

# TEST REPORT

Applicant Name : Polygroup Evergreen Limited  
Address : Unit 606, 6th Floor, Fairmont House, No.8 Cotton Tree Drive, Central,  
Hong Kong  
Report Number : RA230301-09499E-RFA  
FCC ID: 2A62O-TBC007  
IC 28592-TBC007

## 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: Controller  
Model No.: TBC007-24V  
Multiple Model(s) No.: N/A  
Trade Mark: N/A  
Date Received: 2023/03/01  
Report Date: 2023/04/18

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

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

**Prepared and Checked By:**

**Approved By:**



Nick Fang  
EMC Engineer



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

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DOCUMENT REVISION HISTORY

| Revision Number | Report Number       | Description of Revision | Date of Revision |
|-----------------|---------------------|-------------------------|------------------|
| 0               | RA230301-09499E-RFA | Original Report         | 2023-04-18       |

## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

|                                     |                                                                                                  |
|-------------------------------------|--------------------------------------------------------------------------------------------------|
| HVIN                                | TBC007-24V                                                                                       |
| FVIN                                | 2.8.15                                                                                           |
| Frequency Range                     | Bluetooth: 2402-2480MHz                                                                          |
| Maximum Conducted Peak Output Power | 8.54 dBm                                                                                         |
| Modulation Technique                | Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK                                                           |
| Antenna Specification*              | 3.42dBi (It is provided by the applicant)                                                        |
| Voltage Range                       | DC 24V from adapter                                                                              |
| Sample serial number                | 23UJ_2 for Conducted and Radiated Emissions<br>23UJ_1 for RF Conducted Test<br>(Assigned by ATC) |
| Sample/EUT Status                   | Good condition                                                                                   |
| Adapter information                 | Model:TS-48W24V<br>Input: AC 120V~60Hz, 0.83A<br>Output: DC 24V, 2A                              |

### 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         |                 | 0.72dB                 |
| Unwanted Emission, conducted       |                 | 1.6dB                  |
| AC Power Lines Conducted Emissions |                 | 2.72dB                 |
| Emissions,<br>Radiated             | 9kHz - 30MHz    | 2.06dB                 |
|                                    | 30MHz - 1GHz    | 5.08dB                 |
|                                    | 1GHz - 18GHz    | 4.96dB                 |
|                                    | 18GHz - 26.5GHz | 5.16dB                 |
|                                    | 26.5GHz- 40GHz  | 4.64dB                 |
| Temperature                        |                 | 1℃                     |
| Humidity                           |                 | 6%                     |
| Supply voltages                    |                 | 0.4%                   |

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

## Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, Shenzhen, Guangdong, China.

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

Accredited by American Association for Laboratory Accreditation (A2LA). The Certificate Number is 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 30241.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in an engineering mode.

Channel List

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 0       | 2402            | 39      | 2441            |
| 1       | 2403            | 40      | 2442            |
| 2       | 2404            | ...     | ...             |
| ....    | ...             | 76      | 2478            |
| 37      | 2439            | 77      | 2479            |
| 38      | 2440            | 78      | 2480            |

EUT was tested with Channel 0, 39 and 78.

### EUT Exercise Software\*

“EspRFTTestTool.exe ” exercise software was used, Power level is 6. 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

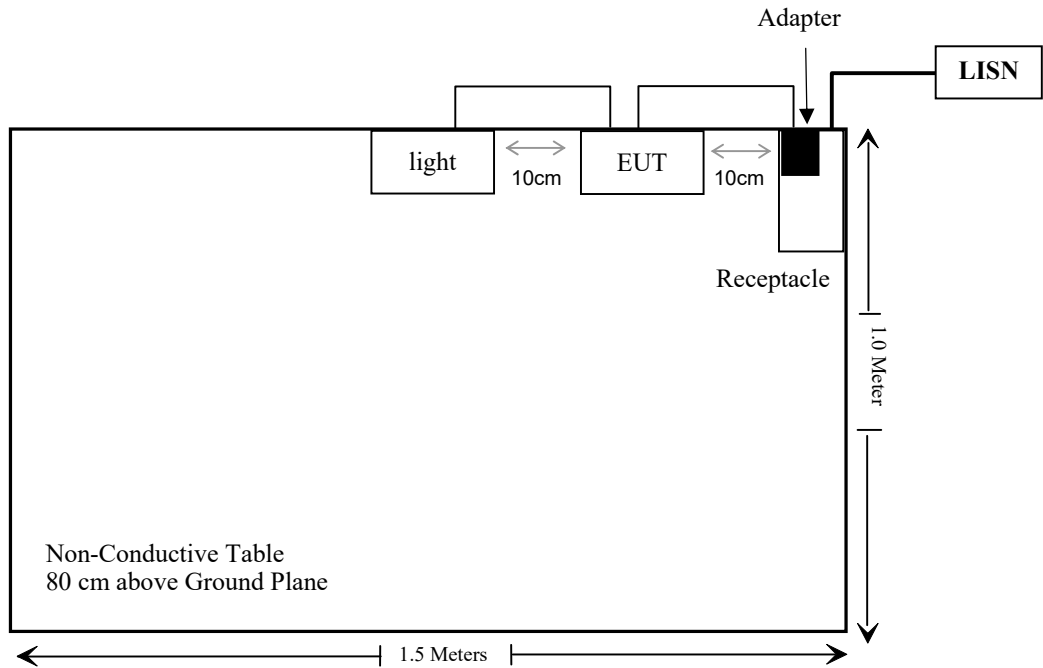
| Manufacturer | Description | Model | Serial Number |
|--------------|-------------|-------|---------------|
| /            | /           | /     | /             |

### External I/O Cable

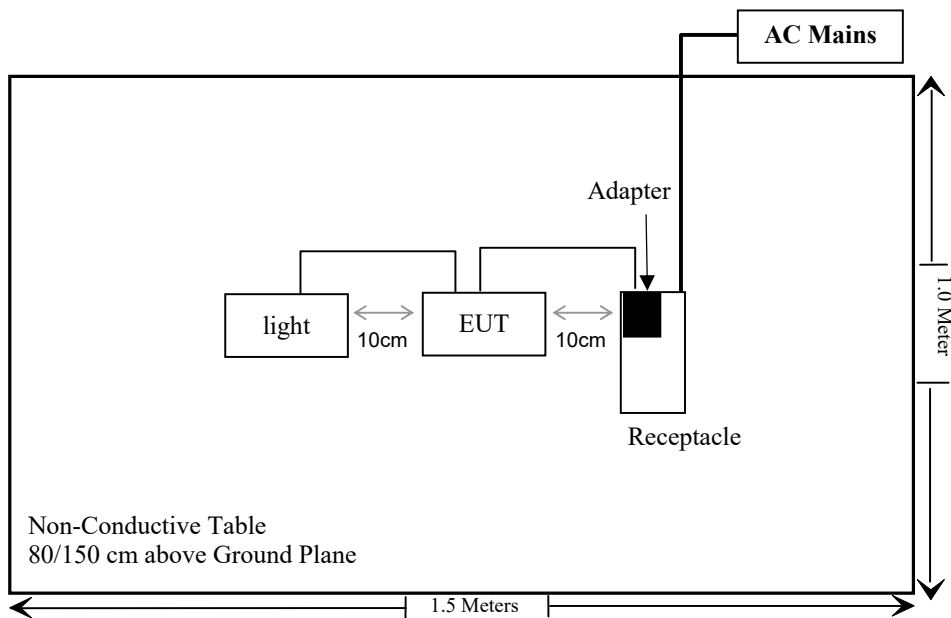
| Cable Description | Length (m) | From Port | To |
|-------------------|------------|-----------|----|
| /                 | /          | /         | /  |

Block Diagram of Test Setup

For conducted emission:



For radiated emission:





**SUMMARY OF TEST RESULTS**

| Rules                                                             | Description of Test                                            | Result    |
|-------------------------------------------------------------------|----------------------------------------------------------------|-----------|
| FCC §15.247 (i) & §1.1307 (b) (3) & §2.1091                       | MPE-Based Exemption                                            | Compliant |
| RSS-102 § 2.5.2                                                   | Exemption Limits For Routine Evaluation-RF Exposure 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                                    | Compliant |
| 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 |

**TEST EQUIPMENT LIST**

| Manufacturer                                     | Description       | Model           | Serial Number | Calibration Date | Calibration Due Date |
|--------------------------------------------------|-------------------|-----------------|---------------|------------------|----------------------|
| <b>Conducted Emissions Test</b>                  |                   |                 |               |                  |                      |
| Rohde& Schwarz                                   | EMI Test Receiver | ESCI            | 100784        | 2022/11/25       | 2023/11/24           |
| Rohde & Schwarz                                  | L.I.S.N.          | ENV216          | 101314        | 2022/11/25       | 2023/11/24           |
| Anritsu Corp                                     | 50 Coaxial Switch | MP59B           | 6100237248    | 2022/12/07       | 2023/12/06           |
| Unknown                                          | RF Coaxial Cable  | No.17           | N0350         | 2022/11/25       | 2023/11/24           |
| Conducted Emission Test Software: e3 19821b (V9) |                   |                 |               |                  |                      |
| <b>Radiated Emissions Test</b>                   |                   |                 |               |                  |                      |
| Rohde& Schwarz                                   | Test Receiver     | ESR             | 102725        | 2022/11/25       | 2023/11/24           |
| Rohde&Schwarz                                    | Spectrum Analyzer | FSV40           | 101949        | 2022/11/25       | 2023/11/24           |
| SONOMA INSTRUMENT                                | Amplifier         | 310 N           | 186131        | 2022/11/08       | 2023/11/07           |
| A.H. Systems, inc.                               | Preamplifier      | PAM-0118P       | 135           | 2022/11/08       | 2023/11/07           |
| Quinstar                                         | Amplifier         | QLW-18405536-J0 | 15964001002   | 2022/11/08       | 2023/11/07           |
| Schwarzbeck                                      | Bilog Antenna     | VULB9163        | 9163-323      | 2021/07/06       | 2024/07/05           |
| Schwarzbeck                                      | Horn Antenna      | BBHA9120D       | 9120D-1067    | 2022/11/30       | 2025/11/29           |
| Schwarzbeck                                      | HORN ANTENNA      | BBHA9170        | 9170-359      | 2022/12/26       | 2025/12/25           |
| Radiated Emission Test Software: e3 19821b (V9)  |                   |                 |               |                  |                      |
| Unknown                                          | RF Coaxial Cable  | No.10           | N050          | 2022/11/25       | 2023/11/24           |
| Unknown                                          | RF Coaxial Cable  | No.11           | N1000         | 2022/11/25       | 2023/11/24           |
| Unknown                                          | RF Coaxial Cable  | No.12           | N040          | 2022/11/25       | 2023/11/24           |
| Unknown                                          | RF Coaxial Cable  | No.13           | N300          | 2022/11/25       | 2023/11/24           |
| Unknown                                          | RF Coaxial Cable  | No.14           | N800          | 2022/11/25       | 2023/11/24           |
| Unknown                                          | RF Coaxial Cable  | No.15           | N600          | 2022/11/25       | 2023/11/24           |
| Unknown                                          | RF Coaxial Cable  | No.16           | N650          | 2022/11/25       | 2023/11/24           |

| Manufacturer      | Description       | Model    | Serial Number | Calibration Date | Calibration Due Date |
|-------------------|-------------------|----------|---------------|------------------|----------------------|
| RF Conducted Test |                   |          |               |                  |                      |
| Rohde&Schwarz     | Spectrum Analyzer | FSV-40   | 101590        | 2022/11/25       | 2023/11/24           |
| Tonscend          | RF Control Unit   | JS0806-2 | 19G8060182    | 2022/10/24       | 2023/10/23           |
| Agilent           | Power Sensor      | U2021XA  | MY5425003     | 2023/02/25       | 2024/02/24           |
| WEINSCHEL         | 10dB Attenuator   | 5324     | AU 3842       | 2022/11/25       | 2023/11/24           |
| Unknown           | RF Coaxial Cable  | No.31    | RF-01         | Each time        |                      |

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

## FCC §15.247 (i) & §1.1307 (b) (3) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

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

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

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

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

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

R is the minimum separation distance in meters

f = frequency in MHz

**Result**

| Mode       | Frequency<br>(MHz) | Tune up<br>conducted<br>power | Antenna Gain |       | ERP   |       | Evaluation<br>Distance<br>(m) | ERP<br>Limit<br>(W) |
|------------|--------------------|-------------------------------|--------------|-------|-------|-------|-------------------------------|---------------------|
|            |                    | (dBm)                         | (dBi)        | (dBd) | (dBm) | (W)   |                               |                     |
| BT         | 2402-2480          | 9.0                           | 3.42         | 1.27  | 10.27 | 0.011 | 0.2                           | 0.768               |
| BLE        | 2402-2480          | 6.0                           | 3.42         | 1.27  | 7.27  | 0.005 | 0.2                           | 0.768               |
| 2.4G Wi-Fi | 2412-2462          | 16.0                          | 3.42         | 1.27  | 17.27 | 0.053 | 0.2                           | 0.768               |

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.

