



# TEST REPORT

Applicant Name : FCC: Porta Phone Company Inc  
ISEDC: PORTA PHONE CO., INC.  
Address : FCC: 145 Dean Knauss Drive Narragansett, Rhode Island 02882  
United States  
ISEDC: 145 Dean Knauss Drive Narragansett, RI 02882, United States of America  
Report Number : SZNS211104-56779E-RFA  
FCC ID: B4HEPAKM  
IC: 3064A-EPAKM

## 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: Full Duplex 2.4 GHz Transceiver- Main  
Model No.: EPAK M  
Multiple Model(s) No.: N/A  
Trade Mark: EVADE PAK  
Date Received: 2021/11/04  
Date of Test: 2021/11/29~2021/12/13  
Report Date: 2021/12/15

|              |       |
|--------------|-------|
| Test Result: | Pass* |
|--------------|-------|

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

## Prepared and Checked By:

*Black Ding*

Black Ding  
EMC Engineer

## Approved By:

*Robert Li*

Robert Li  
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                   | EPAK M                                                                                                  |
| Frequency Range        | Bluetooth: 2402~2480MHz                                                                                 |
| Transmit Peak Power    | 0.63dBm                                                                                                 |
| Modulation Technique   | Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK                                                                  |
| Antenna Specification* | PCB Antenna: 1 dBi                                                                                      |
| Voltage Range          | DC3.7V from battery                                                                                     |
| Sample serial number   | SZNS211104-56779E-RF-S3 for RF conducted<br>SZNS211104-56779E-RF-S4 for radiated test (Assigned by ATC) |
| Sample/EUT Status      | Good condition                                                                                          |

### Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication 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                       |                 | $0.082 \times 10^{-7}$ |
| RF output power, conducted         |                 | 0.73dB                 |
| Unwanted Emission, conducted       |                 | 1.6dB                  |
| AC Power Lines Conducted Emissions |                 | 2.72dB                 |
| Emissions,<br>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

“cybluetool\_setup\_0.1.97.1.exe”\* exercise software was made to the EUT tested and the power level is 0\*. 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

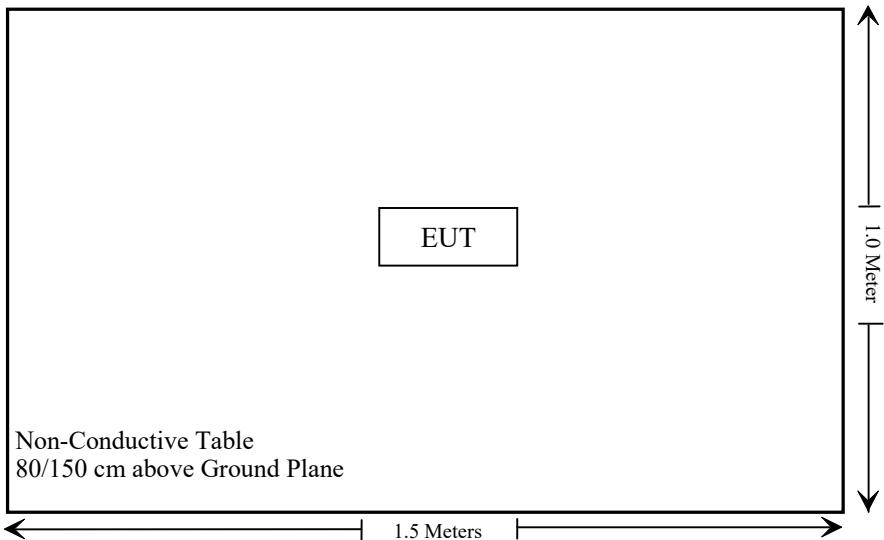
| Manufacturer | Description | Model | Serial Number |
|--------------|-------------|-------|---------------|
| /            | /           | /     | /             |

### External I/O Cable

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

**Block Diagram of Test Setup**

For Radiated Emission



## SUMMARY OF TEST RESULTS

| Rules                                                             | Description of Test                                      | Result         |
|-------------------------------------------------------------------|----------------------------------------------------------|----------------|
| FCC §15.247 (i) & §2.1093                                         | RF Exposure                                              | Compliant      |
| RSS-102 § 2.5.1                                                   | Exemption Limits for Routine Evaluation – SAR Evaluation | Compliant      |
| FCC §15.203<br>RSS-Gen §6.8                                       | Antenna Requirement                                      | Compliant      |
| FCC §15.207(a)<br>RSS-Gen §8.8                                    | AC Line Conducted Emissions                              | Not Applicable |
| FCC §15.205, §15.209, §15.247(d)<br>RSS-247 § 5.5, RSS-GEN § 8.10 | Radiated Emissions                                       | Compliant      |
| FCC §15.247(a)(1)<br>RSS-247 § 5.1(a), RSS-GEN § 6.7              | 20 dB Emission Bandwidth & 99% Occupied Bandwidth        | Compliant      |
| FCC §15.247(a)(1)<br>RSS-247 § 5.1 (b)                            | Channel Separation Test                                  | Compliant      |
| FCC §15.247(a)(1)(iii)<br>RSS-247 § 5.1 (d)                       | Time of Occupancy (Dwell Time)                           | Compliant      |
| FCC §15.247(a)(1)(iii)<br>RSS-247 § 5.1 (d)                       | Quantity of hopping channel Test                         | Compliant      |
| FCC §15.247(b)(1)<br>RSS-247 § 5.1(b) & § 5.4(b)                  | Peak Output Power Measurement                            | Compliant      |
| FCC §15.247(d)<br>RSS-247 § 5.5                                   | Band edges                                               | Compliant      |

Not Applicable: EUT only powered by battery.

**TEST EQUIPMENT LIST**

| Manufacturer                                    | Description                  | Model             | Serial Number | Calibration Date | Calibration Due Date |
|-------------------------------------------------|------------------------------|-------------------|---------------|------------------|----------------------|
| Radiated Emissions Test                         |                              |                   |               |                  |                      |
| Rohde& Schwarz                                  | Test Receiver                | ESR               | 102725        | 2020/12/25       | 2021/12/24           |
| Rohde&Schwarz                                   | Spectrum Analyzer            | FSV40             | 101949        | 2021/5/18        | 2022/5/17            |
| SONOMA INSTRUMENT                               | Amplifier                    | 310 N             | 186131        | 2020/12/25       | 2021/12/24           |
| A.H. Systems, inc.                              | Preamplifier                 | PAM-0118P         | 531           | 2021/11/09       | 2022/11/08           |
| Quinstar                                        | Amplifier                    | QLW-18405536-J0   | 15964001002   | 2021/11/28       | 2022/11/27           |
| Anritsu Corp                                    | 50 Coaxial Switch            | MP59B             | 6100237248    | 2020/12/25       | 2021/12/24           |
| Schwarzbeck                                     | Bilog Antenna                | VULB9163          | 9163-323      | 2020/01/05       | 2023/01/04           |
| Schwarzbeck                                     | Horn Antenna                 | BBHA9120D         | 9120D-1067    | 2020/01/05       | 2023/01/04           |
| Radiated Emission Test Software: e3 19821b (V9) |                              |                   |               |                  |                      |
| Schwarzbeck                                     | HORN ANTENNA                 | BBHA9170          | 9170-359      | 2020/01/05       | 2023/01/04           |
| OREGON SCIENTIFIC                               | Temperature & Humidity Meter | JB913R            | GZ-WS004      | 2020/01/02       | 2023/01/01           |
| Unknown                                         | RF Coaxial Cable             | N-5m              | No.3          | 2020/12/25       | 2021/12/24           |
| Unknown                                         | RF Coaxial Cable             | N-1m              | No.5          | 2020/12/25       | 2021/12/24           |
| Unknown                                         | RF Coaxial Cable             | N-10m             | No.7          | 2021/11/09       | 2022/11/08           |
| Unknown                                         | RF Coaxial Cable             | N-2m              | No.8          | 2021/11/09       | 2022/11/08           |
| Wainwright                                      | High Pass Filter             | WHKX3.6/18 G-10SS | 5             | 2020/12/25       | 2021/12/24           |
| RF Conducted Test                               |                              |                   |               |                  |                      |
| Rohde & Schwarz                                 | Spectrum Analyzer            | FSV-40            | 101495        | 2020/12/24       | 2021/12/23           |
| Tonscend                                        | RF Control Unit              | JS0806-2          | 19G8060182    | 2021/07/06       | 2022/07/05           |

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

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

### Applicable Standard

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

According to KDB 447498 D01 General RF Exposure Guidance

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

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR, where

1.  $f(\text{GHz})$  is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test Exclusion.

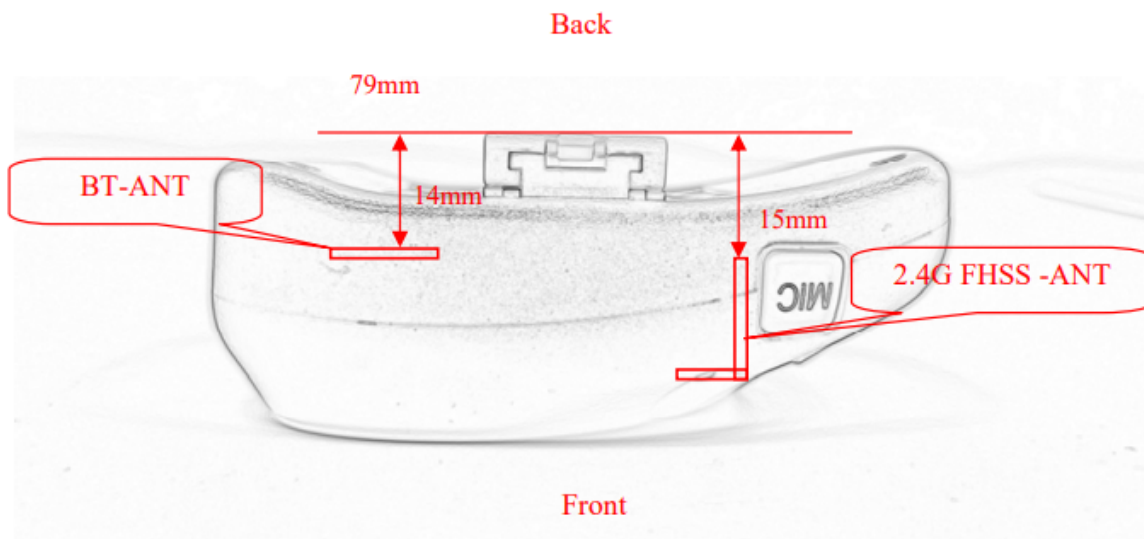
### Measurement Result

For worst case:

| Frequency (MHz) | Tune-up power (dBm) | Tune-up power (mW) | Distance (mm) | Calculated value | Threshold (1-g SAR) | SAR Test Exclusion |
|-----------------|---------------------|--------------------|---------------|------------------|---------------------|--------------------|
| 2480            | 1.0                 | 1.26               | 14            | 0.1              | 3.0                 | Yes                |

**Result: No SAR test is required**

Evaluation distance: 14mm



## RSS-102 § 2.5.1 –EXEMPTION LIMITS FOR ROUTINE EVALUATION-SAR EVALUATION

### Applicable Standard

According to RSS-102 Issue 5 § (2.5.1), SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

**Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance<sup>4,5</sup>**

| Frequency (MHz) | Exemption Limits (mW)           |                                 |                                 |                                 |                                 |
|-----------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
|                 | At separation distance of ≤5 mm | At separation distance of 10 mm | At separation distance of 15 mm | At separation distance of 20 mm | At separation distance of 25 mm |
| ≤300            | 71 mW                           | 101 mW                          | 132 mW                          | 162 mW                          | 193 mW                          |
| 450             | 52 mW                           | 70 mW                           | 88 mW                           | 106 mW                          | 123 mW                          |
| 835             | 17 mW                           | 30 mW                           | 42 mW                           | 55 mW                           | 67 mW                           |
| 1900            | 7 mW                            | 10 mW                           | 18 mW                           | 34 mW                           | 60 mW                           |
| 2450            | 4 mW                            | 7 mW                            | 15 mW                           | 30 mW                           | 52 mW                           |
| 3500            | 2 mW                            | 6 mW                            | 16 mW                           | 32 mW                           | 55 mW                           |
| 5800            | 1 mW                            | 6 mW                            | 15 mW                           | 27 mW                           | 41 mW                           |

| Frequency (MHz) | Exemption Limits (mW)           |                                 |                                 |                                 |                                  |
|-----------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|
|                 | At separation distance of 30 mm | At separation distance of 35 mm | At separation distance of 40 mm | At separation distance of 45 mm | At separation distance of ≥50 mm |
| ≤300            | 223 mW                          | 254 mW                          | 284 mW                          | 315 mW                          | 345 mW                           |
| 450             | 141 mW                          | 159 mW                          | 177 mW                          | 195 mW                          | 213 mW                           |
| 835             | 80 mW                           | 92 mW                           | 105 mW                          | 117 mW                          | 130 mW                           |
| 1900            | 99 mW                           | 153 mW                          | 225 mW                          | 316 mW                          | 431 mW                           |
| 2450            | 83 mW                           | 123 mW                          | 173 mW                          | 235 mW                          | 309 mW                           |
| 3500            | 86 mW                           | 124 mW                          | 170 mW                          | 225 mW                          | 290 mW                           |
| 5800            | 56 mW                           | 71 mW                           | 85 mW                           | 97 mW                           | 106 mW                           |

4. The exemption limits in Table 1 are based on measurements and simulations of half-wave dipole antennas at separation distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from a linear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from a third order polynomial fit.

5. Transmitters operating between 0.003-10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in Section 4.

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

### Test Result:

For worst case:

The higher of the conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power:

For 2480MHz@10mm:  $(2480-2450)/(3500-2450) = (7-P)/(7-6)$ , the exemption limit is  $P = 6.97\text{mW}$

For 2480MHz@15mm:  $(2480-2450)/(3500-2450) = (15-P)/(15-16)$ , the exemption limit is  $P = 15.03\text{mW}$

The distance between antenna and human body is 14mm:

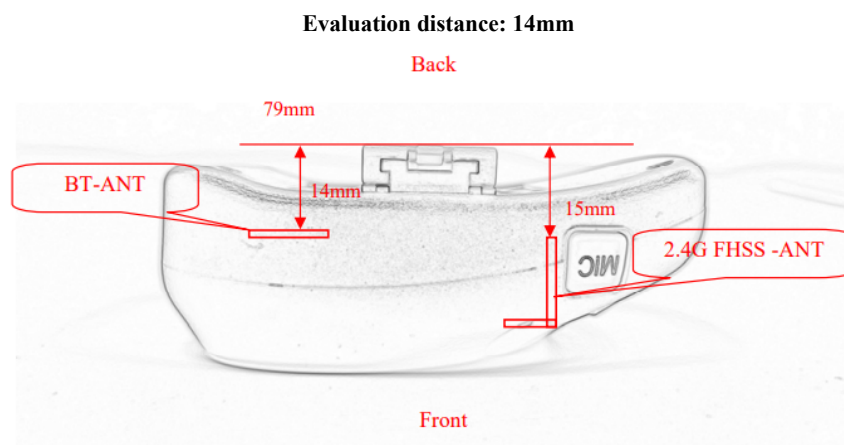
For 2480MHz@14mm:

$$(15-14)/(15-10) = (15.03-P)/(15.03-6.97)$$

The exemption limit of 2480MHz is  $P = 13.42\text{mW}$

The maximum tune-up conducted power is 1.0 dBm, The antenna gain is 1.0 dBi, so the EIRP is 2.0 dBm (1.58 mW), which less than 13.42 mW@2480MHz exemption limit

**So the stand-alone SAR evaluation can be meet.**



## 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 1.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

| Antenna Type | Antenna Gain | Impedance | Frequency Range |
|--------------|--------------|-----------|-----------------|
| PCB          | 1dBi         | 50 Ω      | 2.4~2.5GHz      |

**Result:** Compliance

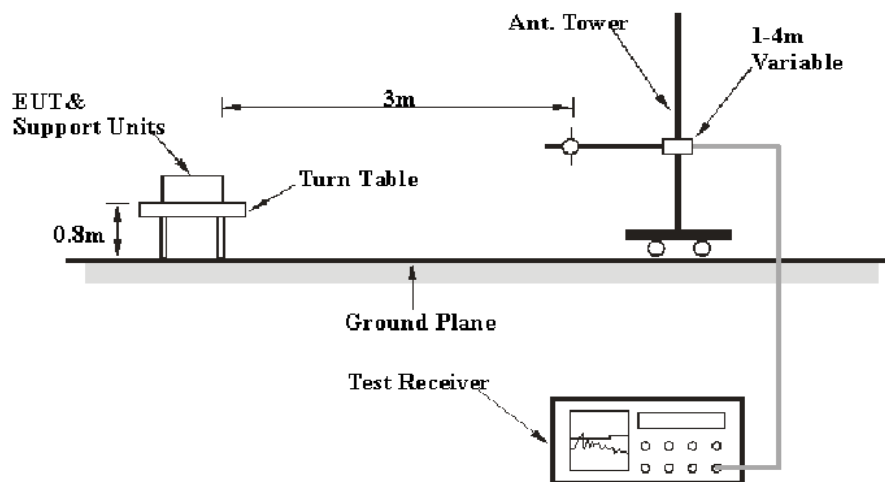
## **FCC §15.209, §15.205 & §15.247(d) & RSS-247§ 5.5 - Spurious Emissions**

### **Applicable Standard**

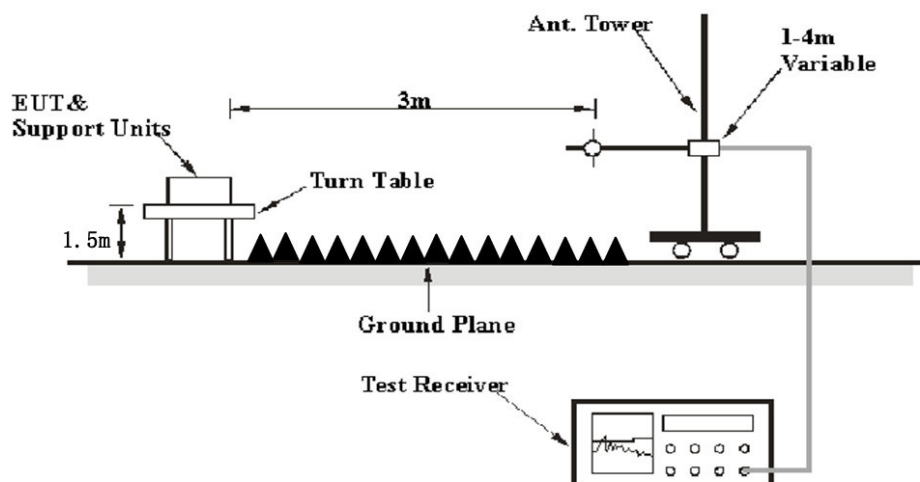
FCC §15.205; §15.209; §15.247(d); RSS-247§ 5.5; RSS-GEN § 8.10

### **EUT Setup**

**Below 1 GHz:**



**Above 1GHz:**



The radiated emission performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, FCC 15.247, RSS-247, RSS-Gen 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.

