FCC Radio Test Report

FCC ID: 2A2P2-SXE-24

Original Grant

Report No.	:	TB-FCC179986
Applicant	:	Shenshen SPAZO techonology co.,Ltd
Equipment Under Test (EUT)		
EUT Name	:	2.4G TWS Gaming Earphone
Model No.	:	SXE-24
Series Model No.	:	SXE24A019b, SXE24-02A, SXE24-02B, SXE24-02C, SXE24-02D, SXE24-02E, SXE24-02F, SXE24-02G, SXE24-02H, SXE24-02I, SXE24-02J
Brand Name	:	SPAZO
Sample ID		20210330-12-1#&20210330-12-2#
Receipt Date	:	2021-04-12
Test Date	:	2021-04-12 to 2021-07-21
Issue Date	:	2021-07-22
Standards	:	FCC Part 15, Subpart C 15.247
Test Method	:	ANSI C63.10: 2013
Conclusions	:	**PASS**

In the configuration tested, the EUT complied with the standards specified above,
The EUT technically complies with the FCC requirements

Test/Witness Engineer	:	Camille Li
Engineer Supervisor	:	Ivan Su
Engineer Manager	:	Ray Lai

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

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Contents

Revision History

Report No.	Version	Description	Issued Date
TB-FCC179986	Rev.01	Initial issue of report	2021-07-22

1. General Information about EUT

1.1 Client Information

Applicant	:	Shenshen SPAZO techonology co.,Ltd
Address	:	D503-f15, Fude center, 145 Longping East Road, Longgang District, Shenzhen
Manufacturer	:	Shenzhen Xingguo Technology co.,Ltd
Address	:	4f, No.2, Huahan science and Technology Industrial Park, No. 16 Jinniu West Road, Pingshan District, Shenzhen, Guangdong, China

1.2 General Description of EUT (Equipment Under Test)

EUT Name	:	2.4G TWS Gaming Earphone	
Models No.	:	SXE-24, SXE24A019b, SXE24-02A, SXE24-02B, SXE24-02C, SXE24-02D, SXE24-02E, SXE24-02F, SXE24-02G, SXE24-02H, SXE24-02I, SXE24-02J	
Model Difference	:	All PCB boards and circuit diagrams are the same, the only difference is the name.	
Product Description	:	Operation Frequency:	2405.889MHz~2477.569MHz
		Number of Channel:	36 Channels See Note 2
		Max Peak Output Power:	7dBm
		Antenna Gain:	0dBi Ceramic Antenna
		Modulation Type:	GFSK
Power Rating (Charger Box)	:	Input: DC 5V DC 3.7V by 5000mAh Li-ion battery	
Power Rating (Dongle)	:	Input: DC 5V	
Power Supply (Earphone)	:	Input: DC 5V DC 3.7V by 100mAh Li-ion battery	
Software Version	:	V1.10	
Hardware Version	:	V1.10	
Remark	:	The adapter and antenna gain provided by the applicant, the verified for the RF conduction test provided by TOBY test lab.	

Note:

(1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

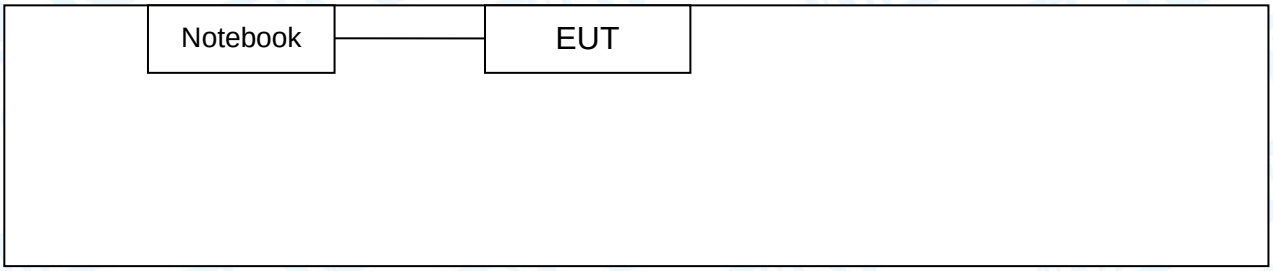
(2) Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	**2405.889**	12	2430.465	24	2455.041
1	2407.937	13	2432.513	25	2457.089
2	2409.985	14	2434.561	26	2459.137
3	2412.033	15	2436.609	27	2461.185
4	2414.081	16	2438.657	28	2463.233
5	2416.129	**17**	**2440.705**	29	2465.281
6	2418.177	18	2442.753	30	2467.329
7	2420.225	19	2444.801	31	2469.377
8	2422.273	20	2446.849	32	2471.425
9	2424.321	21	2448.897	33	2473.473
10	2426.369	22	2450.945	34	2475.521
11	2428.417	23	2452.993	**35**	**2477.569**
Note: Test frequencies are lowest channel: 2405.889MHz, middle channel: 2440.705MHz and highest channel: 2477.569MHz.					

(3) The Antenna information about the equipment is provided by the applicant.

1.3 Block Diagram Showing the Configuration of System Tested

TX Mode



1.4 Description of Support Units

The EUT has been tested as an independent unit.

1.5 Description of Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned follow was evaluated respectively.

For Conducted Test	
Final Test Mode	**Description**
Mode 1	Adapter+ TX Mode

For Radiated Test	
Final Test Mode	**Description**
Mode 1	TX GFSK Mode
Mode 2	TX Mode(GFSK) Channel 00/17/35

Note:

(1) For all test, we have verified the construction and function in typical operation. And all the test modes were carried out with the EUT in transmitting operation in maximum power with all kinds of data rate. We have pretested all the test modes above.
According to ANSI C63.10 standards, the measurements are performed at the highest, middle, lowest available channels, and the worst case data rate as follows:
TX Mode: GFSK (2Mbps)

(2) The EUT is considered a Mobile unit; it was pre-tested on the positioned of each 3 axis, X-plane, Y-plane and Z-plane. The worst case was found positioned on X-plane as the normal use. Therefore only the test data of this X-plane was used for radiated emission measurement test.

1.6 Description of Test Software Setting

During testing channel power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of Bluetooth mode.

Test Software Version	Control by pressing the button		
Frequency	2405.889 MHz	2440 .705MHz	2477.569MHz
GFSK	DEF	DEF	DEF

1.7 Measurement Uncertainty

The reported uncertainty of measurement y ± U，where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2，providing a level of confidence of approximately 95 %.

Test Item	**Parameters**	**Expanded Uncertainty (U_{Lab})**
Conducted Emission	Level Accuracy: 9kHz~150kHz 150kHz to 30MHz	±3.50 dB ±3.10 dB
Radiated Emission	Level Accuracy: 9kHz to 30 MHz	±4.60 dB
Radiated Emission	Level Accuracy: 30MHz to 1000 MHz	±4.20 dB
Radiated Emission	Level Accuracy: Above 1000MHz	±4.20 dB

1.8 Test Facility

The testing report were performed by the Shenzhen Toby Technology Co., Ltd., in their facilities located at 1/F.,Building 6, Rundongsheng Industrial Zone, Longzhu, Xixiang, Bao'an District, Shenzhen, Guangdong, China. At the time of testing, the following bodies accredited the Laboratory:

CNAS (L5813)

The Laboratory has been accredited by CNAS to ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories for the competence in the field of testing. And the Registration No.: CNAS L5813.

A2LA Certificate No.: 4750.01

The laboratory has been accredited by American Association for Laboratory Accreditation(A2LA) to ISO/IEC 17025：2017 General Requirements for the Competence of Testing and Calibration Laboratories for the technical competence in the field of Electrical Testing. And the A2LA Certificate No.: 4750.01.FCC Accredited Test Site Number: 854351.Designation Number: CN1223.

IC Registration No.: (11950A)

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing. The site registration: Site# 11950A.

2. Test Summary

FCC Part 15 Subpart C(15.247)/ RSS 247 Issue 2					
Standard Section		Test Item	Test Sample(s)	Judgment	Remark
FCC	IC				
15.203		Antenna Requirement	20210330-12-1#	PASS	N/A
15.207	RSS-GEN 8.8	Conducted Emission	20210330-12-2#	PASS	N/A
15.205	RSS-Gen 8.10	Restricted Bands	20210330-12-1#	PASS	N/A
15.247(a)(1)	RSS 247 5.1 (b)	Hopping Channel Separation	20210330-12-1#	PASS	N/A
15.247(a)(1)	RSS 247 5.1 (d)	Dwell Time	20210330-12-1#	PASS	N/A
15.247(b)(1)	RSS 247 5.4 (b)	Peak Output Power	20210330-12-1#	PASS	N/A
15.247(b)(1)	15.247(a)1	Number of Hopping Frequency	20210330-12-1#	PASS	N/A
15.247(d)	RSS 247 5.5	Band Edge	20210330-12-1#	PASS	N/A
15.247(c)& 15.209	RSS 247 5.5 &RSS-GEN 8.9	Radiated Spurious Emission	20210330-12-1# 20210330-12-2#	PASS	N/A
15.247(a)	RSS 247 5.1 (a)	99% Occupied Bandwidth & 20dB Bandwidth	20210330-12-1#	PASS	N/A
Note: N/A is an abbreviation for Not Applicable.					

3. Test Software

Test Item	Test Software	Manufacturer	Version No.
Conducted Emission	EZ-EMC	EZ	CDI-03A2
Radiation Emission	EZ-EMC	EZ	FA-03A2RE
RF Conducted Measurement	MTS-8310	MWRFtest	V2.0.0.0

4. Test Equipment

Conducted Emission Test					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
EMI Test Receiver	Rohde & Schwarz	ESCI	100321	Jul. 02, 2021	Jul. 01, 2022
RF Switching Unit	Compliance Direction Systems Inc	RSU-A4	34403	Jul. 02, 2021	Jul. 01, 2022
AMN	SCHWARZBECK	NNBL 8226-2	8226-2/164	Jul. 02, 2021	Jul. 01, 2022
LISN	Rohde & Schwarz	ENV216	101131	Jul. 02, 2021	Jul. 01, 2022
Radiation Emission Test					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 02, 2021	Jul. 01, 2022
EMI Test Receiver	Rohde & Schwarz	ESPI	100010/007	Jul. 02, 2021	Jul. 01, 2022
Spectrum Analyzer	Rohde & Schwarz	FSVR	1311.006K40-100945-DH	Jul. 02, 2021	Jul. 01, 2022
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar.01, 2020	Feb. 28, 2022
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar.01, 2020	Feb. 28, 2022
Horn Antenna	ETS-LINDGREN	BBHA 9170	BBHA9170582	Mar.01, 2020	Feb. 28, 2022
Loop Antenna	SCHWARZBECK	FMZB 1519 B	1519B-059	Jul. 06, 2021	Jul. 05, 2022
Pre-amplifier	Sonoma	310N	185903	Feb.25, 2021	Feb. 24, 2022
Pre-amplifier	HP	8449B	3008A00849	Feb.25, 2021	Feb. 24, 2022
Pre-amplifier	SKET	LNPA_1840G-50	SK201904032	Feb.25, 2021	Feb. 24, 2022
Cable	HUBER+SUHNER	100	SUCOFLEX	Feb.25, 2021	Feb. 24, 2022
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A
Antenna Conducted Emission					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Cal. Due Date**
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 02, 2021	Jul. 01, 2022
Spectrum Analyzer	Rohde & Schwarz	ESCI	100010/007	Jul. 02, 2021	Jul. 01, 2022
MXA Signal Analyzer	Agilent	N9020A	MY49100060	Sep. 11, 2020	Sep. 10, 2021
Vector Signal Generator	Agilent	N5182A	MY50141294	Sep. 11, 2020	Sep. 10, 2021
Analog Signal Generator	Agilent	N5181A	MY50141953	Sep. 11, 2020	Sep. 10, 2021
RF Power Sensor	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO26	Sep. 11, 2020	Sep. 10, 2021
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO29	Sep. 11, 2020	Sep. 10, 2021
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO31	Sep. 11, 2020	Sep. 10, 2021
	DARE!! Instruments	RadiPowerRPR3006W	17I00015SNO33	Sep. 11, 2020	Sep. 10, 2021

