TEST REPORT

Applicant Name :	HONG KONG YO YOUNG INTELLIGENT CO., LIMITED
Address :	19H MAXGRAND PLAZA NO.3 TAI YAU STREET SAN PO KONG,KOWLOON,HONGKONG
Report Number :	RA230421-21182E-RF-00A
FCC ID:	2A8X4-AIR1ULTRAPRO

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Smart phone
Model No.:	Air1 Ultra Pro
Multiple Model(s) No.:	Raptor, Air2 Ultra, B1 Ultra
Trade Mark:	IIIF150
Date Received:	2023/04/21
Report Date:	2023/05/29

Test Result:	Pass*

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

Prepared and Checked By:

Roger Ling
EMC Engineer

Approved By:

Candy Li
EMC Engineer

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230421-21182E-RF-00A	Original Report	2023-05-29

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Smart phone
Tested model	Air1 Ultra Pro
Multiple Model(s)	Raptor, Air2 Ultra, B1 Ultra (model difference see product declaration letter of similarity)
Frequency Range	Bluetooth: 2402~2480MHz
Maximum conducted Peak output power	Bluetooth: 3.43dBm
Modulation Technique	Bluetooth: GFSK, π/4-DQPSK, 8DPSK
Antenna Specification*	4.03dBi (provided by the applicant)
Voltage Range	DC 3.85V from battery
Test Sample serial number	24XH-1 for Conducted and Radiated Emissions Test 24XI-1 for RF Conducted Test (Assigned by ATC)
Sample/EUT Status	Good condition
Adapter information	Model: FC69U Input: AC 100-240V, 50/60Hz, 0.8 A Max Output: QC: DC 5V,3A/DC 9V, 3A/ DC 12V, 2.5A PD: DC 5V,3A/DC 9V, 3A/ DC 12V, 2.5A/ DC 15V,2A PPS: DC 3.3-11V, 2.72A

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.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF Frequency		$0.082*10^{-7}$
RF output power, conducted		0.71dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.06dB
	30MHz - 1GHz	5.08dB
	1GHz - 18GHz	4.96dB
	18GHz - 26.5GHz	5.16dB
	26.5GHz - 40GHz	4.64dB
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

EUT was test in the engineering mode 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

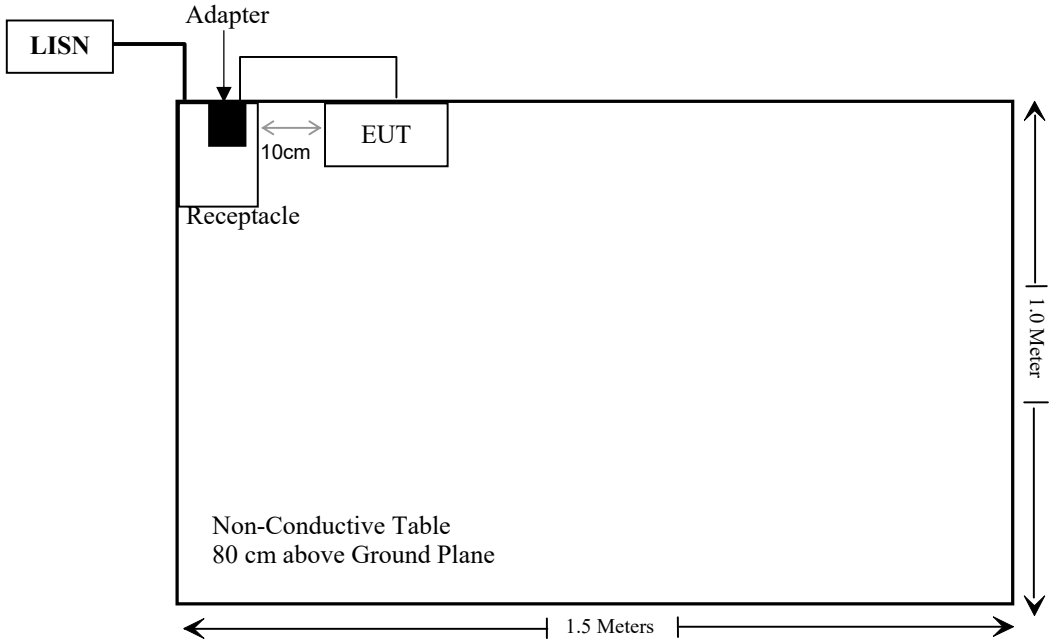
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

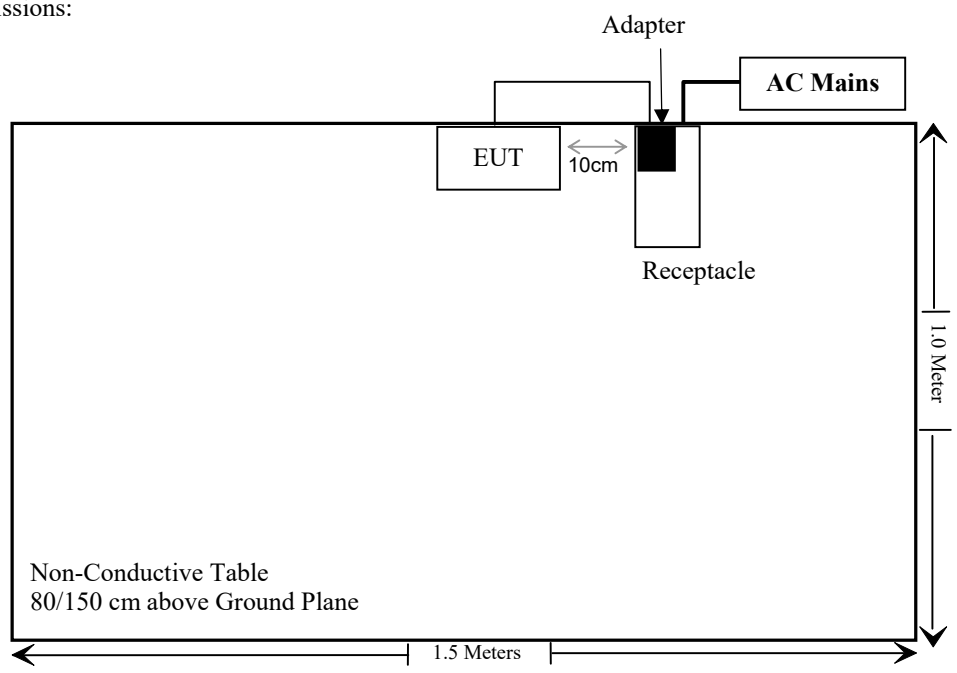
Cable Description	Length (m)	From Port	To
Un-shielding Detachable USB Cable	1.0	EUT	Adapter

Block Diagram of Test Setup

For Conducted Emissions



For Radiated Emissions:



Note: the support table edge was flush with the center of turntable

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1307 (b) & §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

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2022/11/25	2023/11/24
Rohde & Schwarz	L.I.S.N.	ESH3-Z5	100305	2022/12/01	2023/11/30
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2022/12/07	2023/12/06
Unknown	RF Coaxial Cable	No.17	N0350	2022/11/25	2023/11/24
Conducted Emission Test Software: e3 19821b (V9)					
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
Wainwright	High Pass Filter	WHKX3.6/18G-10SS	5	2022/11/25	2023/11/24

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101590	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

*** 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.

a) 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 ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where
1. f(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.

Measurement Result

For worst case:

Frequency (MHz)	Maximum Tune-up power		Calculated Distance (mm)	Calculated Value	Threshold (1-g SAR)	SAR Test Exclusion
	(dBm)	(mW)				
2402-2480	4.0	2.51	5	0.8	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, the antenna gain is 4.03dBi, fulfill the requirement of this section. Please refer to the EUT photos.

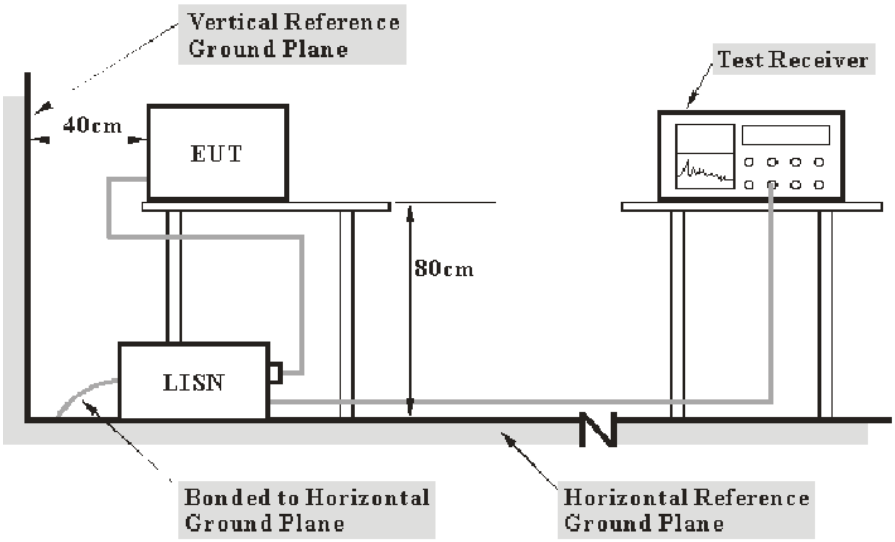
Result: Compliance.

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.

Factor & Over Limit Calculation

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

Factor = LISN VDF + Cable Loss

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

Over Limit = level – Limit
Level= reading level+ Factor

Test Data

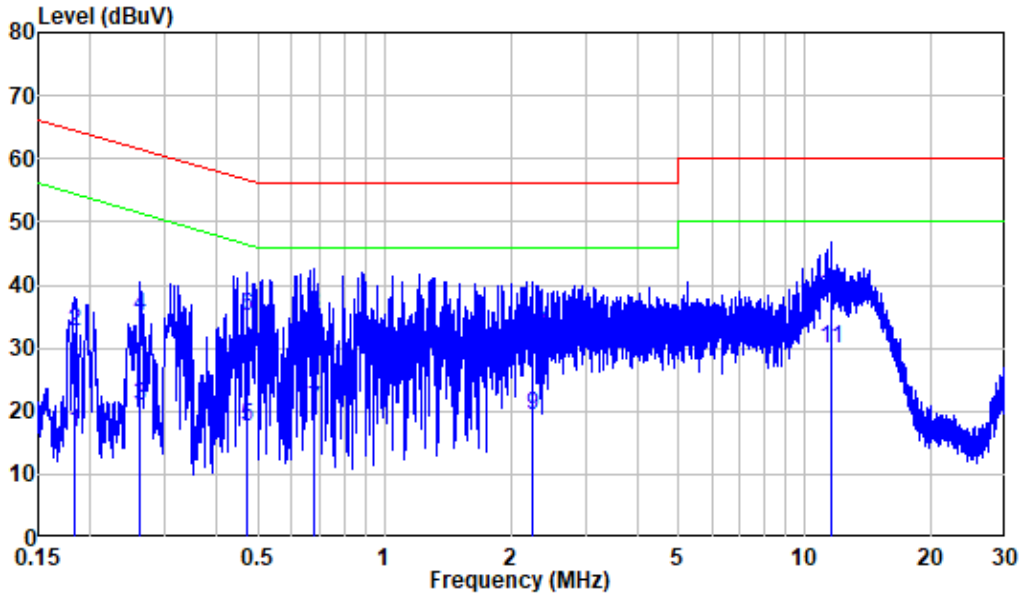
Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	49 %
ATM Pressure:	101.0 kPa

The testing was performed by Jerry Wu on 2023-05-05

EUT operation mode: Transmitting (the worst case is 8DPSK Mode, Middle channel)

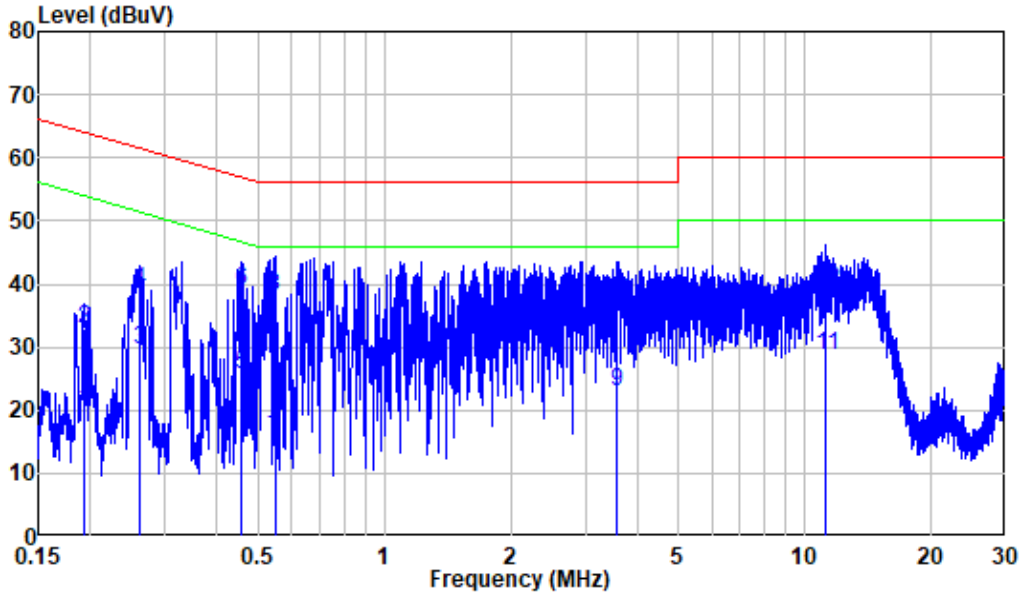
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : RA230421-21182E-RF
Mode : Charging+BT Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.183	10.31	6.21	16.52	54.34	-37.82	Average
2	0.183	10.31	22.24	32.55	64.34	-31.79	QP
3	0.262	10.36	10.32	20.68	51.36	-30.68	Average
4	0.262	10.36	24.69	35.05	61.36	-26.31	QP
5	0.472	10.55	7.03	17.58	46.48	-28.90	Average
6	0.472	10.55	24.57	35.12	56.48	-21.36	QP
7	0.681	10.66	9.49	20.15	46.00	-25.85	Average
8	0.681	10.66	24.54	35.20	56.00	-20.80	QP
9	2.258	10.42	8.93	19.35	46.00	-26.65	Average
10	2.258	10.42	21.88	32.30	56.00	-23.70	QP
11	11.559	10.46	19.49	29.95	50.00	-20.05	Average
12	11.559	10.46	27.83	38.29	60.00	-21.71	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : RA230421-21182E-RF
Mode : Charging+BT Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.193	10.29	9.72	20.01	53.92	-33.91	Average
2	0.193	10.29	22.52	32.81	63.92	-31.11	QP
3	0.262	10.33	19.26	29.59	51.36	-21.77	Average
4	0.262	10.33	28.61	38.94	61.36	-22.42	QP
5	0.457	10.45	15.10	25.55	46.75	-21.20	Average
6	0.457	10.45	28.41	38.86	56.75	-17.89	QP
7	0.548	10.47	4.89	15.36	46.00	-30.64	Average
8	0.548	10.47	27.44	37.91	56.00	-18.09	QP
9	3.572	10.54	12.55	23.09	46.00	-22.91	Average
10	3.572	10.54	26.62	37.16	56.00	-18.84	QP
11	11.220	10.56	18.14	28.70	50.00	-21.30	Average
12	11.220	10.56	28.30	38.86	60.00	-21.14	QP

