TEST REPORT

Applicant Name :	Shenzhen Snapmaker Technologies Co., Ltd.
Address :	4F & 5F, Building 13, Pingshan 1st Road, Nanshan District, Shenzhen, Guangdong, China
Report Number :	SZNS220913-41332E-RFB
FCC ID:	2AVDG-ARTISAN
IC:	26217-ARTISAN

Test Standard (s)

FCC PART 15.247; RSS-GEN ISSUE 5, FEBRUARY 2021 AMENDMENT 2; RSS-247, ISSUE 2, FEBRUARY 2017

Sample Description

Product Type:	3D Printer
Model No.:	Artisan
Multiple Model(s) No.:	N/A
Trade Mark:	SNAPMAKER
Date Received:	2022/09/13
Report Date:	2022/10/19

Test Result:	Pass*

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

Prepared and Checked By:

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Audy Yu
EMC Engineer

Approved By:

Candy. Li

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EMC Engineer

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

Product Description for Equipment under Test (EUT)

HVIN	Artisan
FVIN	Artisan
Frequency Range	Bluetooth: 2402~2480MHz
Transmit Peak Power	3.68dBm
Modulation Technique	Bluetooth: GFSK, π/4-DQPSK, 8DPSK
Antenna Specification*	0.51dBi (It is provided by the applicant)
Voltage Range	AC 110-220V , 50-60Hz
Sample serial number	SZNS220913-41332E-RF-S1 for Conducted and Radiated Emissions SZNS220913-41332E-RF-S2 for RF Conducted Test (Assigned by ATC)
Sample/EUT Status	Good condition

Note: Manufacturers can sell any of the three functions (3DP Module, Laser Module, CNC Module), the corresponding model names are as follows:

Product Name	Model	Note
3DP Module	TH-F-DUAL-AS ,TH-F-DUAL-MS	Only the model name is different between the two models.
Laser Module	TH-L-P100-W450	/
CNC Module	TH-C-200W	/

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules and RSS-247, Issue 2, February 2017, RSS-GEN Issue 5, Feb. 2021Amendment 2 of the Innovation, Science and Economic Development Canada 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 and RSS-247, Issue 2, February 2017, RSS-GEN Issue 5, Feb. 2021Amendment 2 of the Innovation, Science and Economic Development Canada rules.

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

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF Frequency		$0.082*10^{-7}$
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz- 40GHz	4.72dB
Temperature		1℃
Humidity		6%
Supply voltages		0.4%

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

Test Facility

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

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189.

Accredited by American Association for Laboratory Accreditation (A2LA). The Certificate Number is 4297.01

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 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

"QRCT"* exercise software was used and the power level is 7*. The software and power level was provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

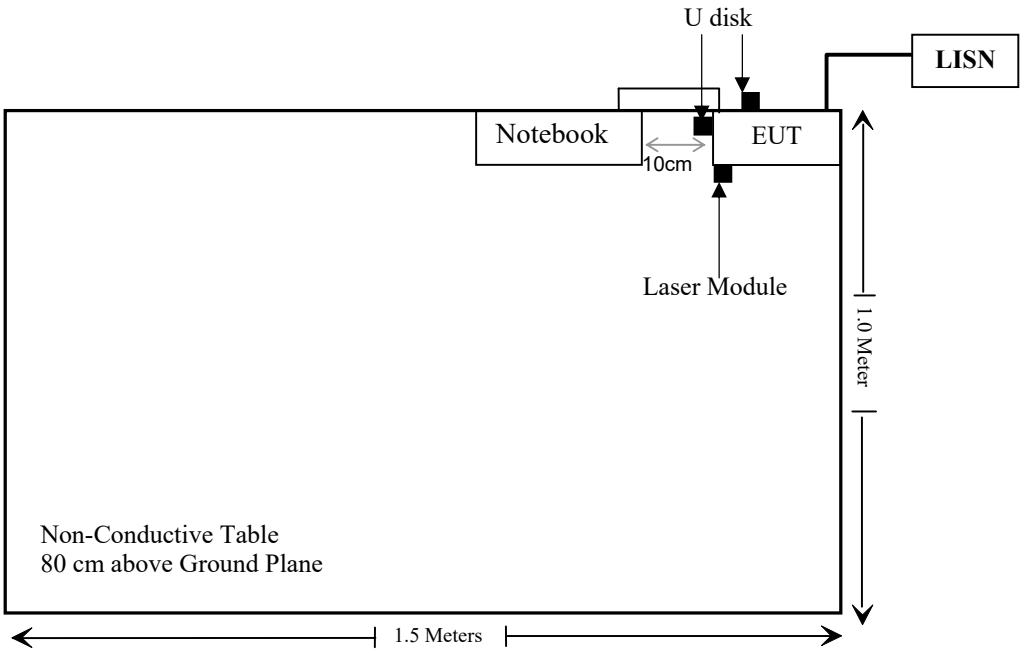
Manufacturer	Description	Model	Serial Number
DELL	NoteBook	Latitude E4710	PC201911252059
Unknown	U disk	Unknown	Unknown
Unknown	U disk	Unknown	Unknown
Snapmaker	Laser Module	TH-L-P100-W450	Unknown

External I/O Cable

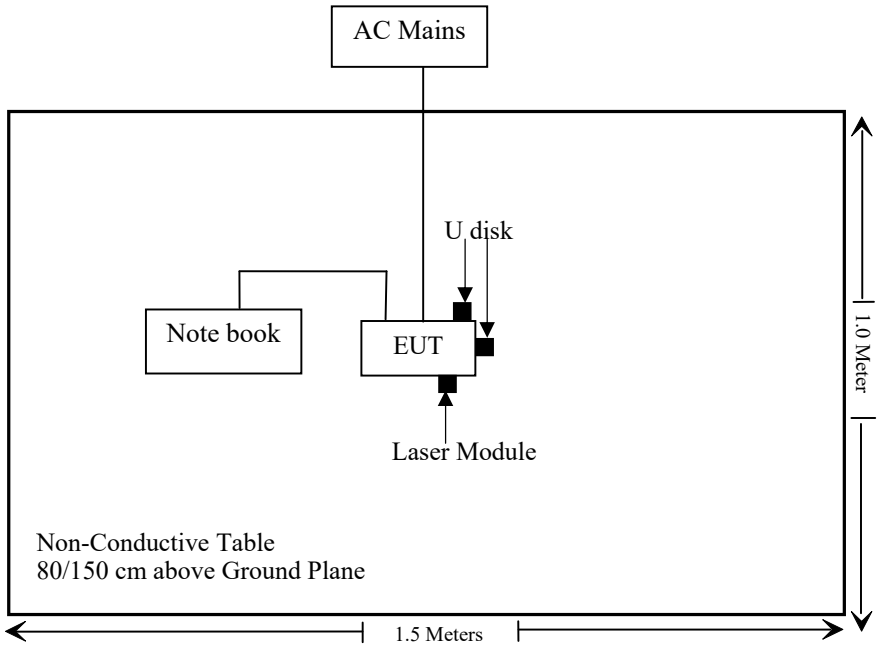
Cable Description	Length (m)	From Port	To
Un-shielded detachable AC cable	1.5	EUT	LISN/AC Mains
Un-shielded detachable USB cable	1.5	EUT	NoteBook

Block Diagram of Test Setup

For conducted emission:



For radiated emission:



SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (3) & §2.1091	Maximum Permissible Exposure (MPE)	Compliant
RSS-102 § 4	Exposure Limits	Compliant
FCC §15.203 RSS-Gen §6.8	Antenna Requirement	Compliant
FCC §15.207(a) RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d) RSS-247 § 5.5, RSS-GEN § 8.10	Radiated Emissions	Compliant
FCC §15.247(a)(1) RSS-247 § 5.1(a), RSS-GEN § 6.7	20 dB Emission Bandwidth & 99% Occupied Bandwidth	Compliant
FCC §15.247(a)(1) RSS-247 § 5.1 (b)	Channel Separation Test	Compliant
FCC §15.247(a)(1)(iii) RSS-247 § 5.1 (d)	Time of Occupancy (Dwell Time)	Compliant
FCC §15.247(a)(1)(iii) RSS-247 § 5.1 (d)	Quantity of hopping channel Test	Compliant
FCC §15.247(b)(1) RSS-247 § 5.1(b) &§ 5.4(b)	Peak Output Power Measurement	Compliant
FCC §15.247(d) RSS-247 § 5.5	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	2021/12/13	2022/12/12
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2021/12/13	2022/12/12
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2021/12/13	2022/12/12
Unknown	RF Coaxial Cable	No.17	N0350	2021/12/14	2022/12/13
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/11/11	2022/11/10
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2021/12/14	2022/12/13

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF conducted test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101590	2022/01/19	2023/01/18
Tonscend	RF Control Unit	JS0806-2	19G8060182	2021/10/26	2022/10/25
WEINSCHEL	10dB Attenuator	5324	AU 3842	2021/12/14	2022/12/13
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- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

An alternative to the SAR-based exemption is provided in § 1.1307(b)(3)(i)(C), for a much wider frequency range, from 300 kHz to 100 GHz, applicable for separation distances greater or equal to λ/2π, where λ is the free-space operating wavelength in meters. The MPE-based test exemption condition is in terms of ERP, defined as the product of the maximum antenna gain and the delivered maximum time-averaged power. For this case, a RF source is an RF exempt device if its ERP (watts) is no more than a frequency-dependent value, as detailed tabular form in Appendix B. These limits have been derived based on the basic specifications on Maximum Permissible Exposure (MPE) considered for the FCC rules in § 1.1310(e)(1).

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.

f = frequency in MHz;
R = minimum separation distance from the body of a nearby person (appropriate units, e.g., m);

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

For worst case:

Mode	Frequency (MHz)	Tune up conducted power	Antenna Gain		ERP		Evaluation Distance (m)	ERP Limit (mW)
		(dBm)	(dBi)	(dBd)	(dBm)	(mW)		
BT	2402-2480	4.0	0.51	-1.64	2.36	1.722	0.2	768
2.4G Wi-Fi	2412-2462	21.0	0.51	-1.64	19.36	86.298	0.2	768
5G Wi-Fi	5150-5250	17.5	0.69	-1.46	16.04	40.179	0.2	768
5G Wi-Fi	5725-5850	15.5	0.69	-1.46	14.04	25.351	0.2	768

Note 1: The tune-up power and antenna gain was declared by the applicant.
Note 2: 0dBd=2.15dBi.
Note 3: The BT can transmit at the same time with the Wi-Fi, the 2.4G Wi-Fi and 5G Wi-Fi cannot Simultaneous transmitting

Simultaneous transmitting consideration (worst case):

The ratio=ERP_{BT}/limit $_{BT}$ + ERP $_{Wi\text{-}Fi}$/limit $_{Wi\text{-}Fi}$ = 1.722/768+86.298/768=0.115＜1.0

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

Result: Compliant.

RSS-102 § 4 –EXPOSURE LIMITS

Applicable Standard

According to RSS-102 §4:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	-2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Result

Mode	Frequency (MHz)	Antenna Gain		Max Tune Up Conducted Power		Evaluation Distance (m)	Power Density (W/m^2)	MPE Limit (W/m^2)
		(dBi)	(numeric)	(dBm)	(W)			
BT	2402-2480	0.51	1.12	4.0	0.003	0.2	0.006	5.351
2.4G Wi-Fi	2412-2462	0.51	1.12	21.0	0.126	0.2	0.282	5.366
5G Wi-Fi	5150-5250	0.69	1.17	17.5	0.056	0.2	0.131	9.011
5G Wi-Fi	5725-5850	0.69	1.17	15.5	0.035	0.2	0.083	9.687

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The BT can transmit at the same time with the Wi-Fi, the 2.4G Wi-Fi and 5G Wi-Fi cannot Simultaneous transmitting

Simultaneous transmitting consideration (worst case):

The ratio=MPE_{BT}/limit+$MPE_{2.4G\ Wi\text{-}Fi}$ /limit=0.006/5.351+0.282/5.366=0.054＜1.0.

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

Result: Pass

FCC §15.203 & RSS-GEN §6.8 – 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.

According to FCC § 15.203, the applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device. Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

Antenna Connector Construction

The EUT has one internal antenna arrangement which was permanently attached and the maximum antenna gain is 0.51dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna Type	Antenna Gain	Impedance	Frequency Range
FPC	0.51dBi	50Ω	2.4~2.5GHz

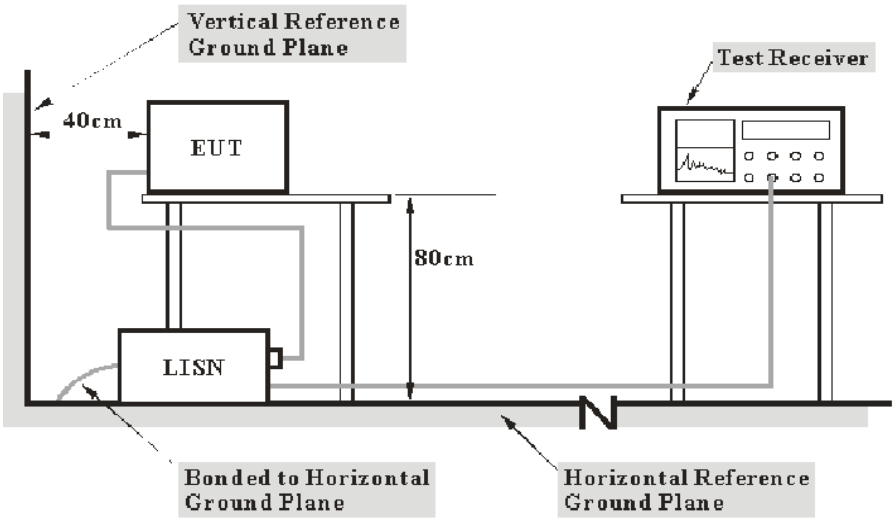
Result: Compliance

FCC §15.207 (a) & RSS-GEN § 8.8 – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a), RSS-GEN § 8.8

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 & RSS-Gen.

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

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.

