TEST REPORT

Applicant Name :	ARICH INTERNATIONAL INC
Address :	360 SUMMERVIEW CT SAN RAMON CA 94583-4463 SAN RAMON California United States
Report Number :	RA230330-15712E-RF-00A
FCC ID:	2ADZTCARPLAYGO

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	CarplayGo
Model No.:	CarplayGo
Multiple Model(s) No.:	AutoCast
Trade Mark:	TUNAI
Date Received:	2023/03/30
Report Date:	2023/04/24

Test Result:	Pass*

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

Prepared and Checked By:

Andy Yu
EMC Engineer

Approved By:

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EMC Engineer

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230330-15712E-RF-00A	Original Report	2023/04/24

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product Type	CarplayGo
Model No.	CarplayGo
Multiple Model(s) No.	AutoCast (model difference see product declaration letter of similarity)
Frequency Range	Bluetooth: 2402~2480MHz
Maximum conducted Peak output power	Bluetooth: 5.54dBm
Modulation Technique	Bluetooth: GFSK, π/4-DQPSK, 8DPSK
Antenna Specification*	2.5dBi (provided by the applicant)
Voltage Range	DC 5V from USB port
Test Sample serial number	23UB_2 for Conducted and Radiated Emissions Test 23UB_1 for RF Conducted Test (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.

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 Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, Shenzhen, Guangdong, 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.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0016. The Registration Number is 30241.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

“SecureCRT*”Exercise Software was used and the power level is default *. The power level was provided by the manufacturer.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

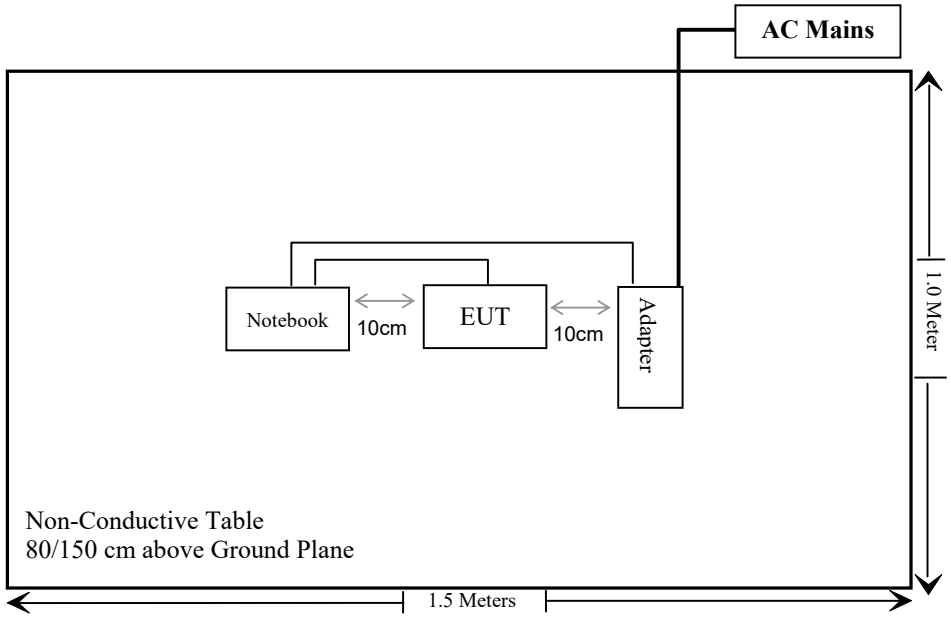
Manufacturer	Description	Model	Serial Number
Lenovo	Notebook	T430	23447YC
GUANG BAO	Adapter	42T4416	11S42T4416ZGWF12O7A1

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding Detachable AC Cable	1.0	AC Mains	Adapter
Un-shielding Un-Detachable DC Cable	1.2	Adapter	Notebook
Un-shielding Detachable USB Cable	1.0	Notebook	EUT

Block Diagram of Test Setup

For Radiated Emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1307 (b) & §2.1091	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: the device is intend for vehicle use.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emissions Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2022/11/25	2023/11/24
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2022/11/25	2023/11/24
SONOMA INSTRUMENT	Amplifier	310 N	186131	2022/11/08	2023/11/07
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2022/11/08	2023/11/07
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	837	2023/02/22	2026/02/21
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2022/12/26	2025/12/25
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.11	N1000	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.12	N040	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.13	N300	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.14	N800	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.15	N600	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.16	N650	2022/11/25	2023/11/24
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101495	2022/11/25	2023/11/24
Tonscend	RF Control Unit	JS0806-2	19G8060182	2022/10/24	2023/10/23
WEINSCHEL	10dB Attenuator	5324	AU 3842	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.31	RF-01	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) & §2.1091- RF Exposure

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

Ris the minimum separation distance in meters
f = frequency in MHz

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

Result

Mode	Frequency (MHz)	Tune up conducted power	Antenna Gain		ERP		Evaluation Distance (m)	ERP Limit (mW)
		(dBm)	(dBi)	(dBd)	(dBm)	(mW)		
BT	2402-2480	6.0	2.5	0.35	6.35	4.32	0.2	768
BLE	2402-2480	6.0	2.5	0.35	6.35	4.32	0.2	768
Wi-Fi	5180-5240	10	2.7	0.55	10.55	11.35	0.2	768

Note: 1. The BT or BLE can transmit at same time with Wi-Fi
2. The tune up conducted power and antenna gain was declared by the applicant.

Simultaneous transmitting consideration (worst case):

The ratio=ERP_{BT}/Limit+$ERP_{Wi\text{-}Fi}$/Limit=4.32/768+11.35/768=0.02＜1.0, so simultaneous exposure is compliant.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

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 which was permanently attached, and the maximum antenna gain is 2.5dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

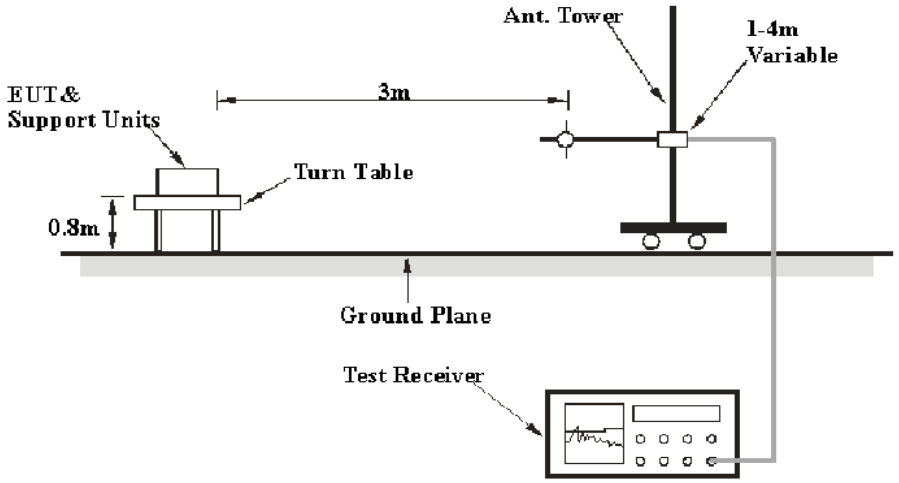
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

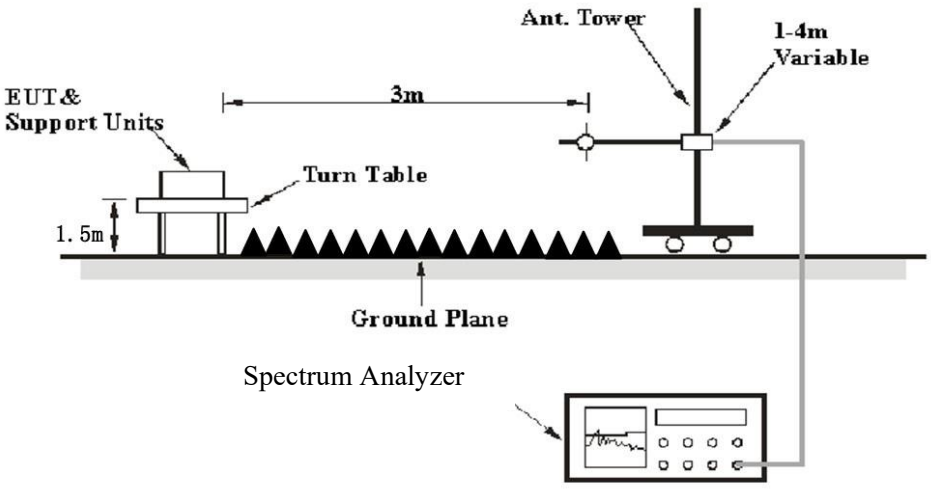
FCC §15.205; §15.209; §15.247(d)

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
	1 MHz	10 Hz	/	Ave.

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.

Corrected Factor & Margin Calculation

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

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

Test Data

Environmental Conditions

Temperature:	24~25.5℃
Relative Humidity:	52~56%
ATM Pressure:	101kPa

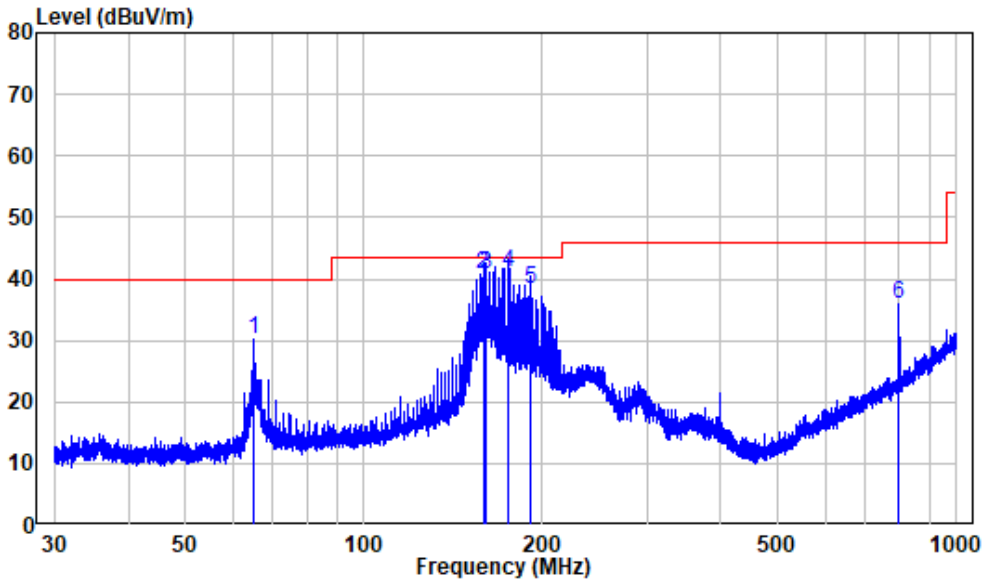
The testing was performed by Jimi Zheng on 2023-04-17 for below 1GHz and Level Li on 2023-04-21 for above 1GHz.

Test mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case X-axes of orientation was recorded)

30MHz-1GHz: *(worst case is GFSK Mode, Middle channel)*

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

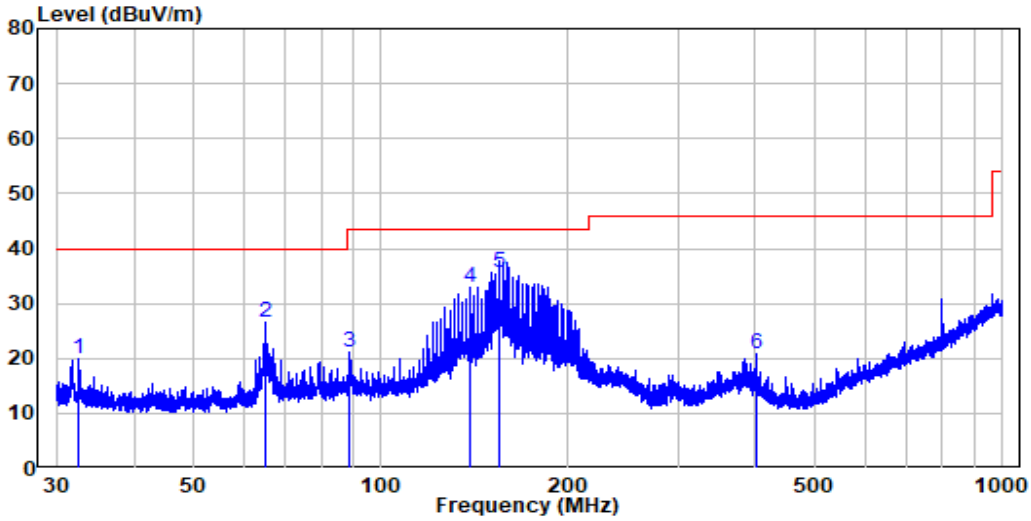
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230330-15712E-RF
Test Mode: BT Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	64.943	-13.76	43.99	30.23	40.00	-9.77	Peak
2	158.877	-10.30	50.94	40.64	43.50	-2.86	QP
3	160.909	-10.29	50.95	40.66	43.50	-2.84	QP
4	174.883	-10.37	51.47	41.10	43.50	-2.40	QP
5	190.906	-10.27	48.75	38.48	43.50	-5.02	QP
6	800.382	-4.33	40.32	35.99	46.00	-10.01	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230330-15712E-RF
Test Mode: BT Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	32.620	-14.37	34.27	19.90	40.00	-20.10	Peak
2	64.972	-13.76	40.34	26.58	40.00	-13.42	Peak
3	88.925	-12.55	33.73	21.18	43.50	-22.32	Peak
4	138.934	-10.55	43.36	32.81	43.50	-10.69	Peak
5	154.888	-10.33	46.00	35.67	43.50	-7.83	QP
6	401.662	-12.36	33.30	20.94	46.00	-25.06	Peak