2. The BT cannot transmit at the same time with the Wi-Fi

3. 0dBd=2.15dBi

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

**Result: Compliant.**

## RSS-102 § 2.5.2 –EXEMPTION LIMITS FOR ROUTINE EVALUATION-RF EXPOSURE EVALUATION

### Applicable Standard

According to RSS-102 § (2.5.2):

#### 2.5.2 Exemption Limits for Routine Evaluation — RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz<sup>6</sup> and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $22.48/f^{0.5}$  W (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $1.31 \times 10^{-2} f^{0.6834}$  W (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

### Calculated Data:

| Mode       | Frequency (MHz) | Maximum tune-up conducted power | Antenna Gain (dBi) | Maximum tune-up EIRP |       | Evaluation Distance (cm) | Limit (W) |
|------------|-----------------|---------------------------------|--------------------|----------------------|-------|--------------------------|-----------|
|            |                 | (dBm)                           |                    | (dBm)                | (W)   |                          |           |
| BT         | 2402-2480       | 9.0                             | 3.42               | 12.42                | 0.017 | 20                       | 2.68      |
| BLE        | 2402-2480       | 6.0                             | 3.42               | 10.42                | 0.011 | 20                       | 2.68      |
| 2.4G Wi-Fi | 2412-2462       | 16.0                            | 3.42               | 19.42                | 0.087 | 20                       | 2.68      |

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

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

**Result:** The RF Exposure evaluation can be exempted.

## 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 3.42dBi, fulfill the requirement of this section. Please refer to the EUT photos.

| Antenna Type | Antenna Gain | Impedance   | Frequency Range |
|--------------|--------------|-------------|-----------------|
| PCB          | 3.42dBi      | 50 $\Omega$ | 2.4~2.5GHz      |

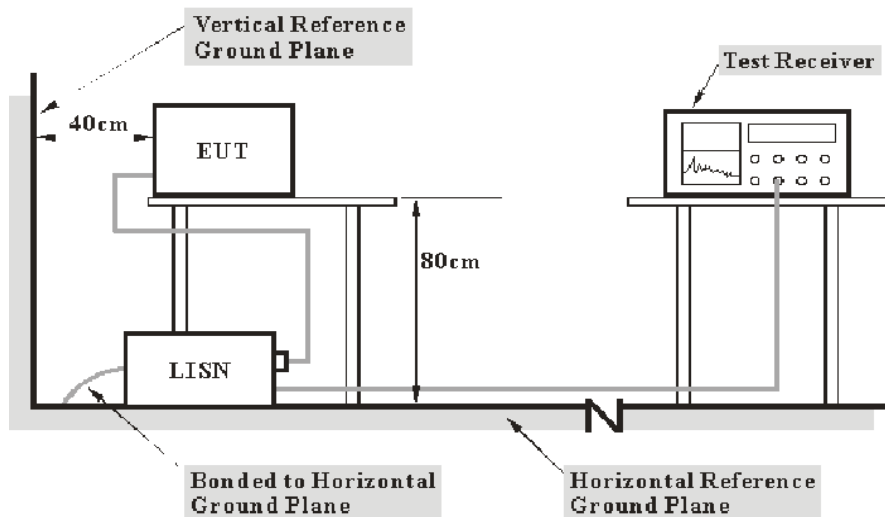
**Result:** Compliance

## 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:

$$\text{Transd Factor} = \text{LISN VDF} + \text{Cable Loss}$$

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:

$$\begin{aligned}\text{Over Limit} &= \text{Level} - \text{Limit} \\ \text{Level} &= \text{Read Level} + \text{Factor}\end{aligned}$$

## Test Data

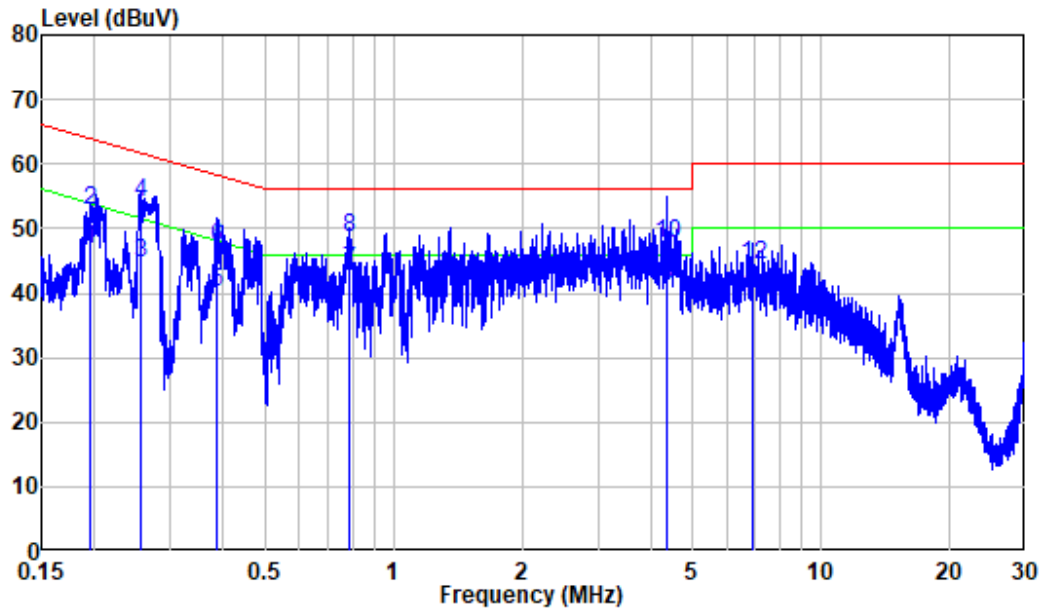
### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 23°C      |
| <b>Relative Humidity:</b> | 49%       |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Jerry on 2023-04-12.*

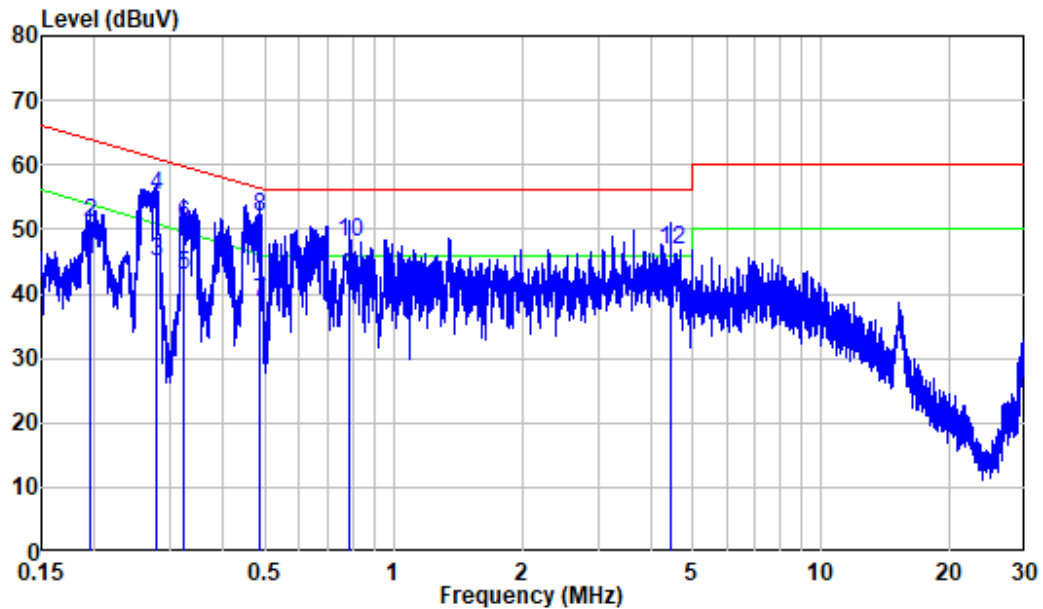
*EUT operation mode: Transmitting (the worst case is 8DPSK Mode, high channel)*

## AC 120V/60 Hz, Line



Site : Shielding Room  
 Condition: Line  
 Job No. : RA230301-09499E-RF  
 Mode : BT Transmitting  
 Power : AC 120V 60Hz

|    | Freq  | Factor | Read<br>Level | Level | Limit<br>Line | Over<br>Limit | Remark  |
|----|-------|--------|---------------|-------|---------------|---------------|---------|
|    | MHz   | dB     | dBuV          | dBuV  | dBuV          | dB            |         |
| 1  | 0.195 | 10.29  | 36.36         | 46.65 | 53.83         | -7.18         | Average |
| 2  | 0.195 | 10.29  | 42.39         | 52.68 | 63.83         | -11.15        | QP      |
| 3  | 0.255 | 10.30  | 34.26         | 44.56 | 51.58         | -7.02         | Average |
| 4  | 0.255 | 10.30  | 43.84         | 54.14 | 61.58         | -7.44         | QP      |
| 5  | 0.387 | 10.30  | 29.82         | 40.12 | 48.12         | -8.00         | Average |
| 6  | 0.387 | 10.30  | 36.73         | 47.03 | 58.12         | -11.09        | QP      |
| 7  | 0.788 | 10.41  | 33.09         | 43.50 | 46.00         | -2.50         | Average |
| 8  | 0.788 | 10.41  | 38.20         | 48.61 | 56.00         | -7.39         | QP      |
| 9  | 4.366 | 10.42  | 30.73         | 41.15 | 46.00         | -4.85         | Average |
| 10 | 4.366 | 10.42  | 37.23         | 47.65 | 56.00         | -8.35         | QP      |
| 11 | 6.914 | 10.37  | 28.74         | 39.11 | 50.00         | -10.89        | Average |
| 12 | 6.914 | 10.37  | 34.09         | 44.46 | 60.00         | -15.54        | QP      |