5. Conducted Emission Test

5.1 Test Standard and Limit

5.1.1Test Standard

FCC Part 15.207/RSS-GEN 8.8

5.1.2 Test Limit

Conducted Emission Test Limit

Frequency	Maximum RF Line Voltage (dBμV)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50

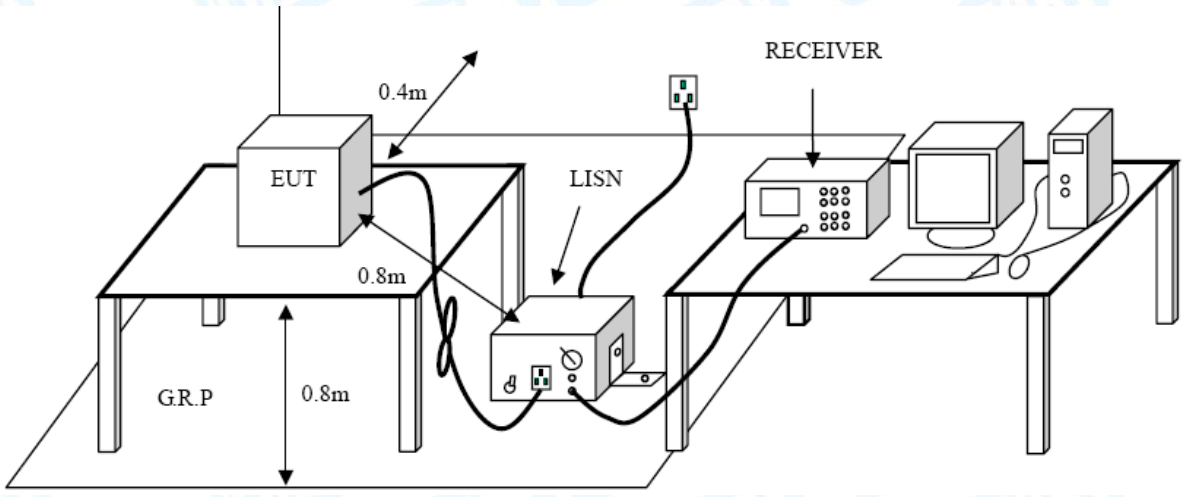
Notes:

(1) *Decreasing linearly with logarithm of the frequency.

(2) The lower limit shall apply at the transition frequencies.

(3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

5.2 Test Setup



5.3 Test Procedure

The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

LISN at least 80 cm from nearest part of EUT chassis

The bandwidth of EMI test receiver is set at 9kHz, and the test frequency band is from 0.15MHz to 30MHz.

5.4 Deviation From Test Standard

No deviation

5.5 EUT Operating Mode

Please refer to the description of test mode.

5.6 Test Data

Please refer to the Attachment A.

6. Radiated Emission Test

6.1 Test Standard and Limit

6.1.1 Test Standard

FCC Part 15.209/RSS-GEN 8.9

6.1.2 Test Limit

Radiated Emission Limit (9 kHz~1000MHz)

Frequency (MHz	Field Strength (microvolt/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

Radiated Emission Limit (Above 1000MHz)

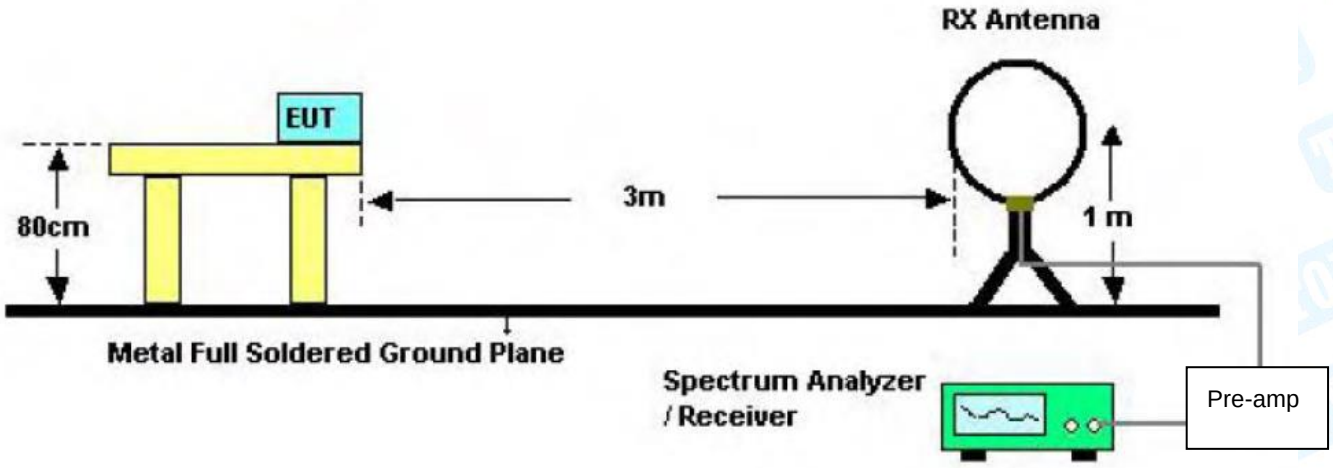
Frequency (MHz)	Distance Meters(at 3m)	
	Peak	Average
Above 1000	74	54

Note:

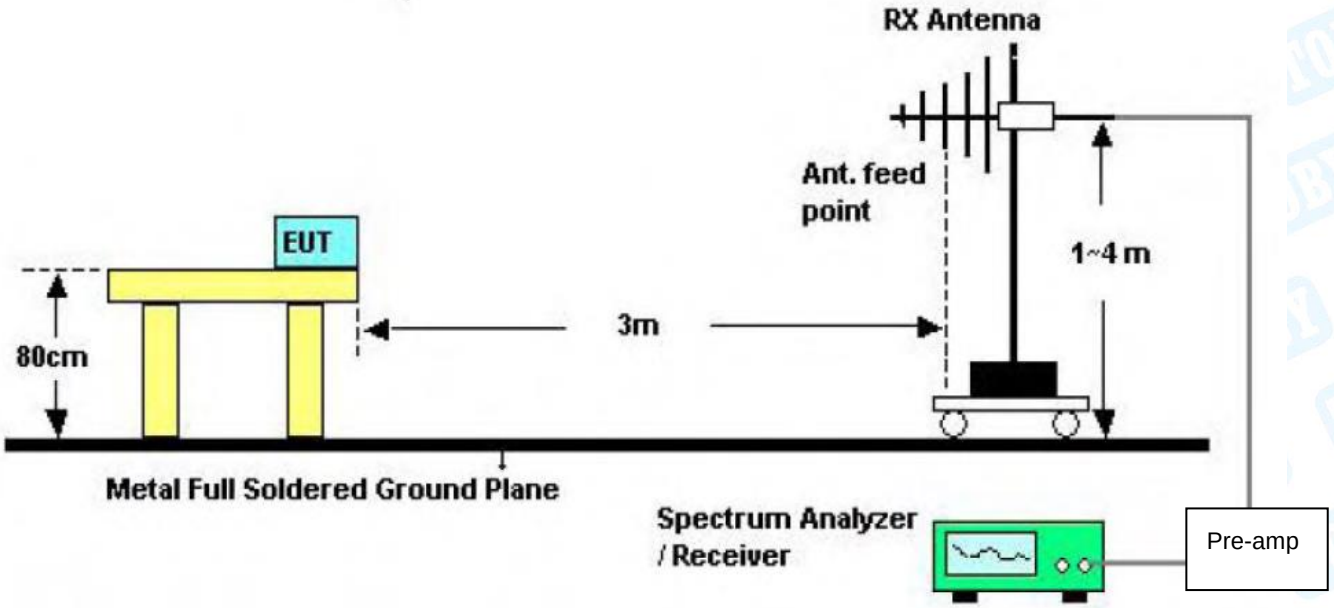
(1) The tighter limit applies at the band edges.

(2) Emission Level (dBuV/m)=20log Emission Level (uV/m)

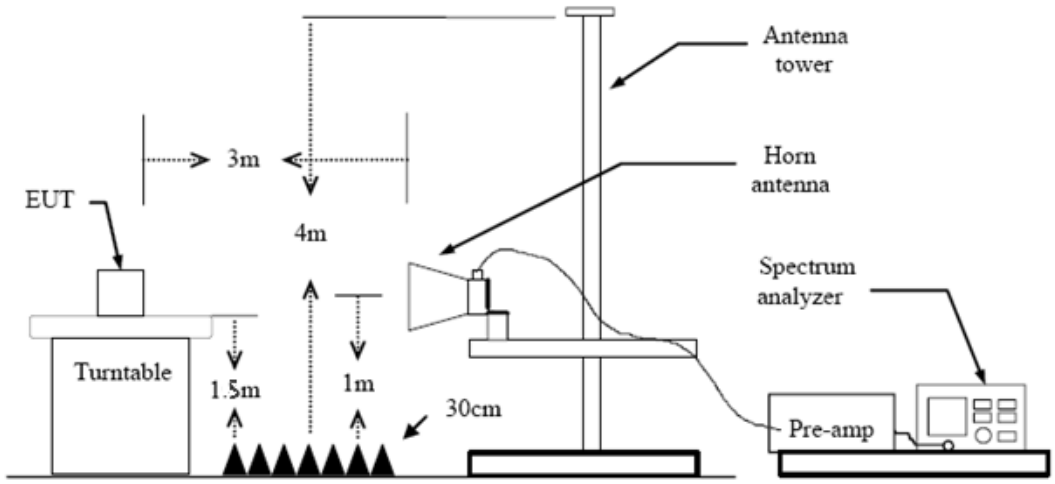
6.2 Test Setup



Below 30MHz Test Setup



Below 1000MHz Test Setup



Above 1GHz Test Setup

6.3 Test Procedure

(1) Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.

(2) Measurements at frequency Below 1GHz. The EUT was placed on a rotating 0.8m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.

(3) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.

(4) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.

(5) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.

(6) Testing frequency range below 1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection.

(7) Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.

(8) For the actual test configuration, please see the test setup photo.

6.4 Deviation From Test Standard

No deviation

6.5 EUT Operating Condition

The Equipment Under Test was set to Continual Transmitting in maximum power.

6.6 Test Data

Remark: During testing above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.

Please refer to the Attachment B.

