FCC PART 15.247

On Behalf of

Shenzhen NEWTEK Technology Co.,Ltd

101, Building A, No. 121, Shapu 2nd Road, Songgang Street, Baoan District, Shenzhen

FCC ID: 2BDWR-5518D
Model: 5518D, 5519D, 5520D, 5518W

December 14, 2023

This Report Concerns:	**Equipment Type:**
☒ Original Report	Wireless keyboard

Test Engineer:	Fan Yang /
Report Number:	**QCT23LR-2236E-02**
Test Date:	December 4~9, 2023
Reviewed By:	Gordon Tan/
Approved By:	Kendy Wang /
Prepared By:	**Shenzhen QC Testing Laboratory Co., Ltd.** East of 1/F., Building E, Xinghong Science Park, No.111, Shuiku Road, Fenghuanggang, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China **Tel: 0755-23008269** **Fax: 0755-23726780**

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Revision History of This Test Report

Report Number	Description	Issued Date
QCT23LR-2236E-02	Initial Issue	2023-12-14

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1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Description	Wireless keyboard
Model No.	5518D, 5519D, 5520D, 5518W
Tested Model	5518D
Sample(s) Status	Engineer sample
Operation Frequency:	2403MHz~2480MHz
Channel numbers:	16
Channel separation:	2MHz
Modulation type:	GFSK
Antenna Type:	Multilayer chip Antenna
Antenna gain*1:	2.67dBi
Power supply:	DC 3V (Powered by battery 1.5V AAA*2)
Trade Mark:	N/A
Applicant	Shenzhen NEWTEK Technology Co.,Ltd
Address	101, Building A, No. 121, Shapu 2nd Road, Songgang Street, Baoan District, Shenzhen
Manufacturer	Shenzhen NEWTEK Technology Co.,Ltd
Address	101, Building A, No. 121, Shapu 2nd Road, Songgang Street, Baoan District, Shenzhen
Sample No.	Y23L2235E01YN

Note: *1This information provided by Manufacturer, SZ QC Lab is not responsible for the accuracy of this information.

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1.2 System Test Configuration

1.2.1 Channel List

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2403	5	2407	9	2414	13	2419
2	2426	6	2422	10	2436	14	2439
3	2441	7	2445	11	2459	15	2453
4	2463	8	2466	12	2473	16	2480

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

Channel	Frequency	Channel	Frequency
The lowest channel	2403MHz	The middle channel	2441MHz
The Highest channel	2480MHz		

1.2.2 EUT Exercise Software

The engineering mode provided by the applicant for testing.

1.2.3 Support Equipment

Manufacturer	Description	Model	Serial Number
Notebook	DELL	Inspiron 15 3511	/

1.2.4 Test mode

Transmitting mode: Keep the EUT in continuously transmitting.

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1.3 Test Facility

Test Firm : Shenzhen QC Testing Laboratory Co., Ltd.

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19. The testing quality system of our laboratory meets with ISO/IEC-17025 requirements. This approval result is accepted by MRA of APLAC.

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

CNAS – Registration No.: L8464

The EMC Laboratory has been accredited by CNAS, and in compliance with ISO/IEC 17025:2017 General Requirements for testing Laboratories.

A2LA Certificate Number: 6759.01

The EMC Laboratory has been accredited by A2LA, and in compliance with ISO/IEC 17025:2017 General Requirements for testing Laboratories.

FCC Registration Number: 561109

The EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications commission.

IC Registration Number: 29628

CAB identifier: CN0141

The EMC Laboratory has been registered and fully described in a report filed with the (IC) Industry Canada.

1.4 Measurement Uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	±1.42 x10^{-4}%
RF output power, conducted	±1.06dB
Power Spectral Density, conducted	±1.06dB
Unwanted Emissions, conducted	±2.51dB
AC Power Line Conducted Emission	±1.80dB
Radiated Spurious Emission test (9kHz-30MHz)	±2.66dB
Radiated Spurious Emission test (30MHz-1000MHz)	±4.04dB
Radiated Spurious Emission test (1000MHz-18000MHz)	±4.70 dB
Radiated Spurious Emission test (18GHz-40GHz)	±4.80dB
Temperature	±0.8℃
Humidity	±3.2%
DC and low frequency voltages	±0.1%
Time	±5%
Duty cycle	±5%

Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2

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2. Summary of Test Results

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

Note: 1. Pass: The EUT complies with the essential requirements in the standard.

2. All indications of Pass/Fail in this report are opinions expressed by Shenzhen QC Testing Laboratory Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.

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3. List of Test and Measurement Instruments

3.1 Conducted Emission Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal.Due
1	EMI Test Receiver	R&S	ESIB 7	2277573376	2023.03.21	2024.03.20
2	Artificial Mains Network	SCHWARZBECK	NSLK8126	8126200	2023.03.21	2024.03.20
3	PULSE LIMITER	R&S	ESH3-Z2	100058	2023.03.21	2024.03.20
4	EMITEST RECEIVER	ROHDE & SCHWARZ	ESCS30	834115/014	2023.03.21	2024.03.20
Conducted Emission Measurement Software: TS						

3.2 Radiated Emission Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal.Due
1.	Spectrum Analyzer	ROHDE&SCHWARZ	FSV 40	101458	2023.04.12	2024.04.11
2.	Loop Antenna	EMCO	6502	2133	2022.07.23	2024.07.22
3.	Logarithmic compound broadband Antenna	SCKWARZBECK	VULB9168	VULB9168-1-588	2023.04.01	2025.03.31
4.	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB 7	2277573376	2023.04.12	2024.04.11
5.	EMI Test Receiver	R&S	ESPI	101131	2023.03.21	2024.03.20
6.	Horn Antenna	SCHWARZBECK	BBHA9120D	02069	2023.04.01	2025.03.31
7.	Horn Antenna	COM-MW	ZLB7-18-40G -950	12221225	2023.01.12	2025.01.09
8.	Amplifier	R&S	BBV9721	9721-031	2023.03.21	2024.03.20
9.	Amplifier	HPX	BP-01G-18G	210902	2023.03.21	2024.03.20
10.	Pre-amplifier	COM-MW	DLAN-18000 -40000-02	10229104	2023.01.11	2024.01.10
11.	966 Chamber	ZhongYu Electron	9*6*6	/	2022.07.25	2025.07.24
Radiated Emission Measurement Software: EZ_EMC						

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3.3 RF Conducted test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal.Due
1.	Wideband Radio Communication Tester	Rohde & Schwarz	CW500	151583	2023.03.21	2024.03.20
2.	Spectrum Analyzer	ROHDE& SCHWARZ	FSV 40	101458	2023.04.12	2024.04.11
3.	Signal Generator	Agilent	N5182A	MY50141563	2023.03.21	2024.03.20
4.	RF Automatic Test System	MW	MW100-RFCB/ MW100-PSB	MW2007004	2023.03.21	2024.03.20
RF Conducted Measurement Software: MTS 8310						

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4. Antenna requirement

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

15.203 requirement:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.
15.247(c) (1)(i) requirement:
(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

EUT Antenna: The Ant is Multilayer chip Antenna, the best case gain of the antenna is 2.67dBi, reference to the Internal photo for details.

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5. Conducted Emissions

5.1 Applicable Standard

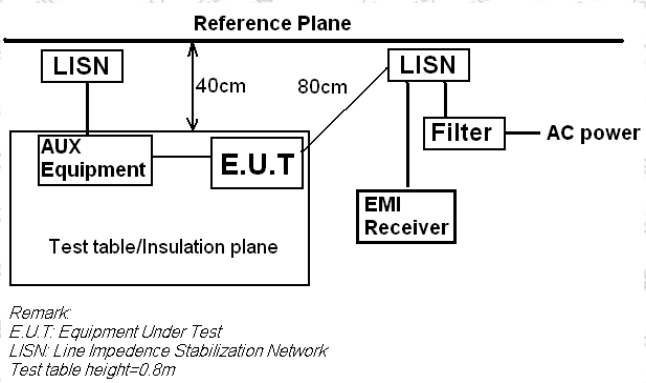
FCC Part15 C Section 15.207

5.2 Limit

Frequency range (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

Note *: The level decreases linearly with the logarithm of the frequency.

