



# FCC PART 15.247 TEST REPORT

For

## Zeeva International Limited

Suite 1007B, 10th Floor, Exchange Tower, 33 Wang Chiu Road, Kowloon Bay, Hong Kong

**FCC ID: 2ADM5-EP-0651V3**

<b>Report Type:</b> Original Report	<b>Product Type:</b> BT TWS CLASSIC AST B; BT TWS CLASSIC NEON AST B
<b>Report Number:</b> SZ3210809-33464E-RF-00	
<b>Report Date:</b> 2021-10-08	
<b>Reviewed By:</b> RF Engineer Candy Li	<i>Candy Li</i>
<b>Prepared By:</b> Shenzhen Accurate Technology Co., Ltd. 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China Tel: (0755) 26503290 Fax: (0755) 26503396 <a href="http://www.atc-lab.com">Http://www.atc-lab.com</a>	

**Note:** This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".

Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '\*'. Customer model name, addresses, names, trademarks etc. are not considered data.

This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

## TABLE OF CONTENTS

<b>GENERAL INFORMATION</b> .....	<b>4</b>
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	4
OBJECTIVE .....	4
TEST METHODOLOGY .....	4
MEASUREMENT UNCERTAINTY.....	5
TEST FACILITY .....	5
<b>SYSTEM TEST CONFIGURATION</b> .....	<b>6</b>
DESCRIPTION OF TEST CONFIGURATION .....	6
EUT EXERCISE SOFTWARE .....	6
SPECIAL ACCESSORIES.....	6
EQUIPMENT MODIFICATIONS .....	6
SUPPORT EQUIPMENT LIST AND DETAILS .....	6
EXTERNAL I/O CABLE.....	6
BLOCK DIAGRAM OF TEST SETUP .....	7
<b>SUMMARY OF TEST RESULTS</b> .....	<b>8</b>
<b>TEST EQUIPMENT LIST</b> .....	<b>9</b>
<b>FCC§15.247 (i), §1.1307 (b) (1) &amp;§2.1093 – RF EXPOSURE</b> .....	<b>11</b>
APPLICABLE STANDARD .....	11
TEST RESULT: .....	11
<b>FCC §15.203 – ANTENNA REQUIREMENT</b> .....	<b>12</b>
APPLICABLE STANDARD .....	12
ANTENNA CONNECTOR CONSTRUCTION .....	12
<b>FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS</b> .....	<b>13</b>
APPLICABLE STANDARD .....	13
EUT SETUP.....	13
EMI TEST RECEIVER SETUP.....	13
TEST PROCEDURE .....	13
TRANSD FACTOR & MARGIN CALCULATION.....	14
TEST DATA .....	14
<b>FCC §15.205, §15.209 &amp; §15.247(d) – RADIATED EMISSIONS</b> .....	<b>17</b>
APPLICABLE STANDARD .....	17
EUT SETUP .....	17
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP .....	18
TEST PROCEDURE .....	18
FACTOR & MARGIN CALCULATION .....	18
TEST DATA .....	18
<b>FCC §15.247(a) (1)-CHANNEL SEPARATION TEST</b> .....	<b>23</b>
APPLICABLE STANDARD .....	23
TEST PROCEDURE .....	23
TEST DATA .....	23
<b>FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH &amp; 99% OCCUPIED BANDWIDTH</b> .....	<b>25</b>
APPLICABLE STANDARD .....	25
TEST PROCEDURE .....	25
TEST DATA .....	26

**FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST .....28**  
    APPLICABLE STANDARD .....28  
    TEST PROCEDURE .....28  
    TEST DATA .....28

**FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME).....30**  
    APPLICABLE STANDARD .....30  
    TEST PROCEDURE .....30  
    TEST DATA .....30

**FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT .....34**  
    APPLICABLE STANDARD .....34  
    TEST PROCEDURE .....34  
    TEST DATA .....34

**FCC §15.247(d) - BAND EDGES TESTING .....37**  
    APPLICABLE STANDARD .....37  
    TEST PROCEDURE .....37  
    TEST DATA .....37

## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

Product	BT TWS CLASSIC AST B; BT TWS CLASSIC NEON AST B
Tested Model	EP-0651
Multiple Model	EP-0652, EP-0652-F21
SKU Number	EP-0651 – 4450046 EP-0652 – 4440108 EP-0652-F21- 4550094, 4550093, 4550092, 4550091
UPC Number	EP-0651 – 1922349900102 EP-0652 – 1922349850124 EP-0652-F21- 1922340900187, 1922340900170, 1922340900163, 1922340900156
Frequency Range	Bluetooth: 2402~2480MHz
Maximum conducted Peak output power	Bluetooth: -1.40dBm
Modulation Technique	Bluetooth: GFSK
Antenna Specification*	Internal Antenna: -0.58dBi(provided by the applicant)
Voltage Range	DC 3.7V from battery or DC 5V from charging box
Date of Test	2021-09-19 to 2021-09-26
Sample number	SZ3210809-33464E-RF-S1 (RF Conducted Test) SZ3210809-33464E-RF-S2 (RF Radiated Test) (Assigned by ATC)
Received date	2021-08-09
Sample/EUT Status	Good condition

### Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation

## Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
Temperature		1°C
Humidity		6%
Supply voltages		0.4%

*Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.*

## Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISED), the Registration Number is 5077A-2.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in an engineering mode.

### EUT Exercise Software

“FCC\_assist\_1.0.2.2”\* software was use to the EUT tested and power level is default\*. The software and power level was provided by applicant.

### Special Accessories

No special accessory.

### Equipment Modifications

No modification was made to the EUT tested.

### Support Equipment List and Details

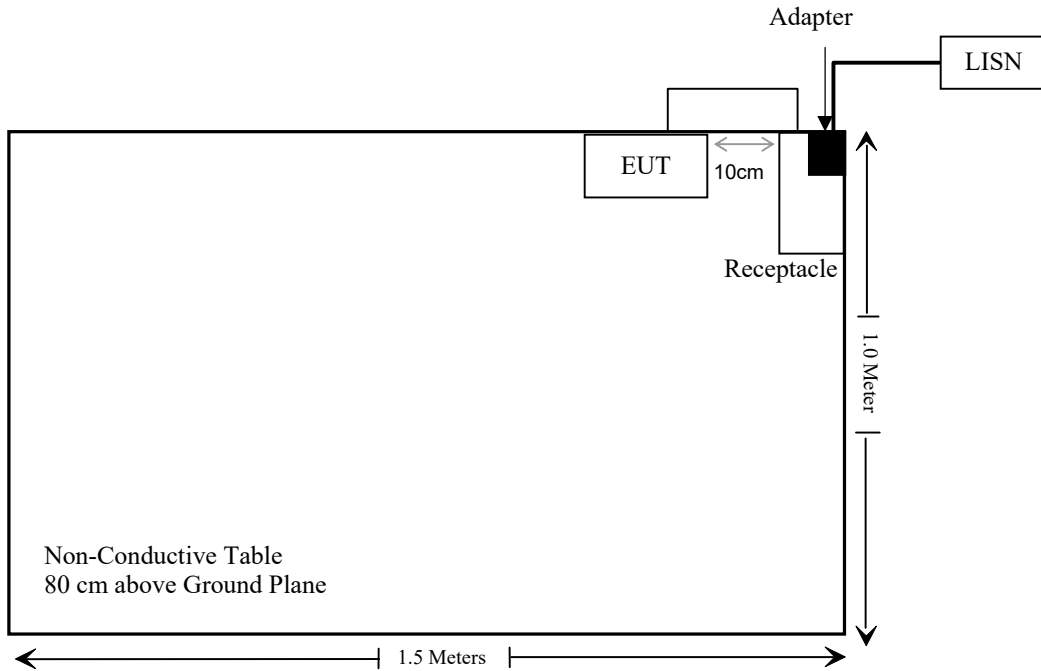
Manufacturer	Description	Model	Serial Number
Infinix	Adapter	CQ-18LX	Unknown

### External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding Un-Detachable AC Cable	1.2	LISN	Receptacle
Un-shielding Detachable USB Cable	1.0	EUT	Adapter

### Block Diagram of Test Setup

For conducted emission:



**SUMMARY OF TEST RESULTS**

<b>FCC Rules</b>	<b>Description of Test</b>	<b>Result</b>
§1.1307 , §2.1093	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliant
§15.247(a)(1)	20 dB Emission Bandwidth & 99% Occupied Bandwidth	Compliant
§15.247(a)(1)	Channel Separation Test	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant
§15.247(b)(1)	Peak Output Power Measurement	Compliant
§15.247(d)	Band edges	Compliant

Note: the left earbud and right earbud is electrical identical, the left earbud was select to test.



**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	Test Receiver	ESPI3	100396	2020/12/24	2021/12/23
R & S	L.I.S.N.	ENV216	101314	2020/12/25	2021/12/24
Anritsu Corp	50Ω Coaxial Switch	MP59B	6200506474	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-2m	No.2	2020/12/25	2021/12/24
Rohde& Schwarz	Test Software	ES-K1	V1.71	NCR	NCR
Radiated Emissions Test					
Rohde&Schwarz	Test Receiver	ESR	101817	2020/12/24	2021/12/23
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2020/12/24	2021/12/23
A.H. Systems, inc.	Preamplifier	PAM-0118P	531	2021/07/08	2022/07/07
SONOMA INSTRUMENT	Amplifier	310 N	186131	2020/12/25	2021/12/24
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Quinstar	Amplifier	QLW-1840553 6-J0	15964001002	2020/11/28	2021/11/27
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2020/01/04	2023/01/03
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Unknown	RF Coaxial Cable	N-5m	No.3	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-5m	No.4	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-1m	No.5	2020/12/25	2021/12/24
Unknown	RF Coaxial Cable	N-1m	No.6	2020/12/25	2021/12/24
FARAD	Test Software	EZ_EM	V 1.1.4.2	NCR	NCR

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV40	101495	2020/12/24	2021/12/23
Rohde & Schwarz	Open Switch and Control Unit	OSP120 +OSP -B157	101244 + 100866	2020/12/24	2021/12/23

\* **Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

## FCC§15.247 (i), §1.1307 (b) (1) &§2.1093 – RF EXPOSURE

### Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot$

$[\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR, where

1.  $f(\text{GHz})$  is the RF channel transmit frequency in GHz.