Above 1GHz: *(the worst case is GFSK Mode, DH5)*

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave.		Height (m)	Polar (H/V)				
Low Channel 2402MHz									
2331.01	66.37	PK	77	1.7	H	-10.59	55.78	74	-18.22
2331.01	53.95	Ave.	77	1.7	H	-10.59	43.36	54	-10.64
2344.09	66.04	PK	271	1.1	V	-10.73	55.31	74	-18.69
2344.09	53.07	Ave.	271	1.1	V	-10.73	42.34	54	-11.66
2390	65.23	PK	306	2.2	H	-10.70	54.53	74	-19.47
2390	53.55	Ave.	306	2.2	H	-10.70	42.85	54	-11.15
2390	64.79	PK	93	1.8	V	-10.70	54.09	74	-19.91
2390	52.79	Ave.	93	1.8	V	-10.70	42.09	54	-11.91
4804	60.08	PK	138	2.1	H	-6.11	53.97	74	-20.03
4804	48.67	Ave.	138	2.1	H	-6.11	42.56	54	-11.44
4804	59.71	PK	73	1.9	V	-6.11	53.60	74	-20.40
4804	46.99	Ave.	73	1.9	V	-6.11	40.88	54	-13.12
Middle Channel 2441MHz									
4882	60.68	PK	193	1.9	H	-5.90	54.78	74	-19.22
4882	49.34	Ave.	193	1.9	H	-5.90	43.44	54	-10.56
4882	60.01	PK	161	1.8	V	-5.90	54.11	74	-19.89
4882	48.20	Ave.	161	1.8	V	-5.90	42.3	54	-11.70
High Channel 2480MHz									
2483.5	73.23	PK	40	1.1	H	-10.55	62.68	74	-11.32
2483.5	58.28	Ave.	40	1.1	H	-10.55	47.73	54	-6.27
2483.5	71.81	PK	281	2.1	V	-10.55	61.26	74	-12.74
2483.5	56.61	Ave.	281	2.1	V	-10.55	46.06	54	-7.94
2500	74.11	PK	111	2.2	H	-10.42	63.69	74	-10.31
2500	59.59	Ave.	111	2.2	H	-10.42	49.17	54	-4.83
2500	72.78	PK	67	1.5	V	-10.42	62.36	74	-11.64
2500	57.92	Ave.	67	1.5	V	-10.42	47.5	54	-6.50
4960	60.67	PK	155	2	H	-5.47	55.20	74	-18.80
4960	50.59	Ave.	155	2	H	-5.47	45.12	54	-8.88
4960	60.50	PK	146	1.8	V	-5.47	55.03	74	-18.97
4960	48.93	Ave.	146	1.8	V	-5.47	43.46	54	-10.54

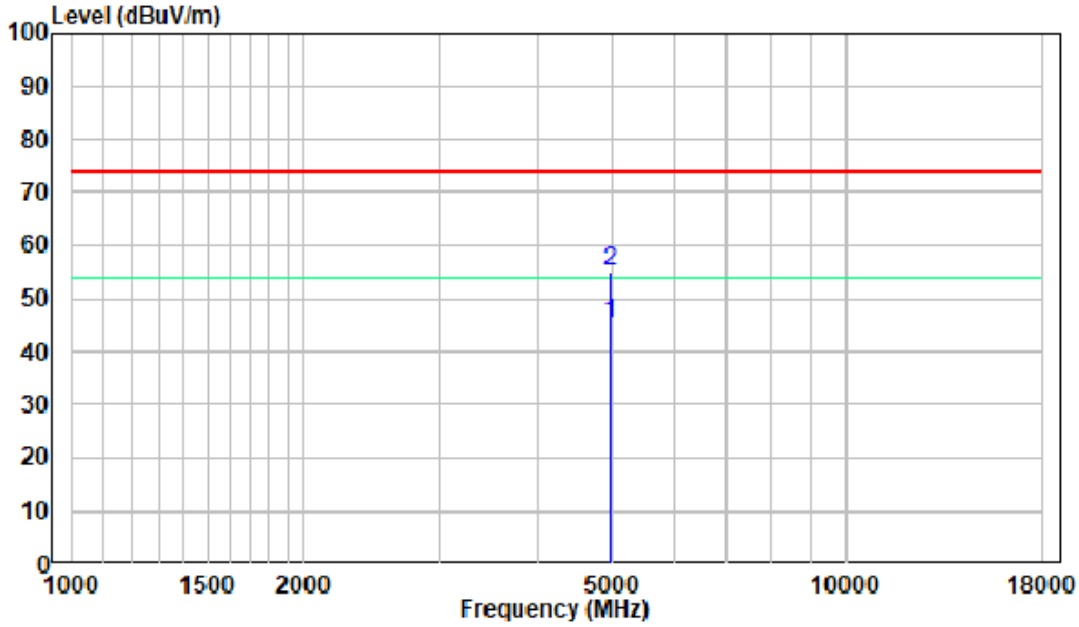
Note:

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.
For the simultaneous transmitting condition, please refer to the NII report.

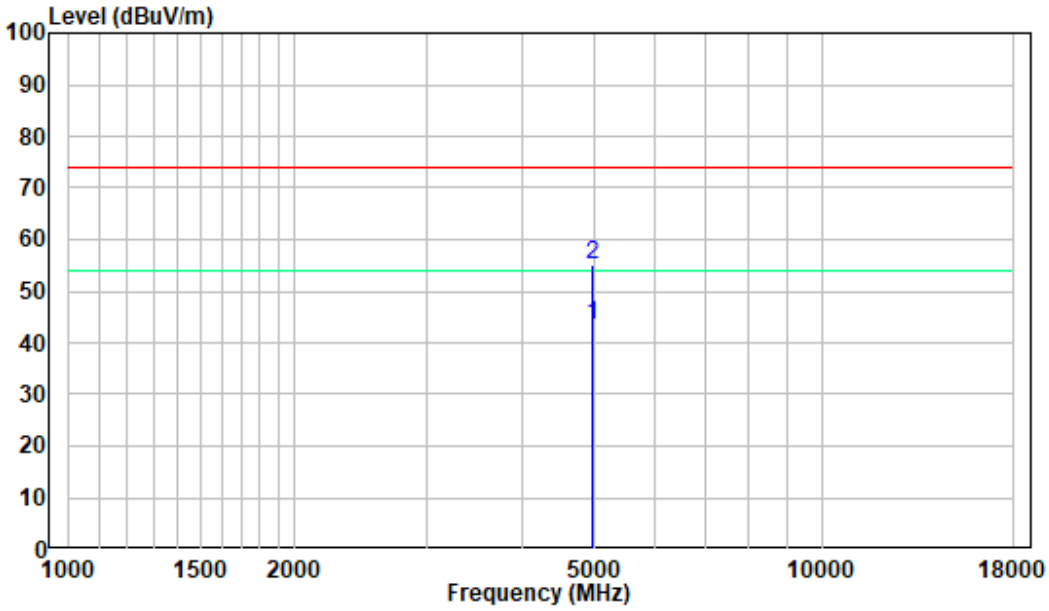
1-18GHz

Pre-scan, High Channel (worst case)

Horizontal:



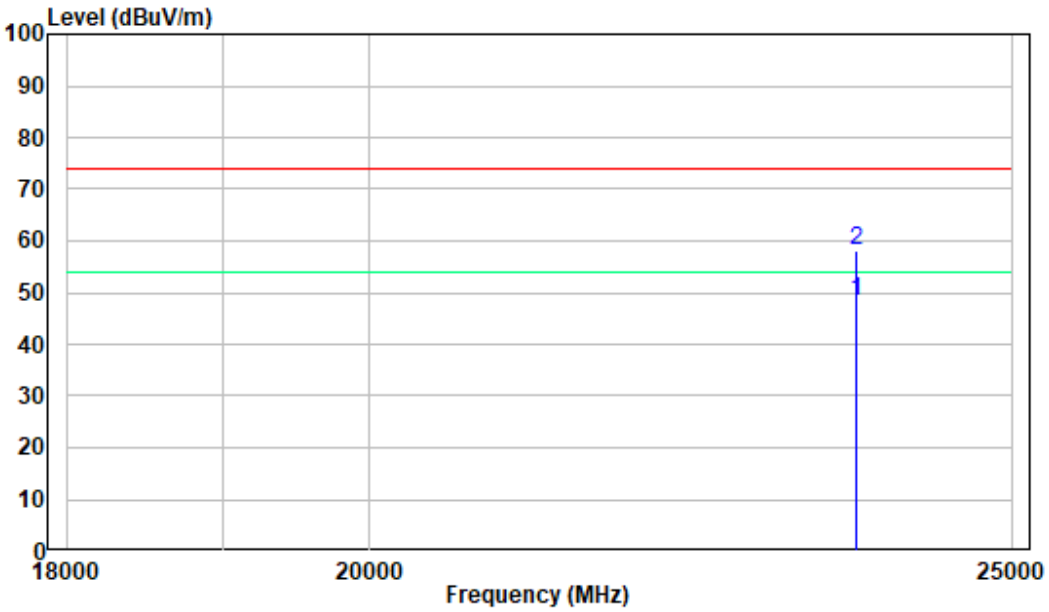
Vertical:



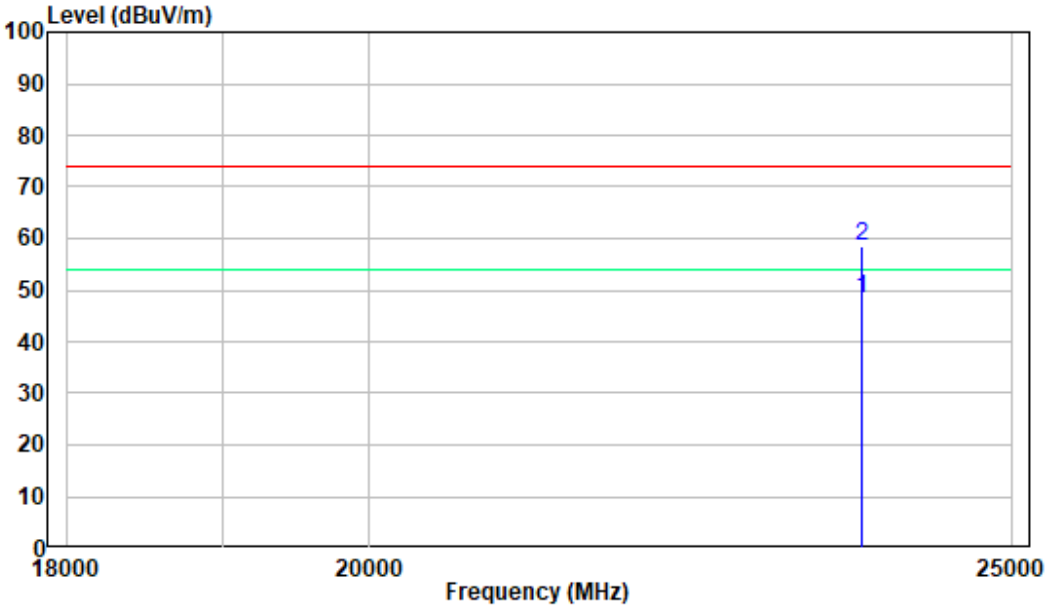
18-25GHz

Pre-scan , High Channel (worst case)

Horizontal:



Vertical:



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

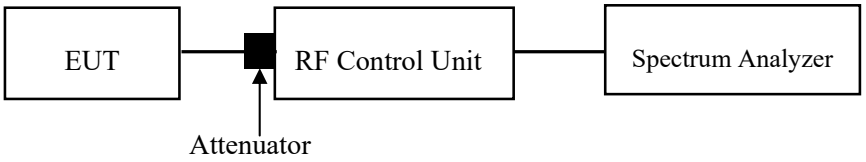
Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 7.8.2

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:	24℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-04-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

Test Method: ANSI C63.10-2013 Clause 7.8.7 & Clause 6.9.2

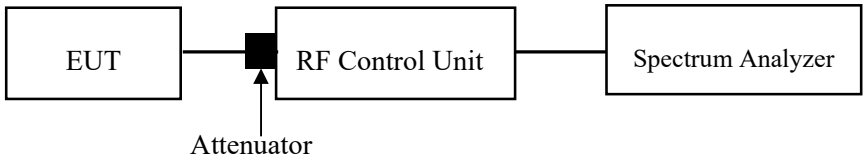
The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• 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:	24℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-04-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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.