5.3 Test setup



Remark:
E.U.T: Equipment Under Test
LISN: Line Impedence Stabilization Network
Test table height=0.8m

5.4 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.
RBW=9 kHz, VBW=30 kHz, Sweep time=auto

5.5 Test procedure

1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment.
2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs).
3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

5.6 Test Data

Temperature	25.9 ℃	Humidity	55%
ATM Pressure	101.1kPa	Antenna Gain	2.67dBi
Test by	Charlie He	Test result	PASS

Test voltage: AC 120V/60Hz

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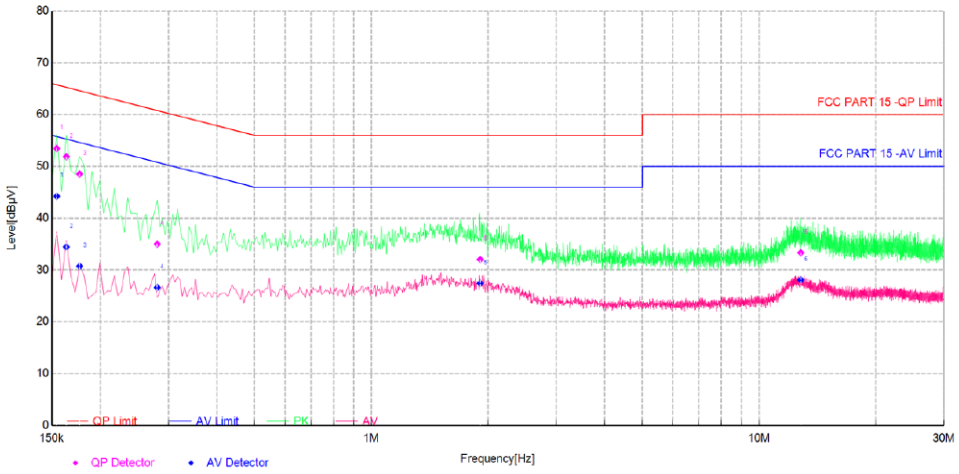
Measurement data:

Pre-scan all test modes, found worst case at 2480MHz, and so only show the test result of 2480MHz

Line:



Final Data List										
NO.	Freq. [MHz]	Factor[dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Phase	Verdict
1	0.1545	10.02	53.47	65.75	12.28	44.23	55.75	11.52	L	PASS
2	0.1635	10.08	51.88	65.28	13.40	34.43	55.28	20.85	L	PASS
3	0.1770	10.14	48.52	64.63	16.11	30.72	54.63	23.91	L	PASS
4	0.2805	10.48	35.00	60.80	25.80	26.60	50.80	24.20	L	PASS
5	1.9095	10.15	32.03	56.00	23.97	27.43	46.00	18.57	L	PASS
6	12.8090	10.32	33.33	60.00	26.67	28.10	50.00	21.90	L	PASS

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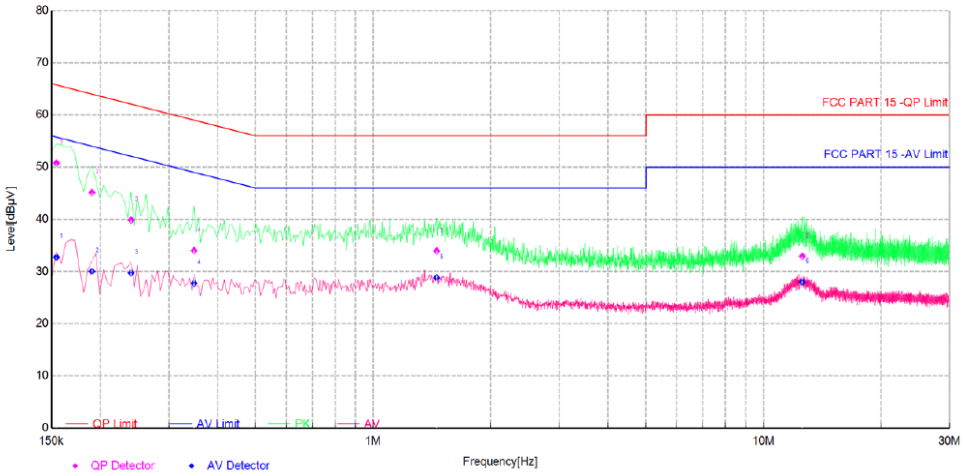
Neutral:



Final Data List										
NO.	Freq. [MHz]	Factor[dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Phase	Verdict
1	0.1545	10.01	50.80	65.75	14.95	32.74	55.75	23.01	N	PASS
2	0.1905	10.25	45.15	64.01	18.86	30.03	54.01	23.98	N	PASS
3	0.2400	10.38	39.85	62.10	22.25	29.73	52.10	22.37	N	PASS
4	0.3480	10.45	34.00	59.01	25.01	27.76	49.01	21.25	N	PASS
5	1.4550	10.05	33.94	56.00	22.06	28.79	46.00	17.21	N	PASS
6	12.5750	10.35	32.90	60.00	27.10	27.99	50.00	22.01	N	PASS

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.

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6. Conducted Peak Output Power

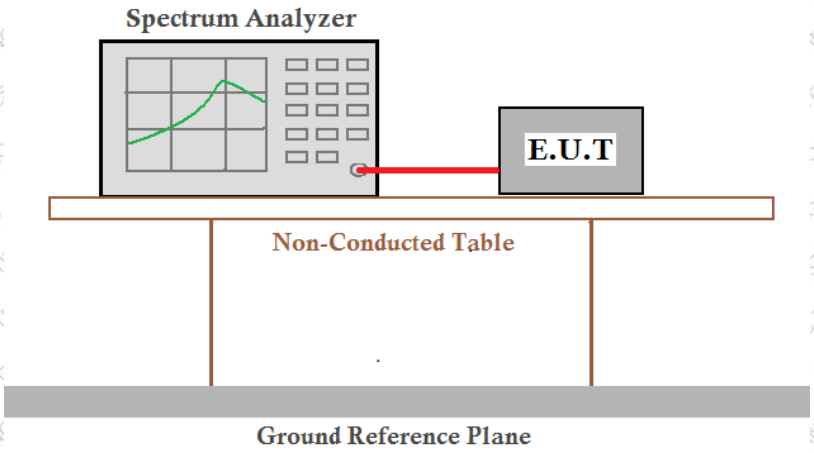
6.1 Applicable Standard

FCC Part15 C Section 15.247(b) (1)

6.2 Limit

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

6.3 Test setup



6.4 Test Data

Temperature	25.9 ℃	Humidity	48%
ATM Pressure	101.1kPa	Antenna Gain	2.67dBi
Test by	Fan Yang	Test result	PASS

Please refer to following table and plots.

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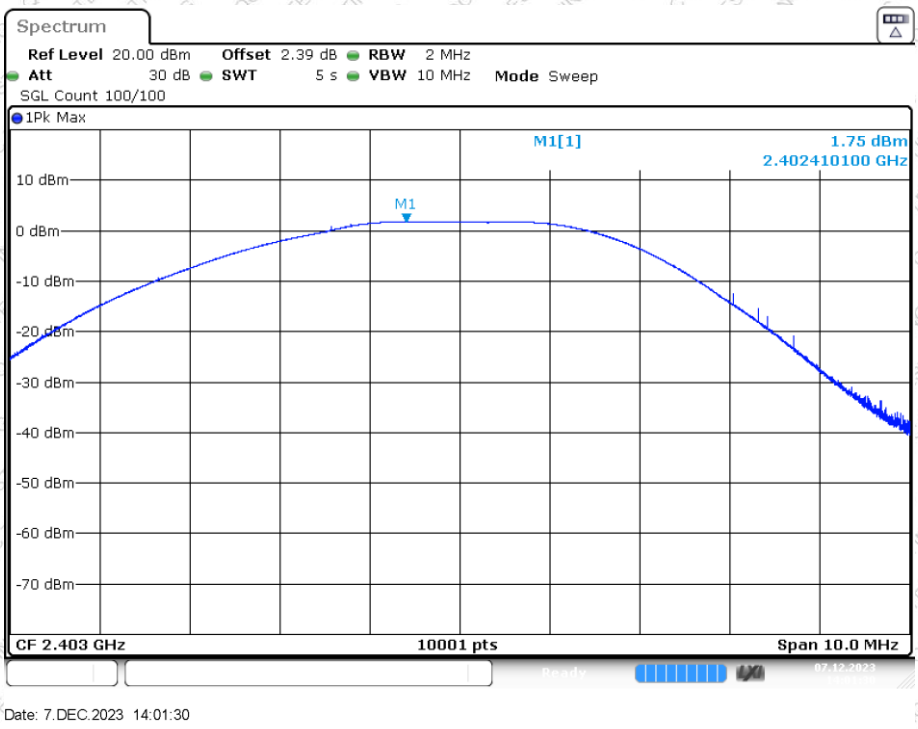
Output Power:

Mode	Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
GFSK	Lowest	1.75	20.97	Pass
	Middle	0.7		
	Highest	1.18		