Corrected Factor & Margin Calculation

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

Transd 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 calculation is as follows:

Over Limit = Level – Limit
Level = Read Level + Factor

Test Data

Environmental Conditions

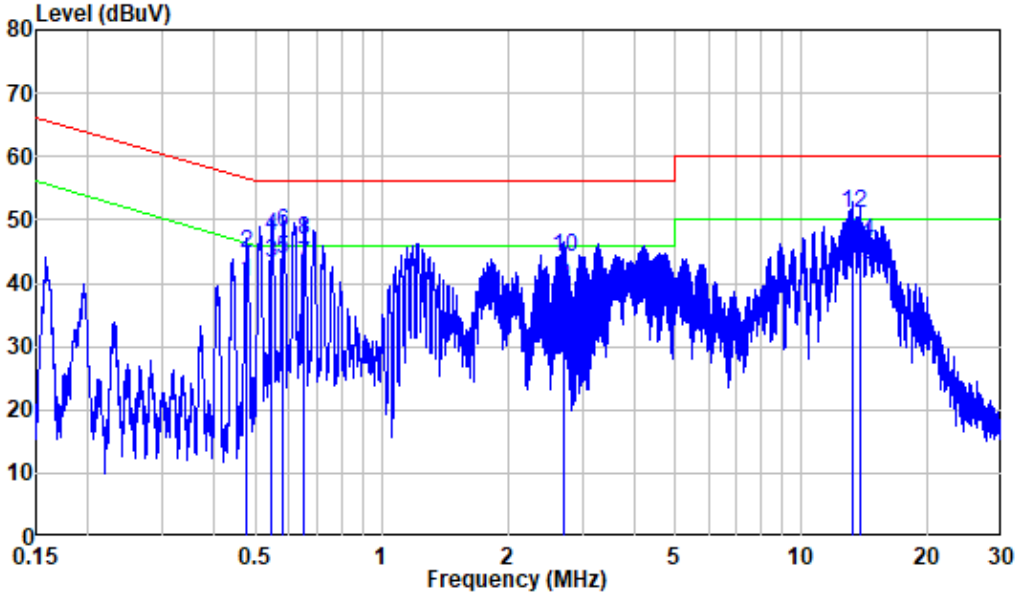
Temperature:	24°C
Relative Humidity:	40%
ATM Pressure:	101.0 kPa

The testing was performed by Jason Liu on 2022-10-09.

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

Note: The EUT's Bluetooth can only be transmitted when the Laser Module is used.

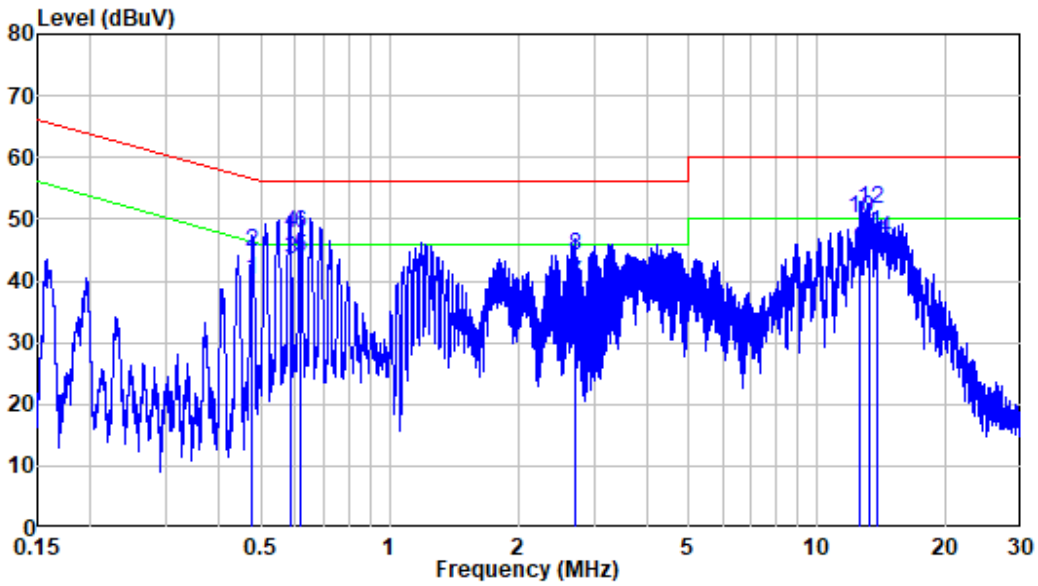
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : SZNS220913-41332E-RF
Mode : BT
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.476	9.80	30.32	40.12	46.40	-6.28	Average
2	0.476	9.80	35.03	44.83	56.40	-11.57	QP
3	0.546	9.81	33.25	43.06	46.00	-2.94	Average
4	0.546	9.81	37.69	47.50	56.00	-8.50	QP
5	0.582	9.81	33.92	43.73	46.00	-2.27	Average
6	0.582	9.81	38.18	47.99	56.00	-8.01	QP
7	0.653	9.81	33.09	42.90	46.00	-3.10	Average
8	0.653	9.81	36.87	46.68	56.00	-9.32	QP
9	2.719	9.83	29.57	39.40	46.00	-6.60	Average
10	2.719	9.83	34.37	44.20	56.00	-11.80	QP
11	13.188	9.93	36.70	46.63	50.00	-3.37	Average
12	13.188	9.93	41.07	51.00	60.00	-9.00	QP
13	13.832	9.94	33.07	43.01	50.00	-6.99	Average
14	13.832	9.94	36.51	46.45	60.00	-13.55	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : SZNS220913-41332E-RF
Mode : BT
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.478	9.80	30.23	40.03	46.37	-6.34	Average
2	0.478	9.80	34.85	44.65	56.37	-11.72	QP
3	0.584	9.81	33.78	43.59	46.00	-2.41	Average
4	0.584	9.81	37.87	47.68	56.00	-8.32	QP
5	0.618	9.81	33.96	43.77	46.00	-2.23	Average
6	0.618	9.81	37.87	47.68	56.00	-8.32	QP
7	2.719	9.83	29.81	39.64	46.00	-6.36	Average
8	2.719	9.83	34.33	44.16	56.00	-11.84	QP
9	12.624	10.03	35.00	45.03	50.00	-4.97	Average
10	12.624	10.03	40.00	50.03	60.00	-9.97	QP
11	13.223	10.03	37.53	47.56	50.00	-2.44	Average
12	13.223	10.03	41.58	51.61	60.00	-8.39	QP
13	13.832	10.04	33.34	43.38	50.00	-6.62	Average
14	13.832	10.04	36.86	46.90	60.00	-13.10	QP

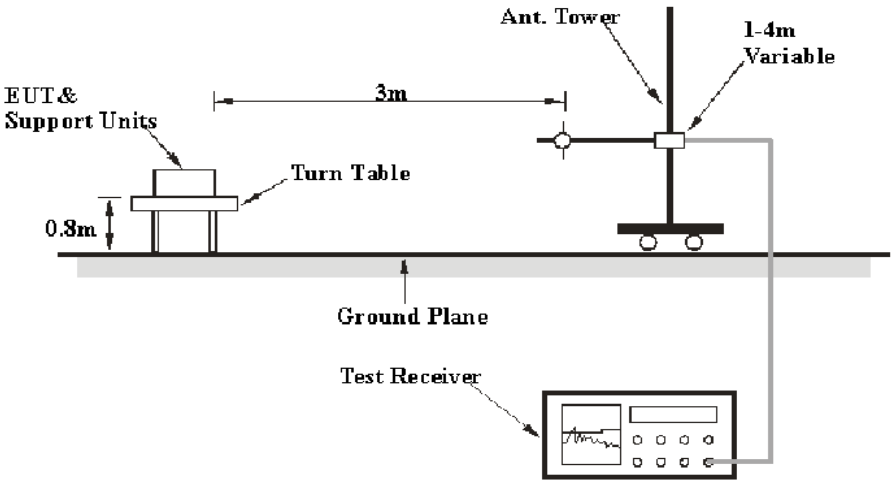
FCC §15.209, §15.205 & §15.247(d) & RSS-247§ 5.5 - SPURIOUS EMISSIONS

Applicable Standard

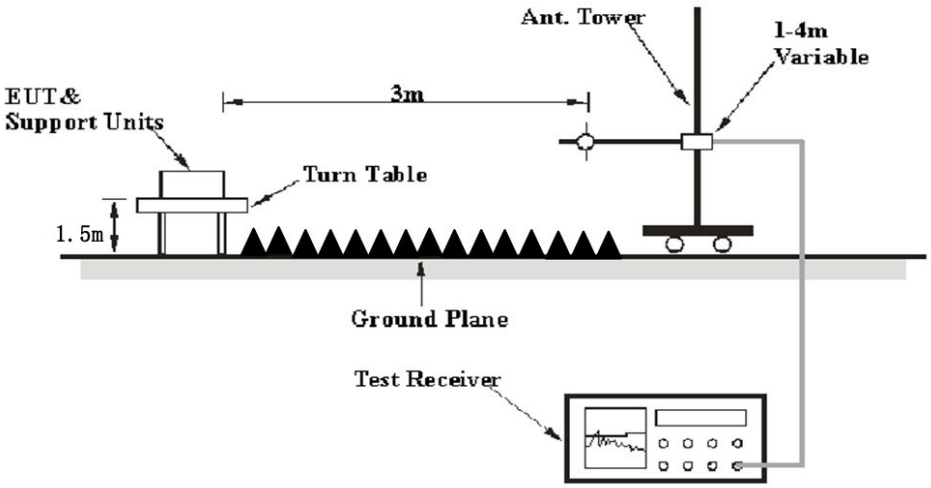
FCC §15.205; §15.209; §15.247(d); RSS-247§ 5.5; RSS-GEN § 8.10

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013 & RSS-Gen. The specification used was the FCC 15.209, and FCC 15.247/RSS-247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

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

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

Test Procedure

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

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

Factor & Margin Calculation

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

Factor = Antenna Factor + Cable Loss - Amplifier Gain

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

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	24.5~25 ℃
Relative Humidity:	50~60 %
ATM Pressure:	101.0 kPa

The testing was performed by Level Li on 2022-10-09 for below 1GHz, Jeff Jiang on 2022-09-28 for above 1GHz.

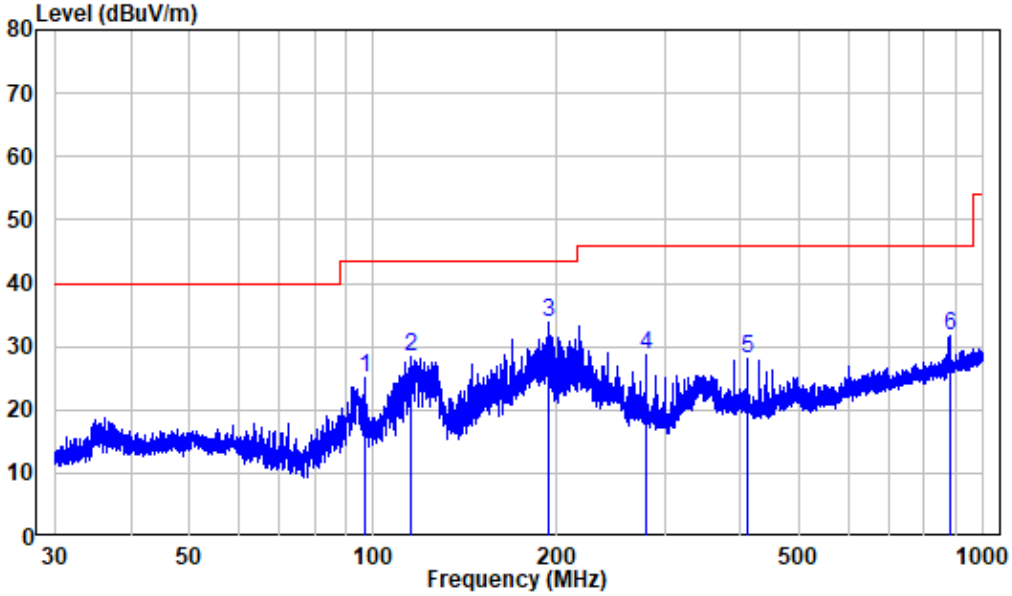
EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case of X-axes orientation was recorded)

Note: The EUT's Bluetooth can only be transmitted when the Laser Module is used.