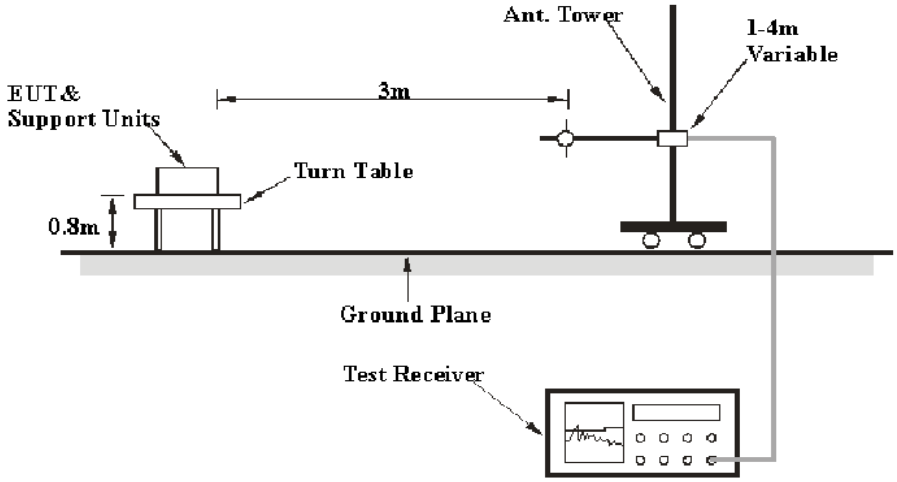
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

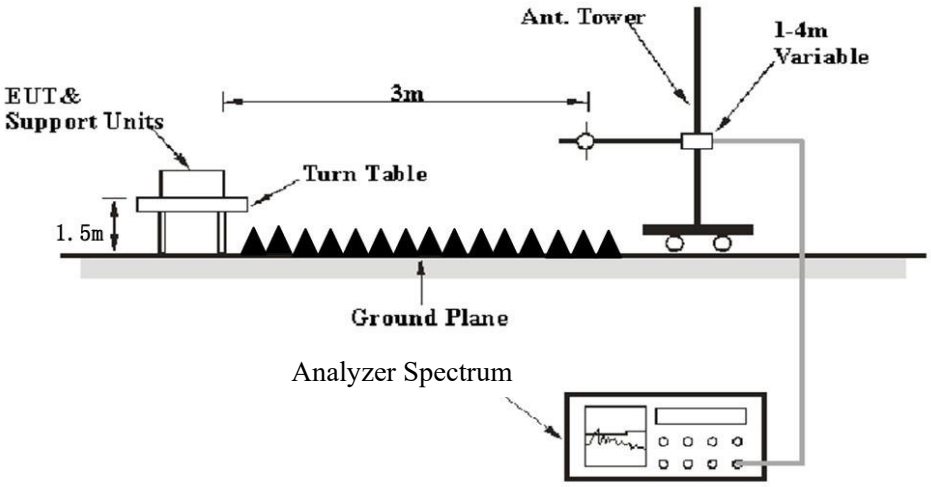
FCC §15.205; §15.209; §15.247(d)

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 & Over Limit/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 or 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:

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

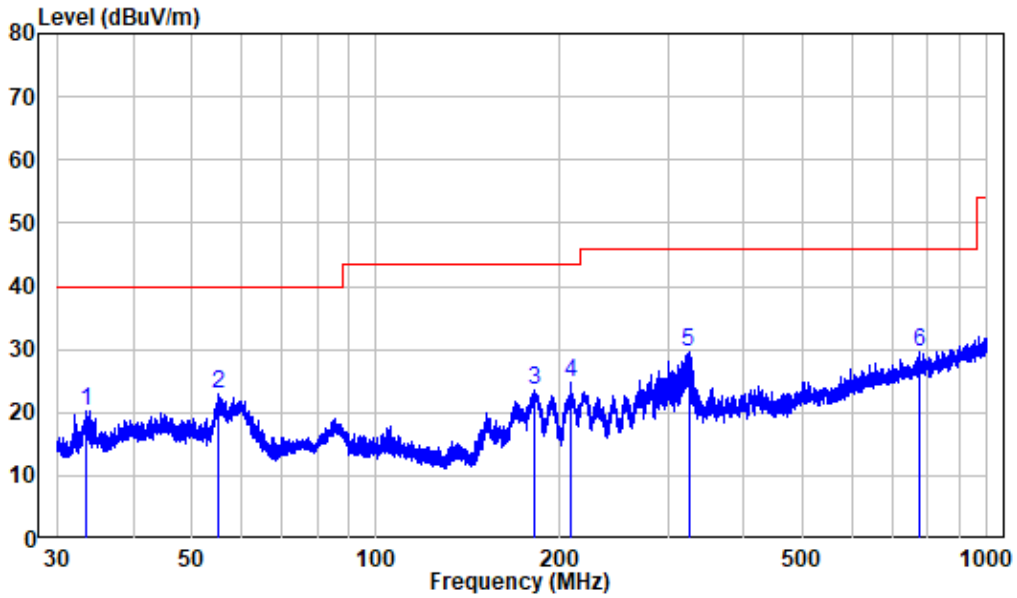
The testing was performed by Jimi Zheng on 2023-05-06 for below 1GHz and on 2023-05-01 for above 1GHz.

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: *(the worst case is 8DPSK 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.

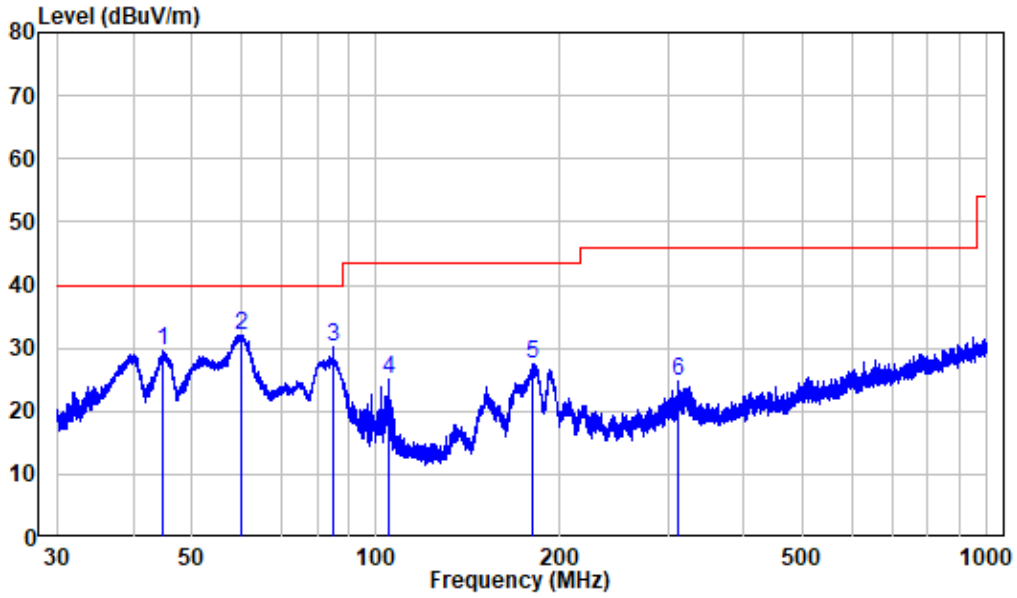
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230421-21182E-RF
Test Mode: BT

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	33.445	-11.94	32.08	20.14	40.00	-19.86	Peak
2	55.221	-10.26	33.35	23.09	40.00	-16.91	Peak
3	182.160	-12.51	36.07	23.56	43.50	-19.94	Peak
4	207.759	-11.85	36.74	24.89	43.50	-18.61	Peak
5	324.741	-8.28	37.78	29.50	46.00	-16.50	Peak
6	775.517	0.05	29.68	29.73	46.00	-16.27	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230421-21182E-RF
Test Mode: BT

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	44.685	-9.92	39.52	29.60	40.00	-10.40	Peak
2	60.175	-10.69	42.72	32.03	40.00	-7.97	Peak
3	84.888	-15.67	45.94	30.27	40.00	-9.73	Peak
4	104.765	-11.81	36.74	24.93	43.50	-18.57	Peak
5	180.807	-12.68	40.08	27.40	43.50	-16.10	Peak
6	312.453	-8.81	33.53	24.72	46.00	-21.28	Peak

Above 1GHz: *(worst case is 8DPSK Mode)*

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									
2348.96	65.31	PK	200	2.1	H	-10.78	54.53	74	-19.47
2333.44	65.15	PK	261	1.1	V	-10.61	54.54	74	-19.46
2390	64.01	PK	309	1.2	H	-10.70	53.31	74	-20.69
2390	64.93	PK	78	2.4	V	-10.70	54.23	74	-19.77
4804	63.49	PK	337	1.4	H	-6.11	57.38	74	-16.62
4804	61.28	PK	293	1.4	V	-6.11	55.17	74	-18.83
Middle Channel 2441MHz									
4882	62.18	PK	157	1.6	H	-5.90	56.28	74	-17.72
4882	61.35	PK	295	1.6	V	-5.90	55.45	74	-18.55
High Channel 2480MHz									
2483.5	68.01	PK	300	1.5	H	-10.55	57.46	74	-16.54
2483.5	67.01	PK	37	2.1	V	-10.55	56.46	74	-17.54
2484.28	72.04	PK	72	1.3	H	-10.54	61.50	74	-12.50
2483.85	69.28	PK	50	2.3	V	-10.55	58.73	74	-15.27
4960	61.21	PK	324	1.1	H	-5.47	55.74	74	-18.26
4960	60.95	PK	342	1.1	V	-5.47	55.48	74	-18.52

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)	Comment
Low Channel(2402MHz)							
2348.96	54.53	H	-24.69	29.84	54	-24.16	Bandedge
2333.44	54.54	V	-24.69	29.85	54	-24.15	Bandedge
2390	53.31	H	-24.69	28.62	54	-25.38	Bandedge
2390	54.23	V	-24.69	29.54	54	-24.46	Bandedge
4804	57.38	H	-24.69	32.69	54	-21.31	Harmonic
4804	55.17	V	-24.69	30.48	54	-23.52	Harmonic
Middle Channel(2441MHz)							
4882	56.28	H	-24.69	31.59	54	-22.41	Harmonic
4882	55.45	V	-24.69	30.76	54	-23.24	Harmonic
High Channel(2480MHz)							
2483.5	57.46	H	-24.69	32.77	54	-21.23	Bandedge
2483.5	56.46	V	-24.69	31.77	54	-22.23	Bandedge
2484.28	61.50	H	-24.69	36.81	54	-17.19	Bandedge
2483.85	58.73	V	-24.69	34.04	54	-19.96	Bandedge
4960	55.74	H	-24.69	31.05	54	-22.95	Harmonic
4960	55.48	V	-24.69	30.79	54	-23.21	Harmonic

Note:

Absolute Level = Corrected Factor + Reading

Margin = Corrected. Amplitude - Limit

Average level= Peak level+ Duty Cycle Corrected Factor

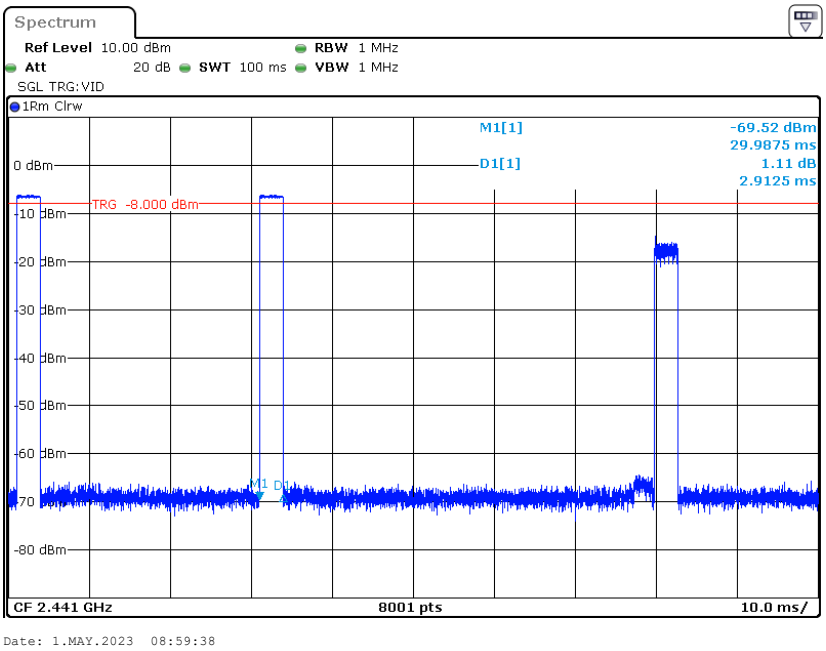
The other spurious emission which is in the noise floor level was not recorded.

Worst case duty cycle:

Duty cycle = Ton/100ms = 2.9125*2/100=0.05825

Duty Cycle Corrected Factor = 20lg (Duty cycle) = 20lg0.05825 = -24.69

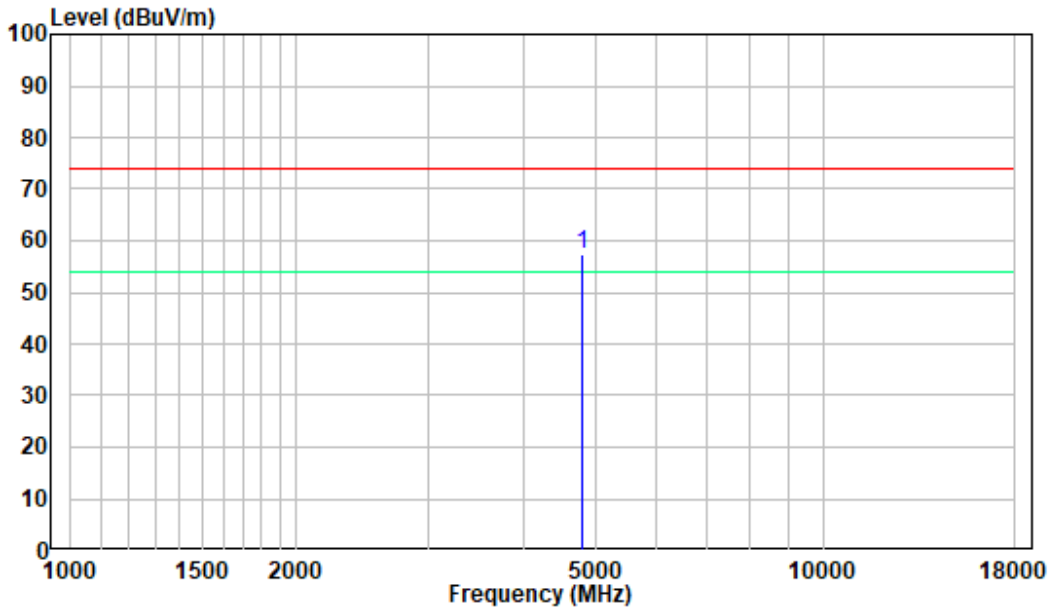
Duty cycle



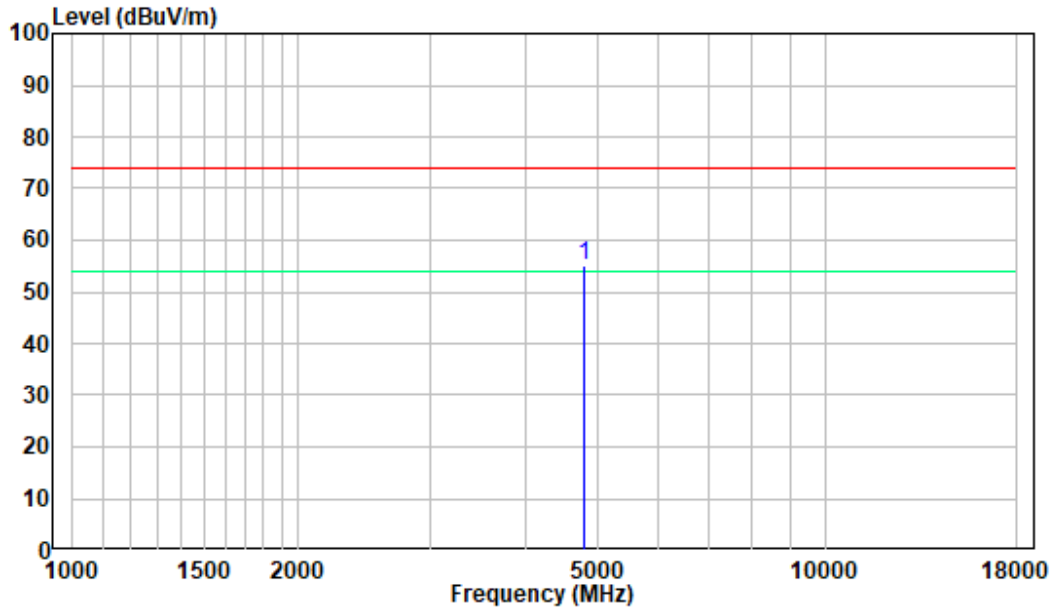
1-18GHz

Pre-scan, Low Channel (worst case)