7. Restricted Bands and Band-edge test

7.1 Test Standard and Limit

7.1.1 Test Standard

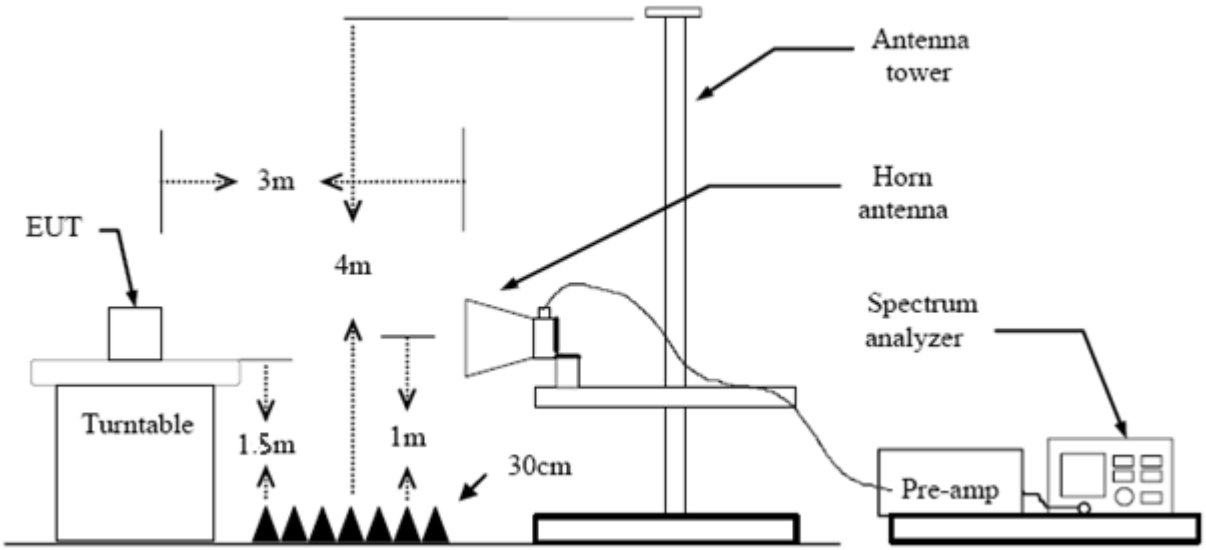
FCC Part 15.209&15.205

RSS-GEN 8.9&8.10

7.1.2 Test Limit

Restricted Frequency Band (MHz)	Distance Meters(at 3m)	
	Peak	Average
2310 ~2390	74	54
2483.5 ~2500	74	54
Note: All restriction bands have been tested, only the worst case is reported.		

7.2 Test Setup



7.3 Test Procedure

(1) The measuring distance of 3m shall be used for measurements at frequency up to 1GHz and above 1 GHz. The EUT was placed on a rotating 0.8m high above ground, the table was rotated 360 degrees to determine the position of the highest radiation.
(2) Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.
(3) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.
(4) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
(5) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.
(6) Testing frequency range below 1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection.
(7) Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with AVG Detector for Average Values.
(8) For the actual test configuration, please see the test setup photo.

7.4 Deviation From Test Standard

No deviation

7.5 EUT Operating Condition

The Equipment Under Test was set to Continual Transmitting in maximum power.

7.6 Test Data

Remark: During testing above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.
All restriction bands have been tested, only the worst case is reported.
Please refer to the Attachment C.

8. Number of Hopping Channel

8.1 Test Standard and Limit

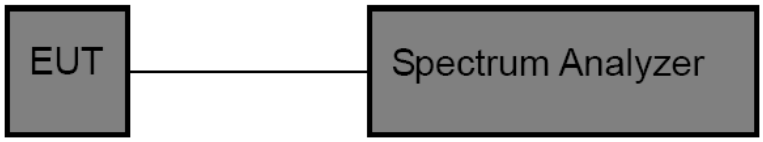
8.1.1 Test Standard

FCC Part 15.247 (a)(1)

8.1.2 Test Limit

Section	Test Item	Limit
15.247	Number of Hopping Channel	>15

8.2 Test Setup



8.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
(2) Spectrum Setting: RBW=100 KHz, VBW=100 KHz, Sweep time= Auto.

8.4 Deviation From Test Standard

No deviation

8.5 EUT Operating Condition

The EUT was set to the Hopping Mode by the Customer.

8.6 Test Data

Please refer to the Attachment D.

9. Average Time of Occupancy

9.1 Test Standard and Limit

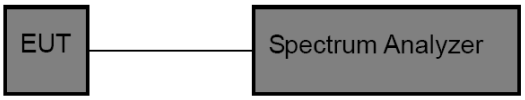
9.1.1 Test Standard

FCC Part 15.247 (a)(1) / RSS 247 5.1(d)

9.1.2 Test Limit

Test Item	Limit
Average Time of Occupancy	0.4 sec

9.2 Test Setup



9.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
(2) Spectrum Setting: RBW=100KHz, VBW=300KHz.
(3) Use video trigger with the trigger level set to enable triggering only on full pulses.
(4) Sweep Time is more than once pulse time.
(5) Set the center frequency on any frequency would be measure and set the frequency span to zero.
(6) Measure the maximum time duration of one single pulse.
(7) Set the EUT for packet transmitting.
(8) Measure the maximum time duration of one single pulse.

9.4 EUT Operating Condition

The average time of occupancy on any channel within the Period can be calculated with formulas:
The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 20 [ch] = 8.0 [s*ch];
The burst width, which is directly measured, refers to the duration on one channel hop.
The maximum number of hopping channels in 8.0s =3*(8.0/0.24) =100
The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

The EUT was set to the Hopping Mode by the Customer.

9.4 Deviation From Test Standard

No deviation

9.5 Test Data

Please refer to the Attachment E.

10. Channel Separation and Bandwidth Test

10.1 Test Standard and Limit

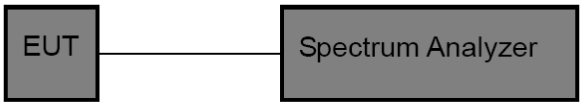
10.1.1 Test Standard

FCC Part 15.247/RSS 247 5.1(b)

10.1.2 Test Limit

Test Item	Limit	Frequency Range(MHz)
Bandwidth	<=1 MHz (20dB bandwidth)	2400~2483.5
Channel Separation	>25KHz or >two-thirds of the 20 dB bandwidth Which is greater	2400~2483.5

10.2 Test Setup



10.3 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting:
Channel Separation: RBW=100 kHz, VBW=100 kHz.
Bandwidth: RBW=30 kHz, VBW=100 kHz.

(3) The bandwidth is measured at an amplitude level reduced 20dB from the reference level. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst –case (i.e the widest) bandwidth.

(4) Measure the channel separation the spectrum analyzer was set to Resolution Bandwidth:30 kHz, and Video Bandwidth:100 kHz. Sweep Time set auto.

10.4 Deviation From Test Standard

No deviation

10.5 EUT Operating Condition

The EUT was set to the Hopping Mode for Channel Separation Test and continuously transmitting for the Bandwidth Test.

10.6 Test Data

Please refer to the Attachment F.

11. Peak Output Power Test

11.1 Test Standard and Limit

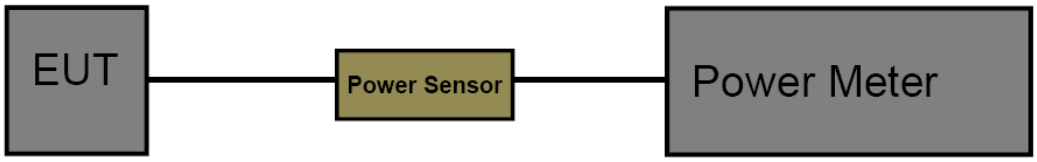
11.1.1 Test Standard

FCC Part 15.247 (b) (1)/RSS 247 5.4(b)

11.1.2 Test Limit

Test Item	Limit	Frequency Range(MHz)
Peak Output Power	Hopping Channels>75 Power<1W(30dBm) Other <125 mW(21dBm)	2400~2483.5

11.2 Test Setup



11.3 Test Procedure

The EUT was connected to RF power meter via a broadband power sensor as show the block above. The power sensor video bandwidth is greater than or equal to the DSS bandwidth of the equipment.

11.4 Deviation From Test Standard

No deviation

11.5 EUT Operating Condition

The EUT was set to continuously transmitting in the max power during the test.

11.6 Test Data

Please refer to the Attachment G.

12. Antenna Requirement

12.1 Standard Requirement

12.1.1 Standard

FCC Part 15.203

12.1.2 Requirement

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

12.2 Deviation From Test Standard

No deviation

12.3 Antenna Connected Construction

The gains of the antenna used for transmitting is 0dBi, and the antenna connector is de-signed with permanent attachment and no consideration of replacement. Please see the EUT photo for details.

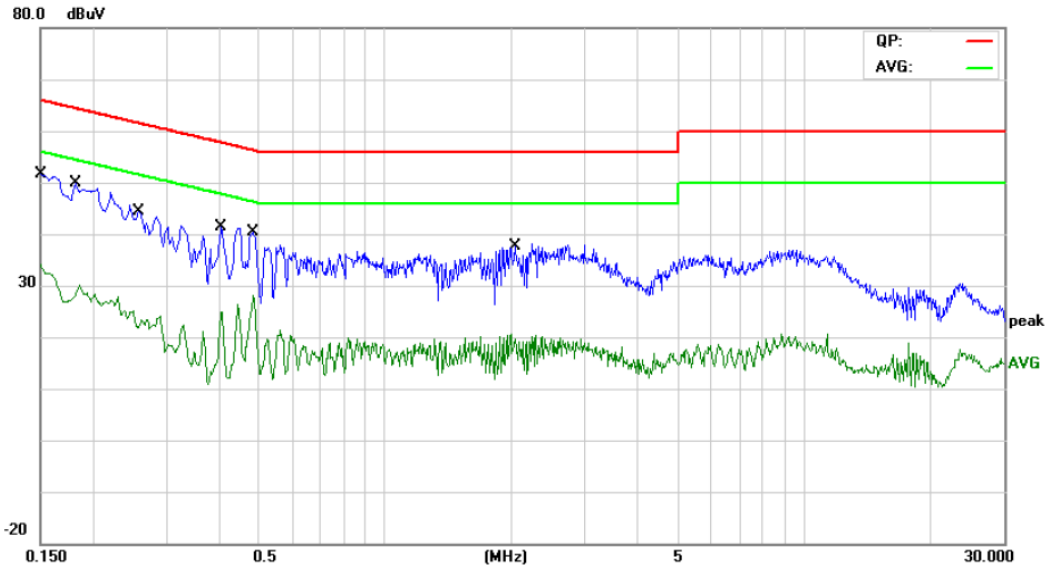
12.4 Result

The EUT antenna is a PCB Antenna. It complies with the standard requirement.