## Corrected 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:

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

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

$$\begin{aligned} \text{Margin/Over Limit} &= \text{Corrected Amplitude/Level-Limit} \\ \text{Corrected Amplitude/Level} &= \text{Reading} + \text{Corrected Factor} \end{aligned}$$

## Test Data

### Environmental Conditions

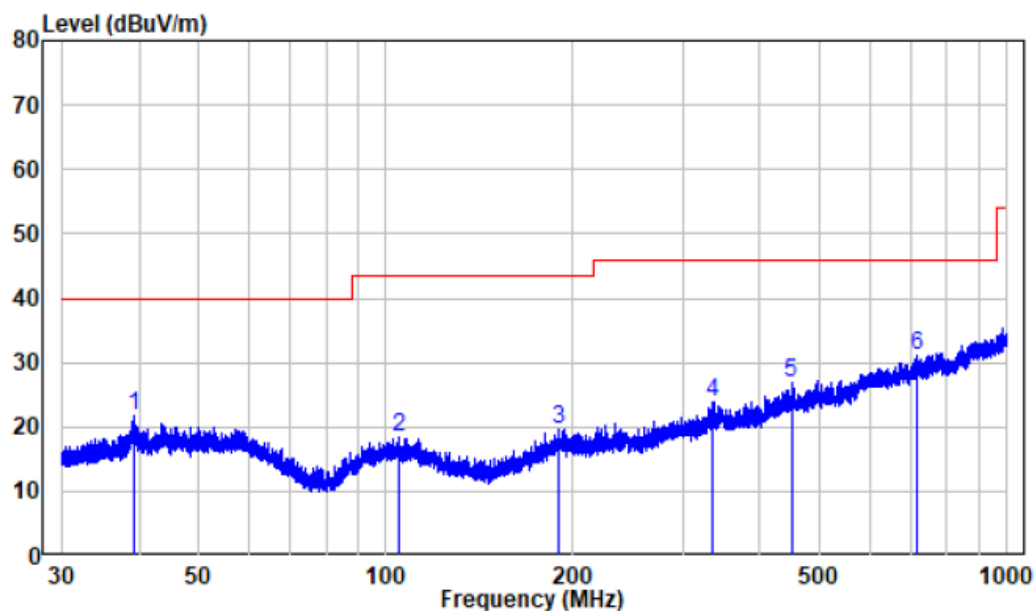
|                           |            |
|---------------------------|------------|
| <b>Temperature:</b>       | 25~26.3 °C |
| <b>Relative Humidity:</b> | 51~64 %    |
| <b>ATM Pressure:</b>      | 101.0 kPa  |

*The testing was performed by Chao Mo from 2021-11-29 for below 1GHz and by Bin Deng to 2021-12-10 for above 1GHz.*

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

**Below 1GHz:****Worst case for 8DPSK Mode, High channel:**

Horizontal



Site : chamber

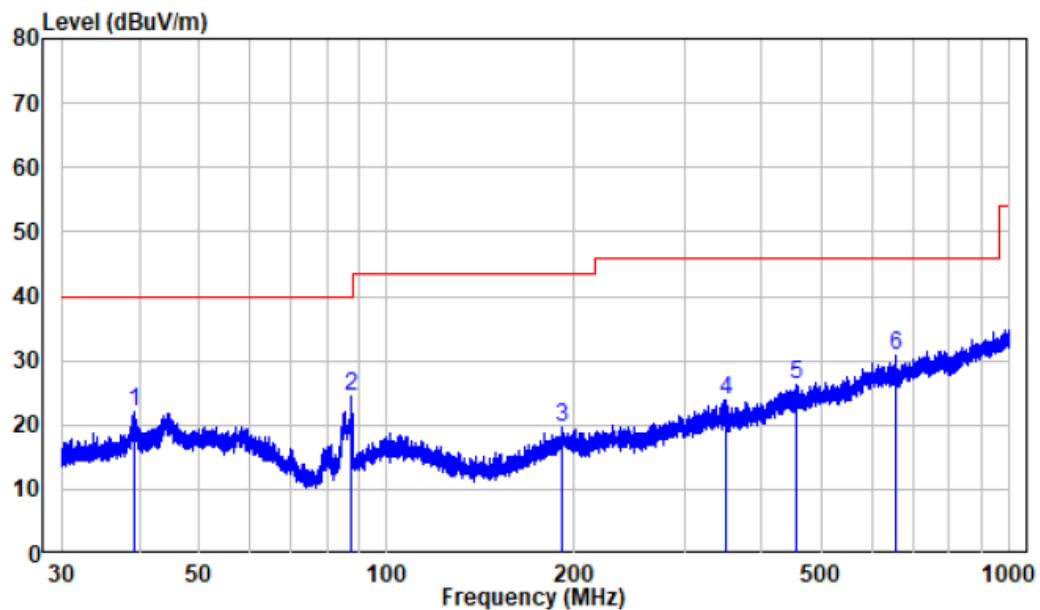
Condition: 3m HORIZONTAL

Job NO : SZNS211104-56779E-RF

Test Mode: BT

|   | Freq   | Factor | Read Level | Limit Level | Over Limit | Remark      |
|---|--------|--------|------------|-------------|------------|-------------|
|   | MHz    | dB/m   | dBuV       | dBuV/m      | dBuV/m     | dB          |
| 1 | 39.25  | -10.44 | 32.03      | 21.59       | 40.00      | -18.41 Peak |
| 2 | 105.09 | -11.89 | 30.19      | 18.30       | 43.50      | -25.20 Peak |
| 3 | 189.99 | -11.45 | 30.95      | 19.50       | 43.50      | -24.00 Peak |
| 4 | 336.04 | -7.39  | 31.35      | 23.96       | 46.00      | -22.04 Peak |
| 5 | 449.36 | -5.11  | 31.83      | 26.72       | 46.00      | -19.28 Peak |
| 6 | 714.80 | -1.27  | 32.50      | 31.23       | 46.00      | -14.77 Peak |

Vertical



Site : chamber

Condition: 3m VERTICAL

Job NO : SZNS211104-56779E-RF

Test Mode: BT

|   | Freq   | Factor | Read<br>Level | Level  | Limit<br>Line | Over<br>Limit | Remark |
|---|--------|--------|---------------|--------|---------------|---------------|--------|
|   | MHz    | dB/m   | dBuV          | dBuV/m | dBuV/m        | dB            |        |
| 1 | 39.18  | -10.45 | 32.43         | 21.98  | 40.00         | -18.02        | Peak   |
| 2 | 87.61  | -14.76 | 39.10         | 24.34  | 40.00         | -15.66        | Peak   |
| 3 | 190.41 | -11.38 | 30.96         | 19.58  | 43.50         | -23.92        | Peak   |
| 4 | 349.10 | -7.24  | 31.07         | 23.83  | 46.00         | -22.17        | Peak   |
| 5 | 454.51 | -5.08  | 31.22         | 26.14  | 46.00         | -19.86        | Peak   |
| 6 | 658.26 | -1.99  | 32.83         | 30.84  | 46.00         | -15.16        | Peak   |

**Above 1GHz: (worst case for 8DPSK)**

| Frequency<br>(MHz) | Receiver          |       | Turntable<br>Angle<br>Degree | Rx Antenna    |                | Factor<br>(dB/m) | Absolute<br>Level<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) |
|--------------------|-------------------|-------|------------------------------|---------------|----------------|------------------|-------------------------------|-------------------|----------------|
|                    | Reading<br>(dBuV) | PK/AV |                              | Height<br>(m) | Polar<br>(H/V) |                  |                               |                   |                |
| Low Channel        |                   |       |                              |               |                |                  |                               |                   |                |
| 2310               | 44.99             | PK    | 169                          | 1.9           | H              | -7.24            | 37.75                         | 74                | -36.25         |
| 2310               | 47.76             | PK    | 329                          | 2.2           | V              | -7.24            | 40.52                         | 74                | -33.48         |
| 2390               | 48.97             | PK    | 62                           | 2.2           | H              | -7.22            | 41.75                         | 74                | -32.25         |
| 2390               | 48.48             | PK    | 235                          | 2.0           | V              | -7.22            | 41.26                         | 74                | -32.74         |
| 4804               | 47.05             | PK    | 86                           | 1.5           | H              | -3.51            | 43.54                         | 74                | -30.46         |
| 4804               | 47.99             | PK    | 37                           | 1.8           | V              | -3.51            | 44.48                         | 74                | -29.52         |
| Middle Channel     |                   |       |                              |               |                |                  |                               |                   |                |
| 4882               | 46.52             | PK    | 136                          | 1.5           | H              | -3.37            | 43.15                         | 74                | -30.85         |
| 4882               | 48.62             | PK    | 49                           | 1.4           | V              | -3.37            | 45.25                         | 74                | -28.75         |
| High Channel       |                   |       |                              |               |                |                  |                               |                   |                |
| 2483.5             | 48.50             | PK    | 192                          | 1.1           | H              | -7.20            | 41.30                         | 74                | -32.70         |
| 2483.5             | 52.23             | PK    | 343                          | 1.3           | V              | -7.20            | 45.03                         | 74                | -28.97         |
| 2500               | 41.54             | PK    | 196                          | 1.4           | H              | -7.18            | 34.36                         | 74                | -39.64         |
| 2500               | 47.16             | PK    | 47                           | 1.7           | V              | -7.18            | 39.98                         | 74                | -34.02         |
| 4960               | 47.77             | PK    | 202                          | 1.4           | H              | -3.01            | 44.76                         | 74                | -29.24         |
| 4960               | 49.18             | PK    | 190                          | 1.4           | V              | -3.01            | 46.17                         | 74                | -27.83         |

Note:

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

Corrected Amplitude = Corrected Factor + Reading

Margin = Corrected. Amplitude - Limit

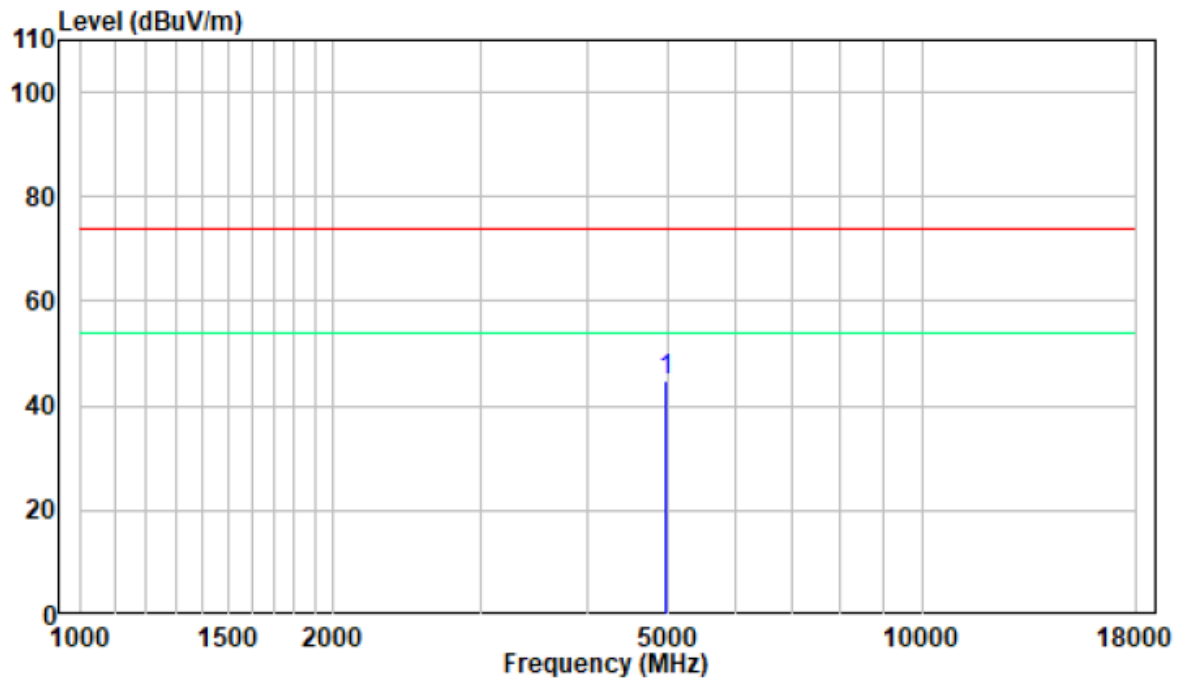
The other spurious emission which is 20dB to the limit was not recorded.

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

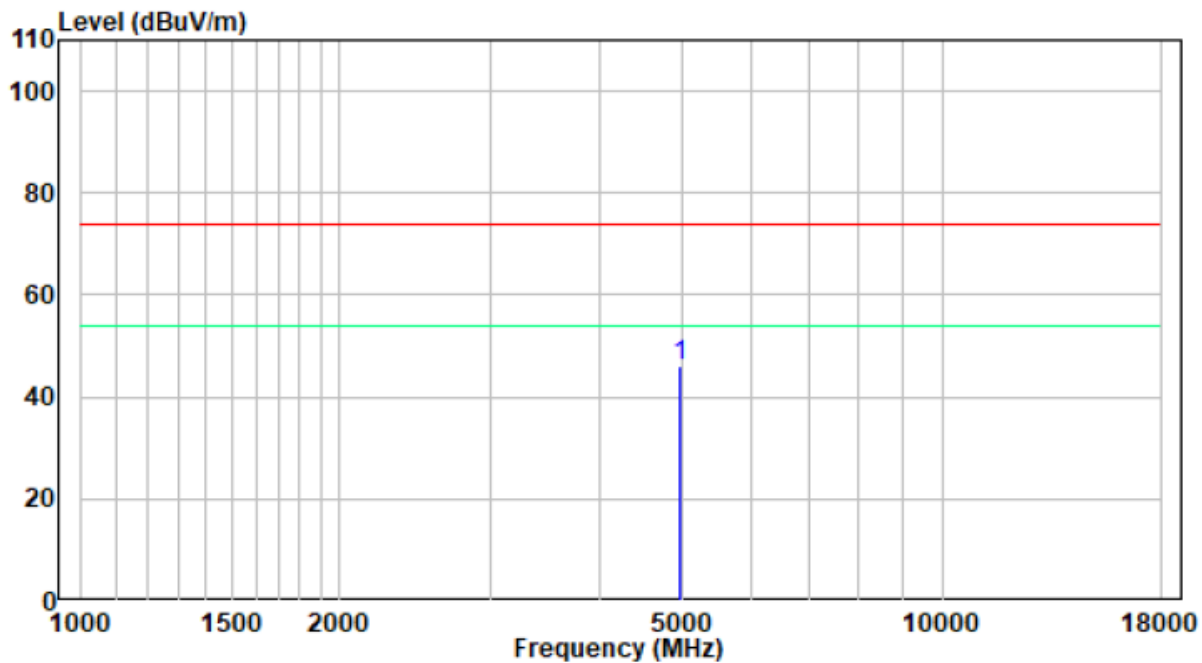
1 GHz - 18 GHz: (Pre-Scan plots)

High channel

Horizontal



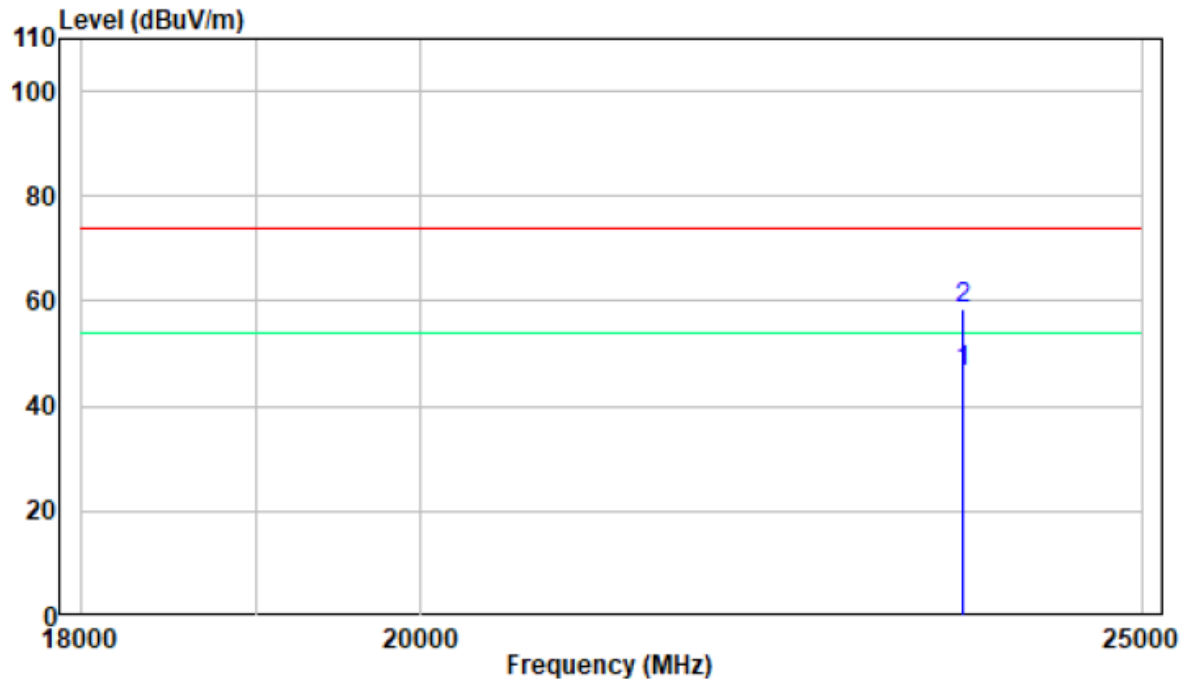
Vertical



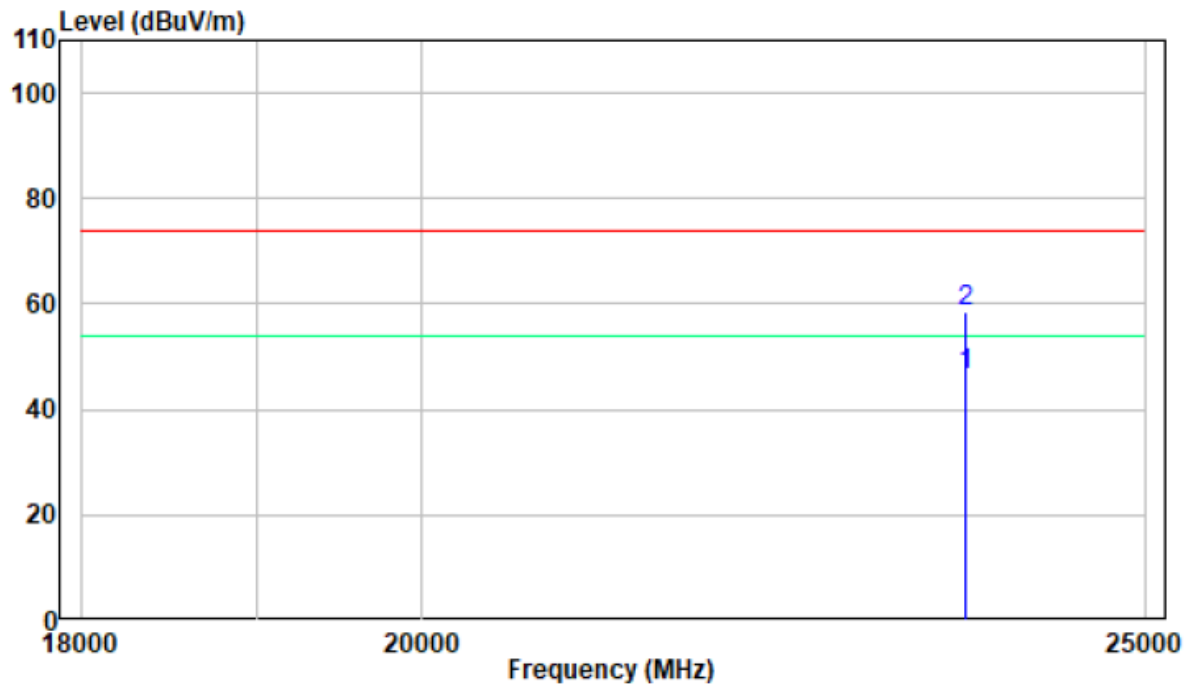
18-25GHz: (Pre-Scan plots)

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 hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

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**

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

**Test Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 23 °C     |
| <b>Relative Humidity:</b> | 52 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Paul Liu on 2021-12-13.*

*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.