Horizontal:



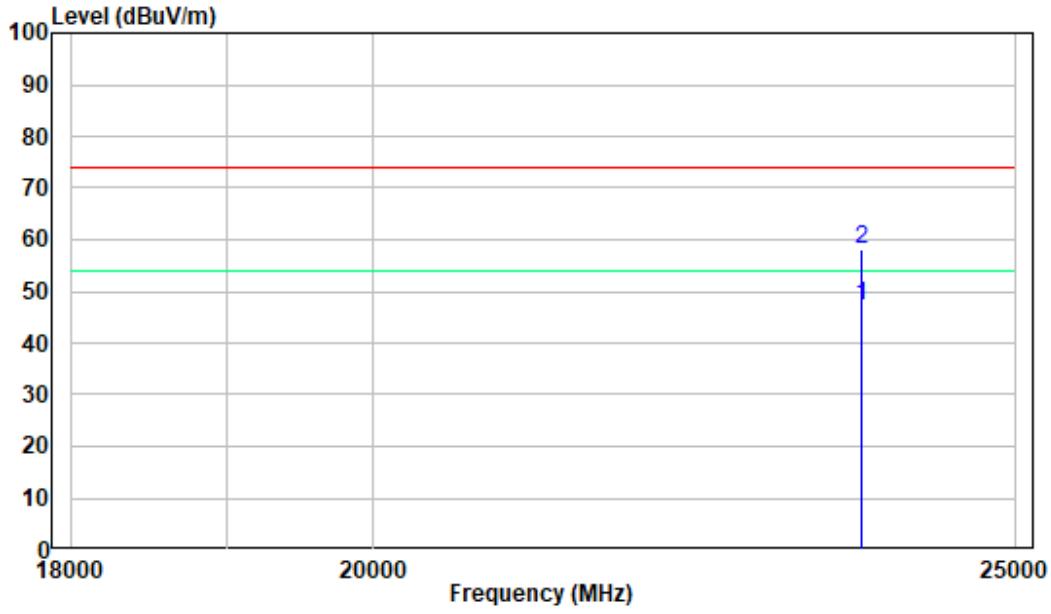
Vertical:



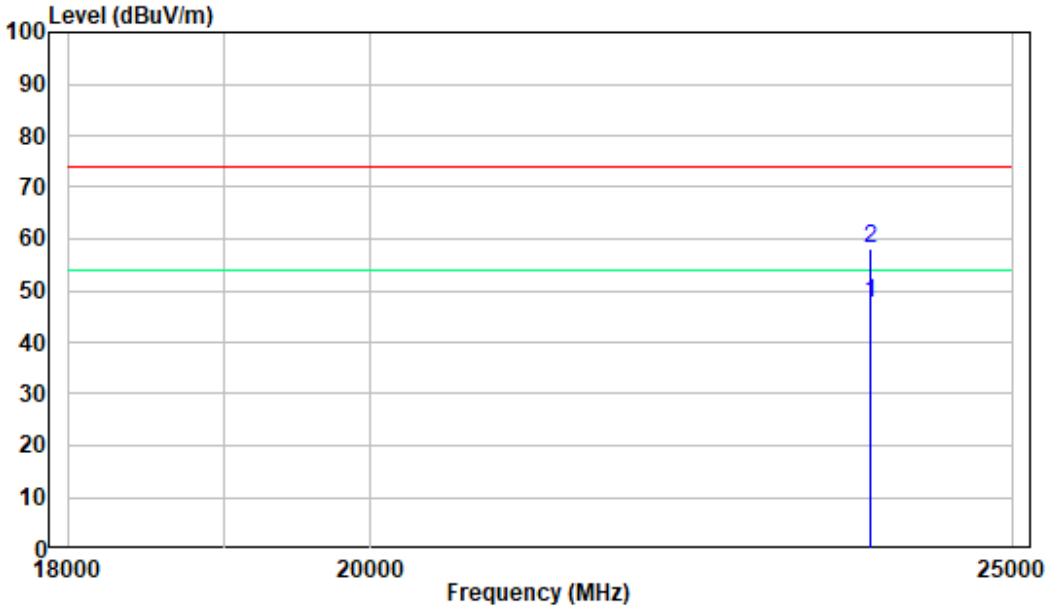
18-25GHz

Pre-scan, Low Channel (worst case)

Horizontal:



Vertical:



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

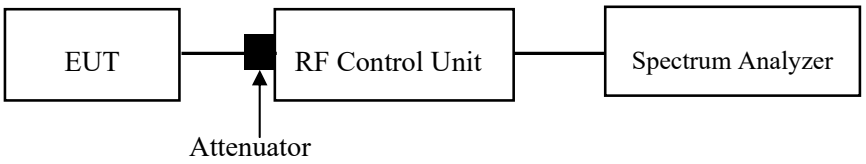
Applicable Standard

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:	25.5 ℃
Relative Humidity:	61 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-05-10.

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

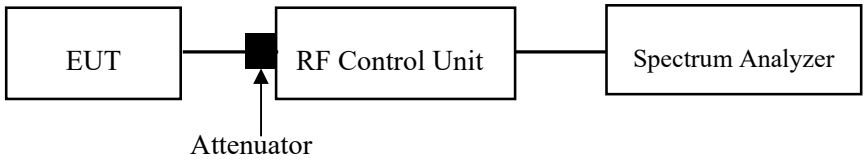
The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• 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:	25.5 ℃
Relative Humidity:	61 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-05-10.

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.

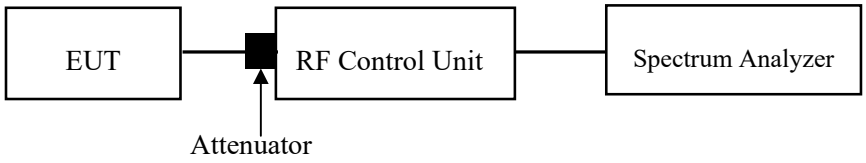
Test Procedure

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:	25.5 ℃
Relative Humidity:	61 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-05-10.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

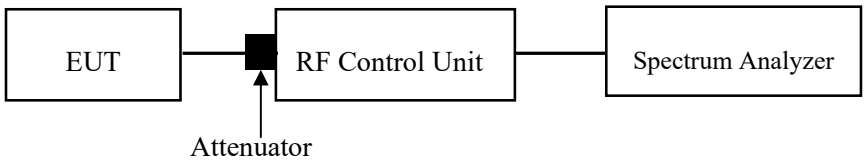
Applicable Standard

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

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



Test Data

Environmental Conditions

Temperature:	25.5 ℃
Relative Humidity:	61 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-05-10.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

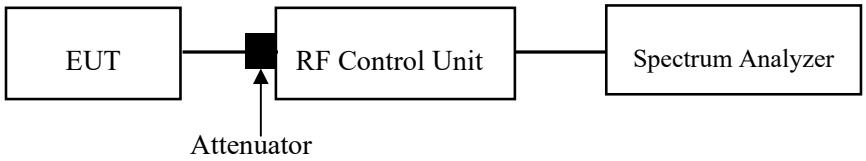
Applicable Standard

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:	25.5 ℃
Relative Humidity:	61 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-05-10.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

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

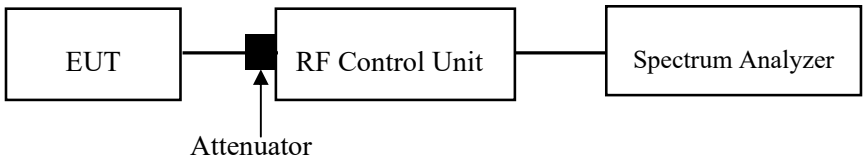
Applicable Standard

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:	25.5 ℃
Relative Humidity:	61 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-05-10.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

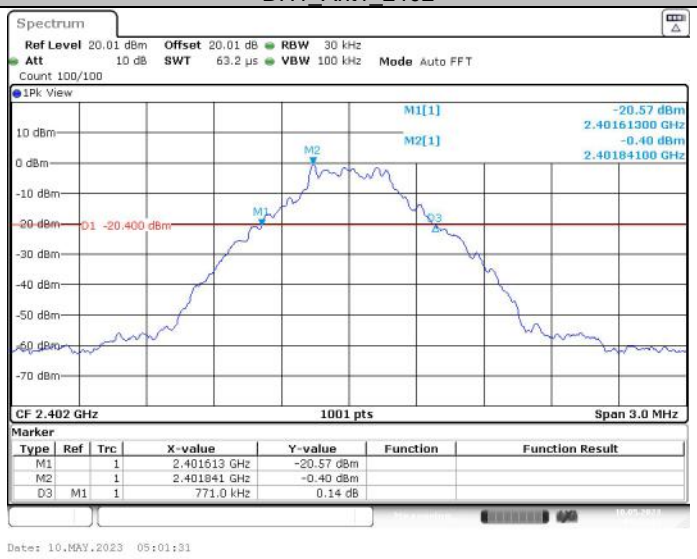
APPENDIX

Appendix A: 20dB Emission Bandwidth
Test Result

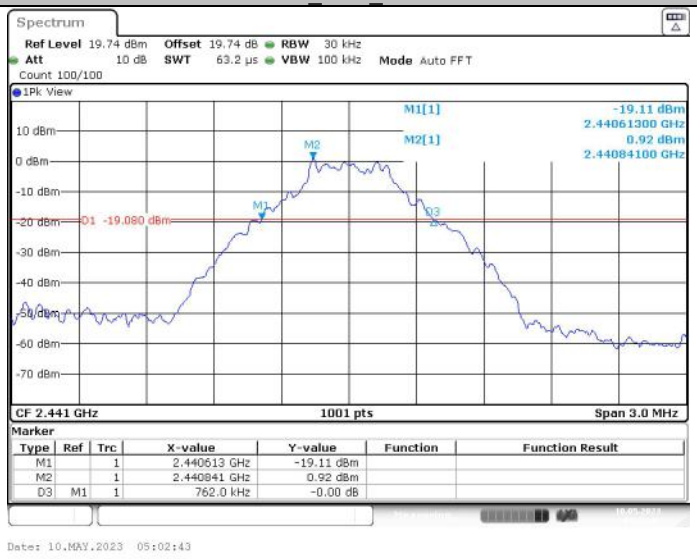
Test Mode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.77	2401.61	2402.38	---	---
		2441	0.76	2440.61	2441.38	---	---
		2480	0.77	2479.61	2480.38	---	---
2DH1	Ant1	2402	1.22	2401.38	2402.59	---	---
		2441	1.21	2440.38	2441.59	---	---
		2480	1.22	2479.38	2480.60	---	---
3DH1	Ant1	2402	1.22	2401.41	2402.62	---	---
		2441	1.22	2440.41	2441.62	---	---
		2480	1.22	2479.40	2480.63	---	---

