TEST REPORT

Applicant Name :	Shenzhen Junge Yunchuang Technology Co., Ltd.
Address :	1204, Unit 3, Building C, Fu Gui Yuan, Fu Gui Road, Fu Hua Community, Xixiang Street, Baoan District, Shenzhen, China
Report Number :	SZNS220718-32595E-RF-00
FCC ID:	2A3FP-DF1TR2204

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	REMOTE
Model No.:	DR-DF100B
Multiple Model(s) No.:	DR-DF100C, DR-DF160B, DR-DF180B, DR-DF200B, DR-DF260B, DR-DF280B, DR-DF200C, DR-DF300B, DR-DF350B, DR-DF300C, DR-DF400B, DR-DF440B, DR-DF400C
Trade Mark:	N/A
Date Received:	2022/07/18
Report Date:	2022/12/02

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Nick Fang

EMC Engineer

Approved By:

Candy Li

EMC Engineer

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

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	REMOTE
Tested Model	DR-DF100B
Multiple Models	DR-DF100C, DR-DF160B, DR-DF180B, DR-DF200B, DR-DF260B, DR-DF280B, DR-DF200C, DR-DF300B, DR-DF350B, DR-DF300C, DR-DF400B, DR-DF440B, DR-DF400C (all are the same except model name, the detail see product declaration letter of similarity)
Frequency Range	FHSS: 2458~2480MHz
Maximum conducted Peak output power	FHSS: 2.81dBm
Modulation Technique	FHSS: GFSK
Antenna Specification*	0dBi(provided by the applicant)
Voltage Range	DC 3*1.5V AAA batteries
Sample serial number	SZNS220718-32595E-RF-S1 (Assigned by ATC)
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, 15.209 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 Frequency		$0.082*10^{-7}$
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
Temperature		1℃
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 (ISEDC), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode, which provided by manufacturer.

FHSS channel list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2458	7	2464	13	2470	19	2476
2	2459	8	2465	14	2471	20	2477
3	2460	9	2466	15	2472	21	2478
4	2461	10	2467	16	2473	22	2479
5	2462	11	2468	17	2474	23	2480
6	2463	12	2469	18	2475	/	/

Channel 1, 12, 23 was tested

EUT Exercise Software

No exercise software was used, EUT was confirgured in testing mode by applicnat and the power level is default*. The 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

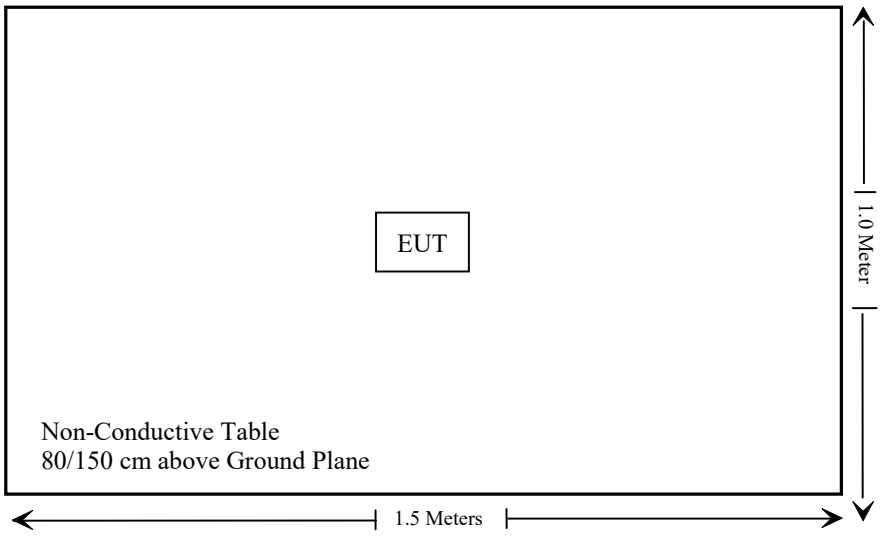
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From Port	To
/	/	/	/

Block Diagram of Test Setup

For radiated emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC§15.247 (i), §1.1307 (b) (3) &§2.1093	RF EXPOSURE	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Not Applicable
§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

Not Applicable: EUT only powered by battery.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emissions Test (30MHz-1GHz)					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Radiated Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test (Above 1GHz)					
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/11/11	2022/11/10
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2022/11/08	2023/11/07
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Wainwright	High Pass Filter	WHKX3.6/18G-10SS	5	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
Radiated Emission Test Software: e3 19821b (V9)					
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101948	2021/12/13	2022/12/12
WEINSCHEL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.31	RF-01	Each time	Each time

*** 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) (3) &§2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (3), 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 D04 Interim General RF Exposure Guidance

SAR-Based Exemption:

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum timeaveraged power or maximum time-averaged ERP, whichever is greater.

Per § 1.1307(b)(3)(i)(B), for single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^x & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

d = the separation distance (cm);

Result

For worst case:

Exemption limit:

For f=2.48GHz, d=0.5cm, the P_{th}= 2.72mW

The higher of the available maximum time-averaged power or effective radiated power (ERP):

The antenna gain is 0dBi(-2.15dBd), 0dBd=2.15dBi

The maximum tune-up conducted power is 3.0dBm (2.00mW), which less than 2.72mW@2480MHz exemption limit.

So the stand-alone SAR evaluation can be exempted.

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 0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

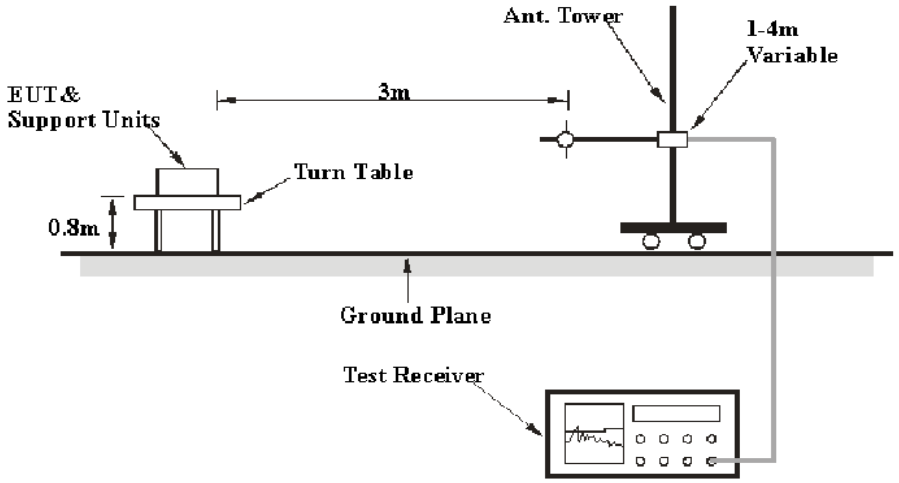
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

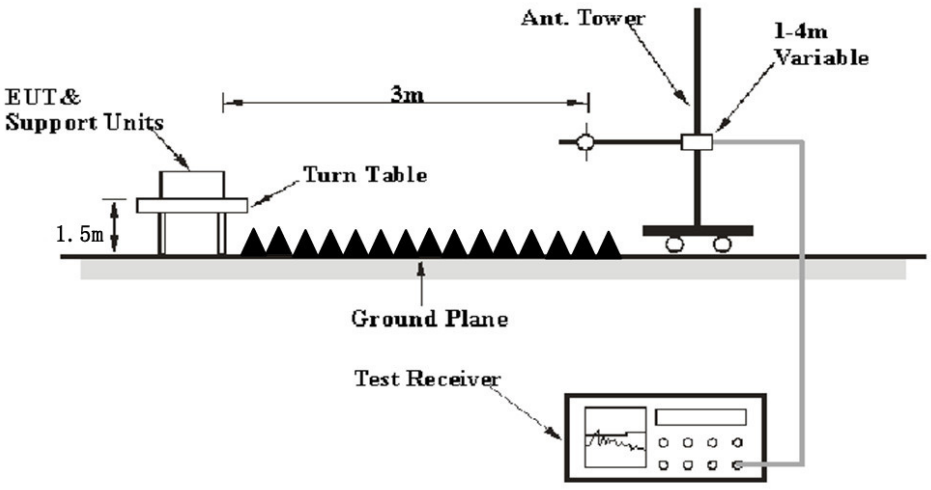
FCC §15.205; §15.209; §15.247(d)