Below 1GHz: (*the worst case is 8DPSK Mode, High channel*)

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

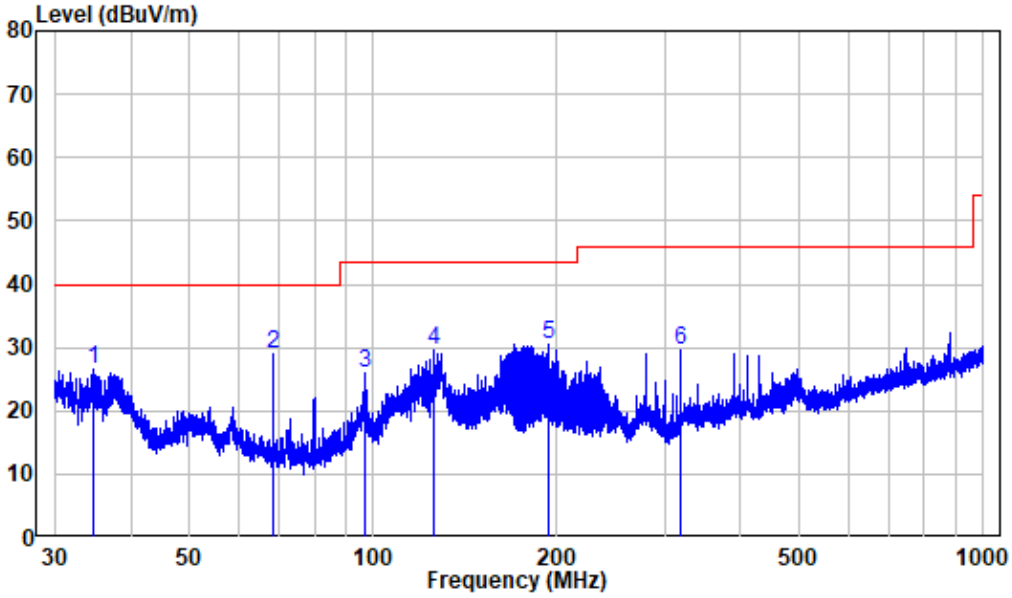
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220913-41332E-RF
Test Mode: BT

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	96.605	-12.29	37.29	25.00	43.50	-18.50	Peak
2	115.220	-12.72	41.14	28.42	43.50	-15.08	Peak
3	193.179	-11.29	45.16	33.87	43.50	-9.63	Peak
4	279.901	-9.59	38.34	28.75	46.00	-17.25	Peak
5	410.023	-6.33	34.51	28.18	46.00	-17.82	Peak
6	879.863	1.24	30.42	31.66	46.00	-14.34	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : SZNS220913-41332E-RF
Test Mode: BT

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	34.623	-11.66	38.31	26.65	40.00	-13.35	Peak
2	68.391	-14.02	42.89	28.87	40.00	-11.13	Peak
3	96.605	-12.29	38.15	25.86	43.50	-17.64	Peak
4	125.997	-14.41	44.13	29.72	43.50	-13.78	Peak
5	193.179	-11.29	41.91	30.62	43.50	-12.88	Peak
6	319.517	-8.48	38.06	29.58	46.00	-16.42	Peak

Above 1GHz: (worst case for 8DPSK, 3DH5)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel									
2310	68.11	PK	333	2.1	H	-7.24	60.87	74	-13.13
2310	43.34	AV	333	2.1	H	-7.24	36.10	54	-17.90
2310	68.05	PK	355	1.2	V	-7.24	60.81	74	-13.19
2310	43.28	AV	355	1.2	V	-7.24	36.04	54	-17.96
2390	69.09	PK	109	1.8	H	-7.22	61.87	74	-12.13
2390	44.32	AV	109	1.8	H	-7.22	37.10	54	-16.90
2390	70.05	PK	324	2.1	V	-7.22	62.83	74	-11.17
2390	45.28	AV	324	2.1	V	-7.22	38.06	54	-15.94
4804	54.39	PK	324	2.3	H	-3.51	50.88	74	-23.12
4804	54.72	PK	323	1.5	V	-3.51	51.21	74	-22.79
Middle Channel									
4882	54.52	PK	64	1.7	H	-3.37	51.15	74	-22.85
4882	54.69	PK	155	2.4	V	-3.37	51.32	74	-22.68
High Channel									
2483.5	69.75	PK	98	1.4	H	-7.2	62.55	74	-11.45
2483.5	44.98	AV	98	1.4	H	-7.2	37.78	54	-16.22
2483.5	69.45	PK	89	2.2	V	-7.2	62.25	74	-11.75
2483.5	44.68	AV	89	2.2	V	-7.2	37.48	54	-16.52
2500	68.77	PK	63	1.4	H	-7.18	61.59	74	-12.41
2500	44.00	AV	63	1.4	H	-7.18	36.82	54	-17.18
2500	68.50	PK	40	1.3	V	-7.18	61.32	74	-12.68
2500	43.73	AV	40	1.3	V	-7.18	36.55	54	-17.45
4960	54.35	PK	224	2.1	H	-3.01	51.34	74	-22.66
4960	54.01	PK	47	1.3	V	-3.01	51	74	-23.00

Simultaneous transmitting consideration：

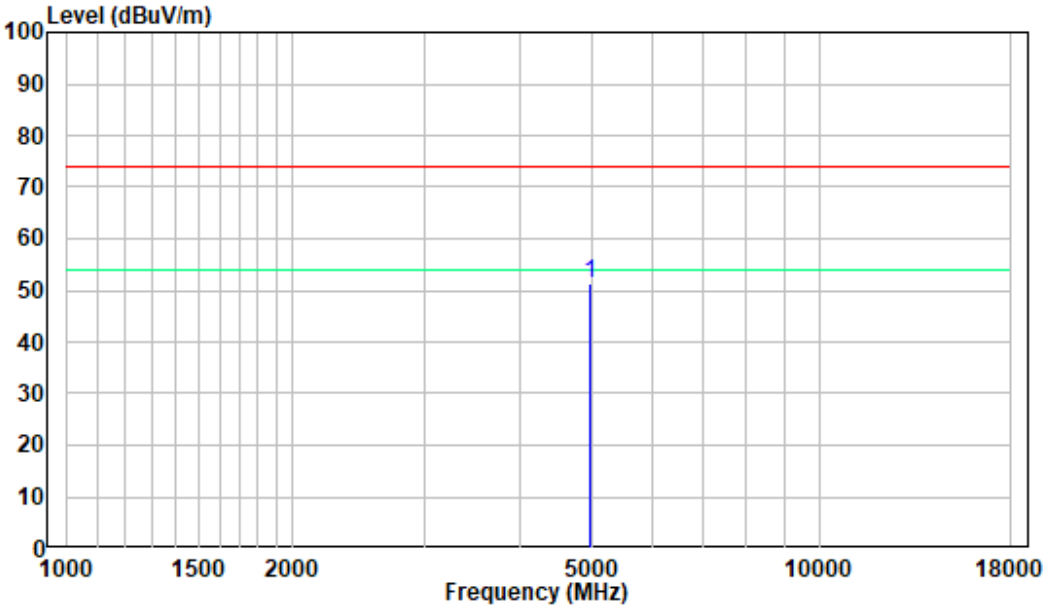
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/AV		Height (m)	Polar (H/V)				
Worst case: Bluetooth 3DH5 2480MHz+ 802.11a 5180MHz									
193.25	44.55	PK	26	1.5	H	-11.29	33.26	43.5	-10.24
193.25	37.42	PK	227	1.5	V	-11.29	26.13	43.5	-17.37
4960	54.19	PK	221	2.1	H	-3.01	51.18	74	-22.82
4960	53.83	PK	46	1.4	V	-3.01	50.82	74	-23.18
10360	42.95	PK	235	2.2	H	8.12	51.07	68.2	-17.13
10360	42.22	PK	307	2.1	V	8.12	50.34	68.2	-17.86

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 20dB to the limit or in the noise floor level was not recorded.
The test result of peak was less than the limit of average or QP, so just the peak value was recorded.

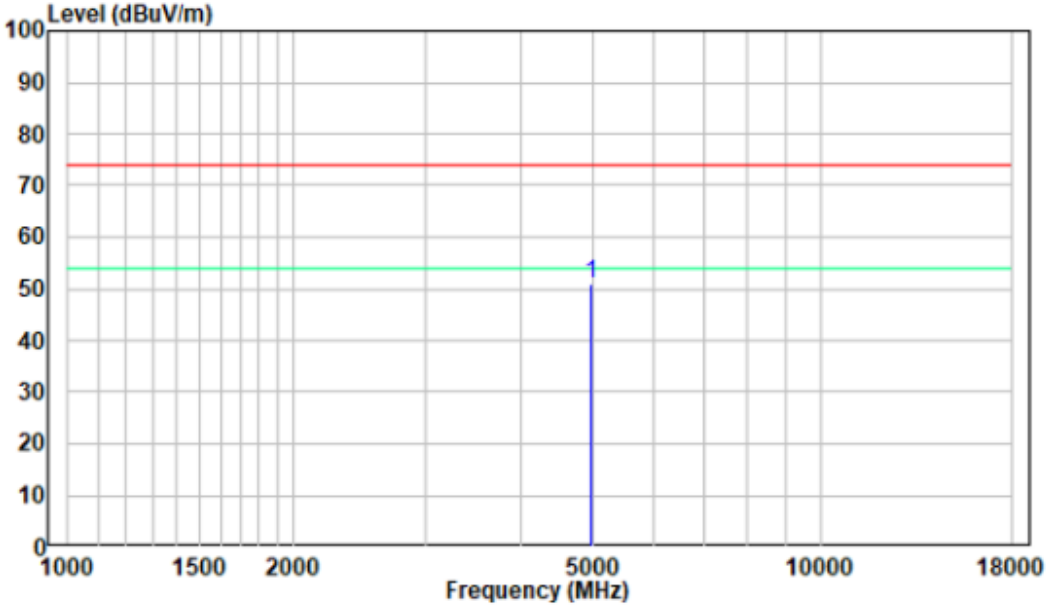
1 GHz - 18 GHz: (Pre-Scan plots)

High channel

Horizontal



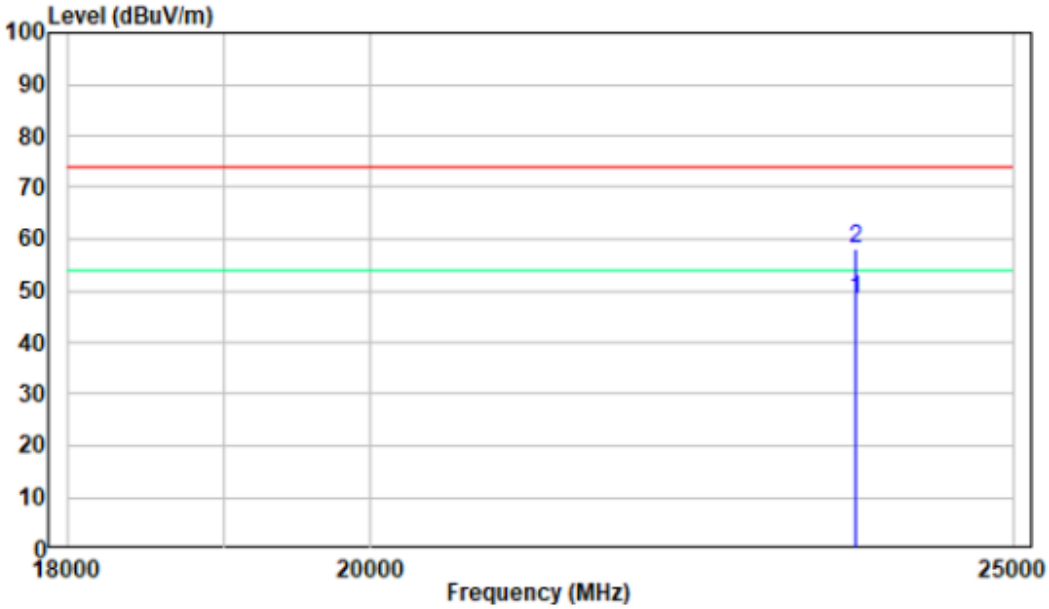
Vertical



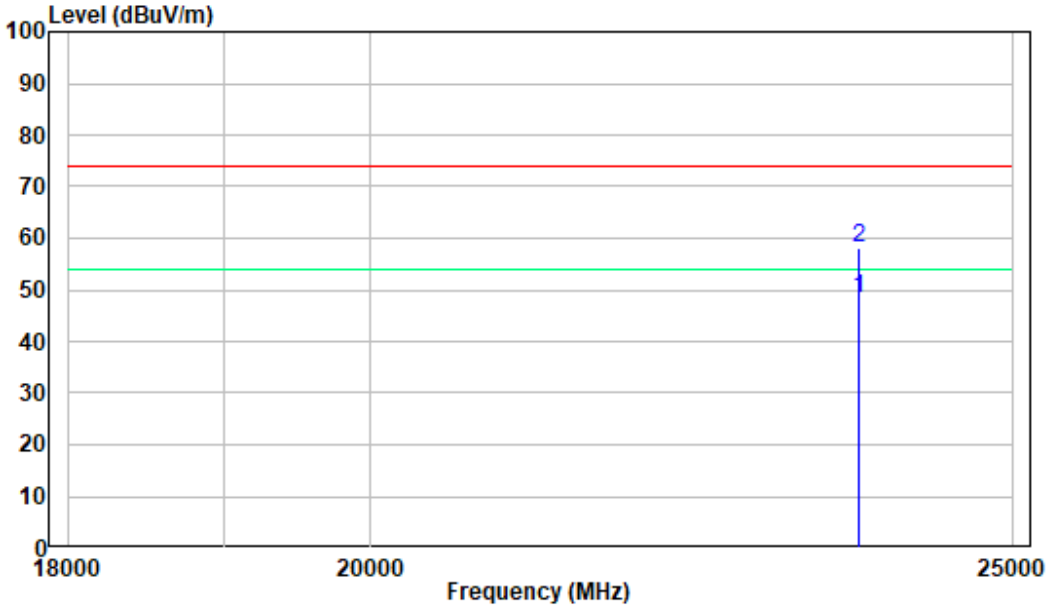
18-25GHz: (Pre-Scan plots)

High channel

Horizontal



Vertical



FCC §15.247(a) (1) & RSS-247 § 5.1 (b) -CHANNEL SEPARATION TEST

Applicable Standard

According to FCC §15.247(a) (1):

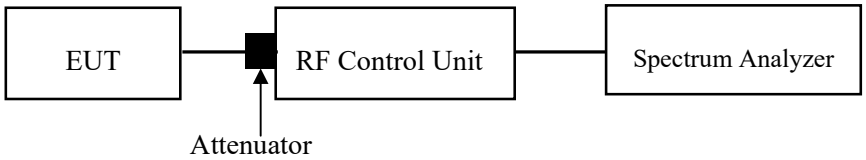
Frequency hopping systems shall have hoping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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.

According to RSS-247 § 5.1 (b):

Frequency hopping systems (FHSs) shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W. 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

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



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65℃
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-09.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(a) (1) & RSS-247 § 5.1 (a), RSS-GEN § 6.7 – 20 dB EMISSION BANDWIDTH & 99% OCCUPIED BANDWIDTH

Applicable Standard

According to FCC §15.247(a) (1):

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.

According to RSS-247 § 5.1 (a), RSS-GEN § 6.7:

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the "20 dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated 20 dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

Test Procedure

The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:

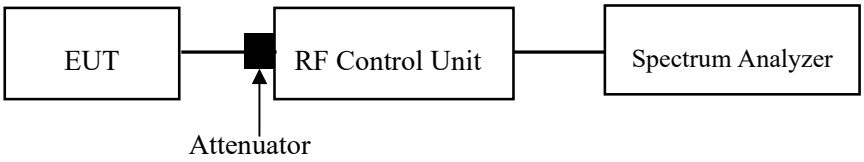
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

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

• The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / 20 dB bandwidth if the device is not transmitting continuously.

• The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.
For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65℃
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-09.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix

FCC §15.247(a) (1) (iii) & RSS-247 § 5.1 (d) - QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

According to FCC §15.247(a) (1) (iii):

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.