**AC 120V/60 Hz, Neutral**

Site : Shielding Room  
 Condition: Neutral  
 Job No. : RA230301-09499E-RF  
 Mode : BT Transmitting  
 Power : AC 120V 60Hz

|    | Freq  | Factor | Read Level | Level | Limit Line | Over Limit | Remark  |
|----|-------|--------|------------|-------|------------|------------|---------|
|    | MHz   | dB     | dBuV       | dBuV  | dBuV       | dB         |         |
| 1  | 0.195 | 9.80   | 35.41      | 45.21 | 53.81      | -8.60      | Average |
| 2  | 0.195 | 9.80   | 41.15      | 50.95 | 63.81      | -12.86     | QP      |
| 3  | 0.278 | 9.80   | 35.14      | 44.94 | 50.87      | -5.93      | Average |
| 4  | 0.278 | 9.80   | 45.53      | 55.33 | 60.87      | -5.54      | QP      |
| 5  | 0.323 | 9.80   | 33.08      | 42.88 | 49.62      | -6.74      | Average |
| 6  | 0.323 | 9.80   | 40.95      | 50.75 | 59.62      | -8.87      | QP      |
| 7  | 0.488 | 9.80   | 28.90      | 38.70 | 46.20      | -7.50      | Average |
| 8  | 0.488 | 9.80   | 42.00      | 51.80 | 56.20      | -4.40      | QP      |
| 9  | 0.789 | 9.81   | 32.82      | 42.63 | 46.00      | -3.37      | Average |
| 10 | 0.789 | 9.81   | 38.06      | 47.87 | 56.00      | -8.13      | QP      |
| 11 | 4.436 | 9.84   | 31.39      | 41.23 | 46.00      | -4.77      | Average |
| 12 | 4.436 | 9.84   | 37.01      | 46.85 | 56.00      | -9.15      | QP      |

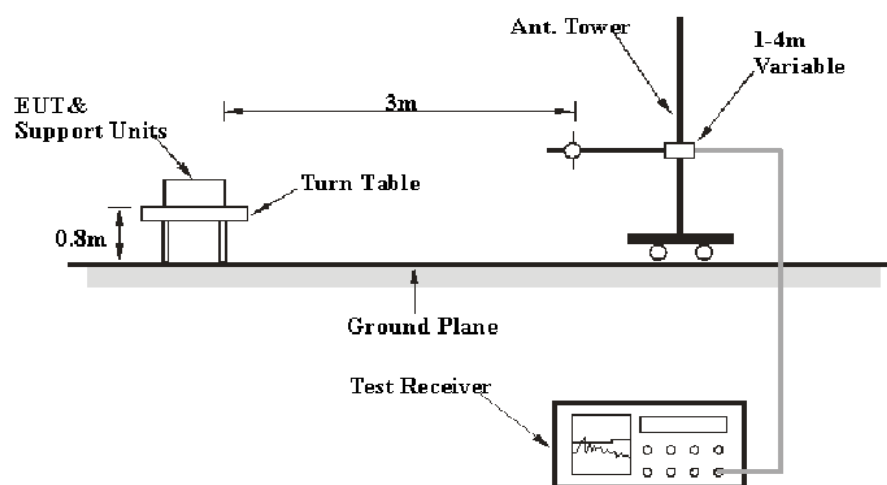
## FCC §15.209, §15.205 & §15.247(d) & RSS-247§ 5.5 - SPURIOUS EMISSIONS

### Applicable Standard

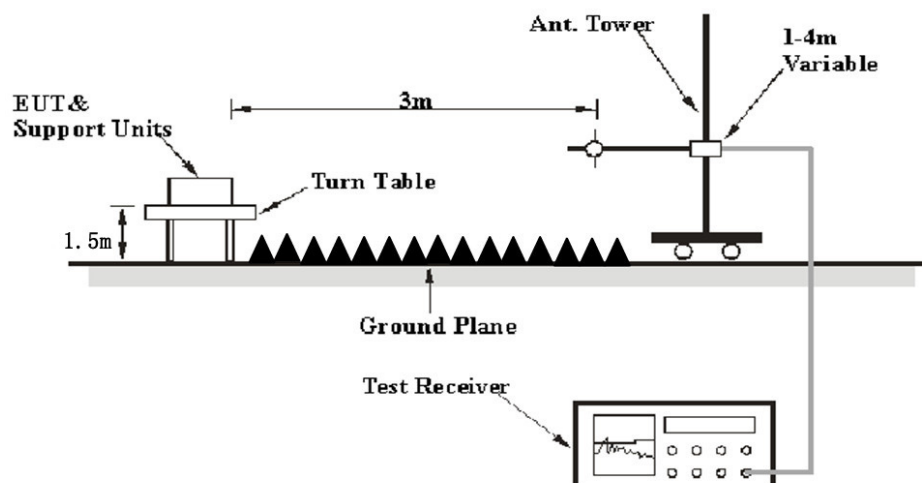
FCC §15.205; §15.209; §15.247(d); RSS-247§ 5.5; RSS-GEN § 8.10

### 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          |

For average measurement:

use the duty cycle factor correction factor method per 15.35(c).

Duty cycle=On time/100milliseconds, On time= $N1*L1+N2*L2+\dots+Nn-1*Ln-1+Nn*Ln$ ,

where N1 is number of type 1 pulses, L1 is length of type 1 pulse, etc.

Average Emission Level=Peak Emission Level+20\*log(Duty cycle)

## Test Procedure

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

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

## Factor & Margin Calculation

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

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

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:

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

## Test Data

### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 23.6~24°C |
| Relative Humidity: | 50~56%    |
| ATM Pressure:      | 101.0 kPa |

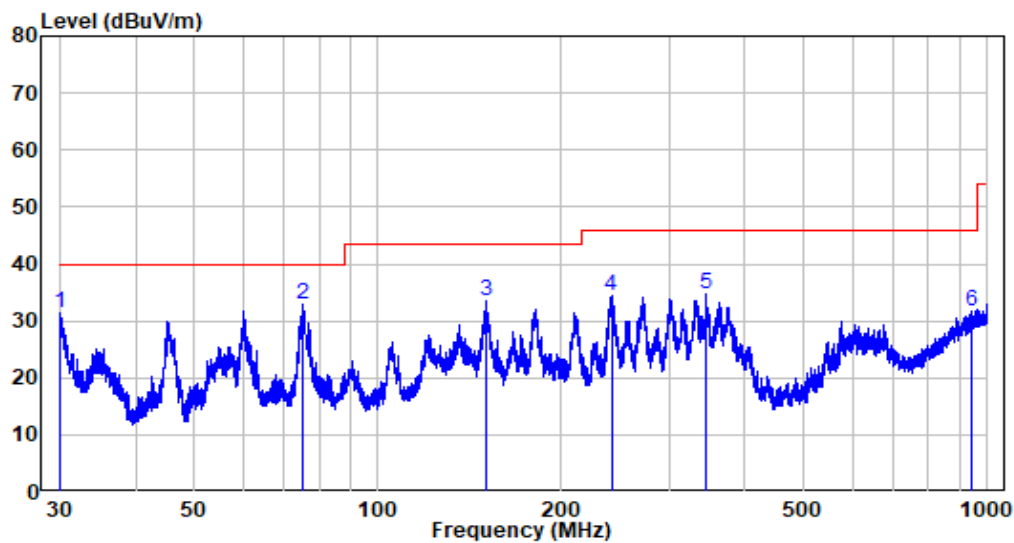
*The testing was performed by Jason Liu on 2023-04-12 for below 1GHz, Jimi Zheng on 2023-04-11 for above 1GHz.*

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

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

Note: When the result of Peak less than the limit of QP by more than 6dB, just the peak value was recorded.

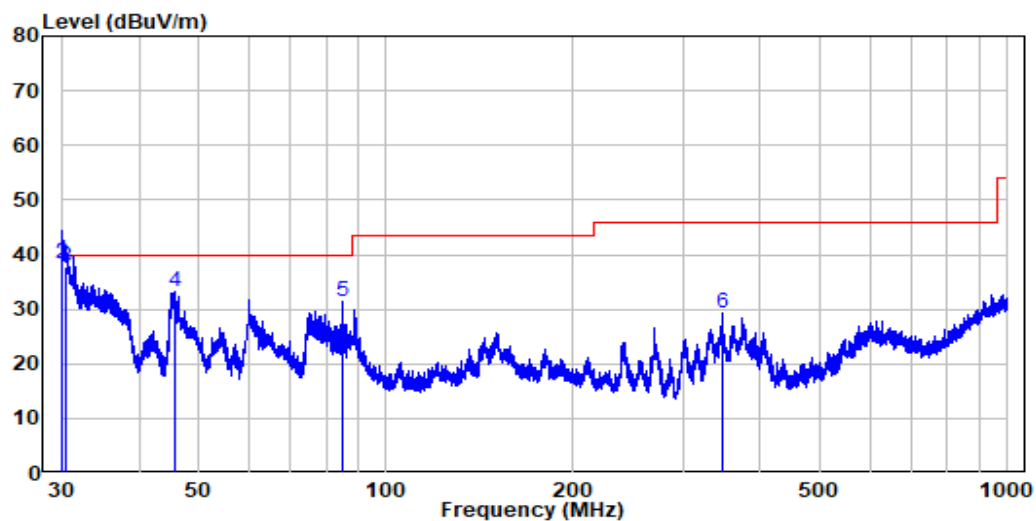
Horizontal



Site : chamber  
Condition: 3m HORIZONTAL  
Job No. : RA230301-09499E-RF  
Test Mode: BT Transmitting

|   | Freq    | Factor | Read Level | Level  | Limit  | Over   | Remark |
|---|---------|--------|------------|--------|--------|--------|--------|
|   | MHz     | dB/m   | dBuV       | dBuV/m | dBuV/m | dB     |        |
| 1 | 30.079  | -14.31 | 45.61      | 31.30  | 40.00  | -8.70  | Peak   |
| 2 | 75.215  | -13.43 | 46.32      | 32.89  | 40.00  | -7.11  | Peak   |
| 3 | 150.274 | -10.37 | 43.84      | 33.47  | 43.50  | -10.03 | Peak   |
| 4 | 241.465 | -11.99 | 46.31      | 34.32  | 46.00  | -11.68 | Peak   |
| 5 | 345.595 | -12.30 | 47.06      | 34.76  | 46.00  | -11.24 | Peak   |
| 6 | 941.718 | 0.68   | 31.14      | 31.82  | 46.00  | -14.18 | Peak   |

## Vertical



Site : chamber  
Condition: 3m VERTICAL  
Job No. : RA230301-09499E-RF  
Test Mode: BT Transmitting

|   | Freq    | Factor | Read<br>Level | Level  | Limit<br>Line | Over<br>Limit | Remark |
|---|---------|--------|---------------|--------|---------------|---------------|--------|
|   | MHz     | dB/m   | dBuV          | dBuV/m | dBuV/m        | dB            |        |
| 1 | 30.000  | -14.30 | 53.20         | 38.90  | 40.00         | -1.10         | QP     |
| 2 | 30.145  | -14.31 | 52.80         | 38.49  | 40.00         | -1.51         | QP     |
| 3 | 30.437  | -14.33 | 51.99         | 37.66  | 40.00         | -2.34         | QP     |
| 4 | 45.555  | -14.29 | 47.55         | 33.26  | 40.00         | -6.74         | Peak   |
| 5 | 84.925  | -12.83 | 44.10         | 31.27  | 40.00         | -8.73         | Peak   |
| 6 | 348.791 | -12.16 | 41.37         | 29.21  | 46.00         | -16.79        | Peak   |

