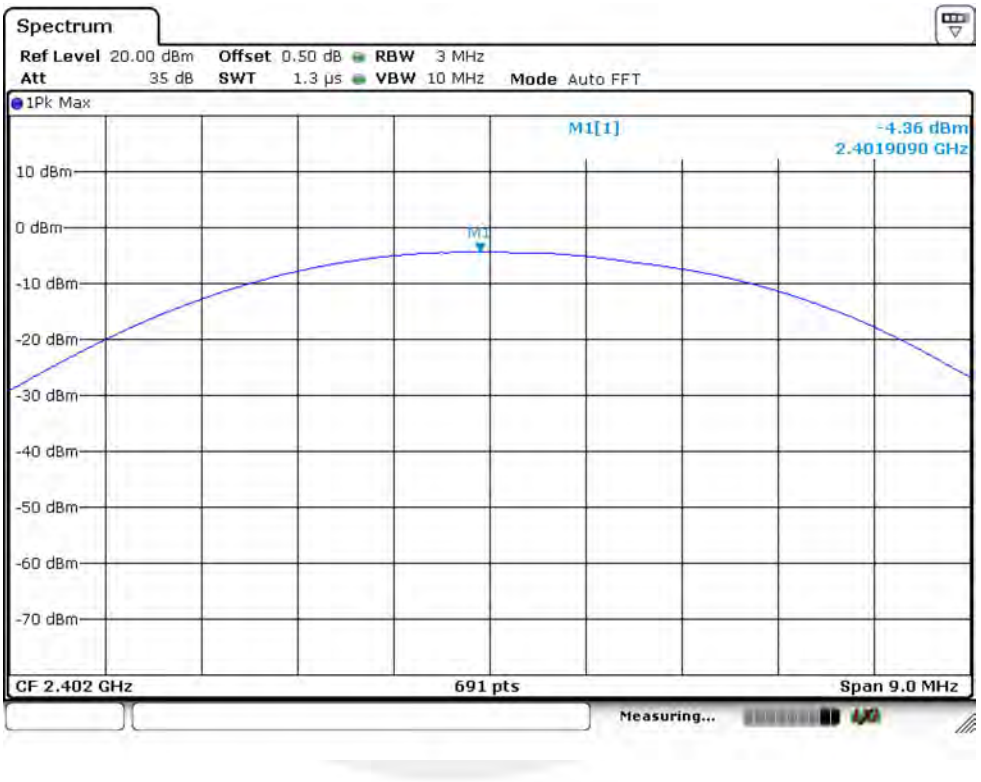
Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

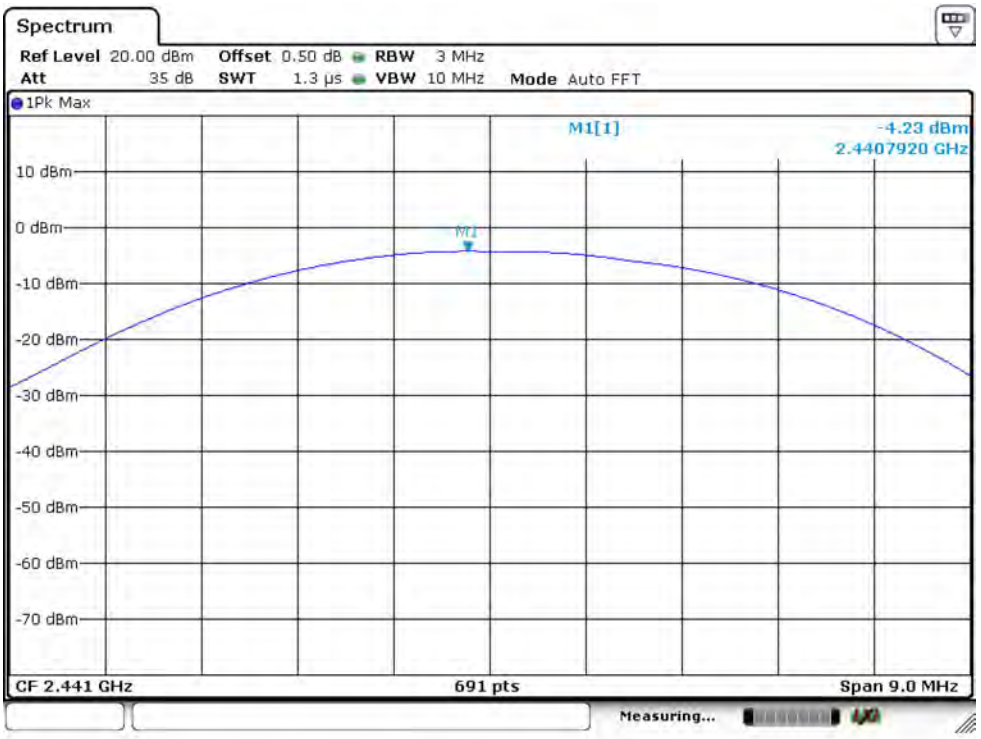
13.4.Measurement Results:

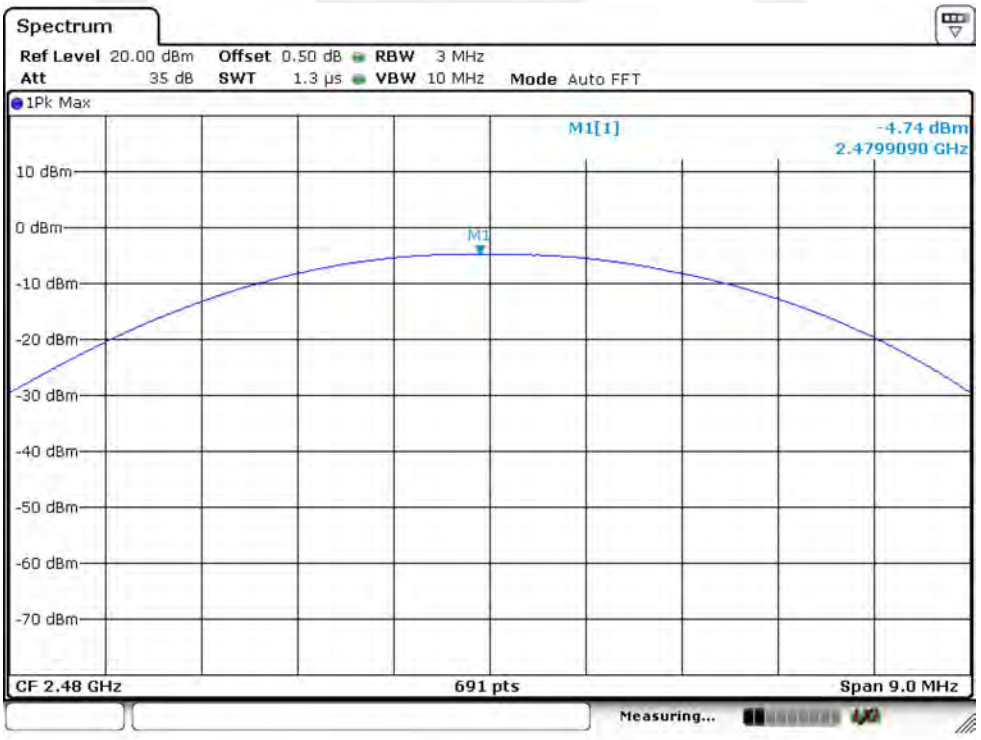
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	GFSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
0	2402	-4.36	0.366	1000	PASS
39	2441	-4.23	0.378	1000	PASS
78	2480	-4.74	0.336	1000	PASS