According to RSS-247 § 5.1 (d):

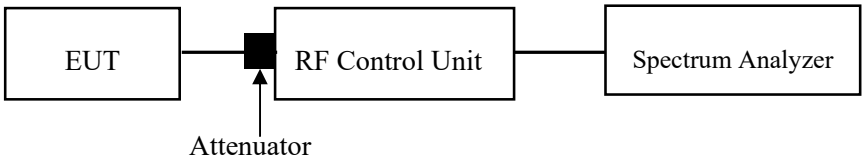
Frequency hopping systems (FHSS) operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

Test Procedure

Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

Set the EUT in hopping mode from first channel to last.

By using the max-hold function record the quantity of the channel.



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65℃
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-09.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(a) (1) (iii) & RSS-247 § 5.1 (d) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

According to FCC §15.247(a) (1) (iii):

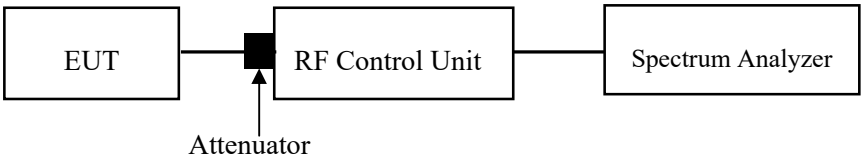
Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions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

According to RSS-247 § 5.1 (d):

Frequency hopping systems (FHSs) operating in the band 2400-2483.5 MHz shall use at least 15 hopping 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

Test Procedure

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



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65℃
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-09.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

FCC §15.247(b) (1) & RSS-247§ 5.1(b) &§ 5.4(b) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to FCC §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.

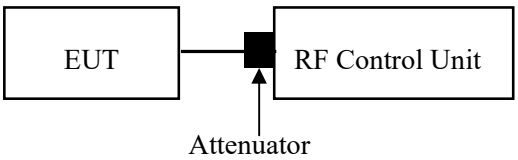
According to RSS-247§ 5.1(b) &§ 5.4(b):

For frequency hopping systems (FHSs) operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W (see Section 5.4(e) for exceptions).

Frequency hopping systems (FHSs) shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W.

Test Procedure

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



Note: the RF control unit has a built-in power sensor.

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65℃
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-09.

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

According to FCC §15.247(d).

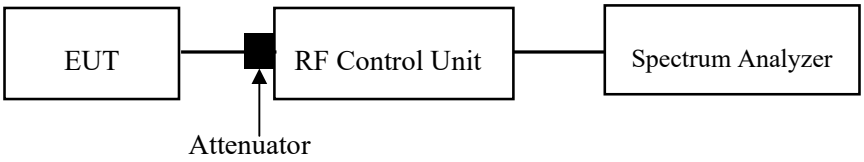
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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)).

According to RSS-247 § 5.5.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(e), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Procedure

Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
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.
Set RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	65℃
ATM Pressure:	101.0 kPa

The testing was performed by Roger Ling on 2022-10-09.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix.

APPENDIX

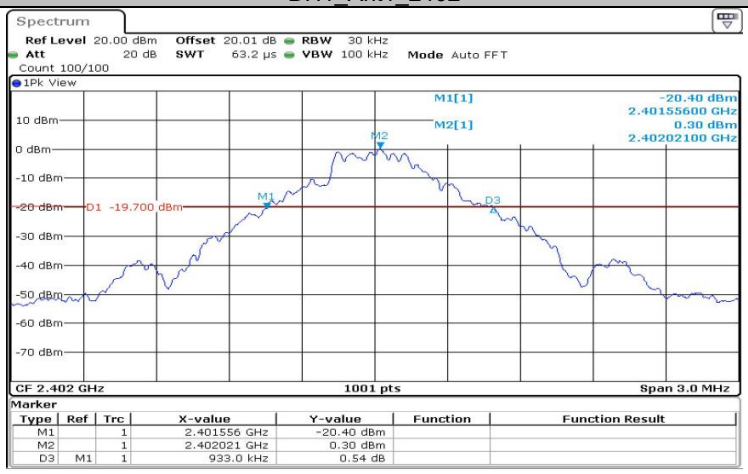
Appendix A: 20dB Emission Bandwidth

Test Result

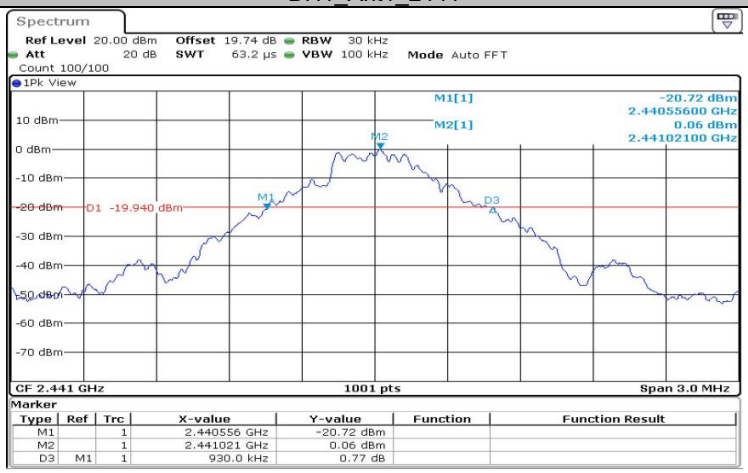
Test Mode	Antenna	Frequency[MHz]	20dB EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.93	2401.56	2402.49	---	---
		2441	0.93	2440.56	2441.49	---	---
		2480	0.93	2479.56	2480.49	---	---
2DH1	Ant1	2402	1.26	2401.38	2402.63	---	---
		2441	1.26	2440.38	2441.63	---	---
		2480	1.25	2479.38	2480.63	---	---
3DH1	Ant1	2402	1.22	2401.41	2402.63	---	---
		2441	1.23	2440.41	2441.63	---	---
		2480	1.23	2479.41	2480.63	---	---

Test Graphs

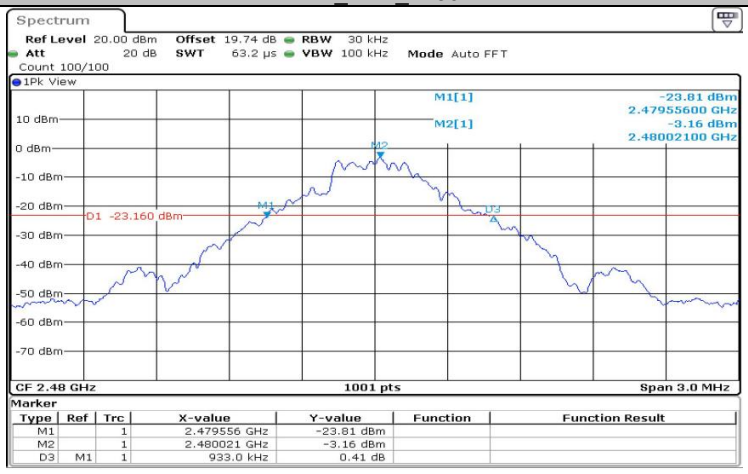
DH1_Ant1_2402



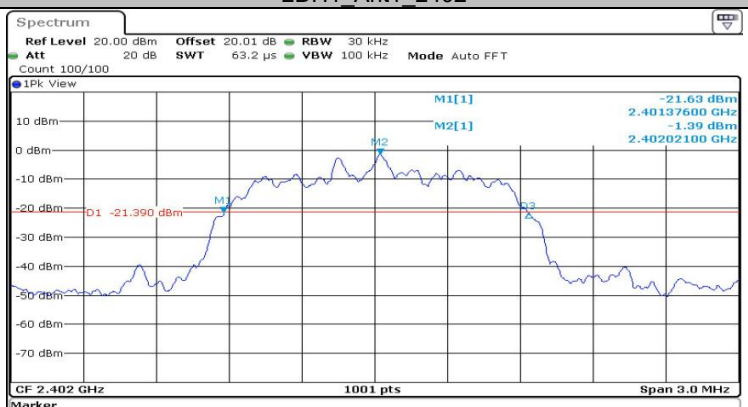
DH1_Ant1_2441



DH1_Ant1_2480



2DH1_Ant1_2402

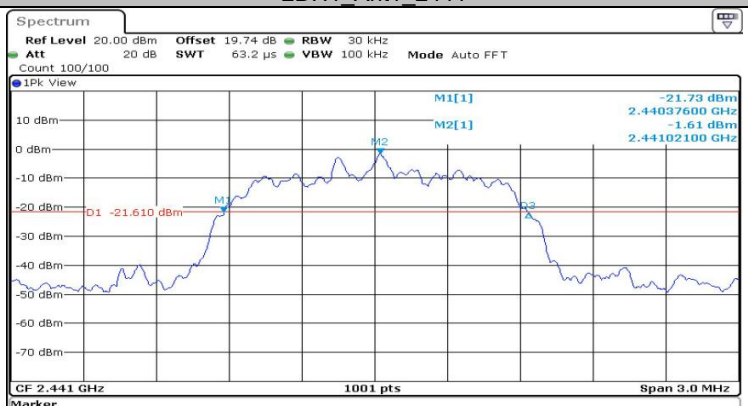


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401376 GHz	-21.63 dBm		
M2		1	2.402021 GHz	-1.39 dBm		
D3	M1	1	1.257 MHz	0.06 dB		

Date: 9.OCT.2022 06:27:35

2DH1_Ant1_2441

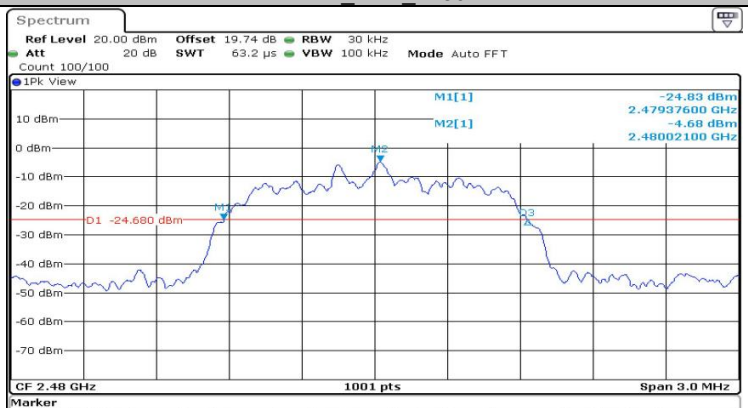


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.440376 GHz	-21.73 dBm		
M2		1	2.441021 GHz	-1.61 dBm		
D3	M1	1	1.257 MHz	-0.18 dB		

Date: 9.OCT.2022 06:28:43

2DH1_Ant1_2480

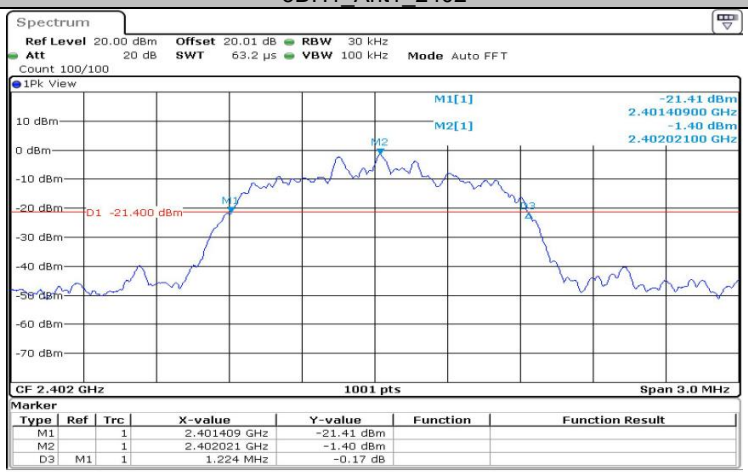


Marker

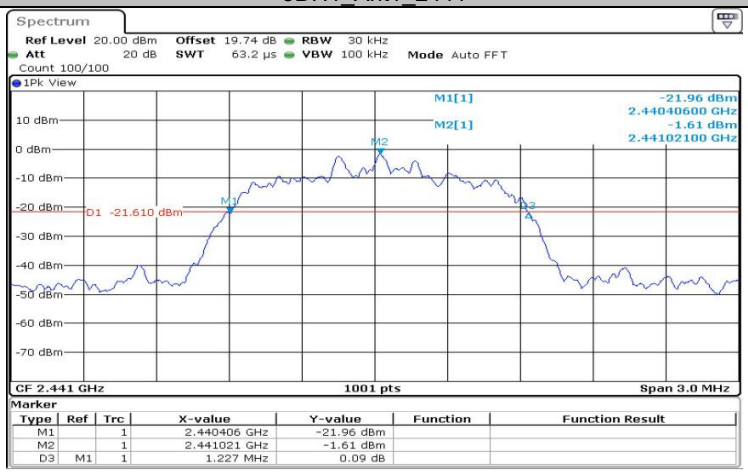
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479376 GHz	-24.83 dBm		
M2		1	2.480021 GHz	-4.68 dBm		
D3	M1	1	1.254 MHz	0.11 dB		