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

For average measurement:

Use the duty cycle factor correction factor method per 15.35(c).
Duty cycle=On time/100milliseconds, On time=N1*L1+N2*L2+…Nn-1*Ln-1+Nn*Ln,
where N1 is number of type 1 pulses, L1 is length of type 1 pulse, etc.
Average Emission Level=Peak Emission Level+20*log(Duty cycle)

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. The basic equation is as follows:

Factor = Antenna Factor + Cable Loss - Amplifier Gain

The "**Over Limit/Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit/margin of -7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Over limit/Margin = Level/Corrected Amplitude-Limit
Level/Corrected Amplitude = Reading + Factor

Test Data

Environmental Conditions

Temperature:	24~25.6 ℃
Relative Humidity:	50~57 %
ATM Pressure:	101.1 kPa

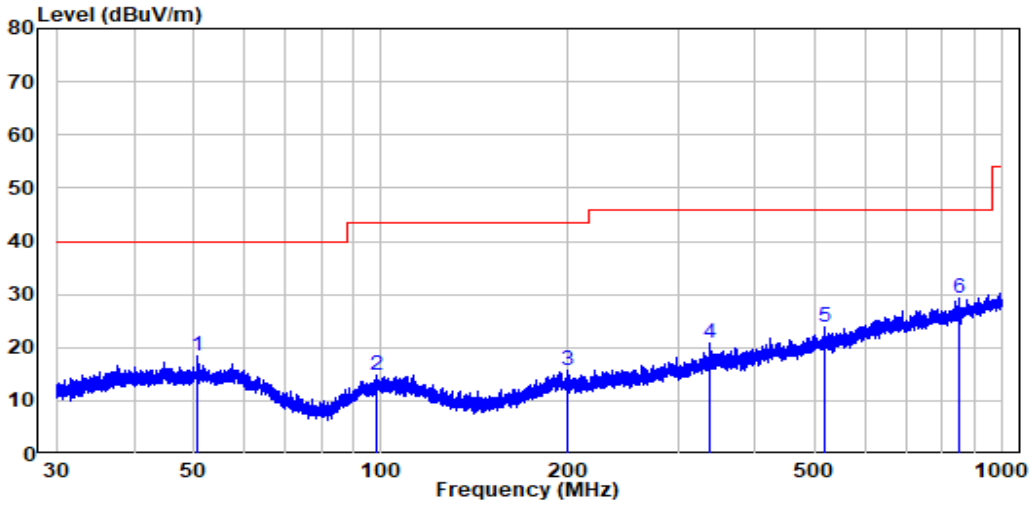
The testing was performed by Jimi on 2022-10-31 for below 1GHz and Level Li from 2022-08-05 to 2022-12-02 for above 1GHz.

EUT operation mode: Transmitting

30MHz-1GHz: *(worst case for Middle channel)*

Note: When the test result of Peak was more than 6dB below the limit of QP, just the Peak value was recorded.

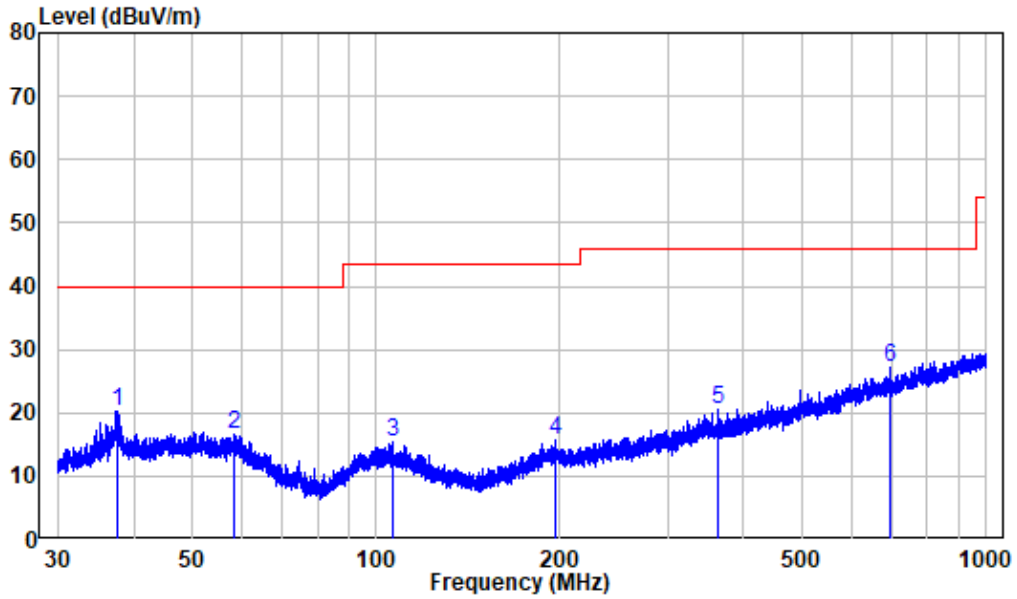
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220718-32595E-RF
Test Mode: Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	50.675	-9.93	28.23	18.30	40.00	-21.70	Peak
2	98.271	-12.19	27.04	14.85	43.50	-28.65	Peak
3	199.460	-11.44	27.02	15.58	43.50	-27.92	Peak
4	337.807	-7.51	28.20	20.69	46.00	-25.31	Peak
5	518.383	-4.29	28.04	23.75	46.00	-22.25	Peak
6	853.276	0.33	28.81	29.14	46.00	-16.86	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : SZNS220718-32595E-RF
Test Mode: Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	37.515	-10.90	31.27	20.37	40.00	-19.63	Peak
2	58.510	-10.08	26.83	16.75	40.00	-23.25	Peak
3	106.199	-11.93	27.22	15.29	43.50	-28.21	Peak
4	196.338	-11.57	27.29	15.72	43.50	-27.78	Peak
5	362.031	-7.62	28.01	20.39	46.00	-25.61	Peak
6	693.505	-1.52	28.65	27.13	46.00	-18.87	Peak

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/AV		Height (m)	Polar (H/V)				
Low Channel(2458MHz)									
2310	67.1	PK	145	1.5	H	-7.24	59.86	74	-14.14
2310	67.07	PK	211	2.4	V	-7.24	59.83	74	-14.17
2390	68.48	PK	40	1.1	H	-7.22	61.26	74	-12.74
2390	67.64	PK	48	1.4	V	-7.22	60.42	74	-13.58
4916	60.81	PK	275	1.1	H	-3.25	57.56	74	-16.44
4916	58.74	PK	33	1.4	V	-3.25	55.49	74	-18.51
Middle Channel(2469MHz)									
4938	60.46	PK	23	2.3	H	-3.14	57.32	74	-16.68
4938	59.13	PK	46	1.5	V	-3.14	55.99	74	-18.01
High Channel(2480 MHz)									
2483.5	69.78	PK	64	1.3	H	-7.2	62.58	74	-11.42
2483.5	68.6	PK	249	1.2	V	-7.2	61.40	74	-12.6
2500	68.36	PK	239	1.8	H	-7.18	61.18	74	-12.82
2500	68.42	PK	340	2.1	V	-7.18	61.24	74	-12.76
4960	60.53	PK	183	2.5	H	-3.01	57.52	74	-16.48
4960	58.03	PK	54	1.3	V	-3.01	55.02	74	-18.98