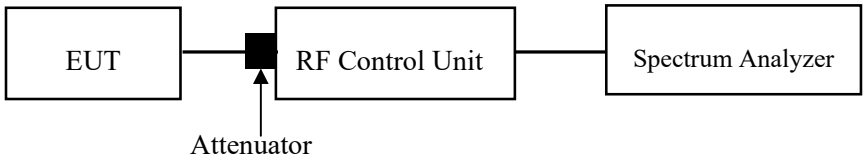
Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.3

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:	24℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-04-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

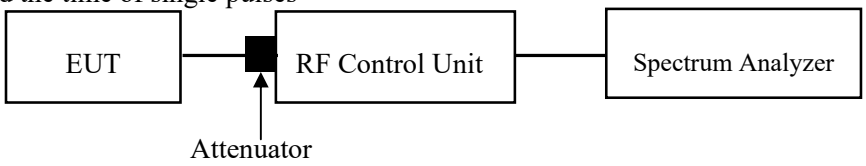
Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 7.8.4

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:	24℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-04-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

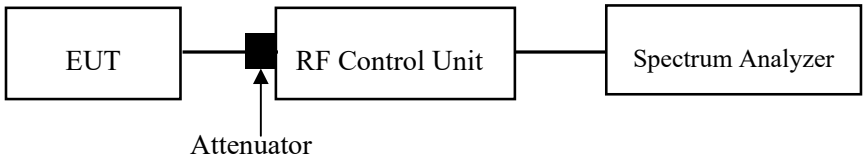
Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 7.8.5

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:	24℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-04-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(d) & RSS-247 § 5.5 - BAND EDGES TESTING

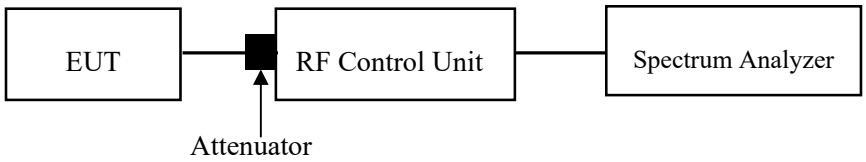
Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 7.8.6 & Clause 6.10

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:	24℃
Relative Humidity:	60 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-04-11.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

APPENDIX

Appendix A: 20dB Emission Bandwidth

Test Result

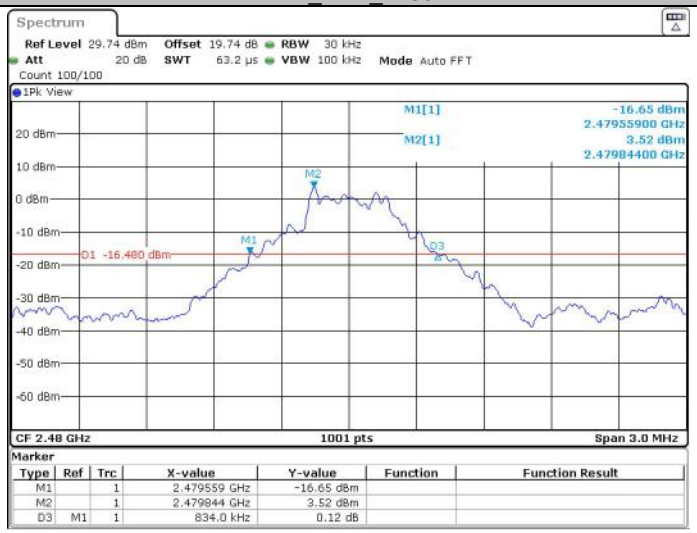
Test Mode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.83	2401.56	2402.39	---	---
		2441	0.84	2440.56	2441.40	---	---
		2480	0.83	2479.56	2480.39	---	---
2DH1	Ant1	2402	1.21	2401.38	2402.59	---	---
		2441	1.22	2440.38	2441.59	---	---
		2480	1.21	2479.39	2480.59	---	---
3DH1	Ant1	2402	1.20	2401.41	2402.62	---	---
		2441	1.21	2440.41	2441.62	---	---
		2480	1.21	2479.41	2480.62	---	---

Test Graphs

DH1_Ant1_2402

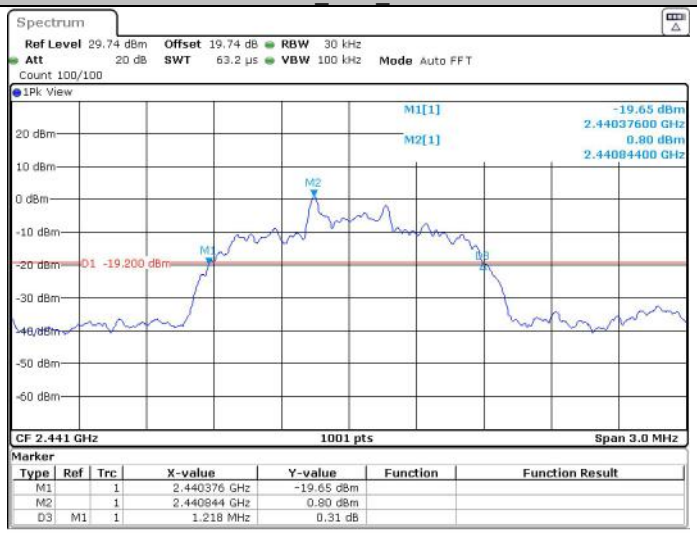
DH1_Ant1_2441

DH1_Ant1_2480

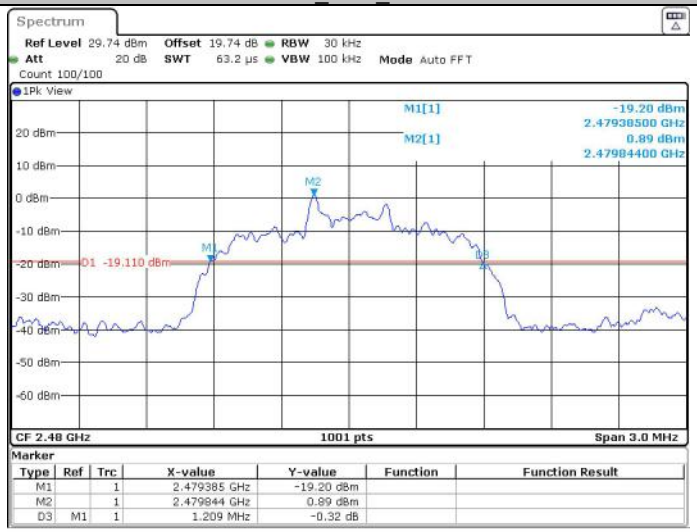


2DH1_Ant1_2402

2DH1_Ant1_2441

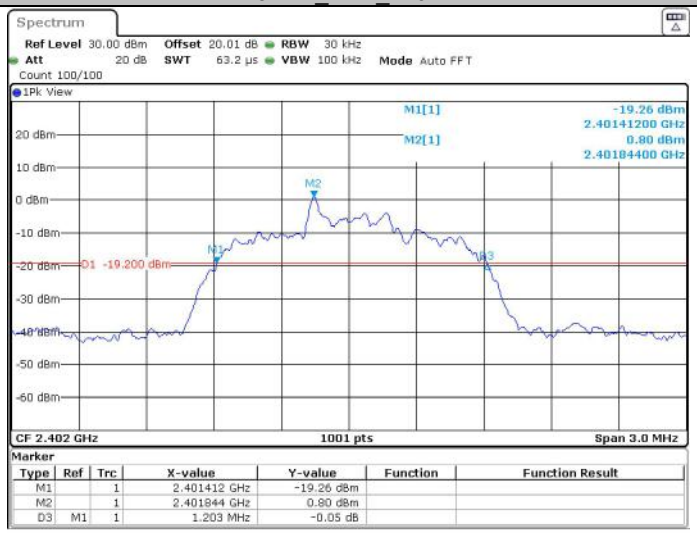


2DH1_Ant1_2480



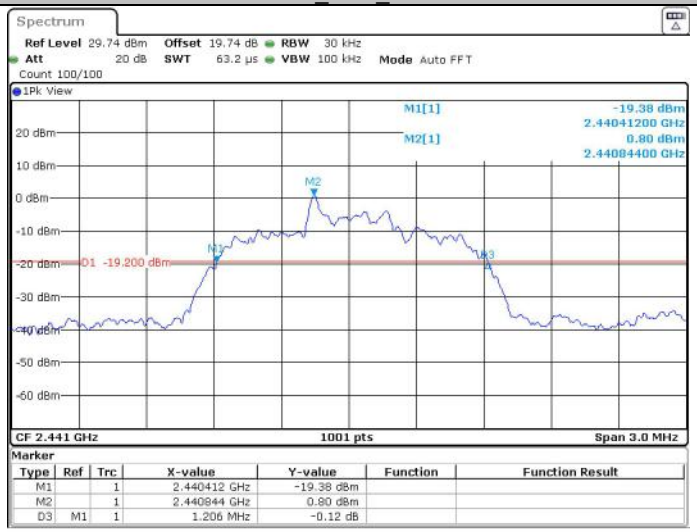
Date: 11.APR.2023 02:06:23

3DH1_Ant1_2402

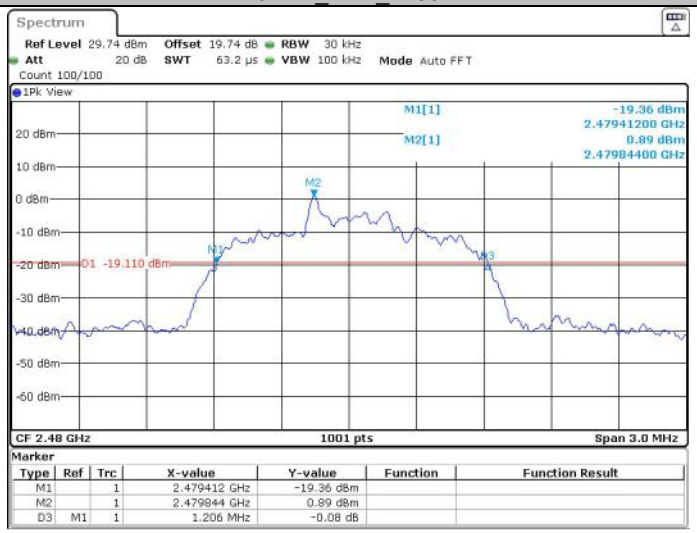


Date: 11.APR.2023 02:07:49

3DH1_Ant1_2441



3DH1_Ant1_2480



Appendix B: Occupied Channel Bandwidth

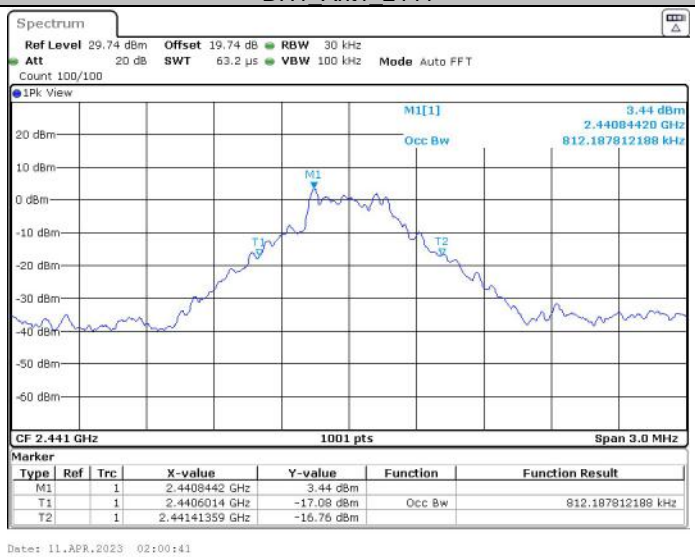
Test Result

Test Mode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.818	2401.592	2402.411	---	---
		2441	0.812	2440.601	2441.414	---	---
		2480	0.818	2479.595	2480.414	---	---
2DH1	Ant1	2402	1.154	2401.419	2402.572	---	---
		2441	1.163	2440.416	2441.578	---	---
		2480	1.151	2479.422	2480.572	---	---
3DH1	Ant1	2402	1.148	2401.437	2402.584	---	---
		2441	1.163	2440.431	2441.593	---	---
		2480	1.151	2479.437	2480.587	---	---