Date: 9.OCT.2022 06:29:38

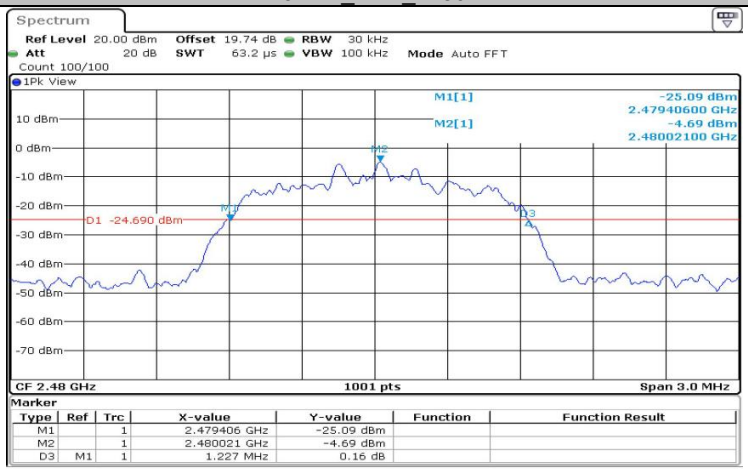
3DH1_Ant1_2402



3DH1_Ant1_2441



3DH1_Ant1_2480



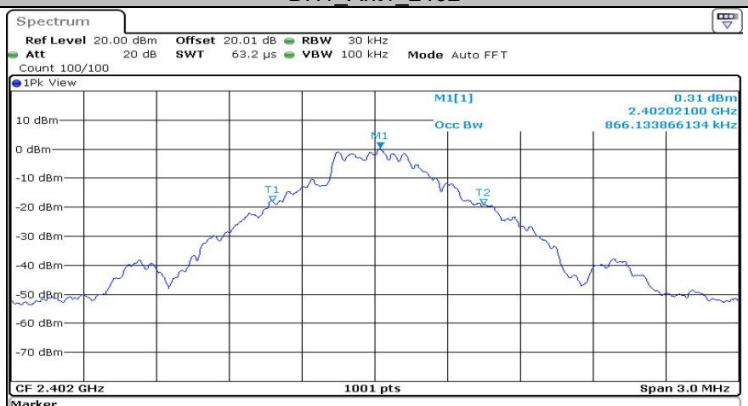
Appendix B: Occupied Channel Bandwidth

Test Result

Test Mode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.866	2401.580	2402.447	---	---
		2441	0.866	2440.577	2441.444	---	---
		2480	0.866	2479.577	2480.444	---	---
2DH1	Ant1	2402	1.166	2401.419	2402.584	---	---
		2441	1.166	2440.419	2441.584	---	---
		2480	1.169	2479.416	2480.584	---	---
3DH1	Ant1	2402	1.151	2401.443	2402.593	---	---
		2441	1.151	2440.443	2441.593	---	---
		2480	1.151	2479.443	2480.593	---	---

Test Graphs

DH1_Ant1_2402

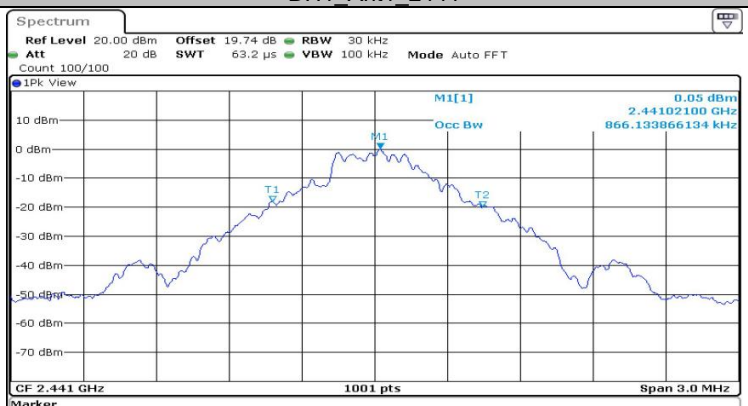


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.402021 GHz	0.31 dBm		
T1		1	2.40158042 GHz	-18.03 dBm	Occ Bw	866.133866134 kHz
T2		1	2.40244655 GHz	-19.28 dBm		

Date: 9.OCT.2022 06:21:17

DH1_Ant1_2441

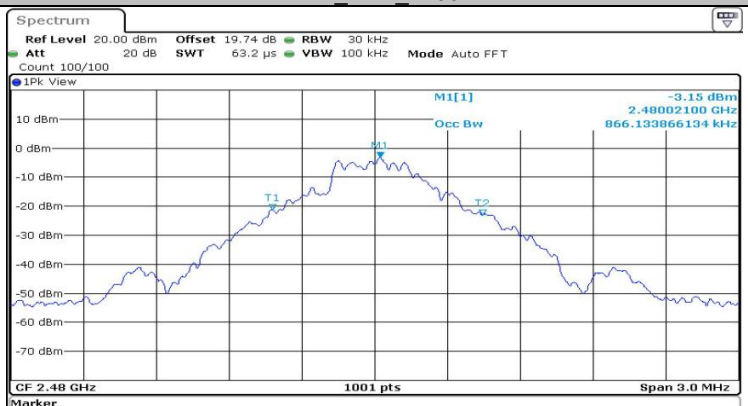


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.441021 GHz	0.05 dBm		
T1		1	2.44057742 GHz	-18.08 dBm	Occ Bw	866.133866134 kHz
T2		1	2.44144356 GHz	-19.95 dBm		

Date: 9.OCT.2022 06:25:24

DH1_Ant1_2480

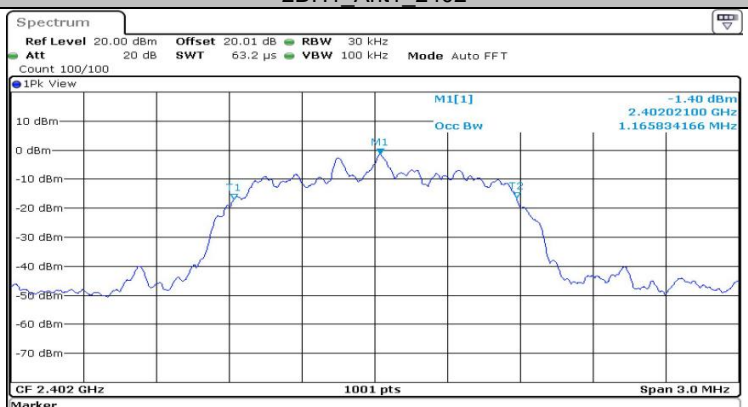


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480021 GHz	-3.15 dBm		
T1		1	2.47957742 GHz	-21.16 dBm	Occ Bw	866.133866134 kHz
T2		1	2.48044356 GHz	-23.11 dBm		

Date: 9.OCT.2022 06:26:26

2DH1_Ant1_2402

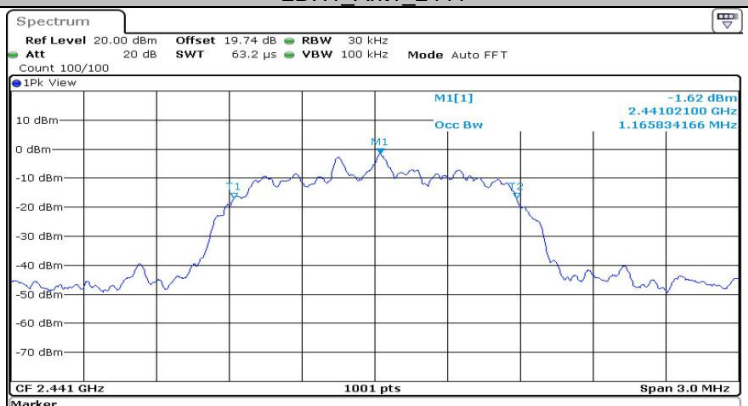


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.402021 GHz	-1.40 dBm		
T1		1	2.40141858 GHz	-16.92 dBm	Occ Bw	1.165834166 MHz
T2		1	2.40258442 GHz	-16.61 dBm		

Date: 9.OCT.2022 06:27:46

2DH1_Ant1_2441

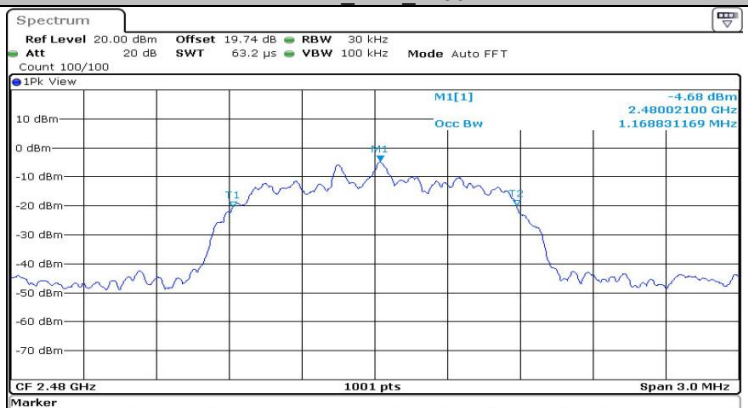


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.441021 GHz	-1.62 dBm		
T1		1	2.44041858 GHz	-17.04 dBm	Occ Bw	1.165834166 MHz
T2		1	2.44158442 GHz	-16.91 dBm		

Date: 9.OCT.2022 06:28:54

2DH1_Ant1_2480

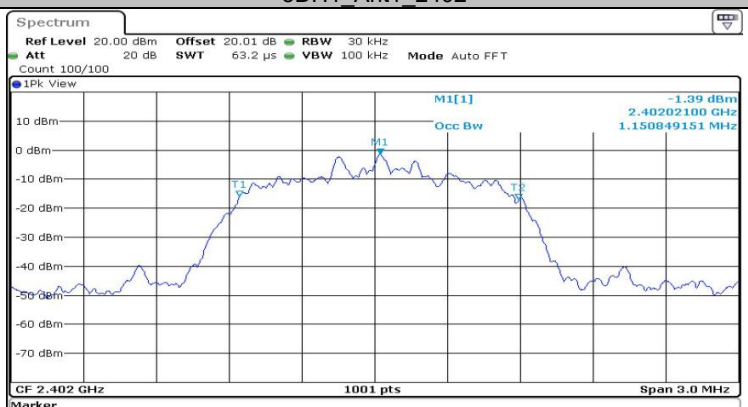


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480021 GHz	-4.68 dBm		
T1		1	2.47941558 GHz	-20.38 dBm	Occ Bw	1.168831169 MHz
T2		1	2.48058442 GHz	-20.04 dBm		

Date: 9.OCT.2022 06:29:49

3DH1_Ant1_2402

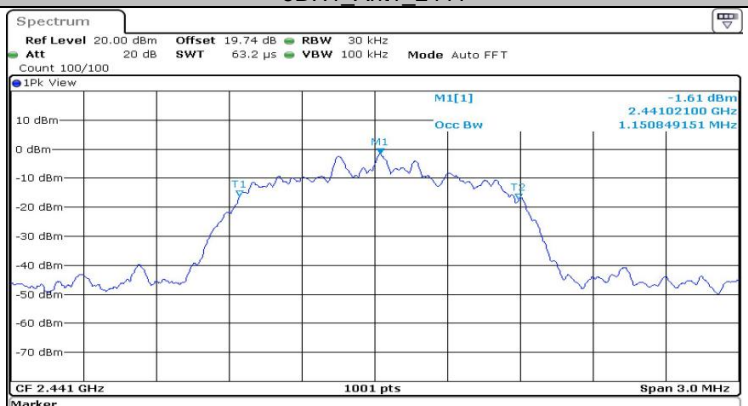


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.402021 GHz	-1.39 dBm		
T1		1	2.40144256 GHz	-16.03 dBm	Occ Bw	1.150849151 MHz
T2		1	2.40259341 GHz	-16.94 dBm		

Date: 9.OCT.2022 06:31:02

3DH1_Ant1_2441

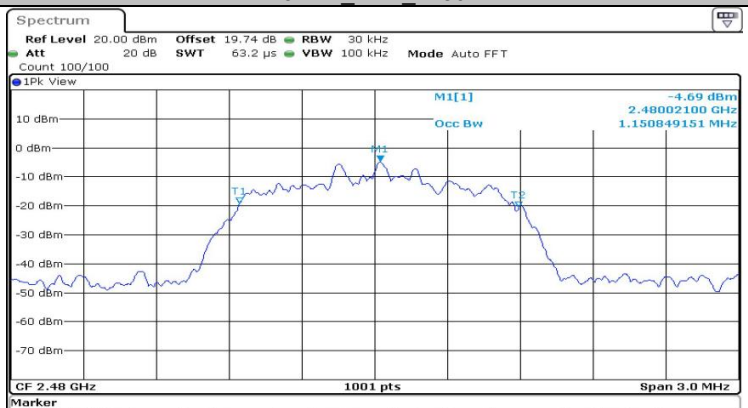


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.441021 GHz	-1.61 dBm		
T1		1	2.44044256 GHz	-16.26 dBm	Occ Bw	1.150849151 MHz
T2		1	2.44159341 GHz	-17.25 dBm		

Date: 9.OCT.2022 06:32:08

3DH1_Ant1_2480



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480021 GHz	-4.69 dBm		
T1		1	2.47944256 GHz	-19.24 dBm	Occ Bw	1.150849151 MHz
T2		1	2.48059341 GHz	-20.45 dBm		

Date: 9.OCT.2022 06:33:04

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	3.68	≤20.97	PASS
		2441	3.23	≤20.97	PASS
		2480	0.37	≤20.97	PASS
2DH1	Ant1	2402	2.78	≤20.97	PASS
		2441	2.68	≤20.97	PASS
		2480	-0.29	≤20.97	PASS
3DH1	Ant1	2402	3.11	≤20.97	PASS
		2441	3.04	≤20.97	PASS
		2480	-0.02	≤20.97	PASS
Note: the antenna gain= 0.51dBi, the maximum EIRP= 4.19dBm<36dBm					

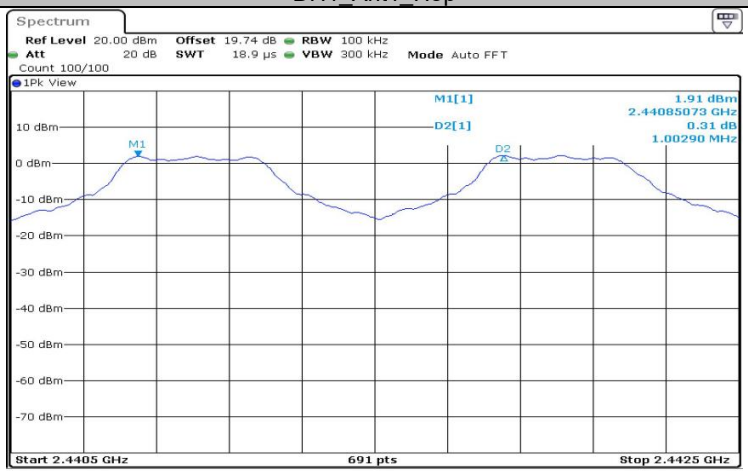
Appendix D: Carrier frequency separation