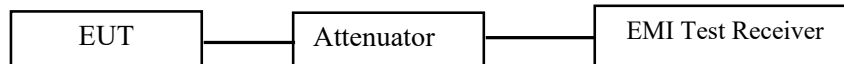
### **Test Procedure**

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:       | 23 °C     |
| Relative Humidity: | 52 %      |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Paul Liu on 2021-12-13.*

*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

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:       | 23 °C     |
| Relative Humidity: | 52 %      |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Paul Liu on 2021-12-13.*

*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

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

### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 23 °C     |
| Relative Humidity: | 52 %      |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Paul Liu on 2021-12-13.*

*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.

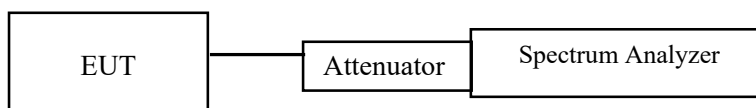
According to RSS-247§ 5.1(b) &§ 5.4(b):

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.



**Test Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 23 °C     |
| <b>Relative Humidity:</b> | 52 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Paul Liu on 2021-12-13.*

*EUT operation mode: Transmitting*

*Test Result: Compliant. Please refer to the Appendix.*

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

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### **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**

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

**Test Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 23 °C     |
| <b>Relative Humidity:</b> | 52 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Paul Liu on 2021-12-13.*

*EUT operation mode: Transmitting*

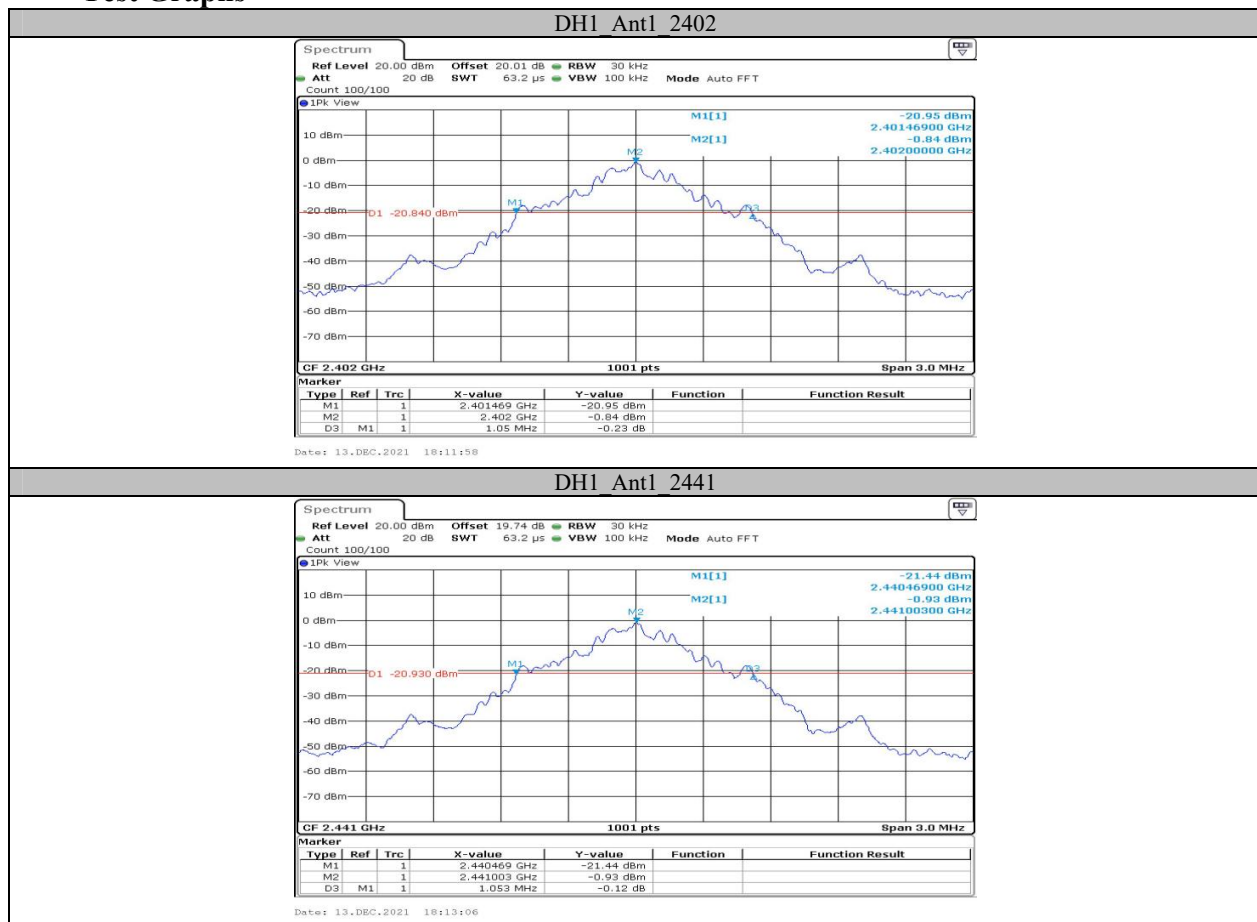
*Test Result: Compliant. Please refer to the Appendix.*

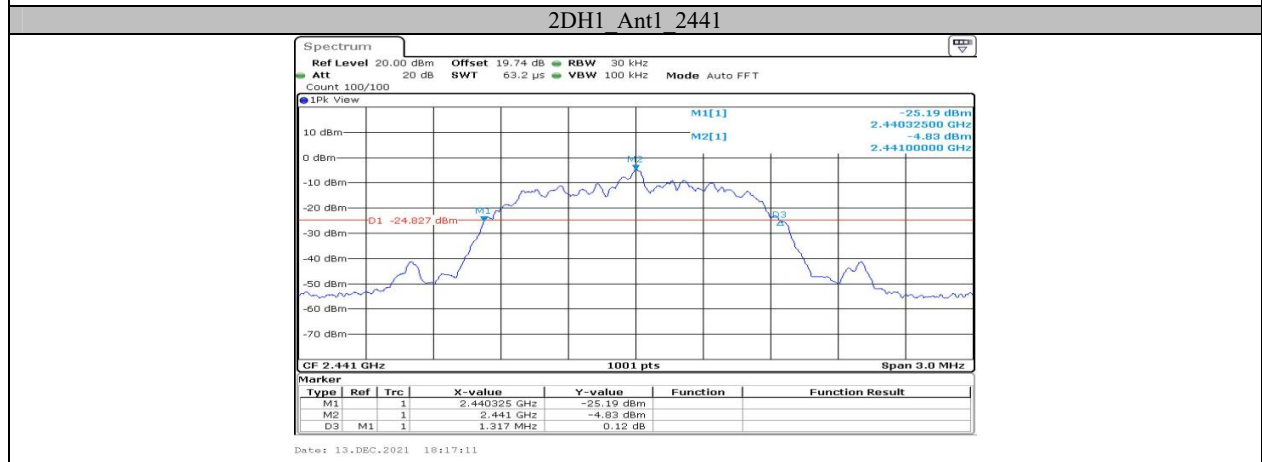
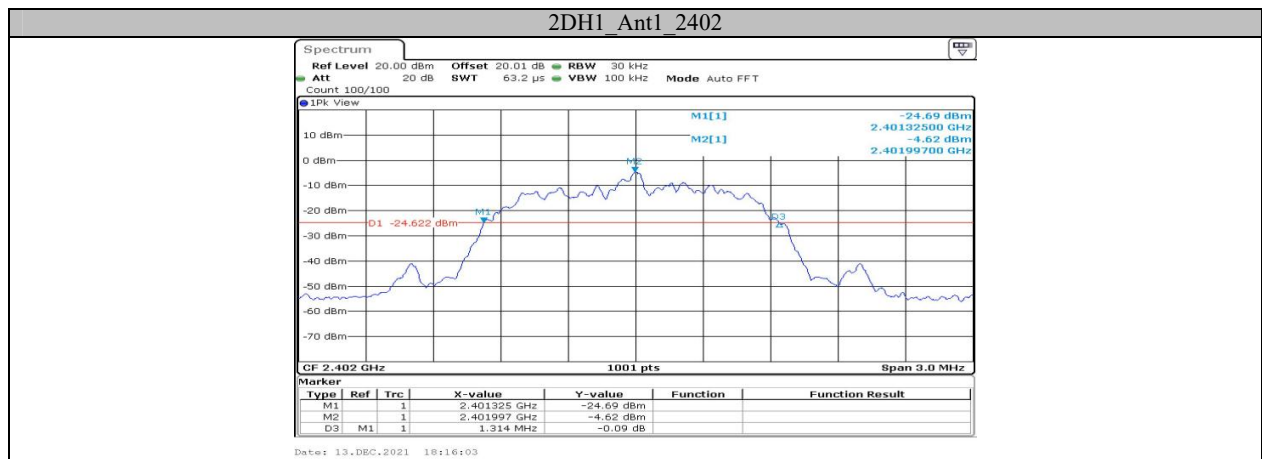
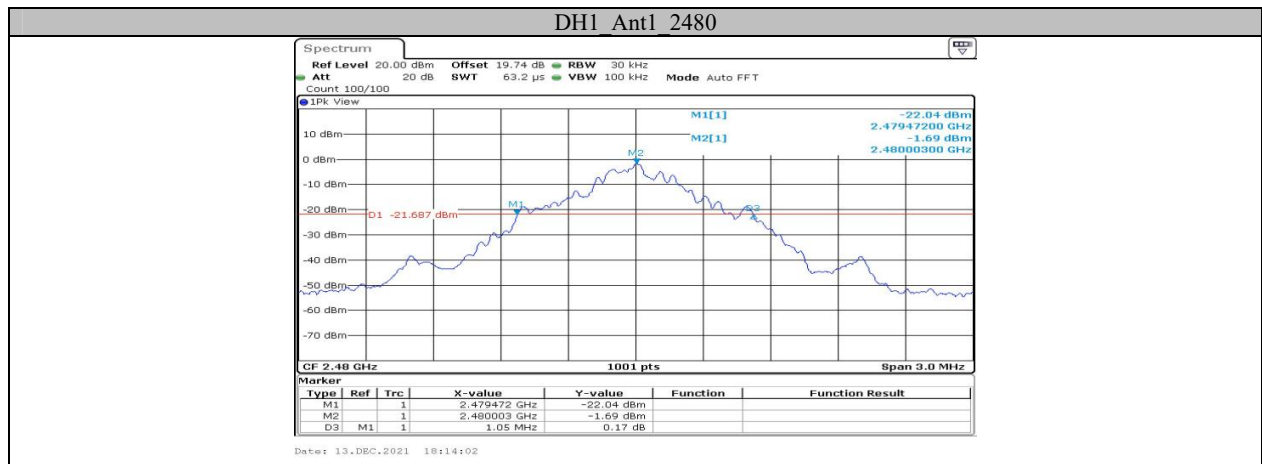
## APPENDIX

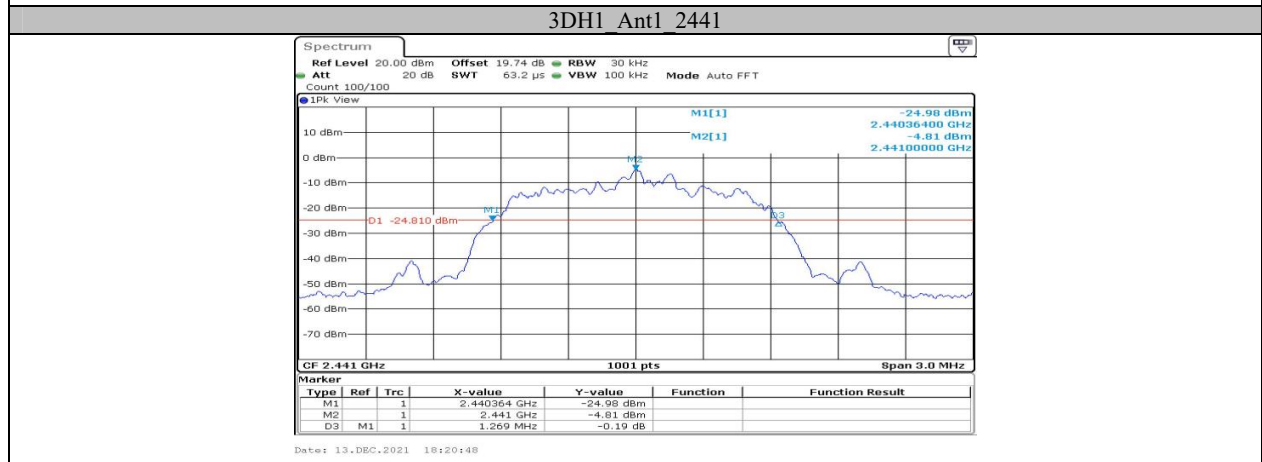
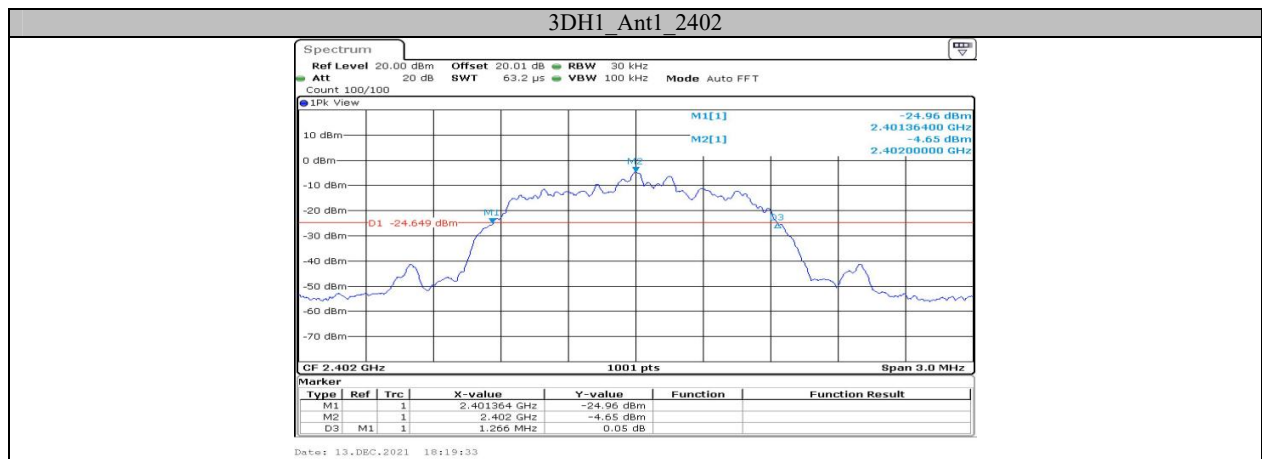
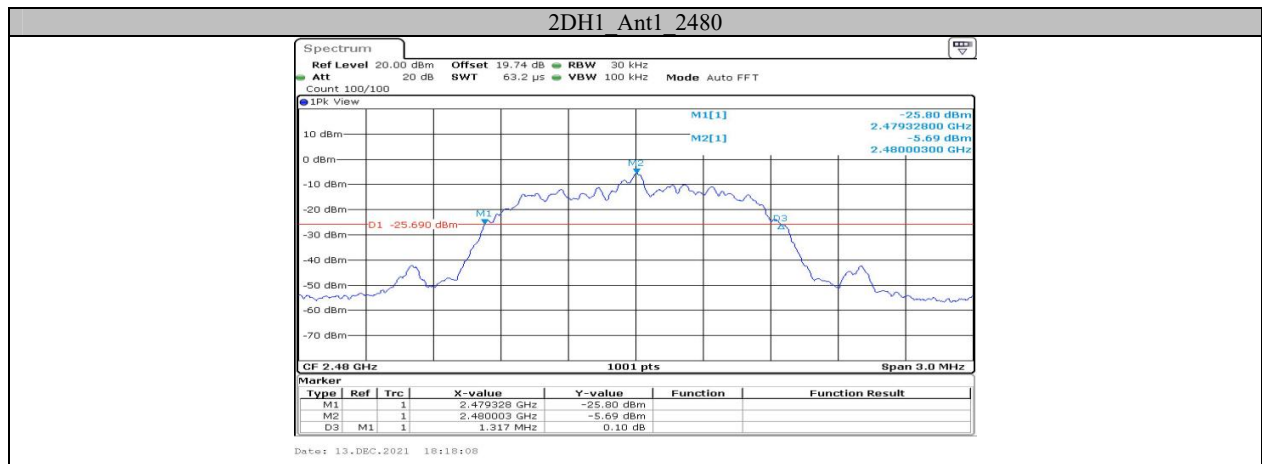
### Appendix A: 20dB Emission Bandwidth Test Result