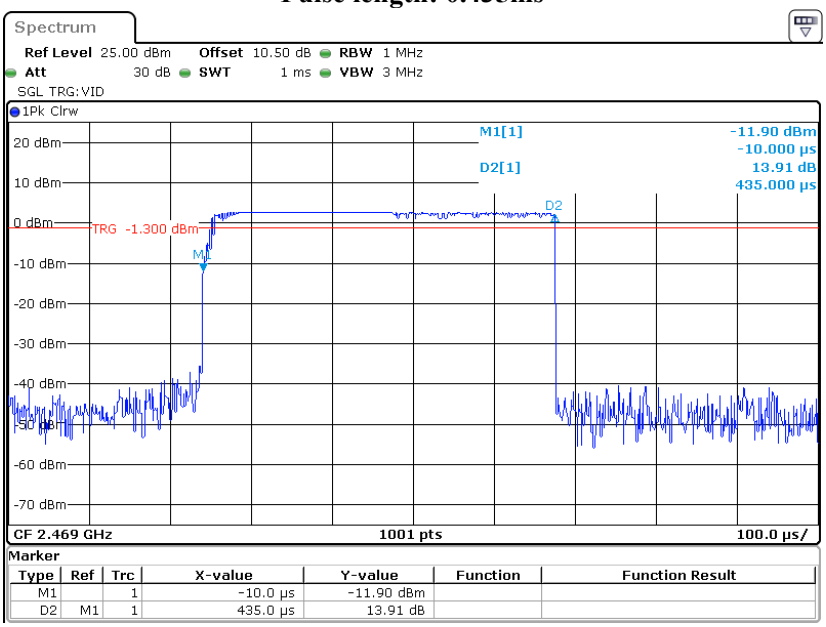
Field Strength of Average						
Frequency (MHz)	Peak Measurement @3m (dBμV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Corrected Ampitude (dBμV/m)	FCC Part 15.247	
					Limit (dBμV/m)	Margin (dB)
Low Channel(2458MHz)						
2310	59.86	H	-37.69	22.17	54	-31.83
2310	59.83	V	-37.69	22.14	54	-31.86
2390	61.26	H	-37.69	23.57	54	-30.43
2390	60.42	V	-37.69	22.73	54	-31.27
4916	57.56	H	-37.69	19.87	54	-34.13
4916	55.49	V	-37.69	17.80	54	-36.20
Middle Channel(2469MHz)						
4938	57.32	H	-37.69	19.63	54	-34.37
4938	55.99	V	-37.69	18.30	54	-35.70
High Channel(2480MHz)						
2483.5	62.58	H	-37.69	24.89	54	-29.11
2483.5	61.40	V	-37.69	23.71	54	-30.29
2500	61.18	H	-37.69	23.49	54	-30.51
2500	61.24	V	-37.69	23.55	54	-30.45
4960	57.52	H	-37.69	19.83	54	-34.17
4960	55.02	V	-37.69	17.33	54	-36.67

Note:

Absolute Level = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
Average level= Peak level+ Duty Cycle Corrected Factor

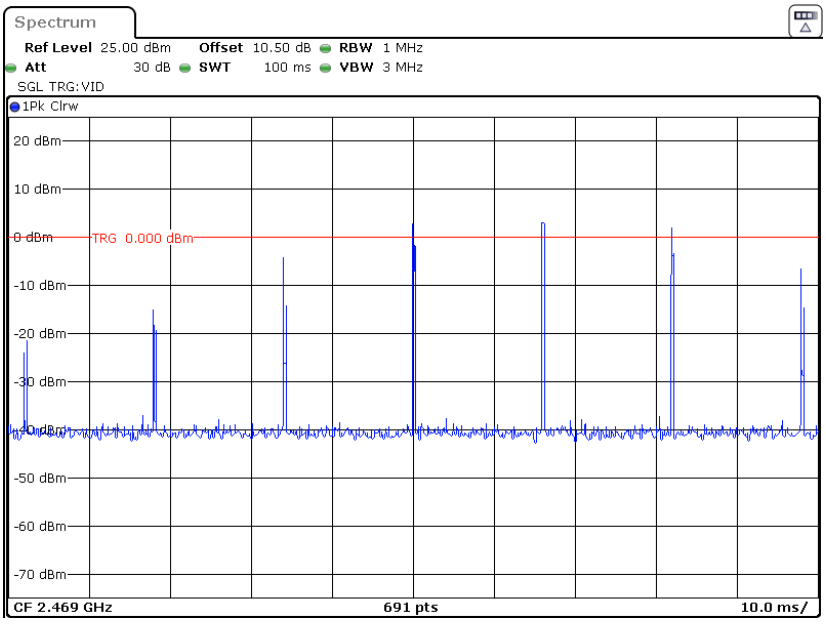
The worst case duty cycle as below:
Duty cycle = Ton/100ms = 0.435*3/100=0.01305
Duty Cycle Corrected Factor = 20lg (Duty cycle) = 20lg0.01305 = -37.69

Pulse length: 0.435ms



Date: 20.OCT.2022 10:39:49

Maximum Pulse number in 100ms: 3

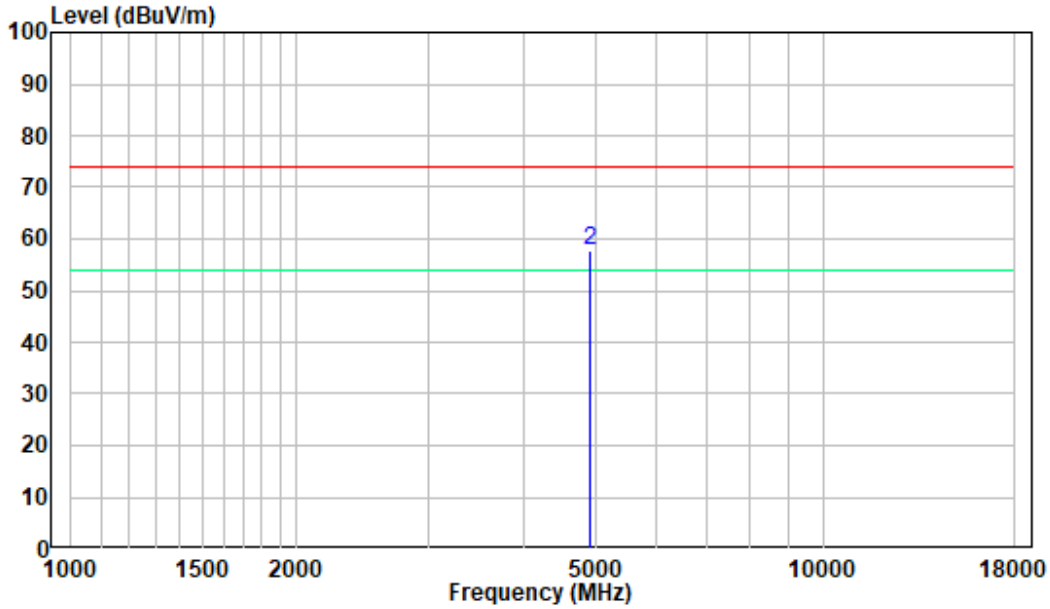


Date: 2.DEC.2022 11:10:05

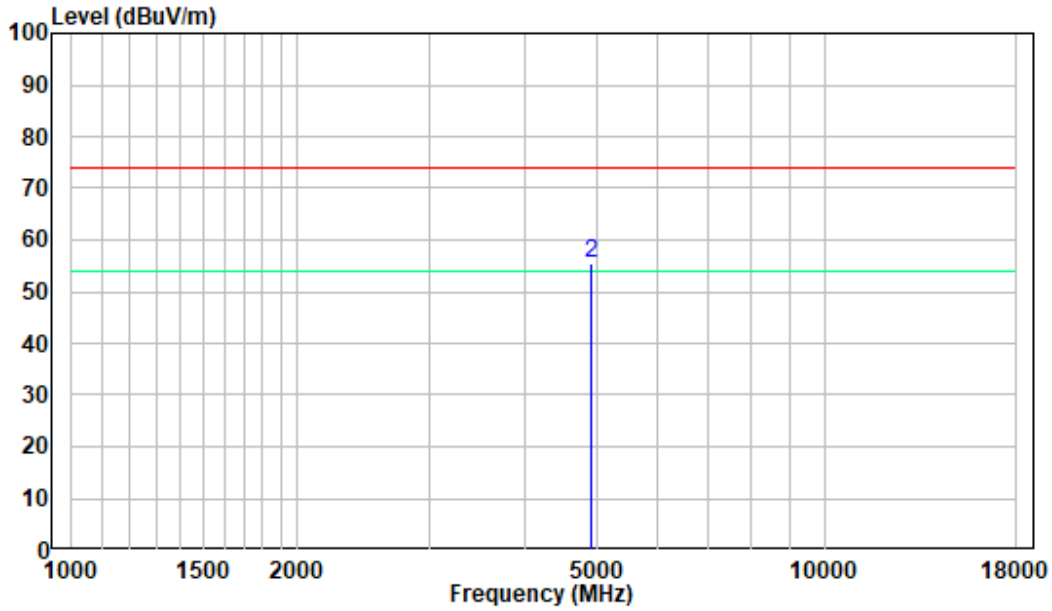
1-18GHz

Pre-scan for Low Channel

Horizontal:



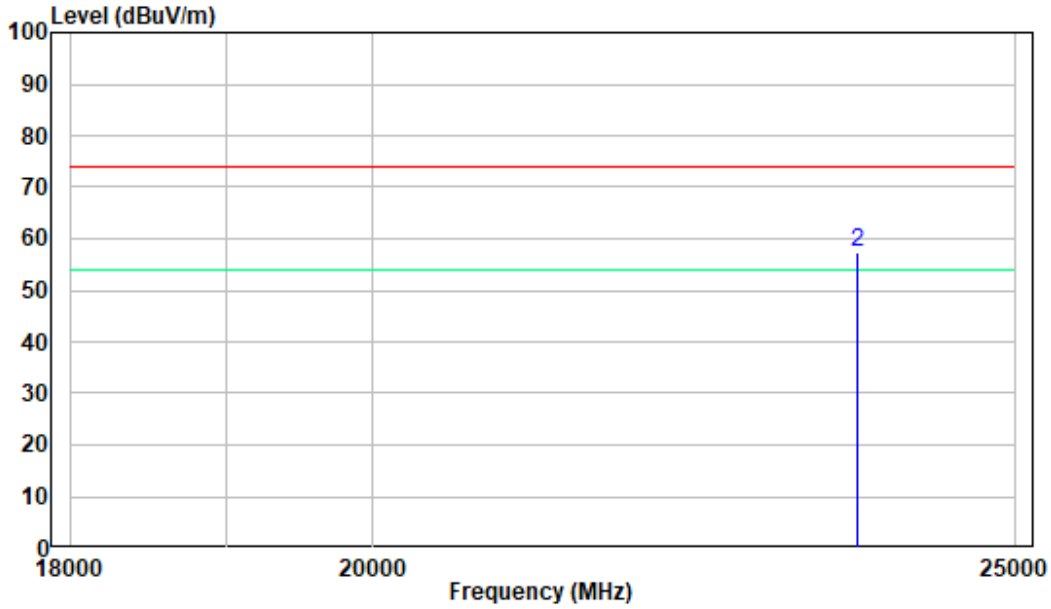
Vertical:



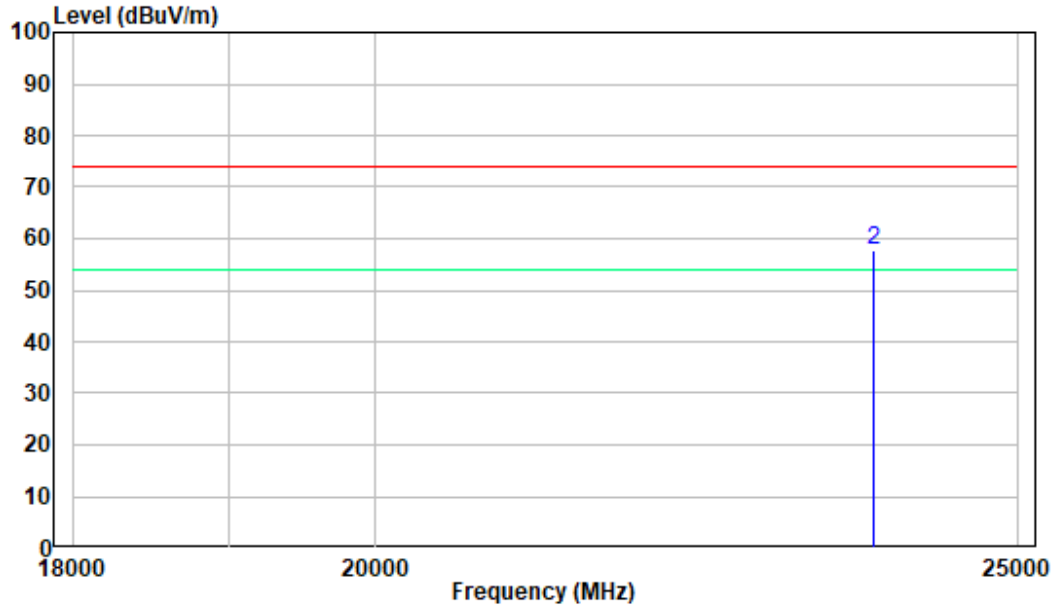
18-25GHz

Pre-scan for Low Channel

Horizontal:



Vertical:



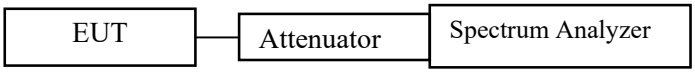
FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

Applicable Standard

Frequency hopping systems shall have hoping 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

Temperature:	27.7 ℃
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

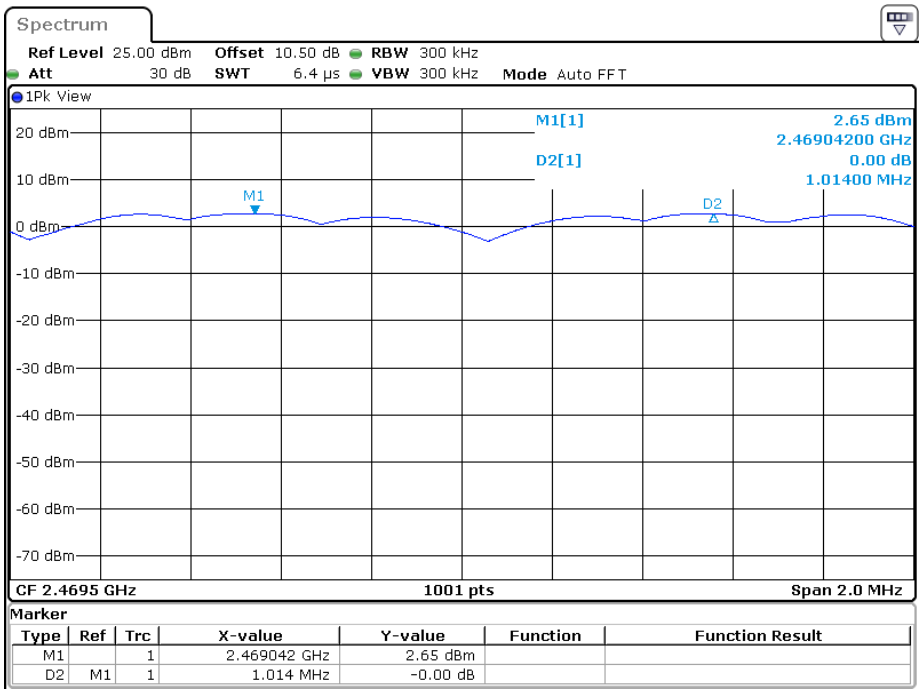
The testing was performed by Cat Kang on 2022-10-20.

EUT operation mode: Transmitting

Test Result: Compliant.