Antenna Type
☒Permanent attached antenna
☐Unique connector antenna
☐Professional installation antenna

Attachment A-- Conducted Emission Test Data

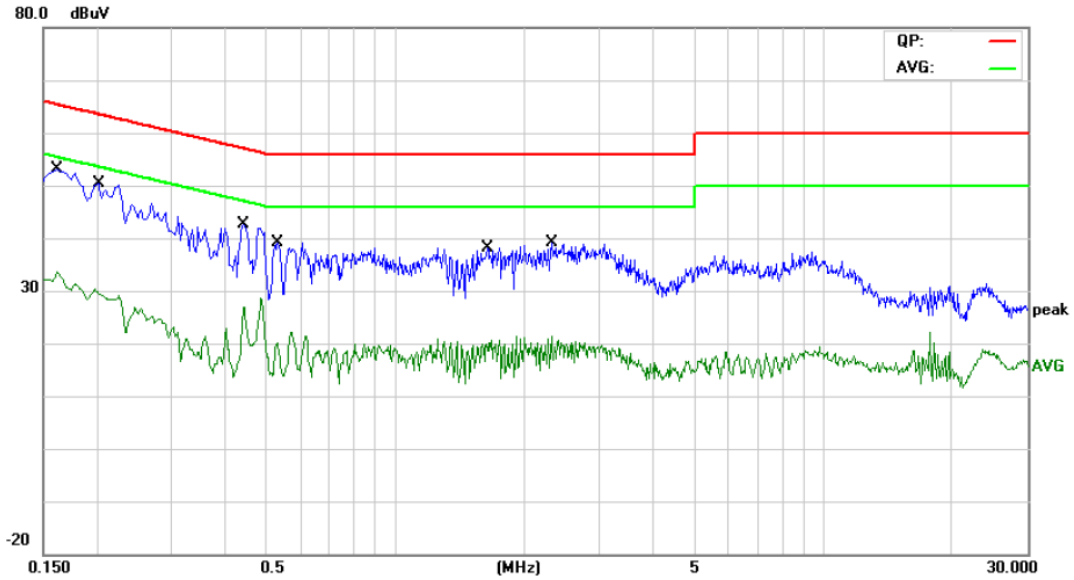
Temperature:	24.3℃	**Relative Humidity:**	44%
Test Voltage:	DC 3.7V		
Terminal:	Line		
Test Mode:	TX GFSK Mode 2405.889MHz		
Remark:	All channels have been tested and Shows only the worst channels.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.1500	38.84	9.70	48.54	65.99	-17.45	QP
2		0.1500	23.05	9.70	32.75	55.99	-23.24	AVG
3		0.1819	35.21	9.70	44.91	64.39	-19.48	QP
4		0.1819	18.68	9.70	28.38	54.39	-26.01	AVG
5		0.2580	28.24	9.70	37.94	61.49	-23.55	QP
6		0.2580	12.38	9.70	22.08	51.49	-29.41	AVG
7		0.4060	27.13	9.70	36.83	57.73	-20.90	QP
8		0.4060	11.28	9.70	20.98	47.73	-26.75	AVG
9		0.4820	28.57	9.70	38.27	56.30	-18.03	QP
10		0.4820	18.11	9.70	27.81	46.30	-18.49	AVG
11		2.0340	21.18	9.71	30.89	56.00	-25.11	QP
12		2.0340	7.70	9.71	17.41	46.00	-28.59	AVG

Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) =QuasiPeak/Average (dBuV)-Limit (dBuV)

Temperature:	24.3℃	Relative Humidity:	44%
Test Voltage:	DC 3.7V		
Terminal:	Neutral		
Test Mode:	TX GFSK Mode 2405.889MHz		
Remark:	All channels have been tested and Shows only the worst channels.		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.1620	38.74	9.80	48.54	65.36	-16.82	QP
2		0.1620	22.50	9.80	32.30	55.36	-23.06	AVG
3		0.2020	34.88	9.80	44.68	63.52	-18.84	QP
4		0.2020	18.39	9.80	28.19	53.52	-25.33	AVG
5		0.4420	28.80	9.80	38.60	57.02	-18.42	QP
6		0.4420	15.14	9.80	24.94	47.02	-22.08	AVG
7		0.5299	24.18	9.80	33.98	56.00	-22.02	QP
8		0.5299	7.52	9.80	17.32	46.00	-28.68	AVG
9		1.6380	21.99	9.80	31.79	56.00	-24.21	QP
10		1.6380	8.49	9.80	18.29	46.00	-27.71	AVG
11		2.3220	24.18	9.80	33.98	56.00	-22.02	QP
12		2.3220	9.62	9.80	19.42	46.00	-26.58	AVG

Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) =QuasiPeak/Average (dBuV)-Limit (dBuV)

Attachment B-- Radiated Emission Test Data

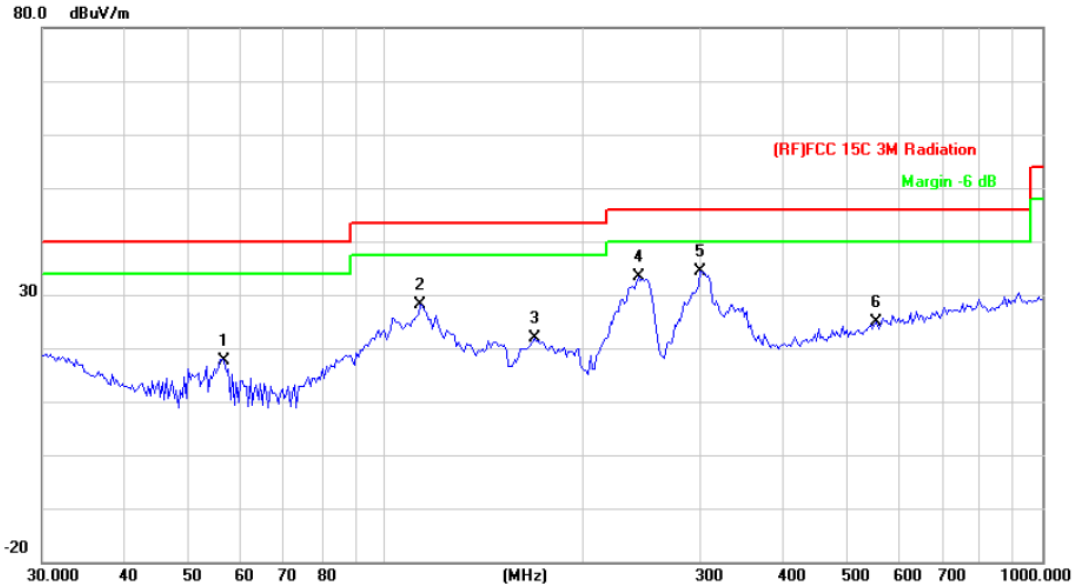
9KHz~30MHz

From 9KHz to 30MHz: Conclusion: PASS

Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

30MHz~1GHz

Temperature:	23.6℃	**Relative Humidity:**	45%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2405.889MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		56.7917	41.48	-23.84	17.64	40.00	-22.36	peak
2		112.9196	50.36	-22.26	28.10	43.50	-15.40	peak
3		168.4138	42.29	-20.52	21.77	43.50	-21.73	peak
4		242.5253	51.10	-17.63	33.47	46.00	-12.53	peak
5	*	301.4224	50.62	-16.25	34.37	46.00	-11.63	peak
6		558.7302	33.70	-8.82	24.88	46.00	-21.12	peak

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

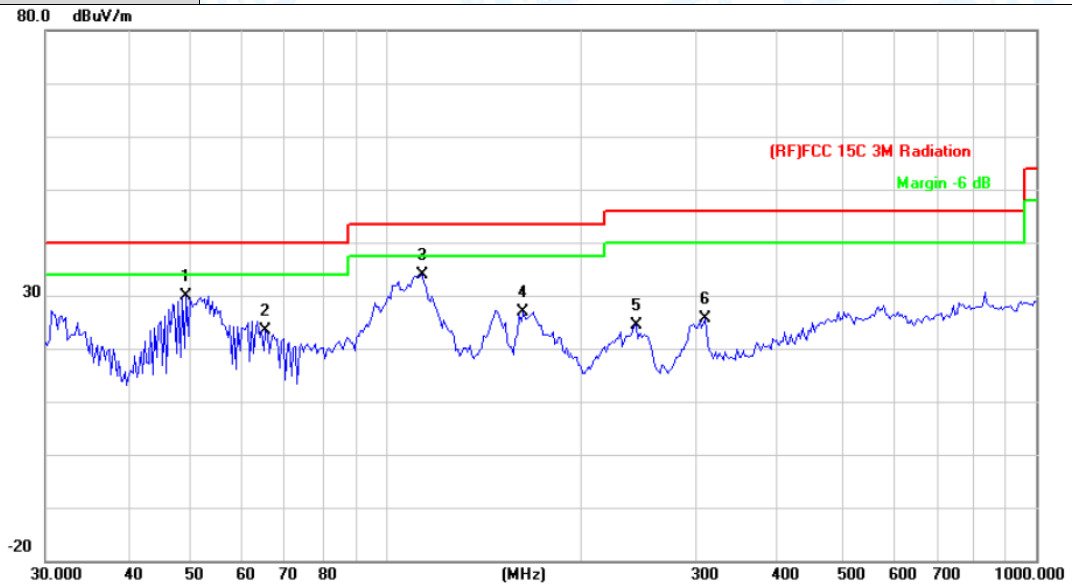
Remark:

1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)

2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)

3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Temperature:	23.6℃	Relative Humidity:	45%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2405.889MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		49.3594	52.80	-22.83	29.97	40.00	-10.03	peak
2		65.3432	47.24	-23.77	23.47	40.00	-16.53	peak
3	*	113.7143	56.07	-22.24	33.83	43.50	-9.67	peak
4		162.6106	47.70	-20.71	26.99	43.50	-16.51	peak
5		242.5253	41.92	-17.63	24.29	46.00	-21.71	peak
6		309.9977	41.64	-15.97	25.67	46.00	-20.33	peak

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

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = QuasiPeak (dBμV/m)-Limit QPK(dBμV/m)

Above 1GHz (Only worse case is reported)

Temperature:	23.5℃	**Relative Humidity:**	42%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2405.889MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		4811.238	48.13	13.07	61.20	74.00	-12.80	peak
2	*	4811.680	33.41	13.07	46.48	54.00	-7.52	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.5℃	**Relative Humidity:**	42%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2405.889MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		4811.750	47.21	13.07	60.28	74.00	-13.72	peak
2	*	4811.900	33.25	13.07	46.32	54.00	-7.68	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.2℃	**Relative Humidity:**	41%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2440.705MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		4881.305	47.45	13.59	61.04	74.00	-12.96	peak
2	*	4881.410	33.70	13.59	47.29	54.00	-6.71	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.2℃	**Relative Humidity:**	41%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2440.705MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1	*	4880.699	32.70	13.58	46.28	54.00	-7.72
2		4881.400	46.54	13.59	60.13	74.00	-13.87

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.2℃	**Relative Humidity:**	41%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2477.569MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1		4955.110	46.39	14.13	60.52	74.00	-13.48
2	*	4955.268	32.46	14.13	46.59	54.00	-7.41

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Temperature:	23.2℃	**Relative Humidity:**	41%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2477.569MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1		4955.022	47.72	14.13	61.85	74.00	-12.15
2	*	4955.420	31.15	14.13	45.28	54.00	-8.72

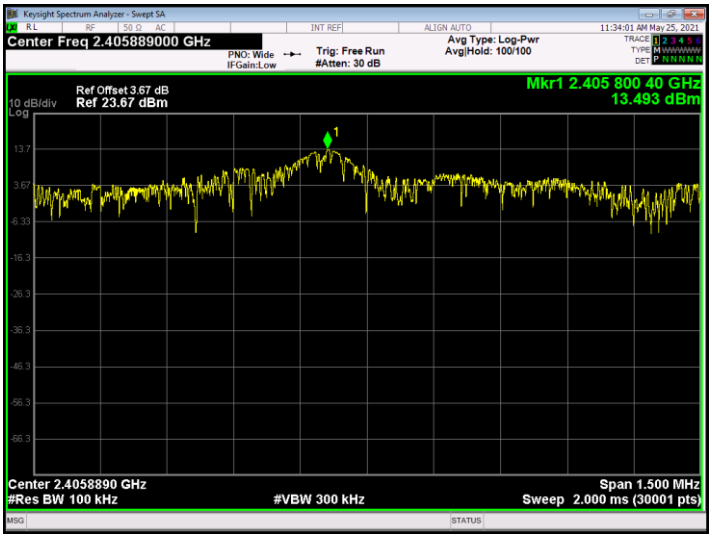
Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)
4. The tests evaluated 1-26.5GHz, The testing has been conformed to the 10th harmonic of the highest fundamental frequency.
5. No report for the emission which more than 20dB below the prescribed limit.