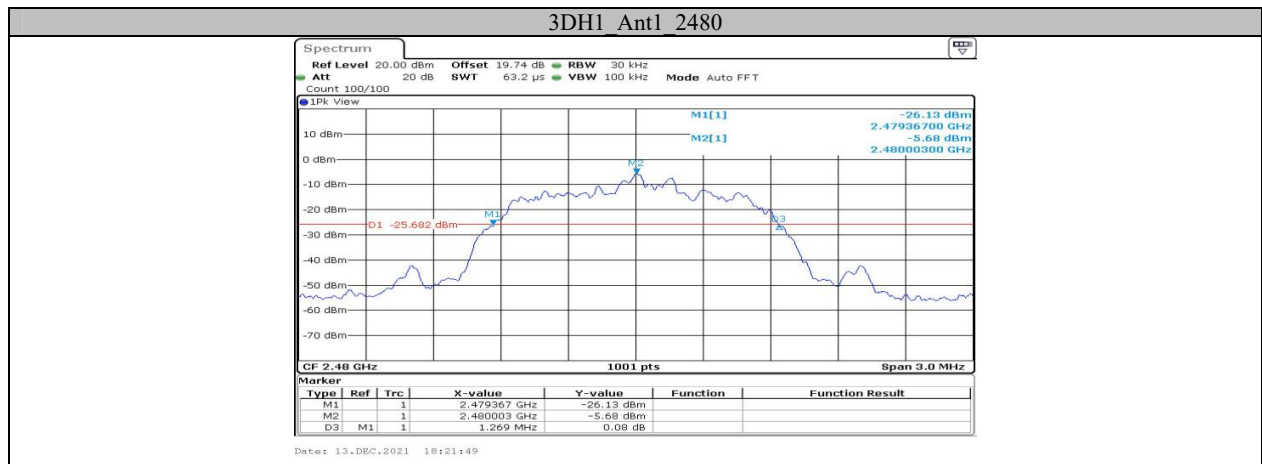
| Test Mode | Antenna | Channel | 20db EBW[MHz] | Limit[MHz] | Verdict |
|-----------|---------|---------|---------------|------------|---------|
| DH1       | Ant1    | 2402    | 1.050         | ---        | PASS    |
|           |         | 2441    | 1.053         | ---        | PASS    |
|           |         | 2480    | 1.050         | ---        | PASS    |
| 2DH1      | Ant1    | 2402    | 1.314         | ---        | PASS    |
|           |         | 2441    | 1.317         | ---        | PASS    |
|           |         | 2480    | 1.317         | ---        | PASS    |
| 3DH1      | Ant1    | 2402    | 1.266         | ---        | PASS    |
|           |         | 2441    | 1.269         | ---        | PASS    |
|           |         | 2480    | 1.269         | ---        | PASS    |

### Test Graphs





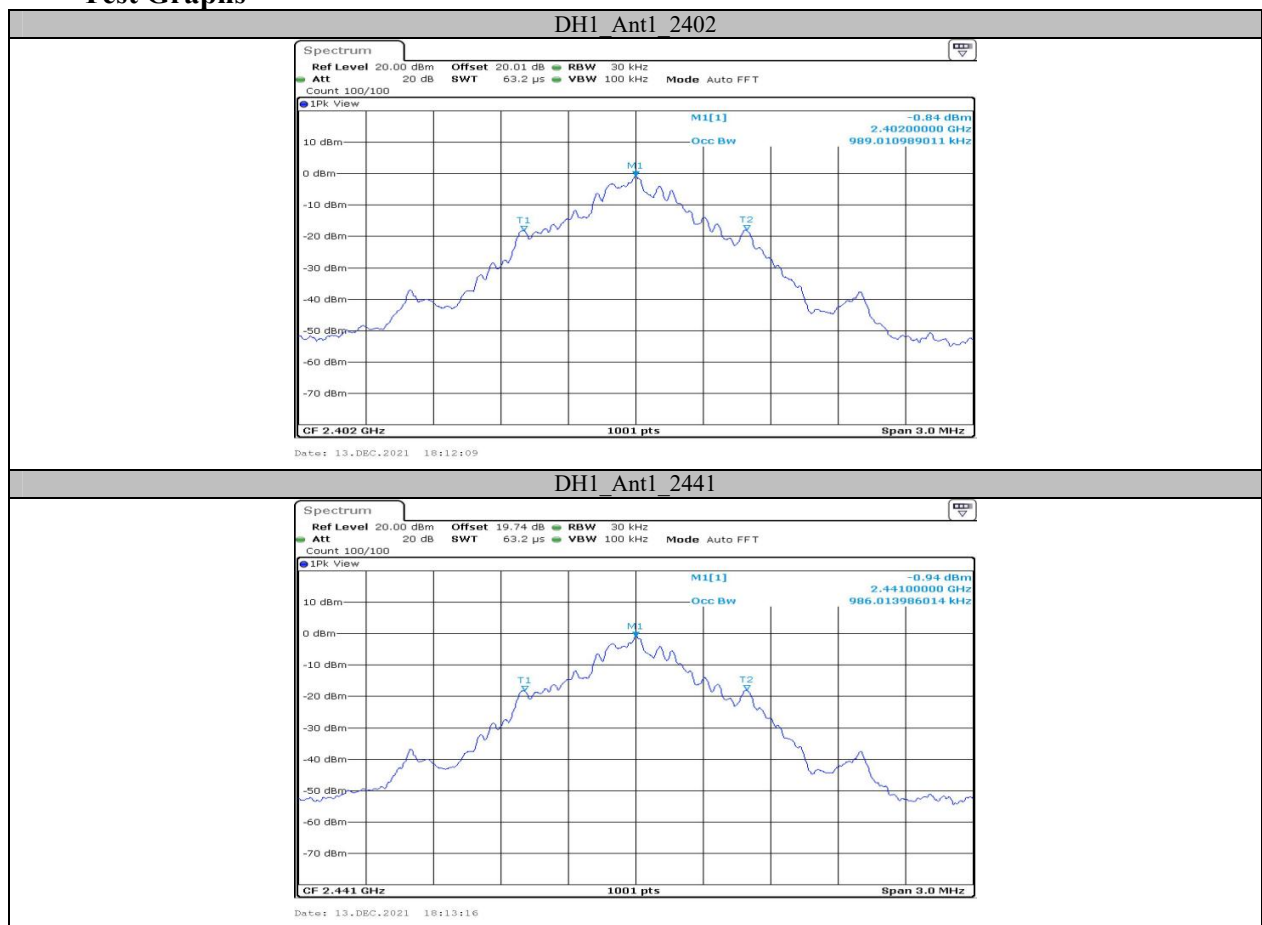


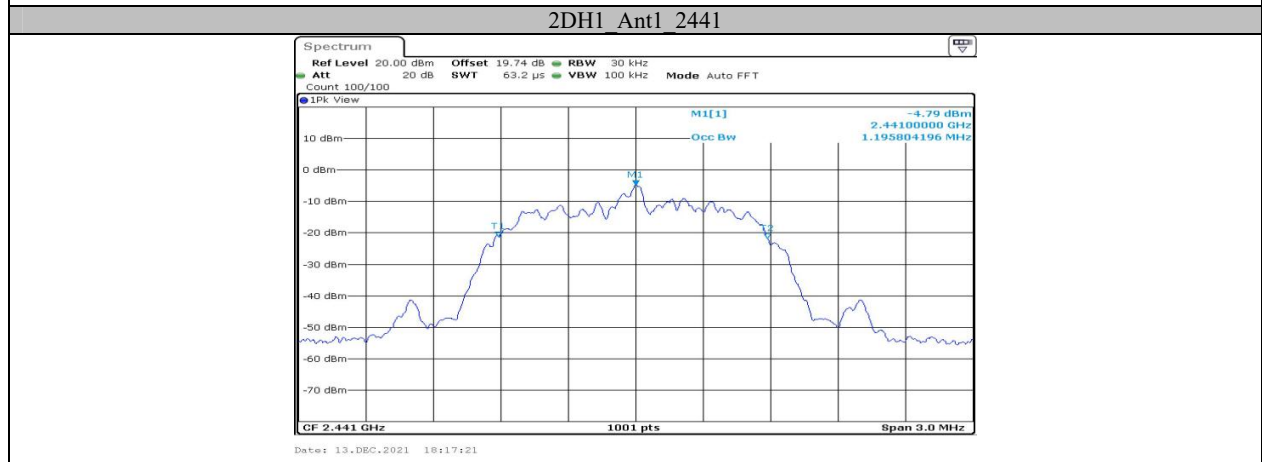
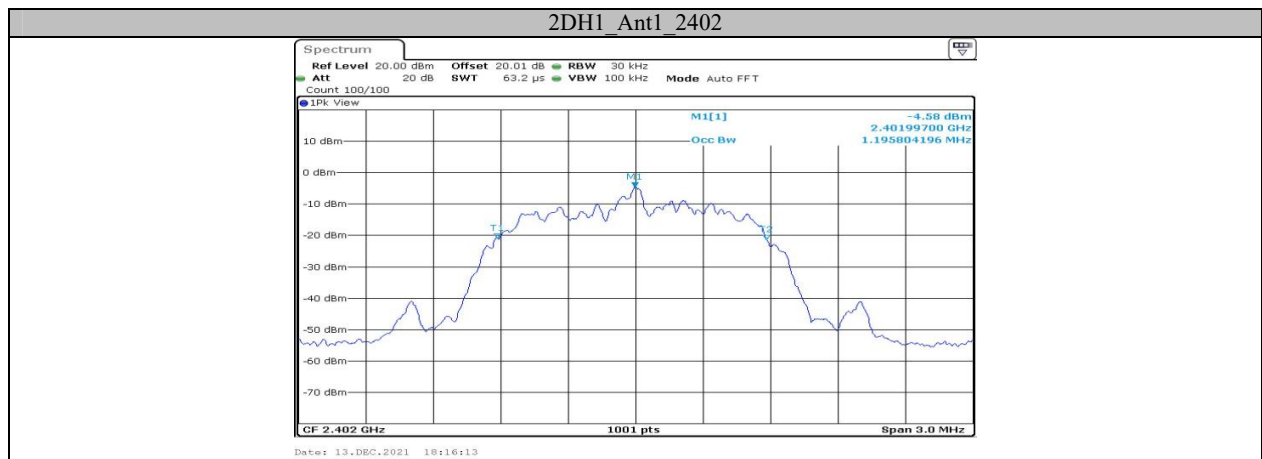
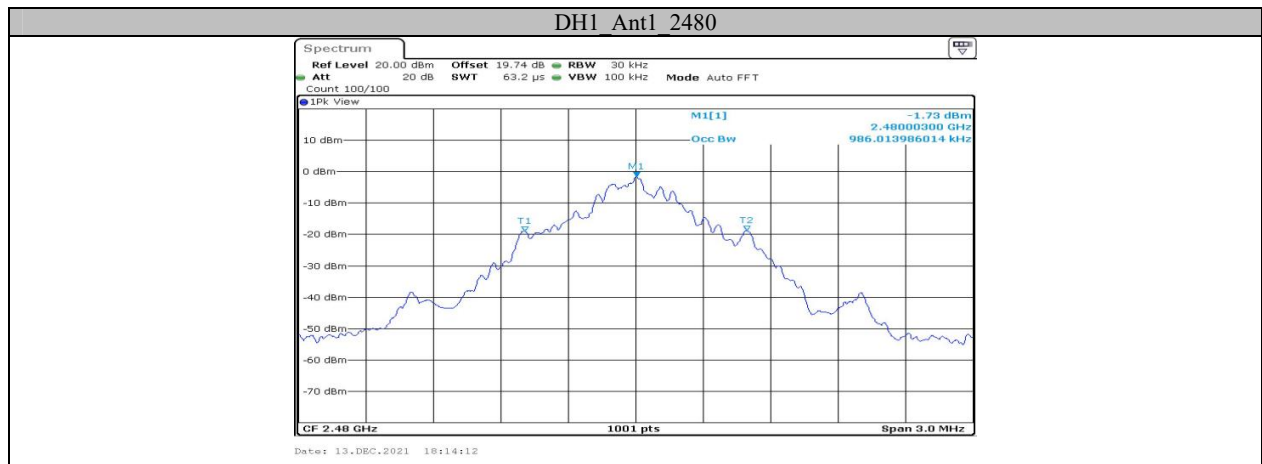


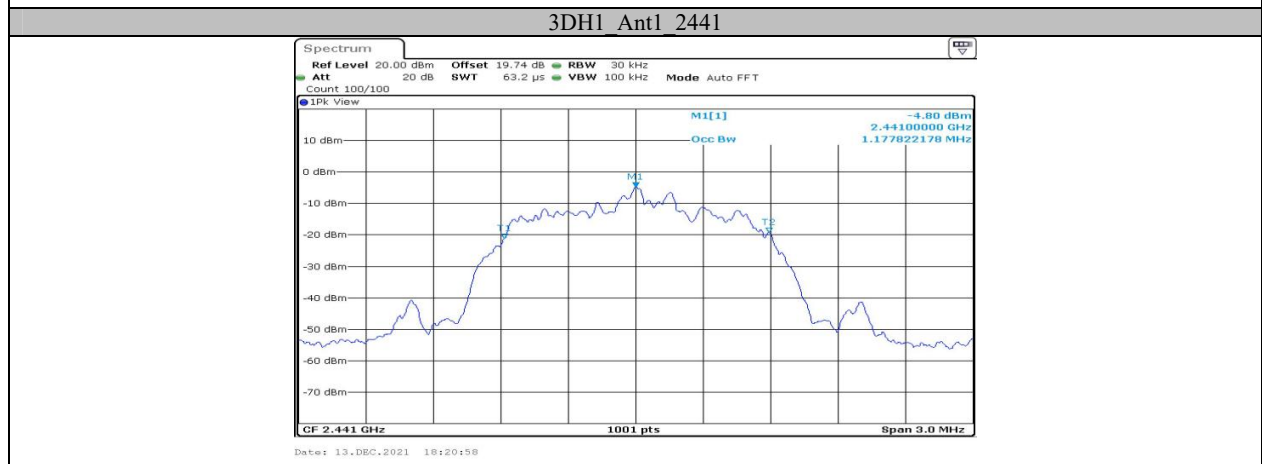
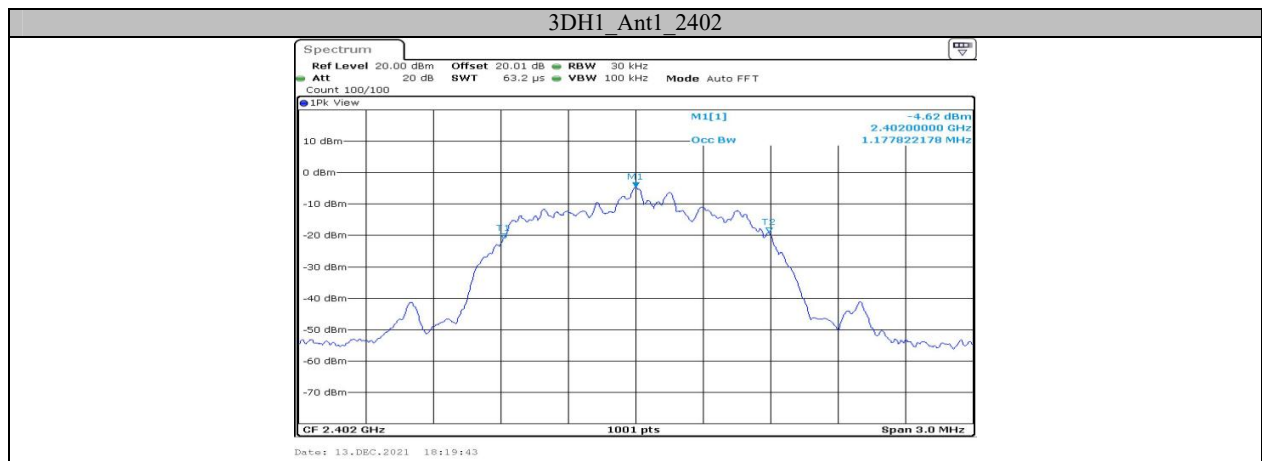
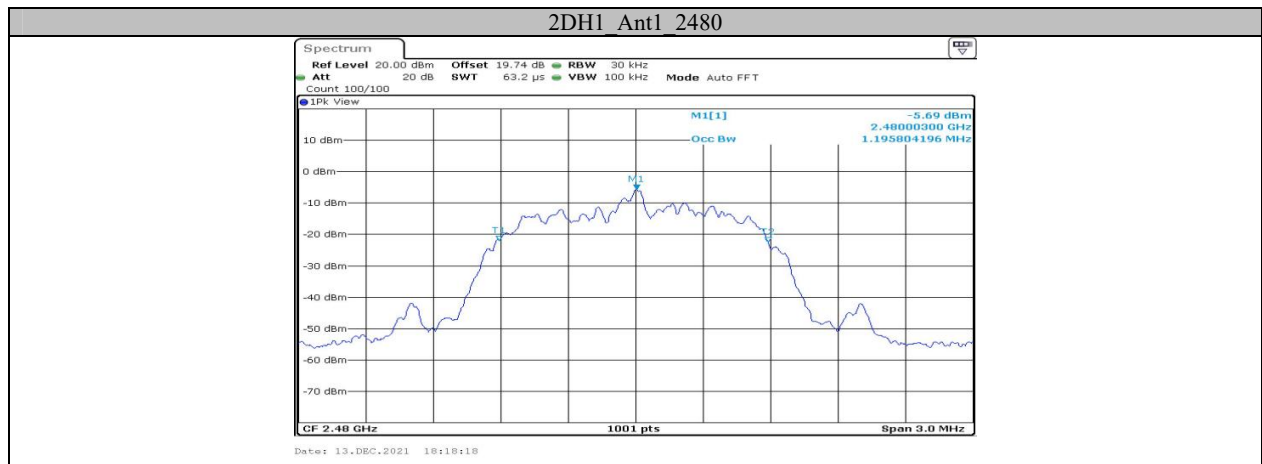
## Appendix B: Occupied Channel Bandwidth Test Result