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

| Frequency<br>(MHz)     | Receiver          |        | Turntable<br>Degree | Rx Antenna    |                | Factor<br>(dB/m) | Absolute<br>Level<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
|------------------------|-------------------|--------|---------------------|---------------|----------------|------------------|-------------------------------|-------------------|----------------|
|                        | Reading<br>(dBμV) | PK/Ave |                     | Height<br>(m) | Polar<br>(H/V) |                  |                               |                   |                |
| Low Channel 2402MHz    |                   |        |                     |               |                |                  |                               |                   |                |
| 2331.59                | 65.87             | PK     | 117                 | 2.4           | H              | -10.59           | 55.28                         | 74                | -18.72         |
| 2354.28                | 66.70             | PK     | 31                  | 1.4           | V              | -10.78           | 55.92                         | 74                | -18.08         |
| 2390                   | 66.60             | PK     | 75                  | 1.6           | H              | -10.70           | 55.90                         | 74                | -18.10         |
| 2390                   | 65.25             | PK     | 347                 | 2.5           | V              | -10.70           | 54.55                         | 74                | -19.45         |
| 4804                   | 60.58             | PK     | 339                 | 1.3           | H              | -6.11            | 54.47                         | 74                | -19.53         |
| 4804                   | 61.10             | PK     | 42                  | 1.3           | V              | -6.11            | 54.99                         | 74                | -19.01         |
| Middle Channel 2441MHz |                   |        |                     |               |                |                  |                               |                   |                |
| 4880                   | 61.49             | PK     | 190                 | 1.1           | H              | -5.91            | 55.58                         | 74                | -18.42         |
| 4880                   | 61.38             | PK     | 275                 | 1.1           | V              | -5.91            | 55.47                         | 74                | -18.53         |
| High Channel 2480MHz   |                   |        |                     |               |                |                  |                               |                   |                |
| 2483.5                 | 66.67             | PK     | 265                 | 1.2           | H              | -10.55           | 56.12                         | 74                | -17.88         |
| 2483.5                 | 67.77             | PK     | 262                 | 2.4           | V              | -10.55           | 57.22                         | 74                | -16.78         |
| 2496.07                | 67.23             | PK     | 234                 | 1.7           | H              | -10.45           | 56.78                         | 74                | -17.22         |
| 2495.35                | 68.42             | PK     | 264                 | 2.4           | V              | -10.46           | 57.96                         | 74                | -16.04         |
| 4960                   | 61.98             | PK     | 208                 | 1.8           | H              | -5.47            | 56.51                         | 74                | -17.49         |
| 4960                   | 61.33             | PK     | 199                 | 1.8           | V              | -5.47            | 55.86                         | 74                | -18.14         |



| Field Strength of Average |                                        |                |                                            |                                    |                                                  |                |          |
|---------------------------|----------------------------------------|----------------|--------------------------------------------|------------------------------------|--------------------------------------------------|----------------|----------|
| Frequency<br>(MHz)        | Peak<br>Measurement<br>@3m<br>(dBμV/m) | Polar<br>(H/V) | Duty Cycle<br>Correction<br>Factor<br>(dB) | Corrected<br>Amplitude<br>(dBμV/m) | RSS-247/RSS-GEN<br>FCC Part 15.247/15.205/15.209 |                |          |
|                           |                                        |                |                                            |                                    | Limit<br>(dBμV/m)                                | Margin<br>(dB) | Comment  |
| Low Channel 2402MHz       |                                        |                |                                            |                                    |                                                  |                |          |
| 2331.59                   | 55.28                                  | H              | -24.84                                     | 30.44                              | 54                                               | -23.56         | Bandedge |
| 2354.28                   | 55.92                                  | V              | -24.84                                     | 31.08                              | 54                                               | -22.92         | Bandedge |
| 2390                      | 55.90                                  | H              | -24.84                                     | 31.06                              | 54                                               | -22.94         | Bandedge |
| 2390                      | 54.55                                  | V              | -24.84                                     | 29.71                              | 54                                               | -24.29         | Bandedge |
| 4804                      | 54.47                                  | H              | -24.84                                     | 29.63                              | 54                                               | -24.37         | Harmonic |
| 4804                      | 54.99                                  | V              | -24.84                                     | 30.15                              | 54                                               | -23.85         | Harmonic |
| Middle Channel 2441MHz    |                                        |                |                                            |                                    |                                                  |                |          |
| 4880                      | 55.58                                  | H              | -24.84                                     | 30.74                              | 54                                               | -23.26         | Harmonic |
| 4880                      | 55.47                                  | V              | -24.84                                     | 30.63                              | 54                                               | -23.37         | Harmonic |
| High Channel 2480MHz      |                                        |                |                                            |                                    |                                                  |                |          |
| 2483.5                    | 56.12                                  | H              | -24.84                                     | 31.28                              | 54                                               | -22.72         | Bandedge |
| 2483.5                    | 57.22                                  | V              | -24.84                                     | 32.38                              | 54                                               | -21.62         | Bandedge |
| 2496.07                   | 56.78                                  | H              | -24.84                                     | 31.94                              | 54                                               | -22.06         | Bandedge |
| 2495.35                   | 57.96                                  | V              | -24.84                                     | 33.12                              | 54                                               | -20.88         | Bandedge |
| 4960                      | 56.51                                  | H              | -24.84                                     | 31.67                              | 54                                               | -22.33         | Harmonic |
| 4960                      | 55.86                                  | V              | -24.84                                     | 31.02                              | 54                                               | -22.98         | Harmonic |

Note:

Absolute Level = Corrected Factor + Reading

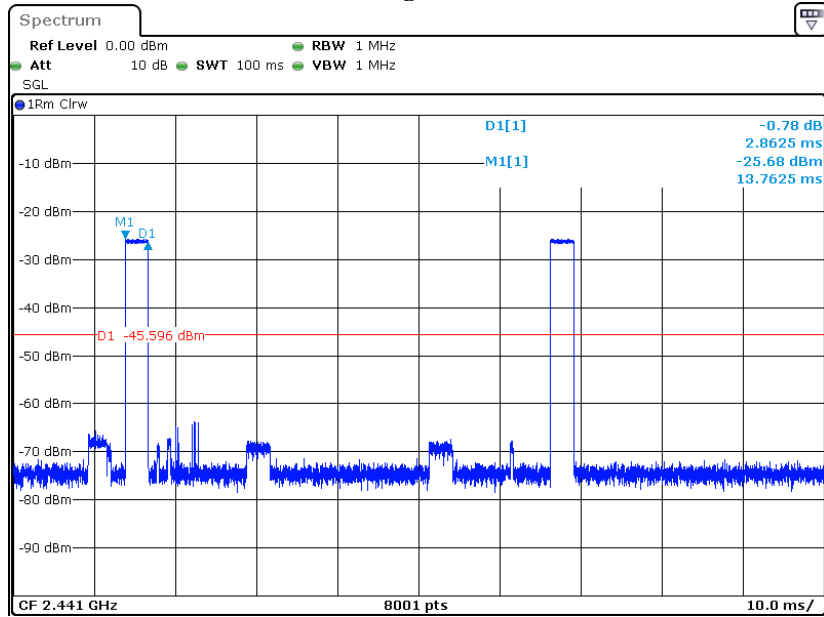
Margin = Corrected. Amplitude - Limit

Average level= Peak level+ Duty Cycle Corrected Factor

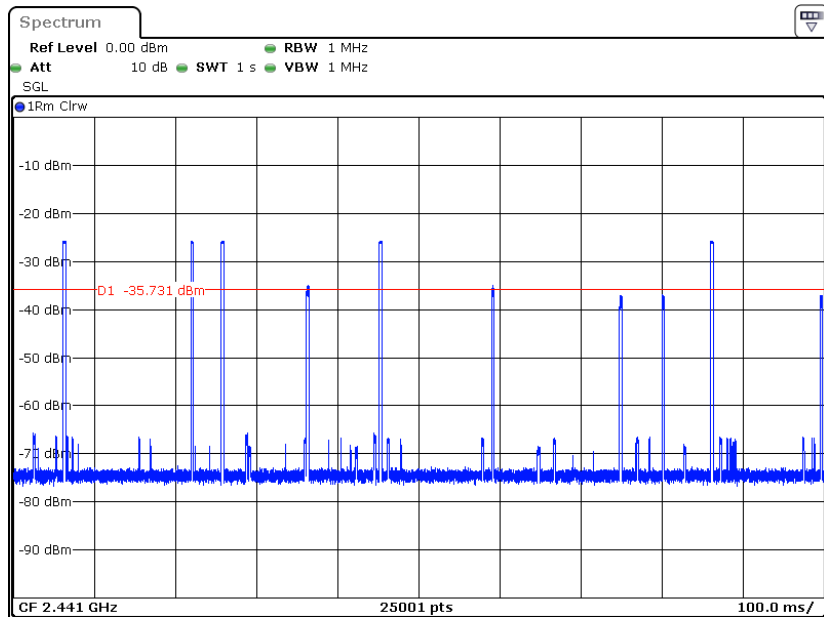
For fundamental, the peak value compliance with the limit of Average.

Duty cycle = Ton/100ms = 2.8625\*2/100=0.05725

Duty Cycle Corrected Factor = 20lg (Duty cycle) = 20lg0.05725 = -24.84

**Pulse length: 2.87ms**

Date: 11.APR.2023 22:04:56

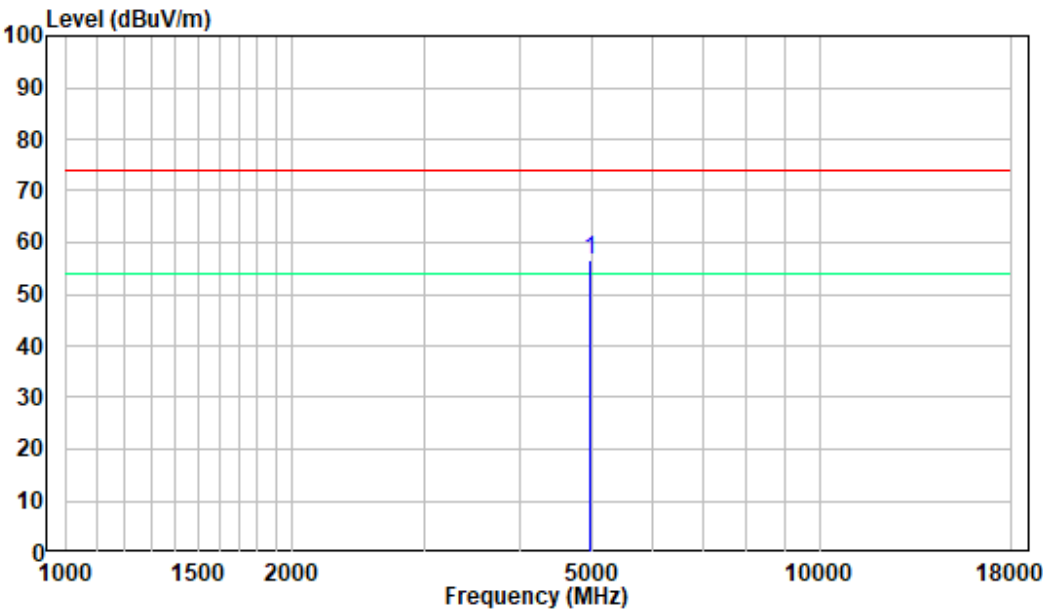
**Maximum Pulse number in 100ms: 2**

Date: 11.APR.2023 22:07:17

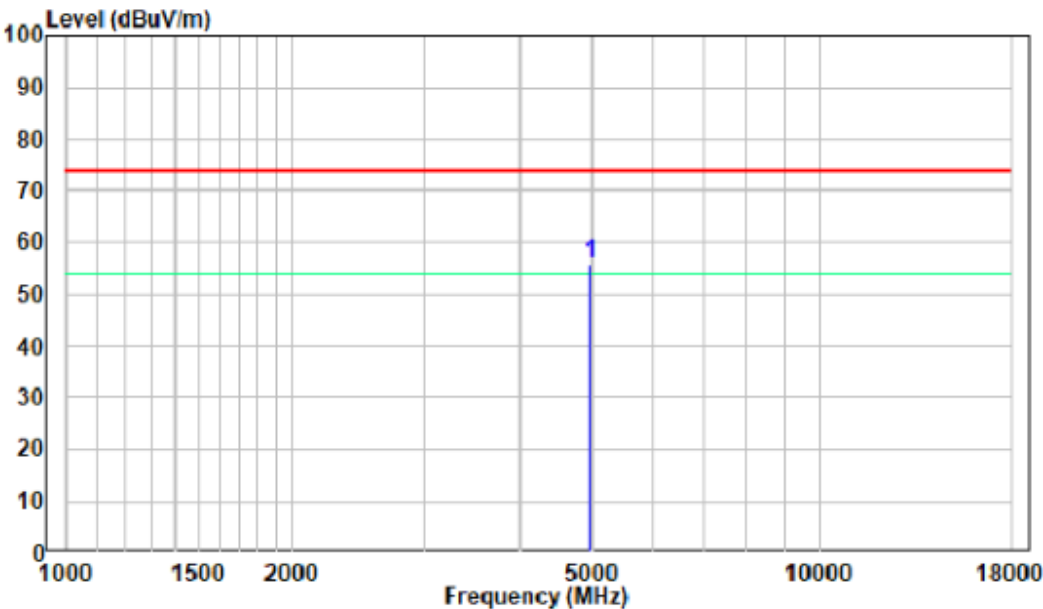
1 GHz - 18 GHz: (Pre-Scan plots)