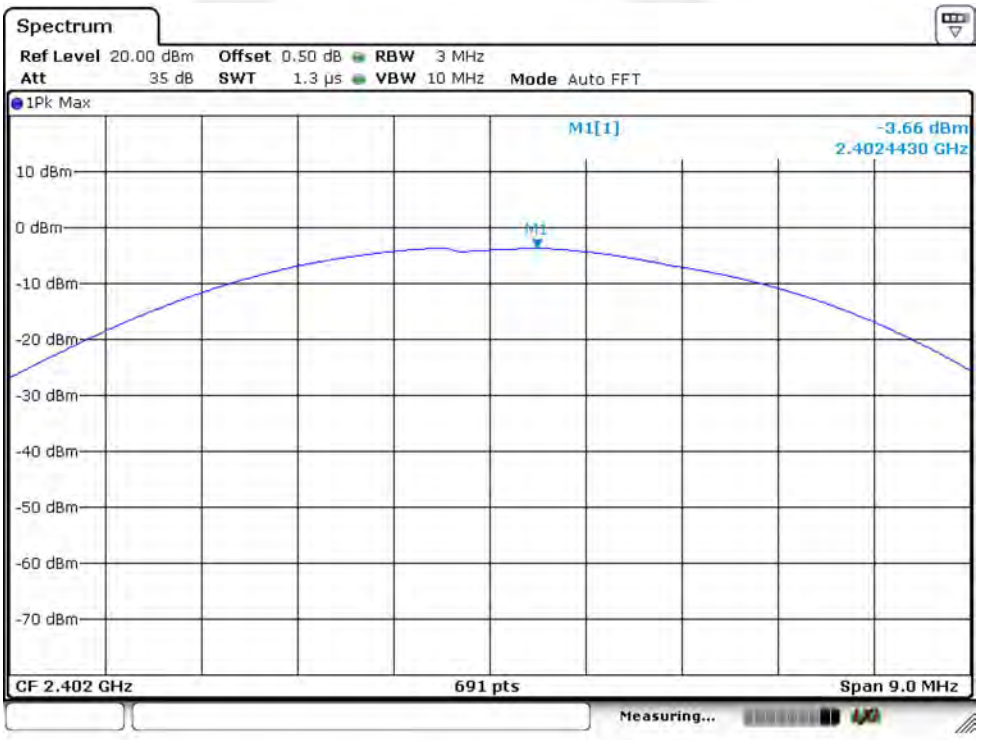


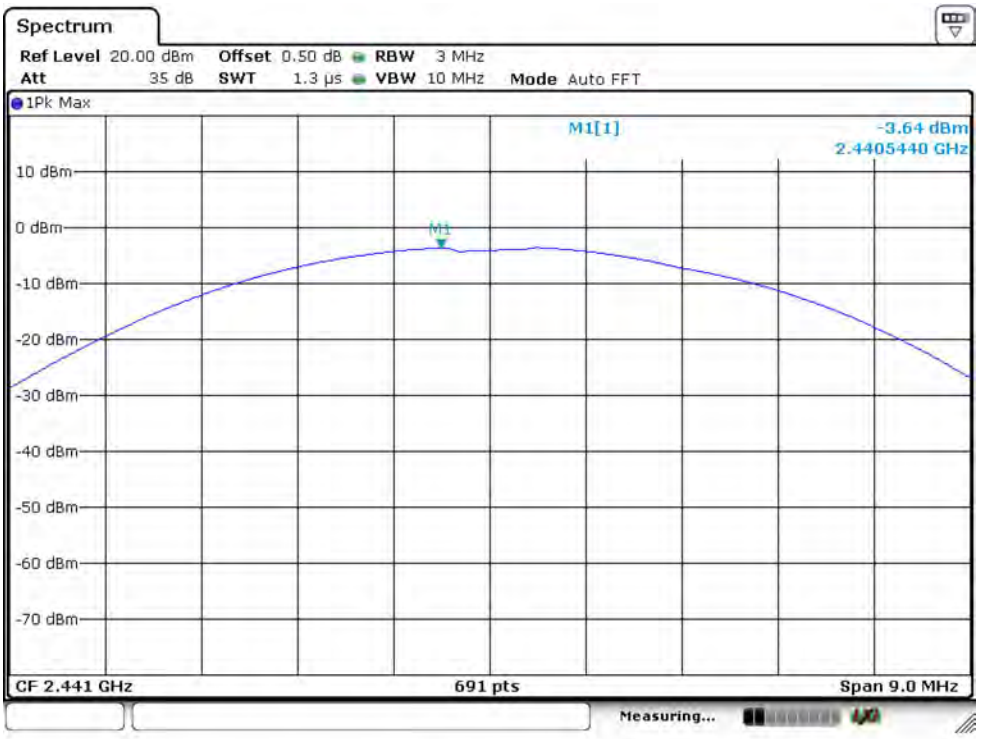

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 3 MHz
Att 35 dB SWT 1.3 µs VBW 10 MHz Mode Auto FFT
1Pk Max
M1[1] -4.23 dBm
2.4407920 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
CF 2.441 GHz
691 pts
Span 9.0 MHz
Measuring...

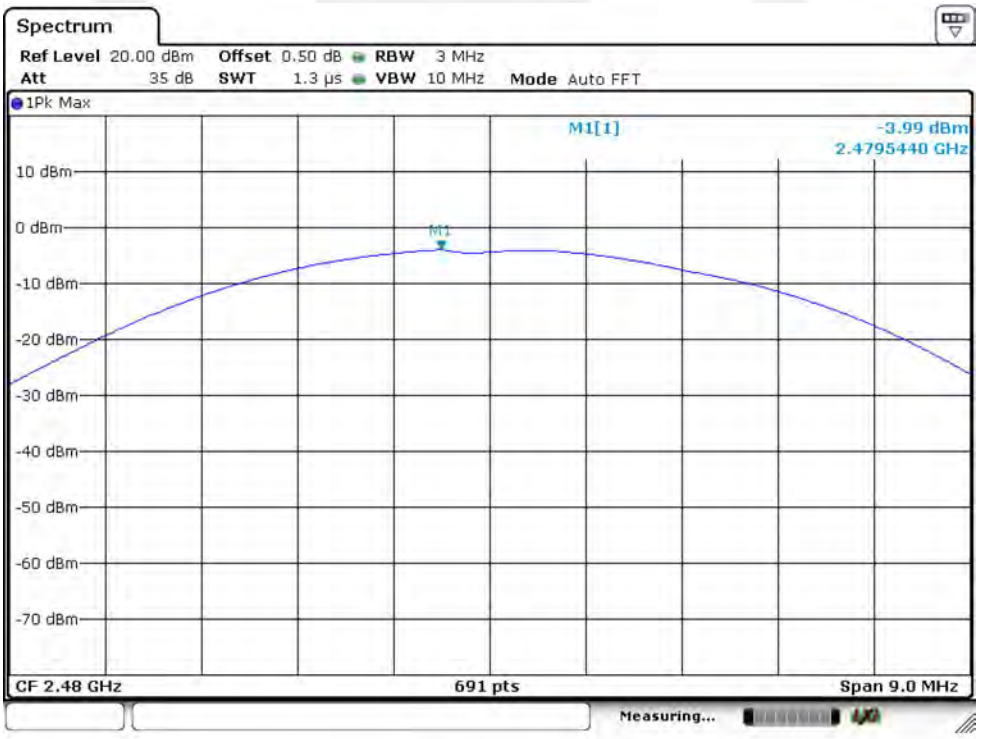

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 3 MHz
Att 35 dB SWT 1.3 µs VBW 10 MHz Mode Auto FFT
1Pk Max
M1[1] -4.74 dBm
2.4799090 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
CF 2.48 GHz
691 pts
Span 9.0 MHz
Measuring...

Spectrum Detector:	PK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	Π/4-DQPSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
0	2402	-3.66	0.431	125	PASS
39	2441	-3.64	0.433	125	PASS
78	2480	-3.99	0.399	125	PASS