Test Graphs

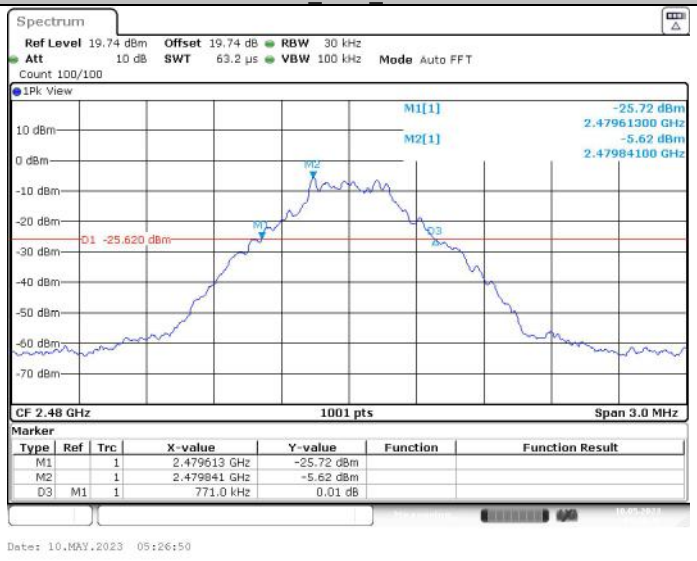
DH1_Ant1_2402



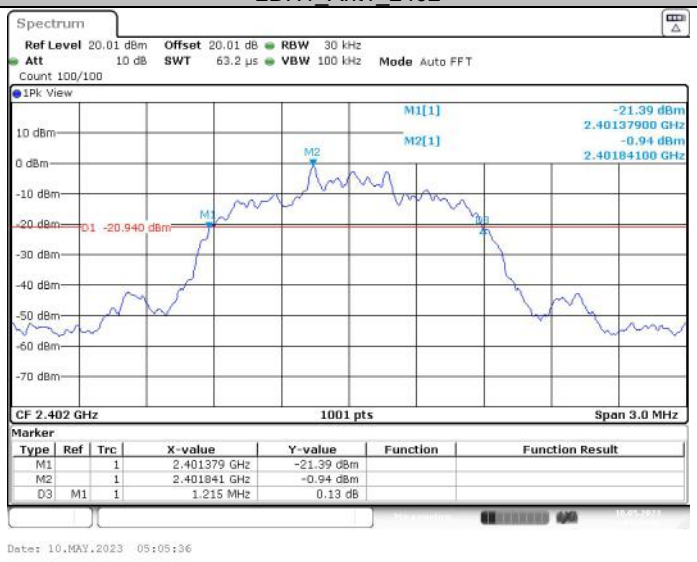
DH1_Ant1_2441



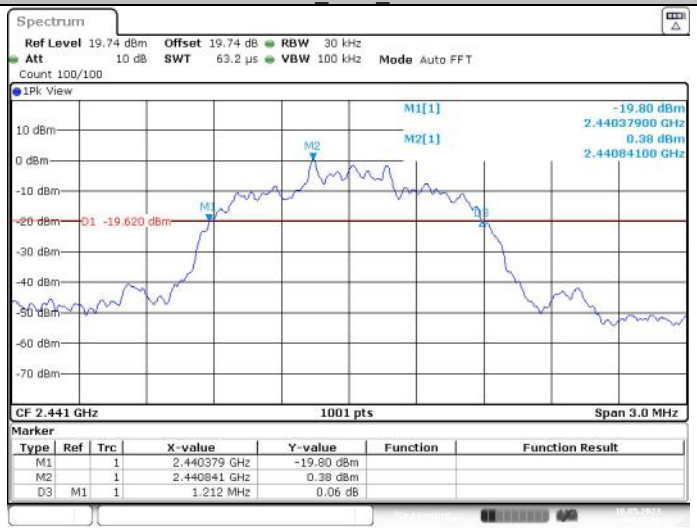
DH1_Ant1_2480



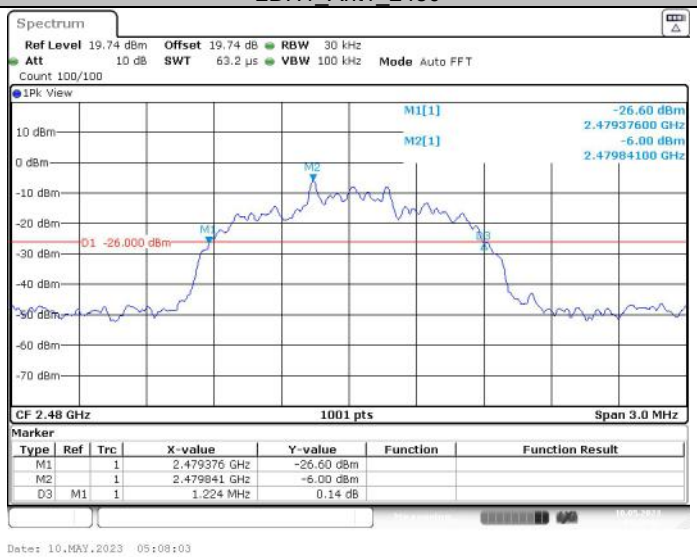
2DH1_Ant1_2402



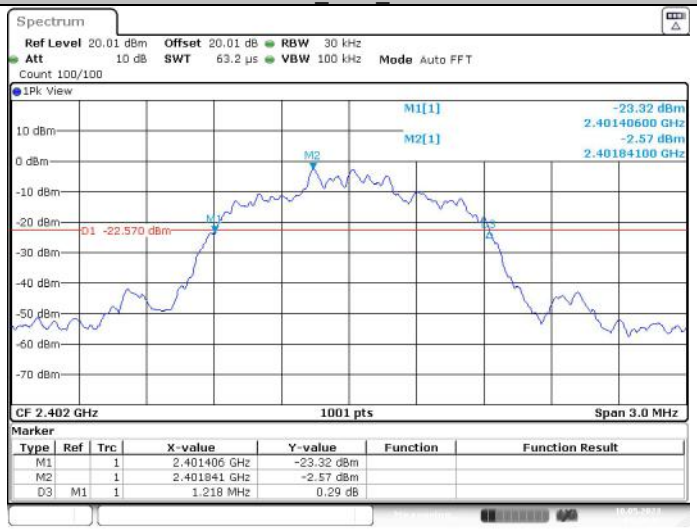
2DH1_Ant1_2441



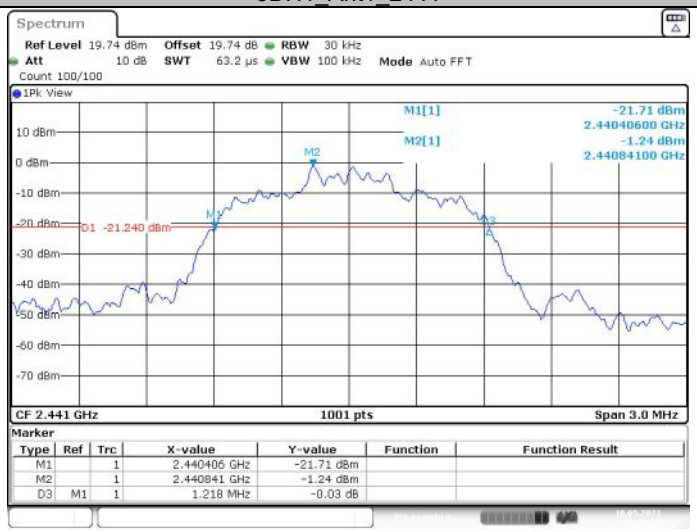
2DH1_Ant1_2480



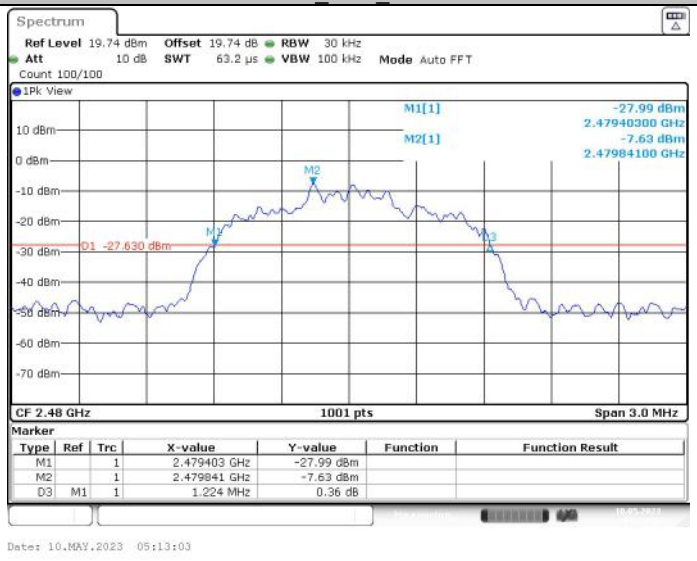
3DH1_Ant1_2402



3DH1_Ant1_2441



3DH1_Ant1_2480

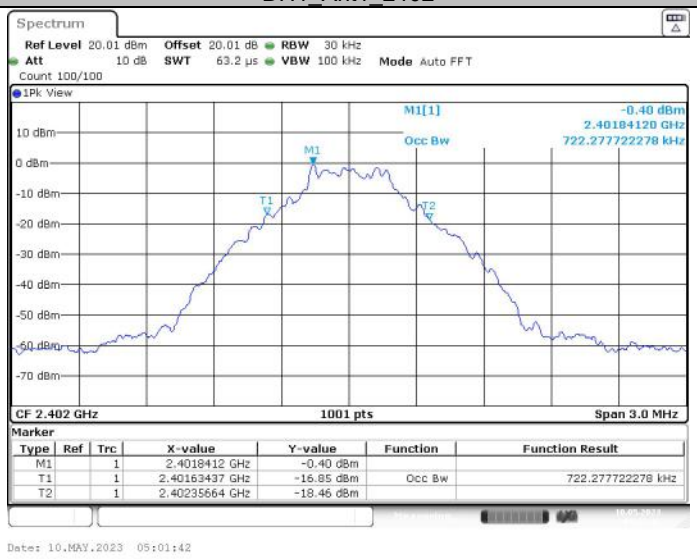


Appendix B: Occupied Channel Bandwidth
Test Result

Test Mode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.722	2401.634	2402.357	---	---
		2441	0.722	2440.631	2441.354	---	---
		2480	0.728	2479.631	2480.360	---	---
2DH1	Ant1	2402	1.130	2401.434	2402.563	---	---
		2441	1.136	2440.428	2441.563	---	---
		2480	1.145	2479.425	2480.569	---	---
3DH1	Ant1	2402	1.121	2401.449	2402.569	---	---
		2441	1.124	2440.446	2441.569	---	---
		2480	1.142	2479.443	2480.584	---	---

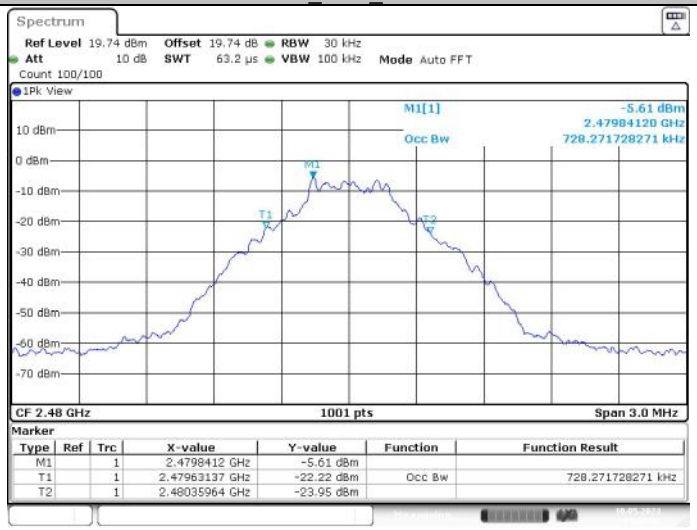
Test Graphs

DH1_Ant1_2402

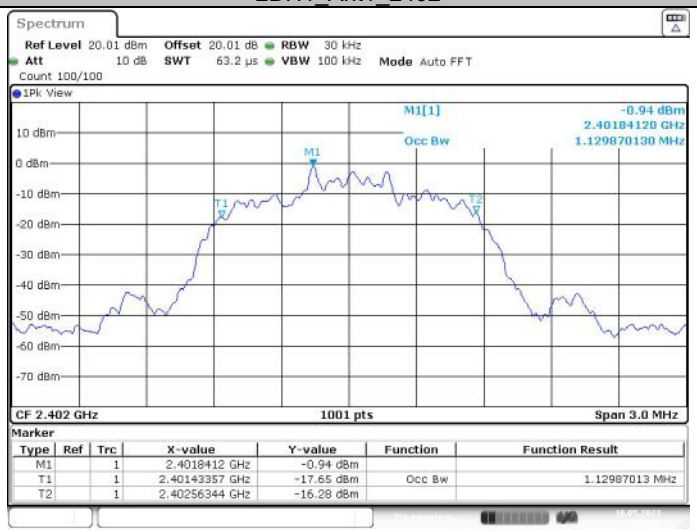


DH1_Ant1_2441

DH1_Ant1_2480

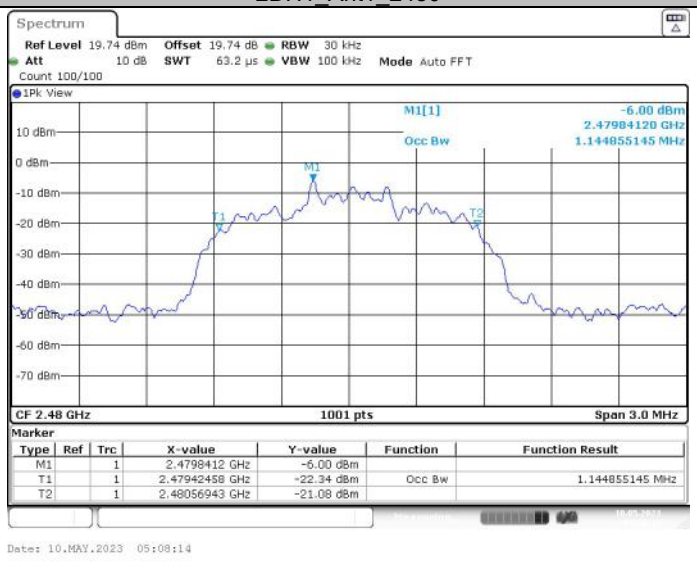


2DH1_Ant1_2402



2DH1_Ant1_2441

2DH1_Ant1_2480



3DH1_Ant1_2402

3DH1_Ant1_2441

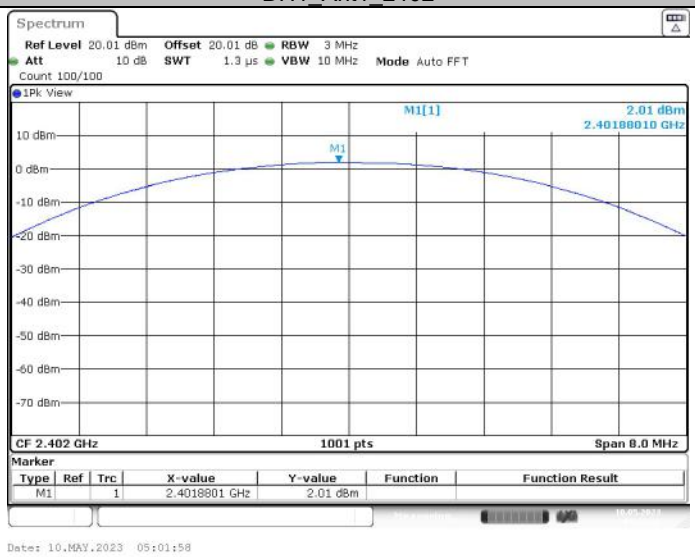
3DH1_Ant1_2480

Appendix C: Maximum conducted output power
Test Result Peak

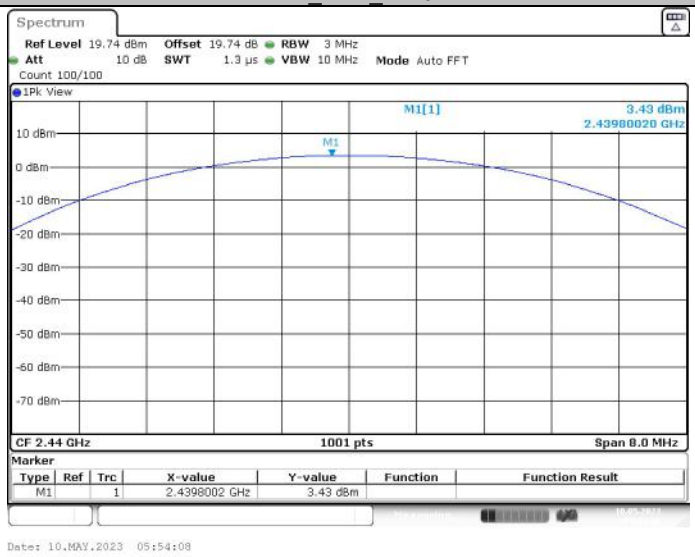
Test Mode	Antenna	Frequency[MHz]	Conducted Peak Power[dBm]	Conducted Limit[dBm]	Verdict
DH1	Ant1	2402	2.01	≤20.97	PASS
		2440	**3.43**	≤20.97	PASS
		2441	3.25	≤20.97	PASS
		2480	-3.32	≤20.97	PASS
2DH1	Ant1	2402	1.23	≤20.97	PASS
		2440	2.73	≤20.97	PASS
		2441	2.58	≤20.97	PASS
		2480	-3.82	≤20.97	PASS
3DH1	Ant1	2402	1.18	≤20.97	PASS
		2439	2.56	≤20.97	PASS
		2441	2.54	≤20.97	PASS
		2480	-3.89	≤20.97	PASS