High channel

Horizontal



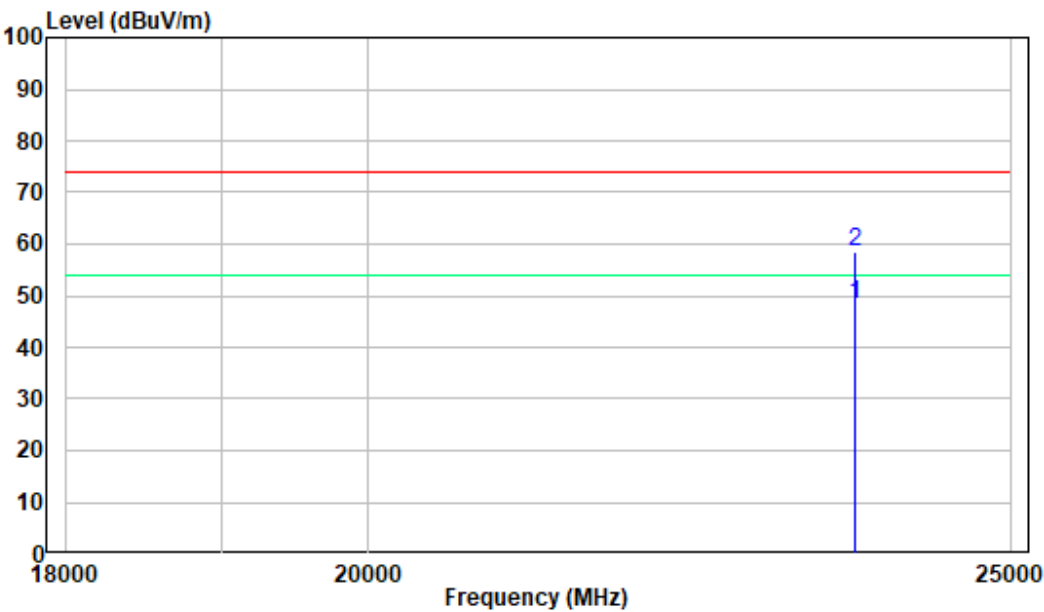
Vertical



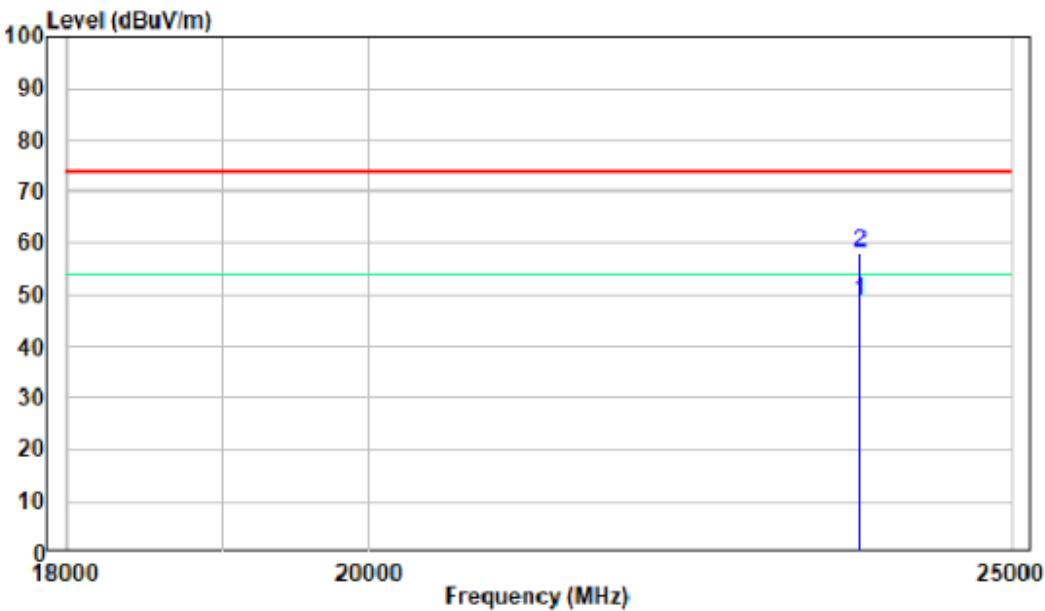
18-25GHz: (Pre-Scan plots)

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.

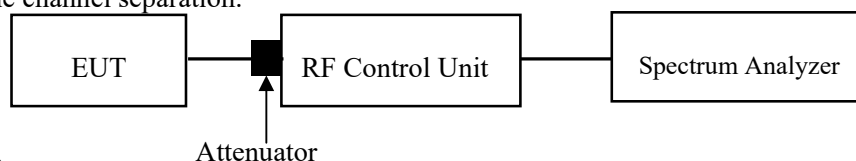
According to RSS-247 § 5.1 (b):

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

Test Method: ANSI C63.10-2013 Clause 7.8.2

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:       | 26 °C     |
| Relative Humidity: | 52%       |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Nick Fang on 2023-04-13.*

*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**

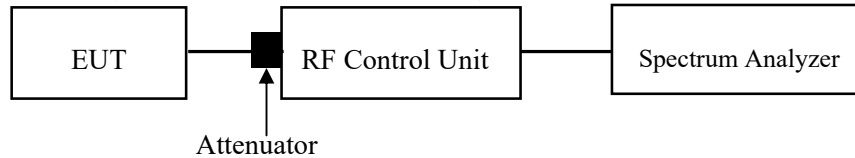
Test Method: ANSI C63.10-2013 Clause 7.8.7 & Clause 6.9.2

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

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20 dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



## Test Data

### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 26 °C     |
| Relative Humidity: | 52%       |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Nick Fang on 2023-04-13.*

*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.

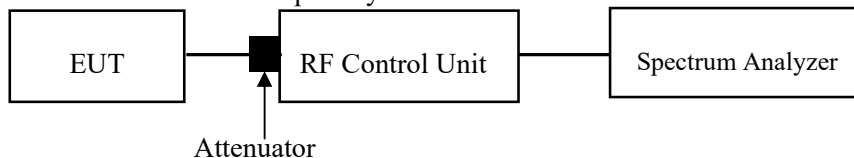
### Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.3

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:       | 26 °C     |
| Relative Humidity: | 52%       |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Nick Fang on 2023-04-13.*

*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

Test Method: ANSI C63.10-2013 Clause 7.8.4

The EUT was worked in channel hopping.

Set the RBW to: 1MHz.

Set the VBW  $\geq 3 \times$  RBW.

Set the span to 0Hz.

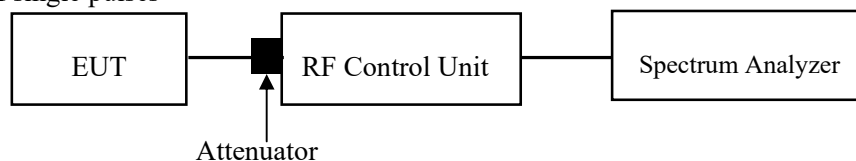
Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Recorded the time of single pulses



### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 26 °C     |
| Relative Humidity: | 52%       |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Nick Fang on 2023-04-13.*

*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):

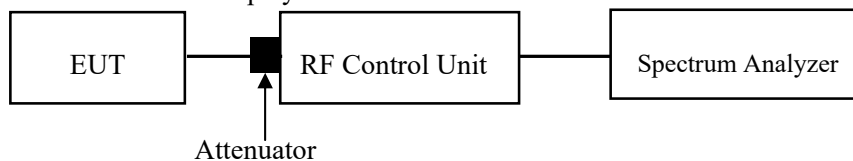
For frequency hopping systems (FHSs) operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. 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

Test Method: ANSI C63.10-2013 Clause 7.8.5

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



### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 26 °C     |
| Relative Humidity: | 52%       |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Nick Fang on 2023-04-13.*

*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

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

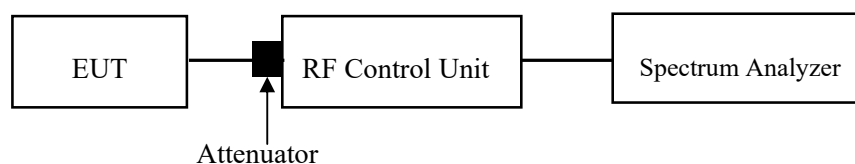
Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

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**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26 °C     |
| <b>Relative Humidity:</b> | 52%       |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Nick Fang on 2023-04-13.*