2. Power and distance are rounded to the nearest mW and mm before calculation.

3. The result is rounded to one decimal place for comparison.

4. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test Exclusion.

### Test Result:

For worst case:

Mode	Frequency (MHz)	Maximum Tune-up power		Calculated Distance (mm)	Calculated Value	Threshold (1-g SAR)	SAR Test Exclusion
		(dBm)	(mW)				
BT	2480	-1.0	0.79	5	0.2	3.0	Yes

Result: No Standalone SAR test is required

---

## **FCC §15.203 – ANTENNA REQUIREMENT**

---

### **Applicable Standard**

According to FCC § 15.203, 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.

### **Antenna Connector Construction**

The EUT has one internal antenna arrangement, which was permanently attached and the antenna gain is -0.58dBi, fulfill the requirement of this section. Please refer to the EUT photos.

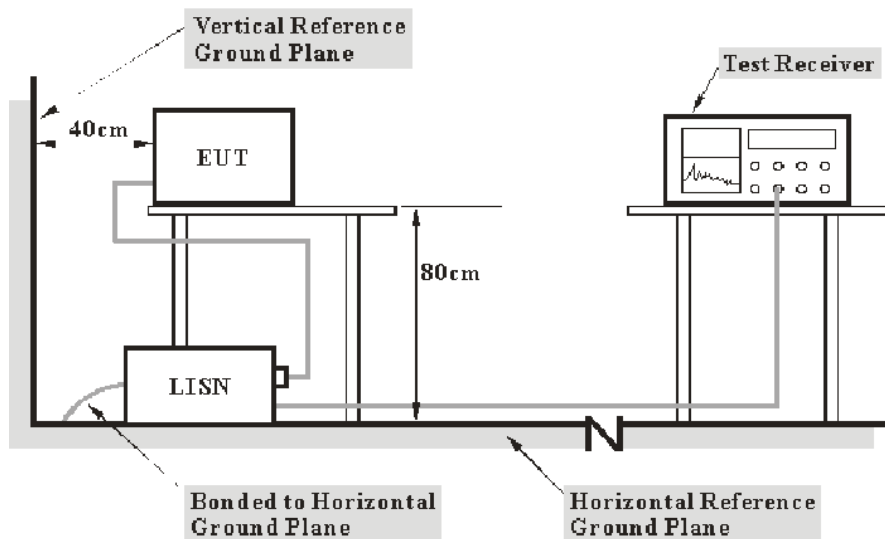
**Result:** Compliance.

## FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

### Applicable Standard

FCC §15.207(a)

### EUT Setup



- Note: 1. Support units were connected to second LISN.  
 2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

### EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

### Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

## Transd Factor & Margin Calculation

The Transd factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Transd Factor} = \text{LISN VDF} + \text{Cable Loss}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\begin{aligned} \text{Margin} &= \text{Limit} - \text{level} \\ \text{Level} &= \text{reading level} + \text{Transd Factor} \end{aligned}$$

## Test Data

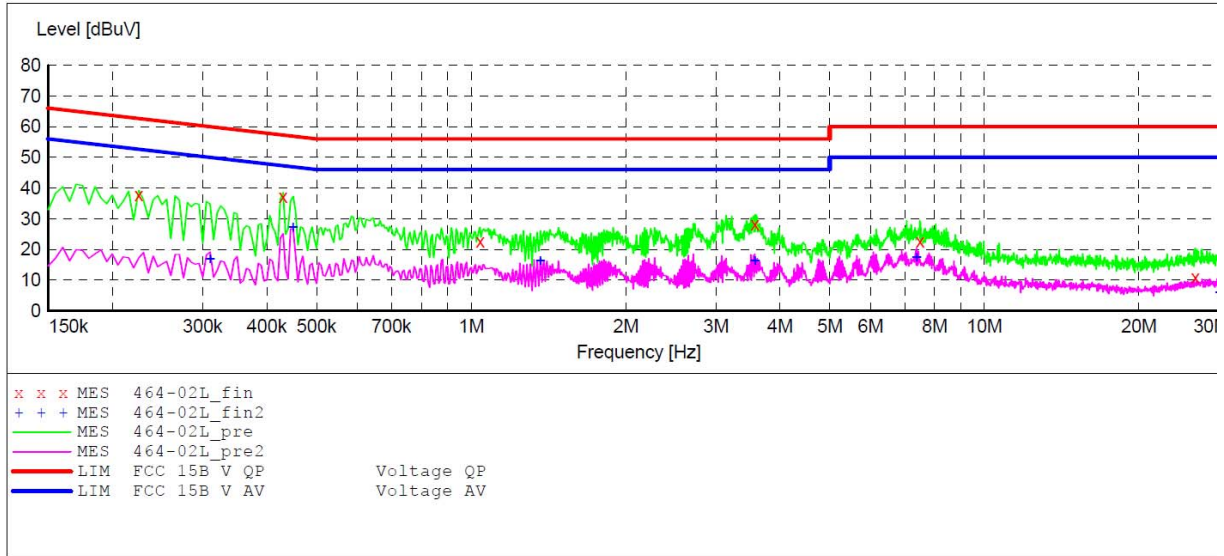
### Environmental Conditions

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	48 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Amy on 2021-09-26.*

*EUT operation mode: Charging*

AC 120V/60 Hz, Line



**MEASUREMENT RESULT: "464-02L\_fin"**

2021-10-11 02:22 下午

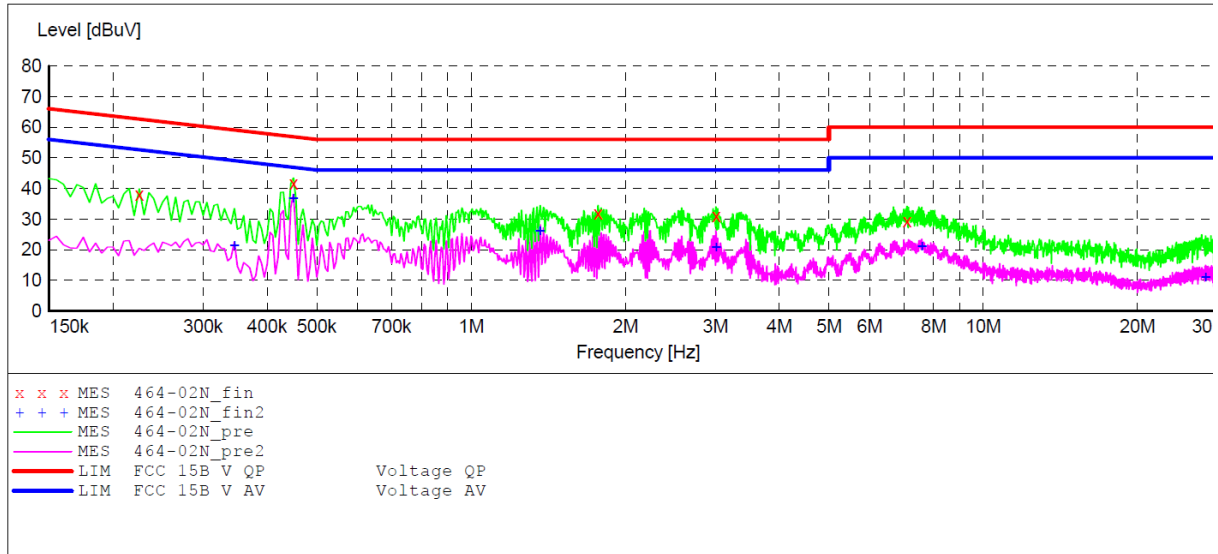
Frequency MHz	Level dBuV	Transd dB	Limiu dBuV	Margin dB	Detector	Line	PE
0.225000	37.80	10.8	63	25.2	QP	L1	GND
0.430000	37.30	11.0	57	19.7	QP	L1	GND
1.040000	22.80	11.1	56	33.2	QP	L1	GND
3.570000	28.10	11.4	56	27.9	QP	L1	GND
7.490000	22.60	11.5	60	37.4	QP	L1	GND
25.775000	11.00	11.8	60	49.0	QP	L1	GND

**MEASUREMENT RESULT: "464-02L\_fin2"**

2021-9-26 09:27 上午

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.310000	16.90	10.9	50	33.1	AV	L1	GND
0.450000	27.20	11.0	47	19.8	AV	L1	GND
1.365000	16.30	11.2	46	29.7	AV	L1	GND
3.570000	16.30	11.4	46	29.7	AV	L1	GND
7.380000	17.40	11.5	50	32.6	AV	L1	GND
28.775000	5.80	11.8	50	44.2	AV	L1	GND

**AC 120V/60 Hz, Neutral**



**MEASUREMENT RESULT: "464-02N\_fin"**

2021-10-11 02:23下午

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.225000	38.00	10.8	63	25.0	QP	N	GND
0.450000	41.60	11.0	57	15.4	QP	N	GND
1.770000	31.90	11.2	56	24.1	QP	N	GND
3.010000	31.10	11.3	56	24.9	QP	N	GND
7.100000	29.30	11.5	60	30.7	QP	N	GND
29.675000	18.70	11.8	60	41.3	QP	N	GND