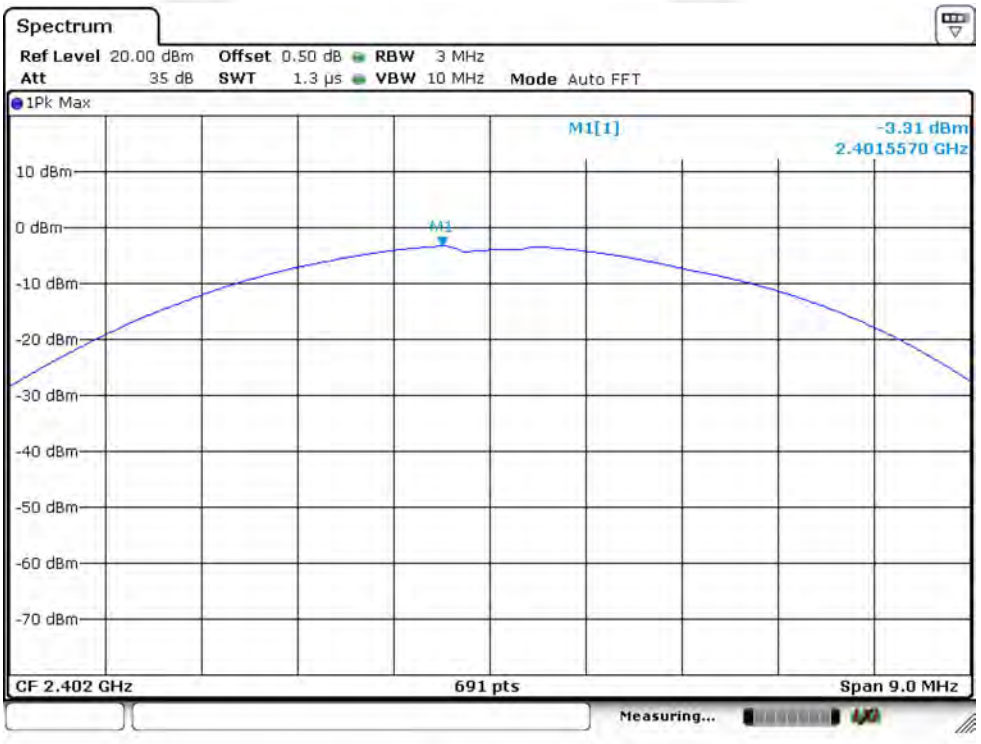


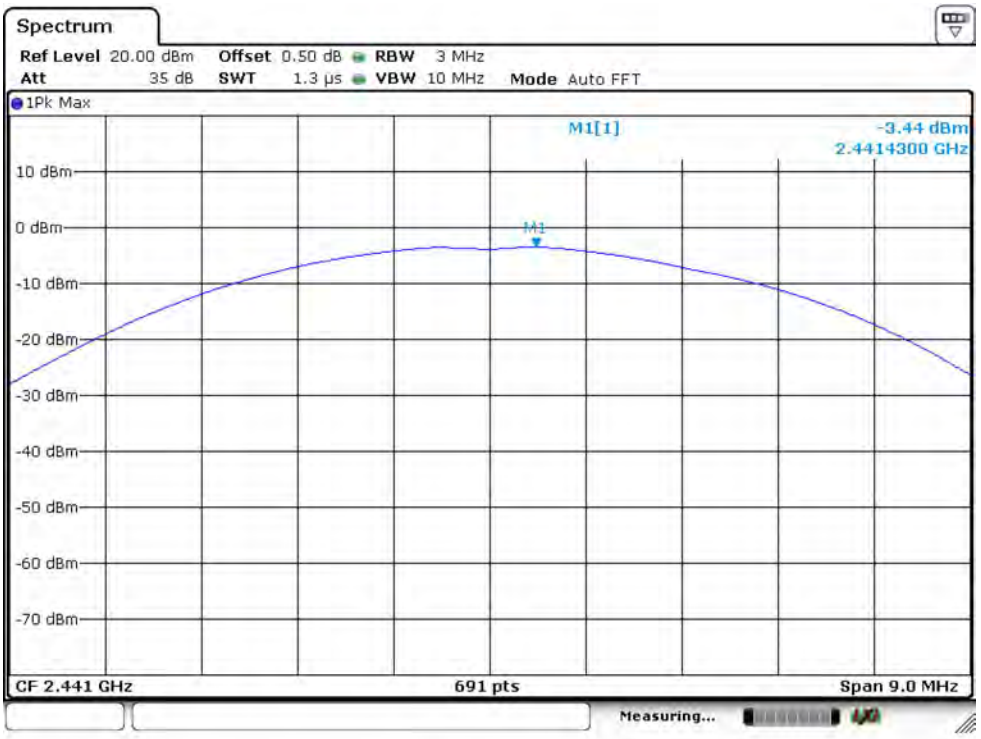

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 3 MHz
Att 35 dB SWT 1.3 µs VBW 10 MHz Mode Auto FFT
1Pk Max
M1[1] -3.64 dBm
2.4405440 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
CF 2.441 GHz
691 pts
Span 9.0 MHz
Measuring...

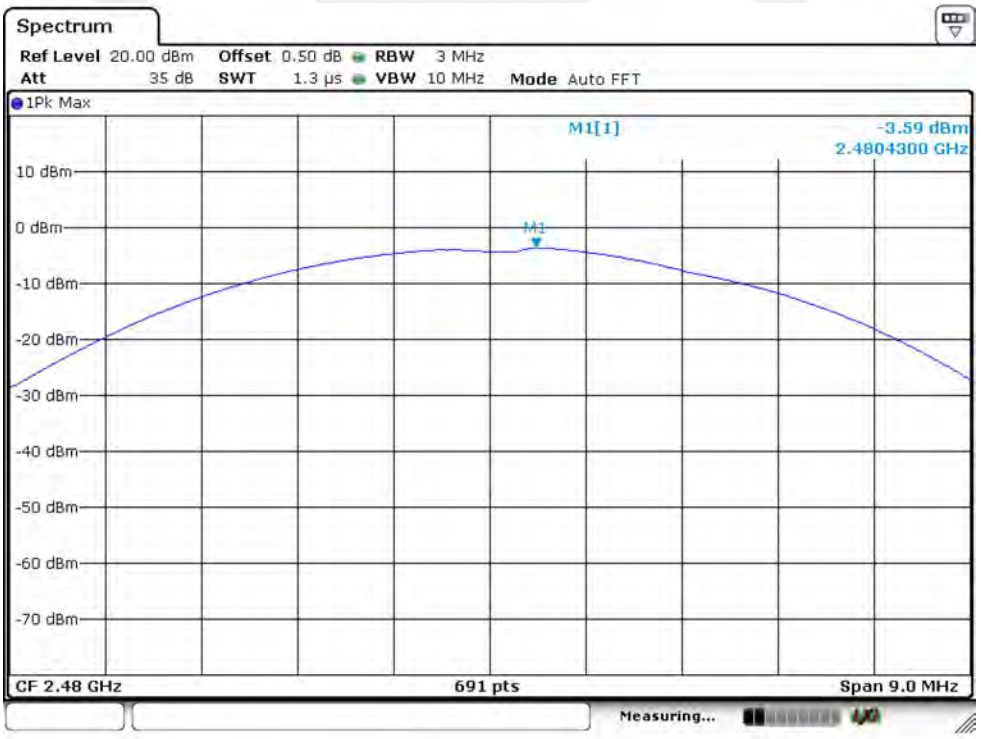

Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 3 MHz
Att 35 dB SWT 1.3 µs VBW 10 MHz Mode Auto FFT
1Pk Max
M1[1] -3.99 dBm
2.4795440 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
CF 2.48 GHz
691 pts
Span 9.0 MHz
Measuring...

Spectrum Detector:	PK	Test Date :	January 25, 2021
Test By:	Loren	Temperature :	25 ℃
Test Result:	PASS	Humidity :	50 %
Modulation:	8DPSK		

Channel number	Channel Frequency (MHz)	Peak Power output(dBm)	Peak Power output(mW)	Peak Power Limit(mW)	Pass/Fail
0	2402	-3.31	0.467	125	PASS
39	2441	-3.44	0.453	125	PASS
78	2480	-3.59	0.438	125	PASS




Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 3 MHz
Att 35 dB SWT 1.3 µs VBW 10 MHz Mode Auto FFT
1Pk Max
M1[1] -3.44 dBm
2.4414300 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.441 GHz
691 pts
Span 9.0 MHz
Measuring...


Spectrum
Ref Level 20.00 dBm Offset 0.50 dB RBW 3 MHz
Att 35 dB SWT 1.3 µs VBW 10 MHz Mode Auto FFT
1Pk Max
M1[1] -3.59 dBm
2.4804300 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.48 GHz
691 pts
Span 9.0 MHz
Measuring...

14. CONDUCTED SUPRIOUS EMISSION

14.1. Applicable Standard

According to FCC Part 15.247(d) and KDB 558074 D01 15.247 MEAS GUIDANCE V05

14.2.Conformance Limit

According to FCC Part 15.247(d):
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, provided the transmitter demonstrates compliance with the peak conducted power limits.

14.3.Test Configuration

Test according to clause 7.1 radio frequency test setup 1

14.4.Test Procedure

The transmitter output (antenna port) was connected to the spectrum analyzer

- **Reference level measurement**

Establish a reference level by using the following procedure:
Set instrument center frequency to DSS channel center frequency.
Set Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel.
Set the RBW = 100 kHz. Set the VBW ≥ 3 x RBW.
Set Detector = peak. Set Sweep time = auto couple.
Set Trace mode = max hold. Allow trace to fully stabilize.
Use the peak marker function to determine the maximum Maximum conduceted level.
Note that the channel found to contain the maximum conduceted level can be used to establish the reference level.

- **Band-edge Compliance of RF Conducted Emissions**

Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation
Set RBW ≥ 1% of the span=100kHz Set VBW ≥ RBW
Set Sweep = auto Set Detector function = peak Set Trace = max hold
Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section.
Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize.
Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

- **Conduceted Spurious RF Conducted Emission**

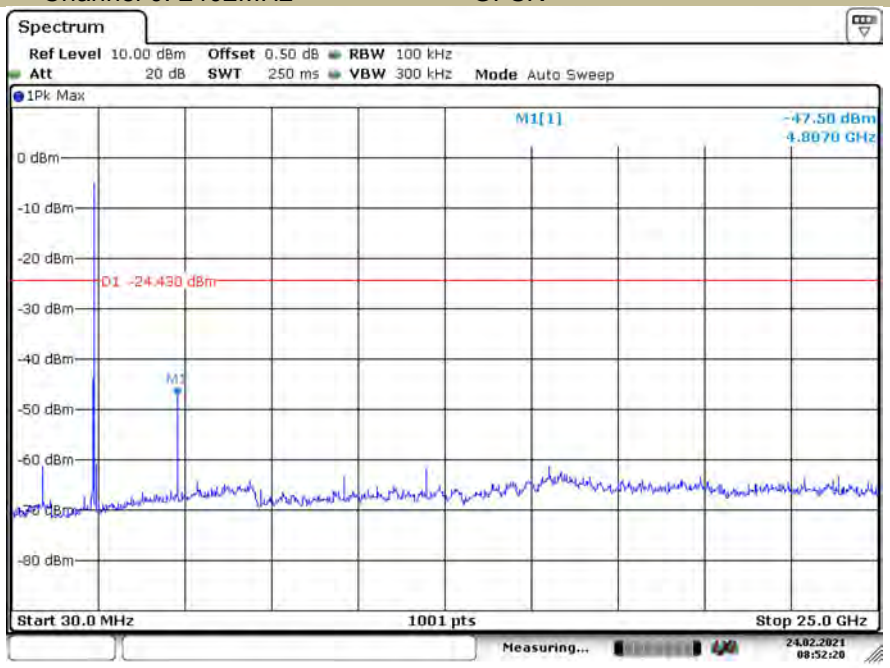
Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.(30MHz to 25GHz). Set RBW = 100 kHz Set VBW ≥ RBW
Set Sweep = auto Set Detector function = peak Set Trace = max hold
Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section.