*EUT operation mode: Transmitting*

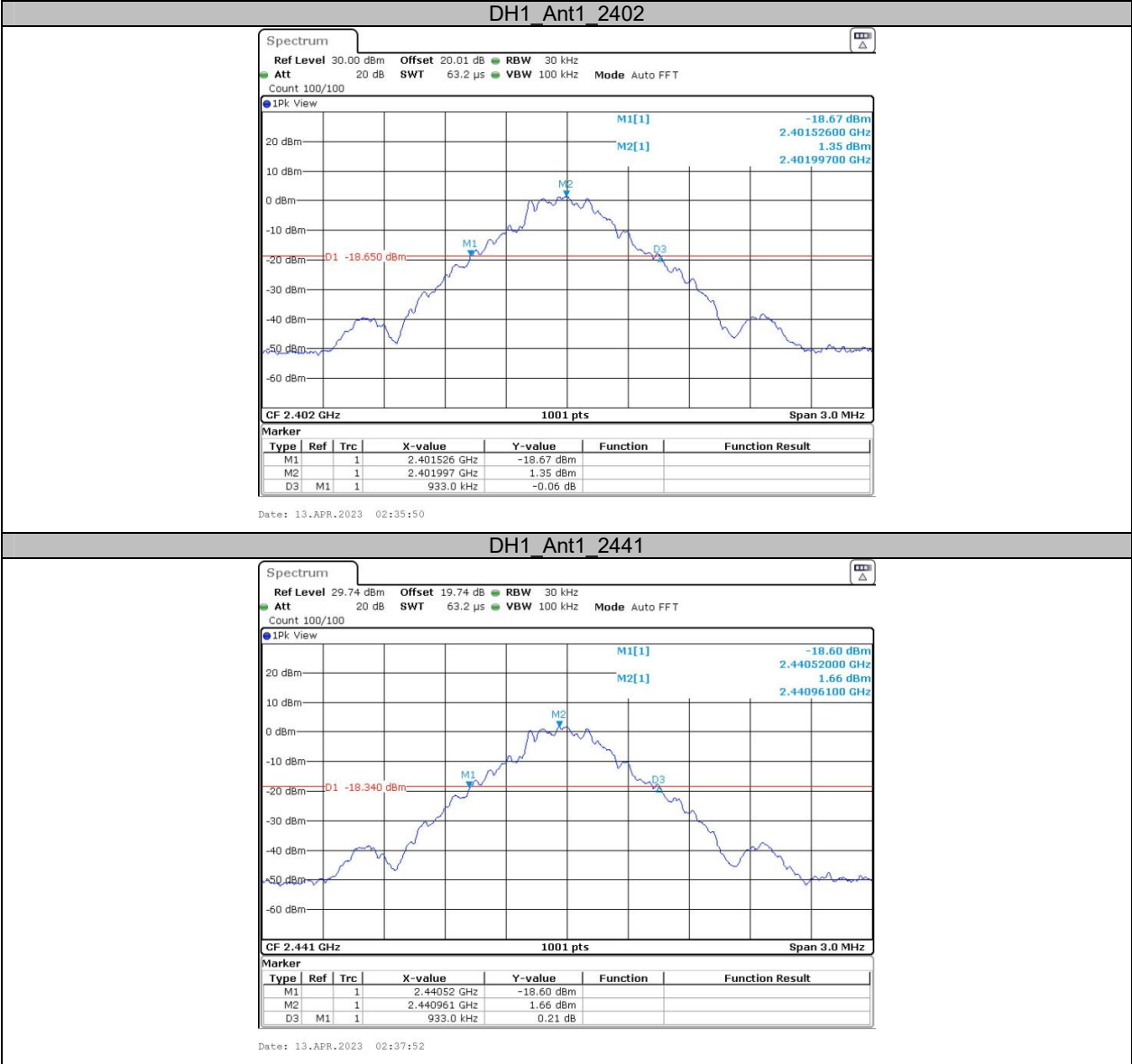
Test Result: Compliant. Please refer to the Appendix.

## APPENDIX

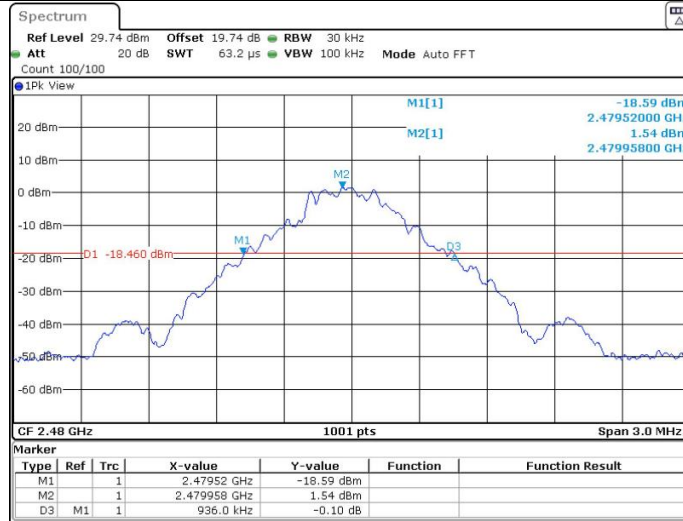
### Appendix A: 20dB Emission Bandwidth Test Result

| Test Mode | Antenna | Frequency[MHz] | 20db<br>EBW[MHz] | FL[MHz] | FH[MHz] | Limit[MHz] | Verdict |
|-----------|---------|----------------|------------------|---------|---------|------------|---------|
| DH1       | Ant1    | 2402           | 0.93             | 2401.53 | 2402.46 | ---        | ---     |
|           |         | 2441           | 0.93             | 2440.52 | 2441.45 | ---        | ---     |
|           |         | 2480           | 0.94             | 2479.52 | 2480.46 | ---        | ---     |
| 2DH1      | Ant1    | 2402           | 1.28             | 2401.34 | 2402.62 | ---        | ---     |
|           |         | 2441           | 1.30             | 2440.33 | 2441.62 | ---        | ---     |
|           |         | 2480           | 1.30             | 2479.32 | 2480.62 | ---        | ---     |
| 3DH1      | Ant1    | 2402           | 1.28             | 2401.34 | 2402.62 | ---        | ---     |
|           |         | 2441           | 1.28             | 2440.34 | 2441.62 | ---        | ---     |
|           |         | 2480           | 1.28             | 2479.34 | 2480.62 | ---        | ---     |