**MEASUREMENT RESULT: "464-02N\_fin2"**

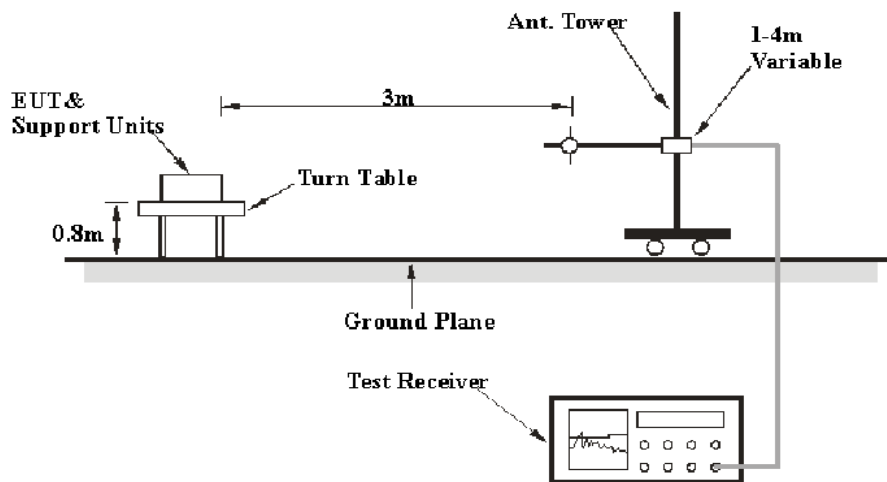
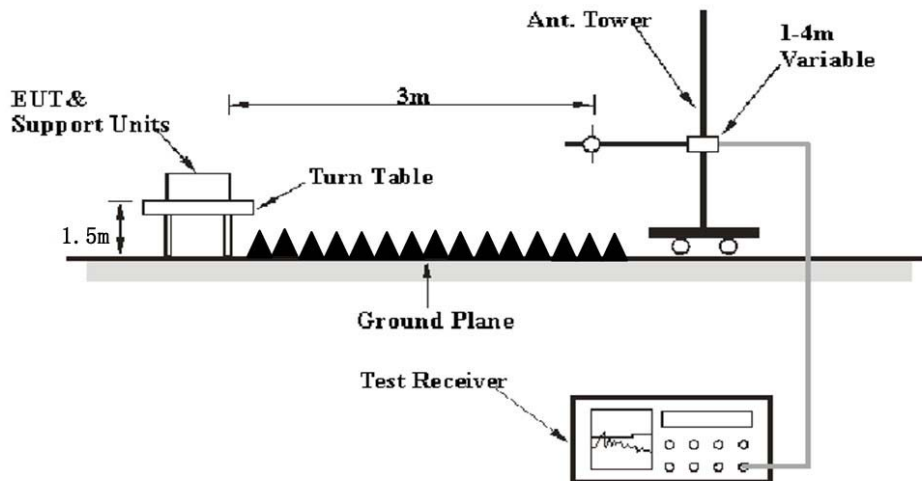
2021-9-26 09:25上午

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.345000	21.40	10.9	49	27.6	AV	N	GND
0.450000	36.50	11.0	47	10.5	AV	N	GND
1.365000	26.10	11.2	46	19.9	AV	N	GND
3.010000	20.80	11.3	46	25.2	AV	N	GND
7.590000	21.10	11.5	50	28.9	AV	N	GND
27.200000	10.80	11.8	50	39.2	AV	N	GND



**FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS****Applicable Standard**

FCC §15.205; §15.209; §15.247(d)

**EUT Setup****Below 1 GHz:****Above 1GHz:**

The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

## EMI Test Receiver & Spectrum Analyzer Setup

The EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

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

## Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

## Factor & Margin Calculation

The Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Factor} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\begin{aligned} \text{Margin} &= \text{Result} - \text{Limit} \\ \text{Result} &= \text{Reading} + \text{Factor} \end{aligned}$$

## Test Data

### Environmental Conditions

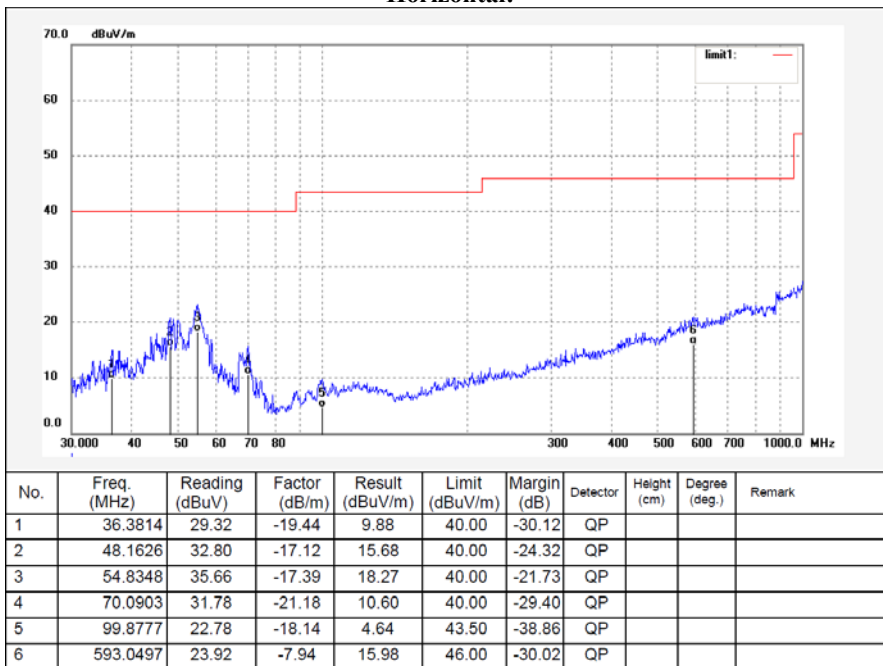
<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	103.0 kPa

The testing was performed by Bin Duan on 2021-09-24 and 2021-09-26.

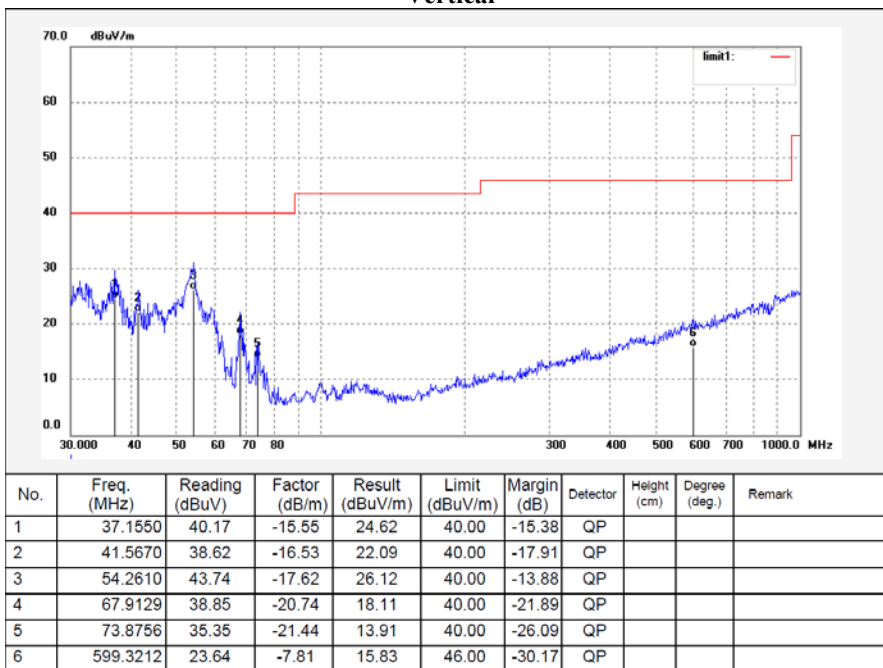
EUT operation mode: Transmitting

**30MHz-1GHz: (GFSK Mode, Low channel)**

**Horizontal:**



**Vertical**



**Above 1GHz:**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2310	49.02	PK	190	1.5	H	-6.84	42.18	74	-31.82
2310	54.97	PK	230	2.2	V	-6.84	48.13	74	-25.87
2390	49.66	PK	246	1.8	H	-6.44	43.22	74	-30.78
2390	57.39	PK	271	1.8	V	-6.44	50.95	74	-23.05
4804	54.65	PK	180	1.8	H	2.81	57.46	74	-16.54
4804	47.57	Ave	180	1.8	H	2.81	50.38	54	-3.62
4804	50.84	PK	11	1.8	V	2.81	53.65	74	-20.35
Middle Channel (2441 MHz)									
4882	52.32	PK	189	1.9	H	3.04	55.36	74	-18.64
4882	45.34	Ave	189	1.9	H	3.04	48.38	54	-5.62
4882	50.82	PK	86	1.6	V	3.04	53.86	74	-20.14
High Channel (2480 MHz)									
2483.5	67.02	PK	165	1.8	H	-5.96	61.06	74	-12.94
2483.5	52.13	Ave	165	1.8	H	-5.96	46.17	54	-7.83
2483.5	65.72	PK	139	2	V	-5.96	59.76	74	-14.24
2483.5	51.61	Ave	139	2	V	-5.96	45.65	54	-8.35
2500	67.39	PK	44	1.1	H	-5.88	61.51	74	-12.49
2500	52.23	Ave	44	1.1	H	-5.88	46.35	54	-7.65
2500	66.58	PK	77	1.7	V	-5.88	60.7	74	-13.3
2500	51.76	Ave	77	1.7	V	-5.88	45.88	54	-8.12
4960	51.77	PK	293	1.2	H	3.29	55.06	74	-18.94
4960	44.64	Ave	293	1.2	H	3.29	47.93	54	-6.07
4960	50.55	PK	68	1.1	V	3.29	53.84	74	-20.16

**Note:**

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

Margin = Corrected. Amplitude - Limit

The other spurious emission which is in the noise floor level was not recorded.

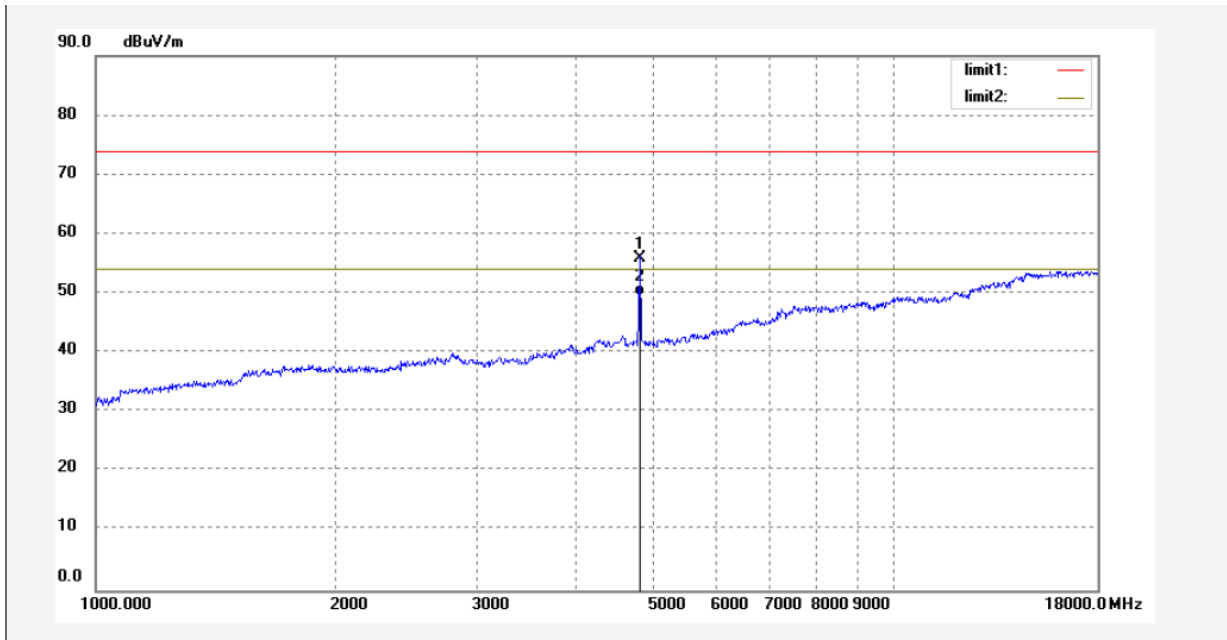
The test result of peak was less than the limit of average, so just peak value were recorded.