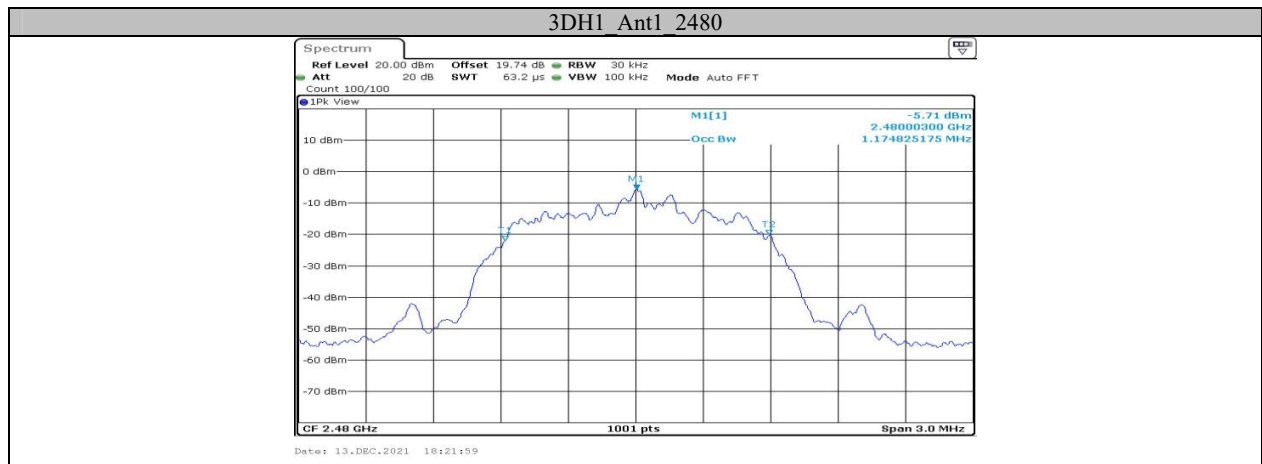
| Test Mode | Antenna | Channel | OCB [MHz] | Limit[MHz] | Verdict |
|-----------|---------|---------|-----------|------------|---------|
| DH1       | Ant1    | 2402    | 0.989     | ---        | PASS    |
|           |         | 2441    | 0.986     | ---        | PASS    |
|           |         | 2480    | 0.986     | ---        | PASS    |
| 2DH1      | Ant1    | 2402    | 1.196     | ---        | PASS    |
|           |         | 2441    | 1.196     | ---        | PASS    |
|           |         | 2480    | 1.196     | ---        | PASS    |
| 3DH1      | Ant1    | 2402    | 1.178     | ---        | PASS    |
|           |         | 2441    | 1.178     | ---        | PASS    |
|           |         | 2480    | 1.175     | ---        | PASS    |

## Test Graphs







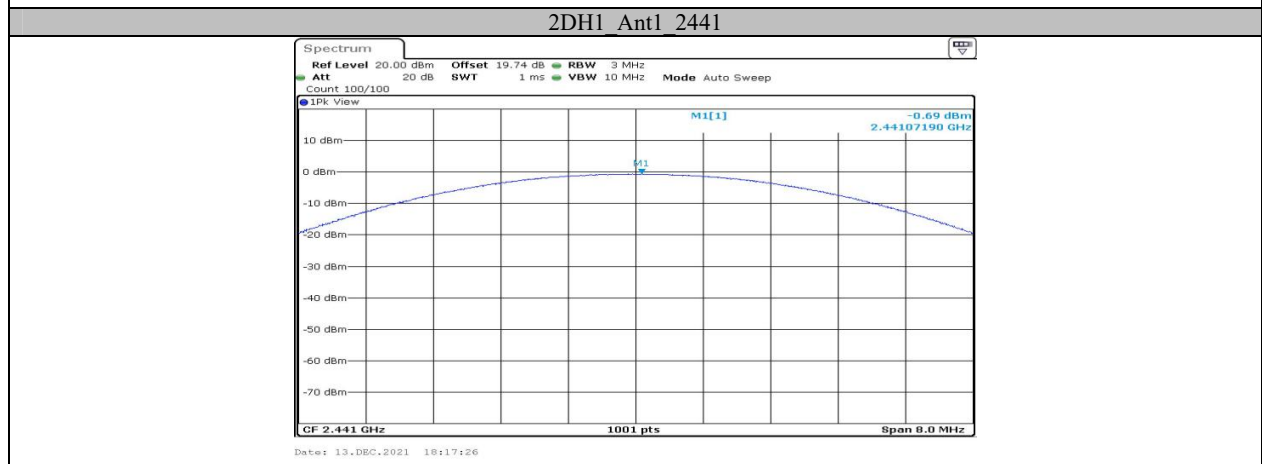
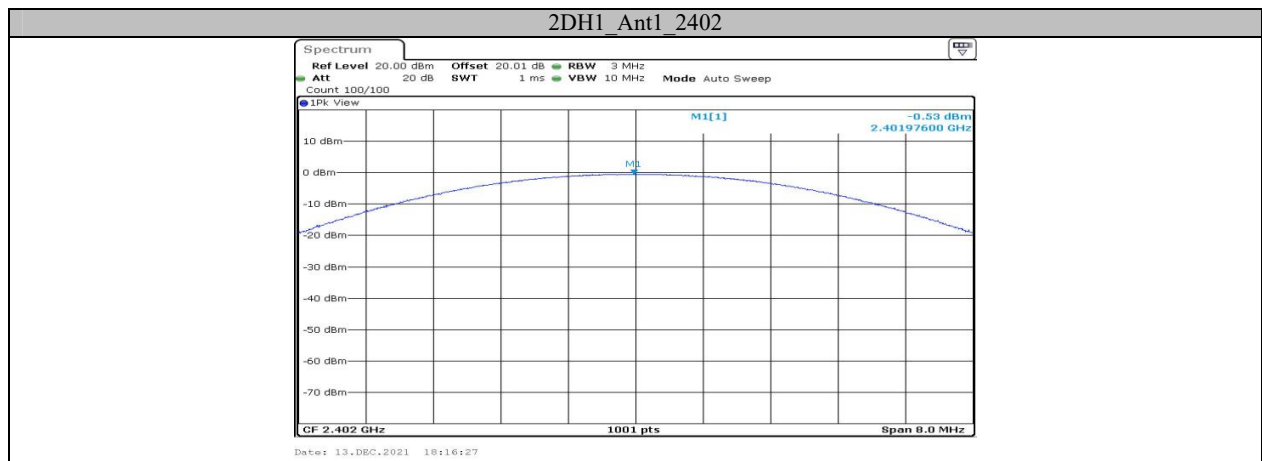
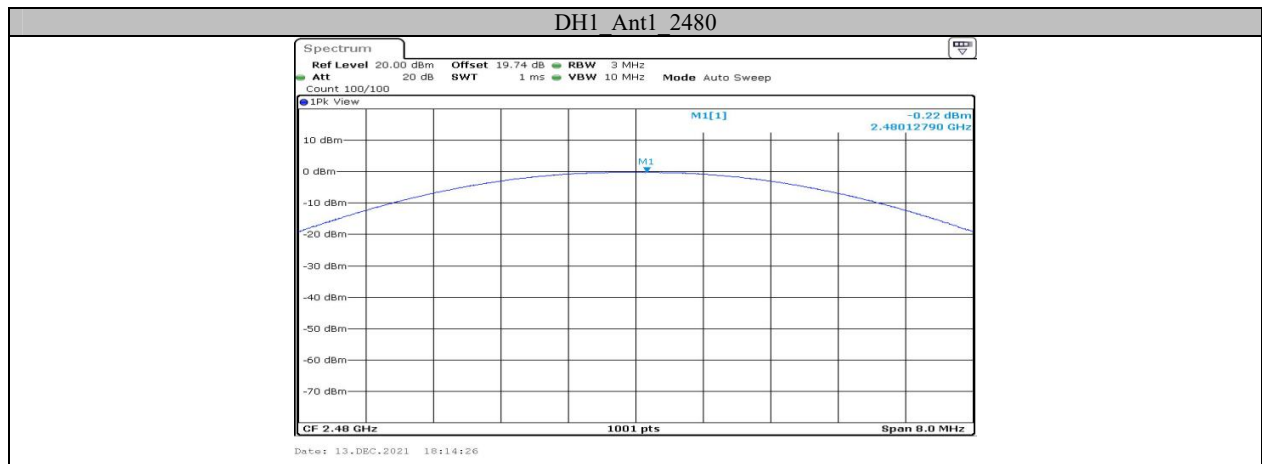


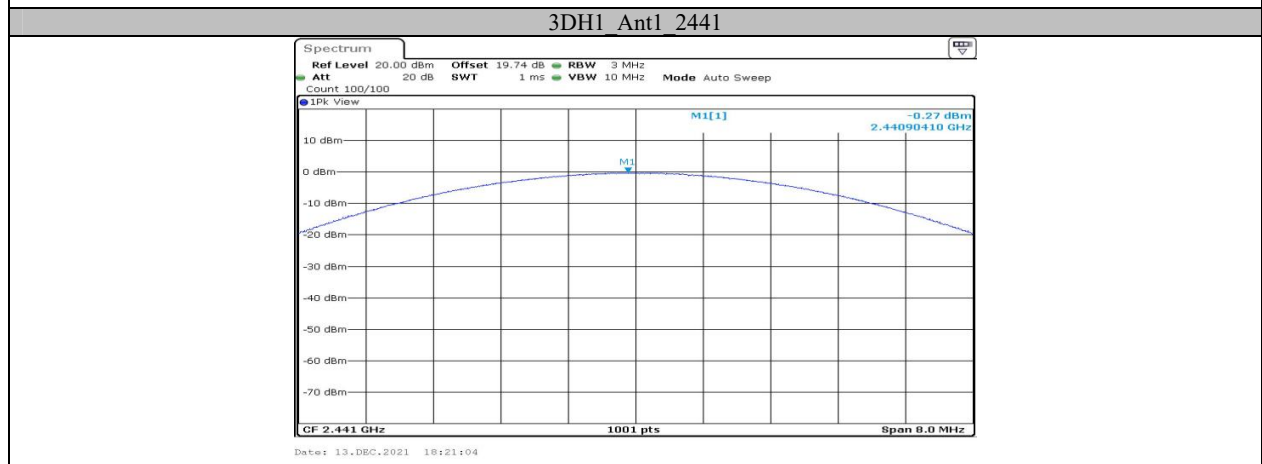
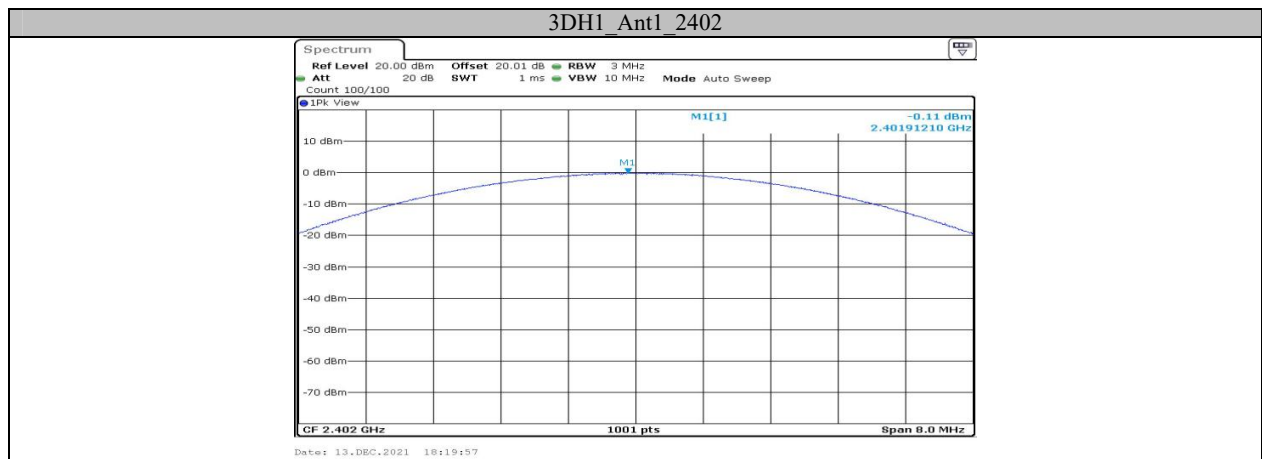
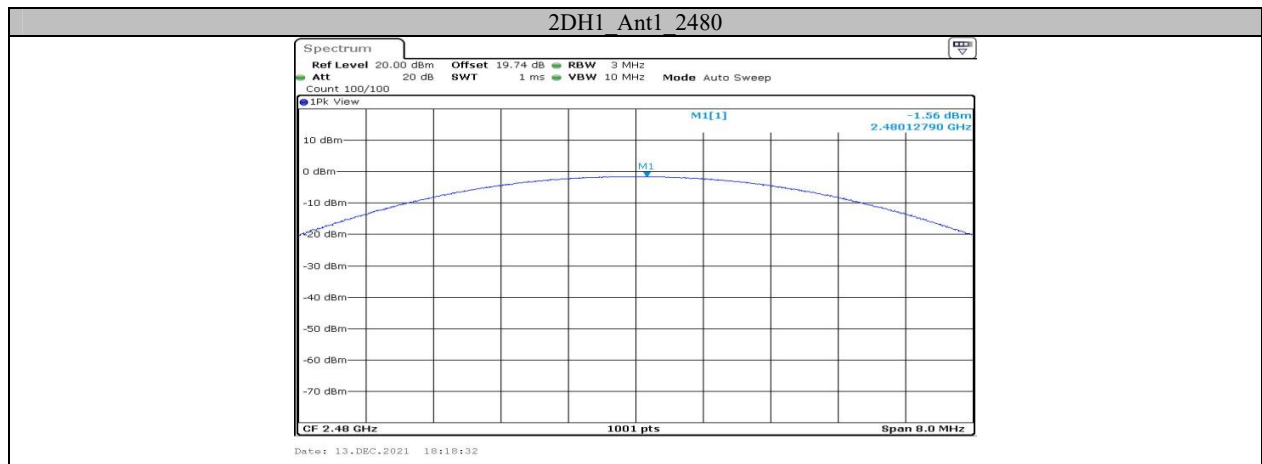
### Appendix C: Maximum conducted Peak output power Test Result

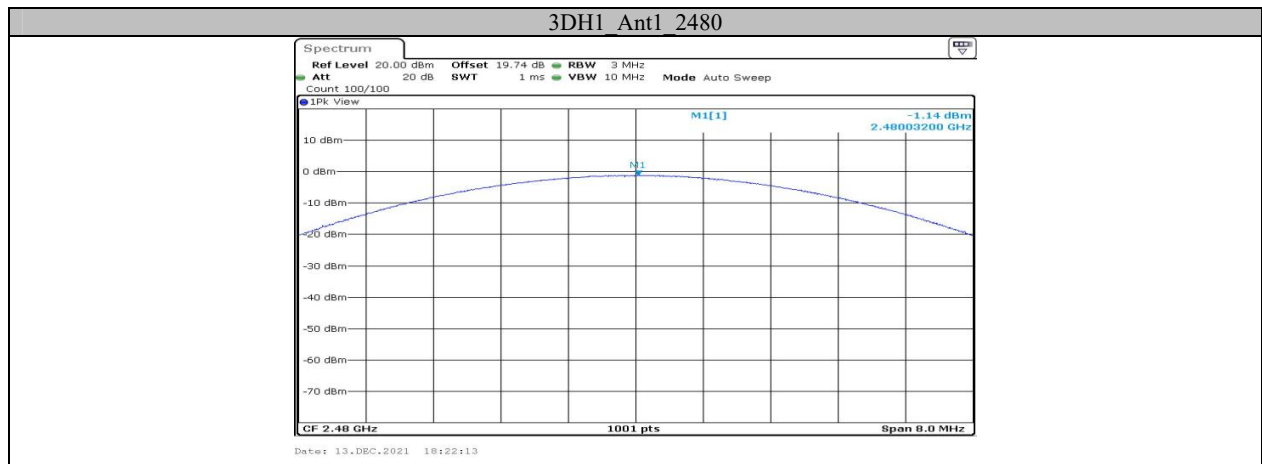
| Test Mode | Antenna | Channel | Result[dBm] | Limit[dBm]   | Verdict |
|-----------|---------|---------|-------------|--------------|---------|
| DH1       | Ant1    | 2402    | 0.63        | $\leq 20.97$ | PASS    |
|           |         | 2441    | 0.56        | $\leq 20.97$ | PASS    |
|           |         | 2480    | -0.22       | $\leq 20.97$ | PASS    |
| 2DH1      | Ant1    | 2402    | -0.53       | $\leq 20.97$ | PASS    |
|           |         | 2441    | -0.69       | $\leq 20.97$ | PASS    |
|           |         | 2480    | -1.56       | $\leq 20.97$ | PASS    |
| 3DH1      | Ant1    | 2402    | -0.11       | $\leq 20.97$ | PASS    |
|           |         | 2441    | -0.27       | $\leq 20.97$ | PASS    |
|           |         | 2480    | -1.14       | $\leq 20.97$ | PASS    |