Conducted Emission Test Data

Temperature:	25 ℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX GFSK Mode		
Remark:	This report only shall the worst case mode.		

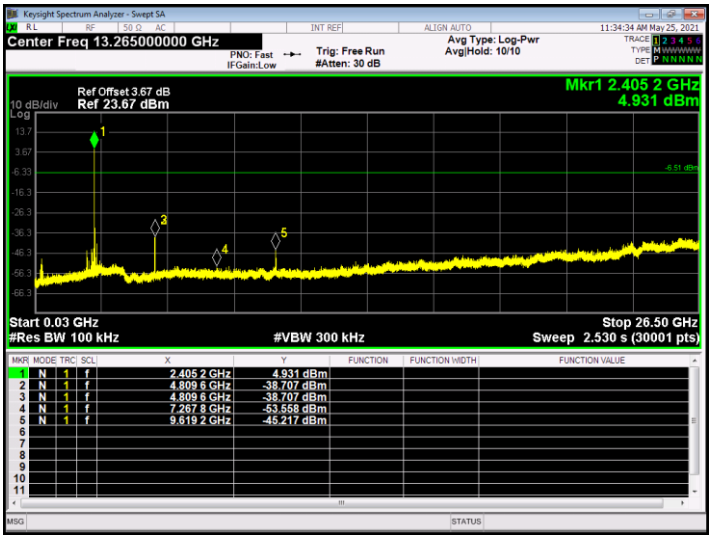
2405.889MHz

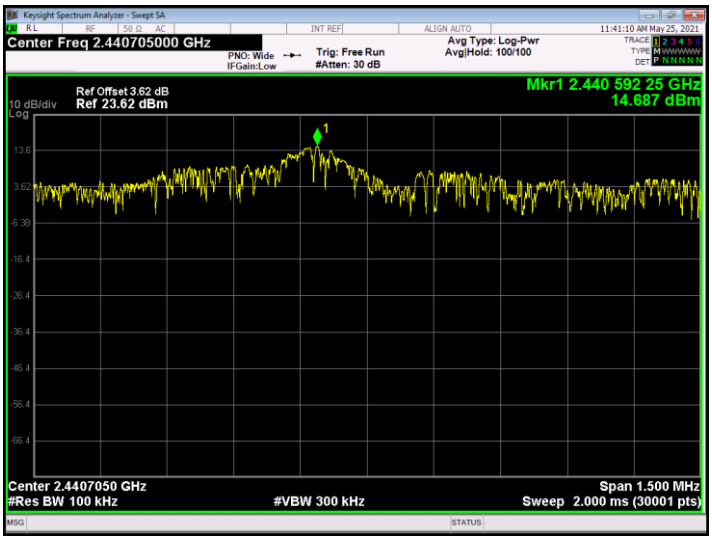
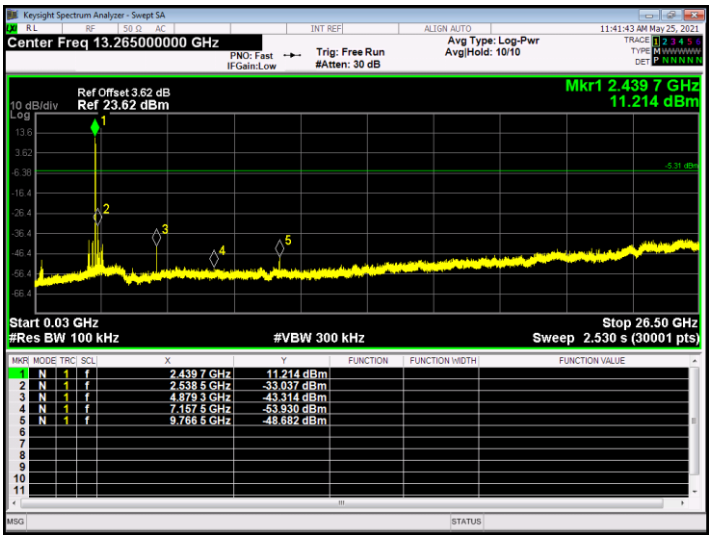
0.03GHz-26.5GHz

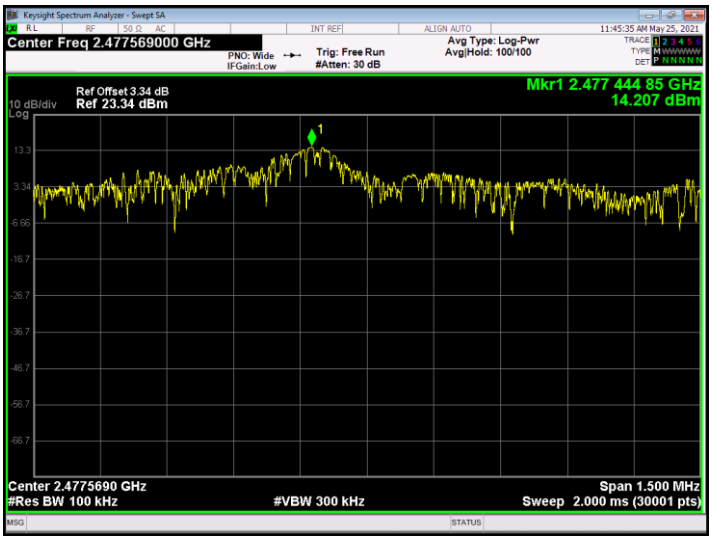
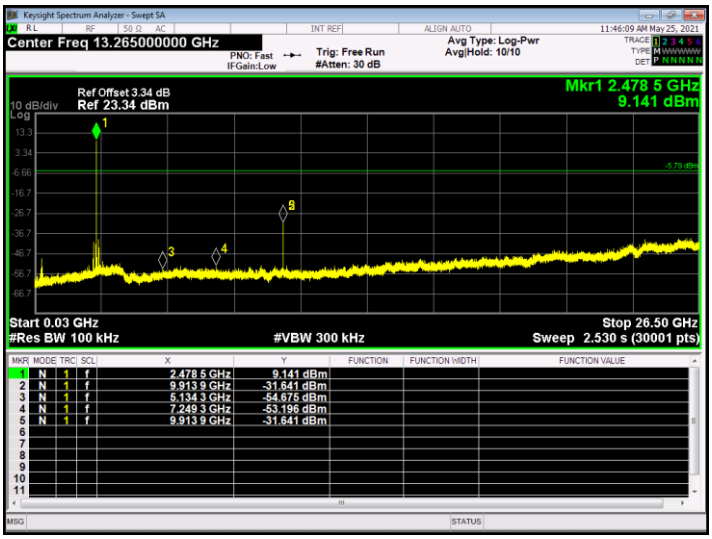


2405.889MHz

0.03GHz-26.5GHz



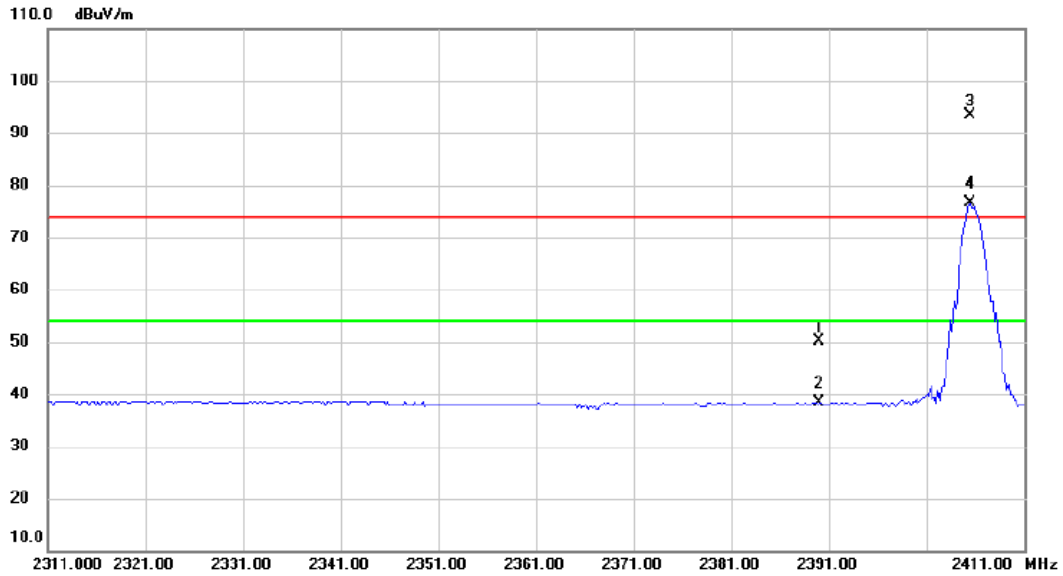
2440.705 MHz
0.03GHz-26.5GHz

2440.705 MHz
0.03GHz-26.5GHz


2477.569 MHz
0.03GHz-26.5GHz

2477.569 MHz
0.03GHz-26.5GHz


Attachment C-- Restricted Bands Requirement Test Data

(1) Radiation Test

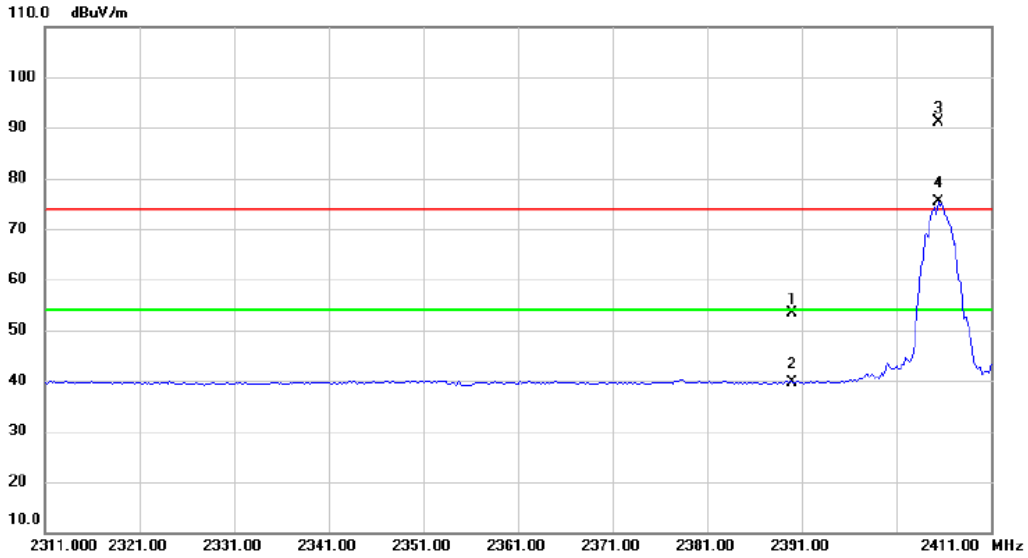
Temperature:	23.5℃	**Relative Humidity:**	42%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2405.889MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2390.000	40.42	9.83	50.25	74.00	-23.75	peak
2		2390.000	28.55	9.83	38.38	54.00	-15.62	AVG
3	X	2405.400	83.51	9.89	93.40	Fundamental Frequency		peak
4	*	2405.400	66.77	9.89	76.66	Fundamental Frequency		AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