14.5.Test Results

Bluetooth (GFSK, pi/4-DQPSK, 8DPSK) mode have been tested, and the worst result(GFSK) was report as below:

Test Model	Maximum Conduceted Level RBW=100kHz Bluetooth V4.0 Channel 0: 2402MHz GFSK

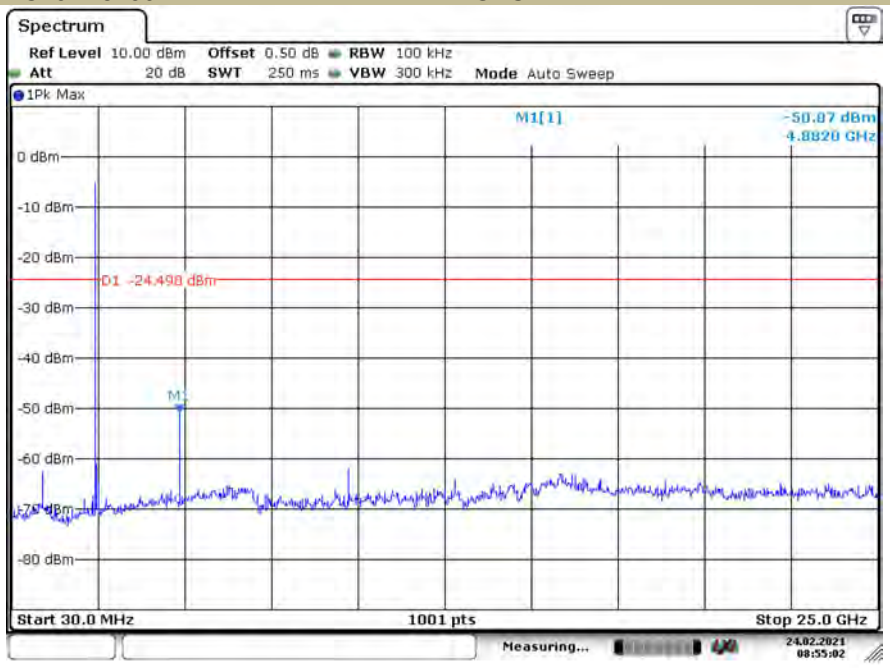
Test Model	Conduceted Spurious RF Conducted Emission Bluetooth V4.0 Channel 0: 2402MHz GFSK



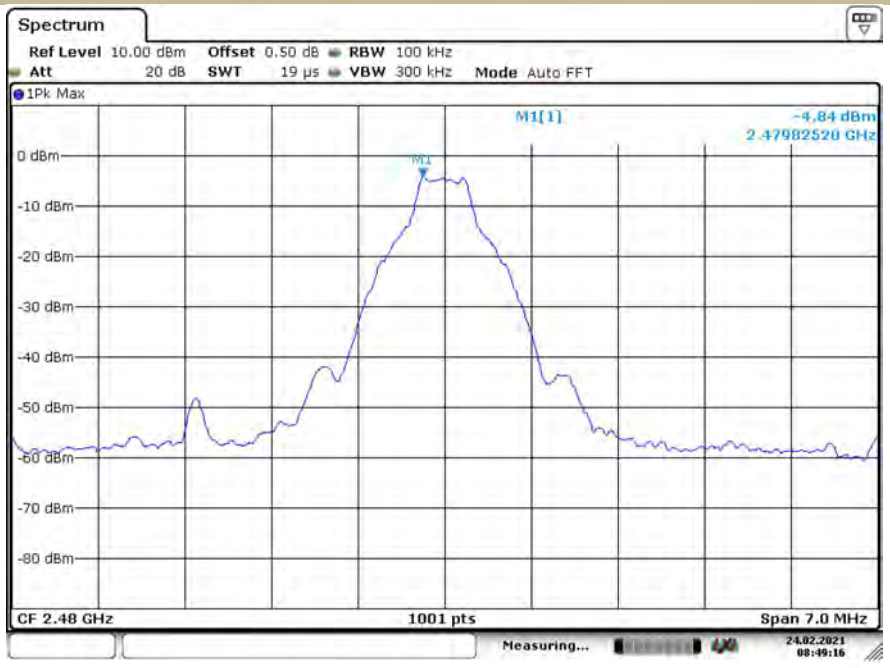
Test Model	Band-edge Conducted Emissions Bluetooth V4.0 Channel 0: 2402MHz GFSK

Test Model	Maximum Conduceted Level RBW=100kHz Bluetooth V4.0 Channel 39: 2441MHz GFSK

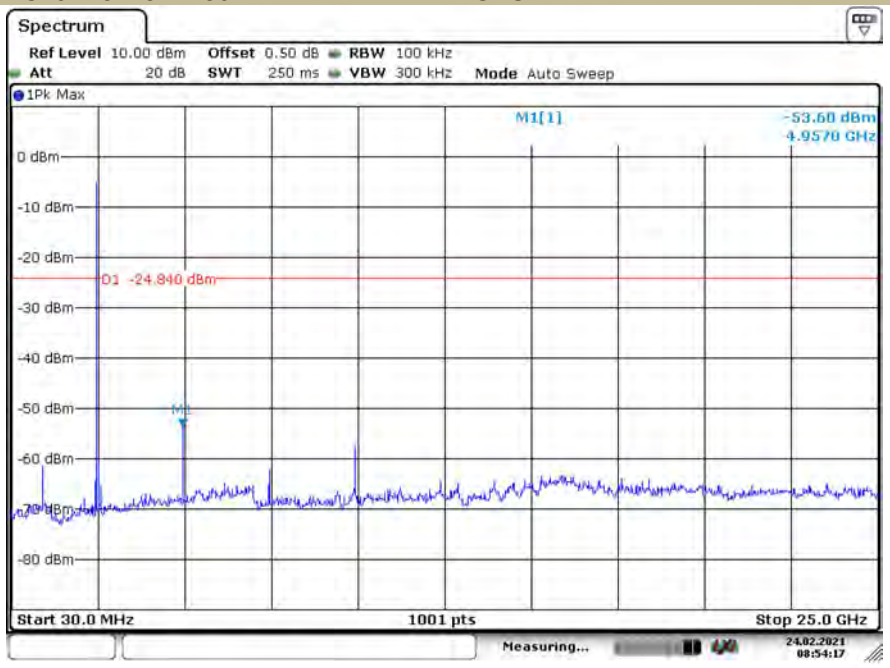
Test Model	Conduceted Spurious RF Conducted Emission Bluetooth V4.0 Channel 39: 2441MHz GFSK



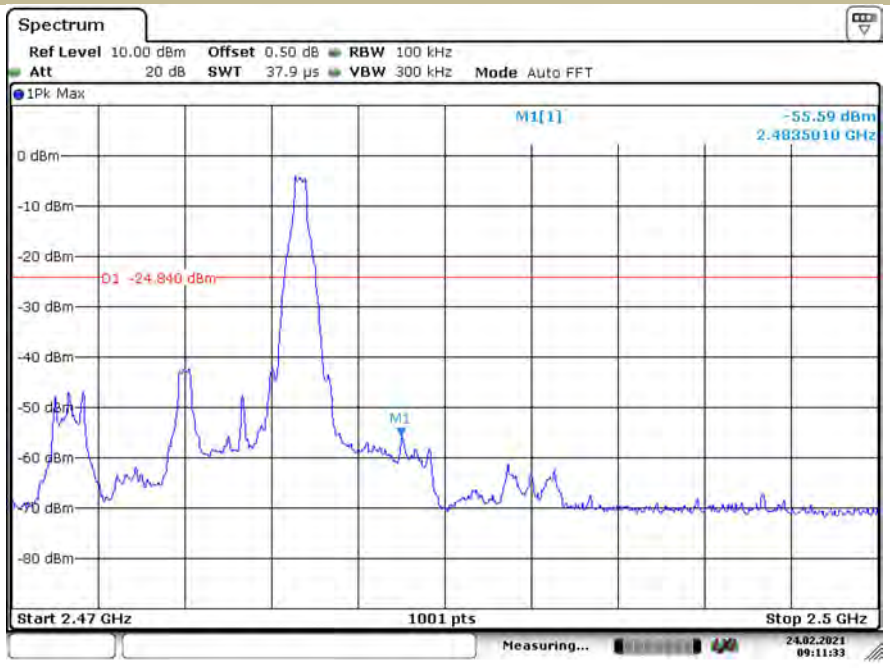
Test Model	Maximum Conduceted Level RBW=100kHz Bluetooth V4.0 Channel 78: 2480MHz GFSK