### Test Graphs







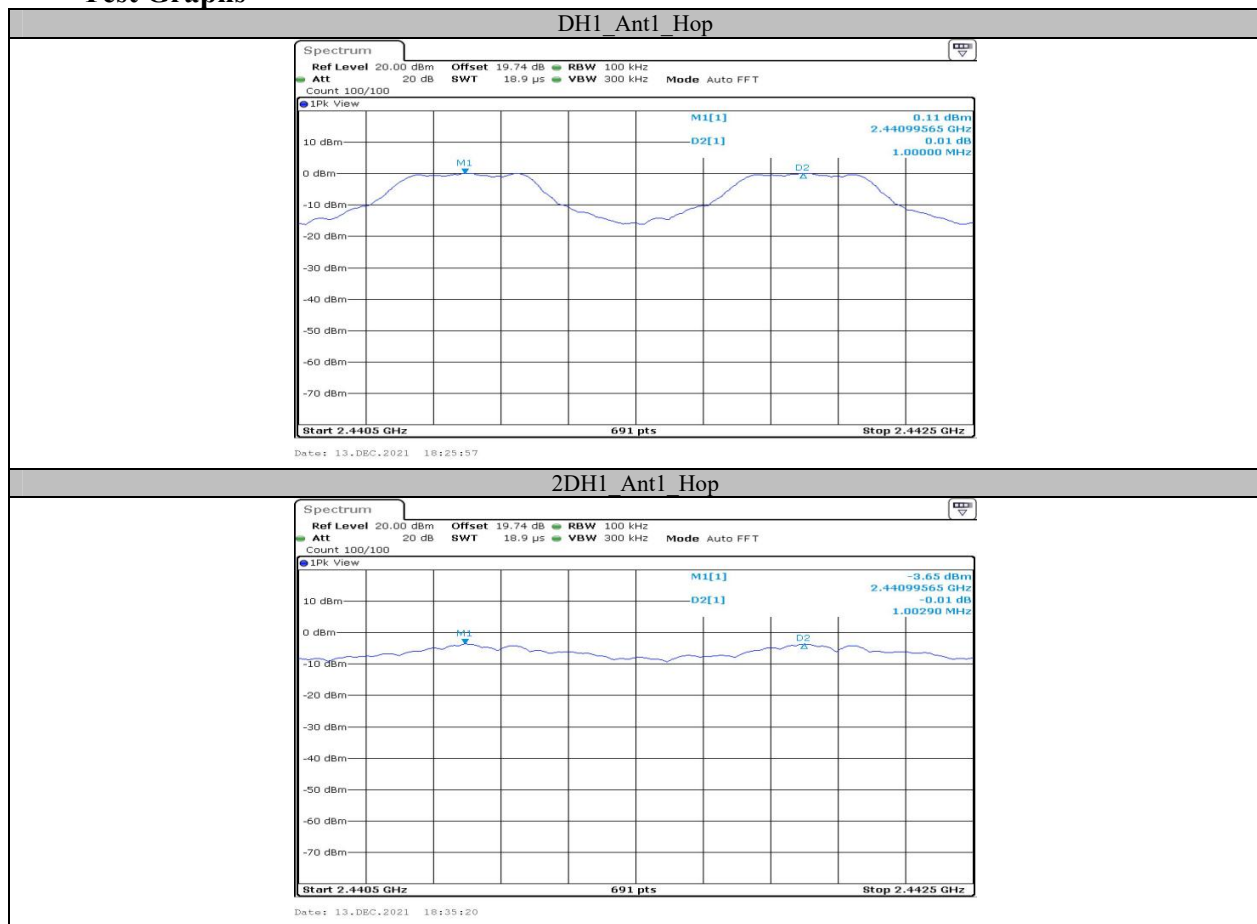


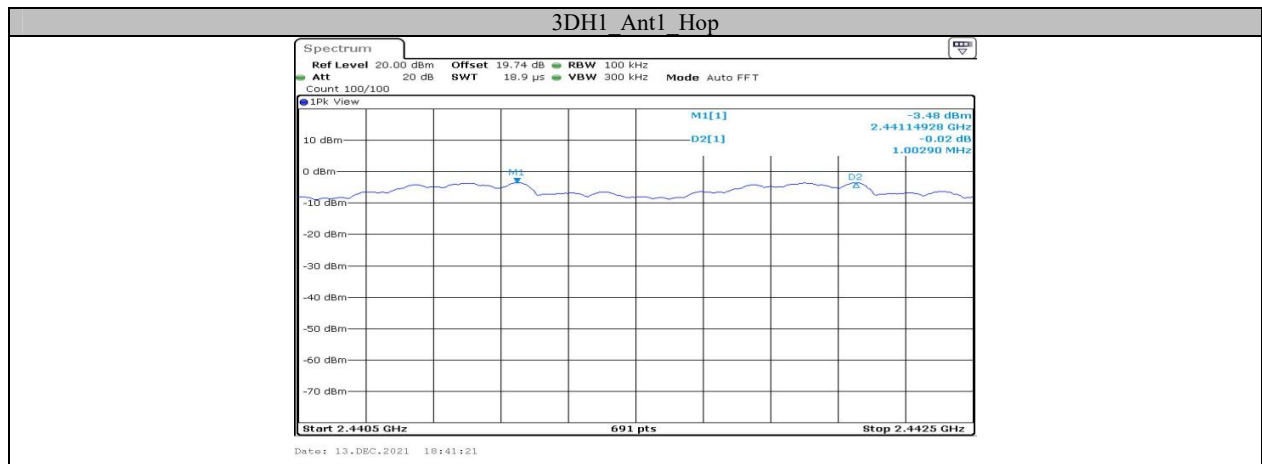
## Appendix D: Carrier frequency separation

### Test Result

| Test Mode | Antenna | Channel | Result[MHz] | Limit[MHz]   | Verdict |
|-----------|---------|---------|-------------|--------------|---------|
| DH1       | Ant1    | Hop     | 1.000       | $\geq 0.702$ | PASS    |
| 2DH1      | Ant1    | Hop     | 1.003       | $\geq 0.878$ | PASS    |
| 3DH1      | Ant1    | Hop     | 1.003       | $\geq 0.846$ | PASS    |

### Test Graphs





## Appendix E: Time of occupancy Test Result

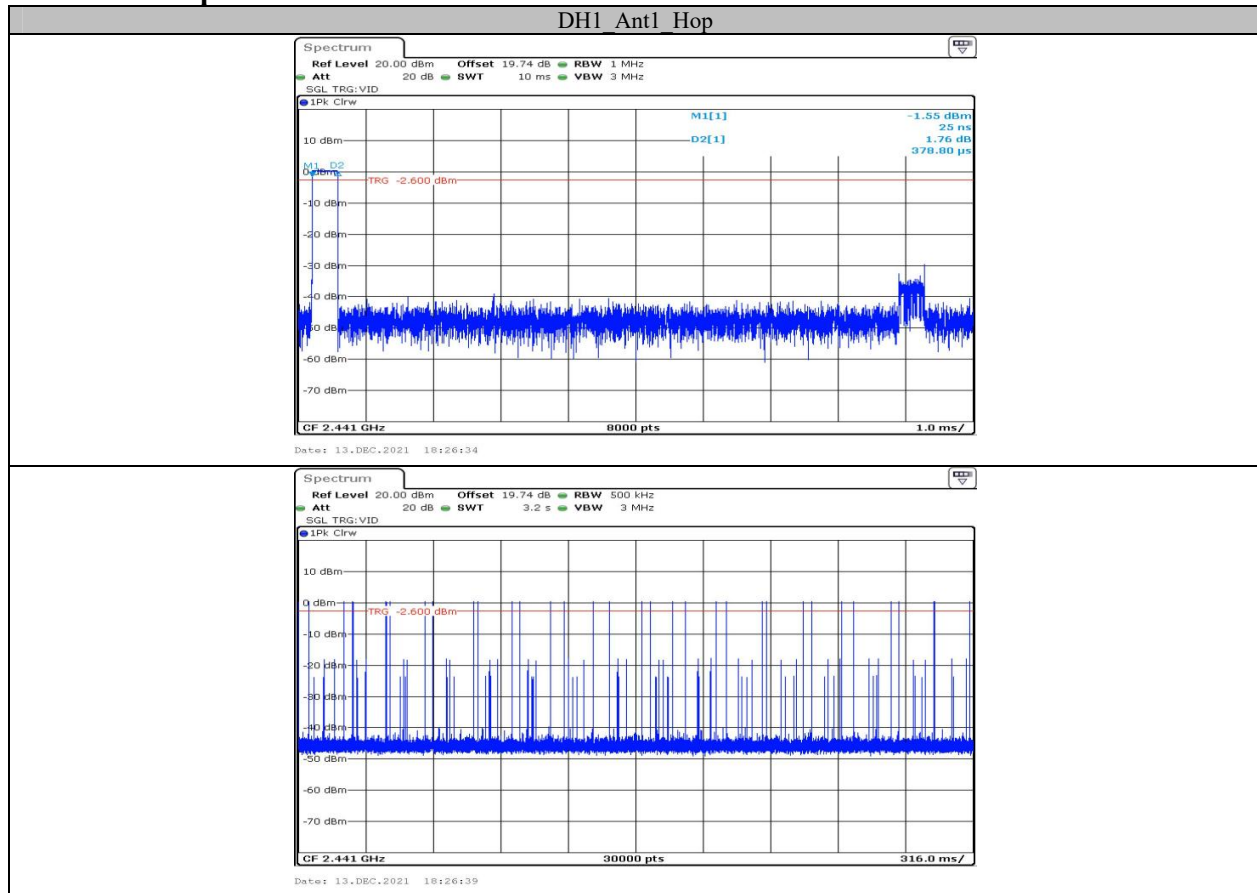
| Test Mode | Antenna | Channel | BurstWidth<br>[ms] | TotalHops<br>[Num] | Result[s] | Limit[s] | Verdict |
|-----------|---------|---------|--------------------|--------------------|-----------|----------|---------|
| DH1       | Ant1    | Hop     | 0.38               | 330                | 0.125     | ≤0.4     | PASS    |
| DH3       | Ant1    | Hop     | 1.63               | 150                | 0.244     | ≤0.4     | PASS    |
| DH5       | Ant1    | Hop     | 2.87               | 130                | 0.373     | ≤0.4     | PASS    |
| 2DH1      | Ant1    | Hop     | 0.39               | 320                | 0.124     | ≤0.4     | PASS    |
| 2DH3      | Ant1    | Hop     | 1.63               | 140                | 0.228     | ≤0.4     | PASS    |
| 2DH5      | Ant1    | Hop     | 2.87               | 120                | 0.344     | ≤0.4     | PASS    |
| 3DH1      | Ant1    | Hop     | 0.39               | 330                | 0.127     | ≤0.4     | PASS    |
| 3DH3      | Ant1    | Hop     | 1.63               | 140                | 0.228     | ≤0.4     | PASS    |
| 3DH5      | Ant1    | Hop     | 2.87               | 130                | 0.373     | ≤0.4     | PASS    |

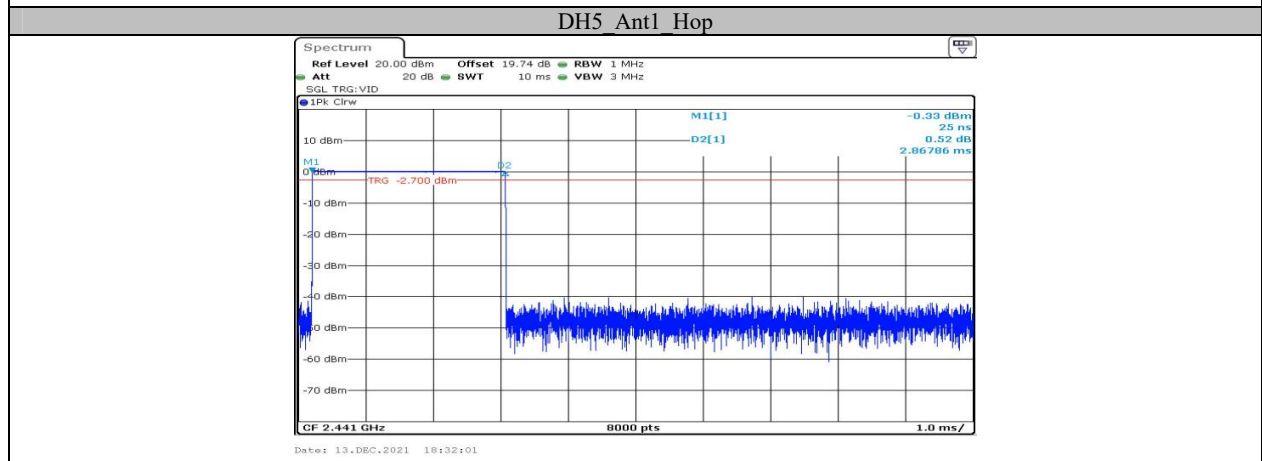
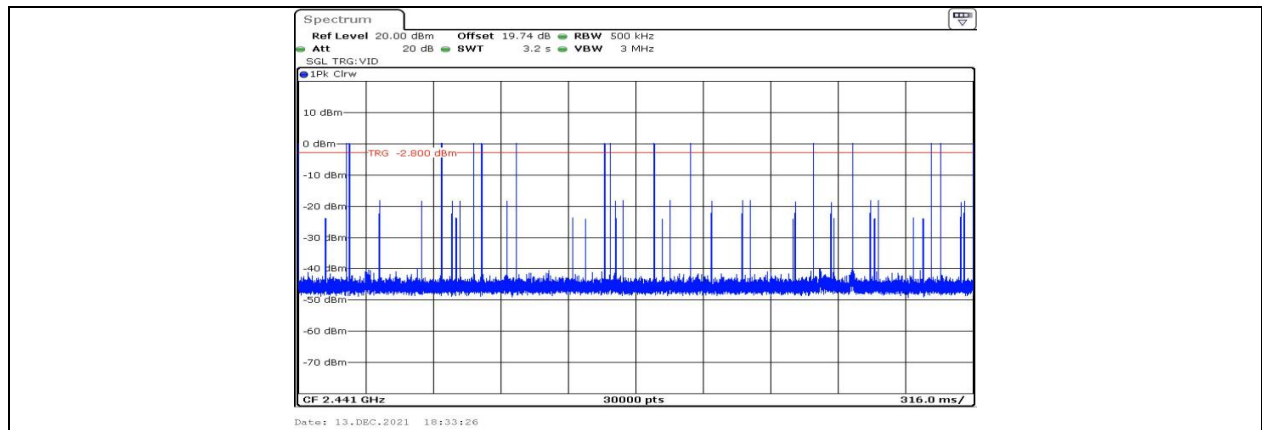
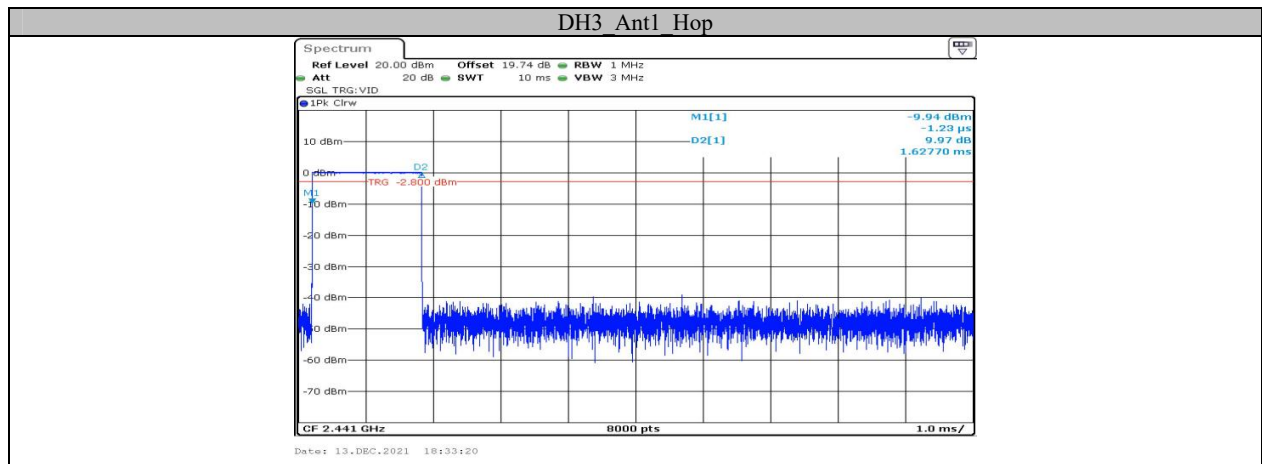
Note 1: A period time= $0.4 \times 79 = 31.6(S)$ , Result=BurstWidth\*Totalhops