Power NVNT GFSK 2403MHz Ant1



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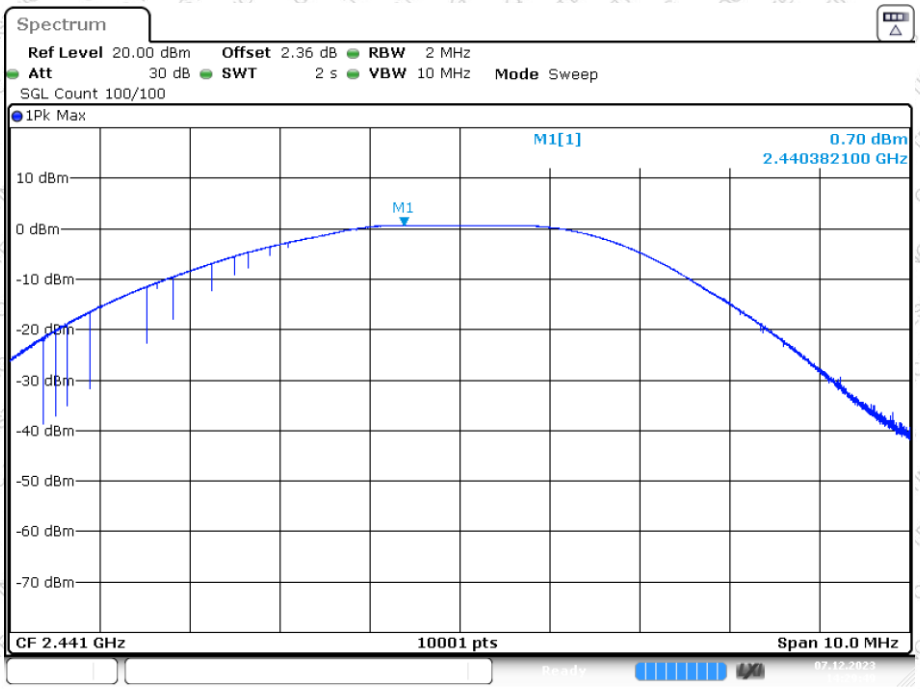
Power NVNT GFSK 2441MHz Ant1



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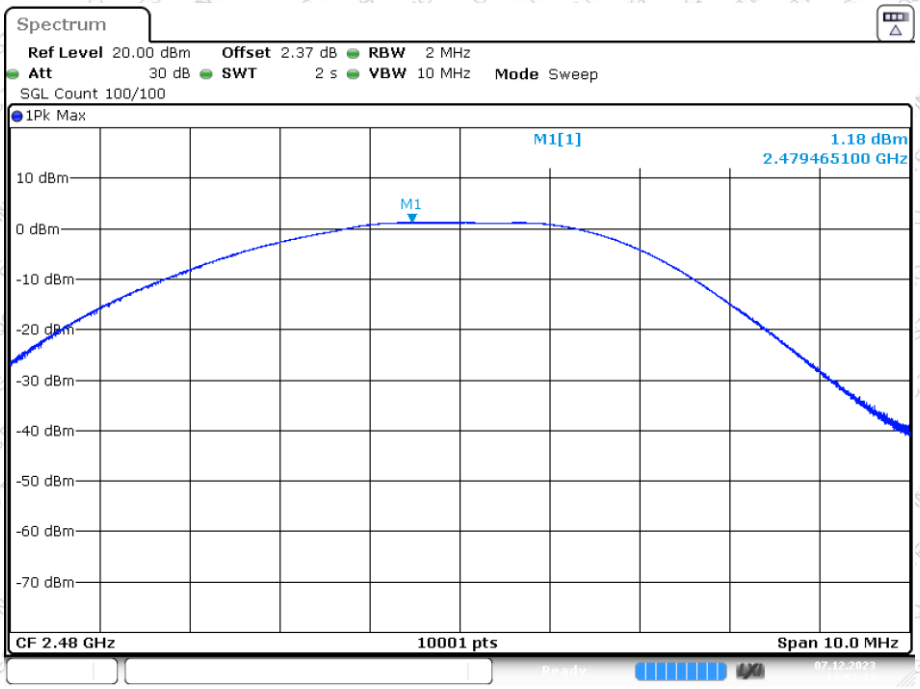
Power NVNT GFSK 2480MHz Ant1



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7. 20dB Emission Bandwidth & 99% Occupy Bandwidth

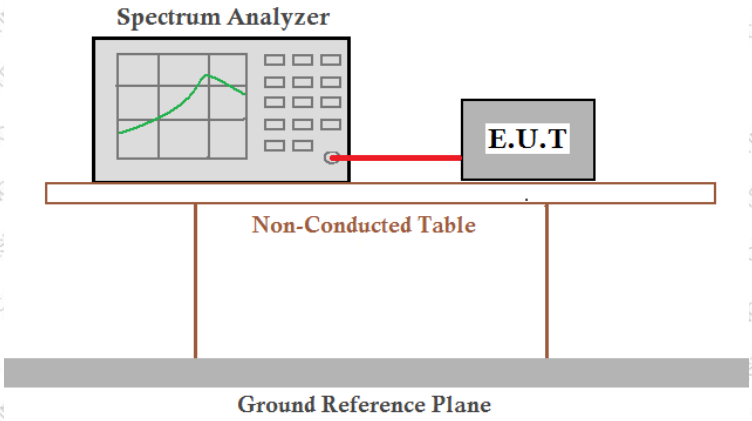
7.1 Applicable Standard

FCC Part15 C Section 15.247 (a)(1)

7.2 Limit

N/A

7.3 Test setup



7.4 Test Procedure

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

• The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

• The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

7.5 Test Data

Temperature	25.9 ℃	Humidity	48%
ATM Pressure	101.1kPa	Antenna Gain	2.67dBi
Test by	Fan Yang	Test result	PASS

Please refer to following table and plots.

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Measurement Data

Mode	Test channel	20dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Verdict
GFSK	Lowest	2.126	2.278	PASS
	Middle	2.124	2.299	PASS
	Highest	2.248	2.273	PASS

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-20dB Bandwidth:

-20dB Bandwidth GFSK 2403MHz Ant1

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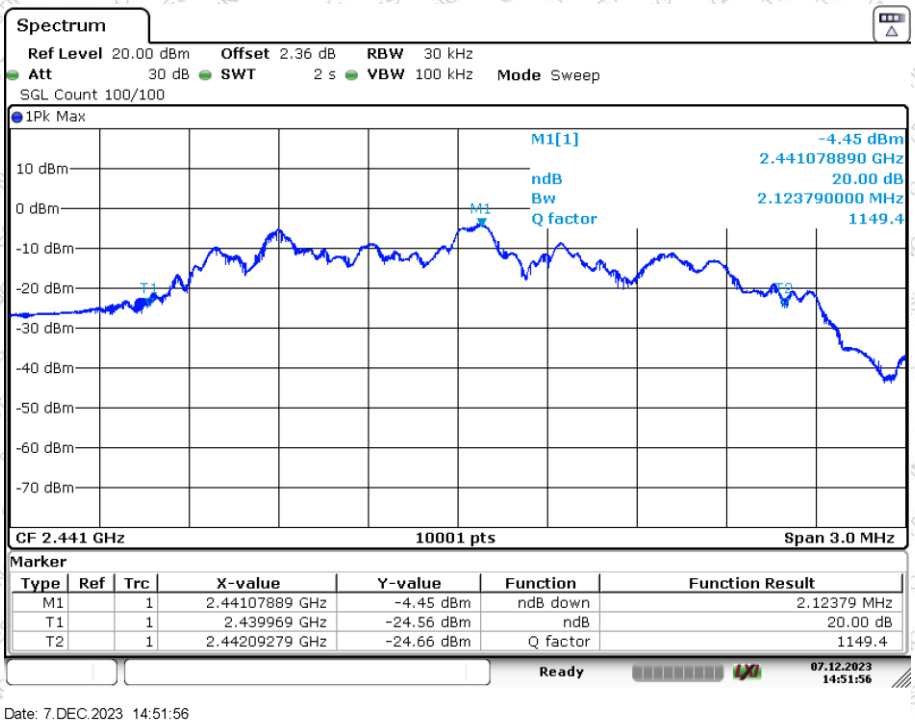
-20dB Bandwidth GFSK 2441MHz Ant1



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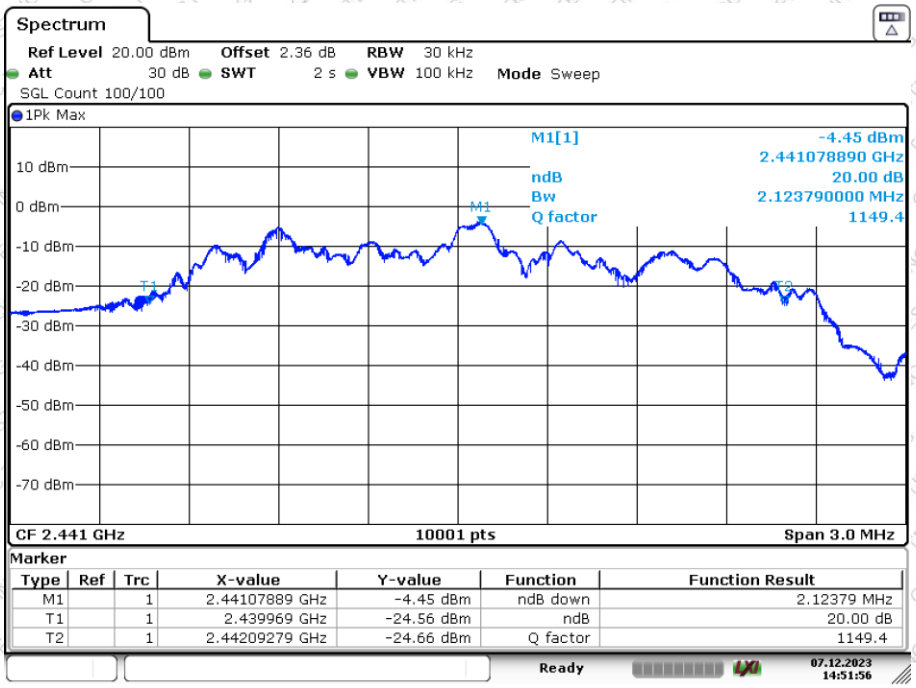
-20dB Bandwidth GFSK 2480MHz Ant1