Test Graphs

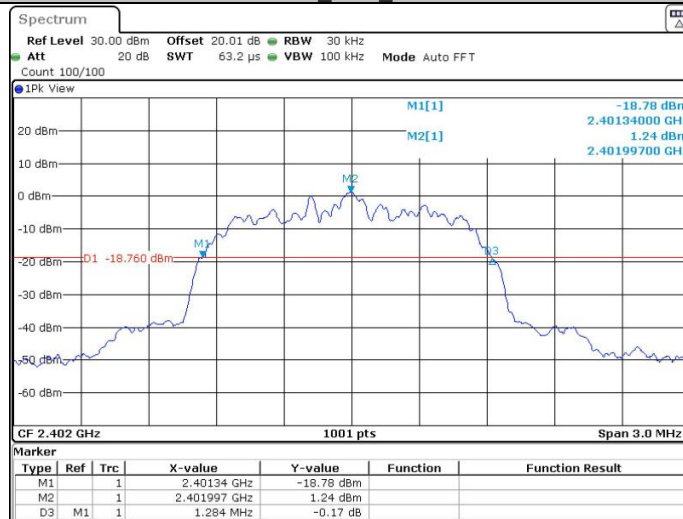


## DH1\_Ant1\_2480

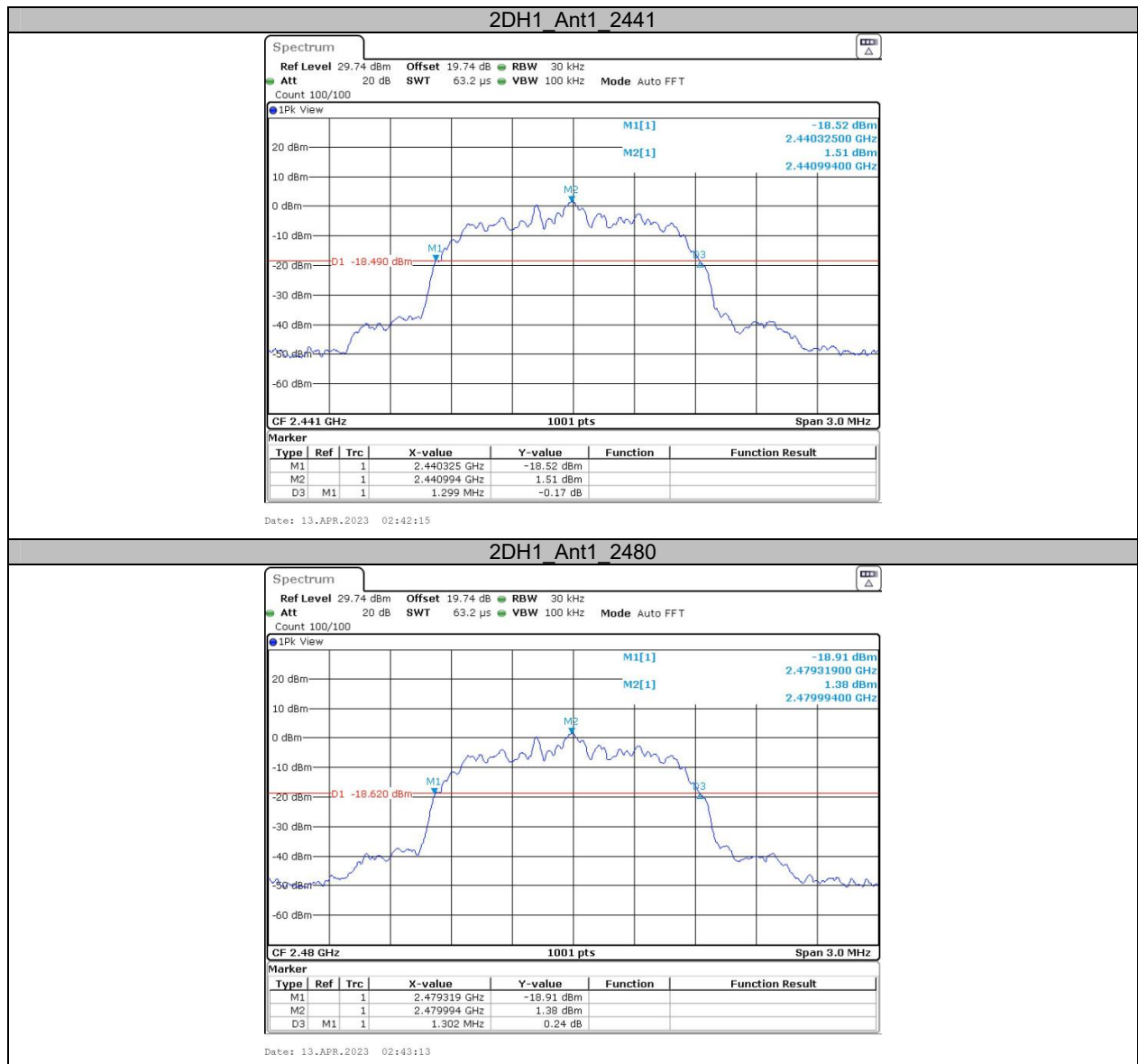


Date: 13.APR.2023 02:38:54

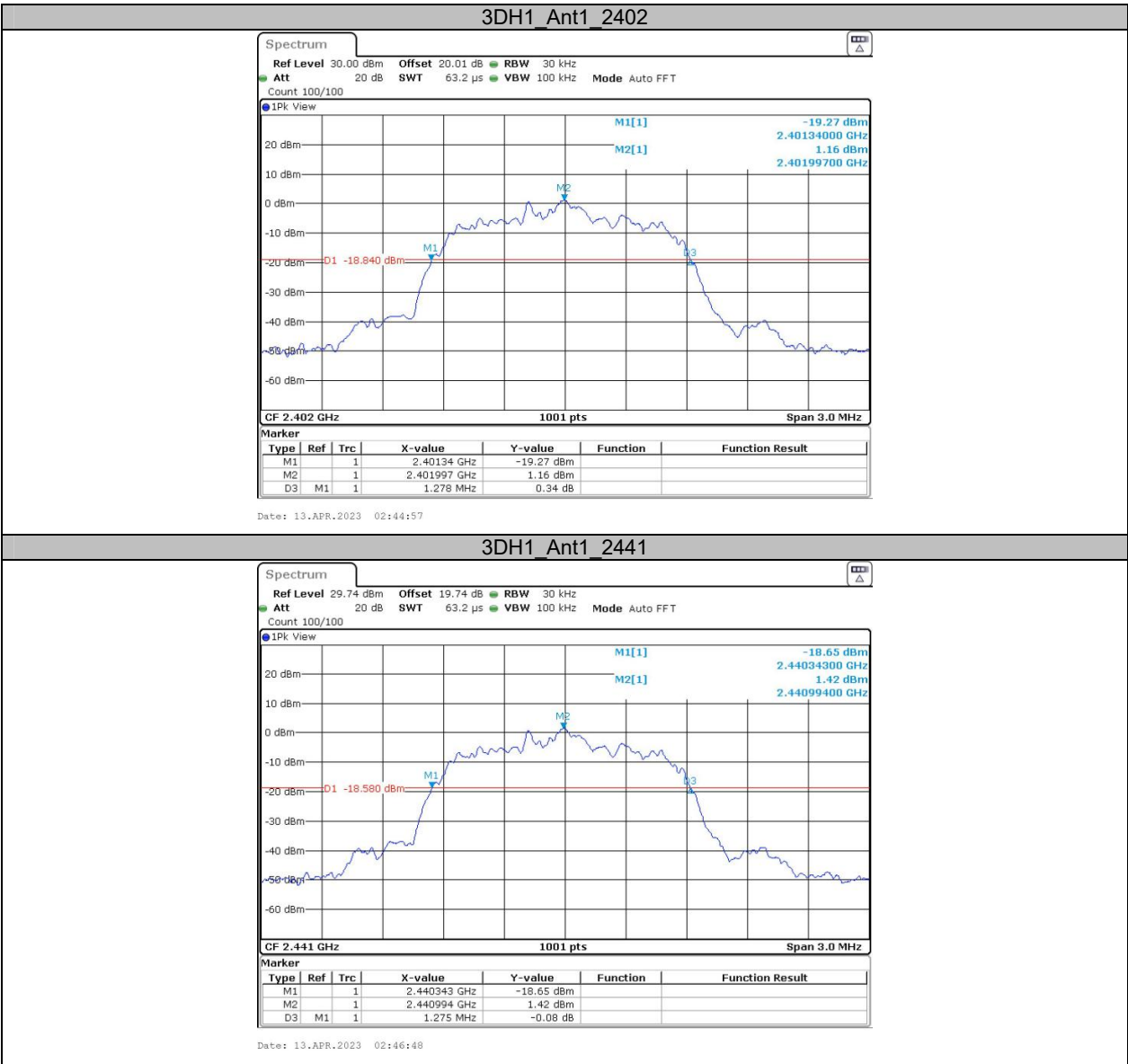
## 2DH1\_Ant1\_2402

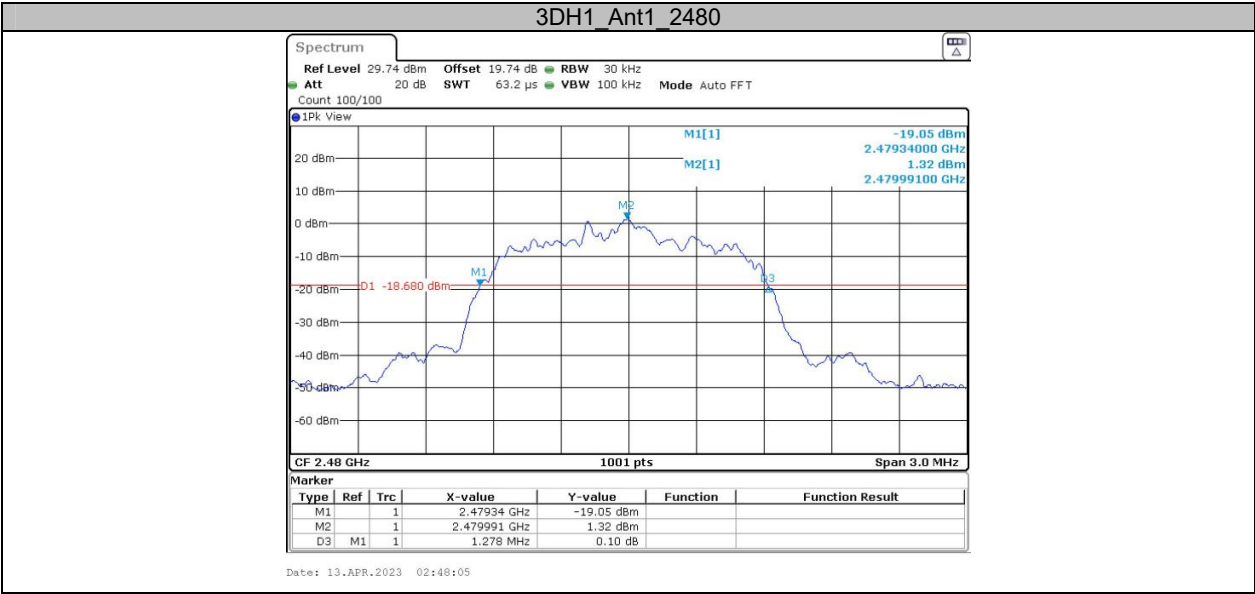


Date: 13.APR.2023 02:40:57





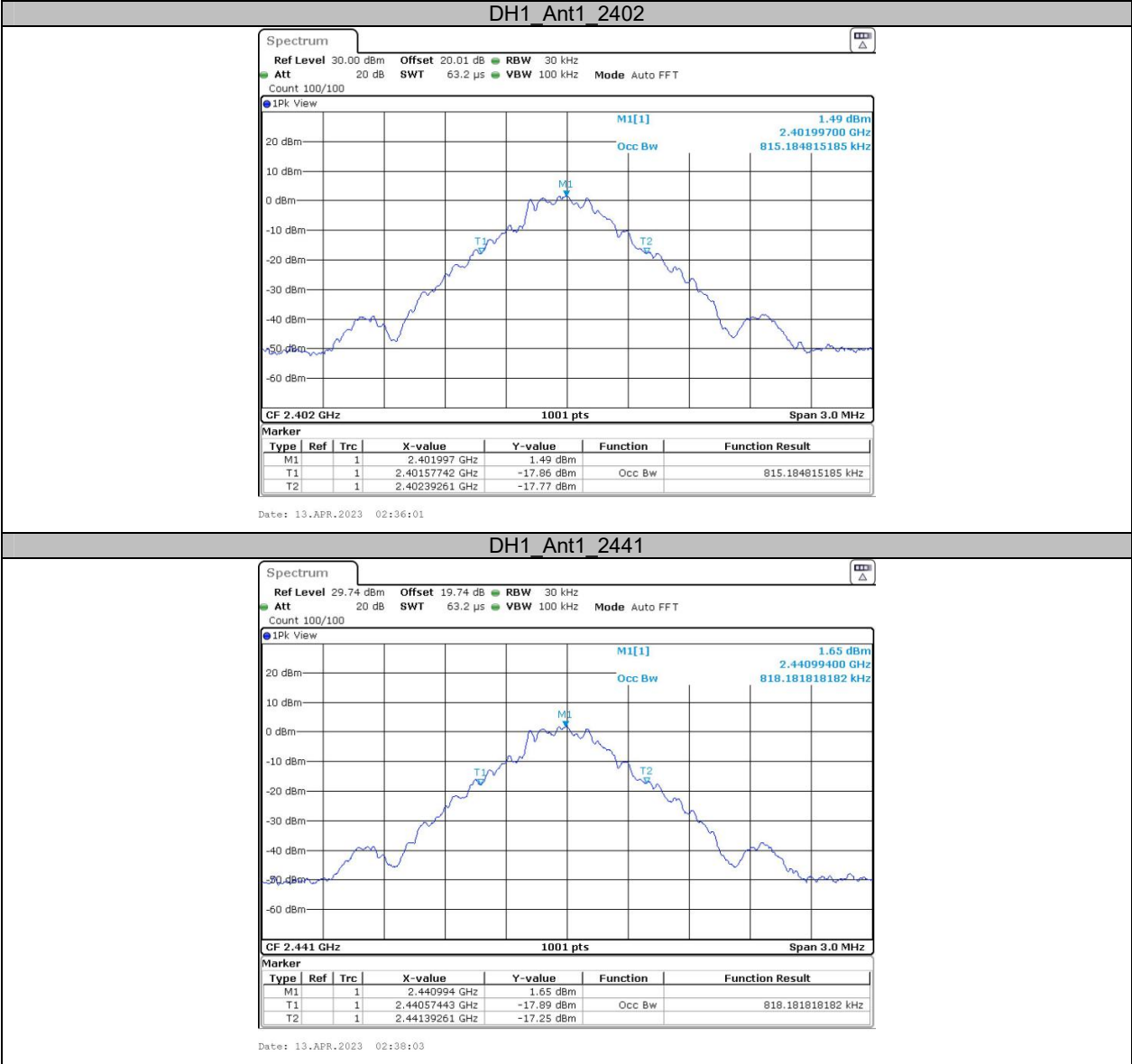


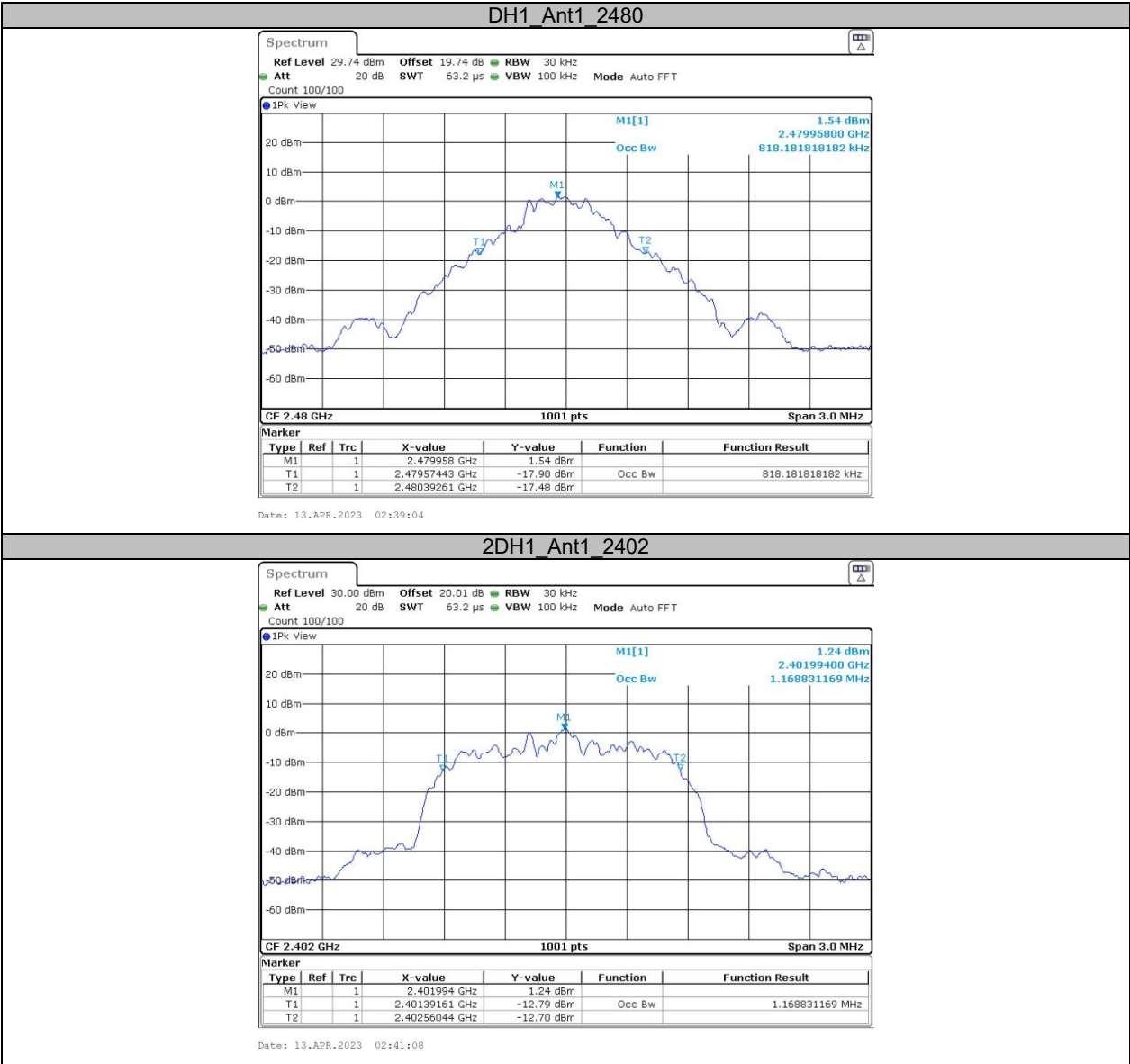


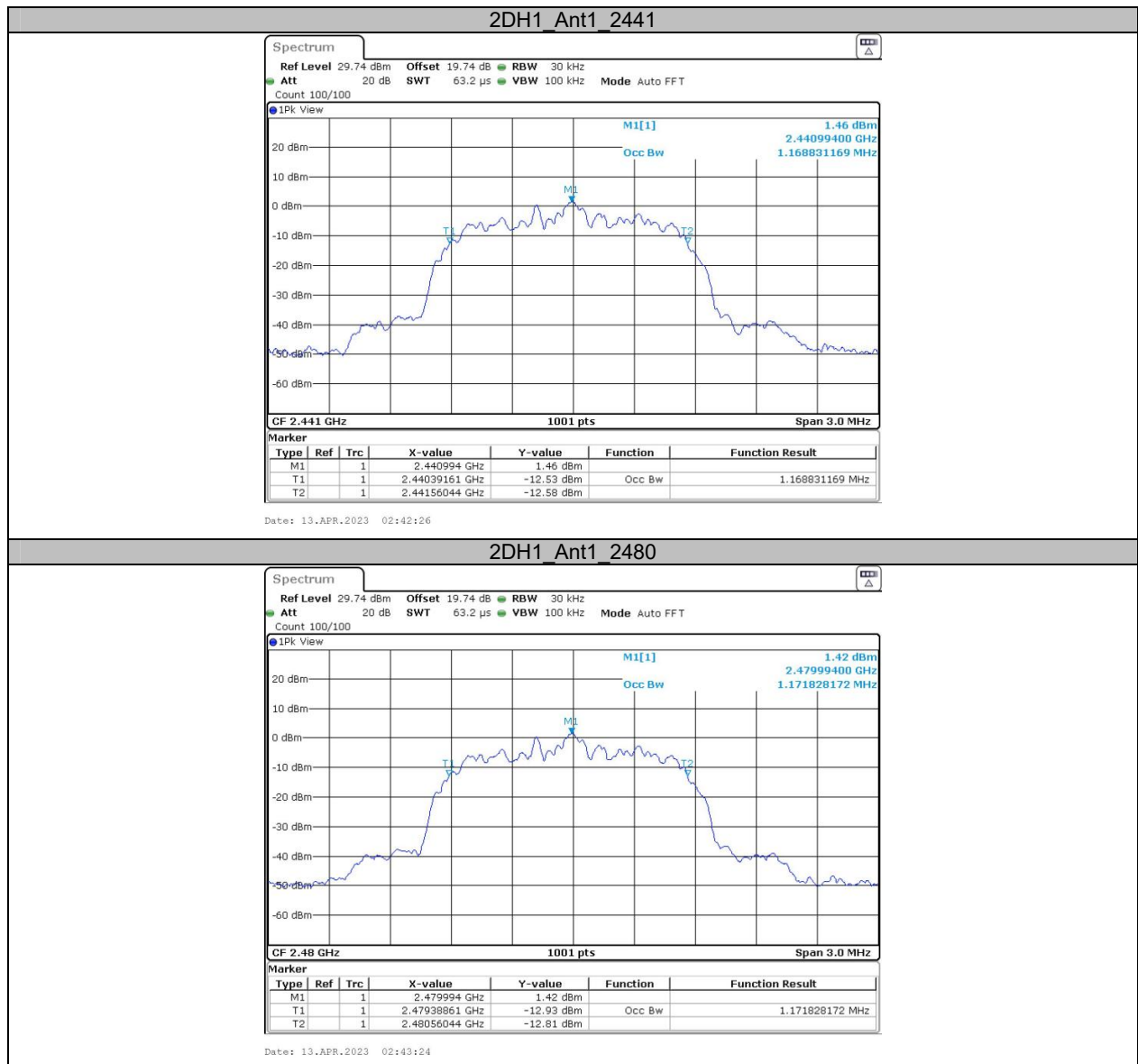
**Appendix B: Occupied Channel Bandwidth  
Test Result**

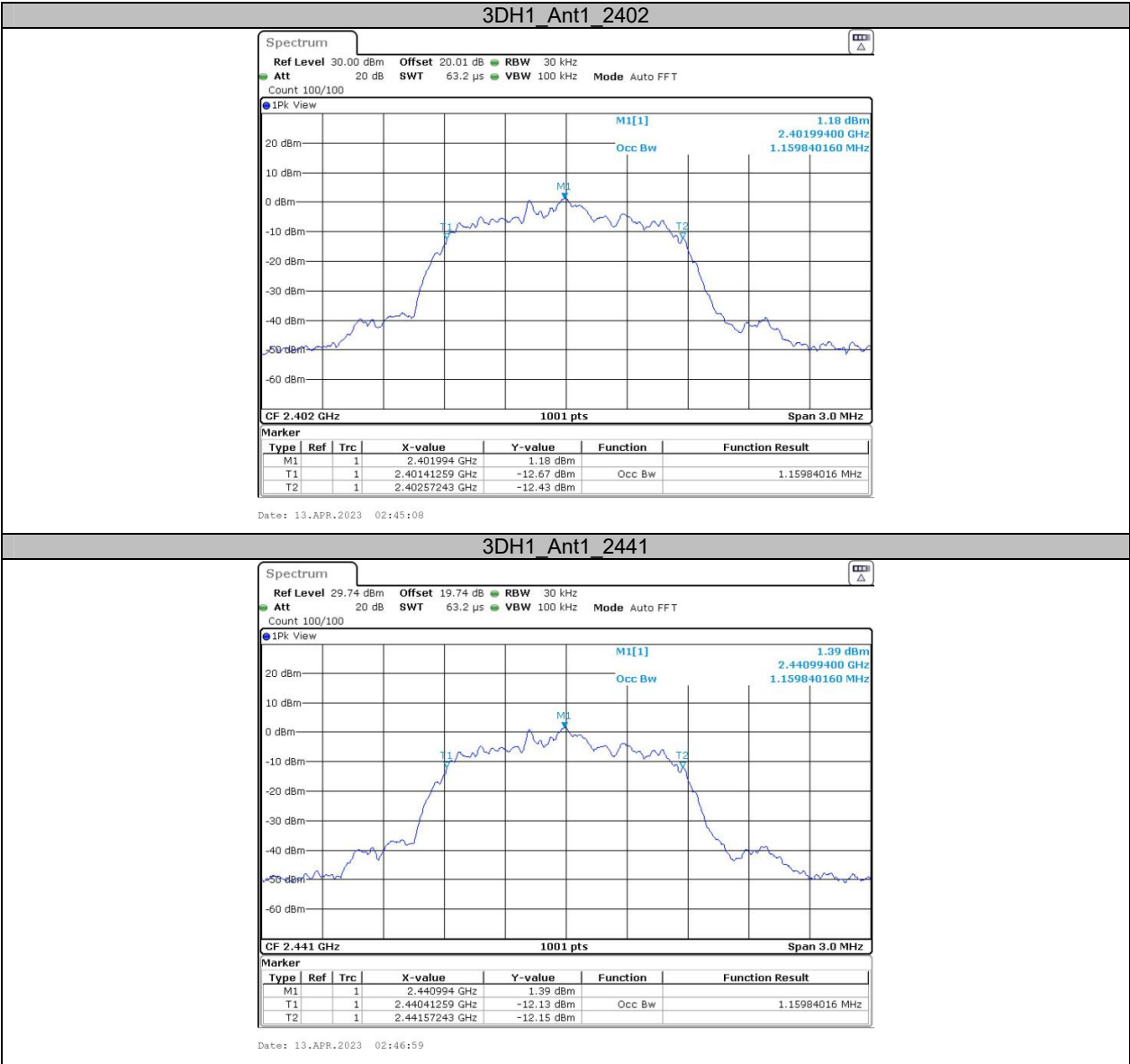
| Test Mode | Antenna | Frequency[MHz] | OCB [MHz] | FL[MHz]  | FH[MHz]  | Limit[MHz] | Verdict |
|-----------|---------|----------------|-----------|----------|----------|------------|---------|
| DH1       | Ant1    | 2402           | 0.815     | 2401.577 | 2402.393 | ---        | ---     |