Test Result

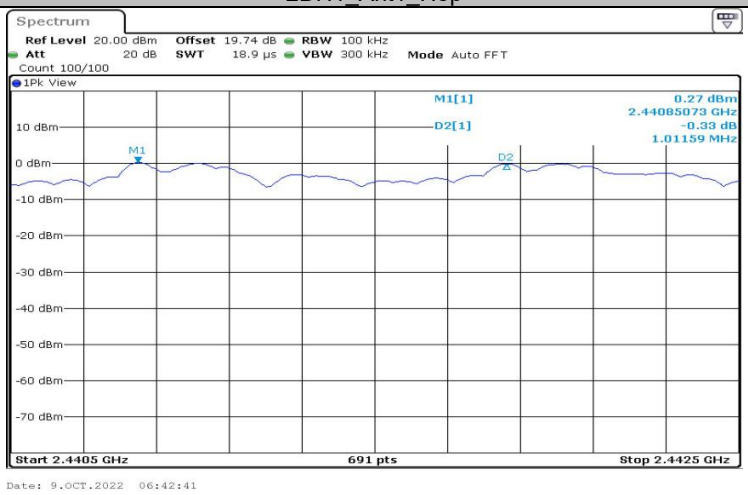
Test Mode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.003	≥0.620	PASS
2DH1	Ant1	Hop	1.012	≥0.840	PASS
3DH1	Ant1	Hop	1.003	≥0.820	PASS

Test Graphs

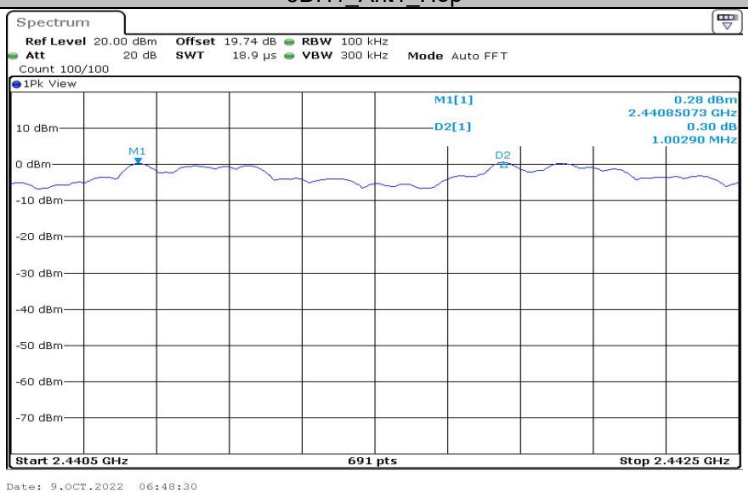
DH1_Ant1_Hop



2DH1_Ant1_Hop



3DH1_Ant1_Hop



Appendix E: Time of occupancy

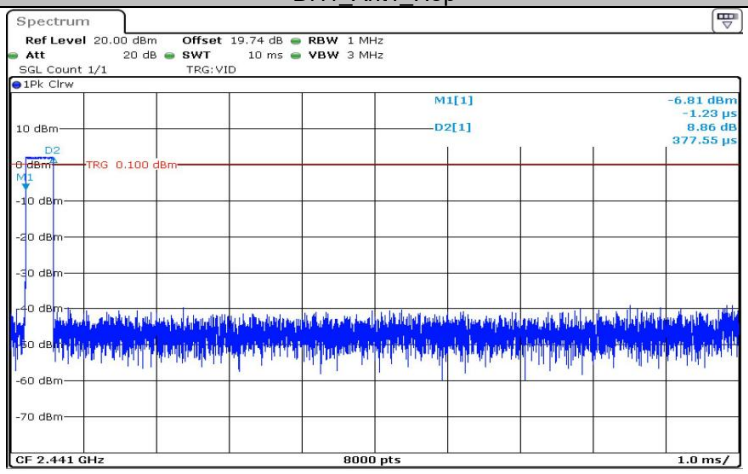
Test Result

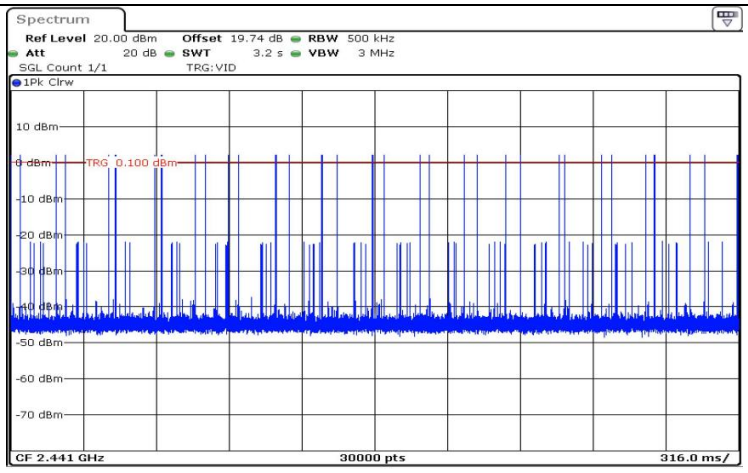
Test Mode	Antenna	Frequency[MHz]	Burst Width [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.38	330	0.125	≤0.4	PASS
DH3	Ant1	Hop	1.63	140	0.228	≤0.4	PASS
DH5	Ant1	Hop	2.87	120	0.344	≤0.4	PASS
2DH1	Ant1	Hop	0.38	320	0.122	≤0.4	PASS
2DH3	Ant1	Hop	1.63	170	0.277	≤0.4	PASS
2DH5	Ant1	Hop	2.87	110	0.316	≤0.4	PASS
3DH1	Ant1	Hop	0.38	320	0.122	≤0.4	PASS
3DH3	Ant1	Hop	1.63	170	0.277	≤0.4	PASS
3DH5	Ant1	Hop	2.87	110	0.316	≤0.4	PASS