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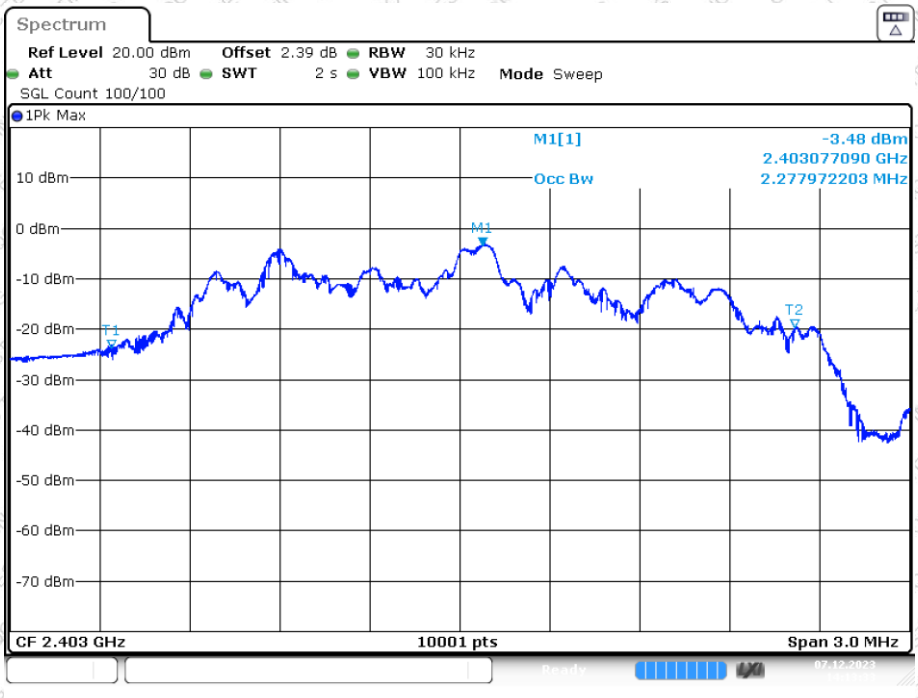
99% Occupied Bandwidth:

OBW GFSK 2403MHz Ant1



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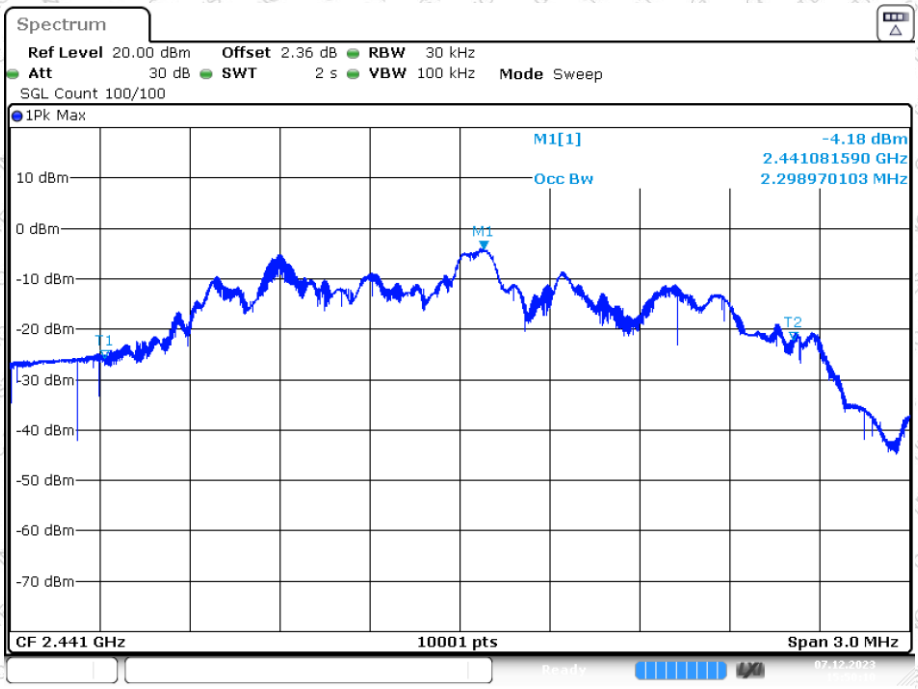
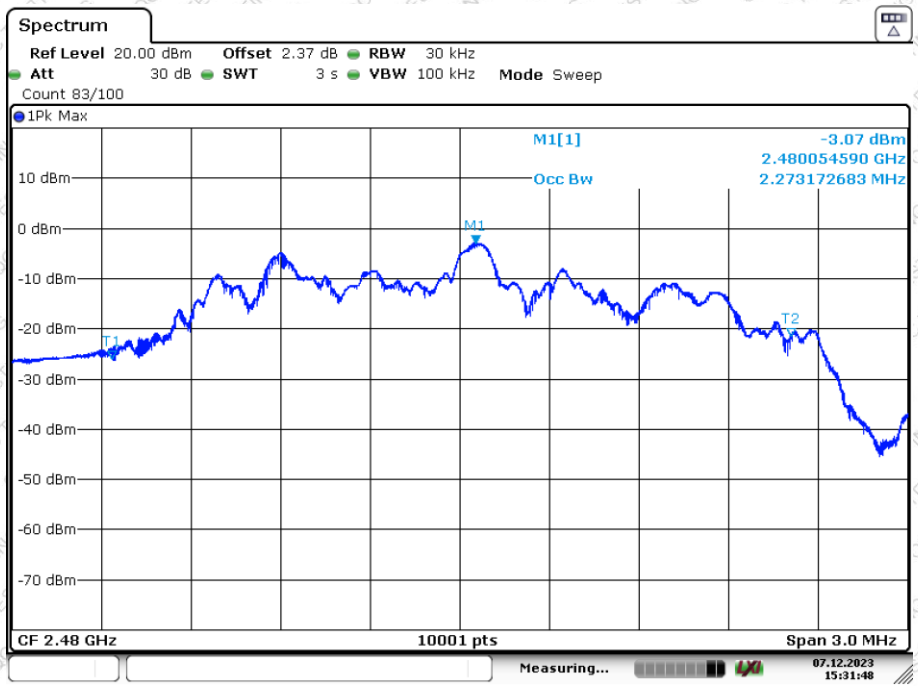
OBW GFSK 2441MHz Ant1



Date: 7.DEC.2023 15:50:10

OBW GFSK 2480MHz Ant1



Date: 7.DEC.2023 15:31:48

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8. Carrier Frequencies Separation

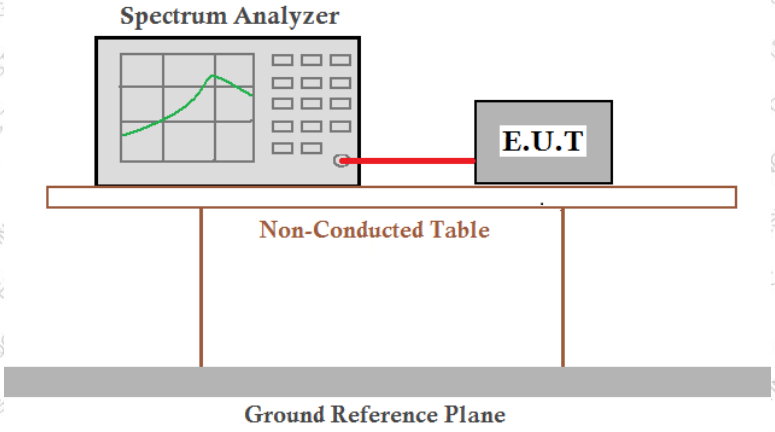
8.1 Applicable Standard

FCC Part15 C Section 15.247 (a)(1)

8.2 Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a 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.

8.3 Test setup



8.4 Test Procedure

1. Set the EUT in transmitting mode, max hold the channel.
2. Set the adjacent channel of the EUT and max hold another trace.
3. Measure the channel separation.

8.5 Test Data

Temperature	25.9 ℃	Humidity	48%
ATM Pressure	101.1kPa	Antenna Gain	2.67dBi
Test by	Fan Yang	Test result	PASS

Please refer to following table and plots.