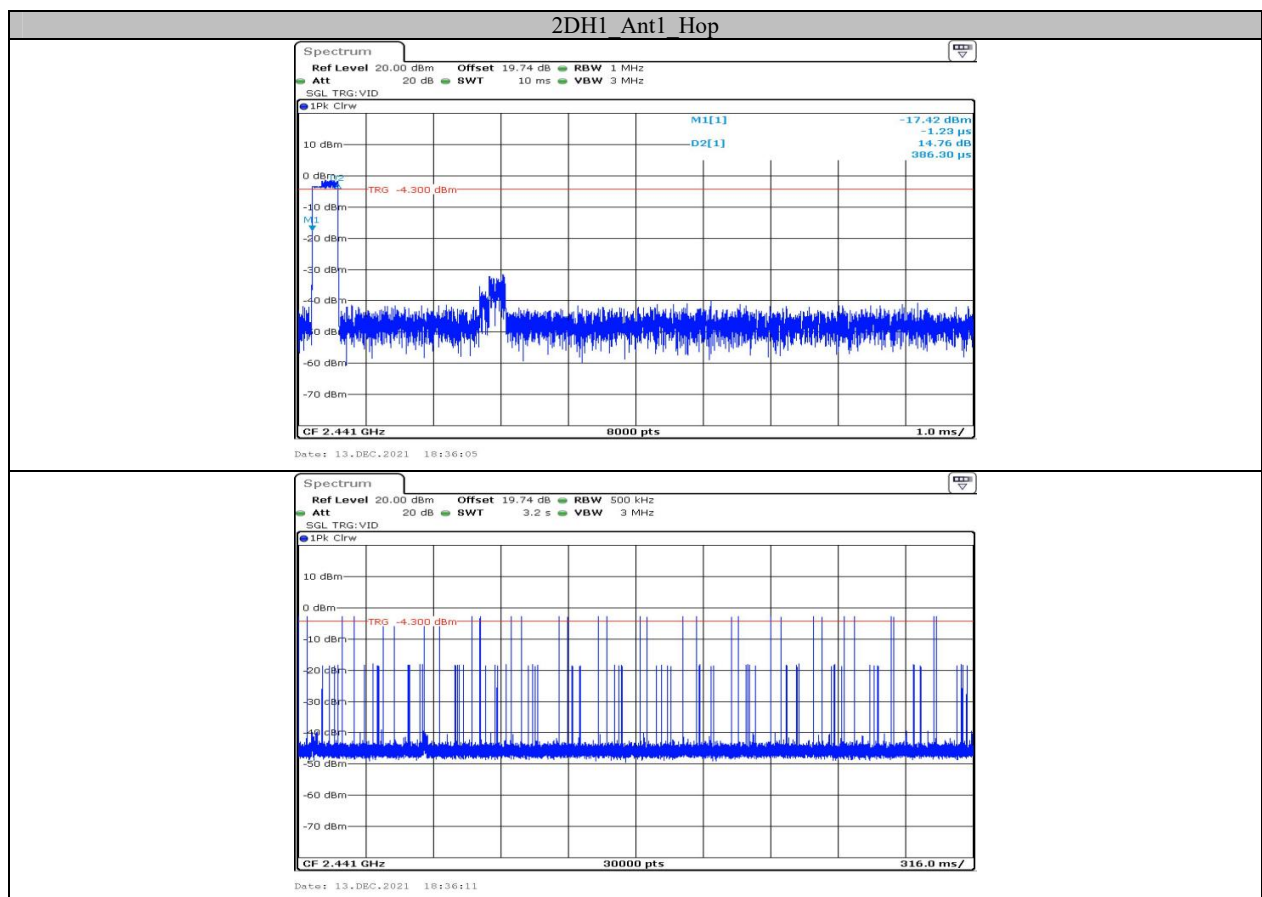
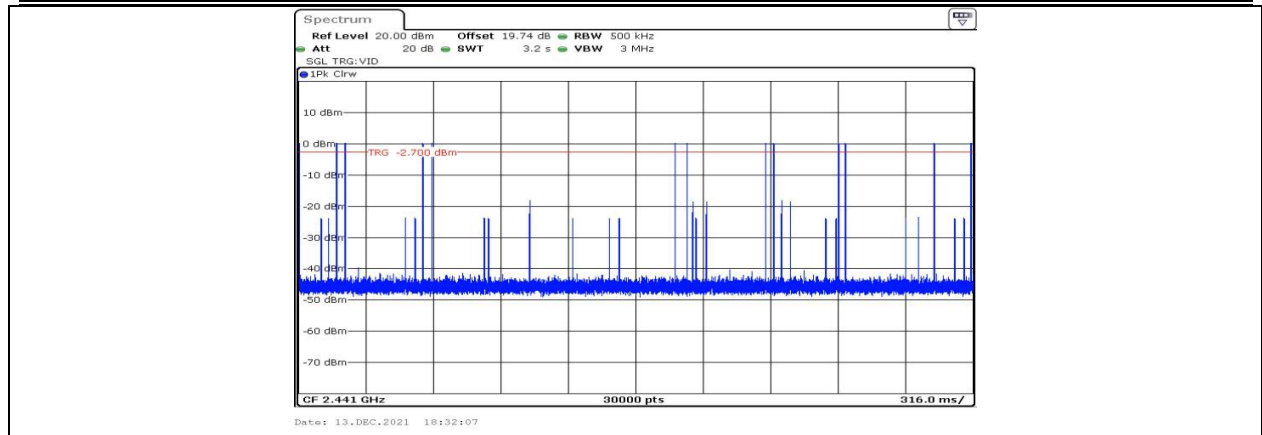
Note 2: Totalhops=Hopping Number in 3.16s\*10

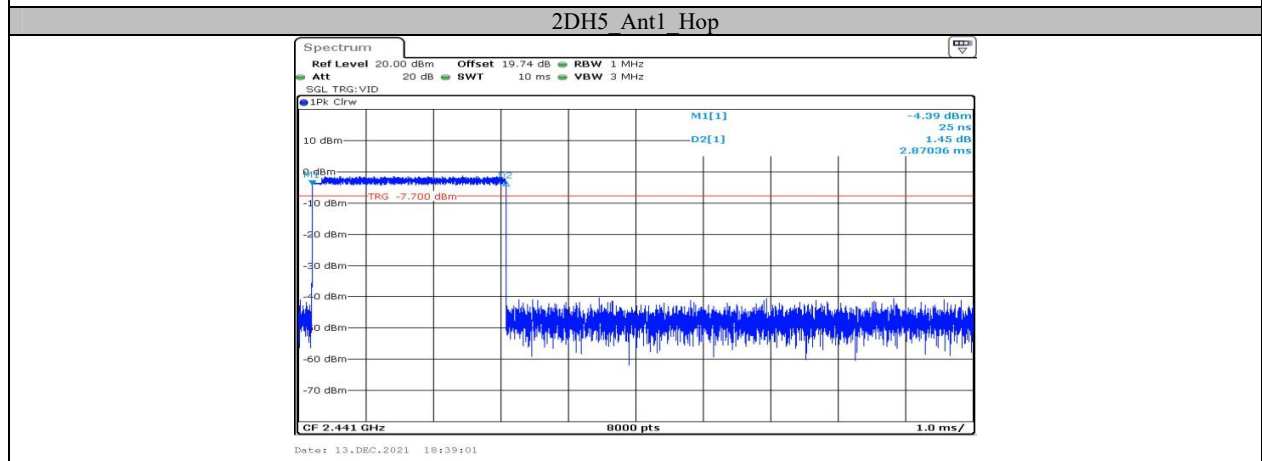
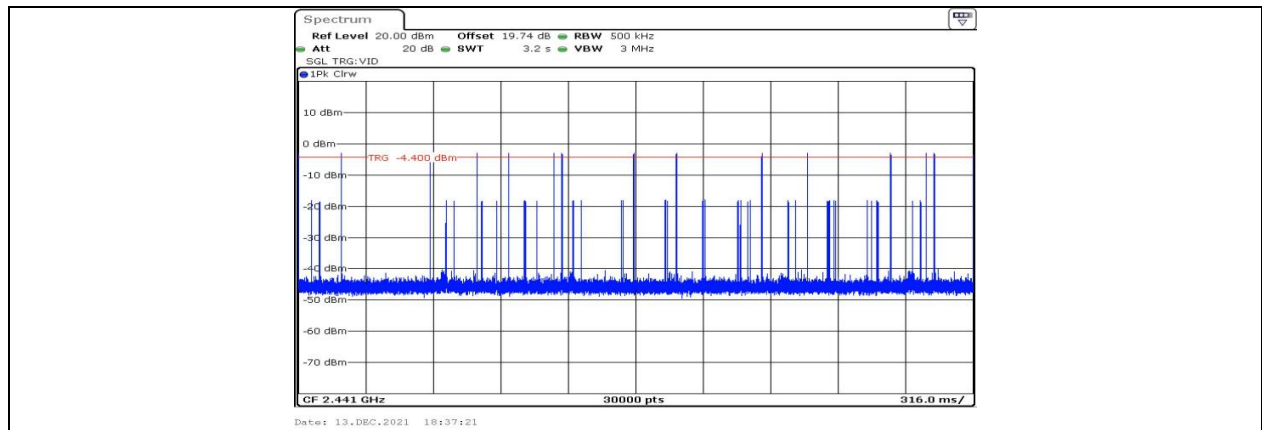
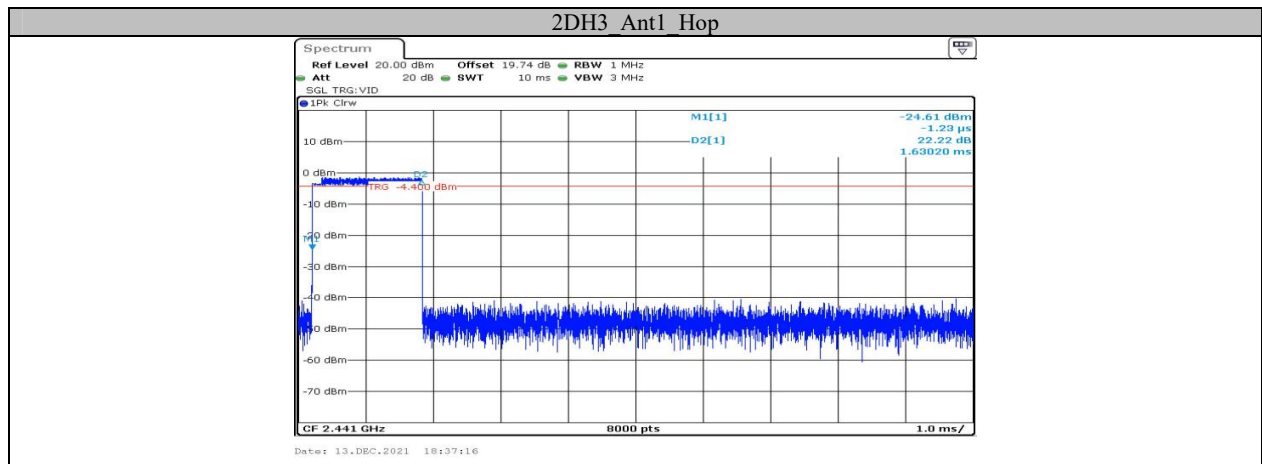
Note 3: Hopping Number in 3.16s=Total of highest signals in 3.16s(Second high signals were other channel)

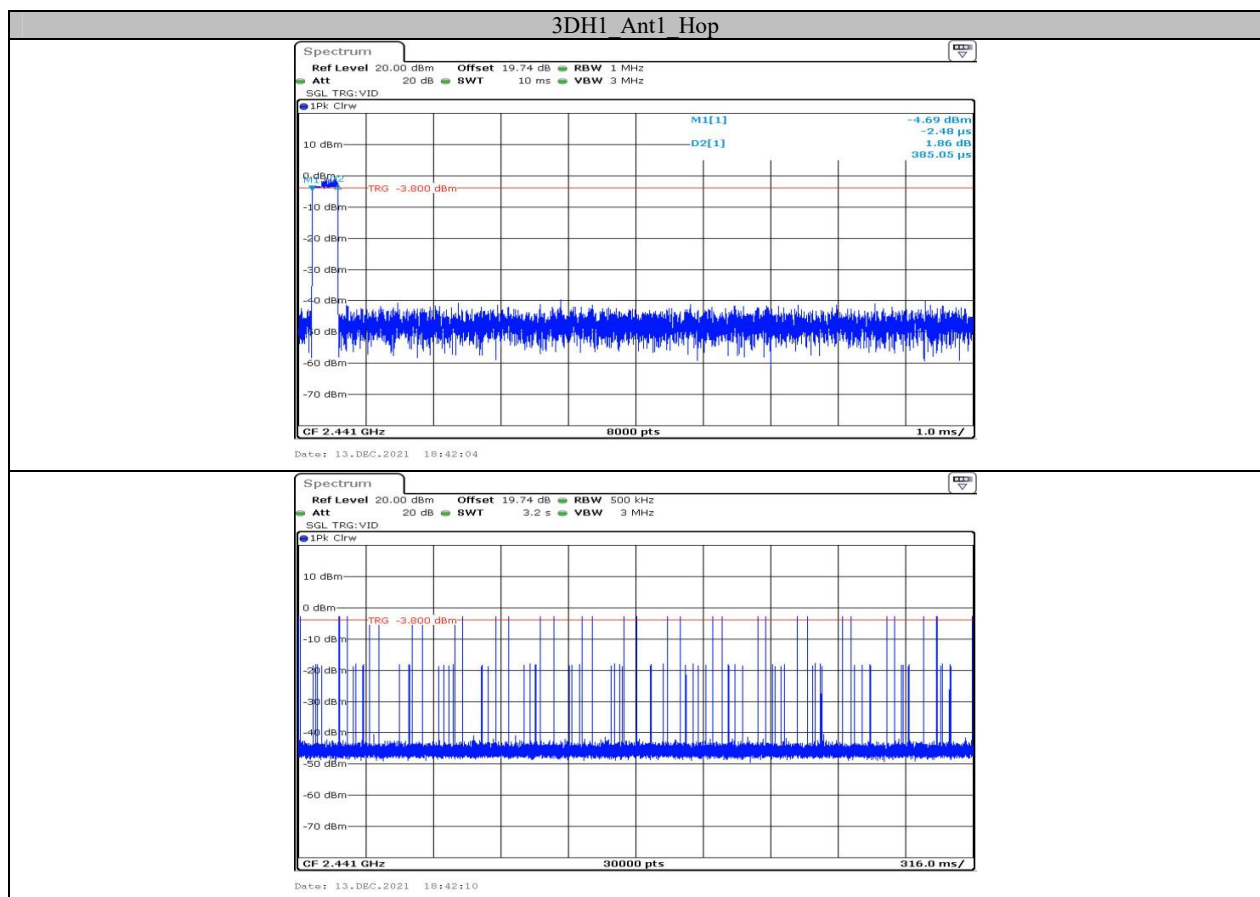
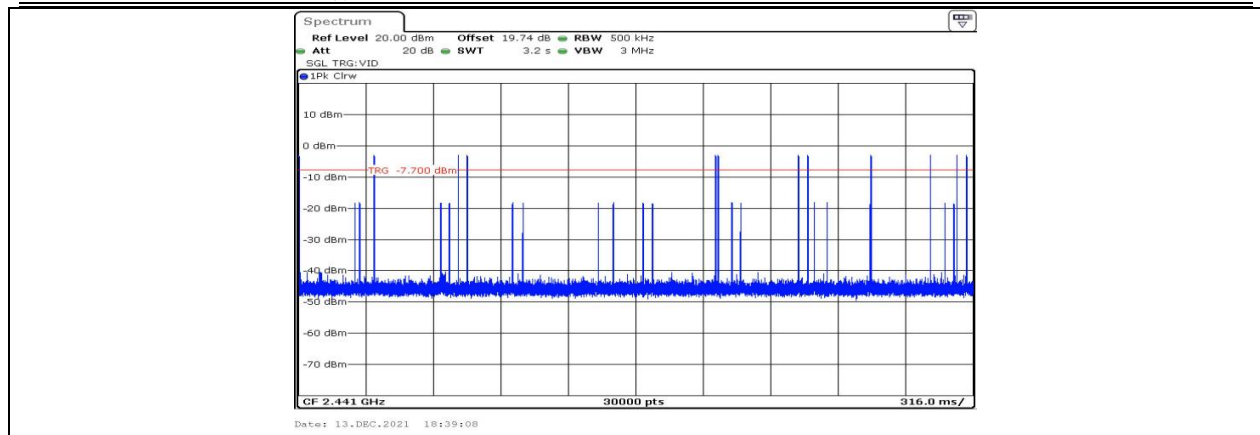
## Test Graphs

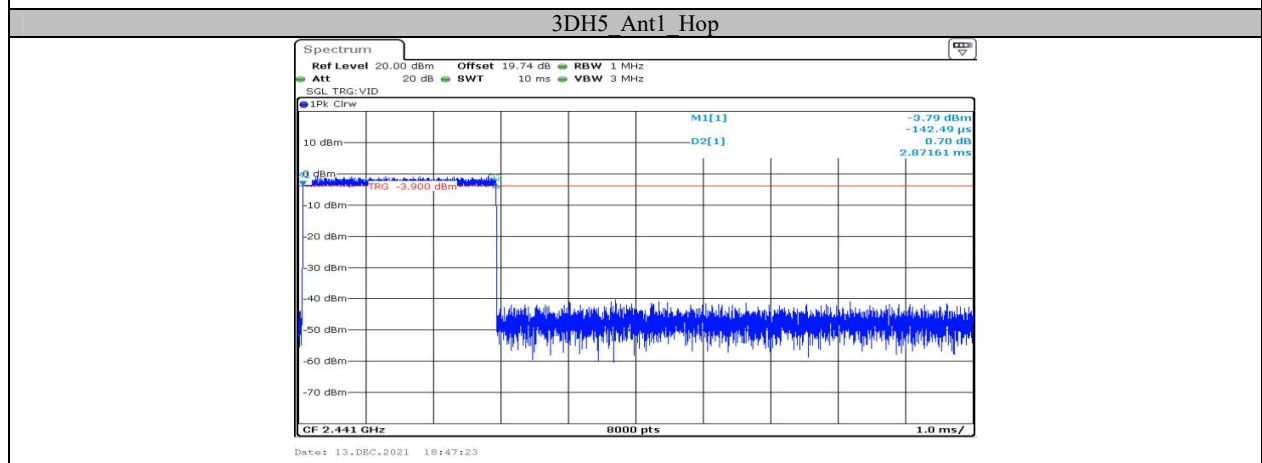
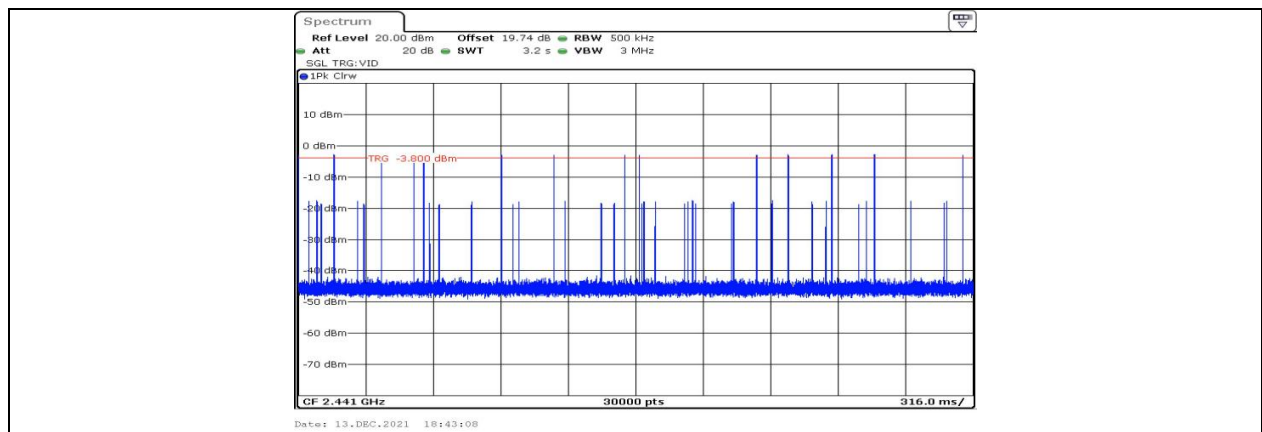
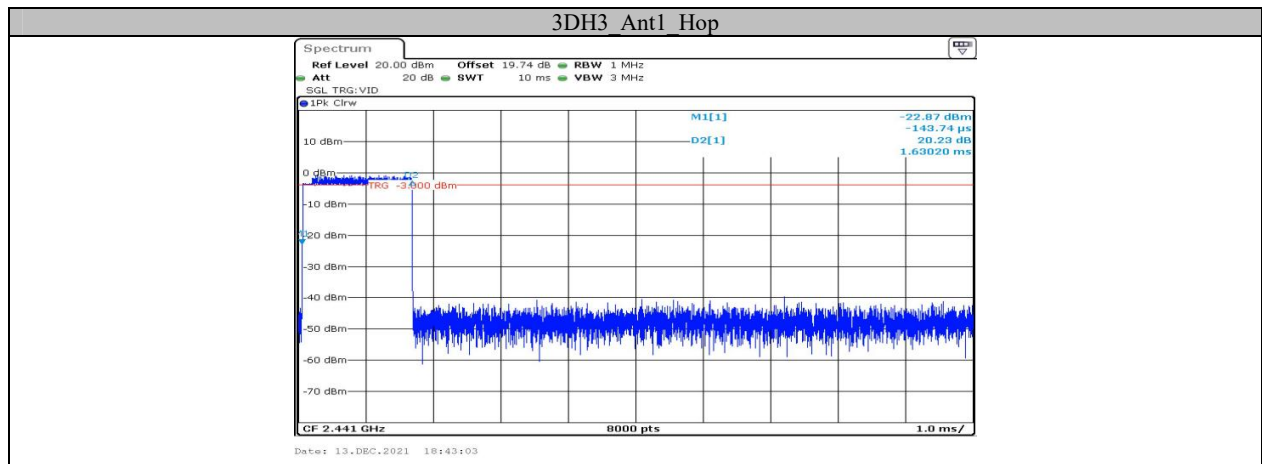