Test Graphs

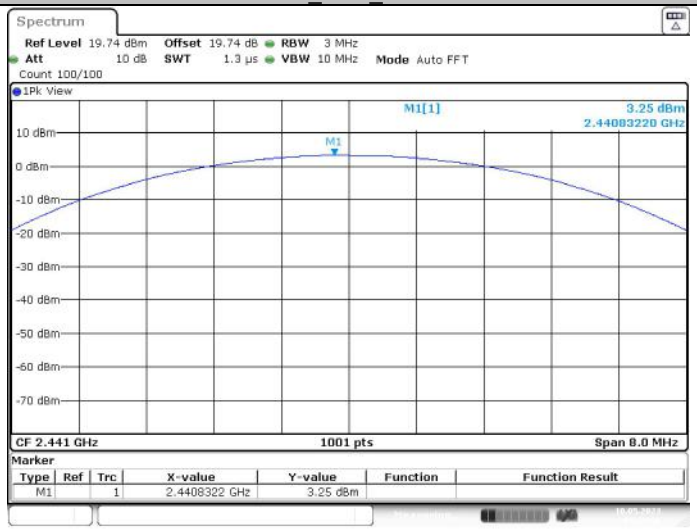
DH1_Ant1_2402



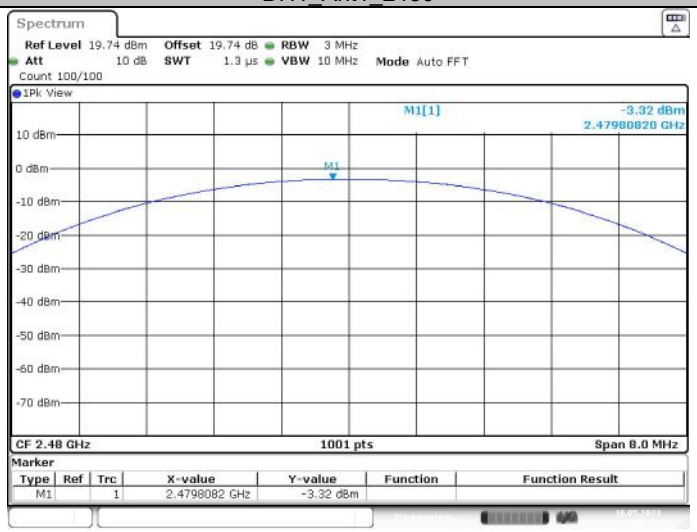
DH1_Ant1_2440



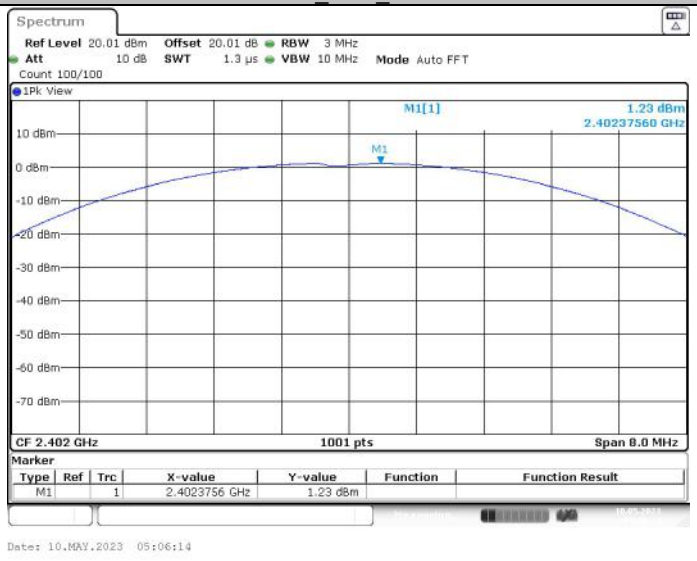
DH1_Ant1_2441



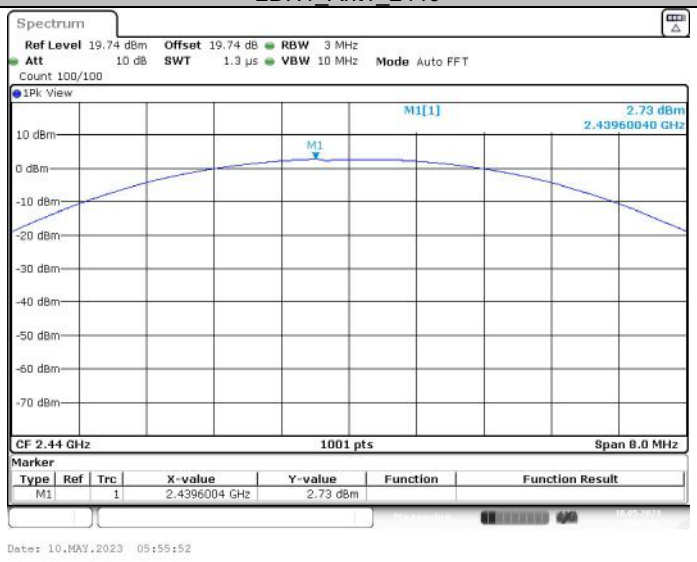
DH1_Ant1_2480



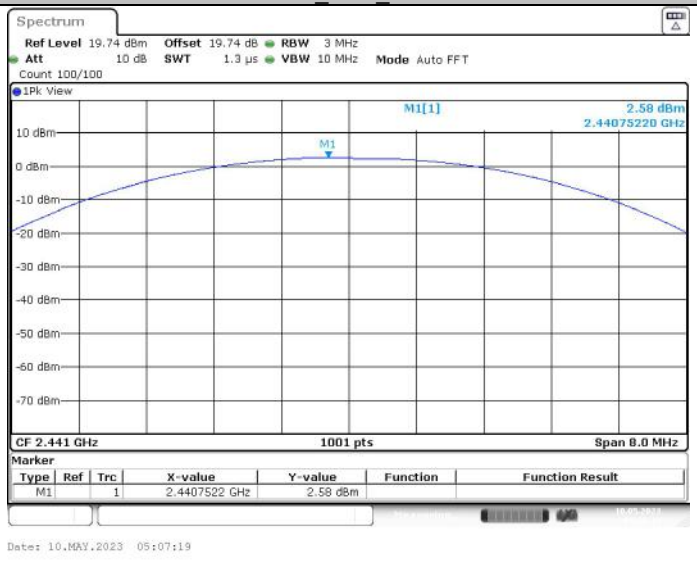
2DH1_Ant1_2402



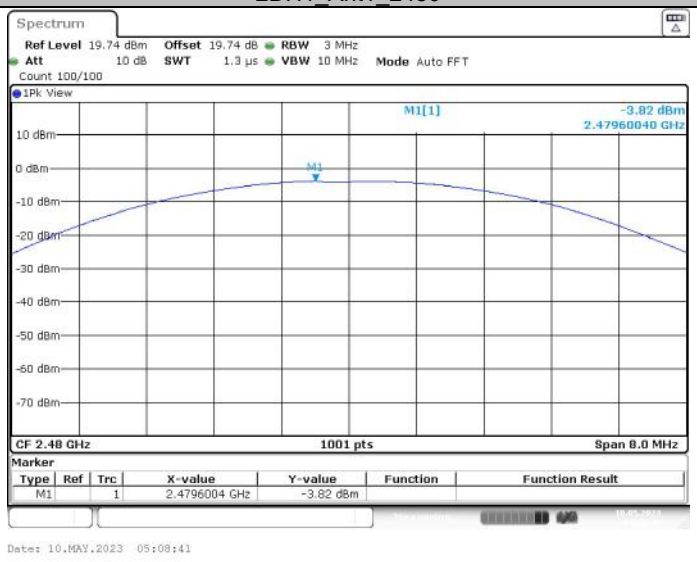
2DH1_Ant1_2440

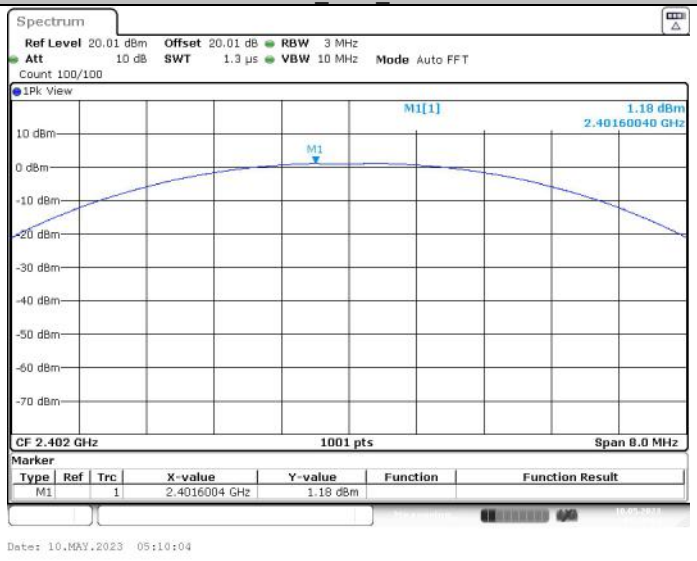


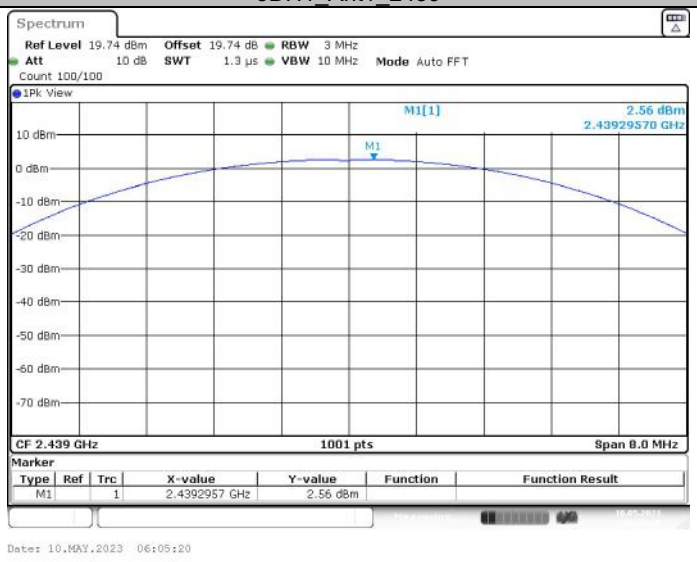
2DH1_Ant1_2441

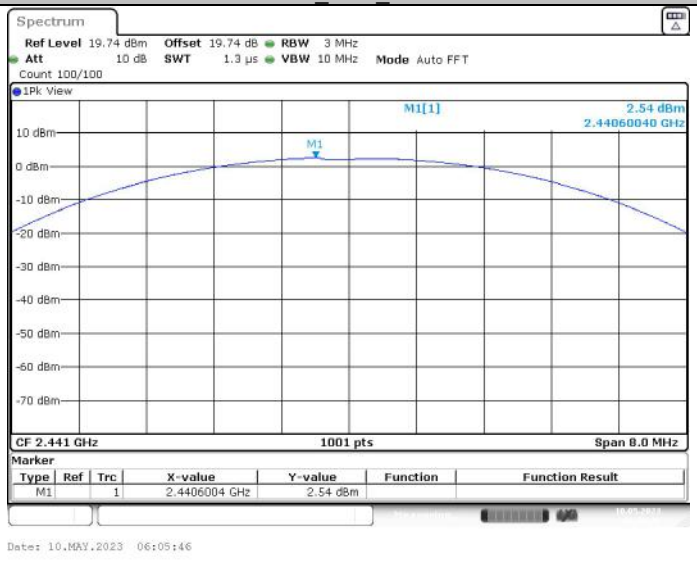


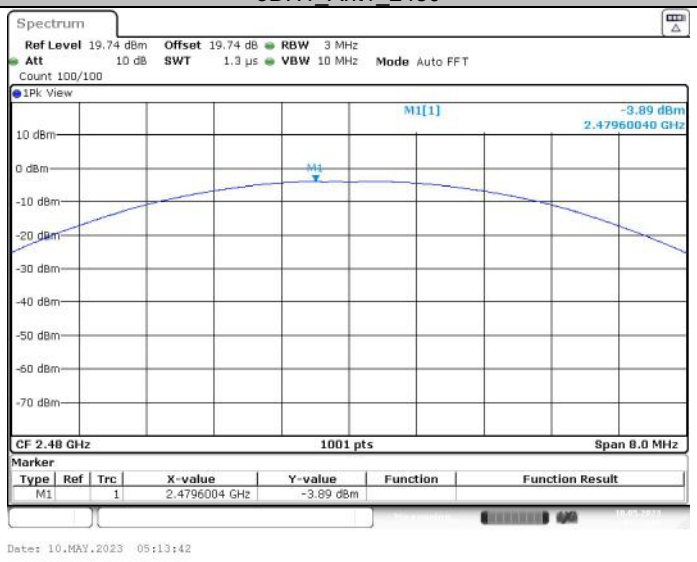
2DH1_Ant1_2480



3DH1_Ant1_2402


3DH1_Ant1_2439


3DH1_Ant1_2441


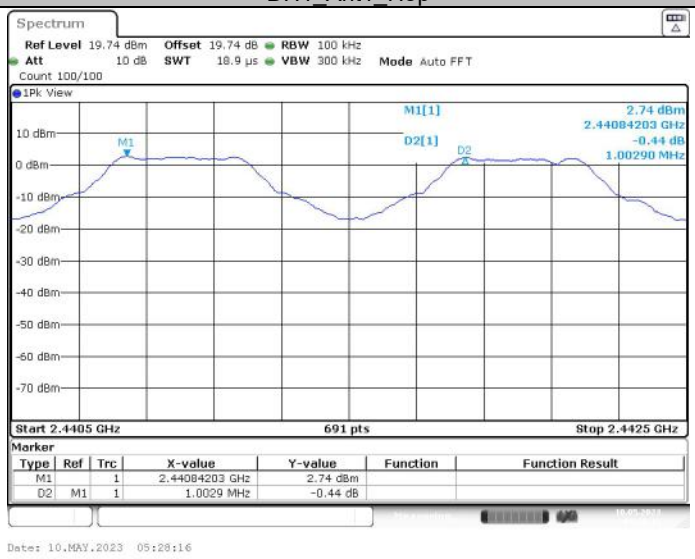
3DH1_Ant1_2480


Appendix D: Carrier frequency separation
Test Result

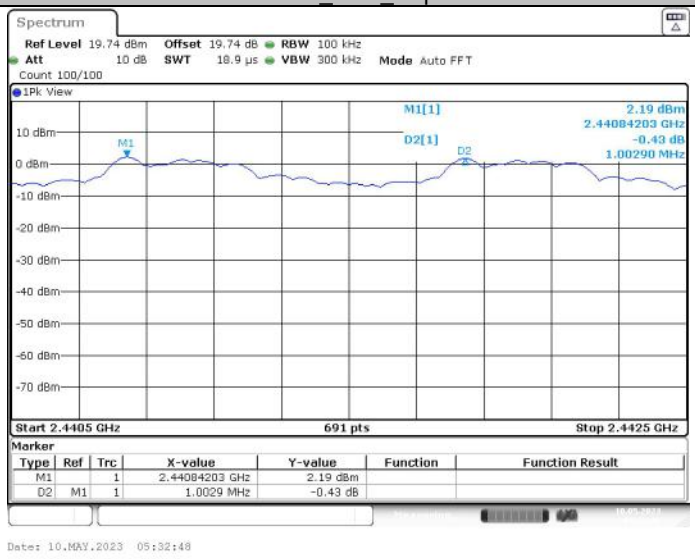
Test Mode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.003	≥0.513	PASS
2DH1	Ant1	Hop	1.003	≥0.813	PASS
3DH1	Ant1	Hop	1	≥0.813	PASS