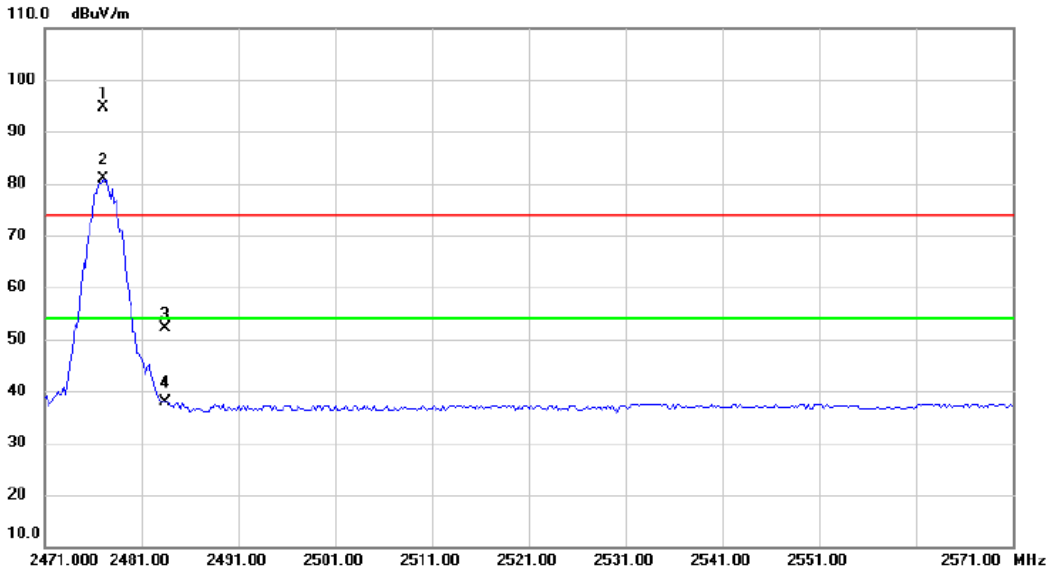
Temperature:	23.5℃	Relative Humidity:	42%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2405.889MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2390.000	43.44	9.83	53.27	74.00	-20.73	peak
2		2390.000	29.92	9.83	39.75	54.00	-14.25	AVG
3	X	2405.400	81.33	9.89	91.22	Fundamental Frequency		peak
4	*	2405.400	65.54	9.89	75.43	Fundamental Frequency		AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

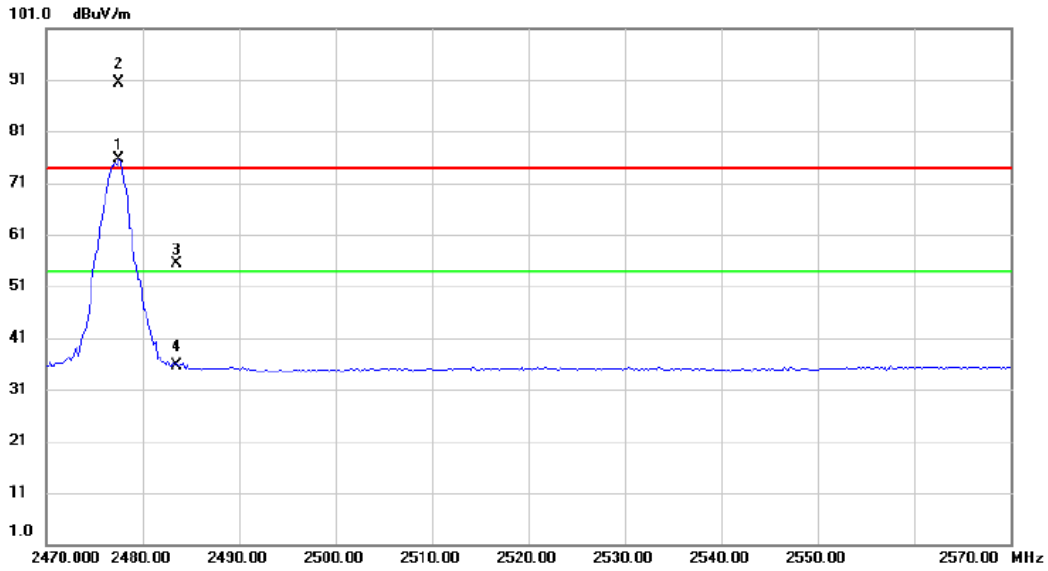
Temperature:	23.5℃	Relative Humidity:	42%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	TX GFSK Mode 2477.569 MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	X	2477.000	92.83	1.84	94.67	Fundamental Frequency		peak
2	*	2477.000	78.98	1.84	80.82	Fundamental Frequency		AVG
3		2483.500	50.18	1.88	52.06	74.00	-21.94	peak
4		2483.500	36.00	1.88	37.88	54.00	-16.12	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

Temperature:	23.5℃	**Relative Humidity:**	42%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	TX GFSK Mode 2477.569 MHz		
Remark:	Only worse case is reported		

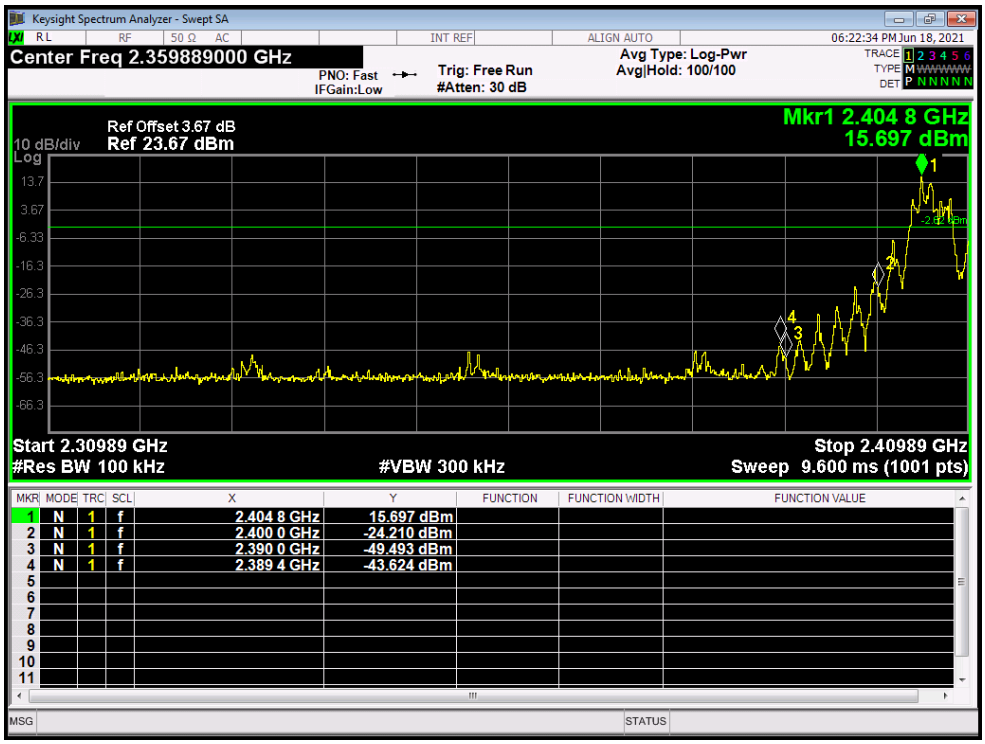


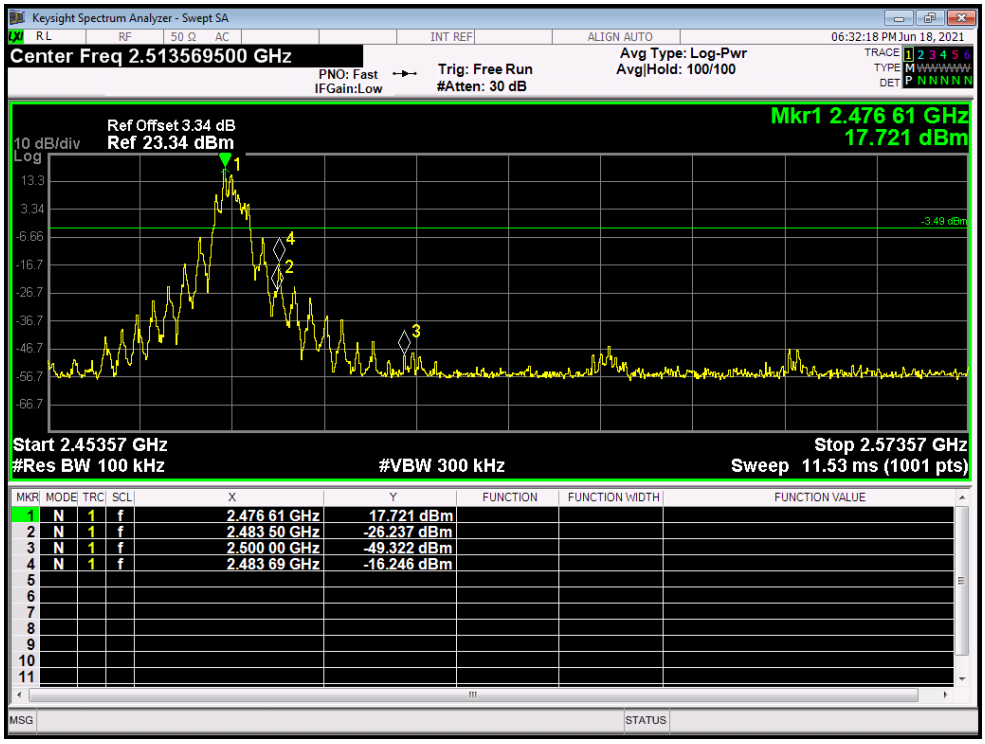
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	X	2477.600	73.77	1.84	75.61	Fundamental Frequency		peak
2	*	2477.600	88.53	1.84	90.37	Fundamental Frequency		AVG
3		2483.500	53.40	1.88	55.28	74.00	-18.72	peak
4		2483.500	33.84	1.88	35.72	54.00	-18.28	AVG

Remark:
1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. Peak/AVG (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Peak/AVG (dBμV/m)-Limit PK/AVG(dBμV/m)