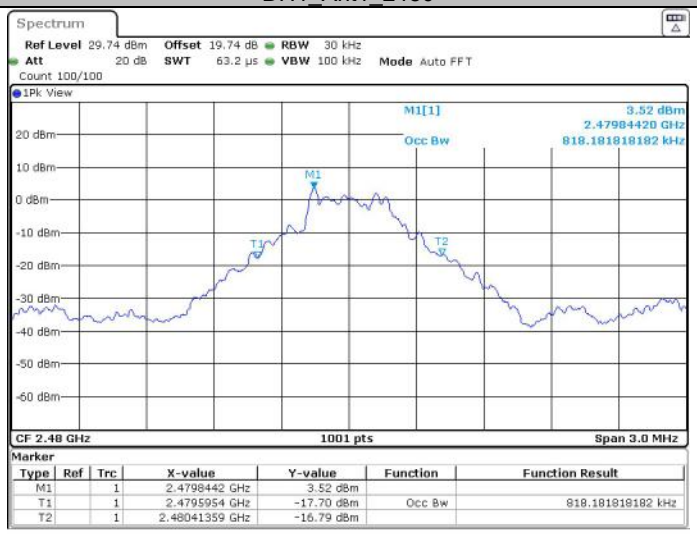
Test Graphs

DH1_Ant1_2402

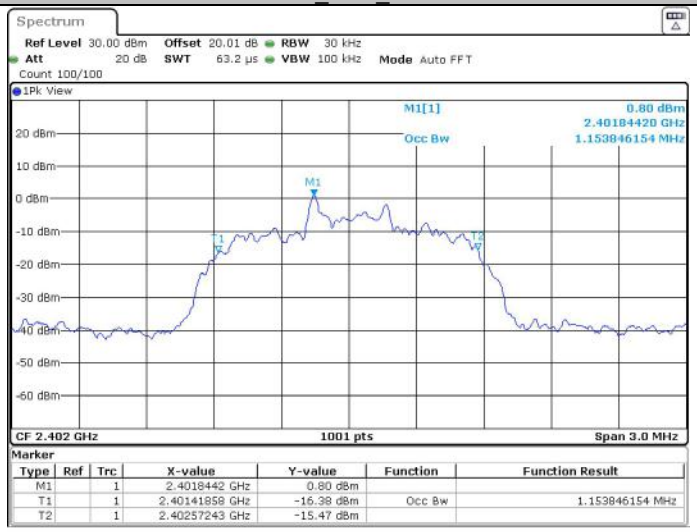
DH1_Ant1_2441



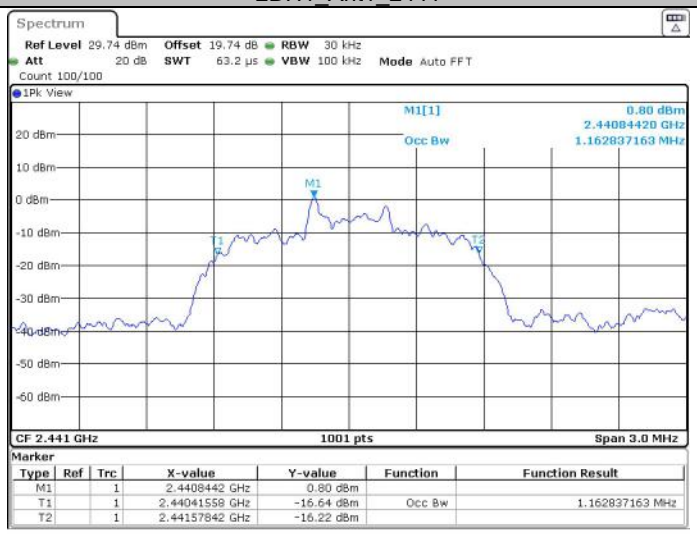
DH1_Ant1_2480



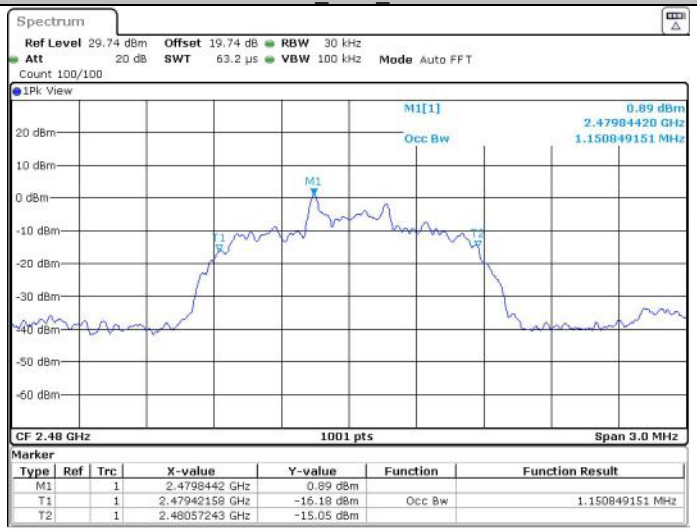
2DH1_Ant1_2402



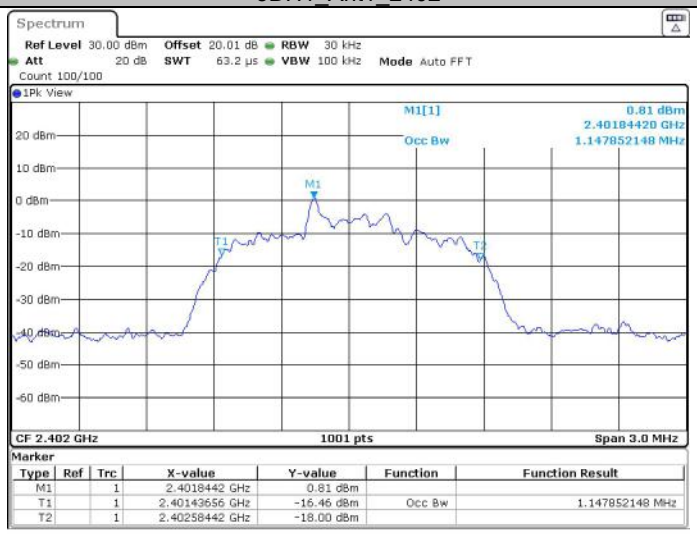
2DH1_Ant1_2441



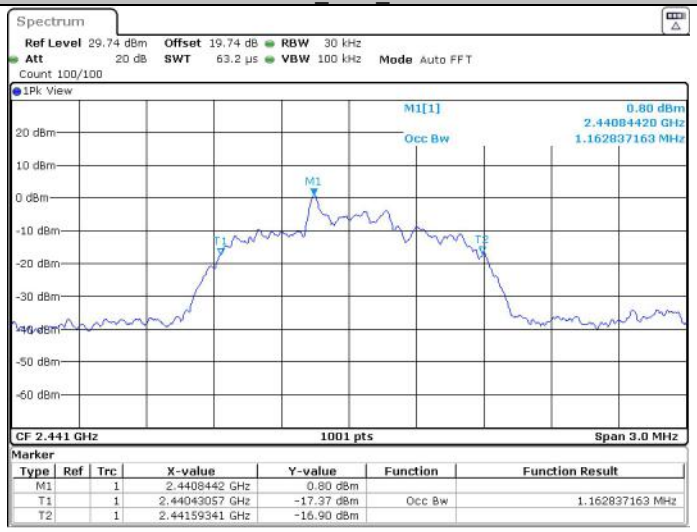
2DH1_Ant1_2480



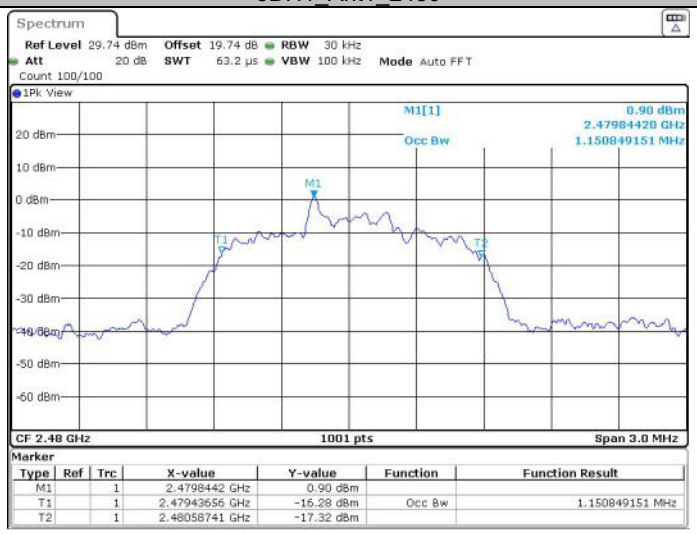
3DH1_Ant1_2402



3DH1_Ant1_2441



3DH1_Ant1_2480



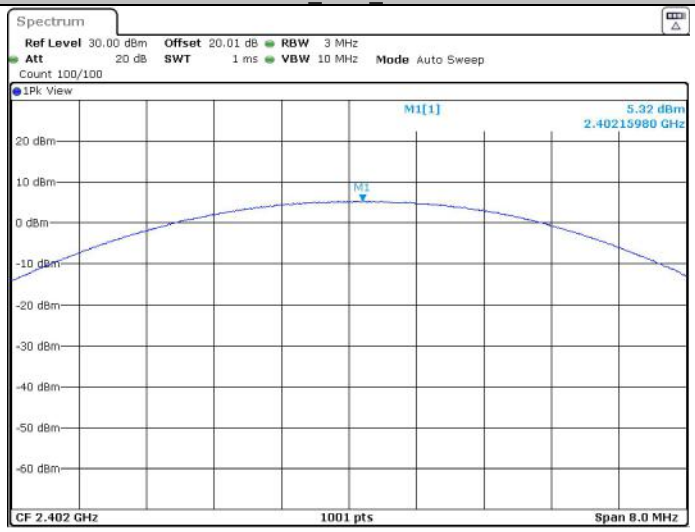
Appendix C: Maximum conducted output power

Test Result Peak

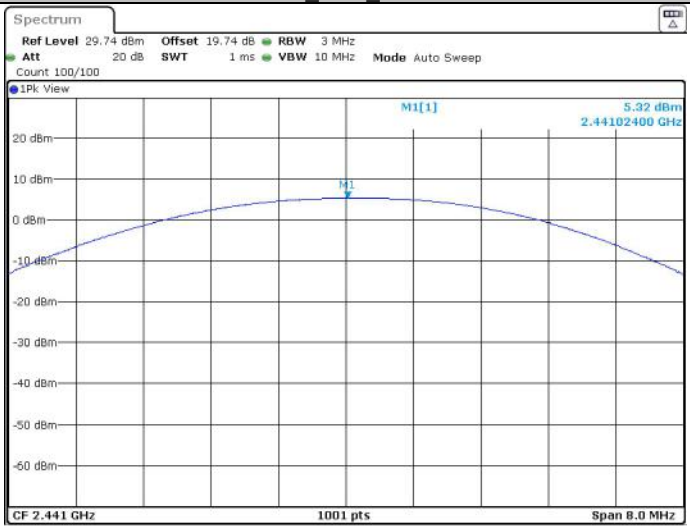
Test Mode	Antenna	Frequency[MHz]	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
DH1	Ant1	2402	5.32	≤20.97	PASS
		2441	5.32	≤20.97	PASS
		2480	5.54	≤20.97	PASS
2DH1	Ant1	2402	2.79	≤20.97	PASS
		2441	2.69	≤20.97	PASS
		2480	2.95	≤20.97	PASS
3DH1	Ant1	2402	2.96	≤20.97	PASS
		2441	2.92	≤20.97	PASS
		2480	3.14	≤20.97	PASS