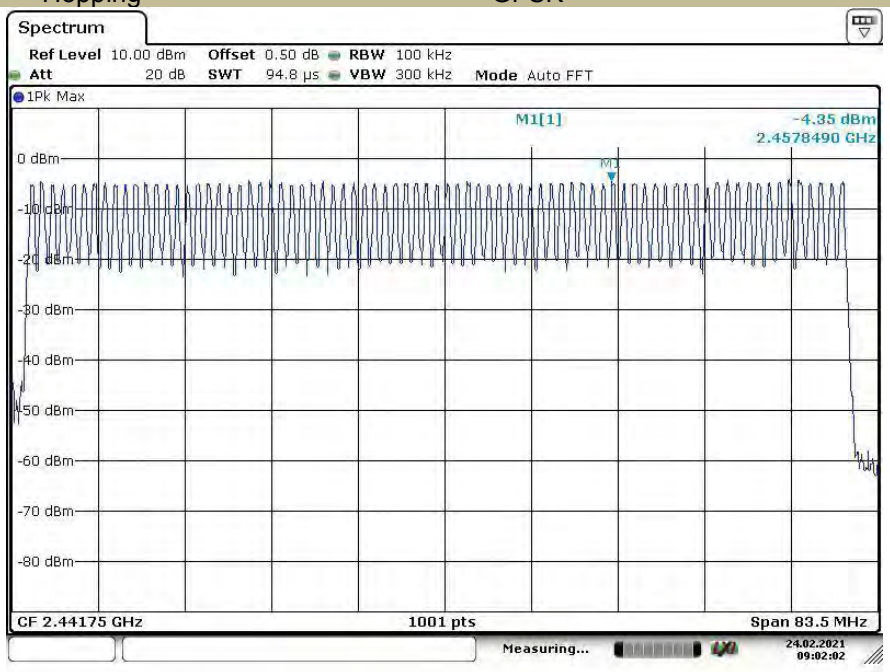
Test Model	Conduceted Spurious RF Conducted Emission Bluetooth V4.0 Channel 78: 2480MHz GFSK



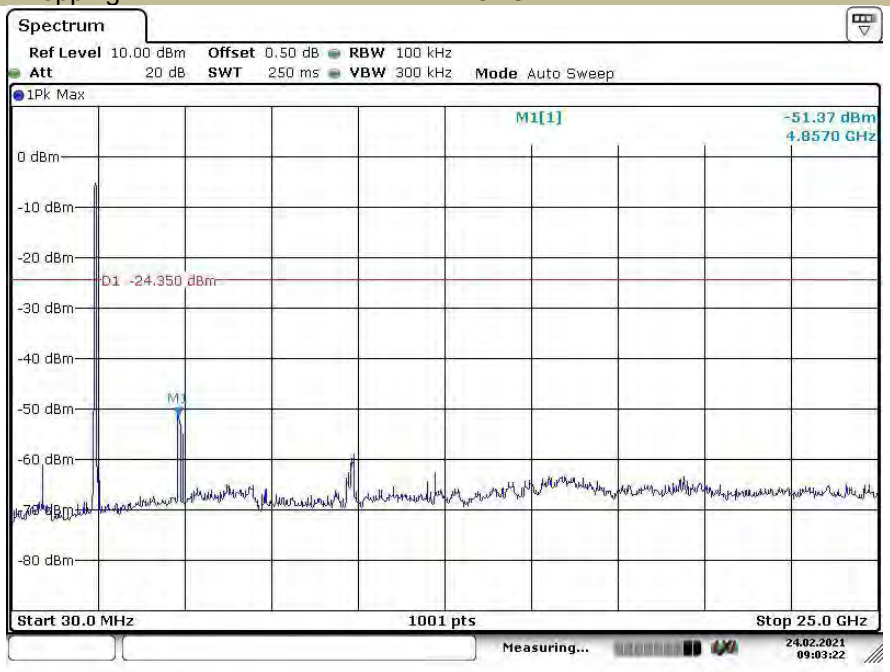
Test Model	Band-edge Conducted Emissions Bluetooth V4.0 Channel 78: 2480MHz GFSK



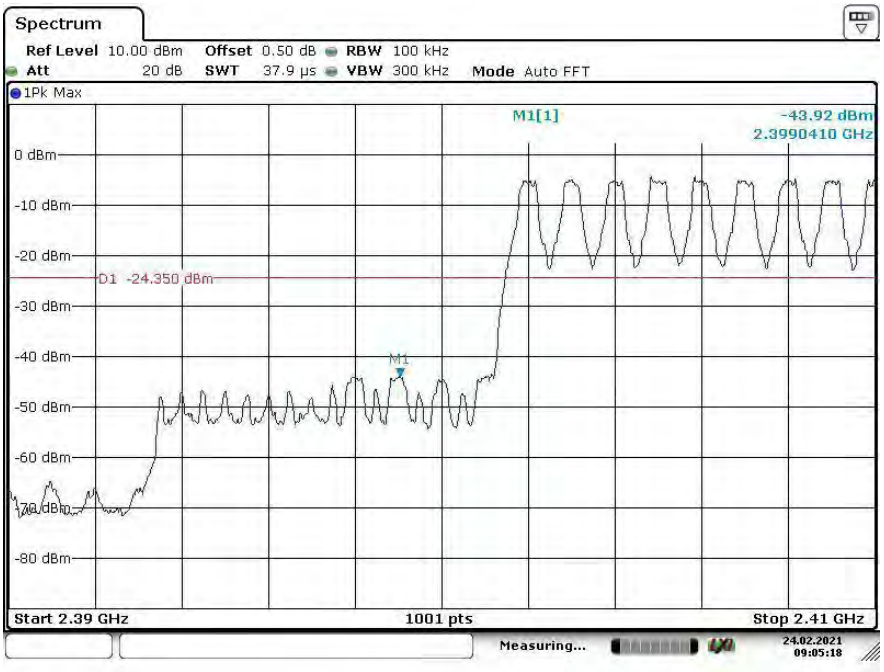
Test Model	Maximum Conduceted Level RBW=100kHz Bluetooth V4.0 Hopping GFSK



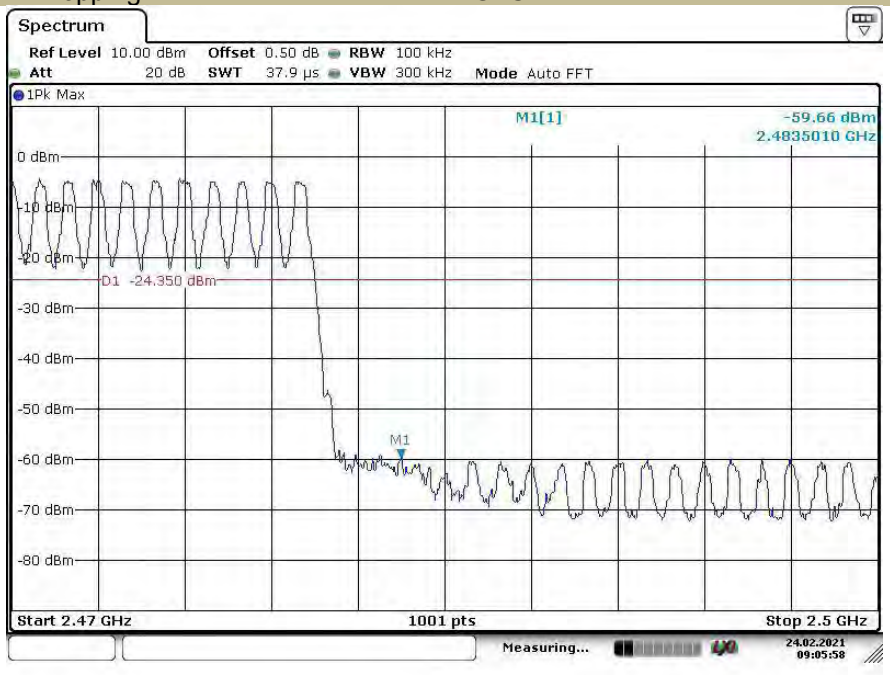
Test Model	Conduceted Spurious RF Conducted Emission Bluetooth V4.0 Hopping GFSK