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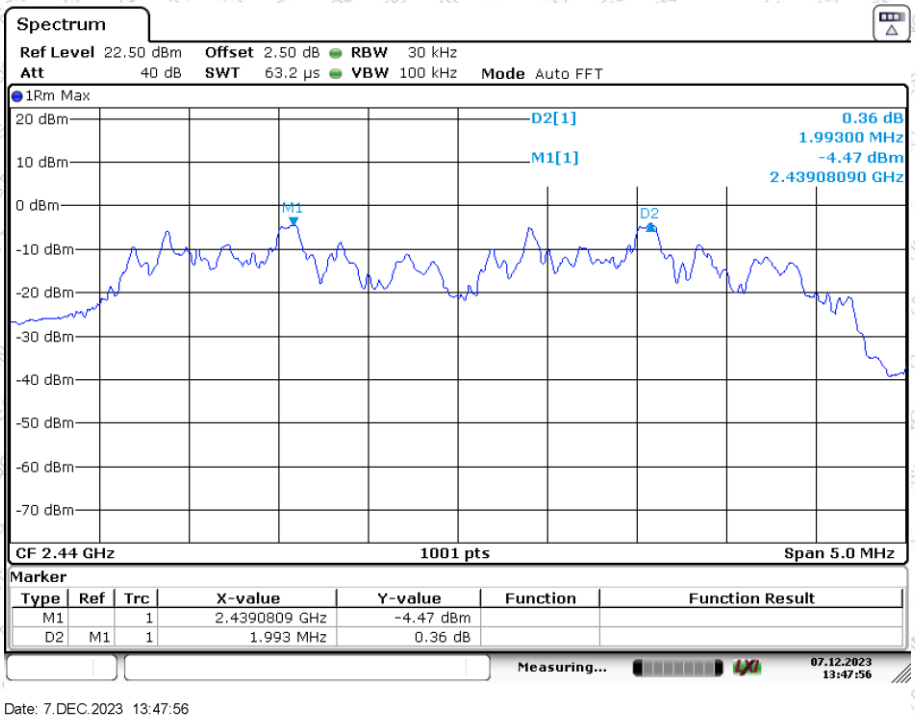
Measurement Data

Mode	Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
GFSK	Middle	1993	1416	Pass

Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
GFSK	2124	1416

Note: According to section 7.5
*Limit = (2/3) * 20dB bandwidth*

CFS GFSK 2441MHz Ant1



Date: 7.DEC.2023 13:47:56

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9. Hopping Channel Number

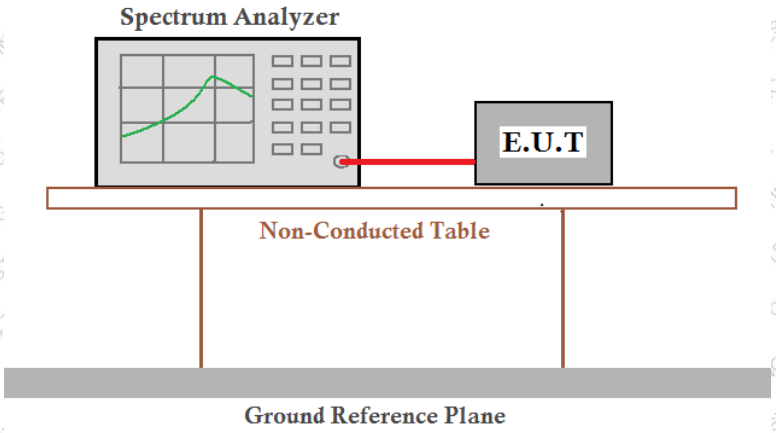
9.1 Applicable Standard

FCC Part15 C Section 15.247 (a)(1)(iii)

9.2 Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

9.3 Test setup



9.4 Test Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the max-hold function record the quantity of the channel.

9.5 Test Data

Temperature	25.9 ℃	Humidity	48%
ATM Pressure	101.1kPa	Antenna Gain	2.67dBi
Test by	Fan Yang	Test result	PASS

Please refer to following table and plots.

Measurement Data:

Mode	Hopping channel numbers	Limit	Result
GFSK	16	15	Pass

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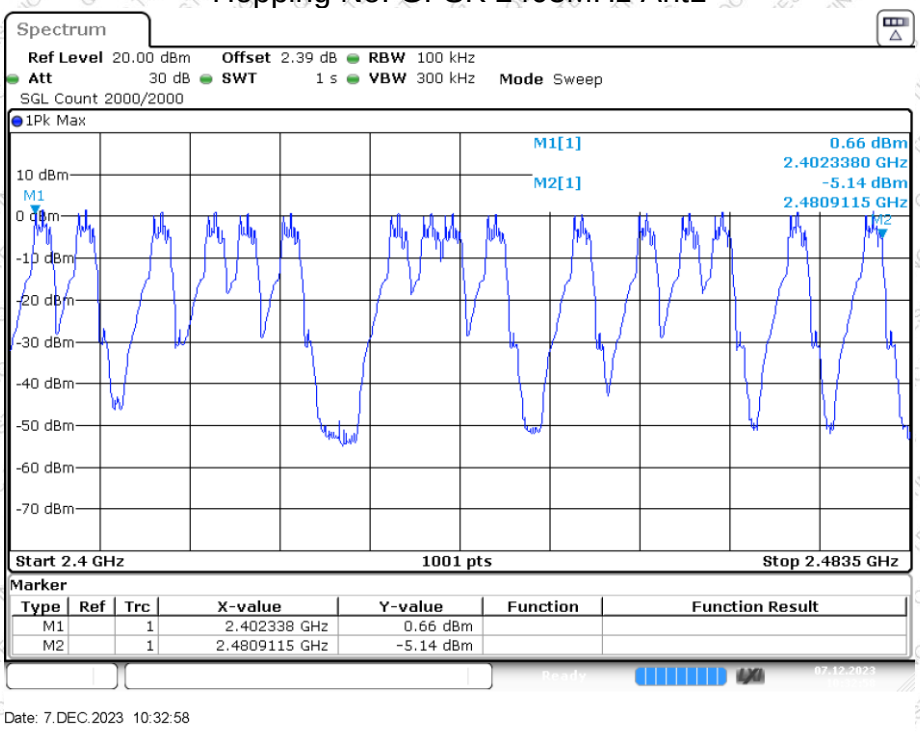
Hopping No. GFSK 2403MHz Ant1



Note: The EUT is 2.4G wireless frequency hopping function is random frequency hopping 16 channels work，The report only show the worst case data.

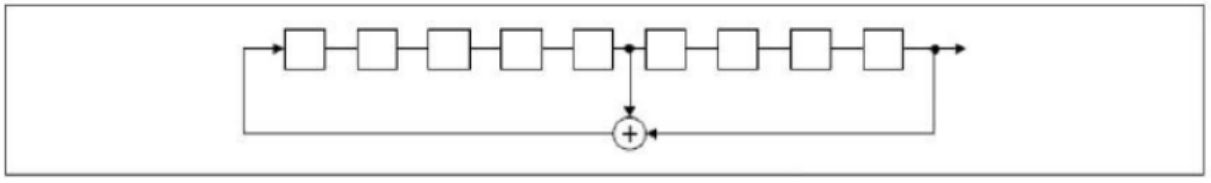
EUT Pseudorandom Frequency Hopping Sequence Requirement:

The pseudorandom frequency hopping sequence may be generated in a nice 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 thefirst slage. The sequence begins with the first one of 9 conseculive ones, for example: the shift register isinitialized with nine ones.

Number of shift register stages.9

Length of pseudo-random sequence 29-1=511 bits

Longestt sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

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An example of pseudorandom frequency hopping sequence as follows:

1	5	9	13	6	2	9	14	3	7	15	11	4	8	12	16
2403	2407	2414	2419	2422	2426	2436	2439	2441	2445	2453	2459	2463	2466	2473	2480

Unit: MHz

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

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10. Dwell Time

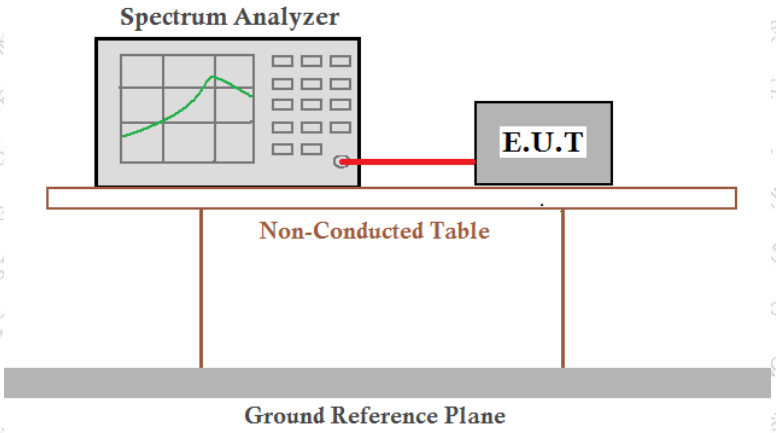
10.1 Applicable Standard

FCC Part15 C Section 15.247 (a)(1)(iii)

10.2 Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

10.3 Test setup



10.4 Test Data

Temperature	25.9 ℃	Humidity	48%
ATM Pressure	101.1kPa	Antenna Gain	2.67dBi
Test by	Fan Yang	Test result	PASS

Please refer to following table and plots.