Test Graphs

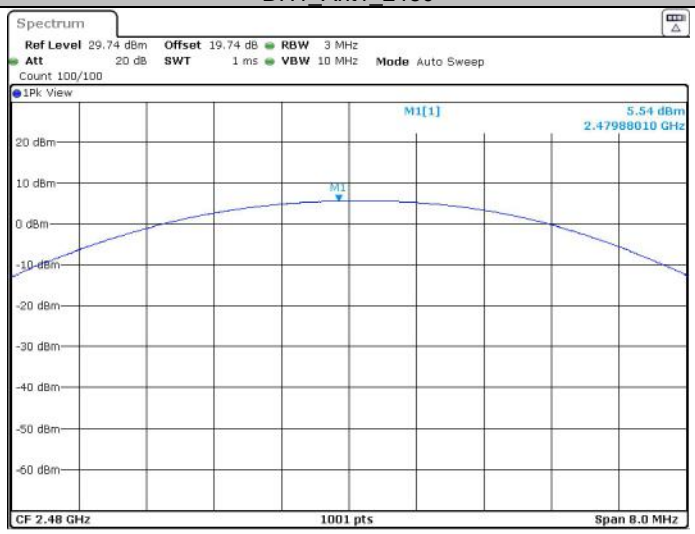
DH1_Ant1_2402



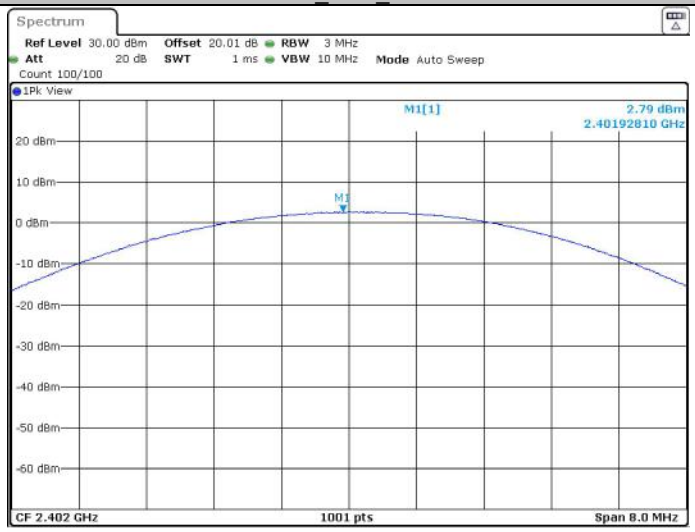
DH1_Ant1_2441



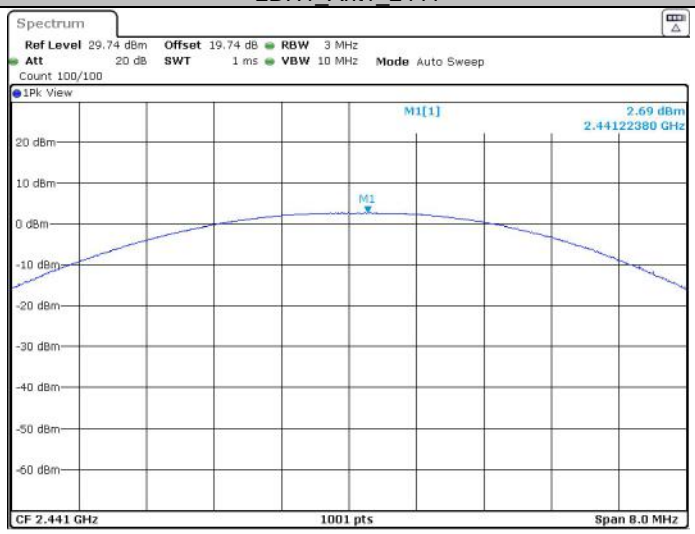
DH1_Ant1_2480



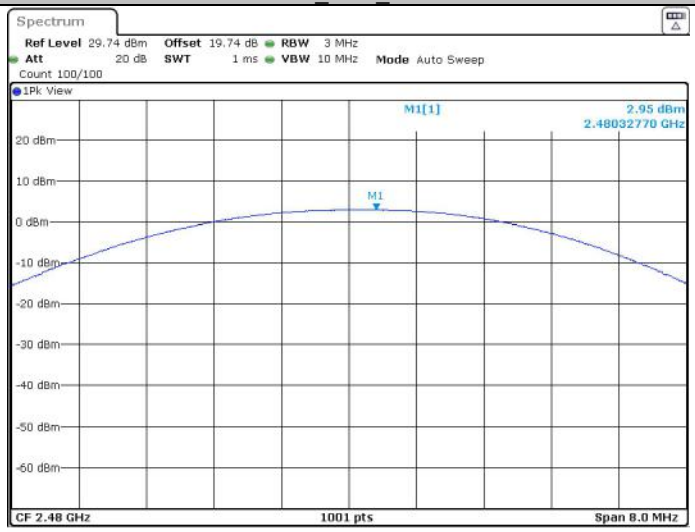
2DH1_Ant1_2402



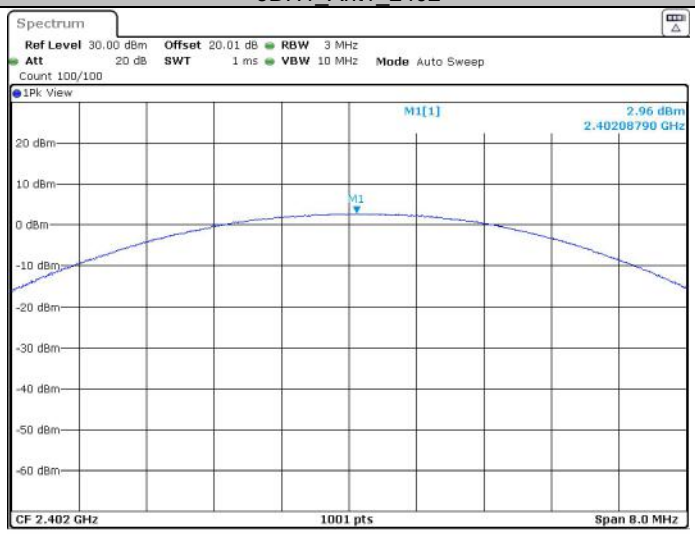
2DH1_Ant1_2441



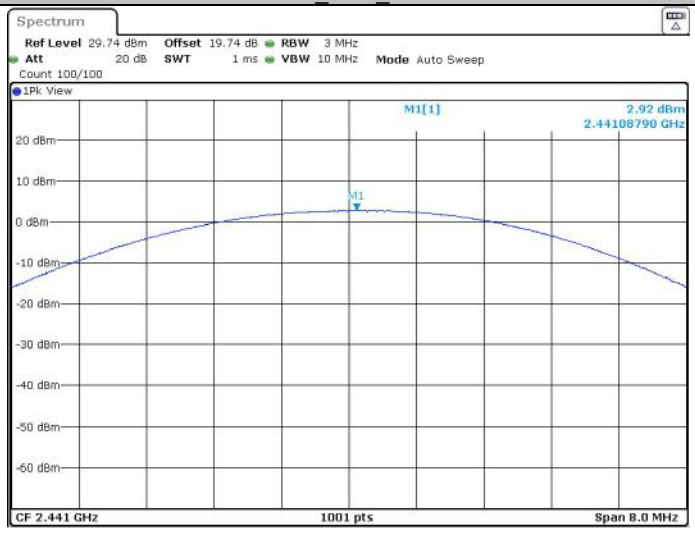
2DH1_Ant1_2480



3DH1_Ant1_2402



3DH1_Ant1_2441



3DH1_Ant1_2480

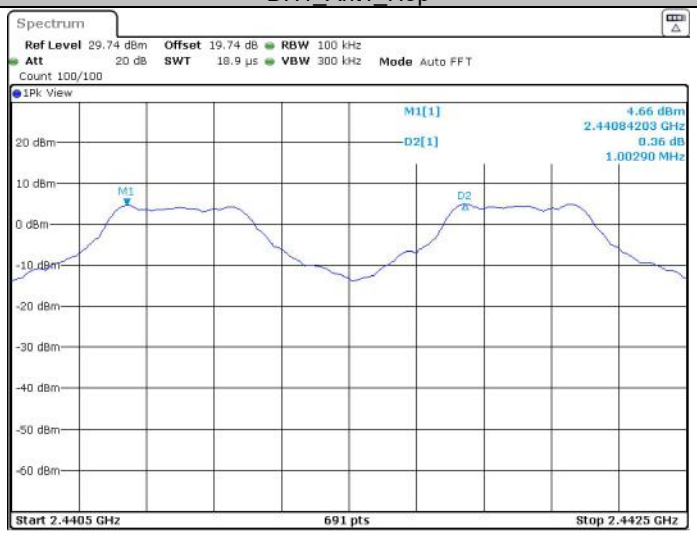

Appendix D: Carrier frequency separation

Test Result

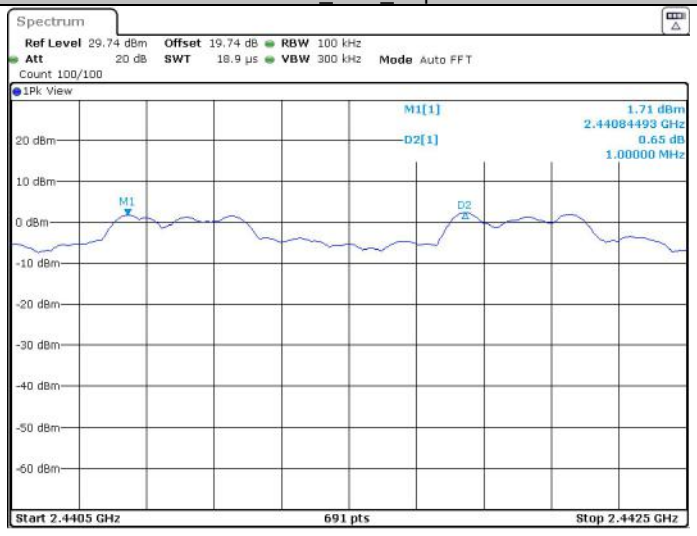
Test Mode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.003	≥0.560	PASS
2DH1	Ant1	Hop	1.000	≥0.813	PASS
3DH1	Ant1	Hop	1.003	≥0.807	PASS

Test Graphs

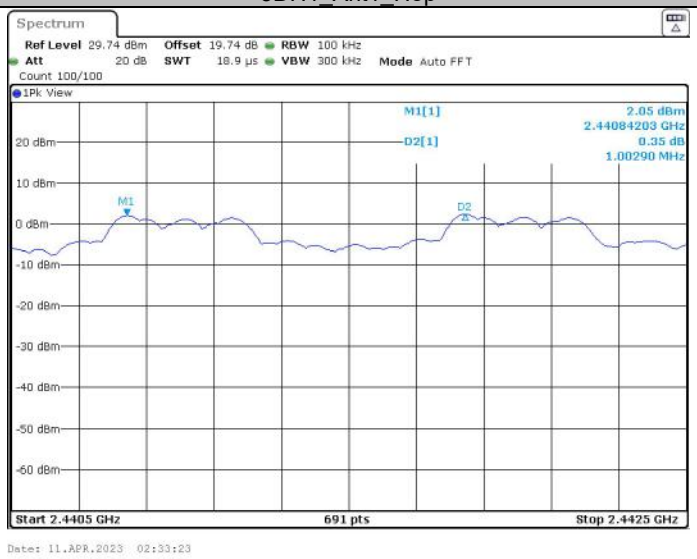
DH1_Ant1_Hop



2DH1_Ant1_Hop



3DH1_Ant1_Hop



Appendix E: Time of occupancy

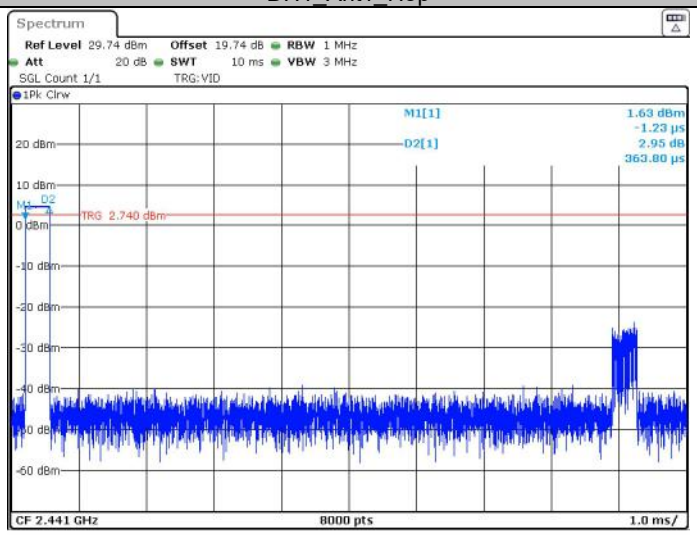
Test Result

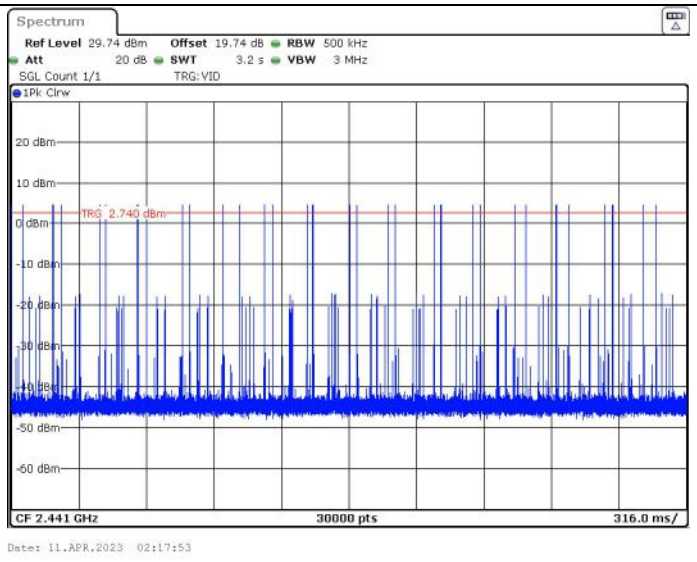
Test Mode	Antenna	Frequency[MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.36	320	0.115	≤0.4	PASS
DH3	Ant1	Hop	1.61	170	0.274	≤0.4	PASS
DH5	Ant1	Hop	2.85	110	0.314	≤0.4	PASS
2DH1	Ant1	Hop	0.37	320	0.118	≤0.4	PASS
2DH3	Ant1	Hop	1.62	140	0.227	≤0.4	PASS
2DH5	Ant1	Hop	2.86	130	0.372	≤0.4	PASS
3DH1	Ant1	Hop	0.38	320	0.122	≤0.4	PASS
3DH3	Ant1	Hop	1.62	170	0.275	≤0.4	PASS
3DH5	Ant1	Hop	2.86	110	0.315	≤0.4	PASS