Test Graphs

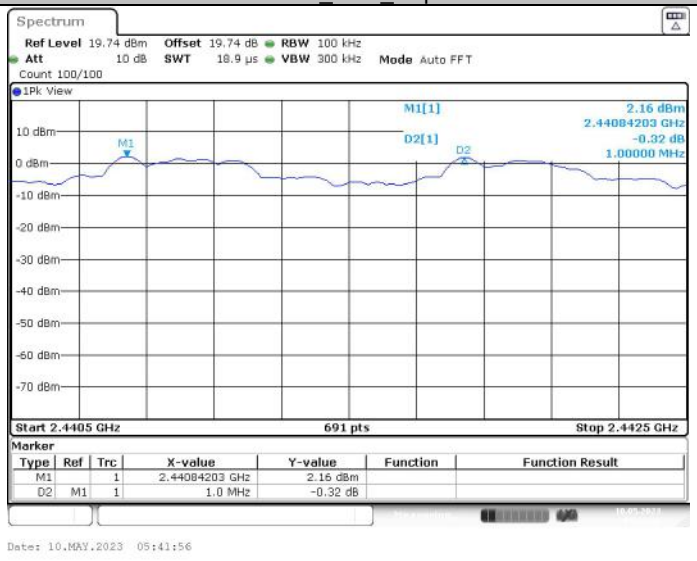
DH1_Ant1_Hop



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	0.37	330	0.122	≤0.4	PASS
DH3	Ant1	Hop	1.63	170	0.277	≤0.4	PASS
DH5	Ant1	Hop	2.88	130	0.374	≤0.4	PASS
2DH1	Ant1	Hop	0.38	320	0.122	≤0.4	PASS
2DH3	Ant1	Hop	1.63	170	0.277	≤0.4	PASS
2DH5	Ant1	Hop	2.88	120	0.346	≤0.4	PASS
3DH1	Ant1	Hop	0.38	320	0.122	≤0.4	PASS
3DH3	Ant1	Hop	1.63	160	0.261	≤0.4	PASS
3DH5	Ant1	Hop	2.89	120	0.347	≤0.4	PASS

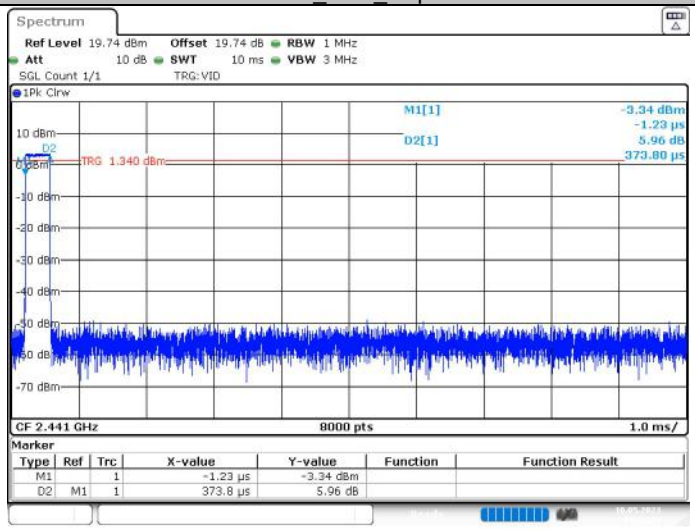
Note 1: A period time=0.4*79=31.6(S), Result=BurstWidth*Totalhops

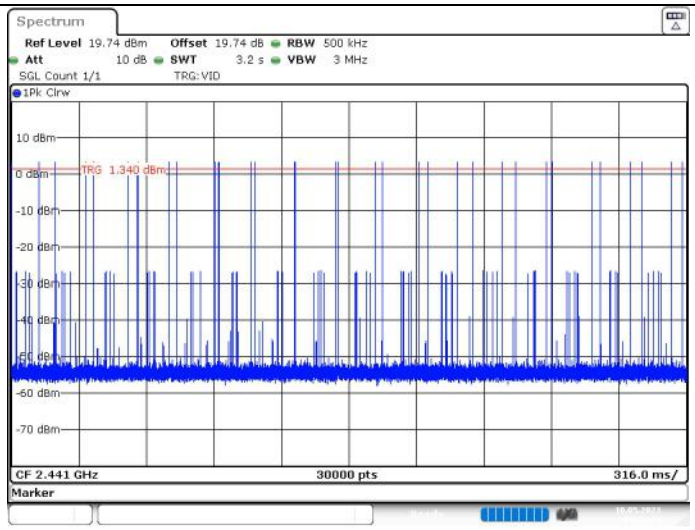
Note 2: Totalhops=Hopping Number in 3.16s*10

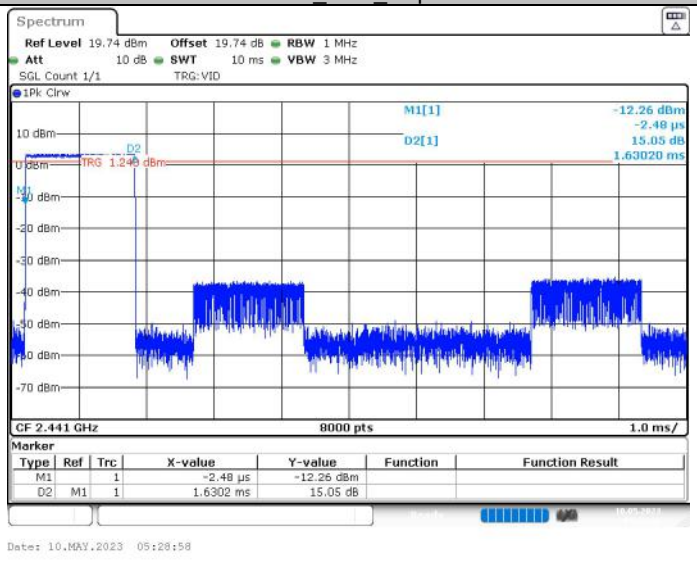
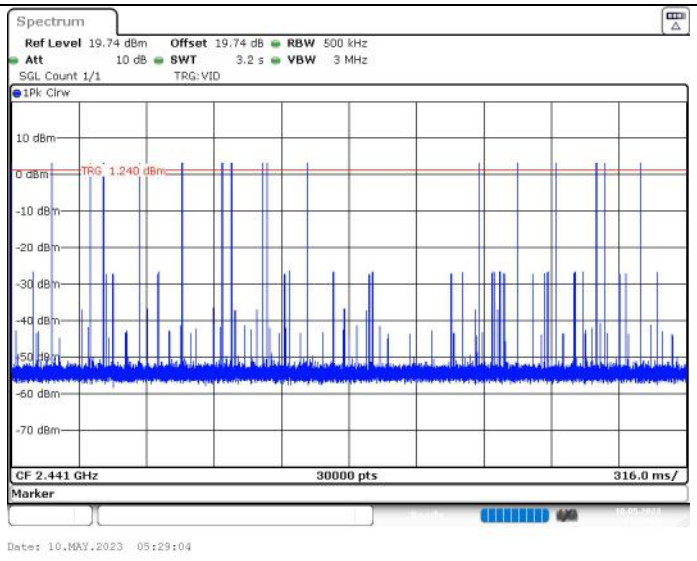
Note 3: Hopping Number in 3.16s=Total of highest signals in 3.16s(Second high signals were other channel)

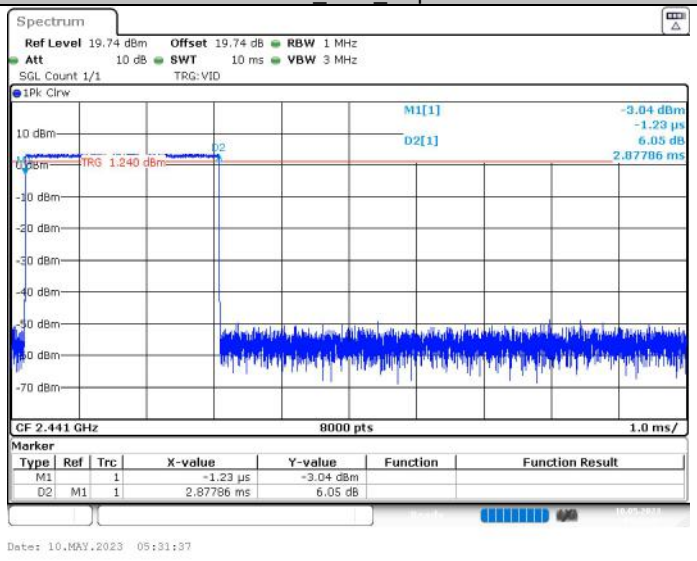
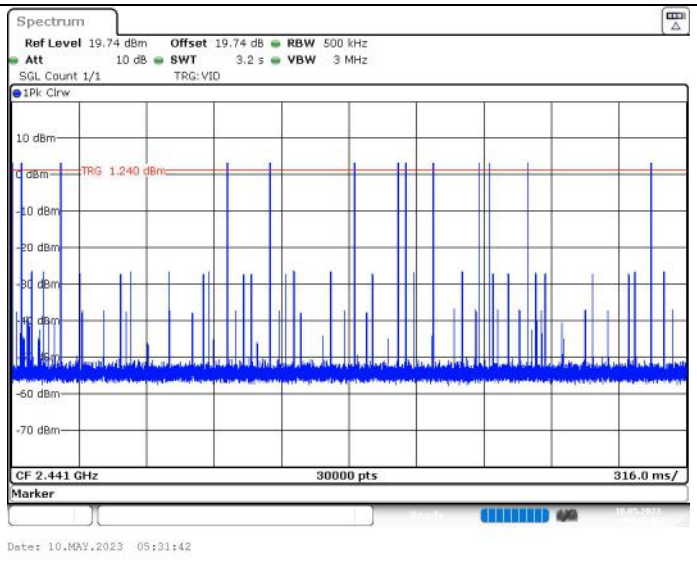
Test Graphs

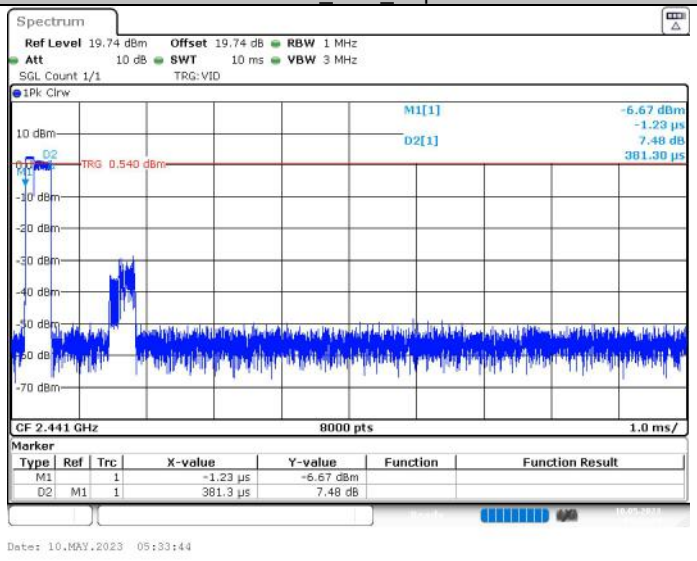
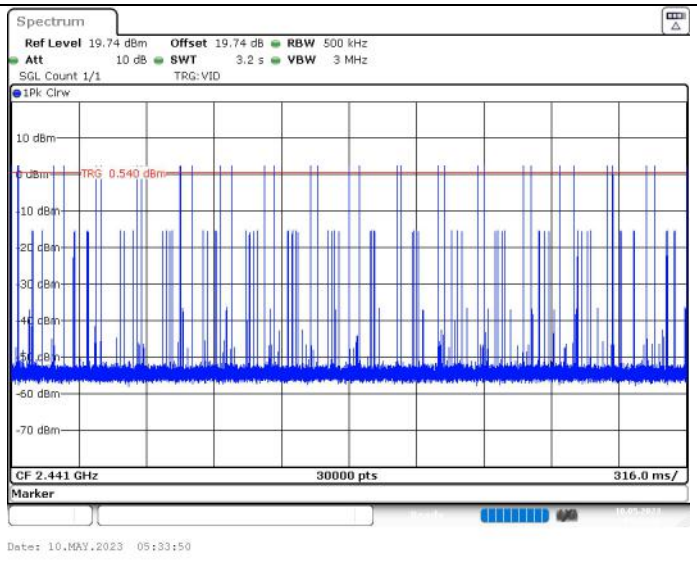
DH1_Ant1_Hop

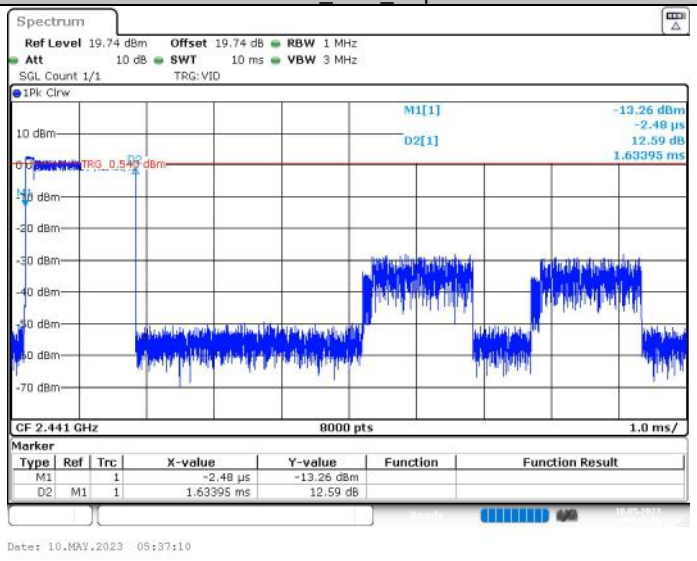
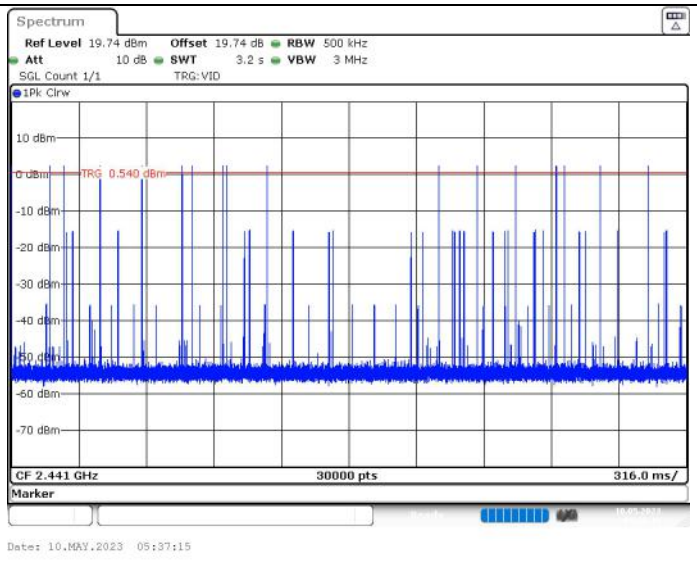