Mode	Channel	Burst Width [ms]	Total Hops [Num]	Result[s]	Limit[s]	Result
GFSK	Hop	0.174	101	0.018	<=0.4	PASS

Note: The test period: T= 0.4 Second/Channel x 16 Channel = 6.4 s.

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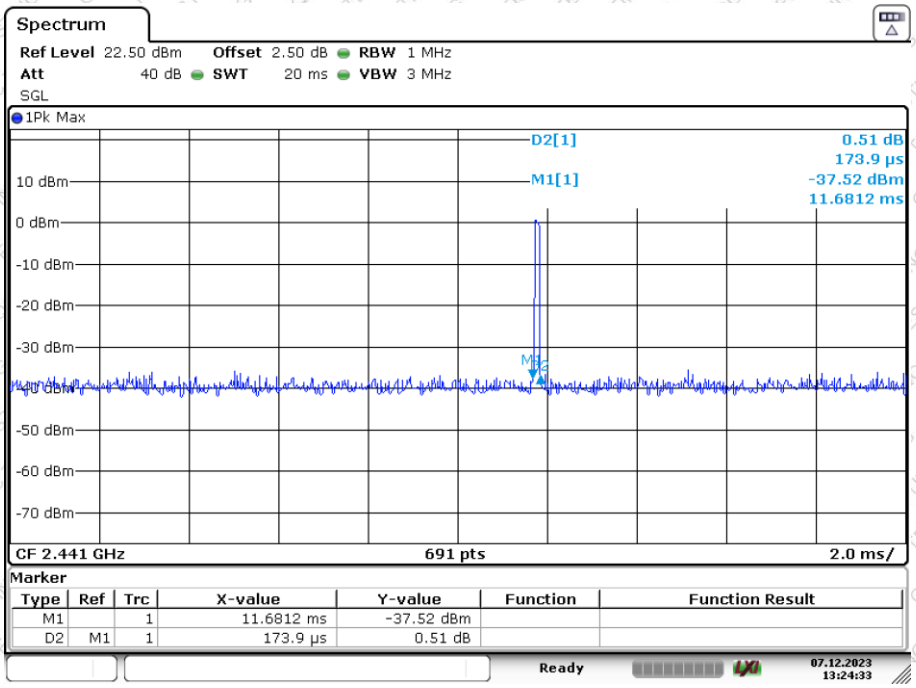
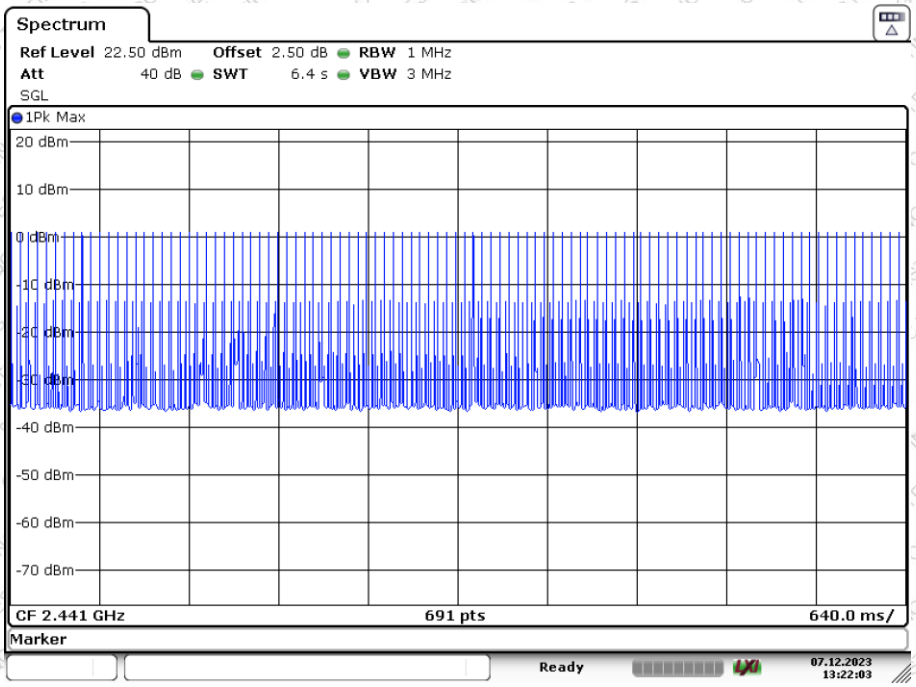
Dwell NVNT GFSK 2441MHz Ant1 One Burst



Date: 7.DEC.2023 13:24:34

Dwell NVNT GFSK 2441MHz Ant1 Accumulated



Date: 7.DEC.2023 13:22:03

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11. Spurious Emission in Non-restricted & restricted Bands

11.1 Conducted Emission Method

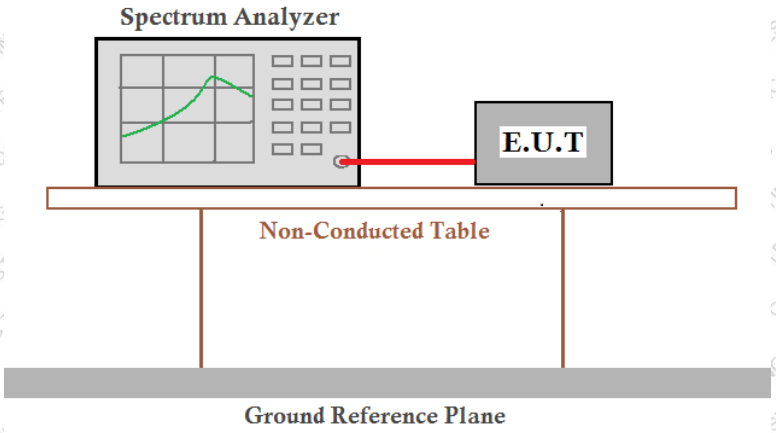
11.1.1 Applicable Standard

FCC Part15 C Section 15.247 (d)

11.1.2 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

11.1.3 Test setup



11.1.4 Test Procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- Repeat above procedures until all measured frequencies were complete.

11.1.5 Test Data

Temperature	25.9 ℃	Humidity	48%
ATM Pressure	101.1kPa	Antenna Gain	2.67dBi
Test by	Fan Yang	Test result	PASS

Please refer to following plots.

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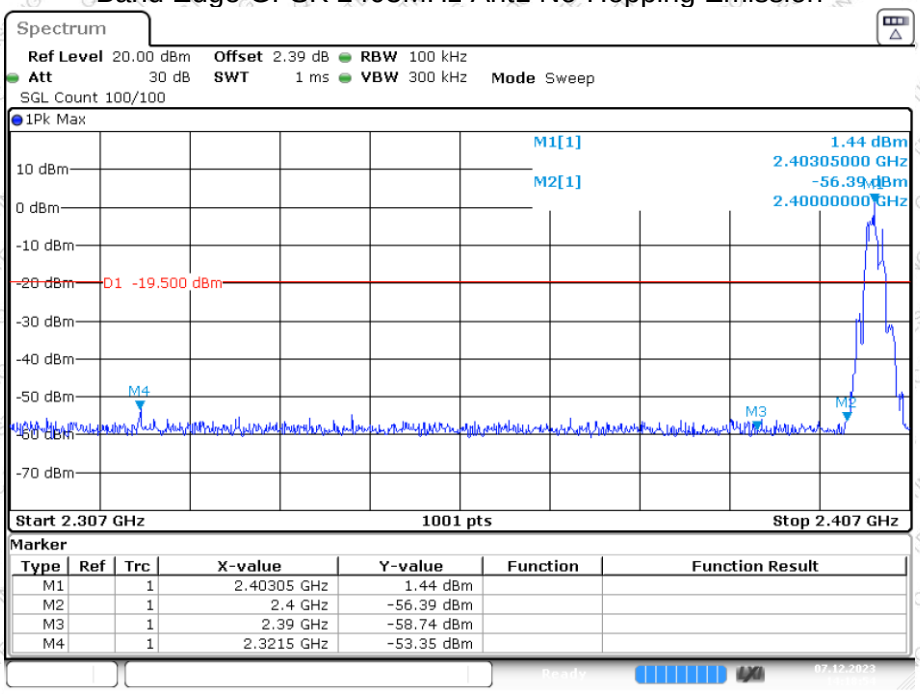
Band Edge GFSK 2403MHz Ant1 No-Hopping Emission