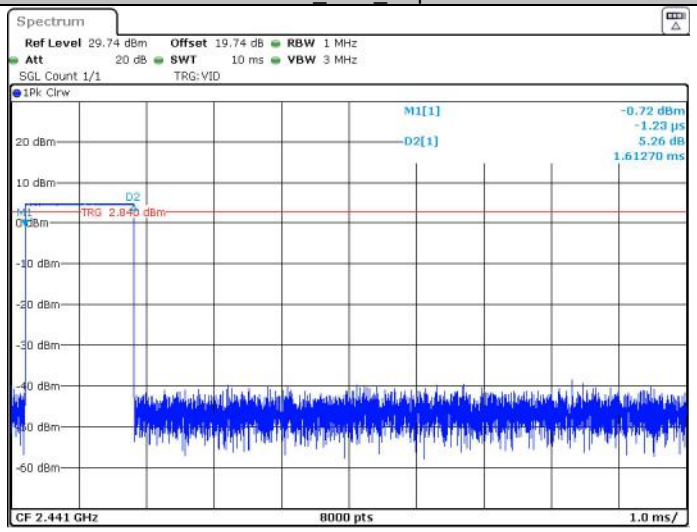
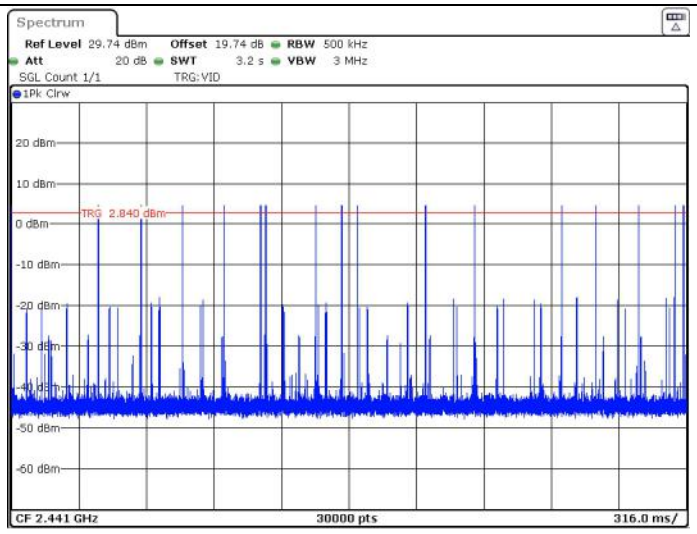
Note 1: A period time=0.4*79=31.6(S), Result= Pulse Time *Total hops
Note 2: Total hops=Hopping Number in 3.16s*10
Note 3: Hopping Number in 3.16s=Total of highest signals in 3.16s (Second high signals were other channel)

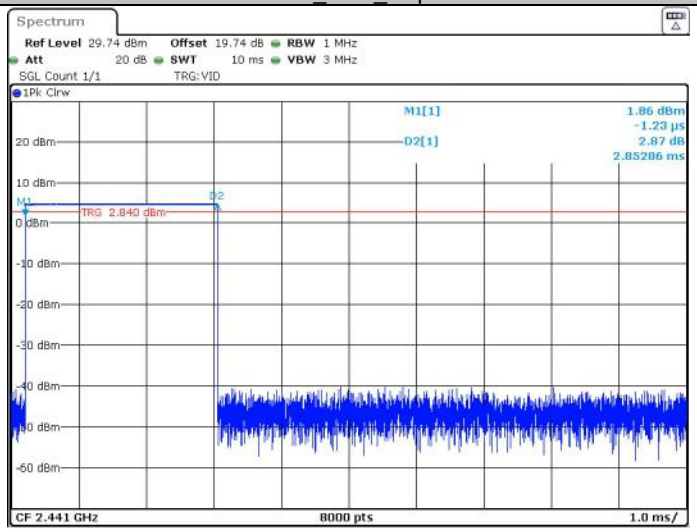
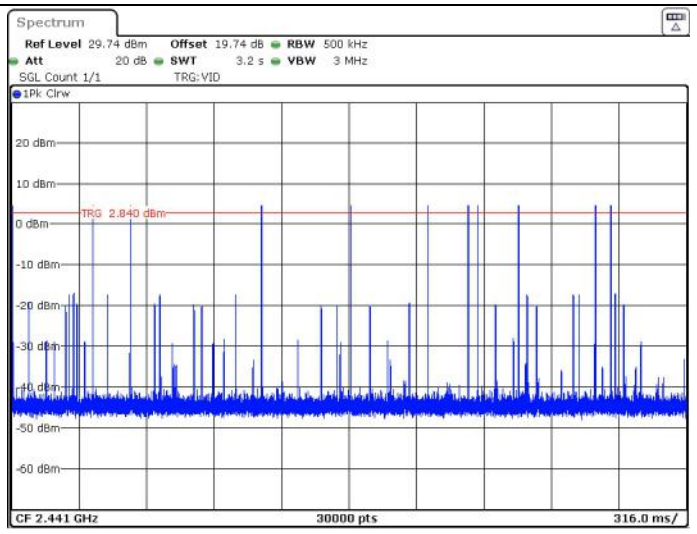
Test Graphs

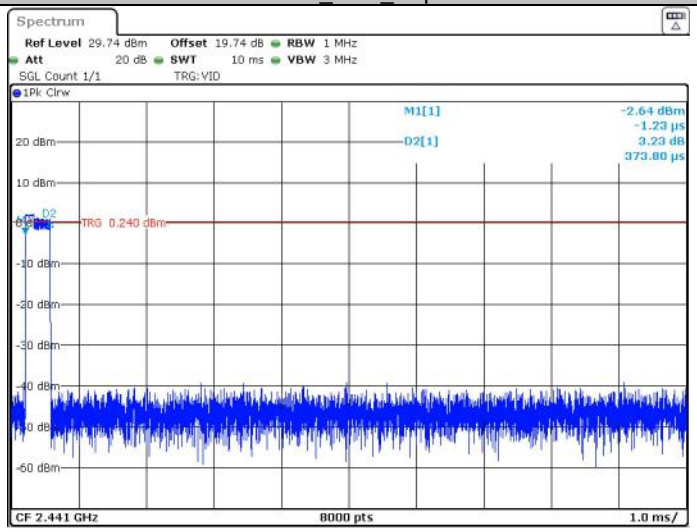
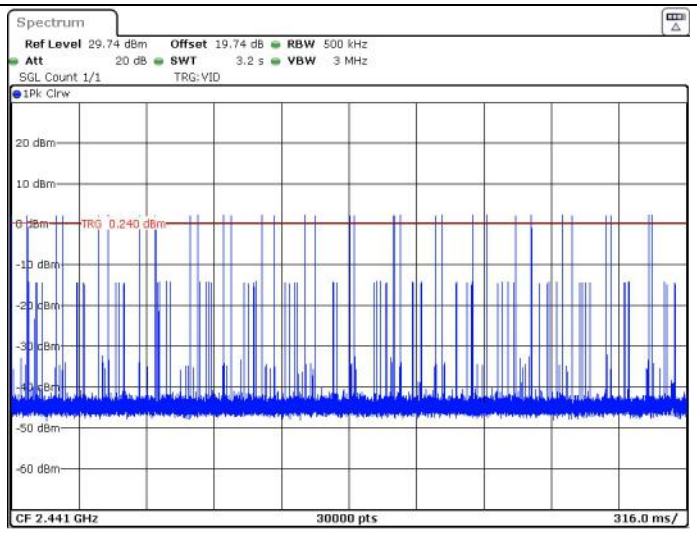
DH1_Ant1_Hop

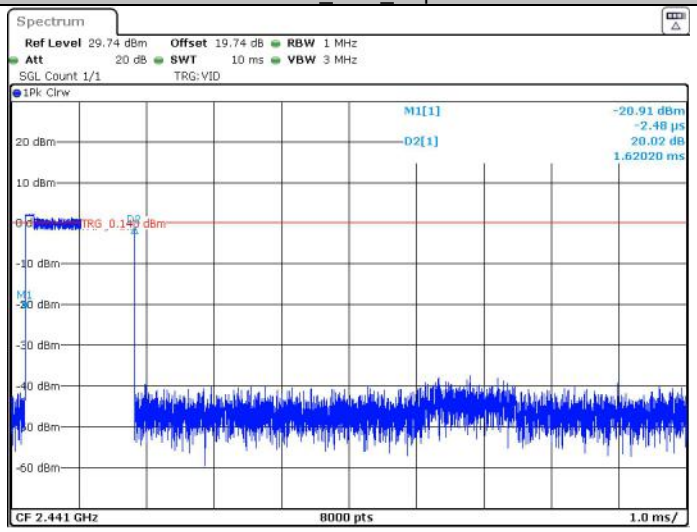
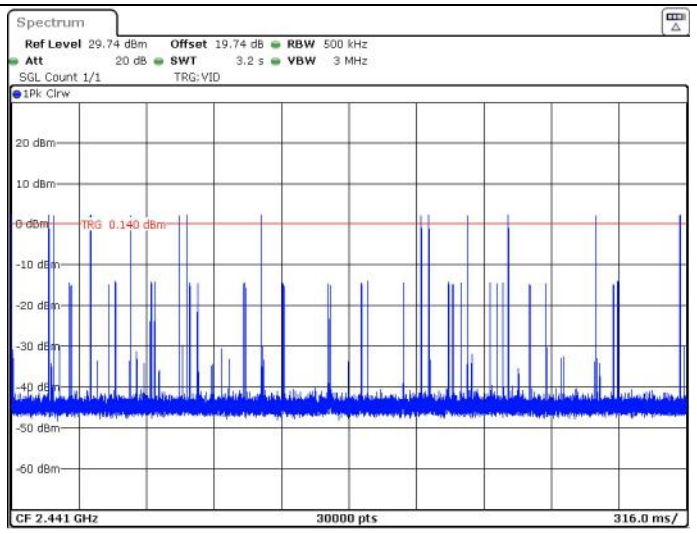


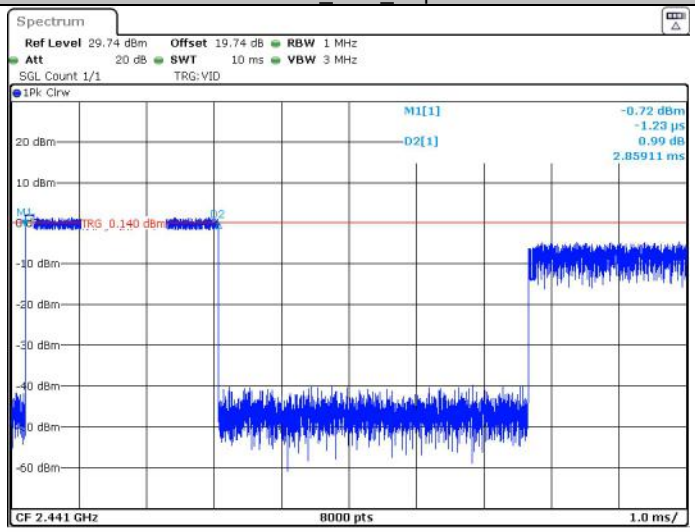
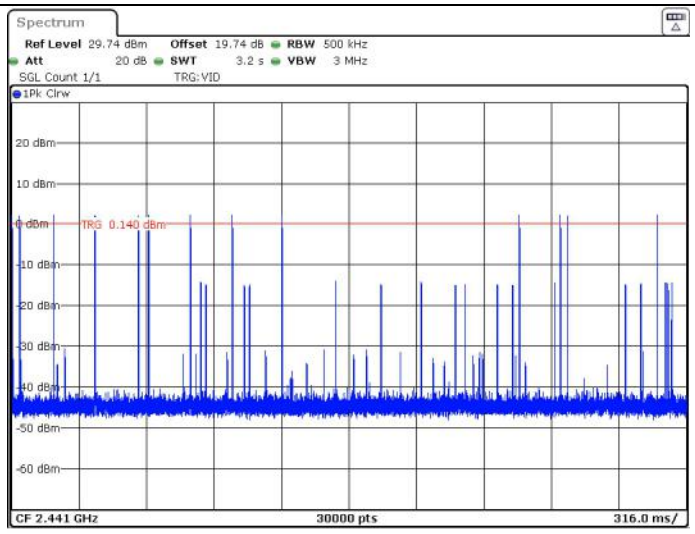