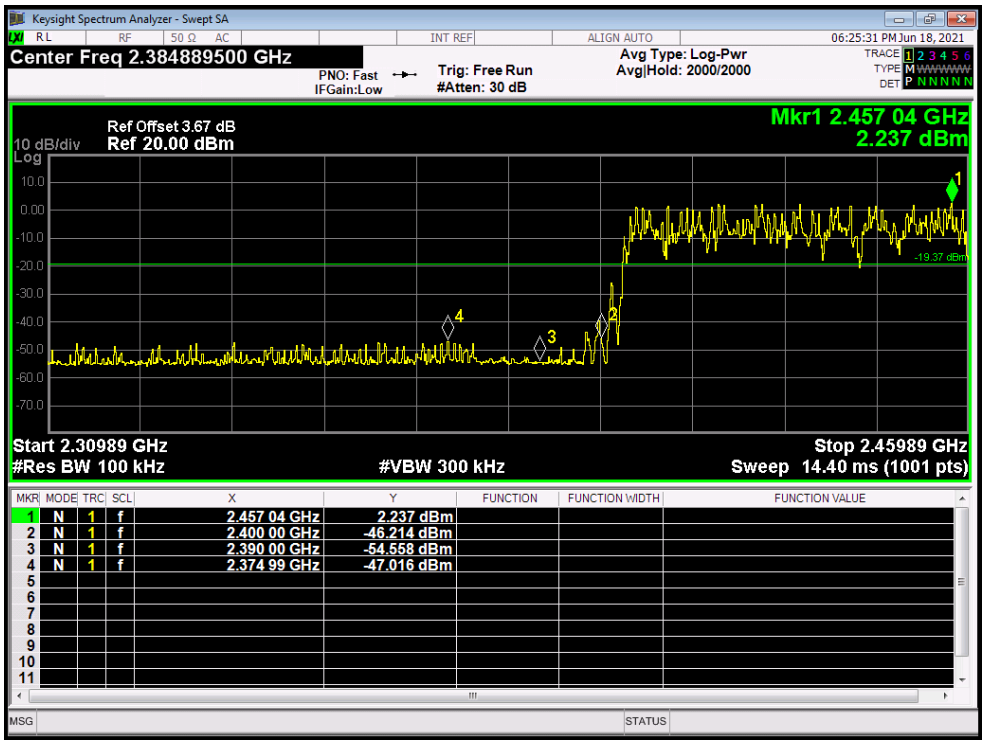
(2) Conducted Band Edge Test

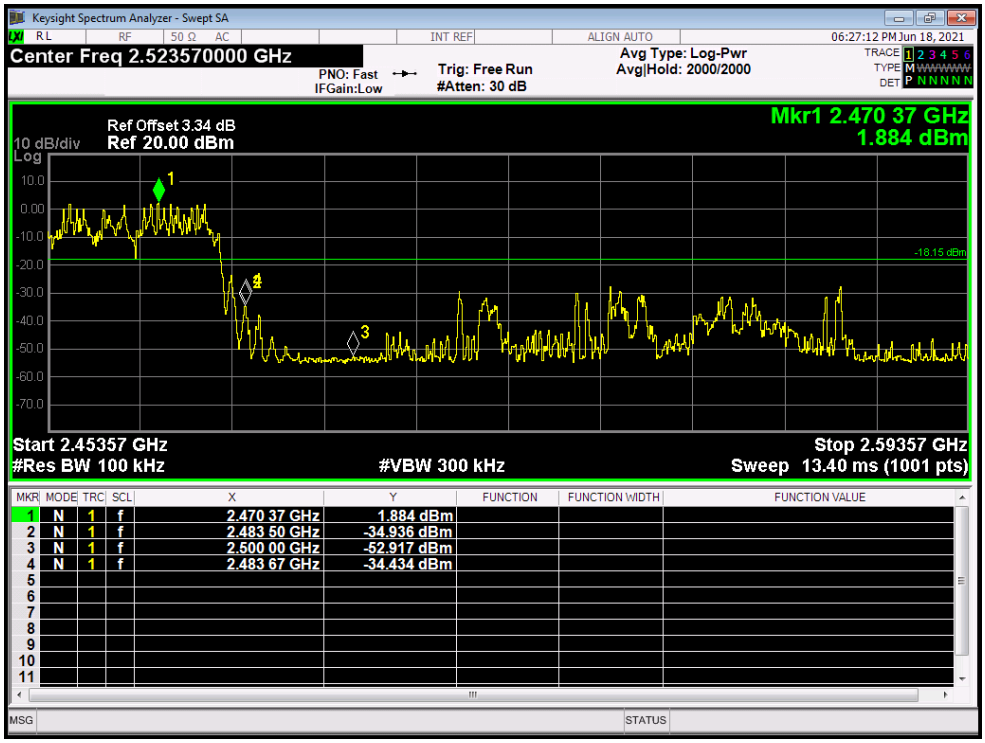
Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX GFSK Mode 2405.889MHz/2477.569 MHz		
Remark:	Only worse case is reported		





Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	GFSK Hopping Mode		
Remark:	Only worse case is reported		



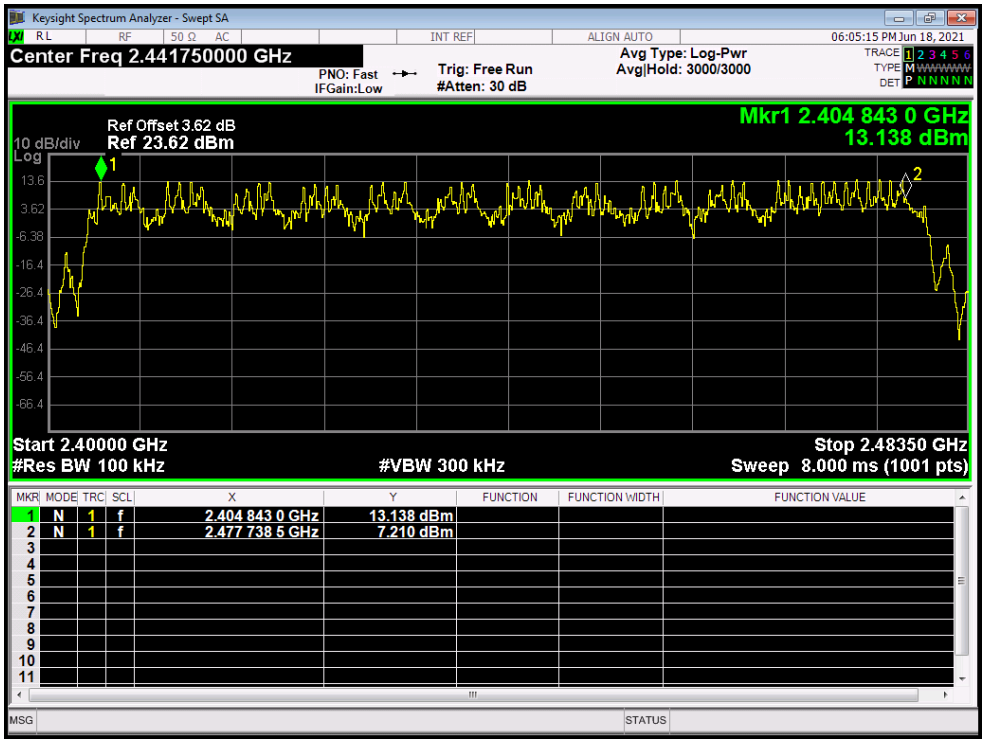


Attachment D-- Number of Hopping Channel Test Data

Temperature:	25℃	**Relative Humidity:**	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode		
Remark:	The number of total hopping frequencies up to 36		

Frequency Range	Test Mode	Quantity of Hopping Channel	Limit
2405.889MHz~2477.569MHz	GFSK	36	**>15**

GFSK Mode



Attachment E-- Average Time of Occupancy Test Data

Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	Hopping Mode (GFSK)		
Remark:	The number of total hopping frequencies up to 36.		

Test Mode	Channel (MHz)	Reading Time (ms)	Total hops (N)	Test Result (ms)	Limit (ms)	Result
GFSK	2440.705	6.228	36	124.56	**400**	**PASS**

The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:

The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 20 [ch] =8[s*ch];

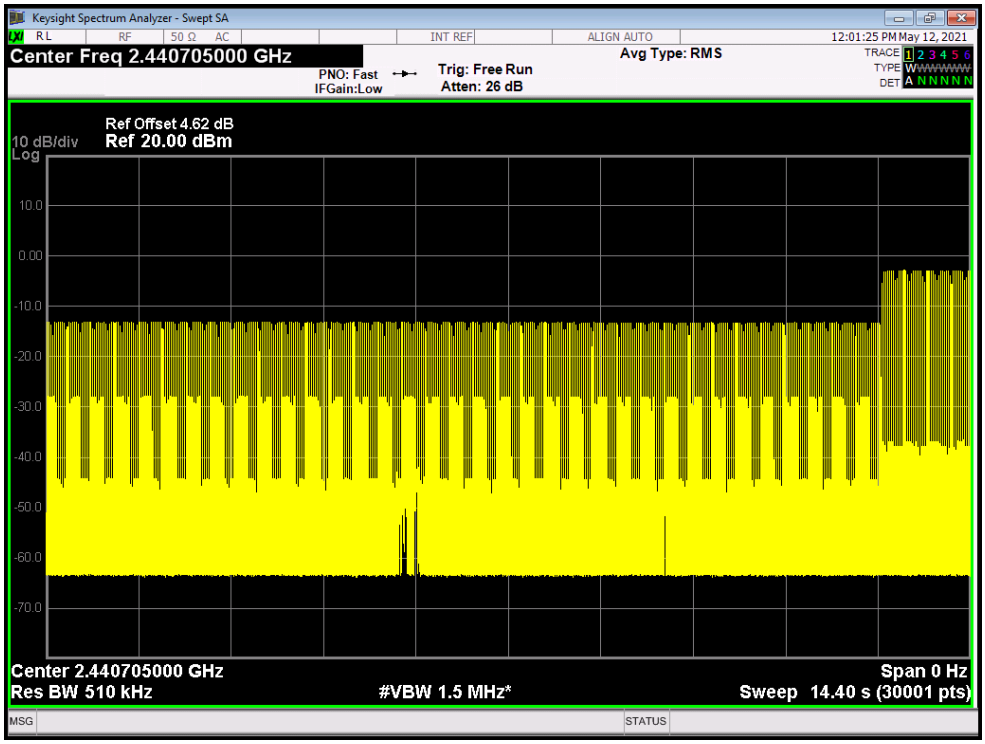
The burst width, which is directly measured, refers to the duration on one channel hop.

The maximum number of hopping channels in 8s is 36.