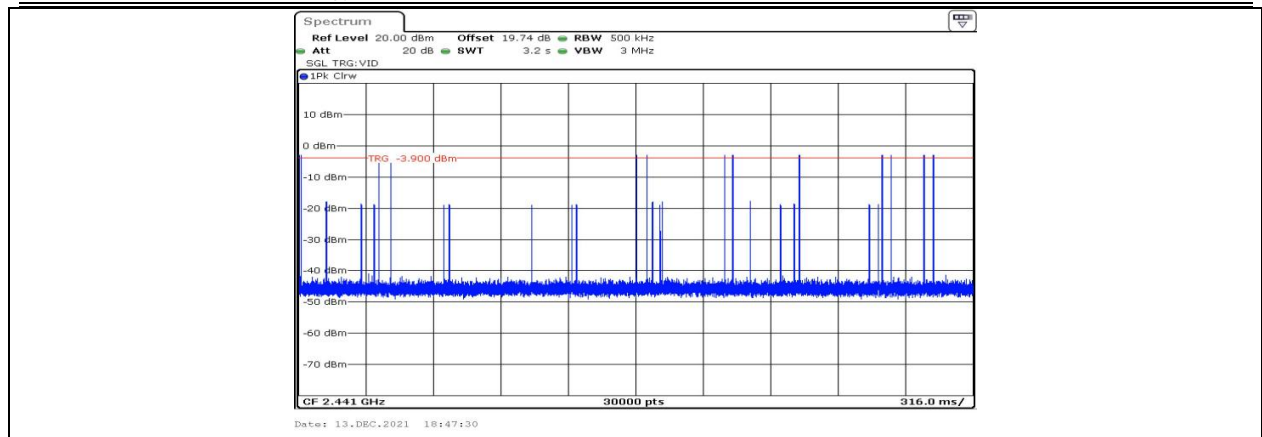












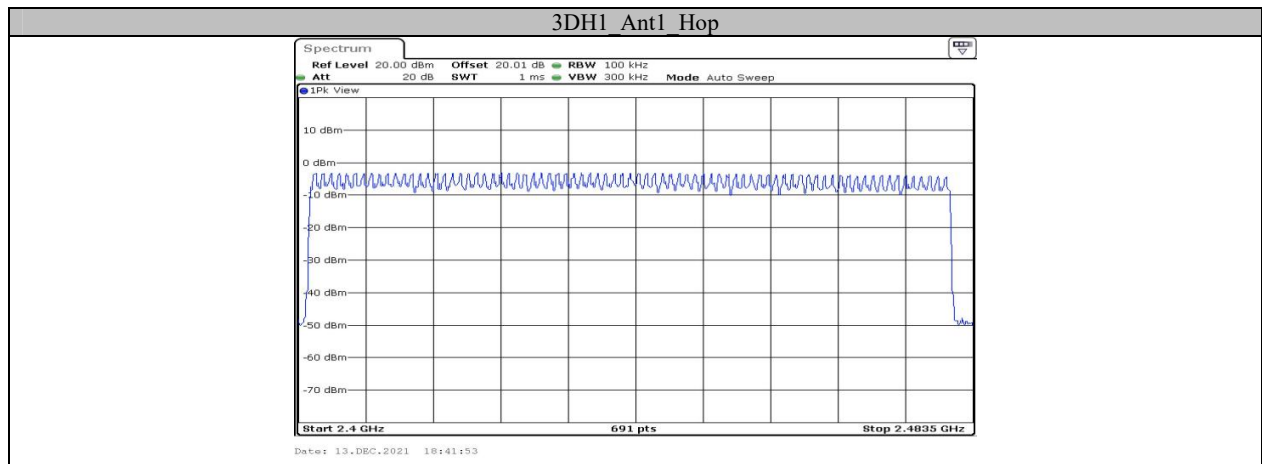
## Appendix F: Number of hopping channels

### Test Result

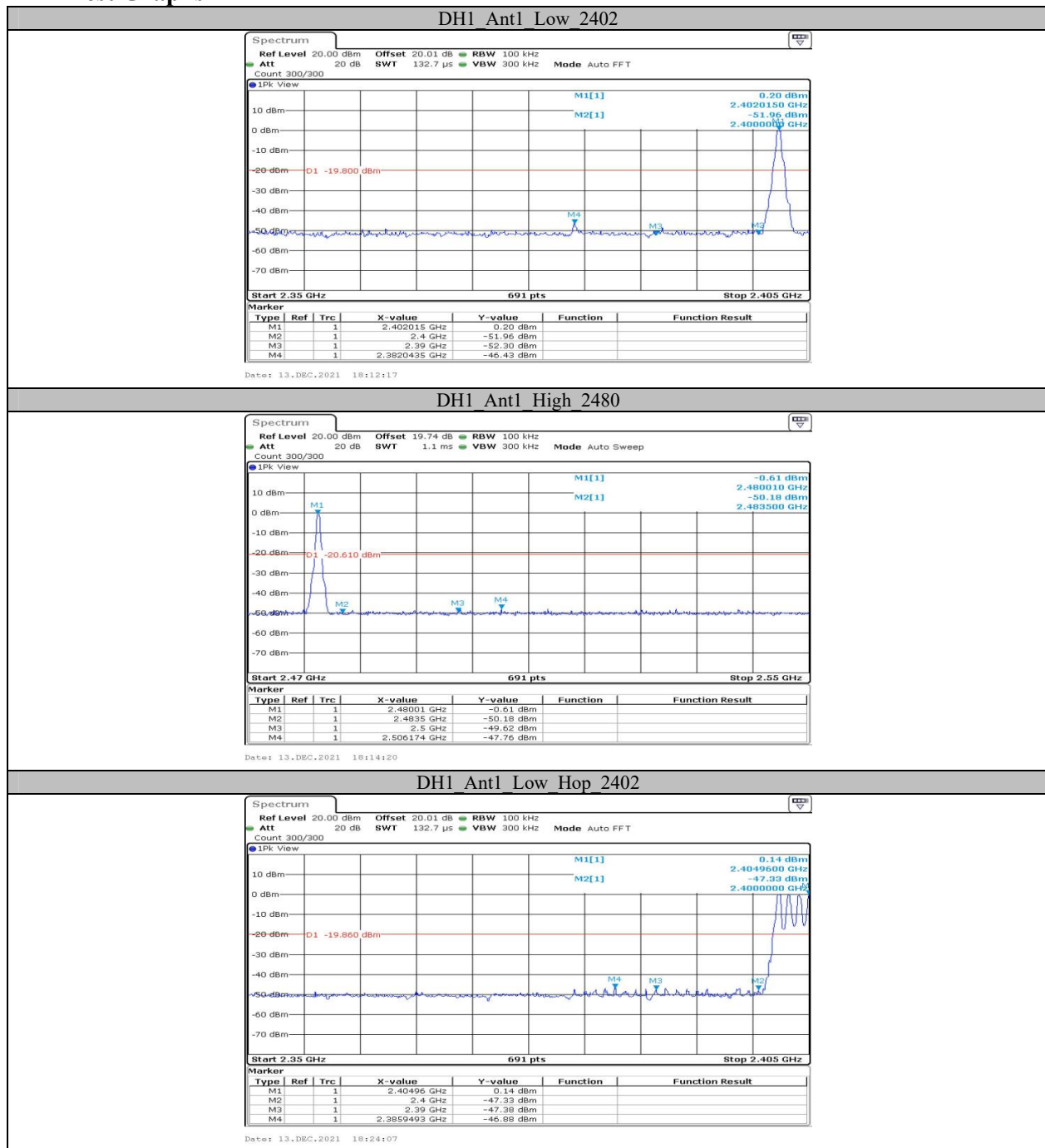
| Test Mode | Antenna | Channel | Result[Num] | Limit[Num] | Verdict |
|-----------|---------|---------|-------------|------------|---------|
| DH1       | Ant1    | Hop     | 79          | $\geq 15$  | PASS    |
| 2DH1      | Ant1    | Hop     | 79          | $\geq 15$  | PASS    |
| 3DH1      | Ant1    | Hop     | 79          | $\geq 15$  | PASS    |

### Test Graphs

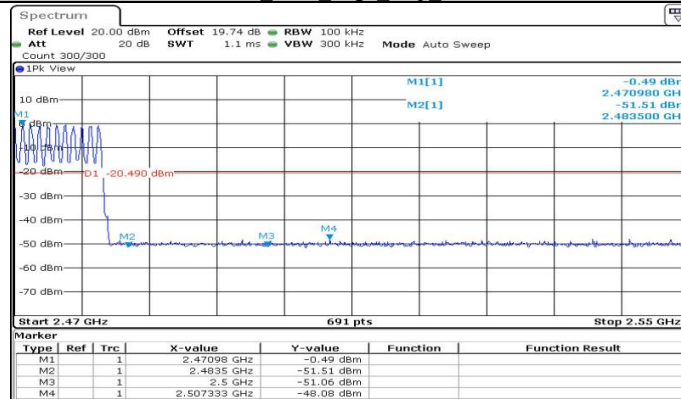




## Appendix G: Band edge measurements Test Graphs

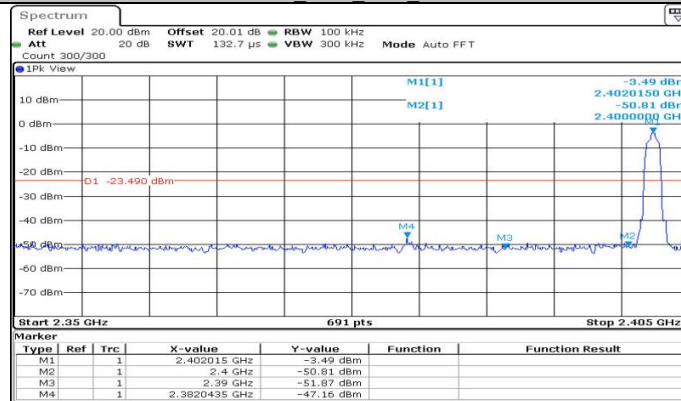


## DH1 Ant1 High Hop 2480



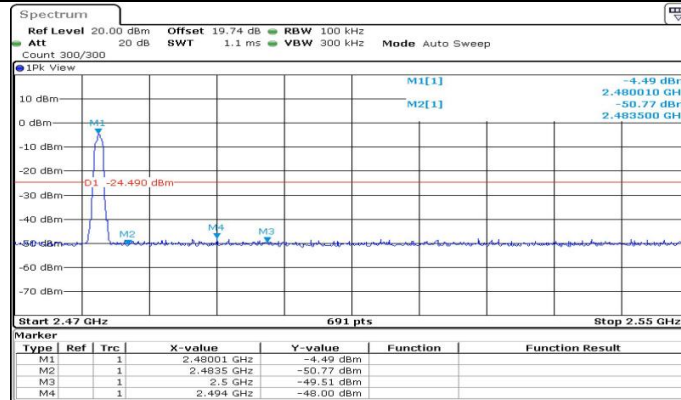
Date: 13.DEC.2021 18:26:49

## 2DH1 Ant1 Low 2402



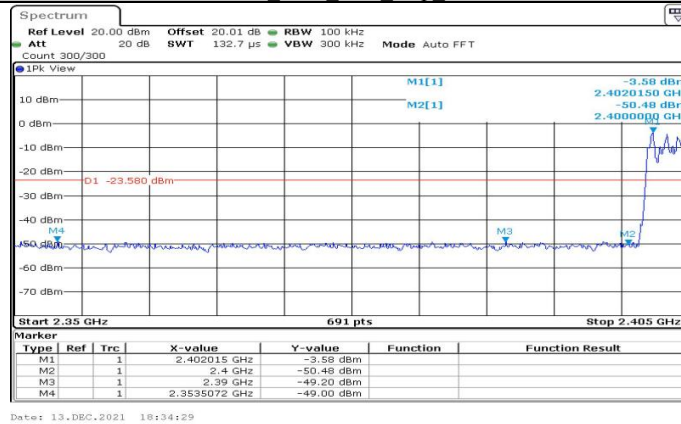
Date: 13.DEC.2021 18:16:21

## 2DH1 Ant1 High 2480

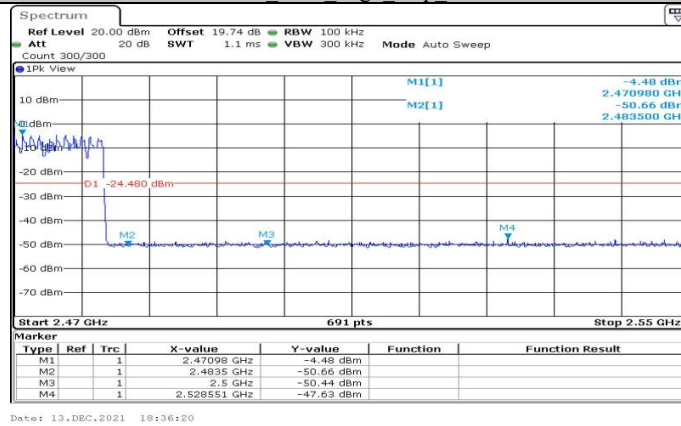


Date: 13.DEC.2021 18:18:26

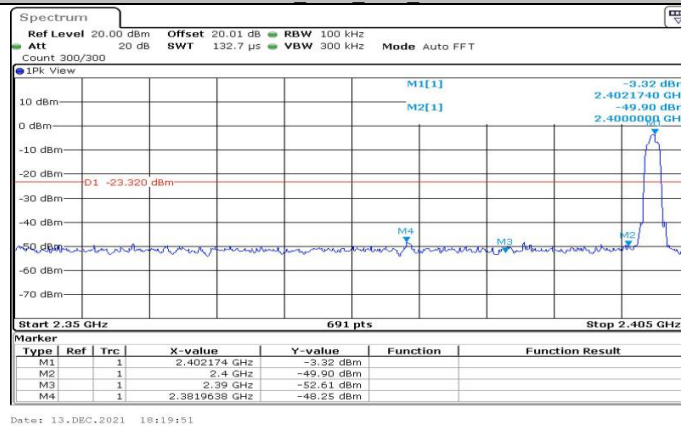
## 2DH1 Ant1 Low Hop 2402



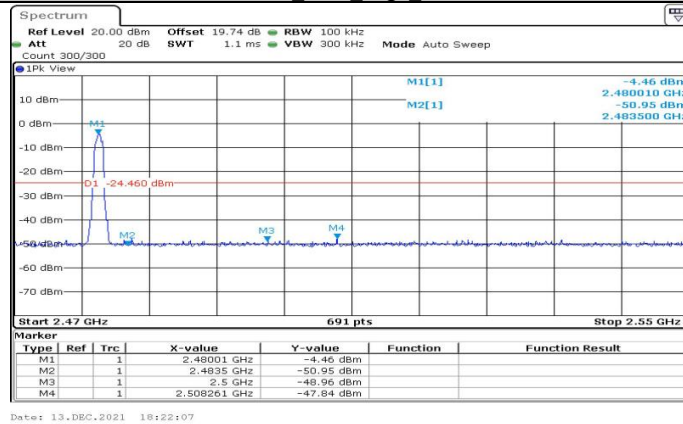
## 2DH1 Ant1 High Hop 2480



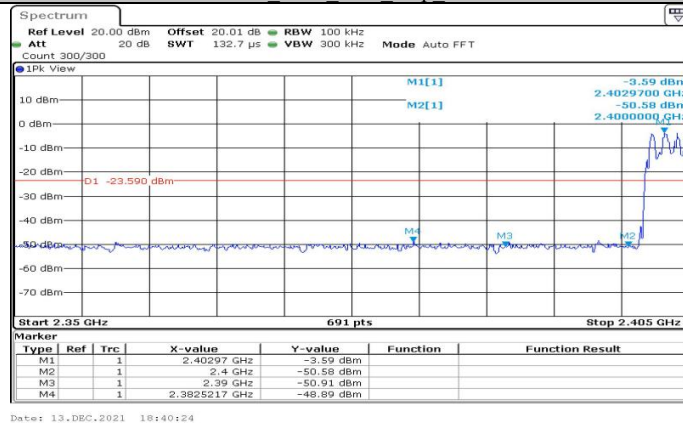
## 3DH1 Ant1 Low 2402



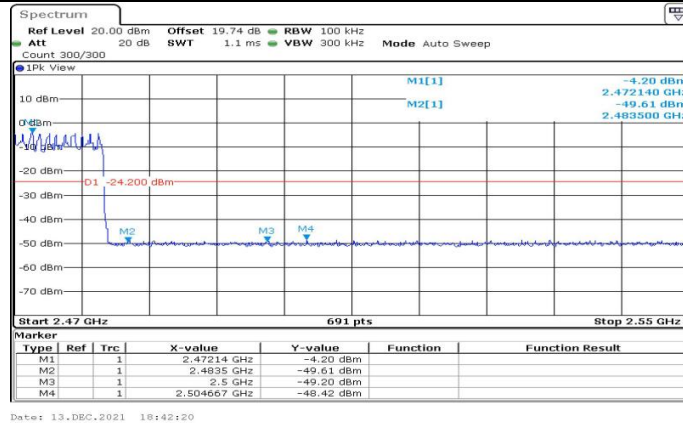
## 3DH1 Ant1 High 2480



## 3DH1 Ant1 Low Hop 2402



## 3DH1 Ant1 High Hop 2480



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