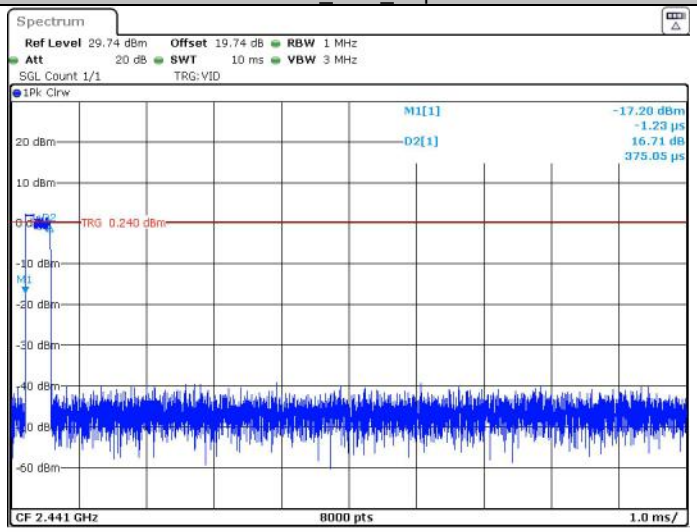
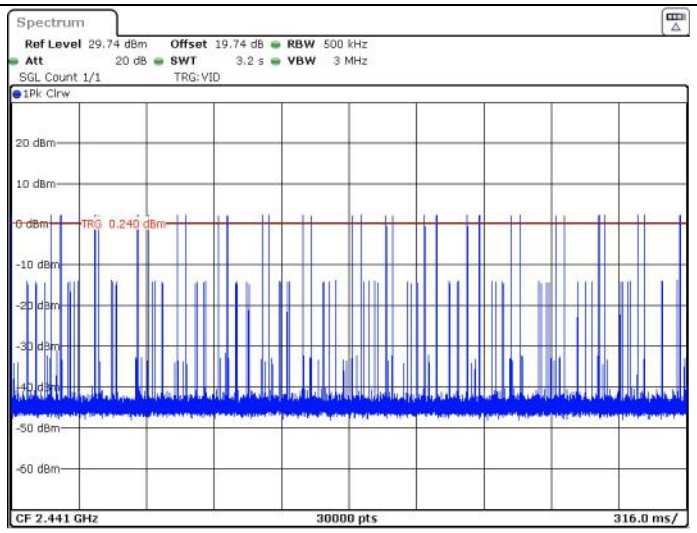
DH3_Ant1_Hop
 Spectrum Ref Level 29.74 dBm Offset 19.74 dB RBW 1 MHz Att 20 dB SWT 10 ms VBW 3 MHz SGL Count 1/1 TRG:VID 1Pk Clrw M1[1] -0.72 dBm -1.23 µs D2[1] 5.26 dB 1.61270 ms TRG 2.840 dBm CF 2.441 GHz 8000 pts 1.0 ms/ Date: 11.APR.2023 02:20:59
 Spectrum Ref Level 29.74 dBm Offset 19.74 dB RBW 500 kHz Att 20 dB SWT 3.2 s VBW 3 MHz SGL Count 1/1 TRG:VID 1Pk Clrw TRG 2.840 dBm CF 2.441 GHz 30000 pts 316.0 ms/ Date: 11.APR.2023 02:21:04

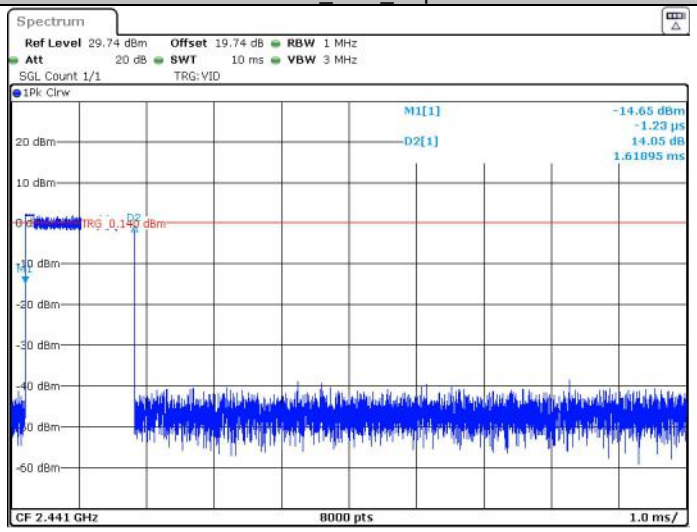
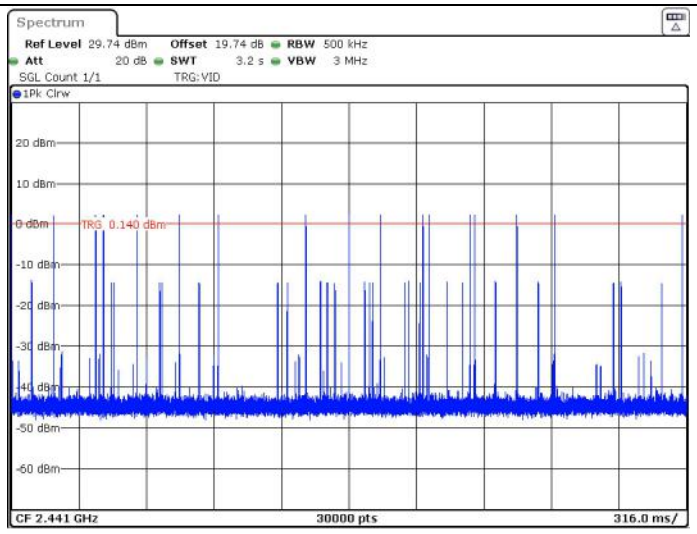
DH5_Ant1_Hop
 Spectrum Ref Level 29.74 dBm Offset 19.74 dB RBW 1 MHz Att 20 dB SWT 10 ms VBW 3 MHz SGL Count 1/1 TRG:VID 1Pk Clrw M1[1] 1.86 dBm -1.23 µs D2[1] 2.87 dB 2.85286 ms TRG 2.840 dBm CF 2.441 GHz 8000 pts 1.0 ms/ Date: 11.APR.2023 02:24:45
 Spectrum Ref Level 29.74 dBm Offset 19.74 dB RBW 500 kHz Att 20 dB SWT 3.2 s VBW 3 MHz SGL Count 1/1 TRG:VID 1Pk Clrw TRG 2.840 dBm CF 2.441 GHz 30000 pts 316.0 ms/ Date: 11.APR.2023 02:24:51

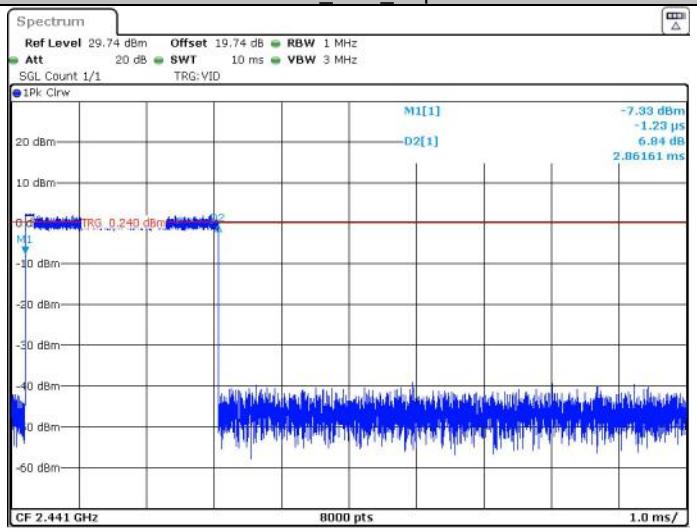
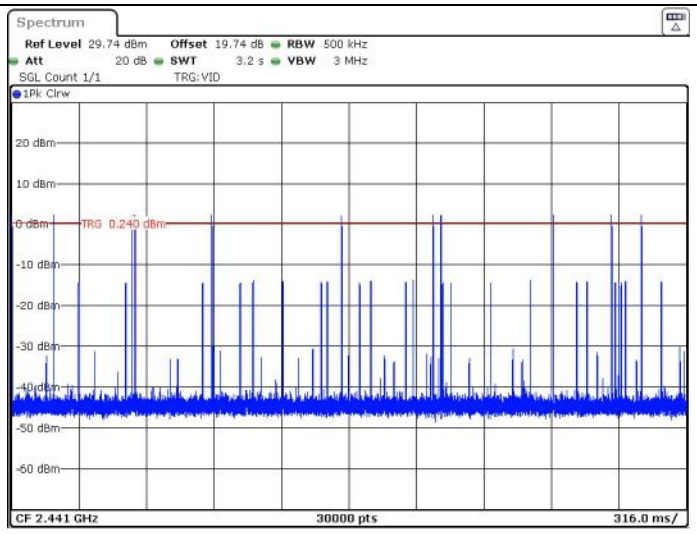
2DH1_Ant1_Hop



2DH3_Ant1_Hop



2DH5_Ant1_Hop



3DH1_Ant1_Hop



3DH3_Ant1_Hop



3DH5_Ant1_Hop



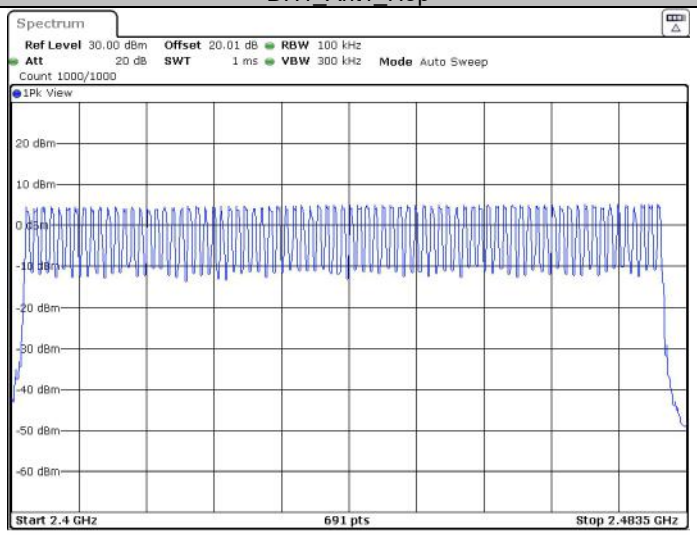
Appendix F: Number of hopping channels

Test Result

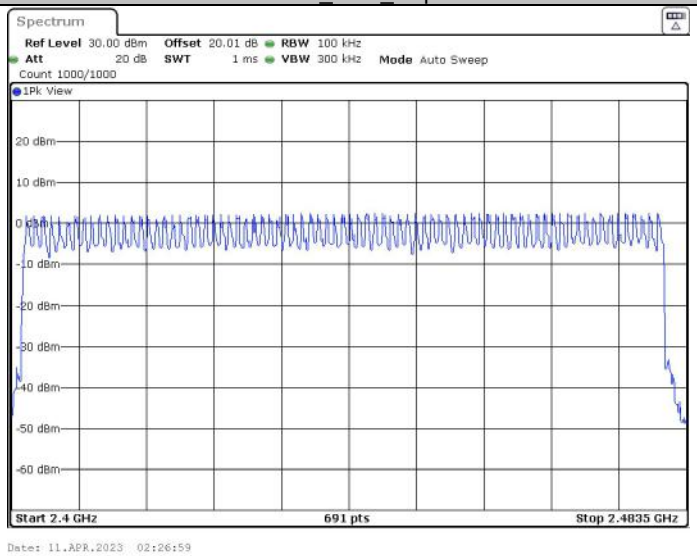
Test Mode	Antenna	Frequency[MHz]	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	≥15	PASS
2DH1	Ant1	Hop	79	≥15	PASS
3DH1	Ant1	Hop	79	≥15	PASS