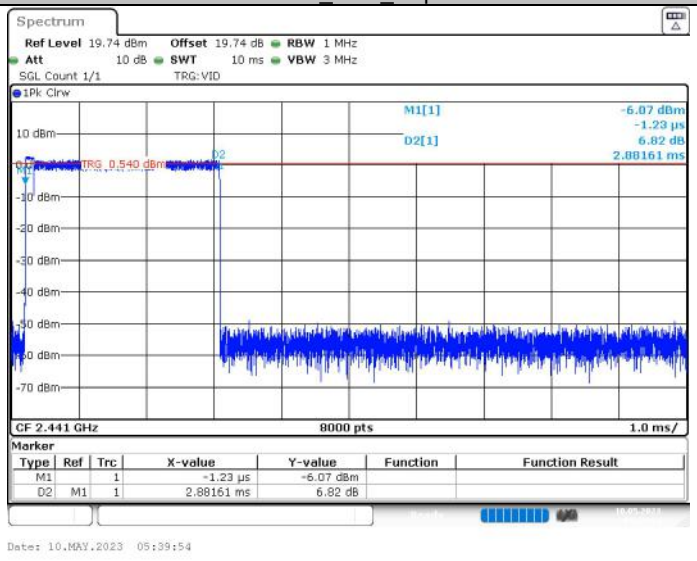
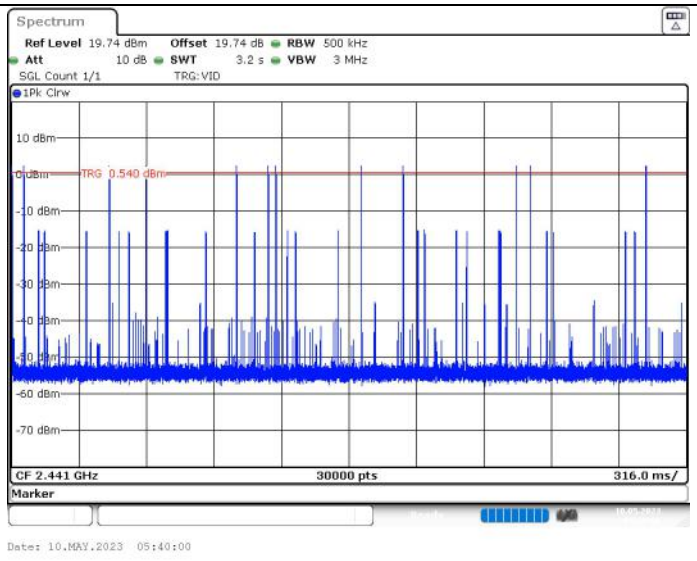


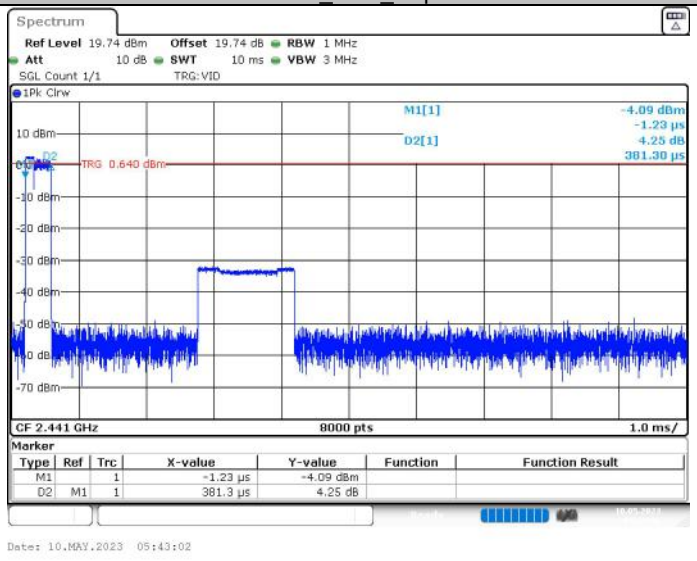
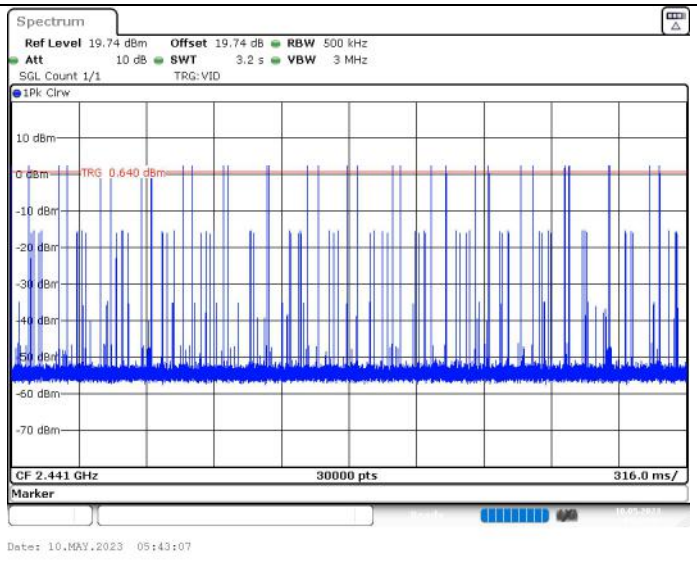
DH3_Ant1_Hop
 Spectrum Ref Level 19.74 dBm Offset 19.74 dB RBW 1 MHz Att 10 dB SWT 10 ms VBW 3 MHz SGL Count 1/1 TRG:VID 1Pk Clrw M1[1] -12.26 dBm -2.48 µs D2[1] 15.05 dB 1.63020 ms TRG 1.240 dBm CF 2.441 GHz 8000 pts 1.0 ms/ Marker Type Ref Trc X-value Y-value Function Function Result M1 1 -2.48 µs -12.26 dBm D2 M1 1 1.6302 ms 15.05 dB Date: 10.MAY.2023 05:28:58
 Spectrum Ref Level 19.74 dBm Offset 19.74 dB RBW 500 kHz Att 10 dB SWT 3.2 s VBW 3 MHz SGL Count 1/1 TRG:VID 1Pk Clrw TRG 1.240 dBm CF 2.441 GHz 30000 pts 316.0 ms/ Marker Date: 10.MAY.2023 05:29:04

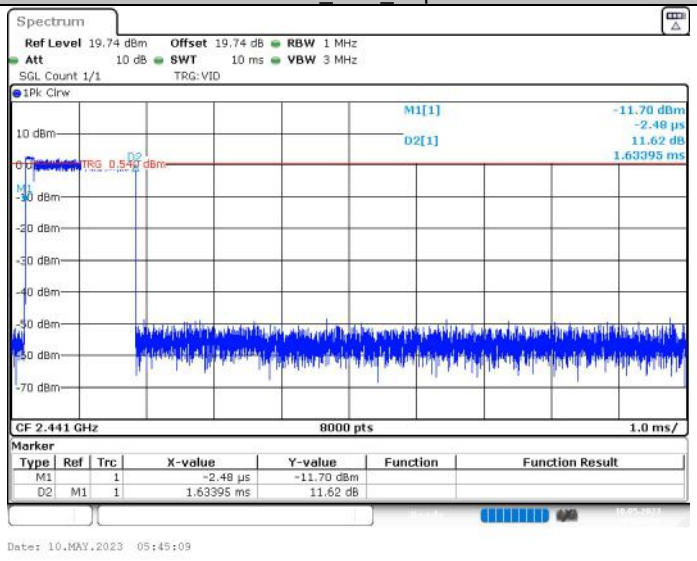
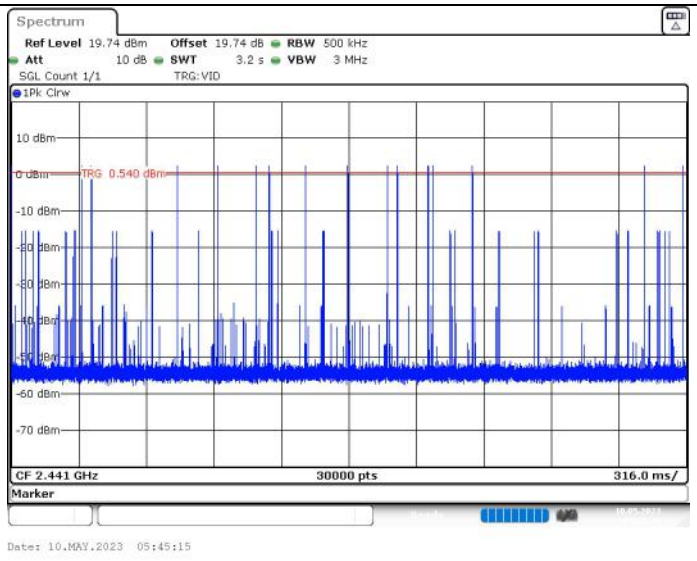
DH5_Ant1_Hop
 Spectrum Ref Level 19.74 dBm Offset 19.74 dB RBW 1 MHz Att 10 dB SWT 10 ms VBW 3 MHz SGL Count 1/1 TRG:VID 1Pk Clrw M1[1] -3.04 dBm -1.23 µs D2[1] 6.05 dB 2.87786 ms TRG 1.240 dBm CF 2.441 GHz 8000 pts 1.0 ms/ Marker Type Ref Trc X-value Y-value Function Function Result M1 1 -1.23 µs -3.04 dBm D2 M1 1 2.87786 ms 6.05 dB Date: 10.MAY.2023 05:31:37
 Spectrum Ref Level 19.74 dBm Offset 19.74 dB RBW 500 kHz Att 10 dB SWT 3.2 s VBW 3 MHz SGL Count 1/1 TRG:VID 1Pk Clrw TRG 1.240 dBm CF 2.441 GHz 30000 pts 316.0 ms/ Marker Date: 10.MAY.2023 05:31:42

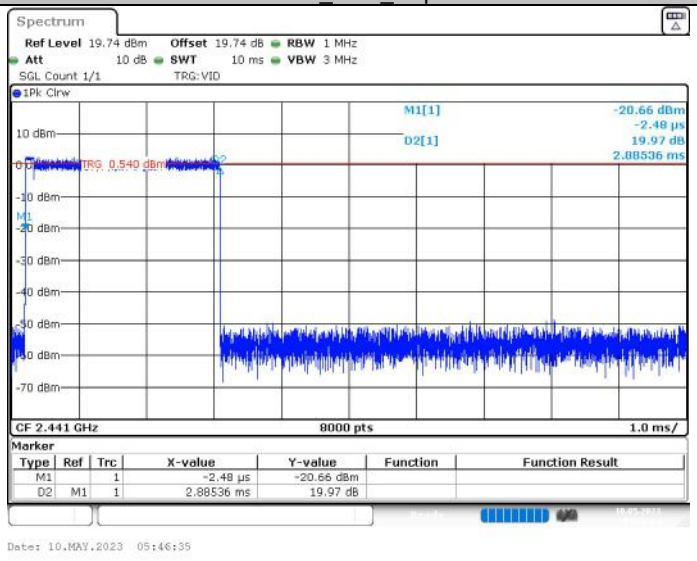
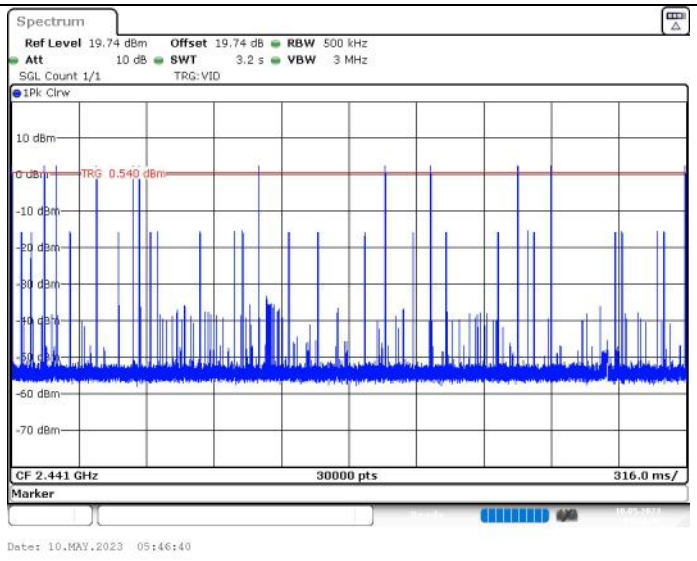
2DH1_Ant1_Hop



2DH3_Ant1_Hop



2DH5_Ant1_Hop



3DH1_Ant1_Hop



3DH3_Ant1_Hop



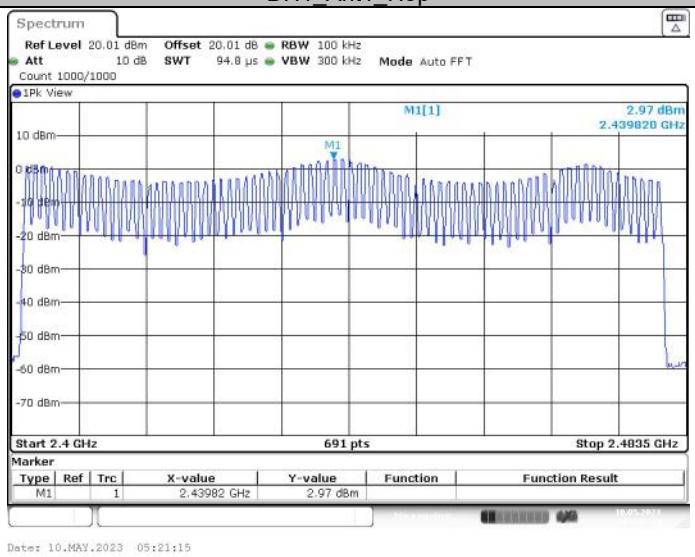
3DH5_Ant1_Hop



Appendix F: Number of hopping channels
Test Result

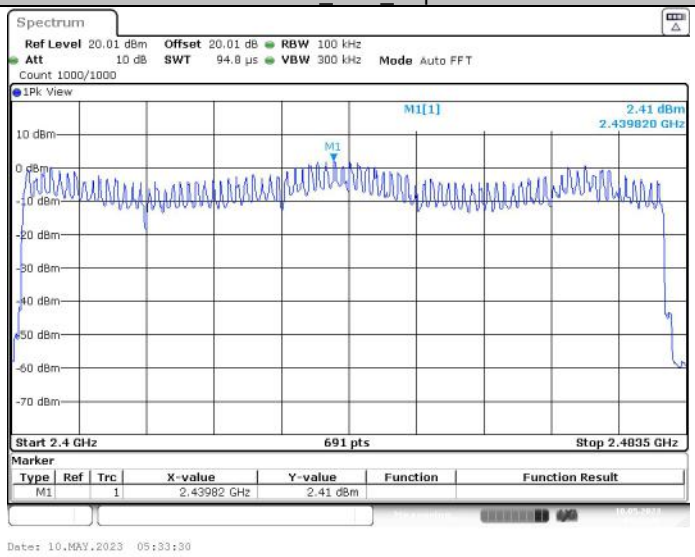
Test Mode	Antenna	Frequency[MHz]	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	≥15	PASS
2DH1	Ant1	Hop	79	≥15	PASS
3DH1	Ant1	Hop	79	≥15	PASS