Test Mode	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
GFSK					
Hopping	1.014	1.137	0.758	> two-thirds of the 20 dB bandwidth	Pass

Please refer to the below plots:


Spectrum
Ref Level 25.00 dBm Offset 10.50 dB RBW 300 kHz
Att 30 dB SWT 6.4 µs VBW 300 kHz Mode Auto FFT
1Pk View
M1[1] 2.65 dBm
2.46904200 GHz
D2[1] 0.00 dB
1.01400 MHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D2
CF 2.4695 GHz
1001 pts
Span 2.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.469042 GHz 2.65 dBm
D2 M1 1 1.014 MHz -0.00 dB
Date: 20.OCT.2022 10:41:07

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

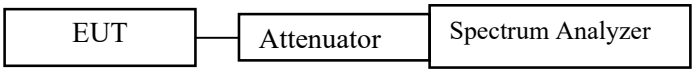
The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• 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

Temperature:	27.7 ℃
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang on 2022-10-20.

EUT operation mode: Transmitting

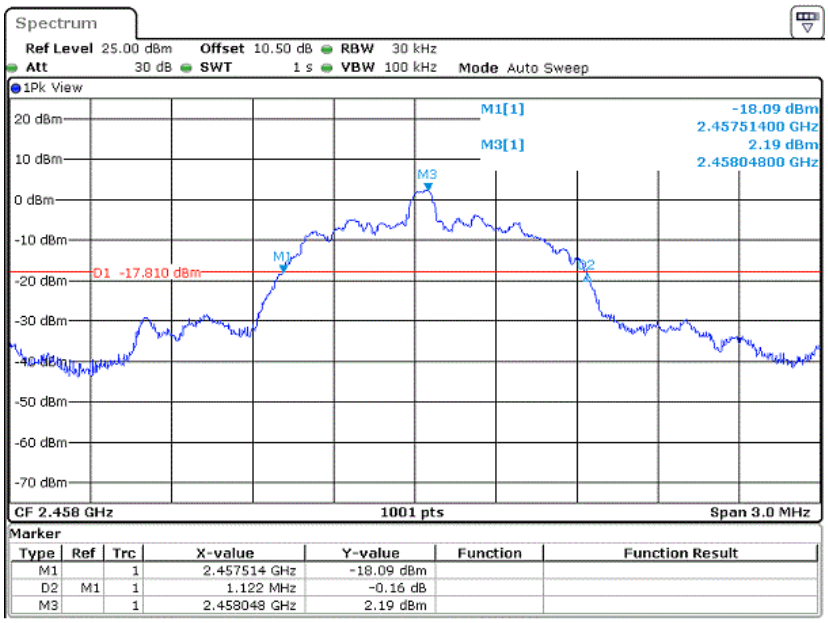
Test Result: Compliant.

Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	20 dB Emission Bandwidth (MHz)
Low	2458	1.067	1.122
Middle	2469	1.070	1.137
High	2480	1.061	1.125

Please refer to the below plots:

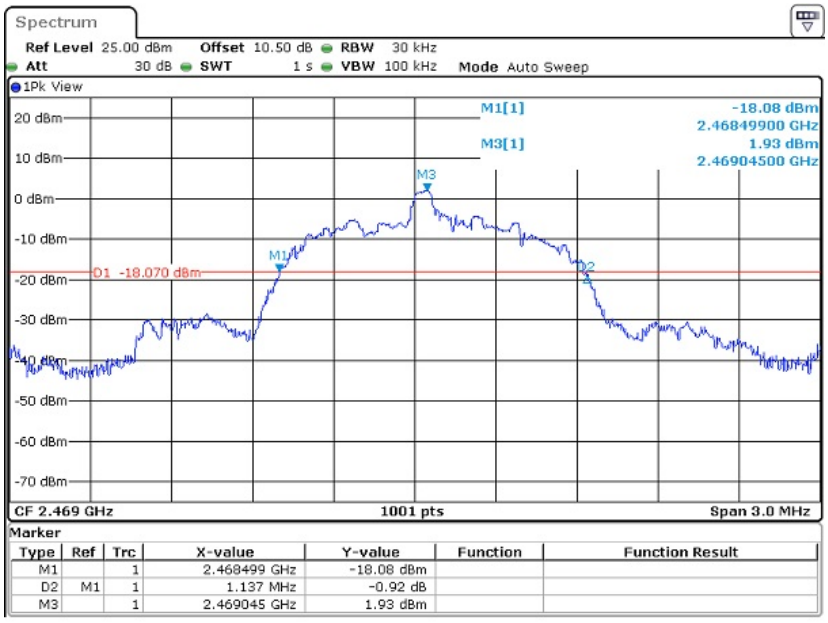
20 dB EMISSION BANDWIDTH

Low Channel



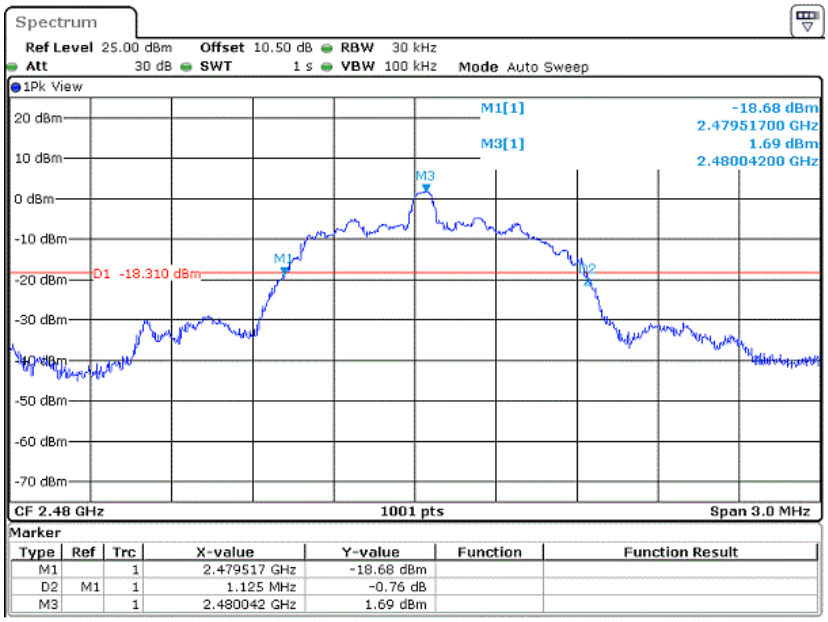
Date: 20.OCT.2022 10:59:50

Middle Channel



Date: 20.OCT.2022 11:02:05

High Channel

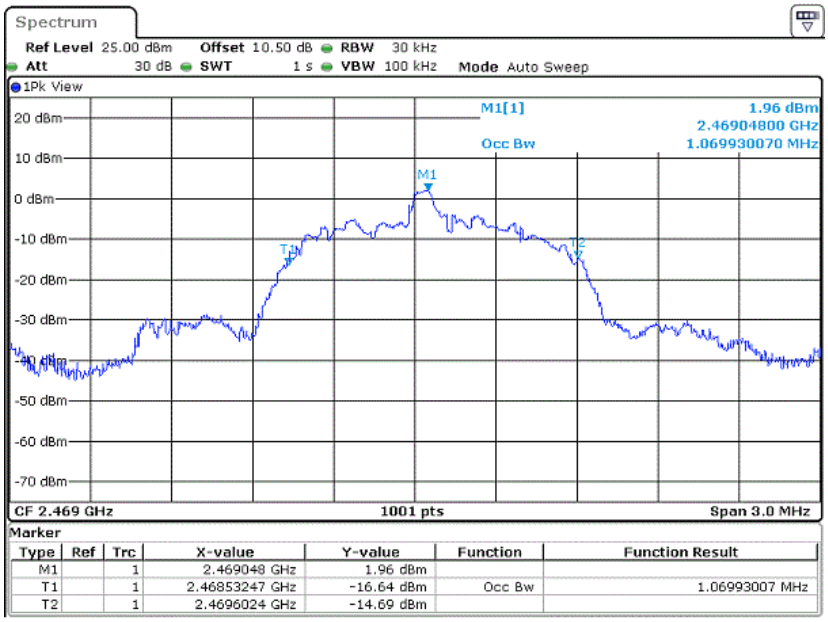


99% OCCUPIED BANDWIDTH

Low Channel

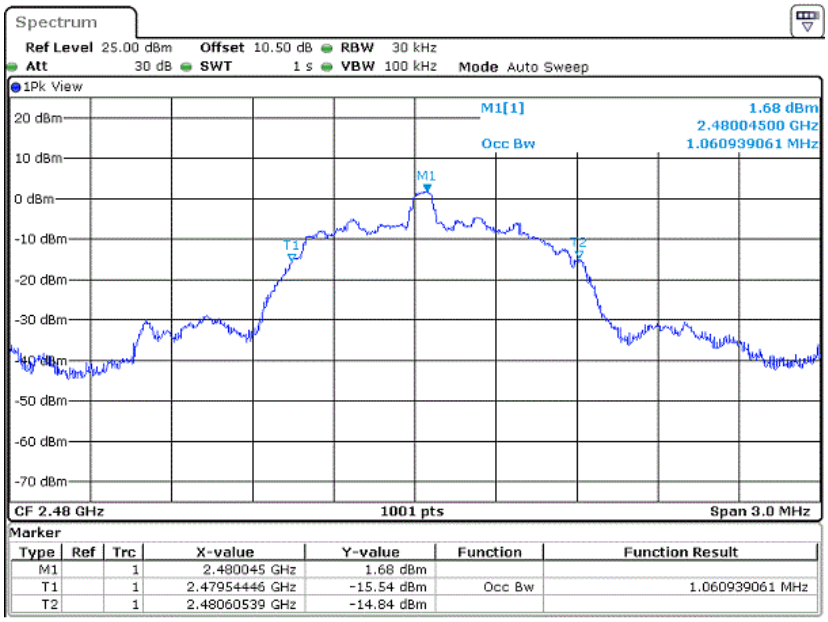
Date: 20.OCT.2022 10:58:17

Middle Channel



Date: 20.OCT.2022 11:01:15

High Channel



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

Applicable Standard

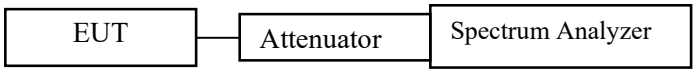
Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress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

Temperature:	27.7 ℃
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

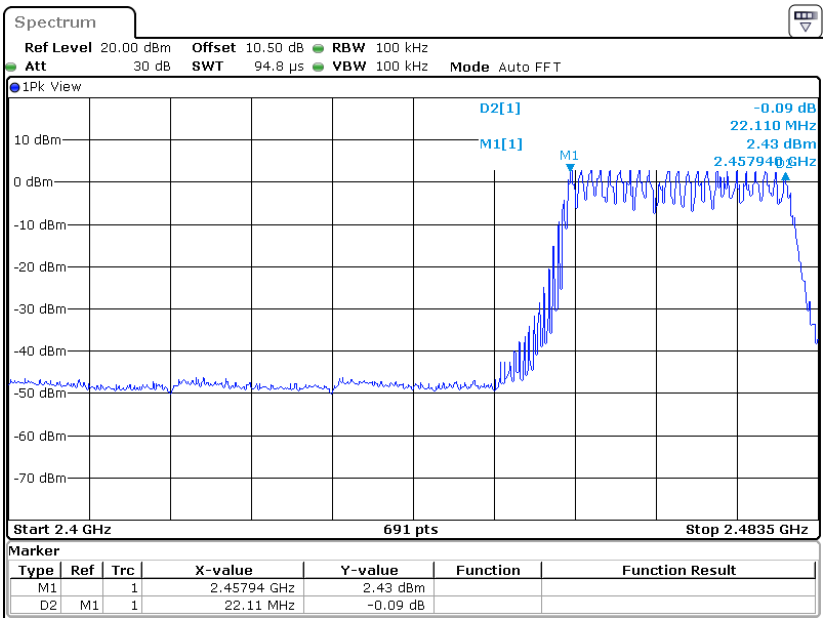
The testing was performed by Cat Kang on 2022-10-29.

EUT operation mode: Transmitting

Test Result: Compliant.

Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
GFSK	2400-2483.5	23	≥15

Hoppping Number



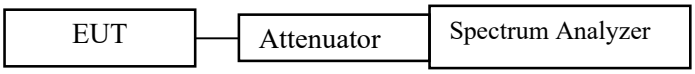
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)

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 ≥ 3×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

Temperature:	27.7~29 ℃
Relative Humidity:	47~54 %
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang from 2022-10-20 to 2022-12-02.

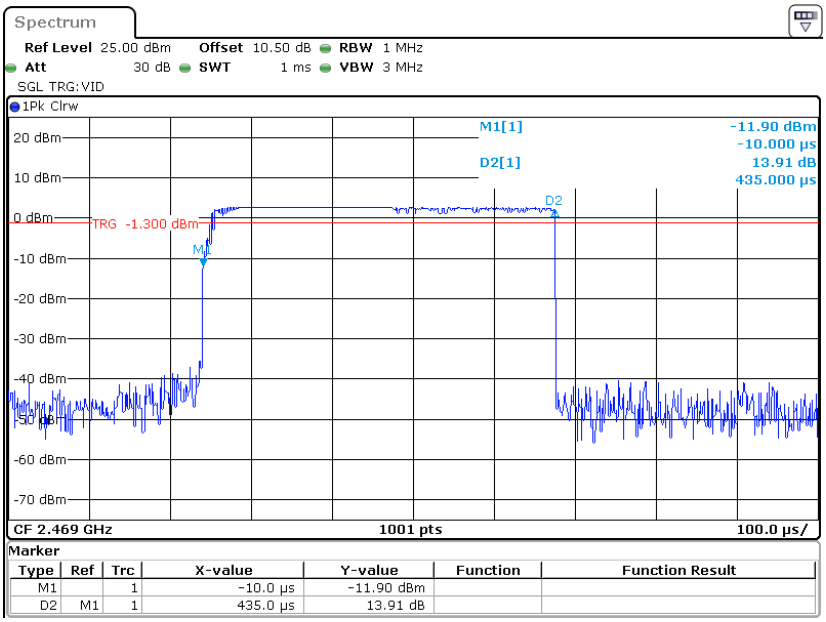
EUT operation mode: Transmitting

Test Result: Compliant.

Test Mode	Channel	Pulse Time [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
GFSK	Hop	0.435	75	0.033	<=0.4	PASS

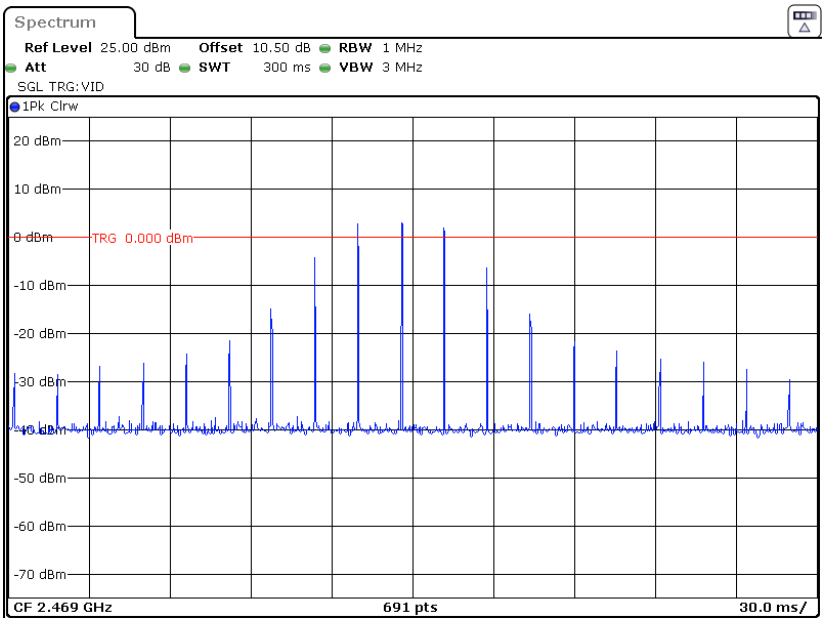
Note: Period time=0.4s*23=9.2s, Result= Pulse Time*Total hops
Total hops = 25*3 =75