Test Model	Band-edge Conducted Emissions Bluetooth V4.0 Hopping	 GFSK



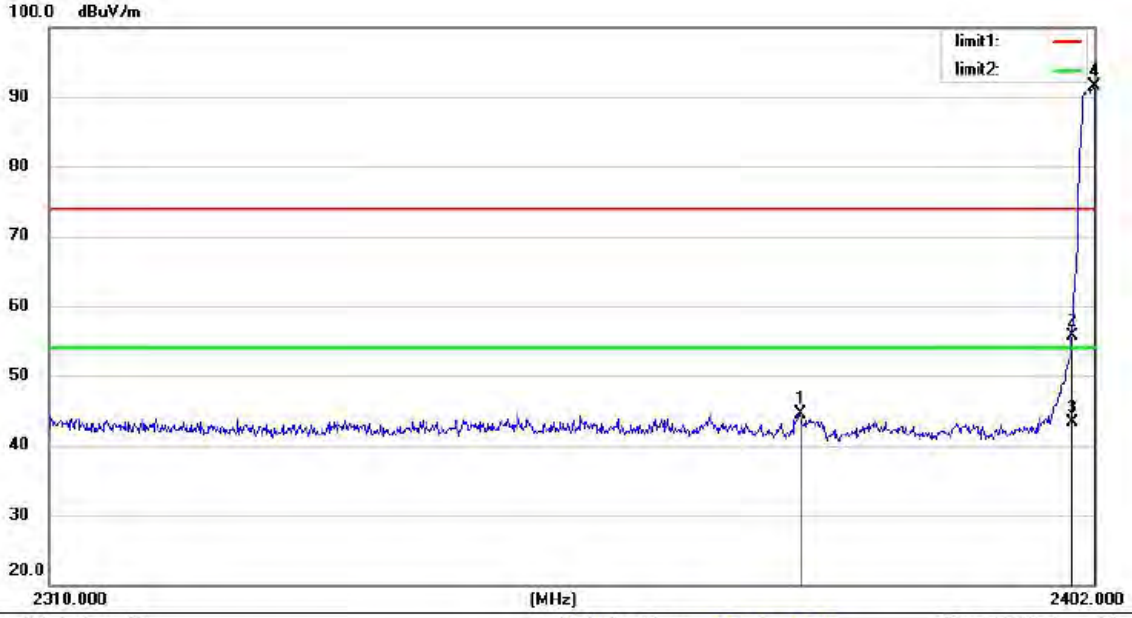
Test Model	Band-edge Conducted Emissions Bluetooth V4.0 Hopping	 GFSK



14.6.Radiated emission Test

Worst test modulation GFSK

For Non-Hopping Mode:



Site Chamber #1 Polarization: *Horizontal* Temperature: 25

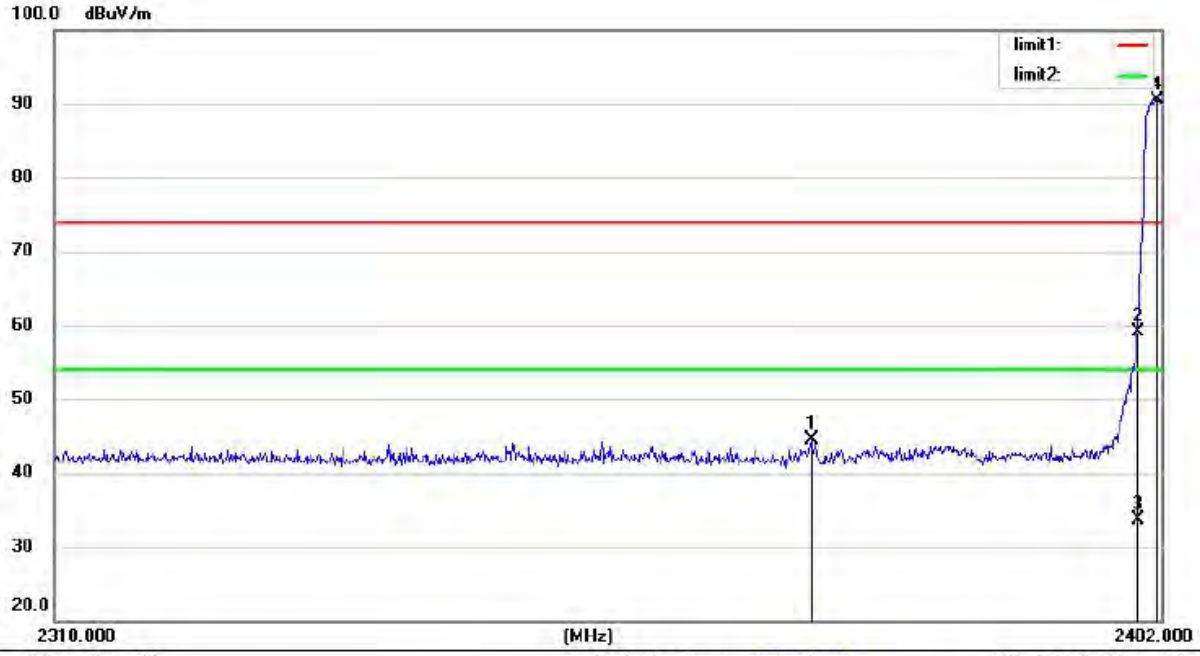
Limit: (RE)FCC PART 15 C 3m_PEAK Power: DC 3.7V Humidity: 55 %

Mode:TX 2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		2375.780	56.13	-11.68	44.45	74.00	-29.55	peak			
2		2400.000	67.39	-11.63	55.76	74.00	-18.24	peak			
3		2400.000	54.97	-11.63	43.34	54.00	-10.66	AVG			
4	*	2401.908	103.10	-11.63	91.47	74.00	17.47	peak			

*:Maximum data x:Over limit !:over margin Operator: XIA



Site Chamber #1 Polarization: *Vertical* Temperature: 25

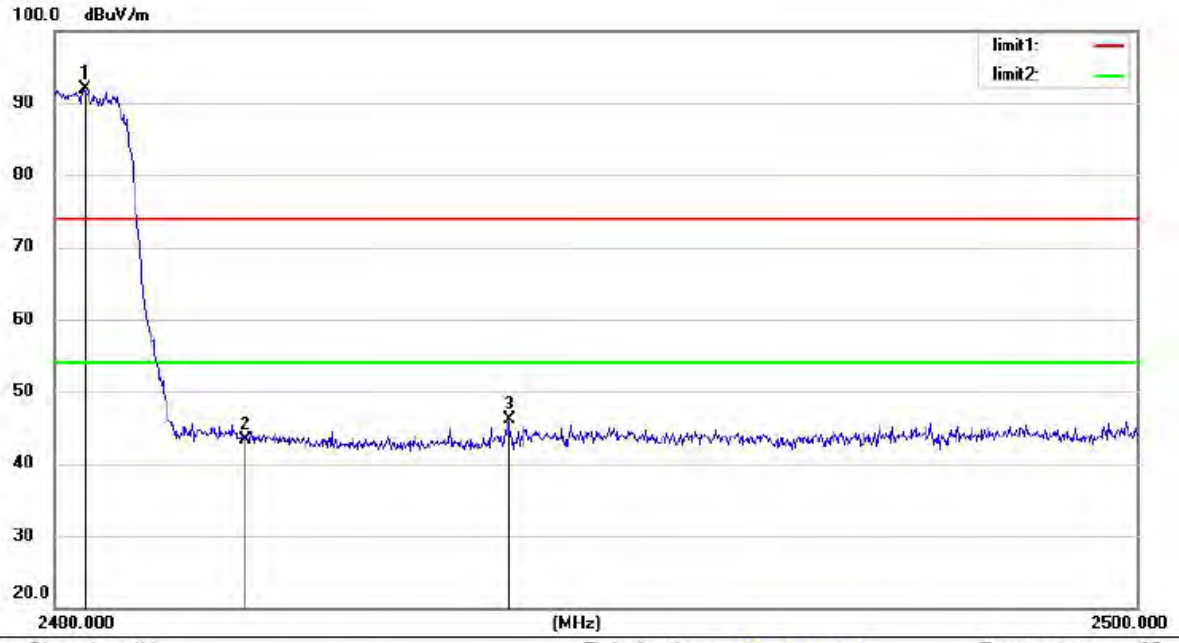
Limit: (RE)FCC PART 15 C 3m_PEAK Power: DC 3.7V Humidity: 55 %

Mode: TX 2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		2372.560	56.18	-11.68	44.50	74.00	-29.50	peak			
2		2400.000	70.71	-11.63	59.08	74.00	-14.92	peak			
3		2400.000	45.25	-11.63	33.62	54.00	-20.38	AVG			
4	*	2401.540	102.22	-11.63	90.59	74.00	16.59	peak			