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

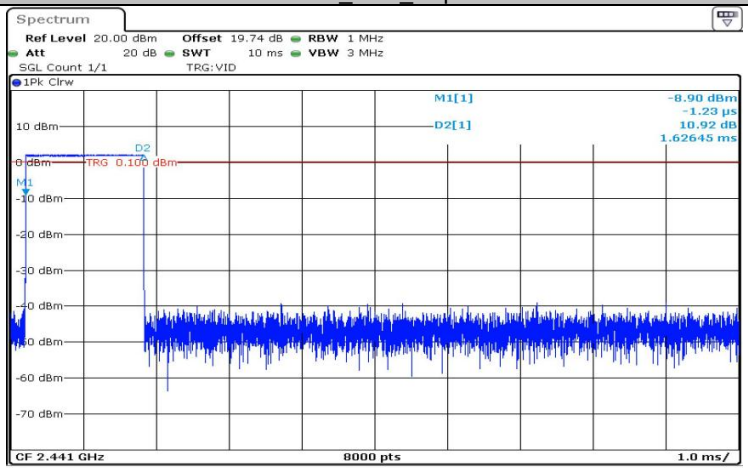
Test Graphs

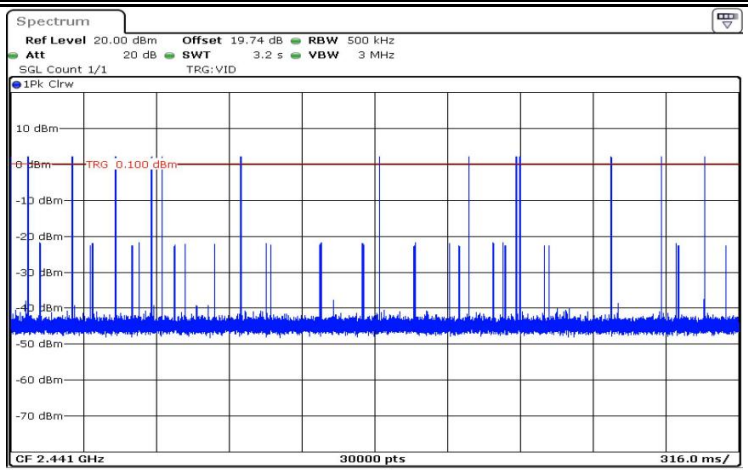
DH1_Ant1_Hop





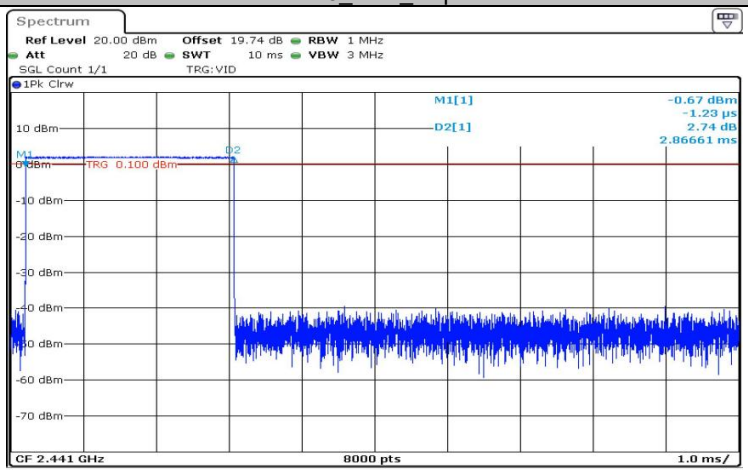
DH3_Ant1_Hop



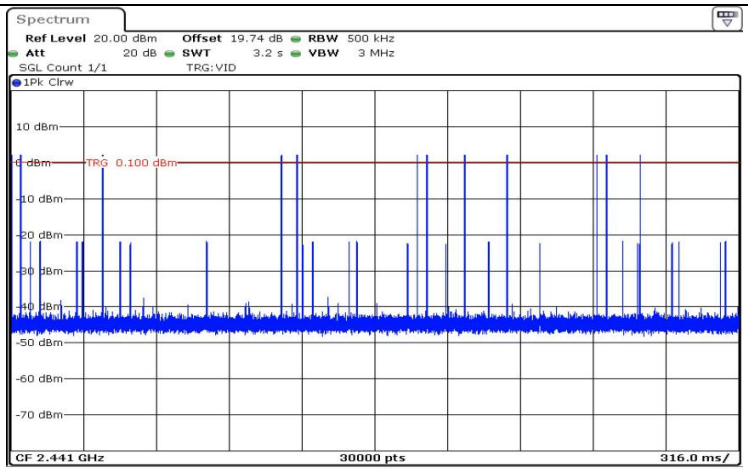


Date: 9.OCT.2022 06:38:10

DH5_Ant1_Hop

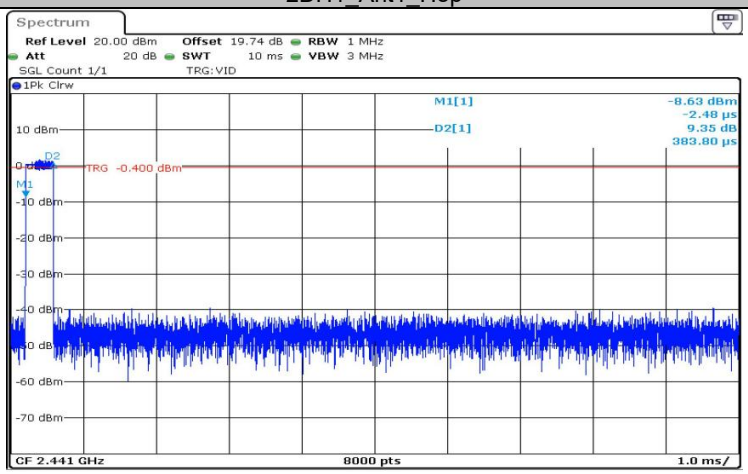


Date: 9.OCT.2022 06:39:13

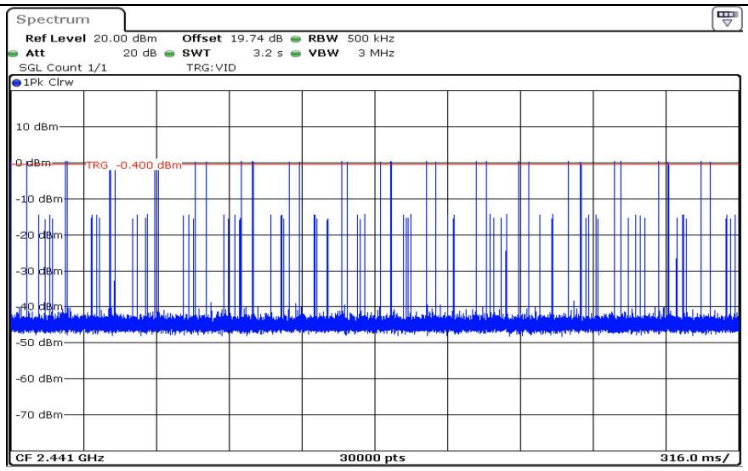


Date: 9.OCT.2022 06:39:18

2DH1_Ant1_Hop

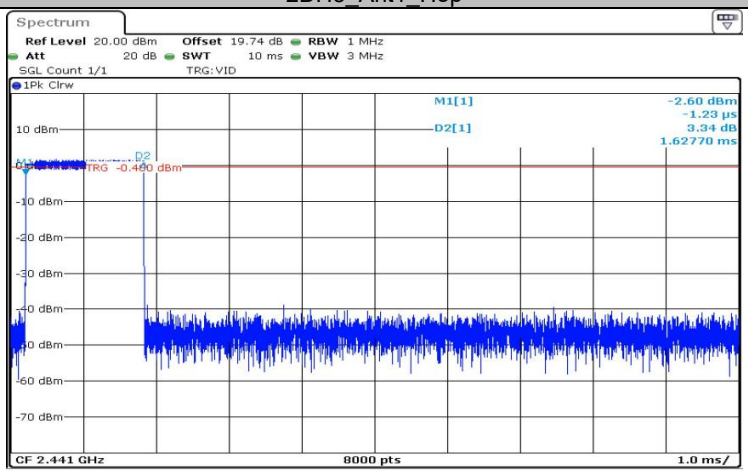


Date: 9.OCT.2022 06:40:59

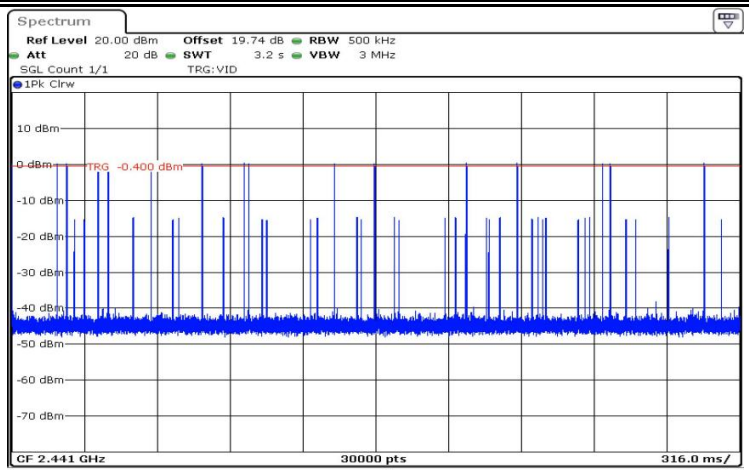


Date: 9.OCT.2022 06:41:05

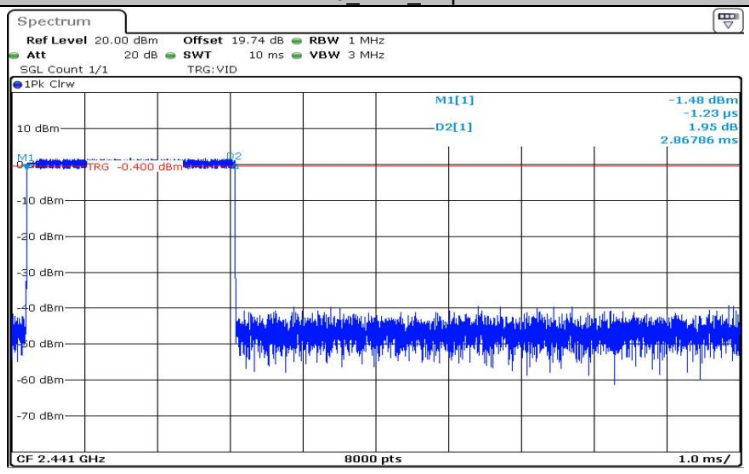
2DH3_Ant1_Hop

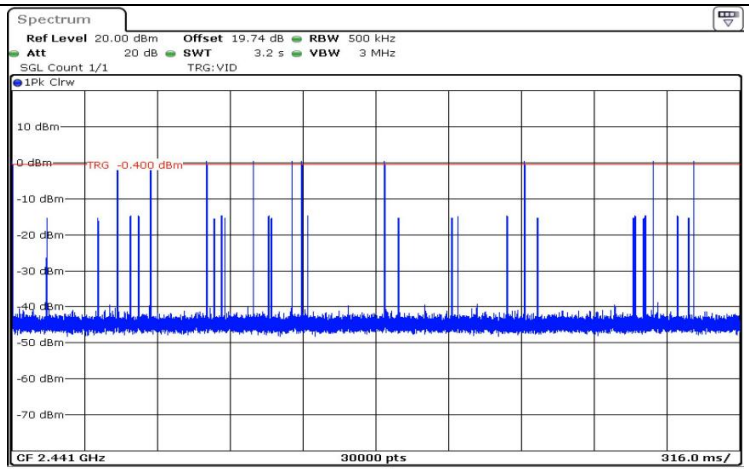


Date: 9.OCT.2022 06:45:20

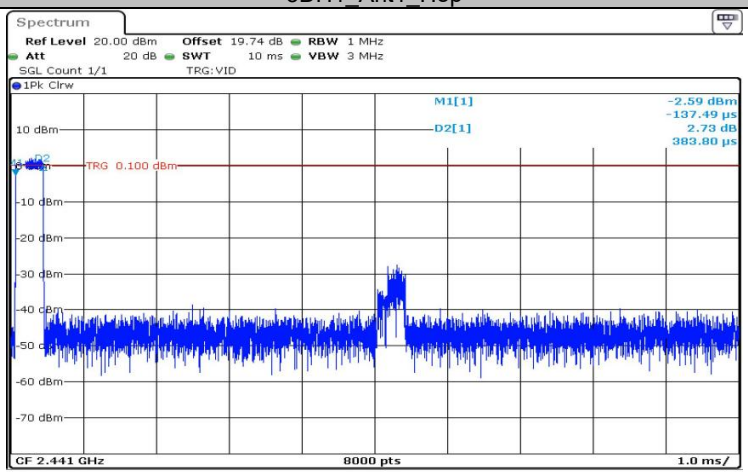


2DH5_Ant1_Hop

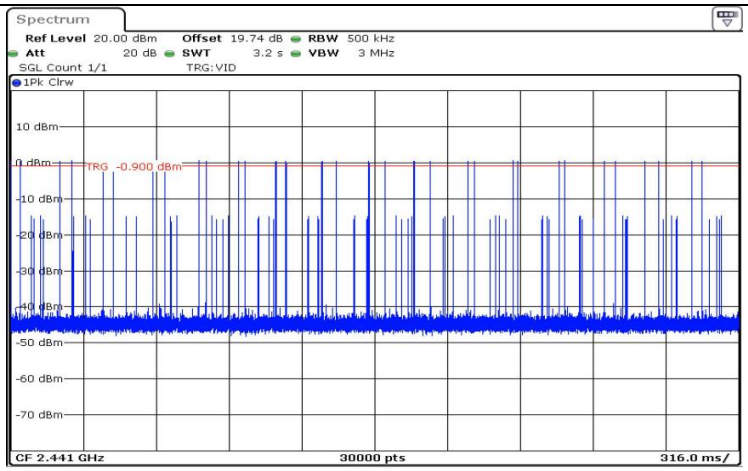




3DH1_Ant1_Hop



Date: 9.OCT.2022 06:49:08



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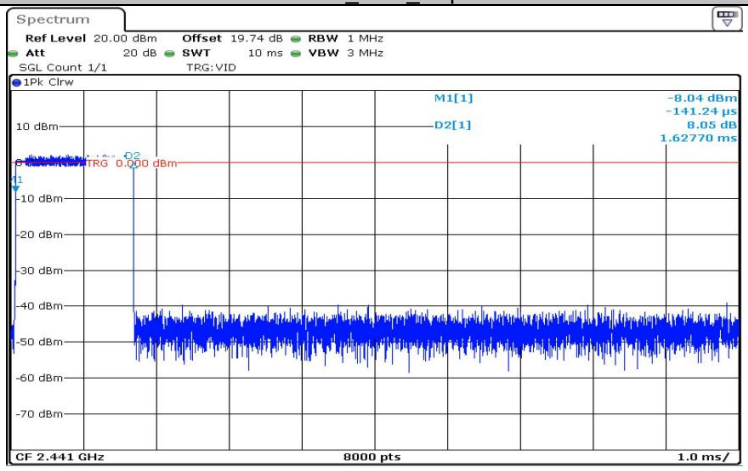
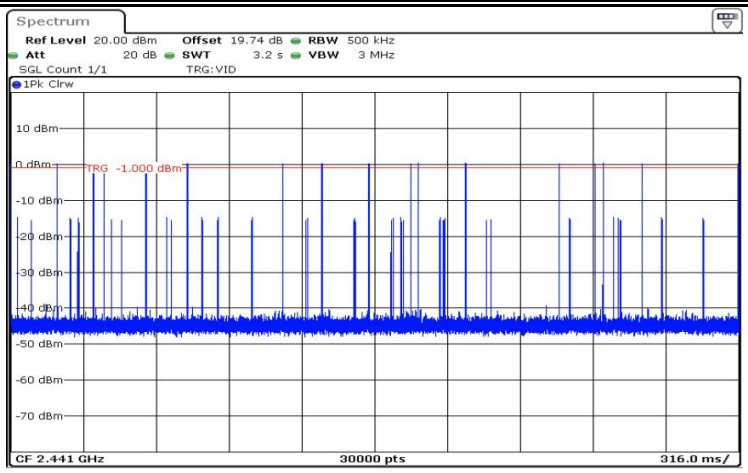
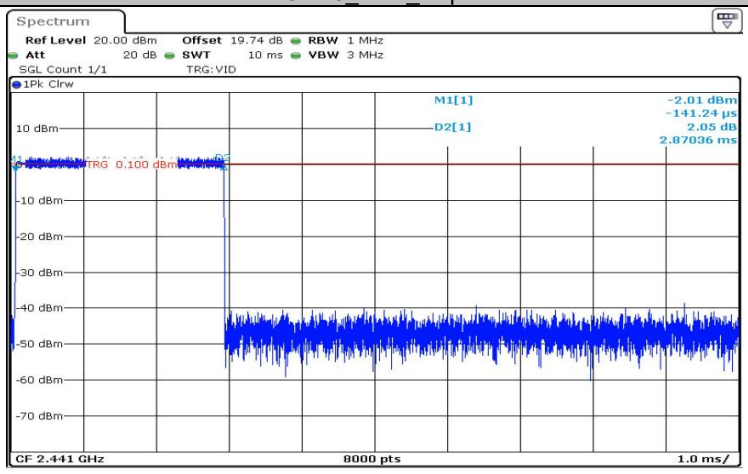
3DH3_Ant1_Hop

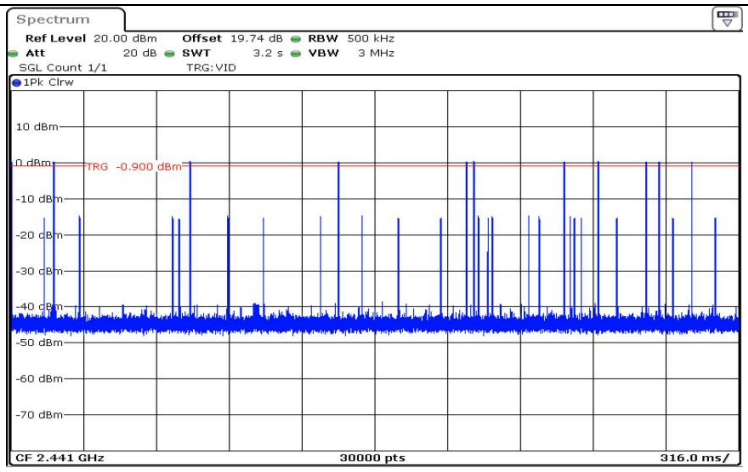


Date: 9.OCT.2022 06:50:56



3DH5_Ant1_Hop





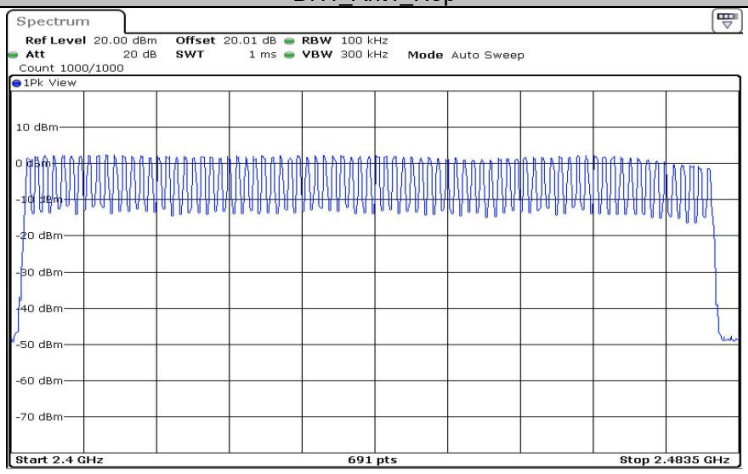
Appendix F: Number of hopping channels

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

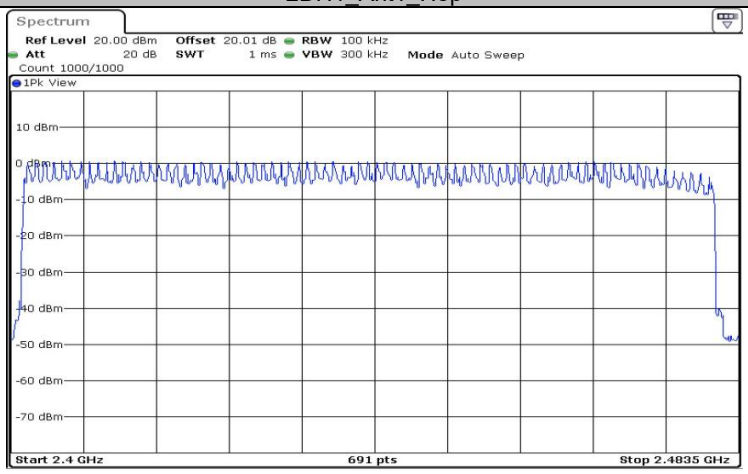
Test Graphs

DH1_Ant1_Hop



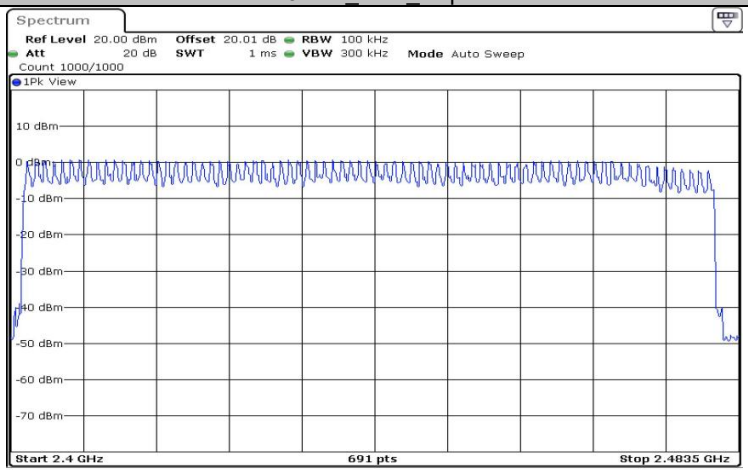
Date: 9.OCT.2022 06:35:38

2DH1_Ant1_Hop



Date: 9.OCT.2022 06:40:45

3DH1_Ant1_Hop

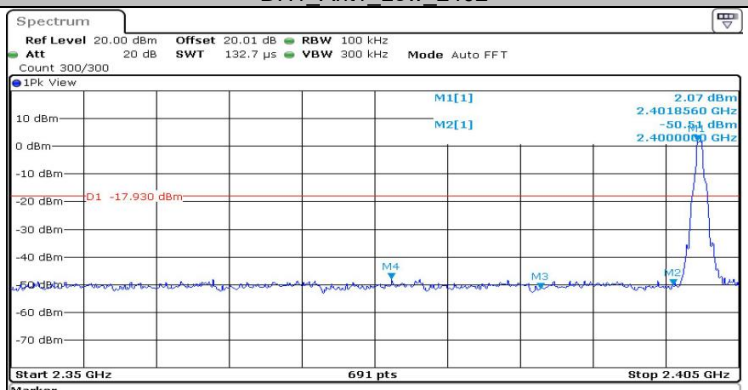


Date: 9.OCT.2022 06:48:54

Appendix G: Band edge measurements

Test Graphs

DH1_Ant1_Low_2402

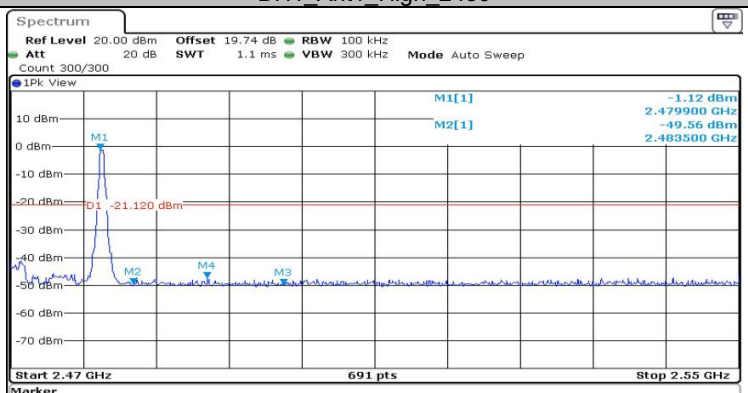


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401856 GHz	2.07 dBm		
M2		1	2.4 GHz	-50.51 dBm		
M3		1	2.39 GHz	-51.60 dBm		
M4		1	2.3787754 GHz	-47.95 dBm		