Pulse Time



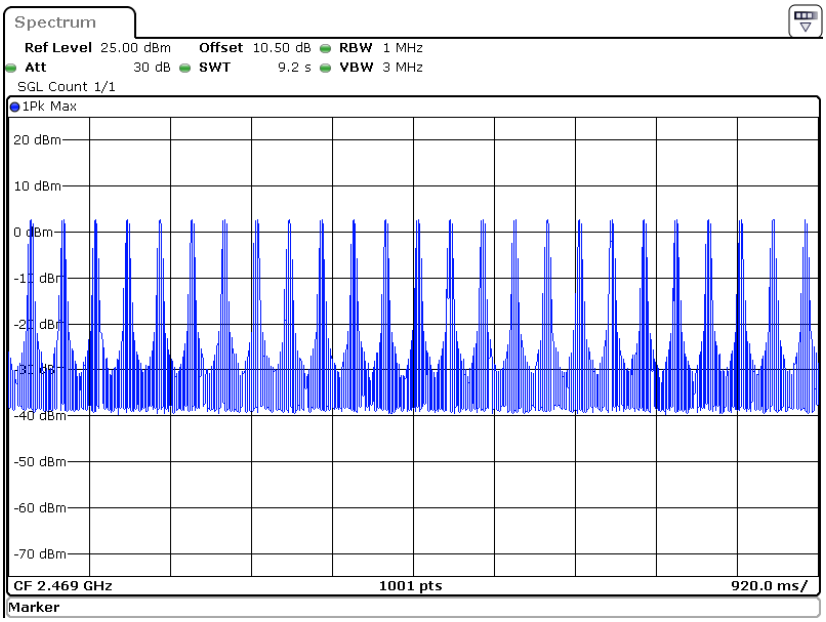
Date: 20.OCT.2022 10:39:49

Maximum Pulse number in one hop: 3



Date: 2.DEC.2022 11:11:08

Total Hops in 9.2s



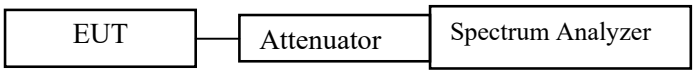
FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

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

Temperature:	27.7 ℃
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

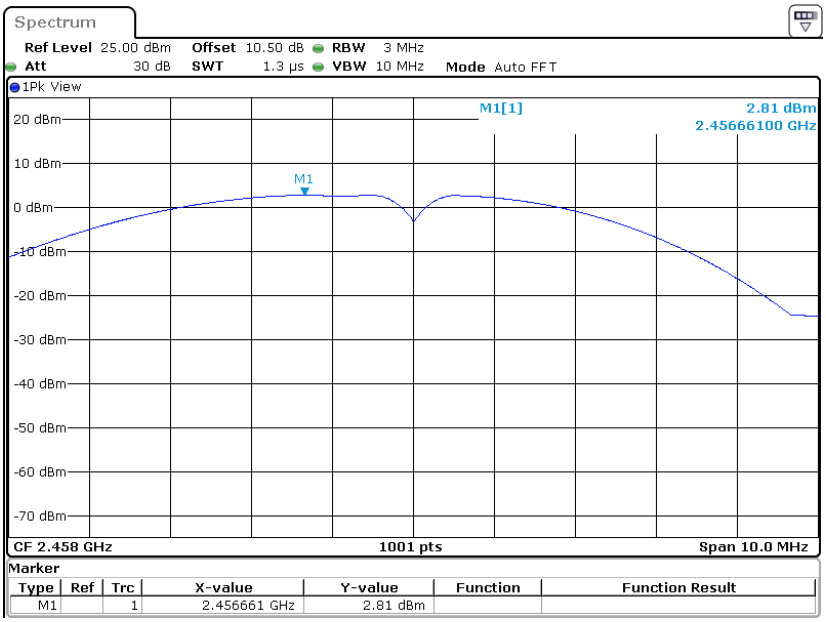
The testing was performed by Cat Kang on 2022-10-20

EUT operation mode: Transmitting

Test Result: Compliant.

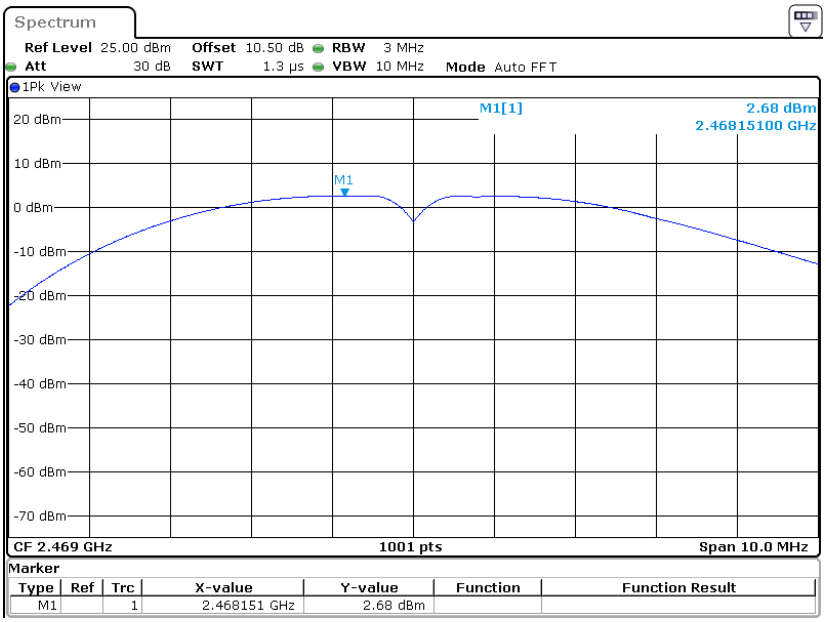
Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
Low	2458	2.81	21
Middle	2469	2.68	21
High	2480	2.52	21