Test Graphs

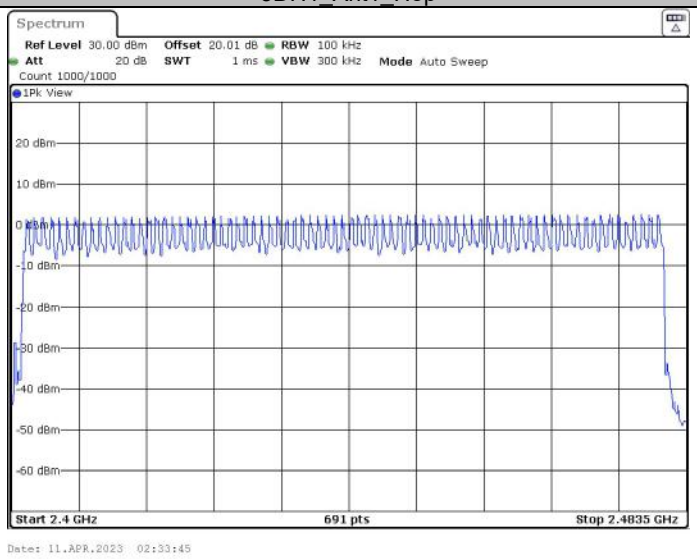
DH1_Ant1_Hop



2DH1_Ant1_Hop



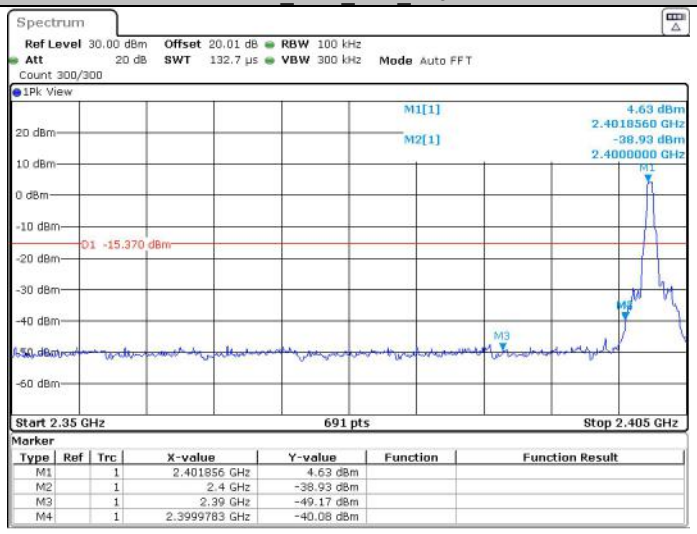
3DH1_Ant1_Hop



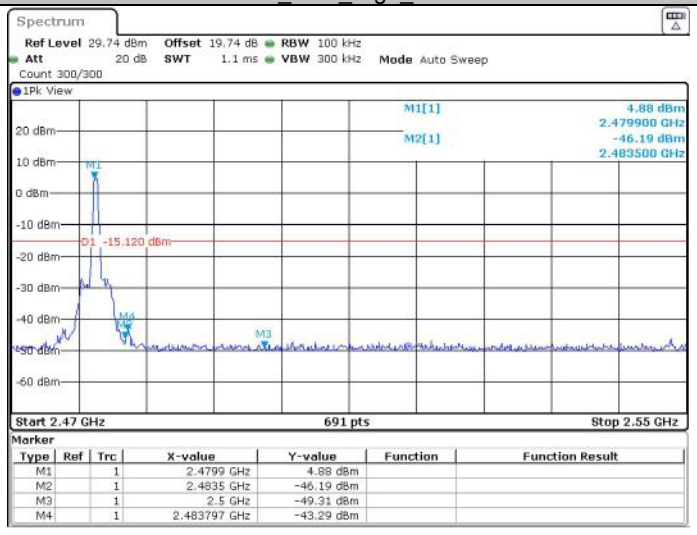
Appendix G: Band edge measurements

Test Graphs

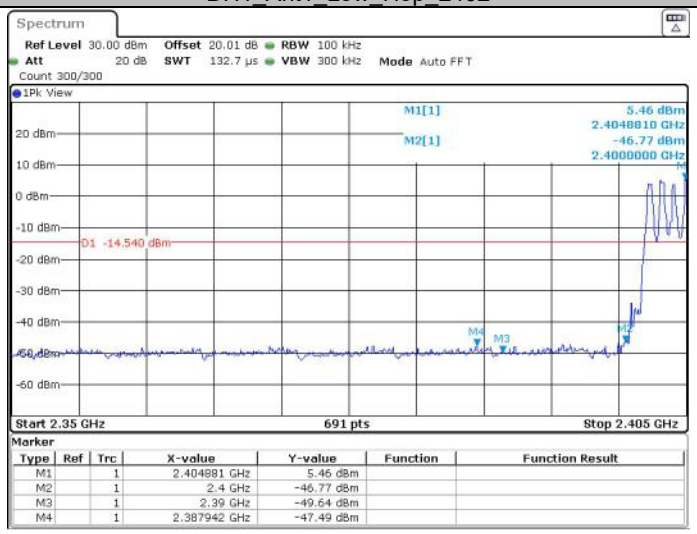
DH1_Ant1_Low_2402



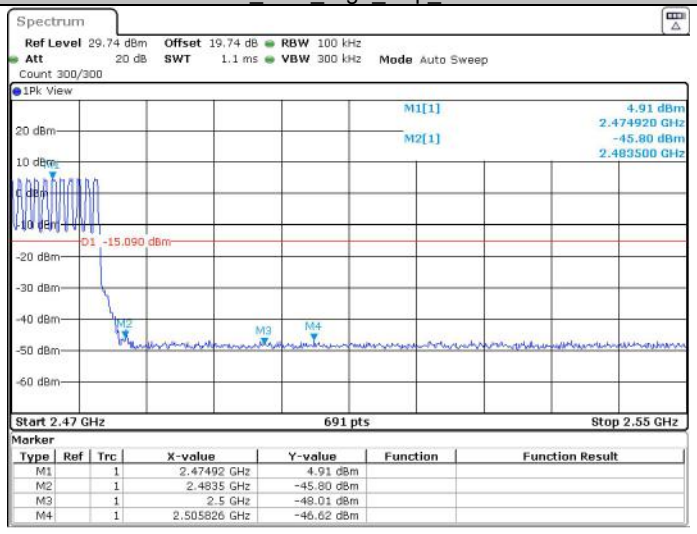
DH1_Ant1_High_2480



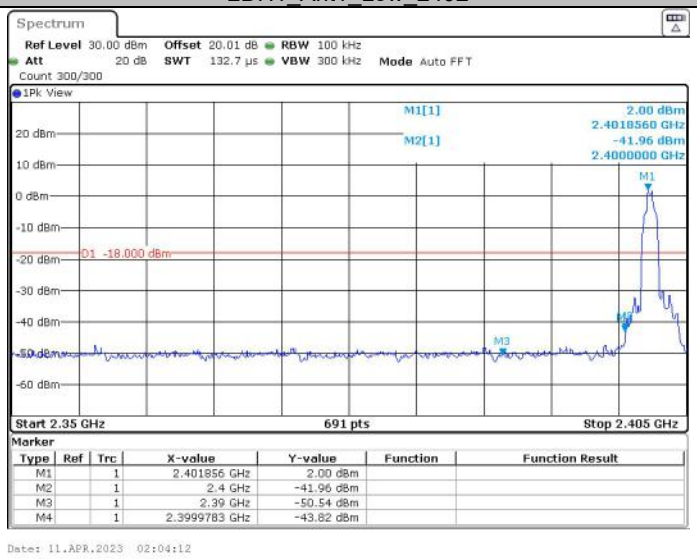
DH1_Ant1_Low_Hop_2402



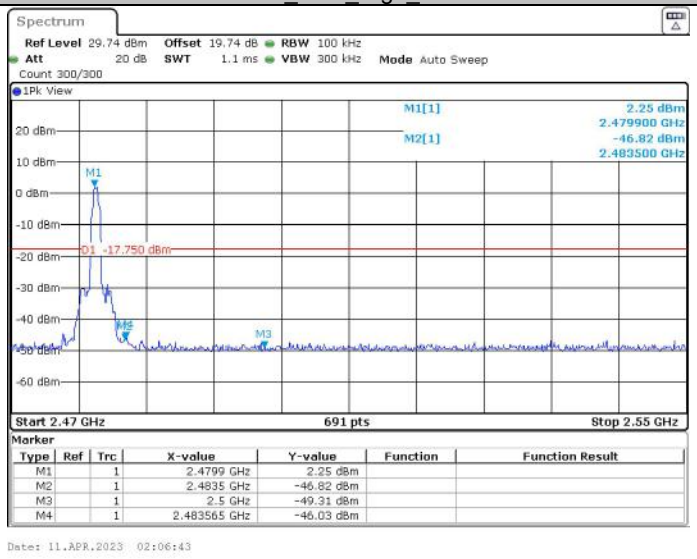
DH1_Ant1_High_Hop_2480



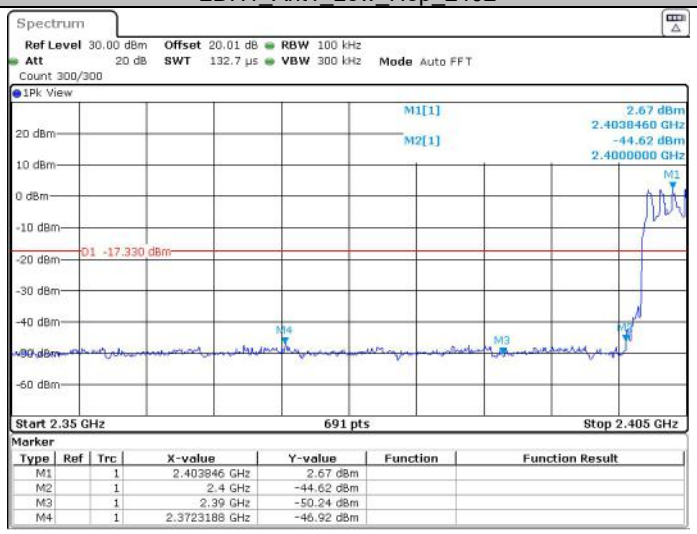
2DH1_Ant1_Low_2402



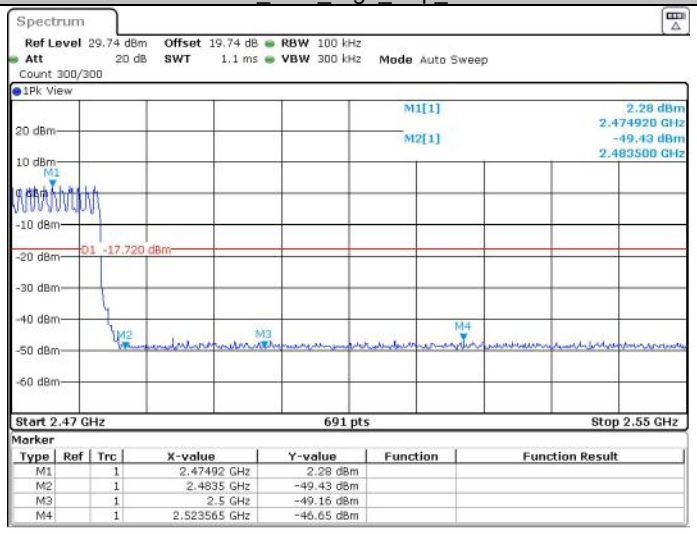
2DH1_Ant1_High_2480



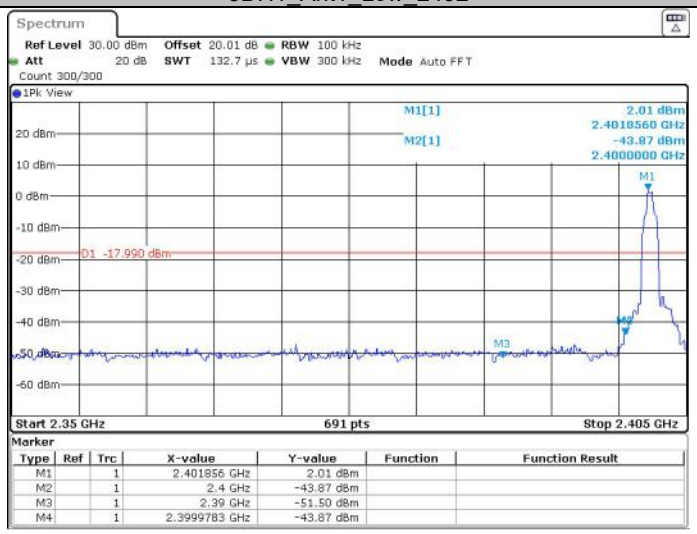
2DH1_Ant1_Low_Hop_2402



2DH1_Ant1_High_Hop_2480

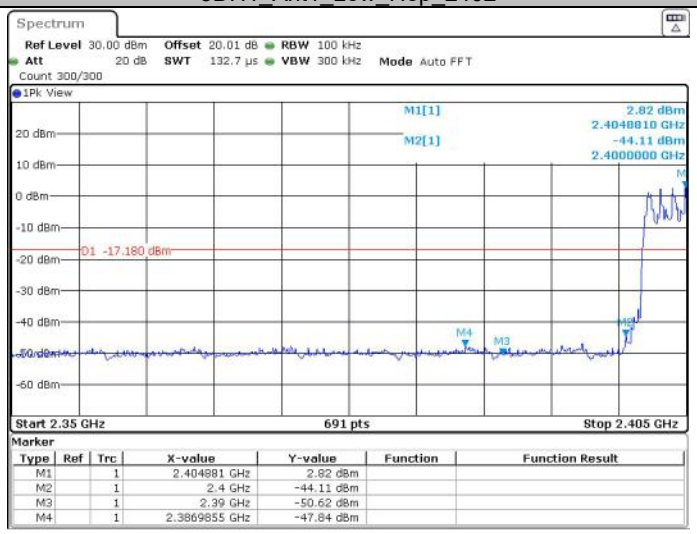


3DH1_Ant1_Low_2402

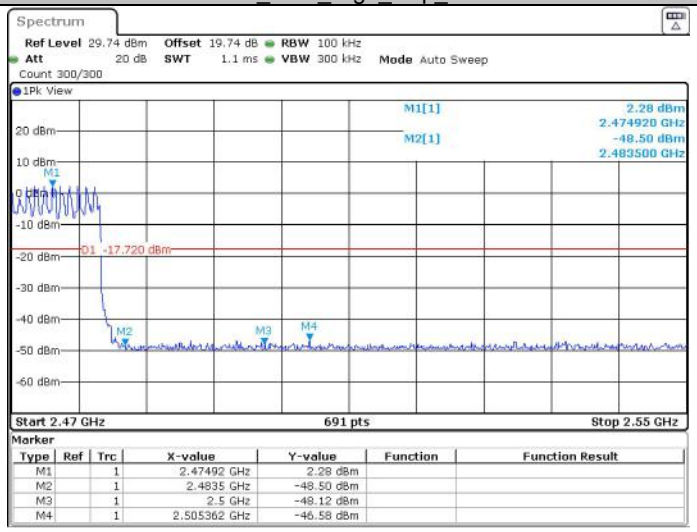


3DH1_Ant1_High_2480

3DH1_Ant1_Low_Hop_2402



3DH1_Ant1_High_Hop_2480



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