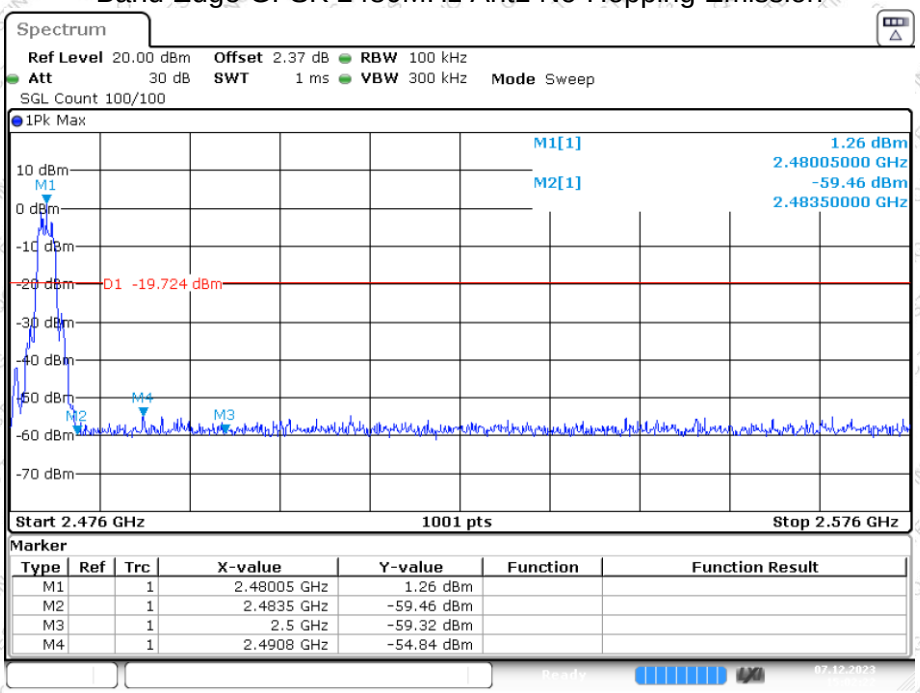


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40305 GHz	1.44 dBm		
M2		1	2.4 GHz	-56.39 dBm		
M3		1	2.39 GHz	-58.74 dBm		
M4		1	2.3215 GHz	-53.35 dBm		

Date: 7.DEC.2023 14:18:55

Band Edge GFSK 2480MHz Ant1 No-Hopping Emission



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48005 GHz	1.26 dBm		
M2		1	2.4835 GHz	-59.46 dBm		
M3		1	2.5 GHz	-59.32 dBm		
M4		1	2.4908 GHz	-54.84 dBm		

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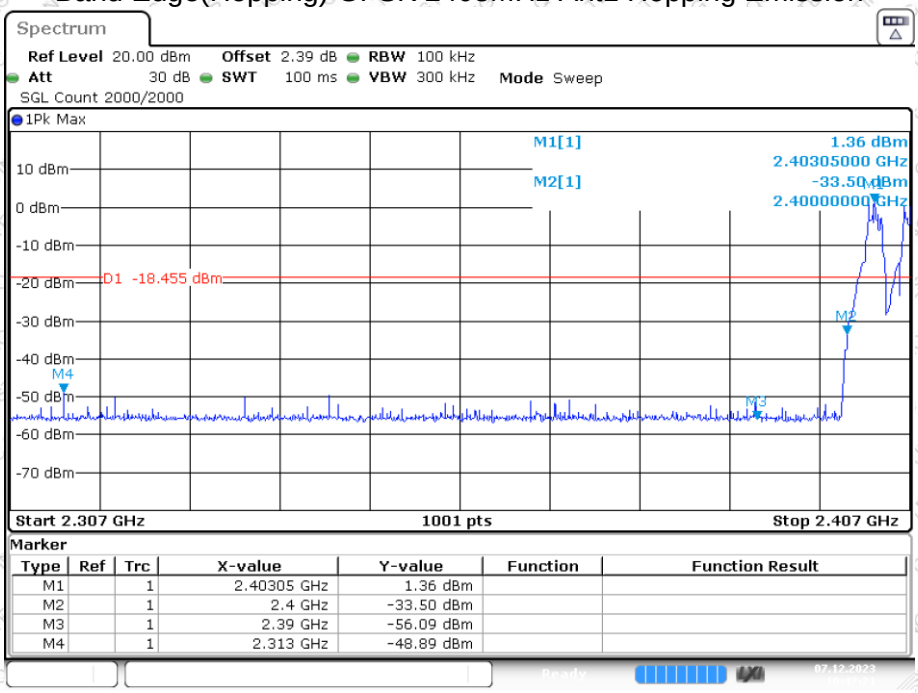
Band Edge(Hopping) GFSK 2403MHz Ant1 Hopping Emission

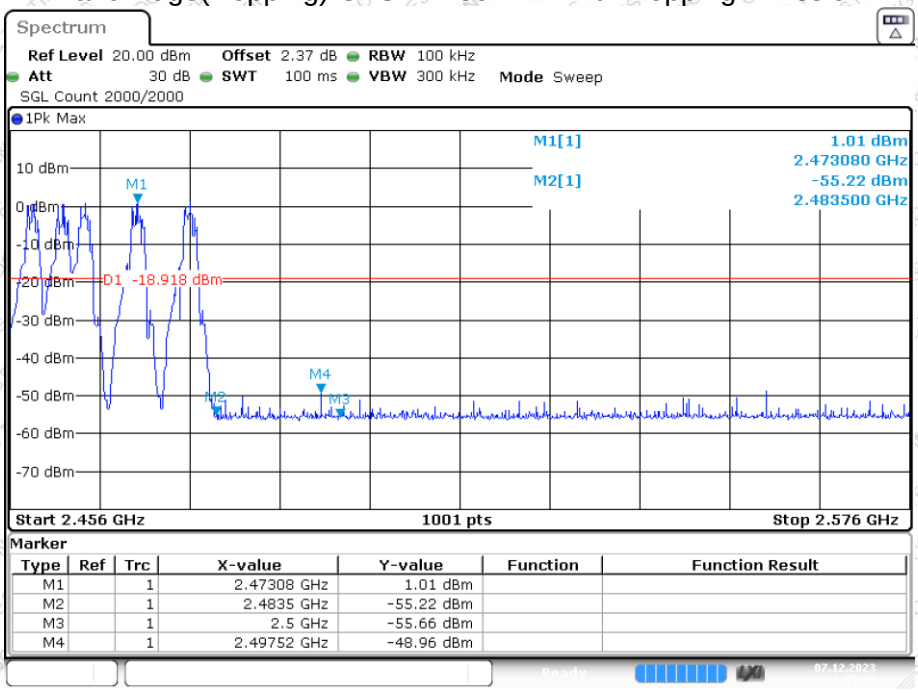


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40305 GHz	1.36 dBm		
M2		1	2.4 GHz	-33.50 dBm		
M3		1	2.39 GHz	-56.09 dBm		
M4		1	2.313 GHz	-48.89 dBm		

Date: 7.DEC.2023 10:47:22

Band Edge(Hopping) GFSK 2480MHz Ant1 Hopping Emission



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47308 GHz	1.01 dBm		
M2		1	2.4835 GHz	-55.22 dBm		
M3		1	2.5 GHz	-55.66 dBm		
M4		1	2.49752 GHz	-48.96 dBm		

Date: 7.DEC.2023 12:55:21

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11.2 Radiated Emission Method

11.2.1 Applicable Standard

FCC Part15 C Section 15.209 and 15.205

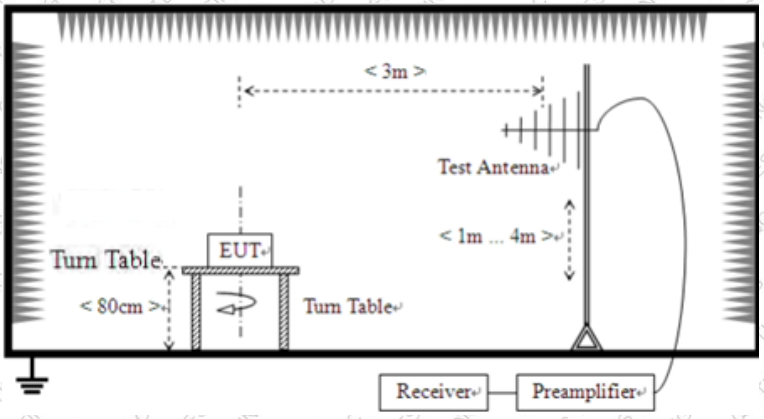
11.2.2 Limit

Frequency	Field Strengths Limits (μV/m at 3 m)	Field Strengths Limits (dBμV/m at 3 m)	Remark
30 – 88	100	40.0	Quasi-peak
88 – 216	150	43.5	Quasi-peak
216 – 960	200	46.0	Quasi-peak
Above 960	500	54.0	Quasi-peak
Above 1GHz	/	54.0	Peak
		74.0	Average

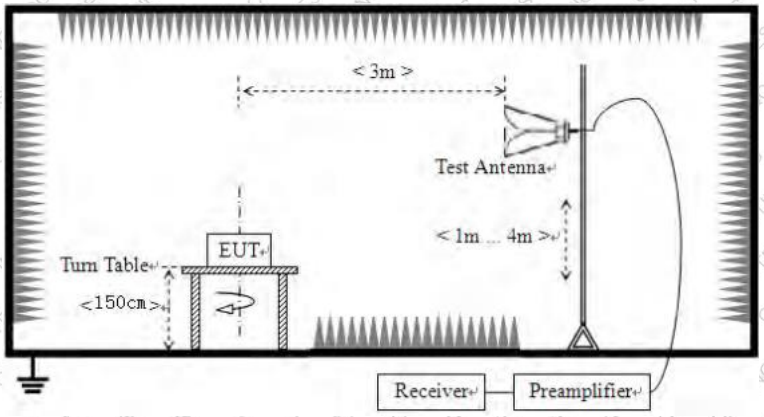
Note: dBμV/m =20log(μV/m)