Date: 9.OCT.2022 06:21:26

DH1_Ant1_High_2480

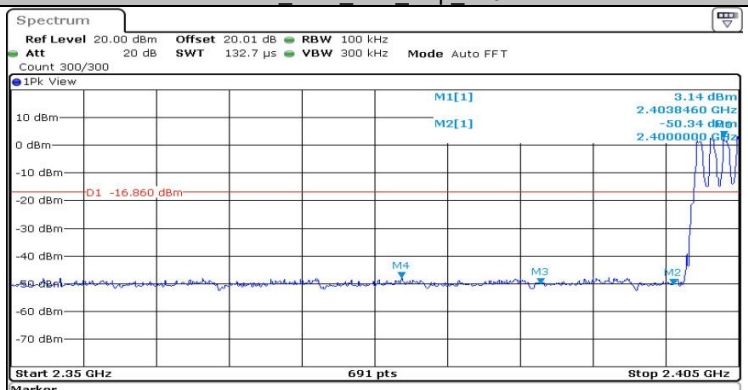


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4799 GHz	-1.12 dBm		
M2		1	2.4835 GHz	-49.56 dBm		
M3		1	2.5 GHz	-49.83 dBm		
M4		1	2.491565 GHz	-47.25 dBm		

Date: 9.OCT.2022 06:26:36

DH1_Ant1_Low_Hop_2402

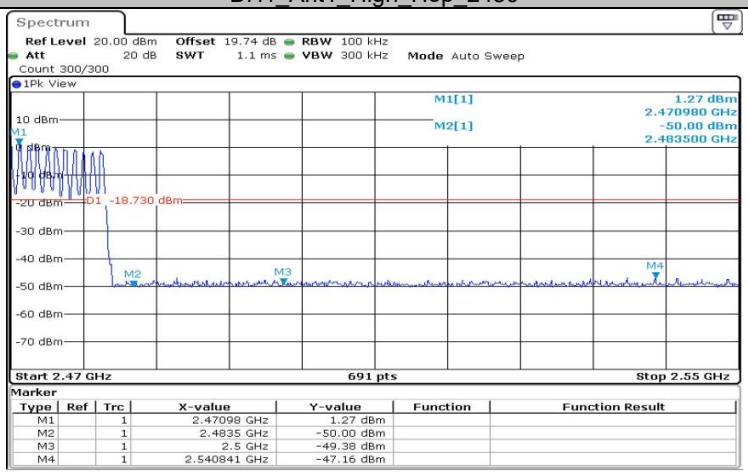


Marker

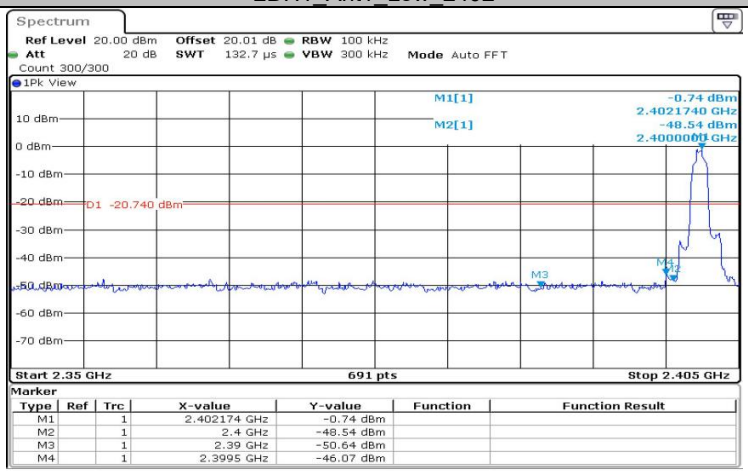
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.403846 GHz	3.14 dBm		
M2		1	2.4 GHz	-50.34 dBm		
M3		1	2.39 GHz	-50.20 dBm		
M4		1	2.3794928 GHz	-47.94 dBm		

Date: 17.OCT.2022 19:34:30

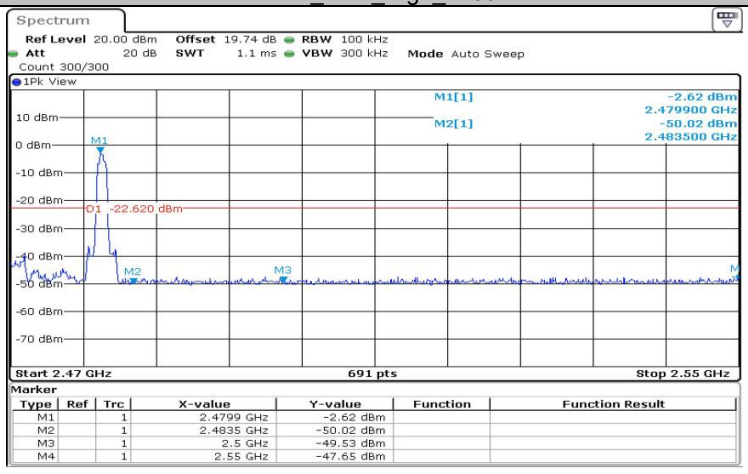
DH1_Ant1_High_Hop_2480



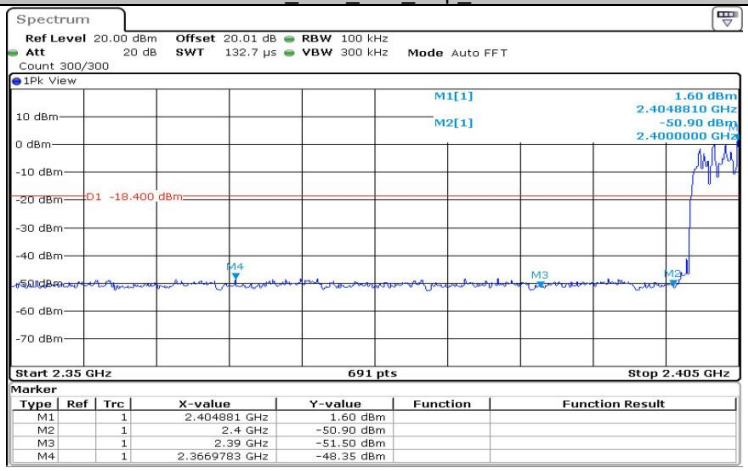
2DH1_Ant1_Low_2402



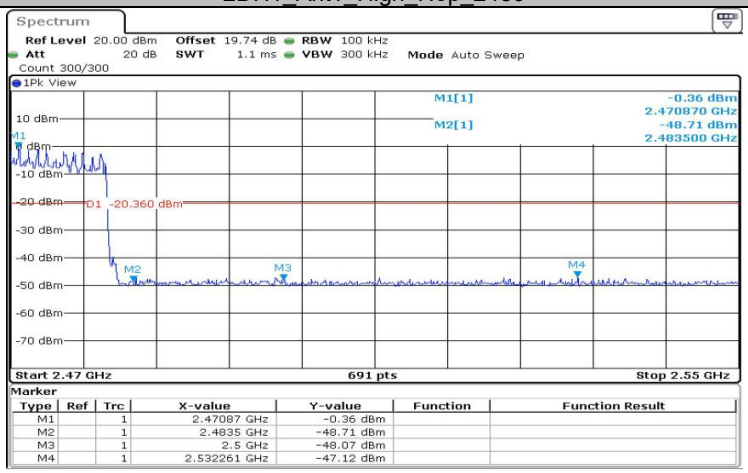
2DH1_Ant1_High_2480



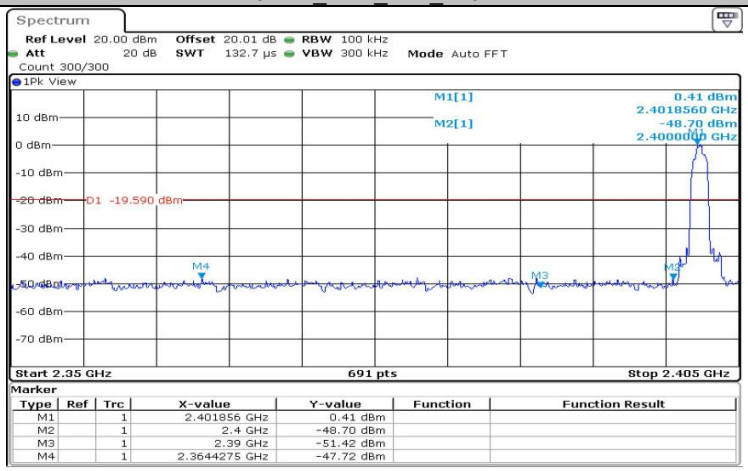
2DH1_Ant1_Low_Hop_2402



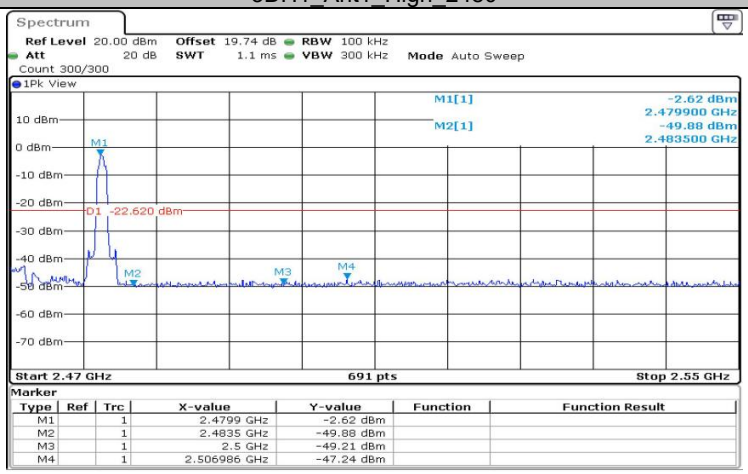
2DH1_Ant1_High_Hop_2480



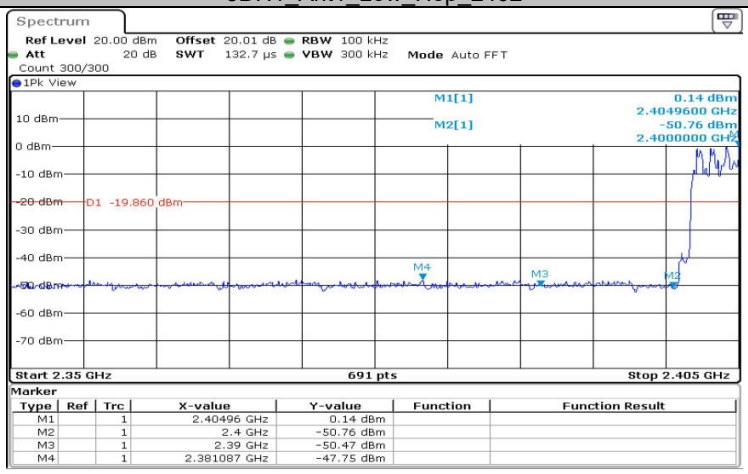
3DH1_Ant1_Low_2402



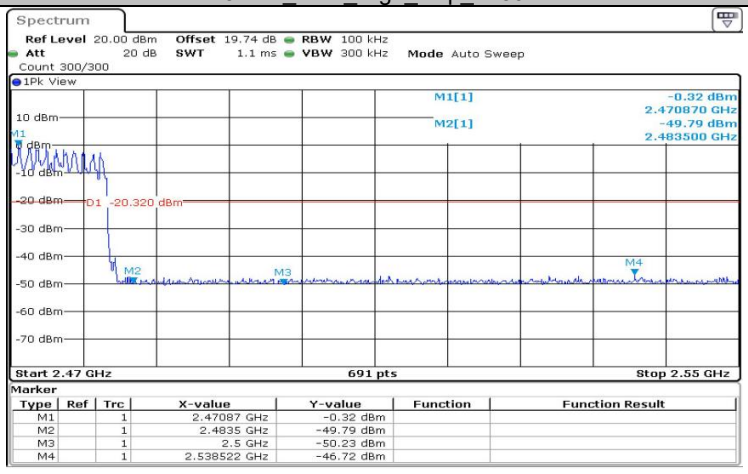
3DH1_Ant1_High_2480



3DH1_Ant1_Low_Hop_2402



3DH1_Ant1_High_Hop_2480



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