Low Channel



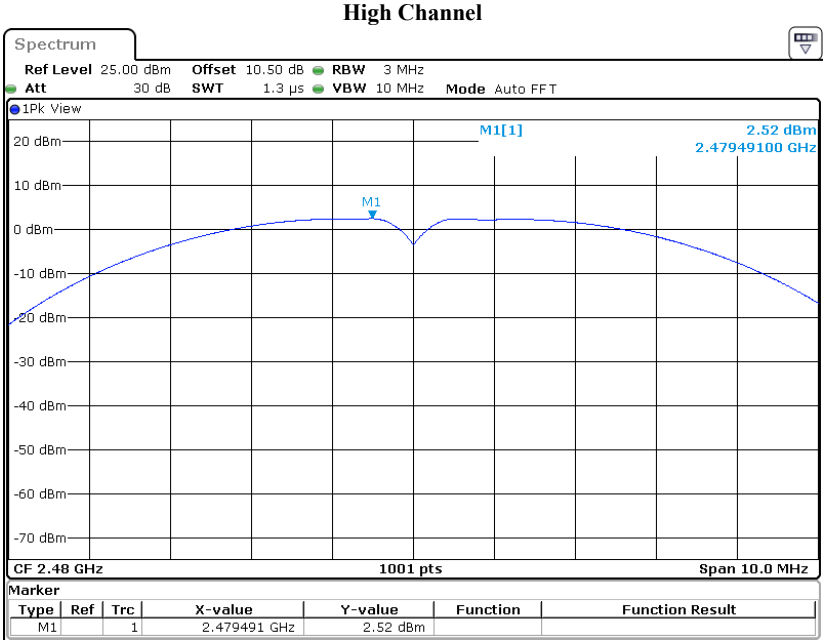
Date: 20.OCT.2022 10:01:30

Middle Channel



Date: 20.OCT.2022 10:09:34

High Channel



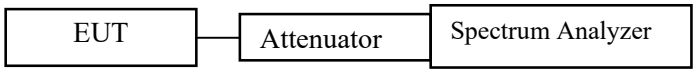
FCC §15.247(d) - BAND EDGES TESTING

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

Temperature:	25~27.7 ℃
Relative Humidity:	47~52 %
ATM Pressure:	101.0 kPa

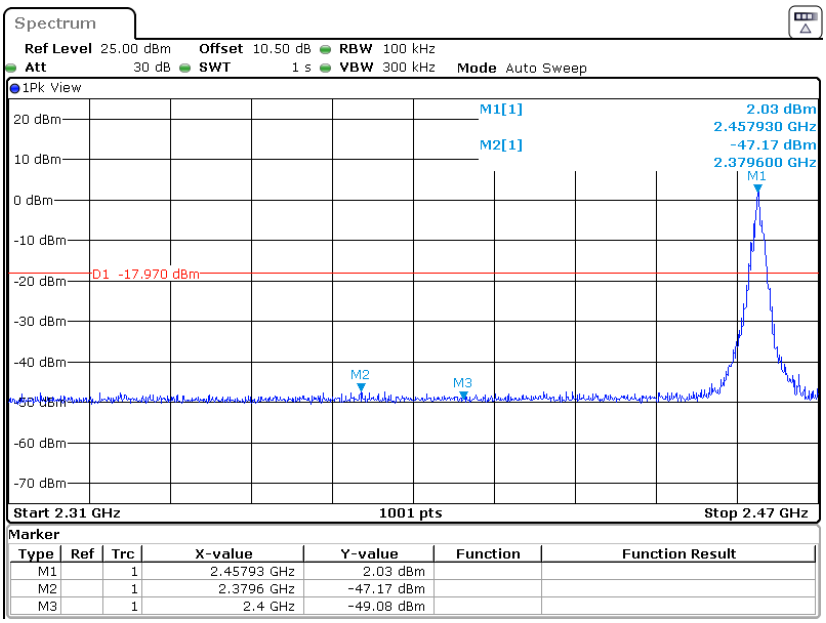
The testing was performed by Cat Kang from 2022-10-20 to 2022-11-14.

EUT operation mode: Transmitting

Test Result: Compliant.

Conducted Band Edge Result:

GFSK_Low Channel

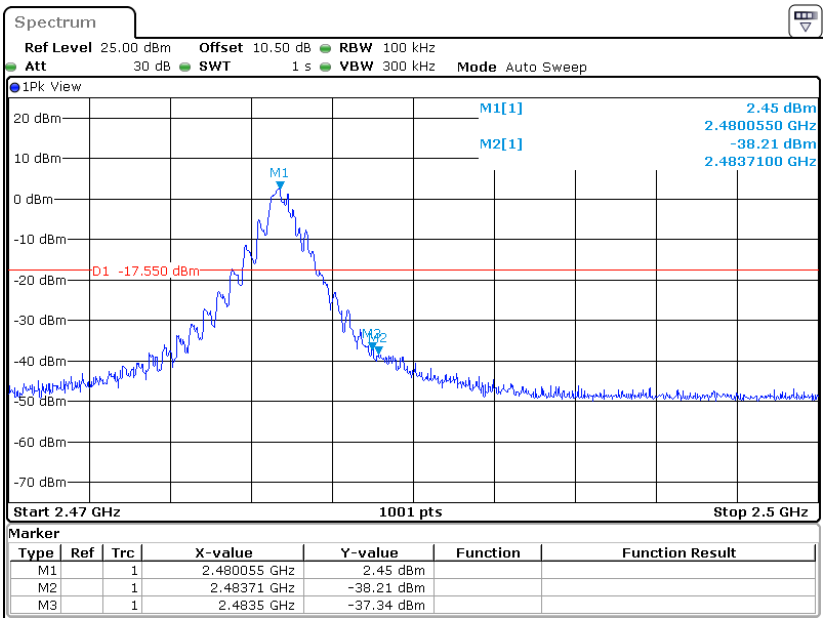


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.45793 GHz	2.03 dBm		
M2		1	2.3796 GHz	-47.17 dBm		
M3		1	2.4 GHz	-49.08 dBm		

Date: 14.NOV.2022 16:48:08

GFSK_High Channel

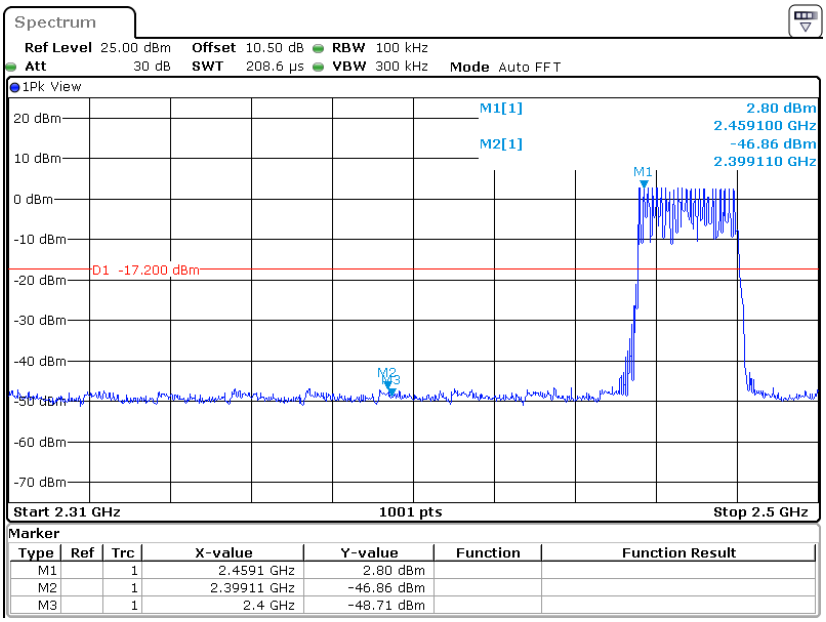


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480055 GHz	2.45 dBm		
M2		1	2.48371 GHz	-38.21 dBm		
M3		1	2.4835 GHz	-37.34 dBm		

Date: 20.OCT.2022 10:27:23

GFSK_Hop_Low Channel

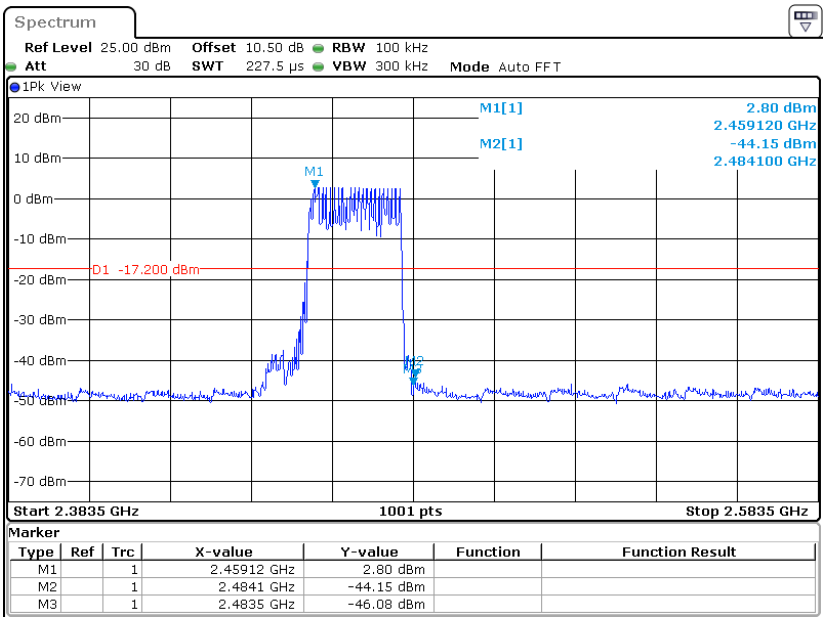


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4591 GHz	2.80 dBm		
M2		1	2.39911 GHz	-46.86 dBm		
M3		1	2.4 GHz	-48.71 dBm		

Date: 20.OCT.2022 10:43:39

GFSK_Hop_High Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.45912 GHz	2.80 dBm		
M2		1	2.4841 GHz	-44.15 dBm		
M3		1	2.4835 GHz	-46.08 dBm		

Date: 20.OCT.2022 10:44:59

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