*:Maximum data x:Over limit !:over margin Operator: XIA



Site Chamber #1 Polarization: *Horizontal* Temperature: 25

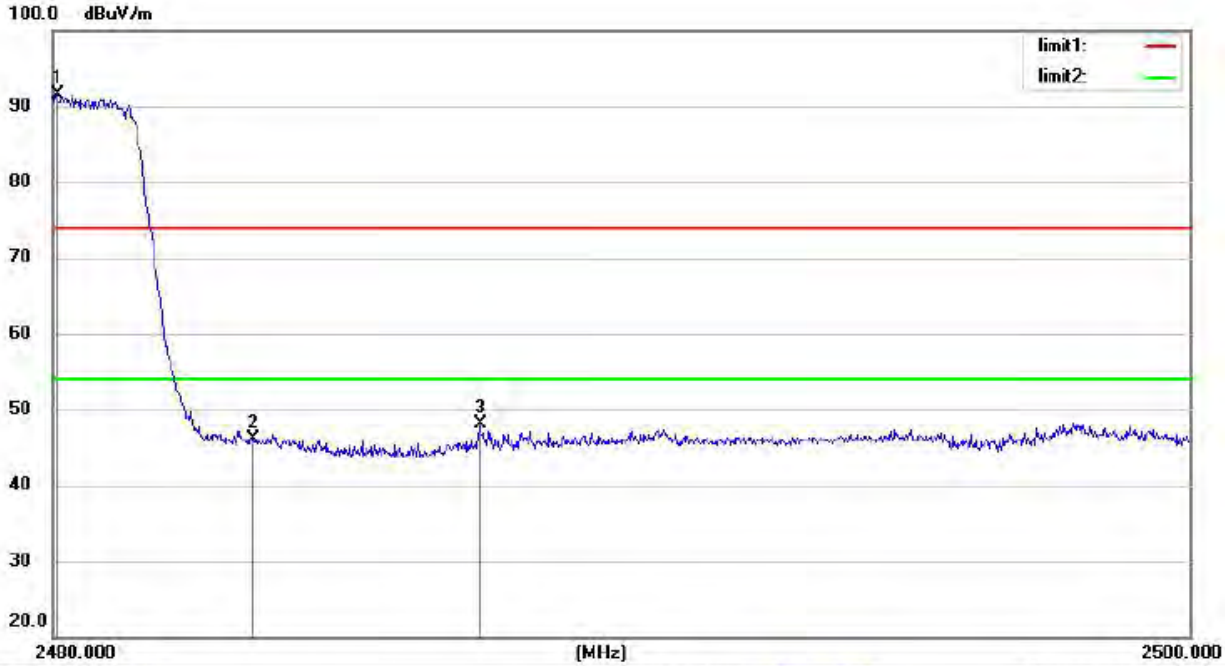
Limit: (RE)FCC PART 15 C 3m_PEAK Power: DC 3.7V Humidity: 55 %

Mode: TX 2480

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	2480.540	103.32	-11.45	91.87	74.00	17.87	peak			
2		2483.500	54.81	-11.46	43.35	74.00	-30.65	peak			
3		2488.380	57.59	-11.45	46.14	74.00	-27.86	peak			

*:Maximum data x:Over limit !:over margin Operator: XIA



Site Chamber #1 Polarization: *Vertical* Temperature: 25

Limit: (RE)FCC PART 15 C 3m_PEAK Power: DC 3.7V Humidity: 55 %

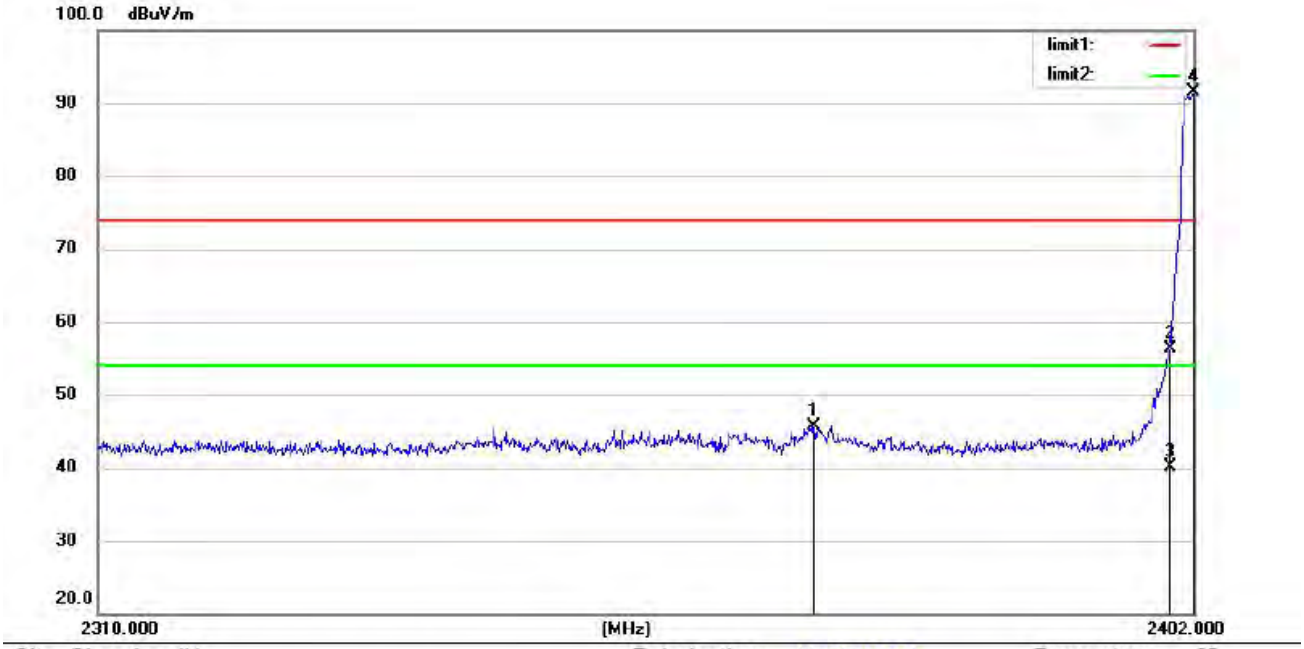
Mode: TX 2480

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	2480.080	101.60	-10.02	91.58	74.00	17.58	peak			
2		2483.500	56.16	-10.01	46.15	74.00	-27.85	peak			
3		2487.500	58.07	-9.98	48.09	74.00	-25.91	peak			

*:Maximum data x:Over limit !:over margin Operator: XIA

For Hopping Mode:



Site Chamber #1 Polarization: *Horizontal* Temperature: 25

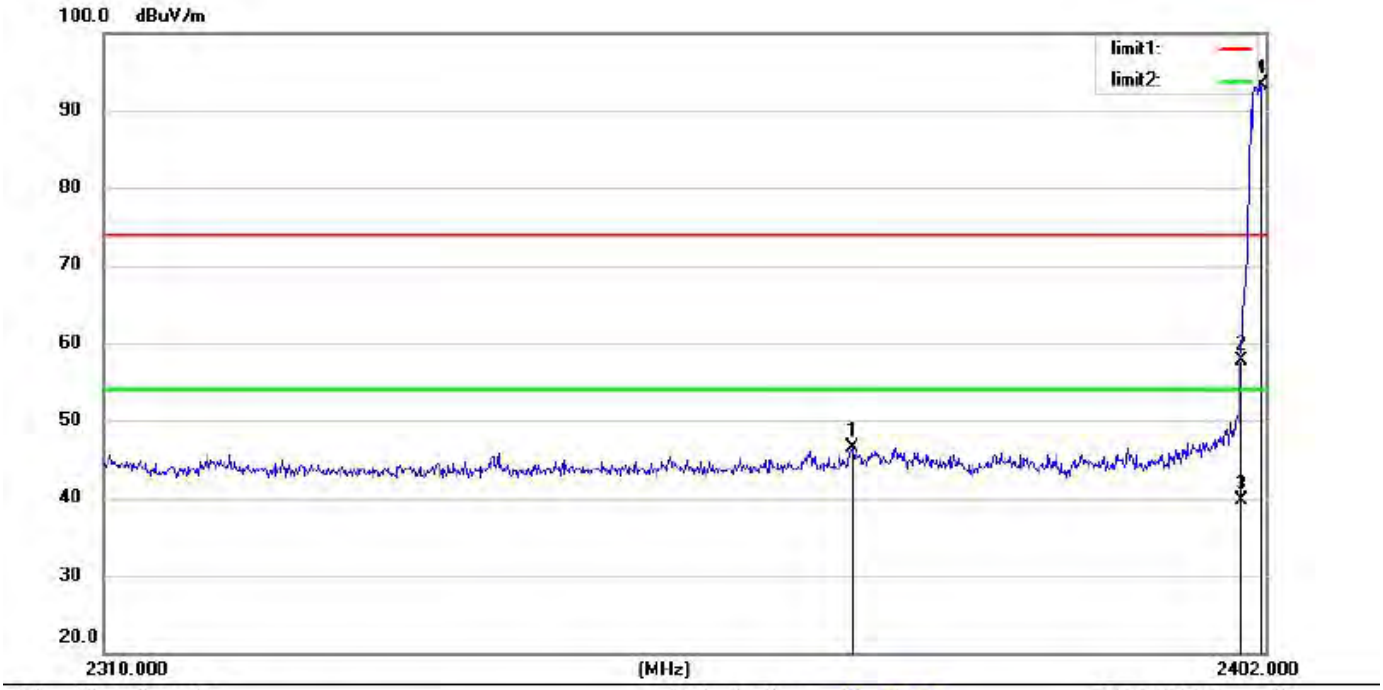
Limit: (RE)FCC PART 15 C 3m_PEAK Power: DC 3.7V Humidity: 55 %