Reading Time=0.173ms*36=6.228

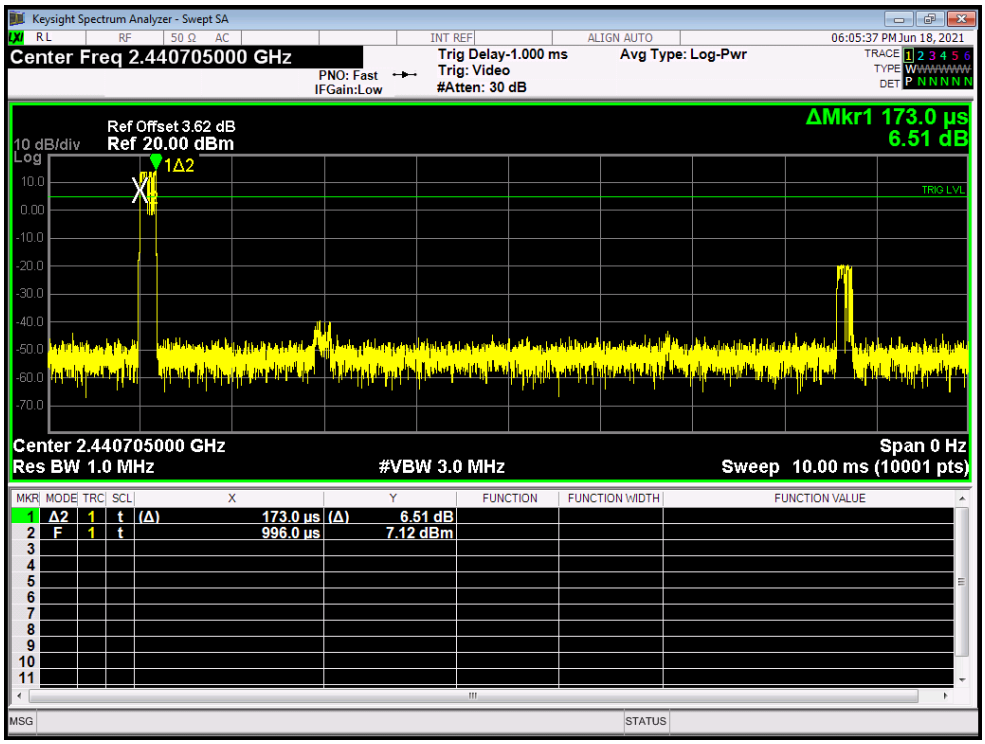
GFSK Hopping Mode

2440.705 MHz



GFSK Hopping Mode

2440.705 MHz



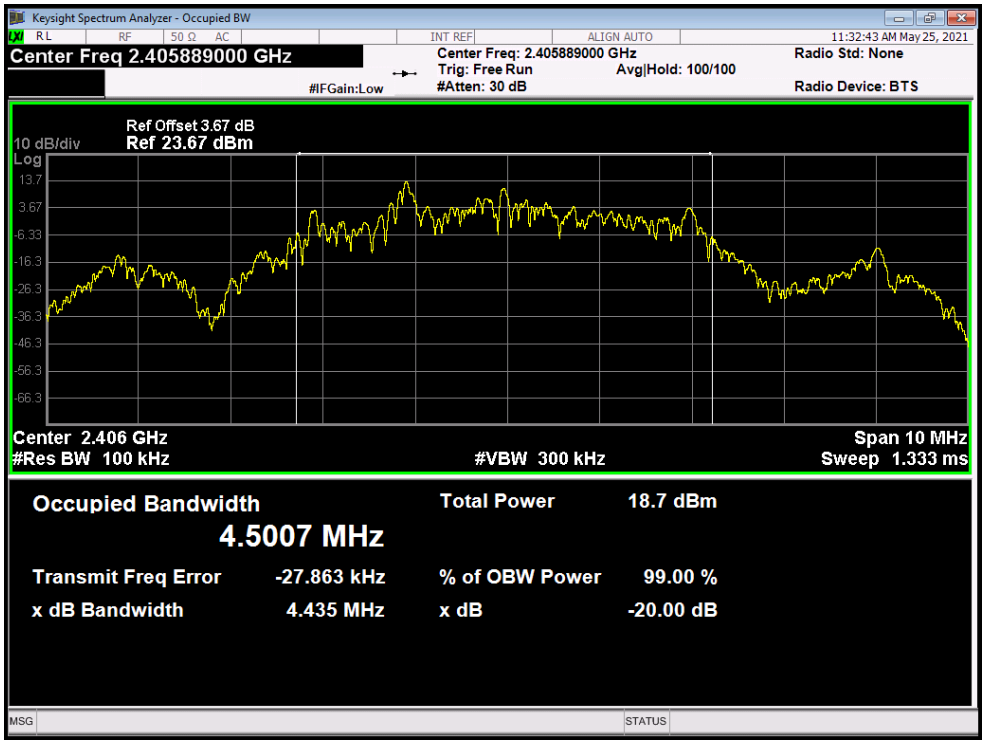
Attachment F-- Channel Separation and Bandwidth Test Data

Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Test Mode:	TX Mode (GFSK)		

Channel frequency (MHz)	99% OBW (kHz)	20dB Bandwidth (kHz)	20dB Bandwidth *2/3 (kHz)
2405.889	4500.66	4435	2956.66
2440.705	4455.27	4625	3083.33
2477.569	4612.33	4696	3130.66

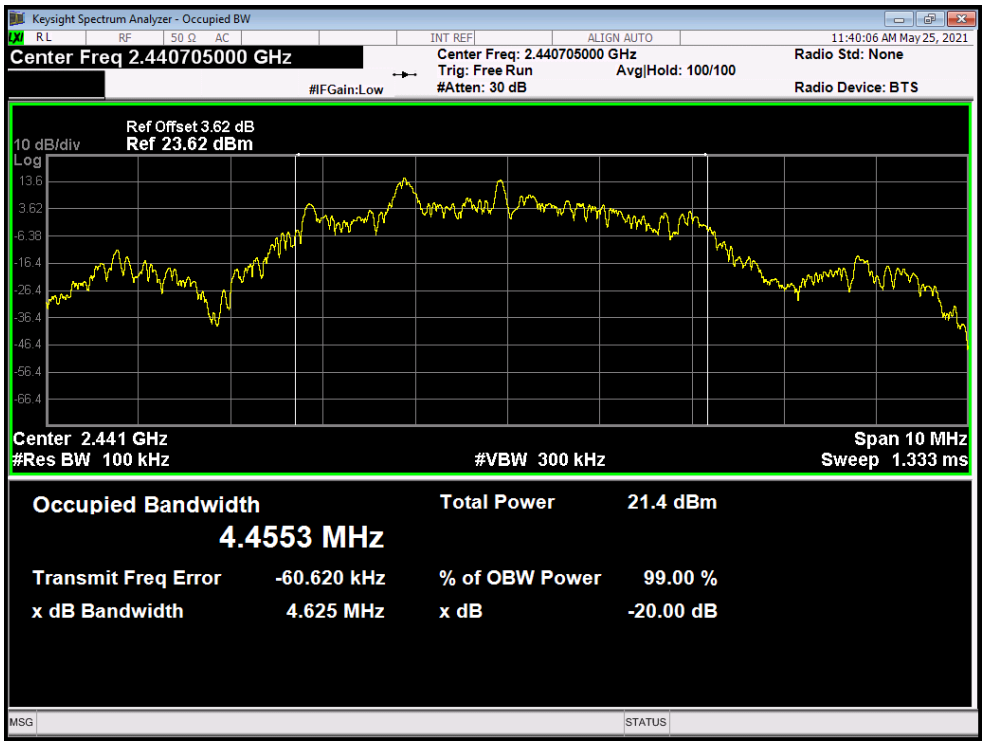
GFSK TX Mode

2405.889MHz



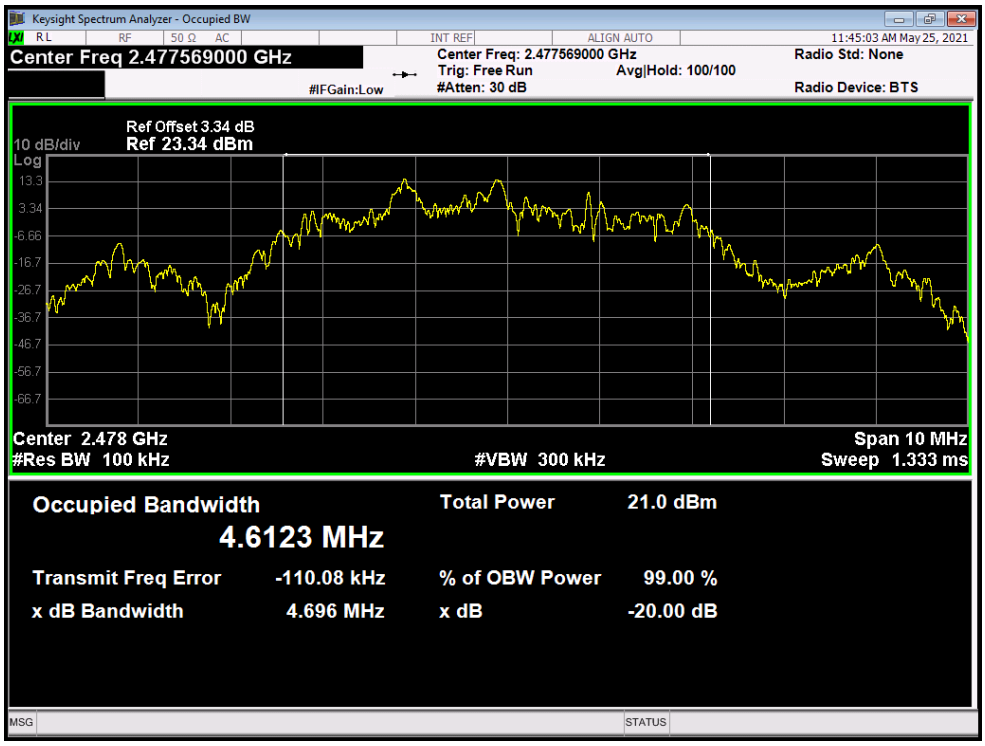
GFSK TX Mode

2440.705MHz



GFSK TX Mode

2477.569MHz



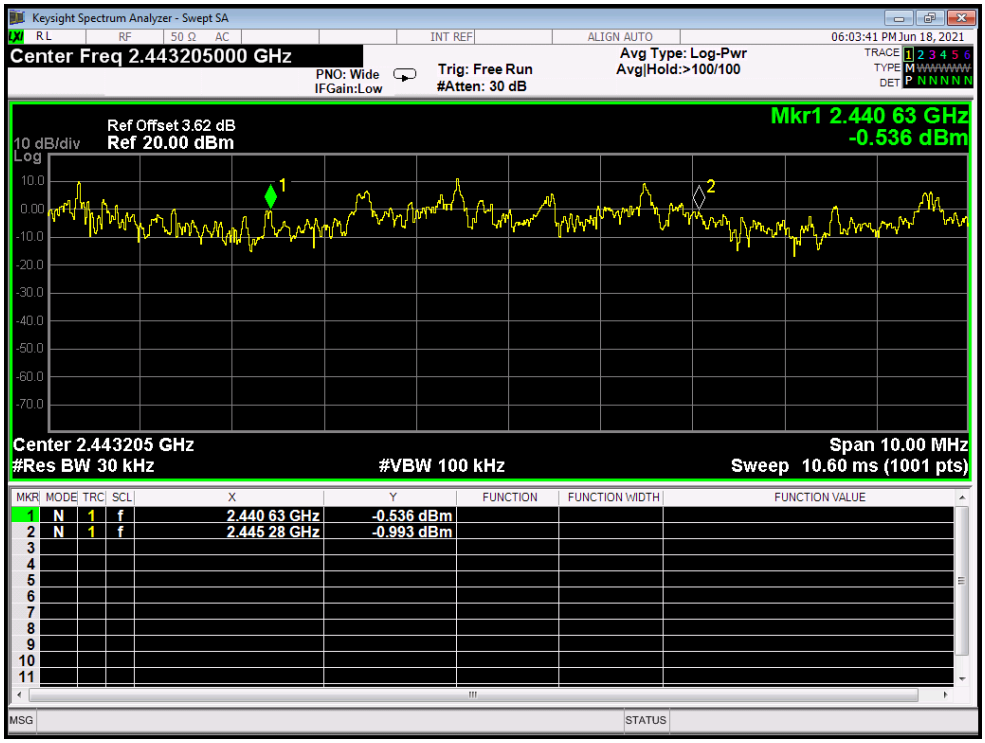
Channel Separation Test data:

Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	Hopping Mode (GFSK)		
Remark:	We test all channel and worse case recorded in the report.		

Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Separation Limit (kHz)
2440.625	2445.275	4.65	3083.33

GFSK Hopping Mode

2440MHz



Attachment G-- Peak Output Power Test Data

Temperature:	25℃	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Test Mode:	TX Mode (GFSK)		

Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)
2405.889	7	30
2440.705	6.88	
2477.569	6.92	

-----END OF REPORT-----