### 1-18GHz

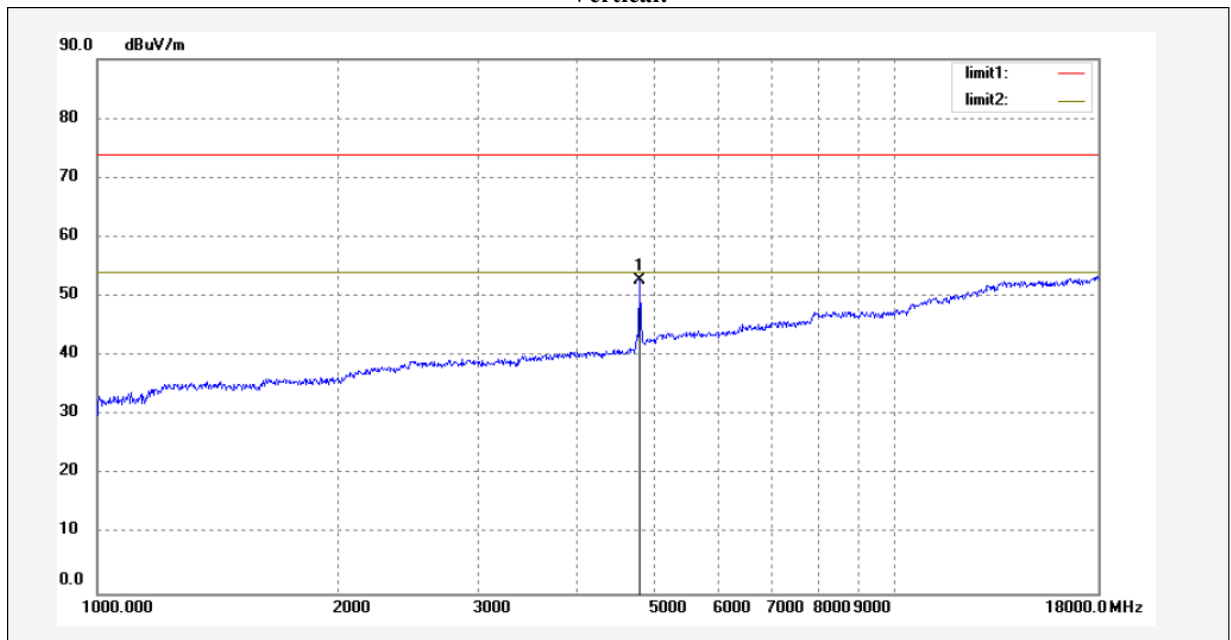
Pre-scan for Peak

Low Channel

Horizontal:



Vertical:

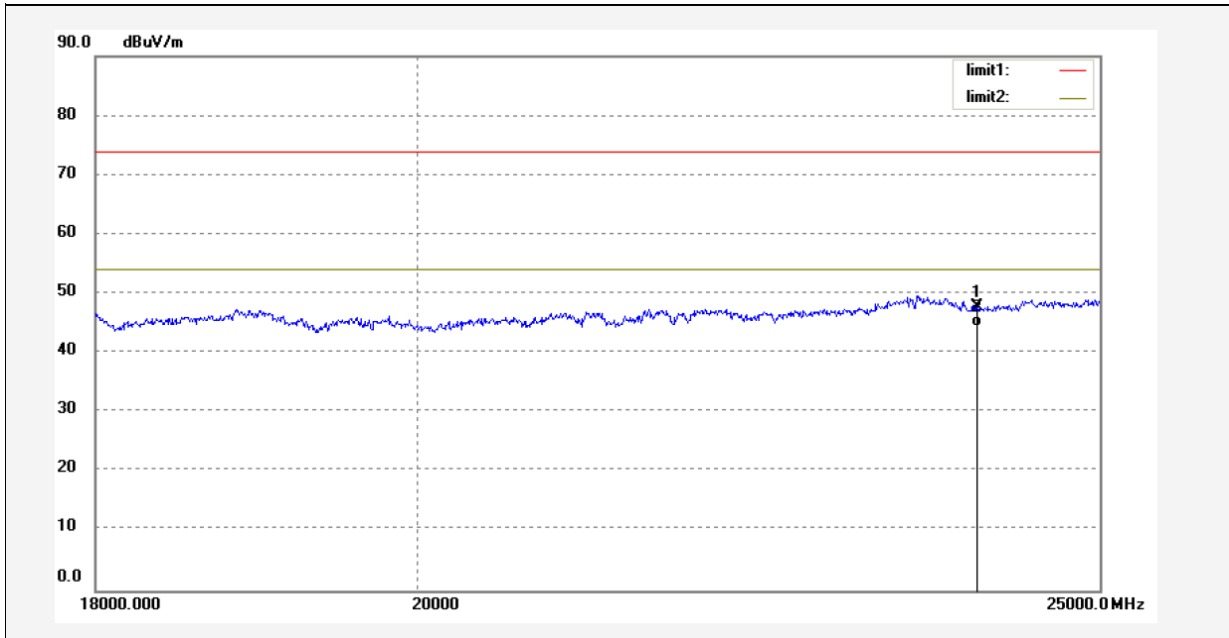


18-25GHz

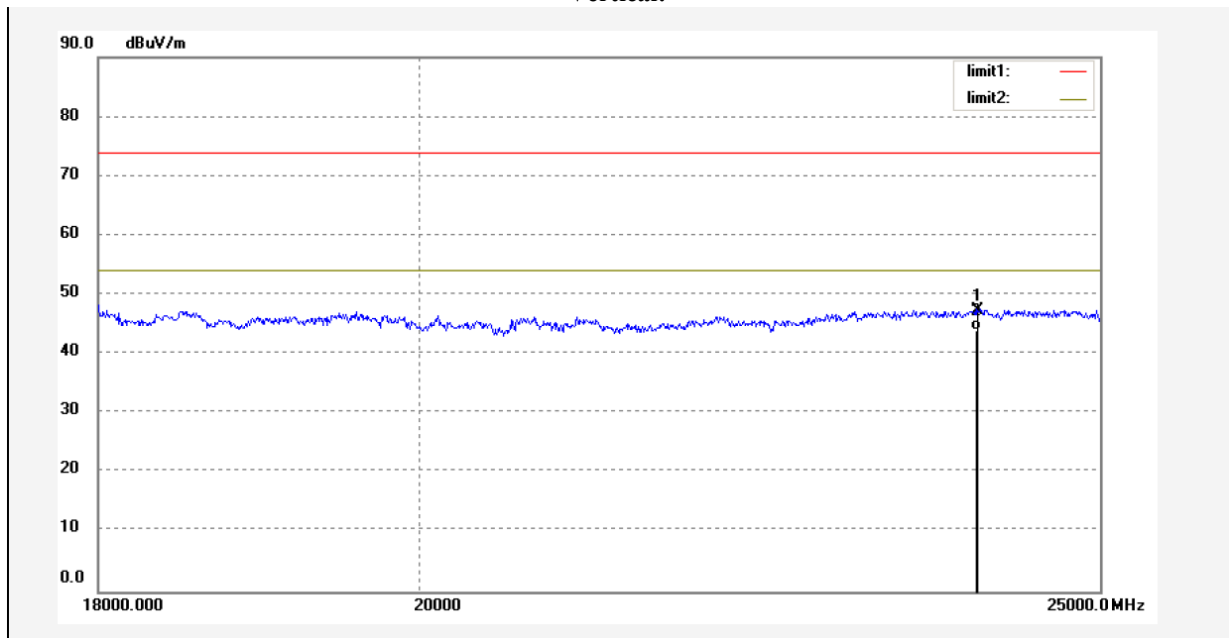
Pre-scan for Peak

Low Channel

Horizontal:



Vertical:



## FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

### Applicable Standard

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.

### Test Procedure

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

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	25.2 °C
<b>Relative Humidity:</b>	47 %
<b>ATM Pressure:</b>	101.0 kPa

The testing was performed by Bin Duan on 2021-09-19.