Test Graphs

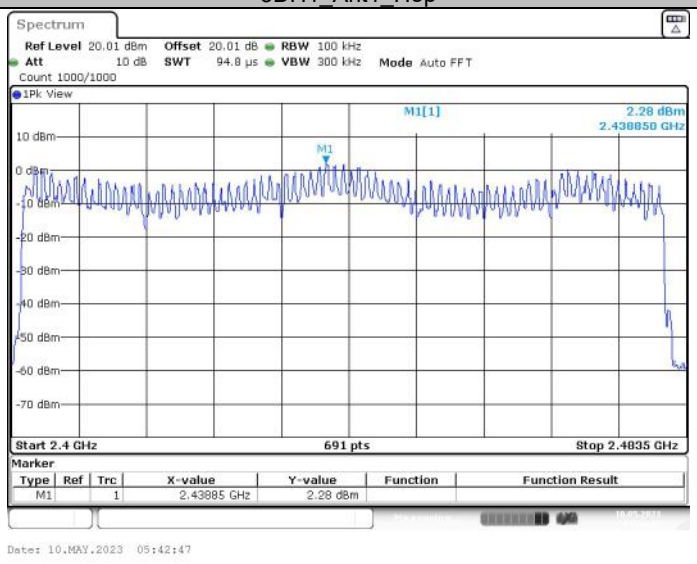
DH1_Ant1_Hop



2DH1_Ant1_Hop

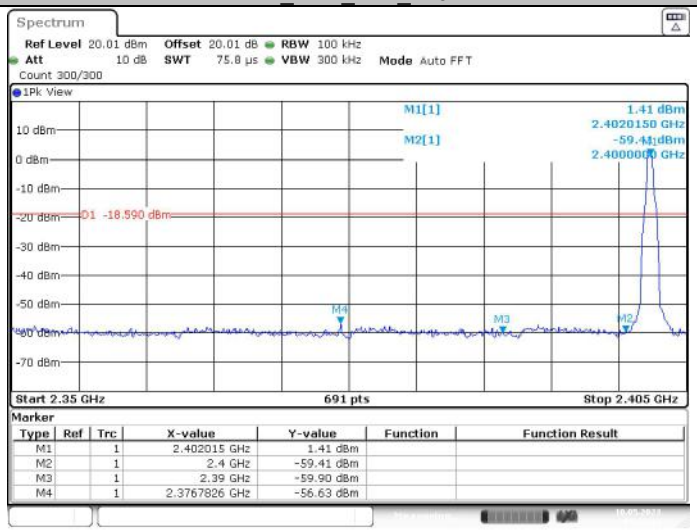


3DH1_Ant1_Hop

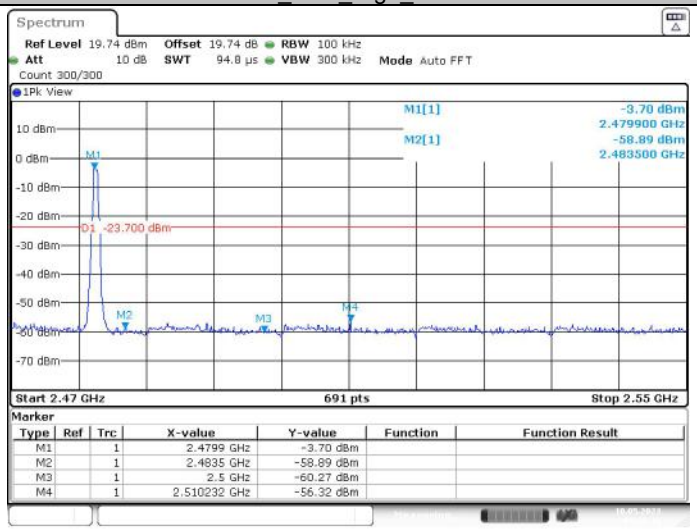


Appendix G: Band edge measurements
Test Graphs

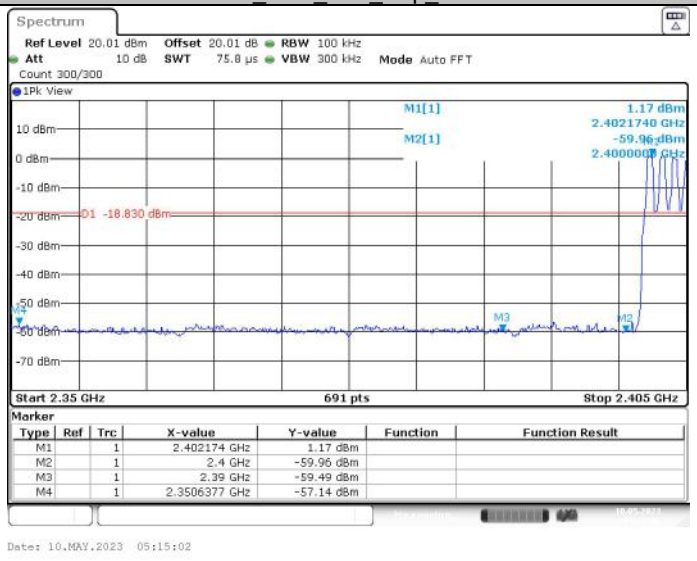
DH1_Ant1_Low_2402



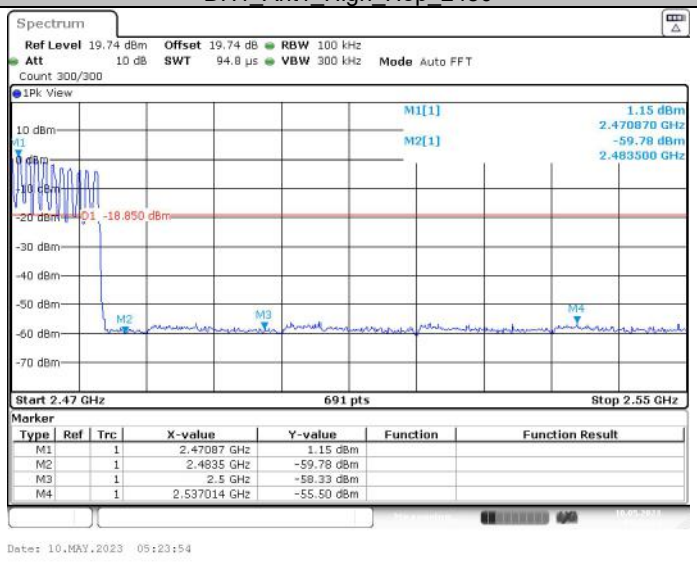
DH1_Ant1_High_2480



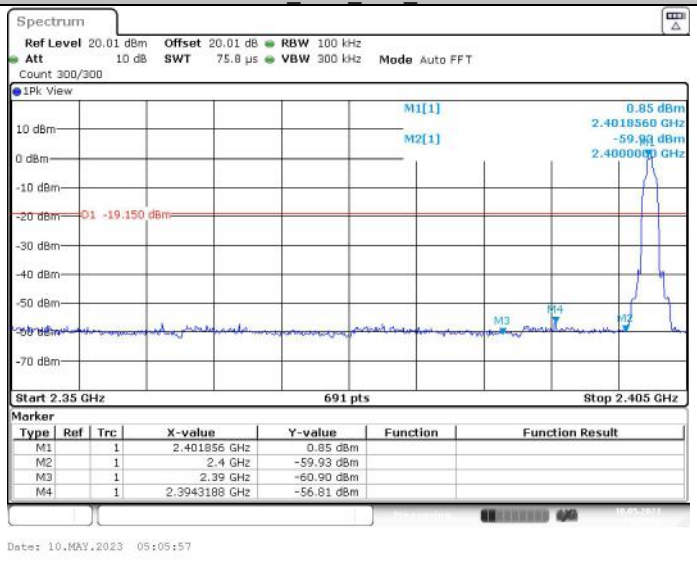
DH1_Ant1_Low_Hop_2402



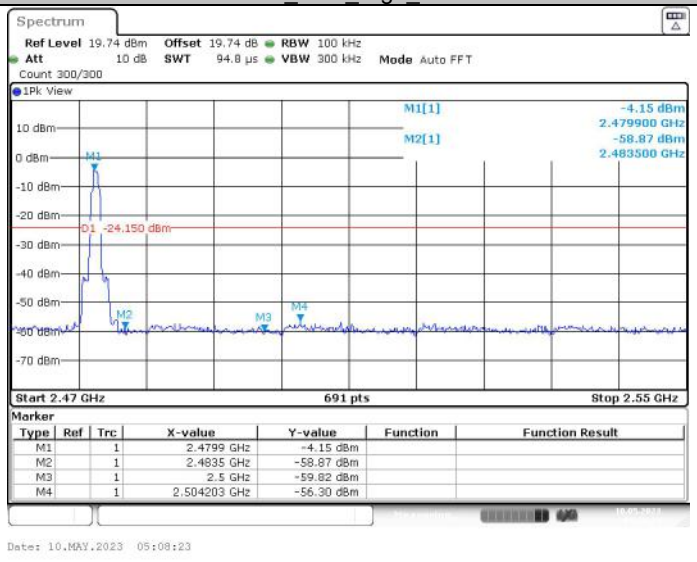
DH1_Ant1_High_Hop_2480



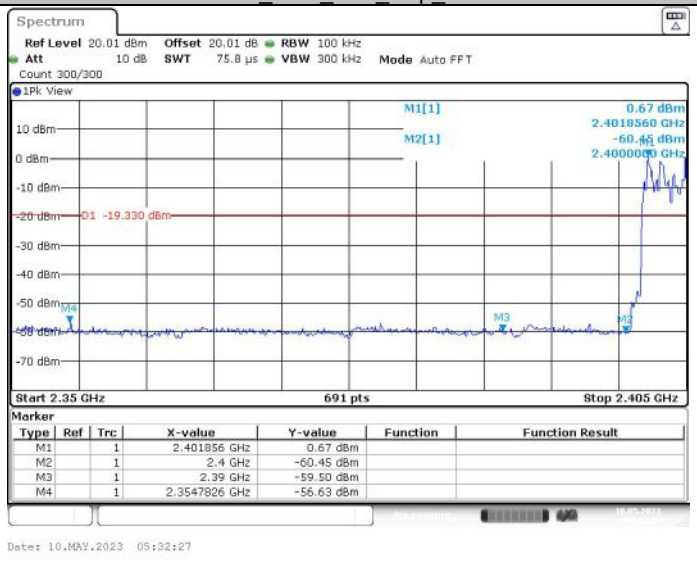
2DH1_Ant1_Low_2402



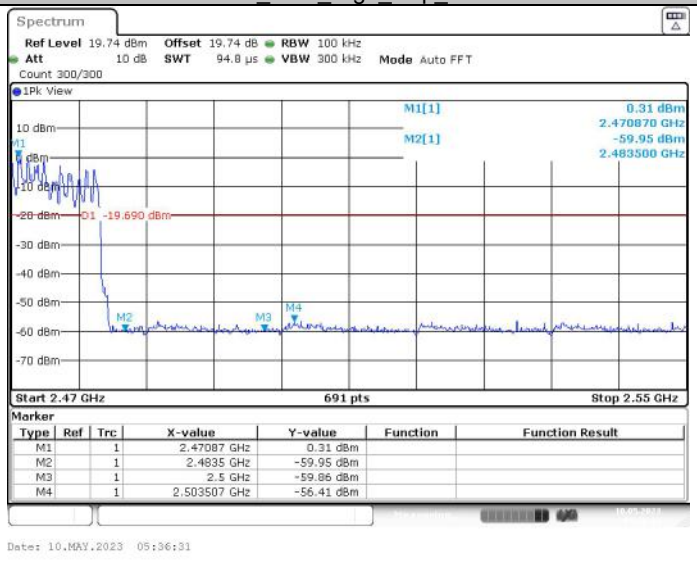
2DH1_Ant1_High_2480



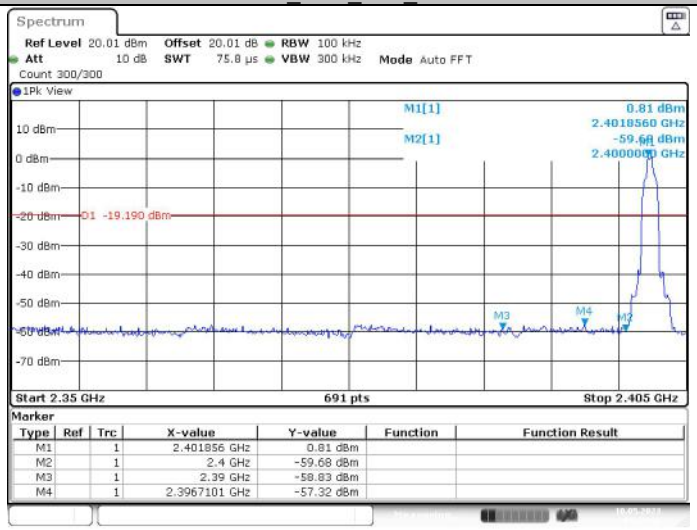
2DH1_Ant1_Low_Hop_2402



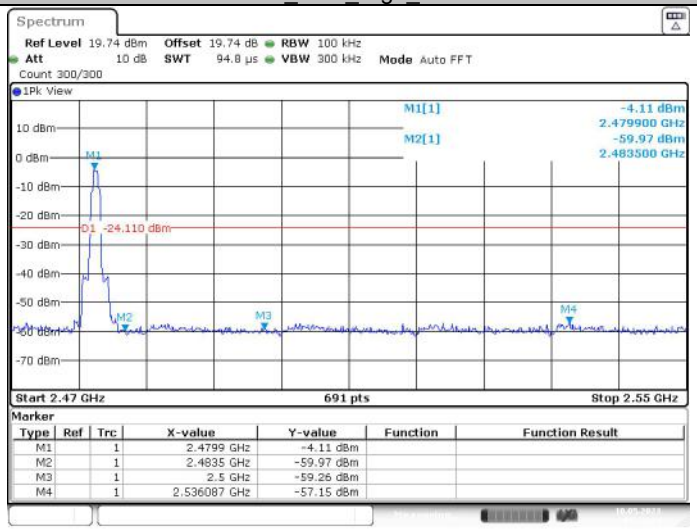
2DH1_Ant1_High_Hop_2480



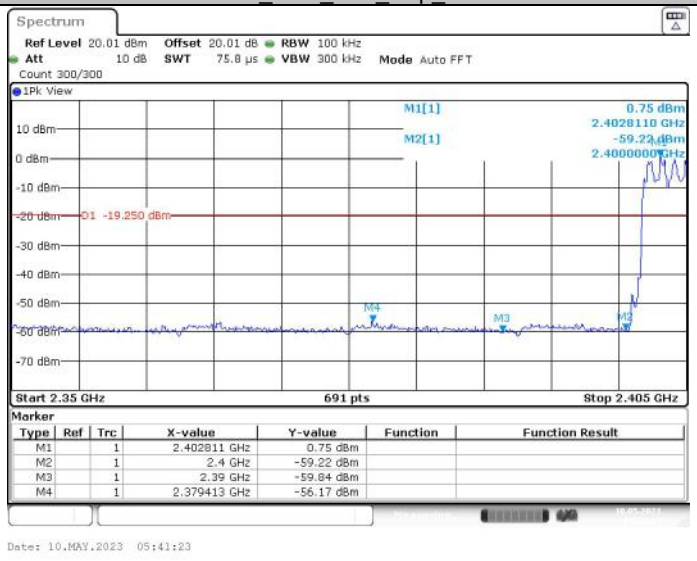
3DH1_Ant1_Low_2402



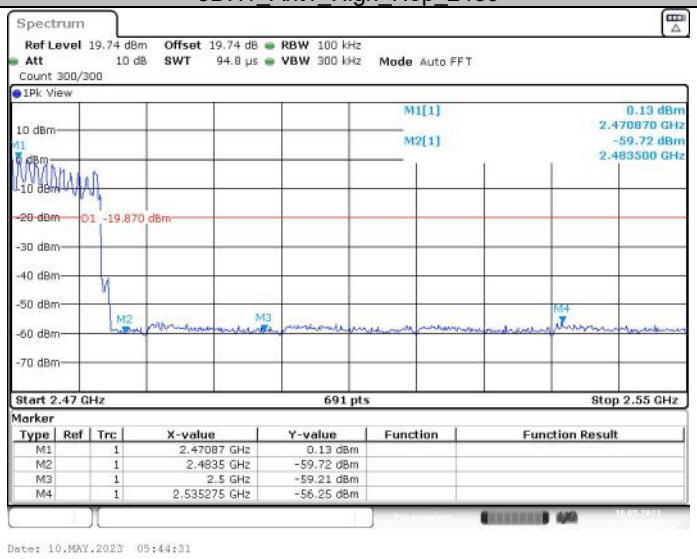
3DH1_Ant1_High_2480



3DH1_Ant1_Low_Hop_2402



3DH1_Ant1_High_Hop_2480



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