Mode: Hopping 2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		2369.708	57.36	-11.70	45.66	74.00	-28.34	peak			
2		2400.000	67.84	-11.63	56.21	74.00	-17.79	peak			
3		2400.000	51.81	-11.63	40.18	54.00	-13.82	AVG			
4	*	2402.000	103.23	-11.63	91.60	74.00	17.60	peak			

*:Maximum data x:Over limit l:over margin Operator: XIA



Site Chamber #1 Polarization: *Vertical* Temperature: 25

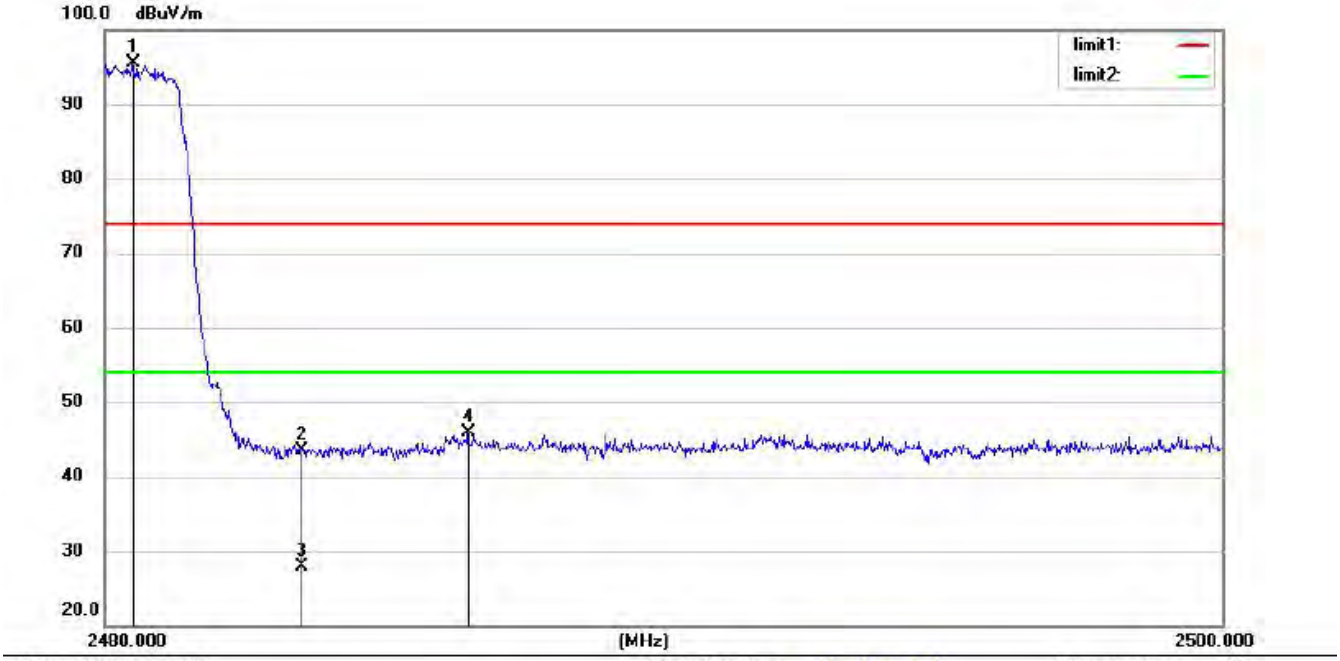
Limit: (RE)FCC PART 15 C 3m_PEAK Power: DC 3.7V Humidity: 55 %

Mode: Hopping 2402

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		2368.880	57.19	-10.64	46.55	74.00	-27.45	peak			
2		2400.000	68.19	-10.47	57.72	74.00	-16.28	peak			
3		2400.000	50.12	-10.47	39.65	54.00	-14.35	AVG			
4	*	2401.540	103.84	-10.46	93.38	74.00	19.38	peak			

*:Maximum data x:Over limit !:over margin Operator: XIA



Site Chamber #1 Polarization: *Horizontal* Temperature: 25

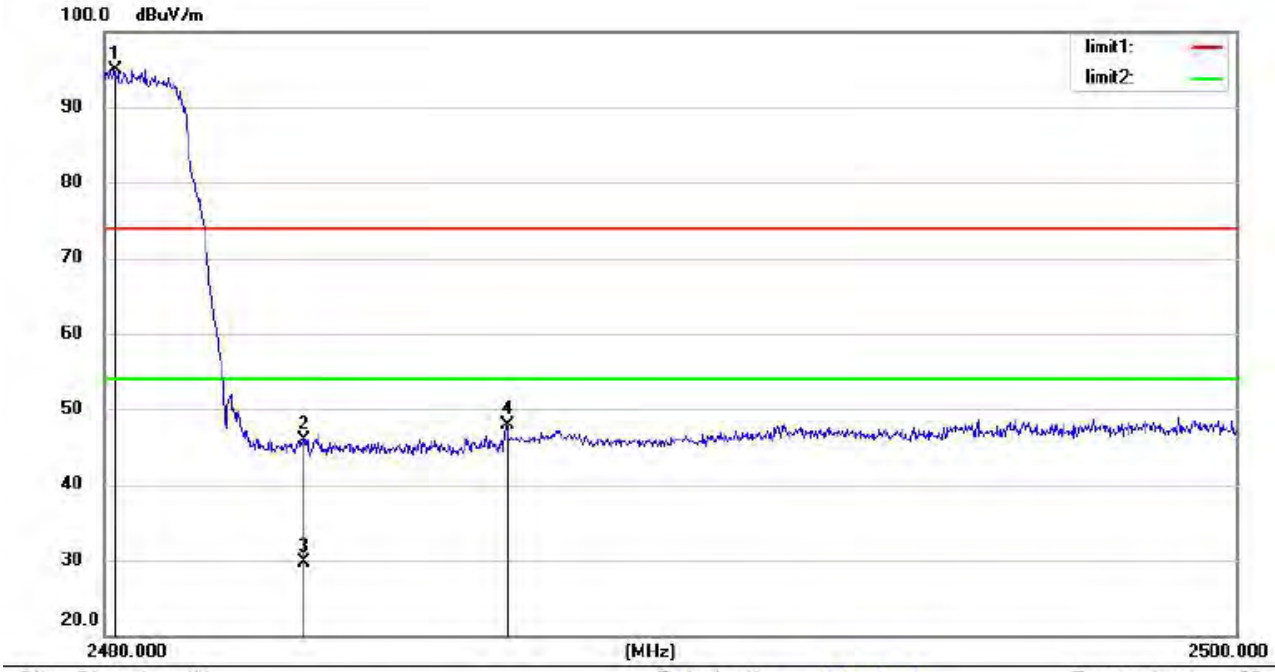
Limit: (RE)FCC PART 15 C 3m_PEAK Power: DC 3.7V Humidity: 55 %

Mode: Hopping 2480

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	2480.500	107.01	-11.45	95.56	74.00	21.56	peak			
2		2483.500	54.89	-11.46	43.43	74.00	-30.57	peak			
3		2483.500	39.31	-11.46	27.85	54.00	-26.15	AVG			
4		2486.500	57.25	-11.44	45.81	74.00	-28.19	peak			

*:Maximum data x:Over limit !:over margin Operator: XIA



Site Chamber #1 Polarization: *Vertical* Temperature: 25

Limit: (RE)FCC PART 15 C 3m_PEAK Power: DC 3.7V Humidity: 55 %

Mode: Hopping 2480

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	2480.180	104.98	-10.02	94.96	74.00	20.96	peak			
2		2483.500	55.99	-10.01	45.98	74.00	-28.02	peak			
3		2483.500	39.64	-10.01	29.63	54.00	-24.37	AVG			
4		2487.100	57.91	-9.98	47.93	74.00	-26.07	peak			

*:Maximum data x:Over limit !:over margin Operator: XIA

15. Antenna Application

15.1. 14.1 Antenna requirement

The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247.

FCC part 15C section 15.247 requirements:
Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

15.2. 14.2 Result

The EUT's antenna, permanent attached antenna, used a PCB antenna and integrated on PCB, The antenna's gain is 0 dBi and meets the requirement.

16. Photos of EUT

Please refer to external photos and internal photos.

*** End of Report ***

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