EUT operation mode: Transmitting

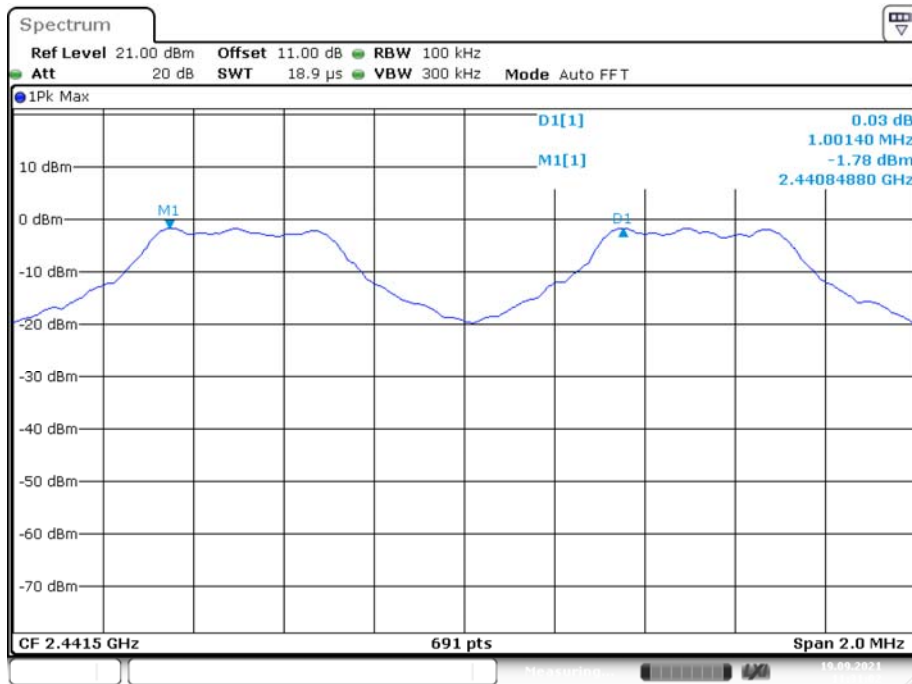
Test Result: Compliant.

Channel	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit
<b>BDR(GFSK)</b>				
Middle	1.001	0.883	0.589	> two-thirds of the 20 dB bandwidth

Note: The limit > two-thirds of the 20 dB bandwidth

Please refer to the below plots:

DH1\_Ant1\_Hop





## FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH & 99% OCCUPIED BANDWIDTH

### Applicable Standard

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.

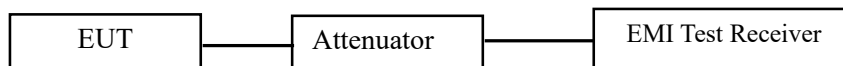
### Test Procedure

The following conditions shall be observed for measuring the occupied bandwidth and 20 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 / 20 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 / 20 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).



**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	25.2 °C
<b>Relative Humidity:</b>	47 %
<b>ATM Pressure:</b>	101.0 kPa

The testing was performed by Bin Duan on 2021-09-19.

EUT operation mode: Transmitting

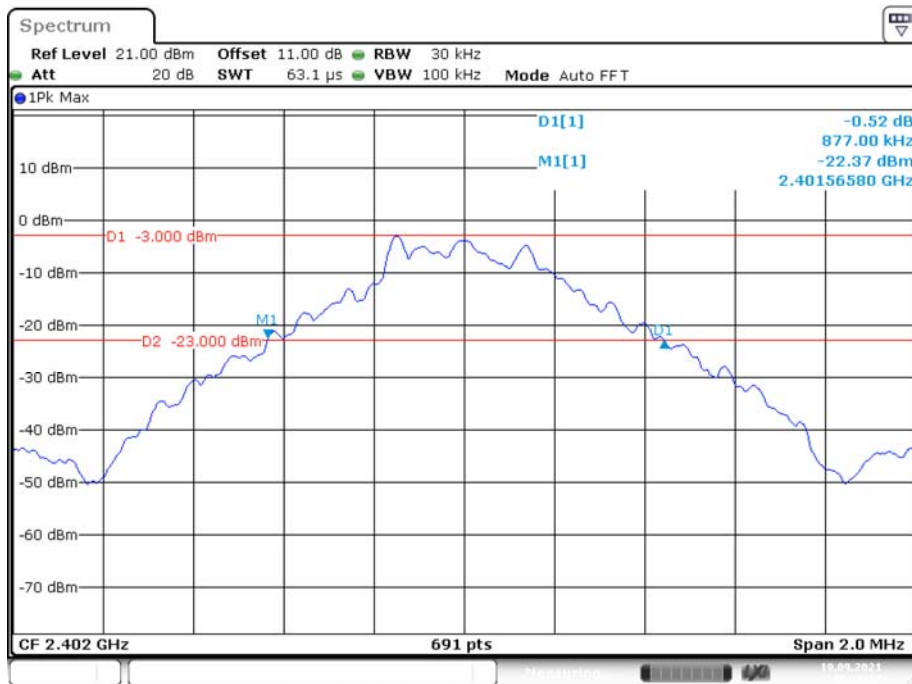
Test Result: Compliant.

Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
<b>BDR (GFSK)</b>	Low	2402	0.877
	Middle	2441	0.877
	High	2480	0.883

Please refer to the below plots:

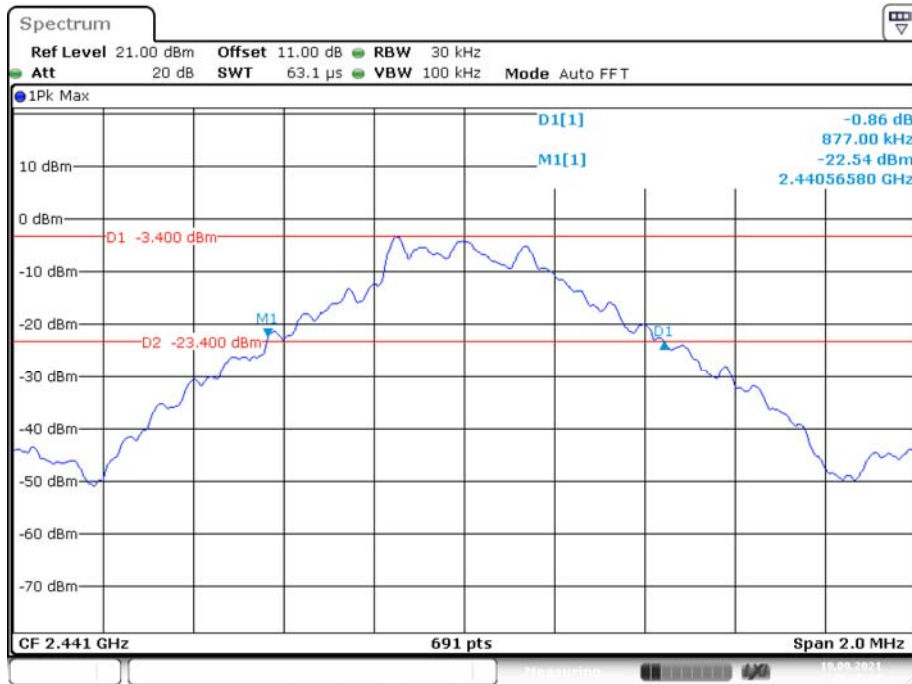
**20 dB EMISSION BANDWIDTH**

DH1\_Ant1\_2402MHz

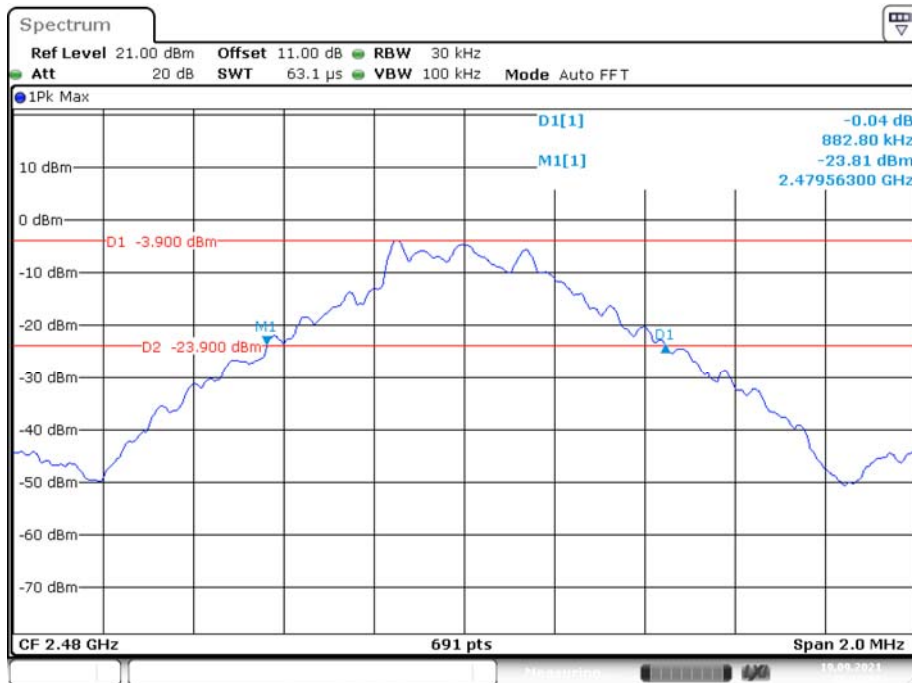


Date: 19.SEP.2021 11:16:31

DH1\_Ant1\_2441MHz



DH1\_Ant1\_2480MHz



## **FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST**

### **Applicable Standard**

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.

### **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.

### **Test Data**

#### **Environmental Conditions**

<b>Temperature:</b>	25.2 °C
<b>Relative Humidity:</b>	47 %
<b>ATM Pressure:</b>	101.0 kPa

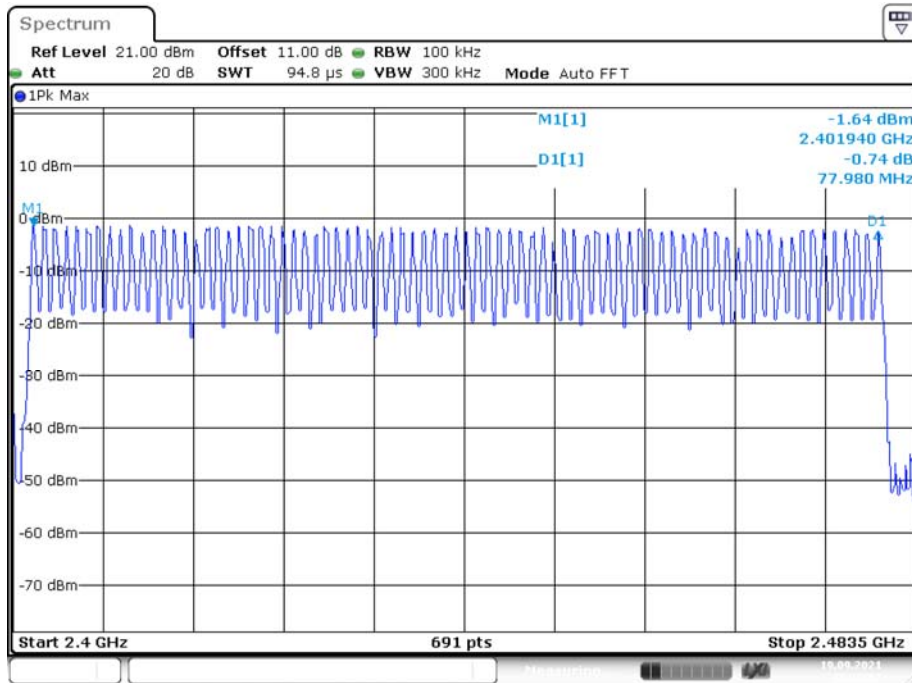
*The testing was performed by Bin Duan on 2021-09-19.*

*EUT operation mode: Transmitting*

Test Result: Compliant.