11.2.3 Test setup

For radiated emissions from 30MHz to1GHz



For radiated emissions above 1GHz



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11.2.4 EMI Test Receiver Setup

Frequency	RBW	VBW	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	Peak
	1 MHz	10 Hz	/	Average

11.2.5 Test procedure

- The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

11.2.6 Test Data

Temperature	26~26.1 ℃	Humidity	54~55.2%
ATM Pressure	101.1kPa	Antenna Gain	2.67dBi
Test by	Fan Yang	Test result	PASS

Test voltage: DC 3V

Remarks:

1. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.
2. The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

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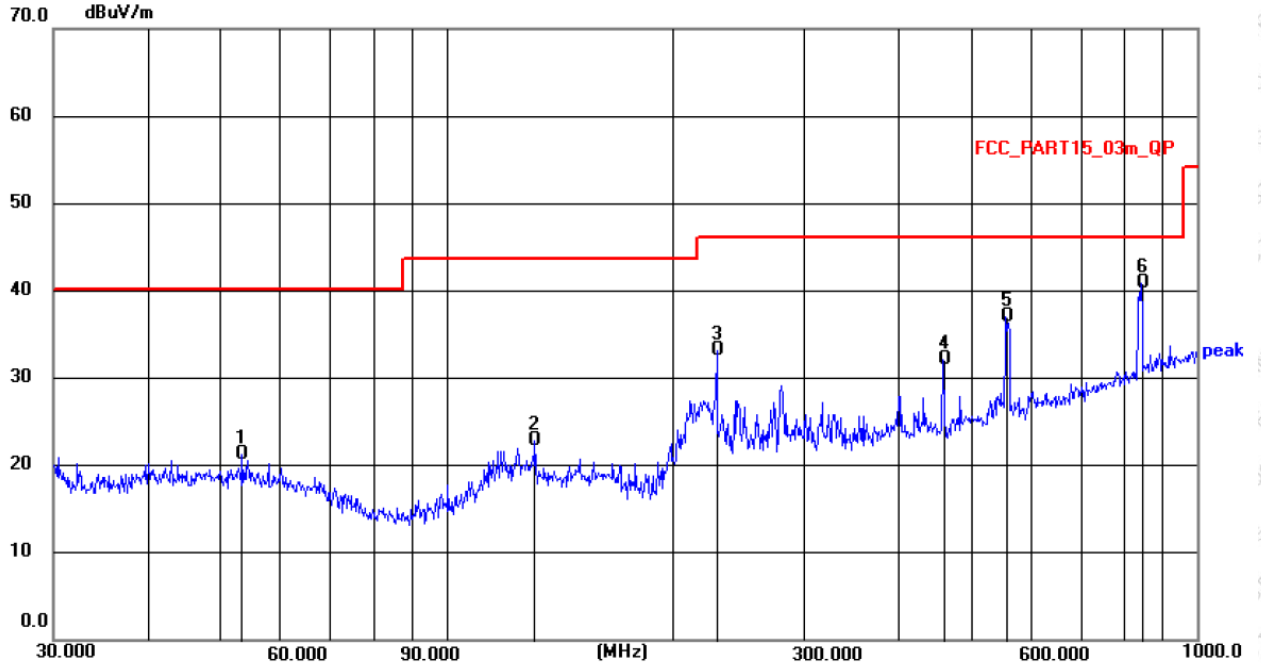
Below 1GHz

Pre-scan all test modes, found worst case at 2480MHz, and so only show the test result of 2480MHz.

Horizontal:



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	53.5052	6.81	14.37	21.18	40.00	18.82	QP
2	131.2965	8.83	14.02	22.85	43.50	20.65	QP
3	229.2931	20.34	12.76	33.10	46.00	12.90	QP
4	459.1144	13.00	19.13	32.13	46.00	13.87	QP
5	556.7744	16.24	20.71	36.95	46.00	9.05	QP
6 *	842.1296	15.50	25.33	40.83	46.00	5.17	QP

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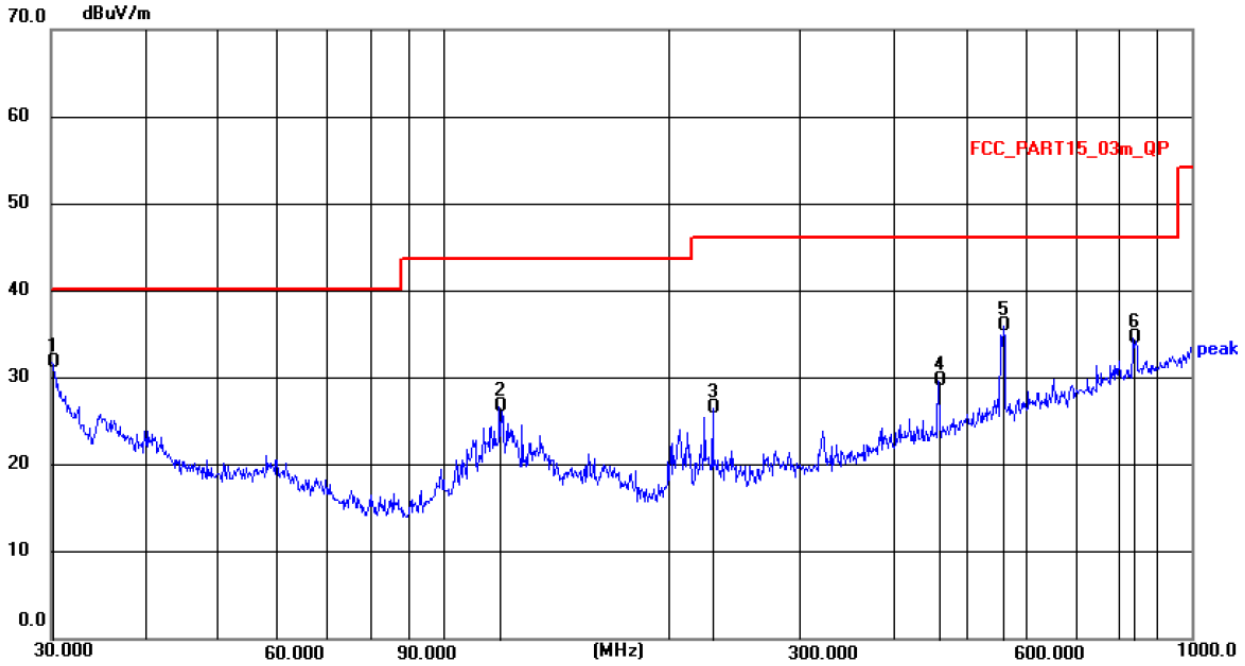
Vertical:



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 *	30.1054	19.29	12.46	31.75	40.00	8.25	QP
2	119.0180	13.59	13.02	26.61	43.50	16.89	QP
3	229.2931	13.74	12.74	26.48	46.00	19.52	QP
4	459.1144	10.97	18.75	29.72	46.00	16.28	QP
5	560.6928	15.36	20.62	35.98	46.00	10.02	QP
6	836.2443	9.34	25.25	34.59	46.00	11.41	QP

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Above 1GHz

Test channel: Lowest channel

Frequency (MHz)	Read Level (dBμV)	polarization	Factor (dB/m)	Level (dBμV/m)	Limit Line (dBμV/m)	Margin (dB)	Detector
2310	50.91	H	-11.14	39.77	74	34.23	peak
2310	50.43	V	-11.16	39.27	74	34.73	peak
2390	50.84	H	-10.9	39.94	74	34.06	peak
2390	51.27	V	-10.96	40.31	74	33.69	peak
4806	43.71	H	-4.36	39.35	74	34.65	peak
4806	43.64	V	-4.36	39.28	74	34.72	peak

Test channel: Middle channel

Frequency (MHz)	Read Level (dBμV)	polarization	Factor (dB/m)	Level (dBμV/m)	Limit Line (dBμV/m)	Margin (dB)	Detector
4882	44.93	H	-4.1	40.83	74	33.17	peak
4882	45.01	V	-4.22	40.79	74	33.21	peak

Test channel: Highest channel

Frequency (MHz)	Read Level (dBμV)	polarization	Factor (dB/m)	Level (dBμV/m)	Limit Line (dBμV/m)	Margin (dB)	Detector
2483.5	49.94	H	-10.61	39.33	74	34.67	peak
2483.5	49.6	V	-10.71	38.89	74	35.11	peak
2500	49.3	H	-10.57	38.73	74	35.27	peak
2500	49.66	V	-10.67	38.99	74	35.01	peak
4960	45.97	H	-3.82	42.15	74	31.85	peak
4960	44.58	V	-3.93	40.65	74	33.35	peak

Remarks:

1. Level =Receiver Read level + Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.

---------- THE END OF TEST REPORT ----------

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