<b>Mode</b>	<b>Frequency Range (MHz)</b>	<b>Number of Hopping Channel (CH)</b>	<b>Limit (CH)</b>
BDR (GFSK)	2400-2483.5	79	≥15

DH1\_Ant1\_Hop



Date: 19.SEP.2021 11:33:01

## **FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)**

### **Applicable Standard**

Frequency hopping systems in the 2400-2483.5 MHz 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.

### **Test Procedure**

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW  $\geq 3 \times$ RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

### **Test Data**

#### **Environmental Conditions**

<b>Temperature:</b>	25.2 °C
<b>Relative Humidity:</b>	47 %
<b>ATM Pressure:</b>	101.0 kPa

The testing was performed by Bin Duan on 2021-09-19.

EUT operation mode: Transmitting

Test Result: Compliant.

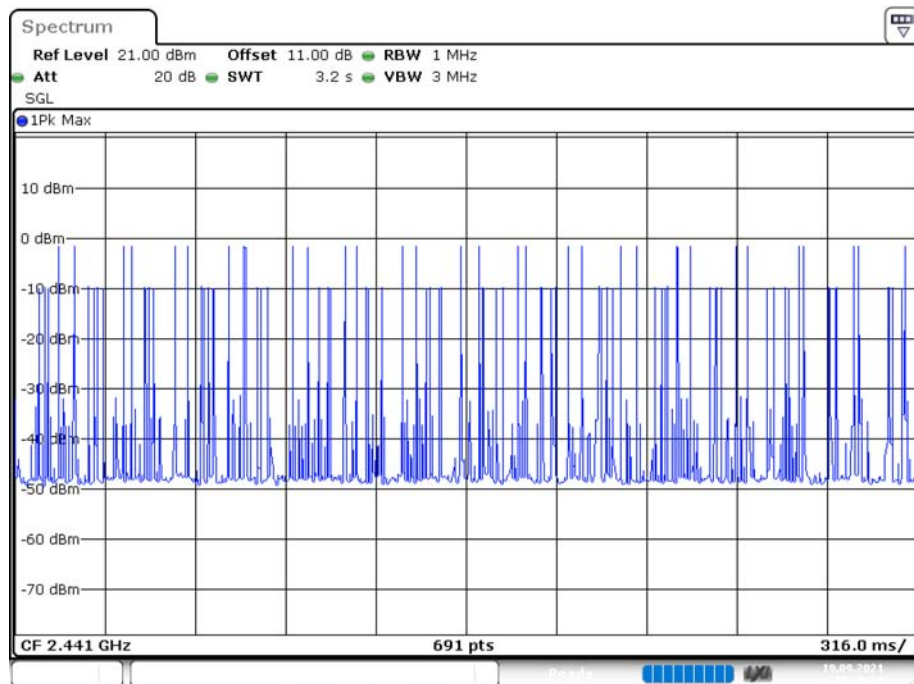
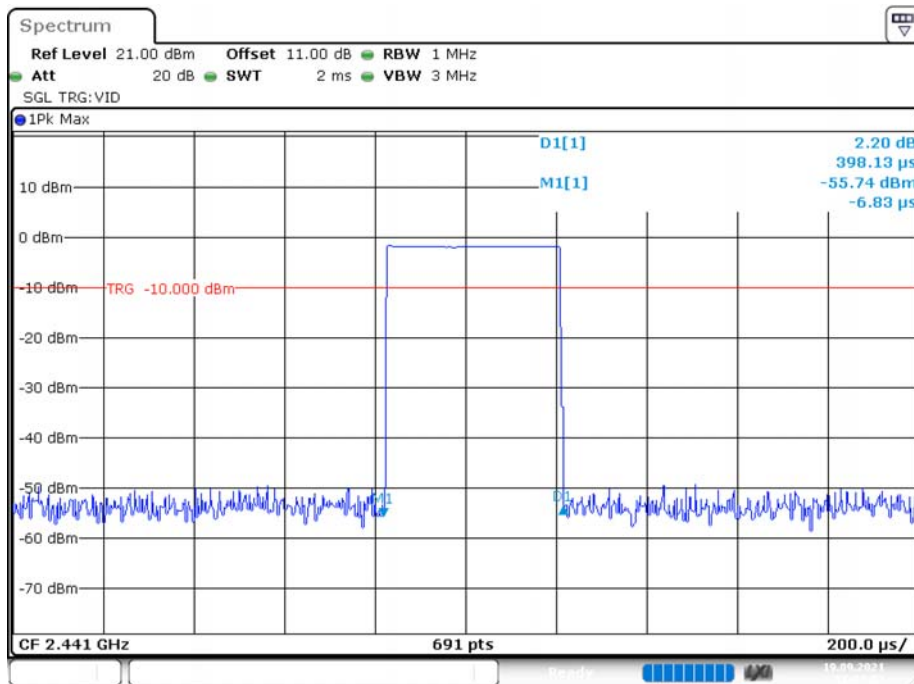
Test Mode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.40	330	0.132	$\leq 0.4$	PASS
DH3	Ant1	Hop	1.67	120	0.200	$\leq 0.4$	PASS
DH5	Ant1	Hop	2.95	70	0.207	$\leq 0.4$	PASS

Note 1: A period time= $0.4 \times 79 = 31.6$ (S), Result=BurstWidth\*Totalhops

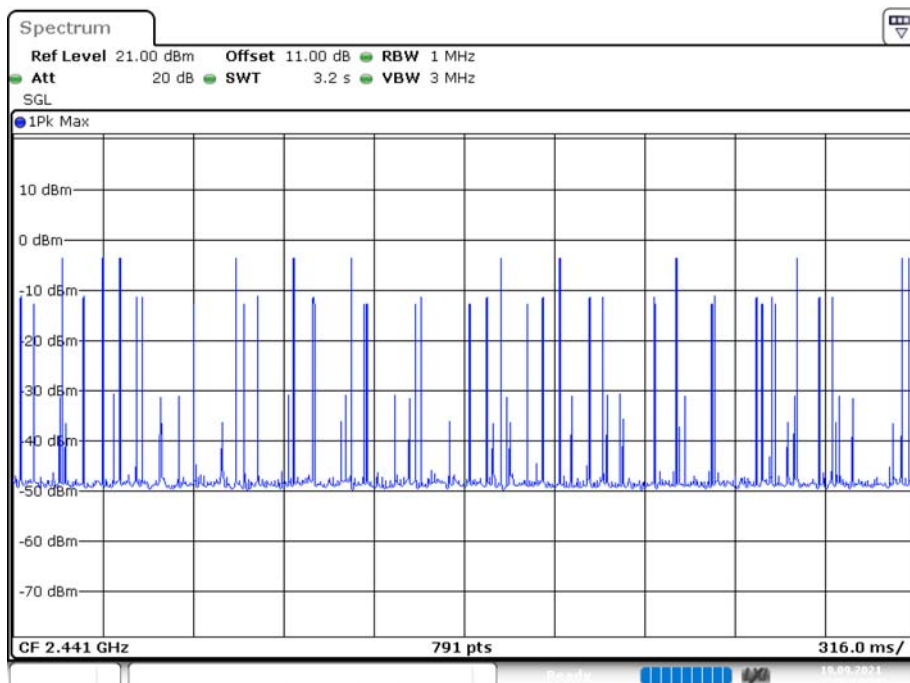
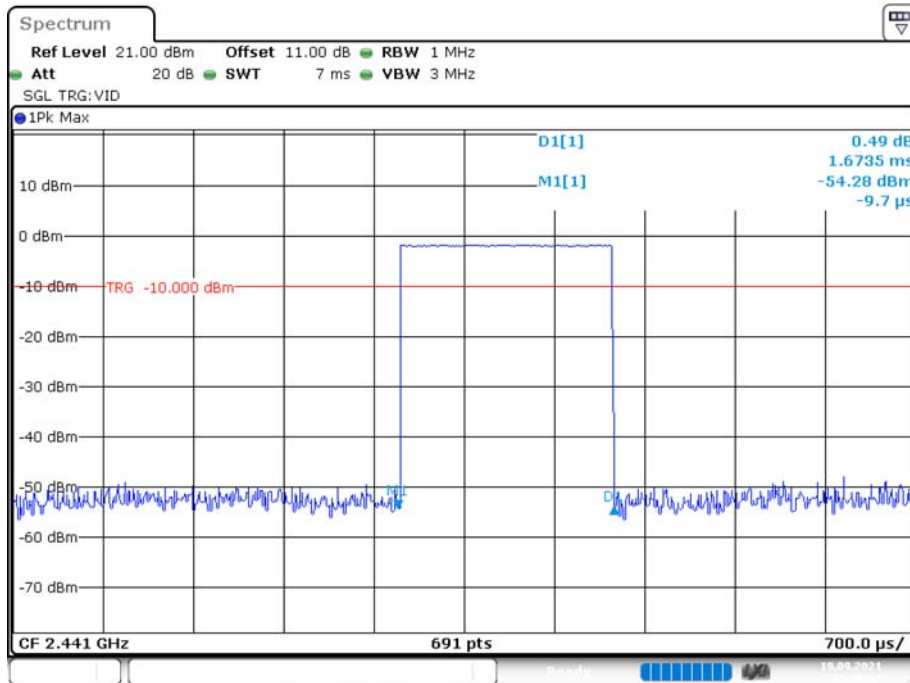
Note 2: Totalhops=Hopping Number in  $3.16s \times 10$

Note 3: Hopping Number in  $3.16s =$ Total of highest signals in  $3.16s$ (Second high signals were other channel)

### DH1\_Ant1\_Hop

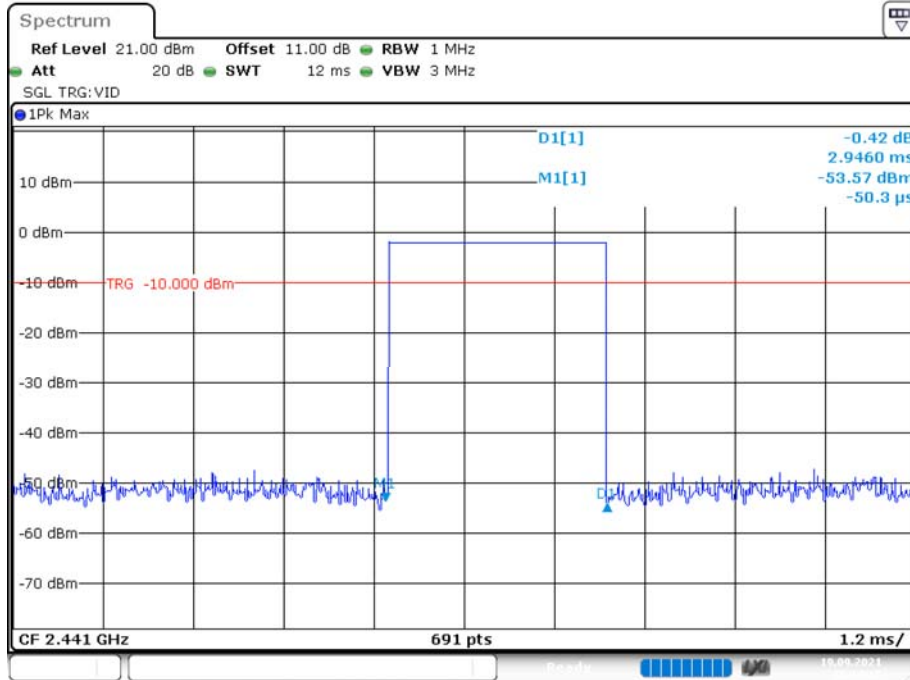


DH3\_Ant1\_Hop

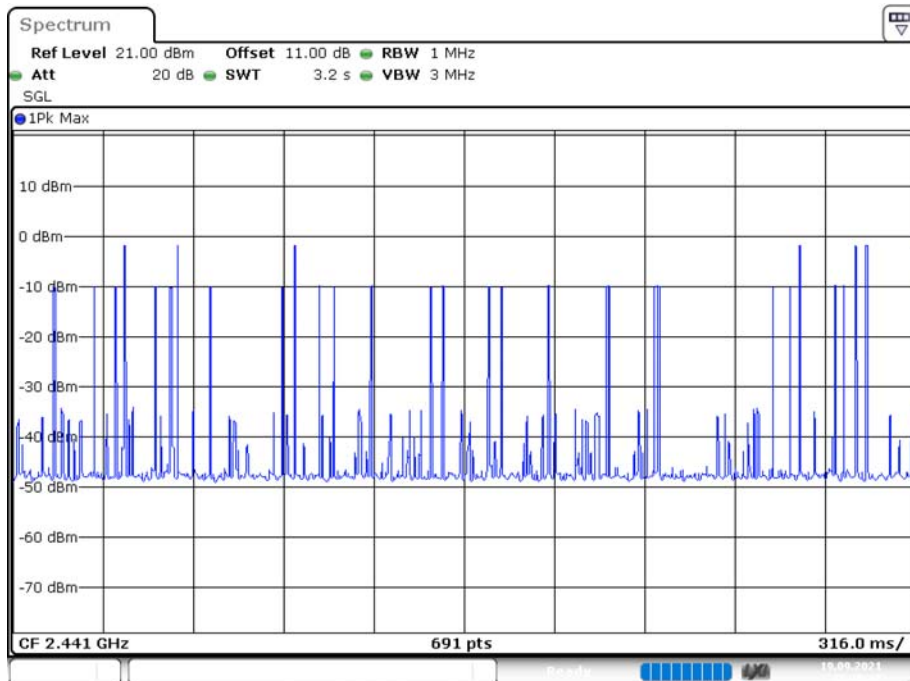




DH5\_Ant1\_Hop



Date: 19.SEP.2021 11:44:15



Date: 19.SEP.2021 11:40:48

## FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

### Applicable Standard

According to §15.247(b) (1), 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. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

### Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	25.2 °C
<b>Relative Humidity:</b>	47 %
<b>ATM Pressure:</b>	101.0 kPa

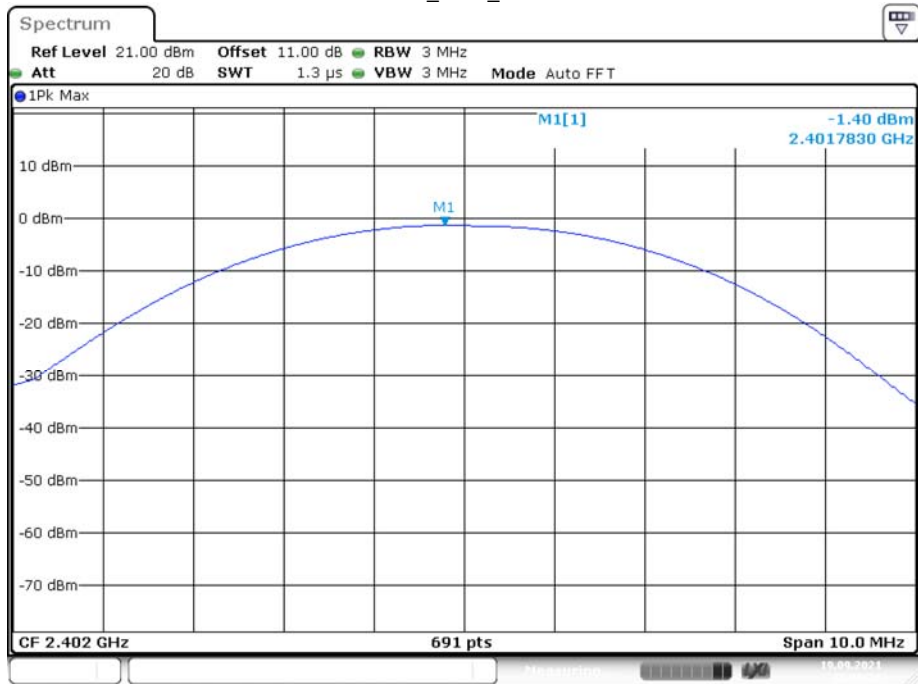
The testing was performed by Bin Duan on 2021-09-19.

EUT operation mode: Transmitting

Test Result: Compliant.

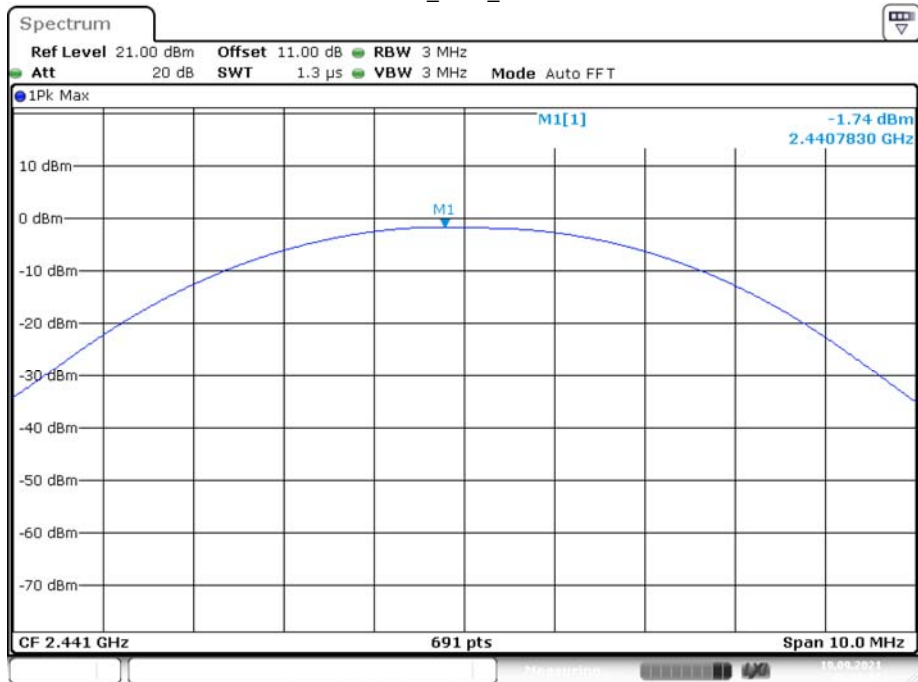
Mode	Channel	Frequency (MHz)	Peak Output Power	Limit (dBm)
			(dBm)	
BDR (GFSK)	Low	2402	-1.40	21
	Middle	2441	-1.74	21
	High	2480	-2.17	21

DH1\_Ant1\_2402



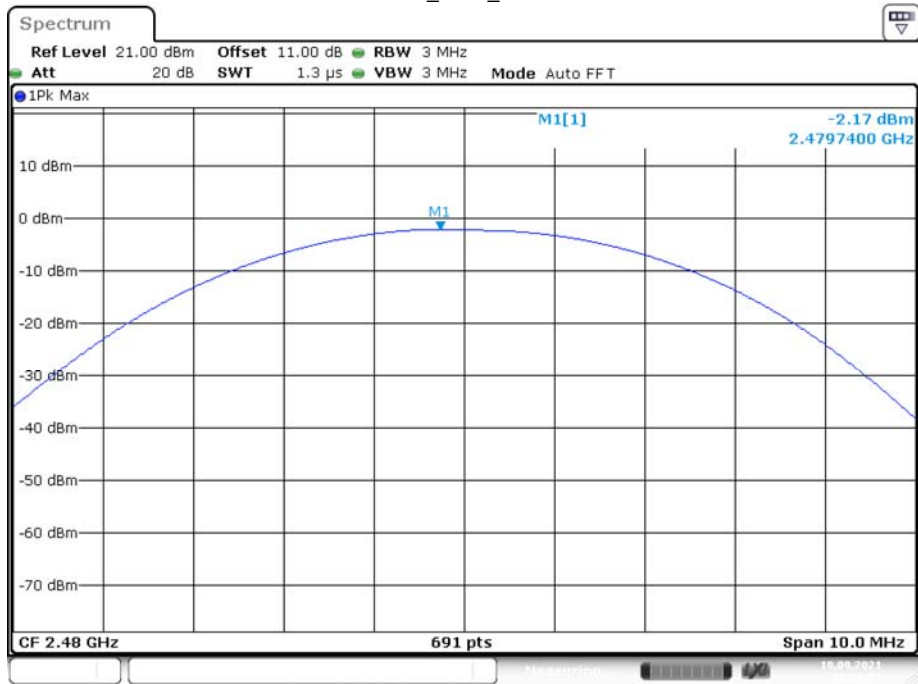
Date: 19.SEP.2021 11:09:25

DH1\_Ant1\_2441



Date: 19.SEP.2021 11:08:05

DH1\_Ant1\_2480



Date: 19.SEP.2021 11:10:57

## **FCC §15.247(d) - BAND EDGES TESTING**

### **Applicable Standard**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **Test Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. 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.
5. Repeat above procedures until all measured frequencies were complete.

### **Test Data**

#### **Environmental Conditions**

<b>Temperature:</b>	25.2 °C
<b>Relative Humidity:</b>	47 %
<b>ATM Pressure:</b>	101.0 kPa

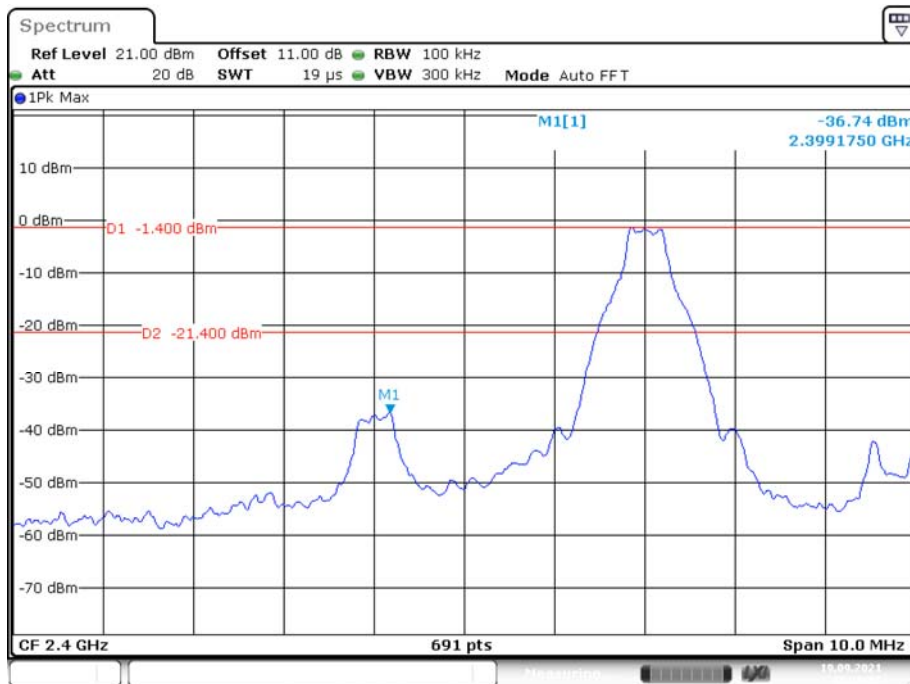
*The testing was performed by Bin Duan on 2021-09-19.*

*EUT operation mode: Transmitting*

Test Result: Compliant.

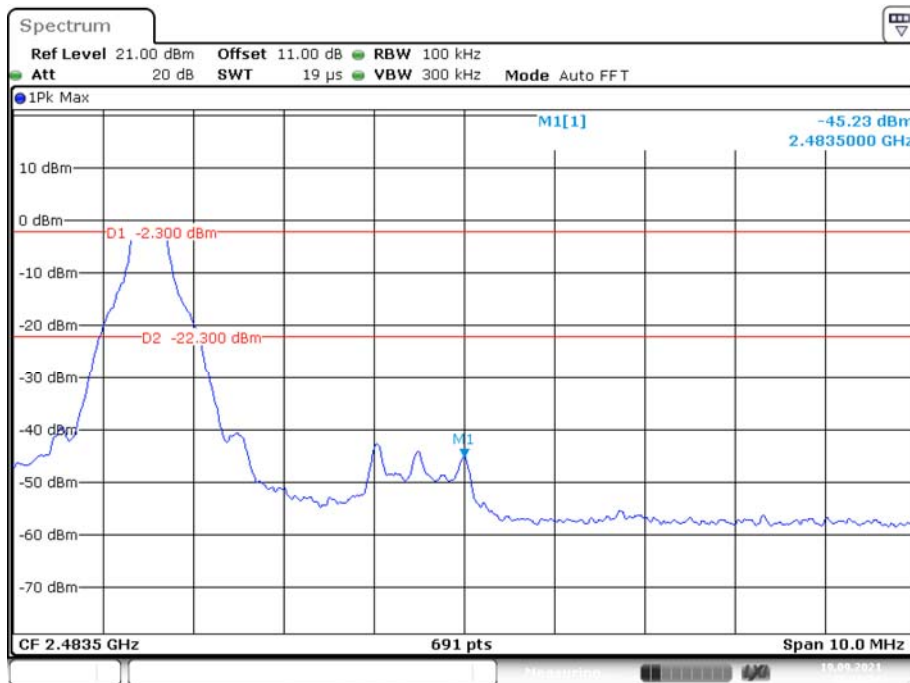
### Conducted Band Edge Result:

#### DH1\_Ant1\_Low\_2402MHz



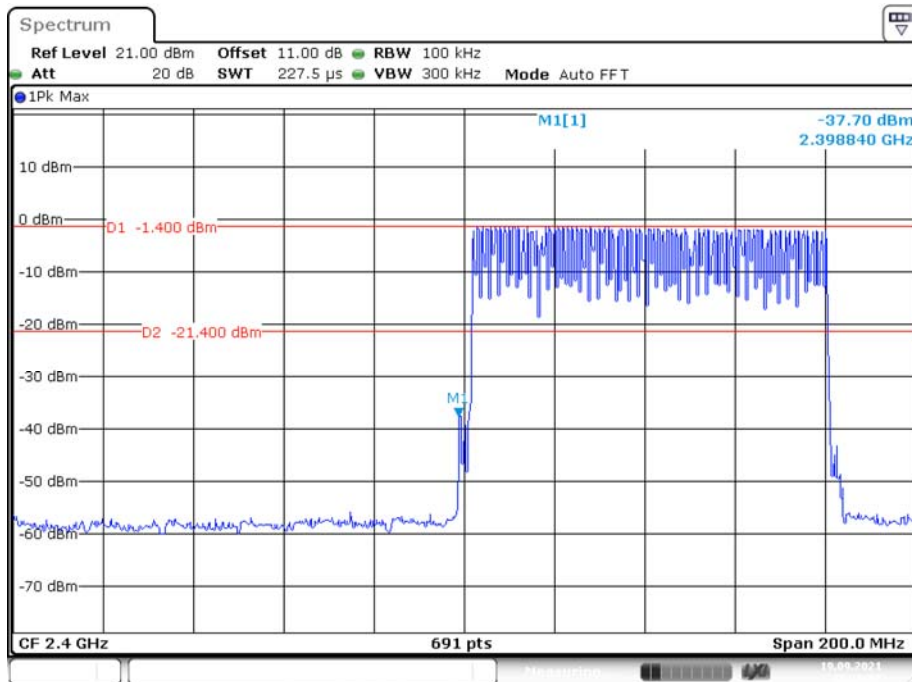
Date: 19.SEP.2021 11:19:05

#### DH1\_Ant1\_High\_2480MHz

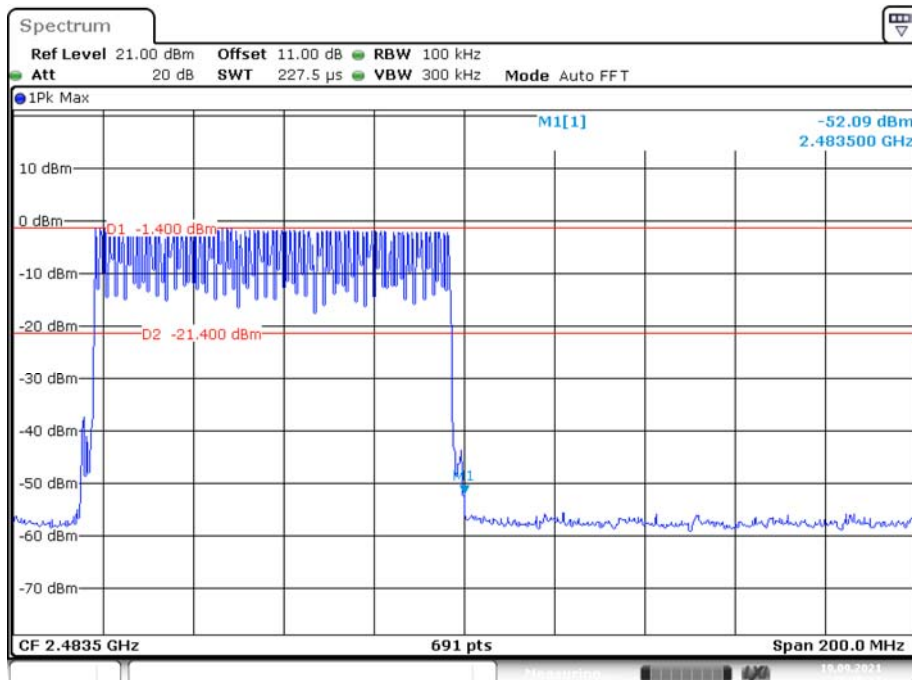


Date: 19.SEP.2021 11:21:36

### DH1\_Ant1\_Low\_Hop\_2402MHz



### DH1\_Ant1\_High\_Hop\_2480MHz



\*\*\*\*\* END OF REPORT \*\*\*\*\*