|           |         | 2441           | 0.818     | 2440.574 | 2441.393 | ---        | ---     |
|           |         | 2480           | 0.818     | 2479.574 | 2480.393 | ---        | ---     |
| 2DH1      | Ant1    | 2402           | 1.169     | 2401.392 | 2402.560 | ---        | ---     |
|           |         | 2441           | 1.169     | 2440.392 | 2441.560 | ---        | ---     |
|           |         | 2480           | 1.172     | 2479.389 | 2480.560 | ---        | ---     |
| 3DH1      | Ant1    | 2402           | 1.16      | 2401.413 | 2402.572 | ---        | ---     |
|           |         | 2441           | 1.16      | 2440.413 | 2441.572 | ---        | ---     |
|           |         | 2480           | 1.163     | 2479.410 | 2480.572 | ---        | ---     |

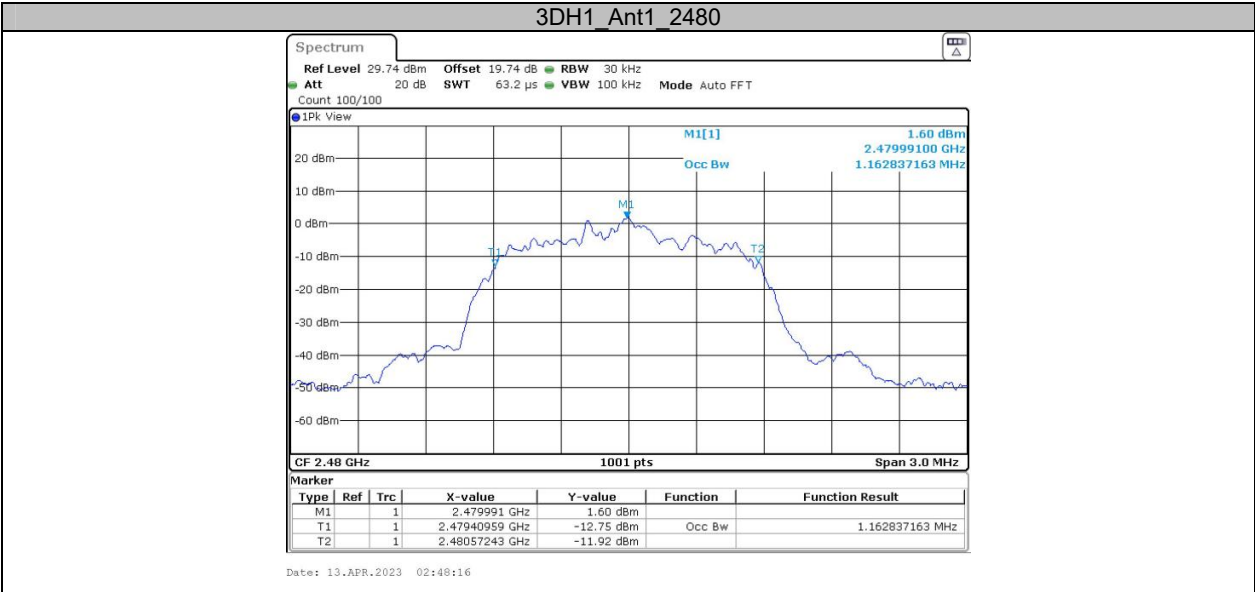
Test Graphs









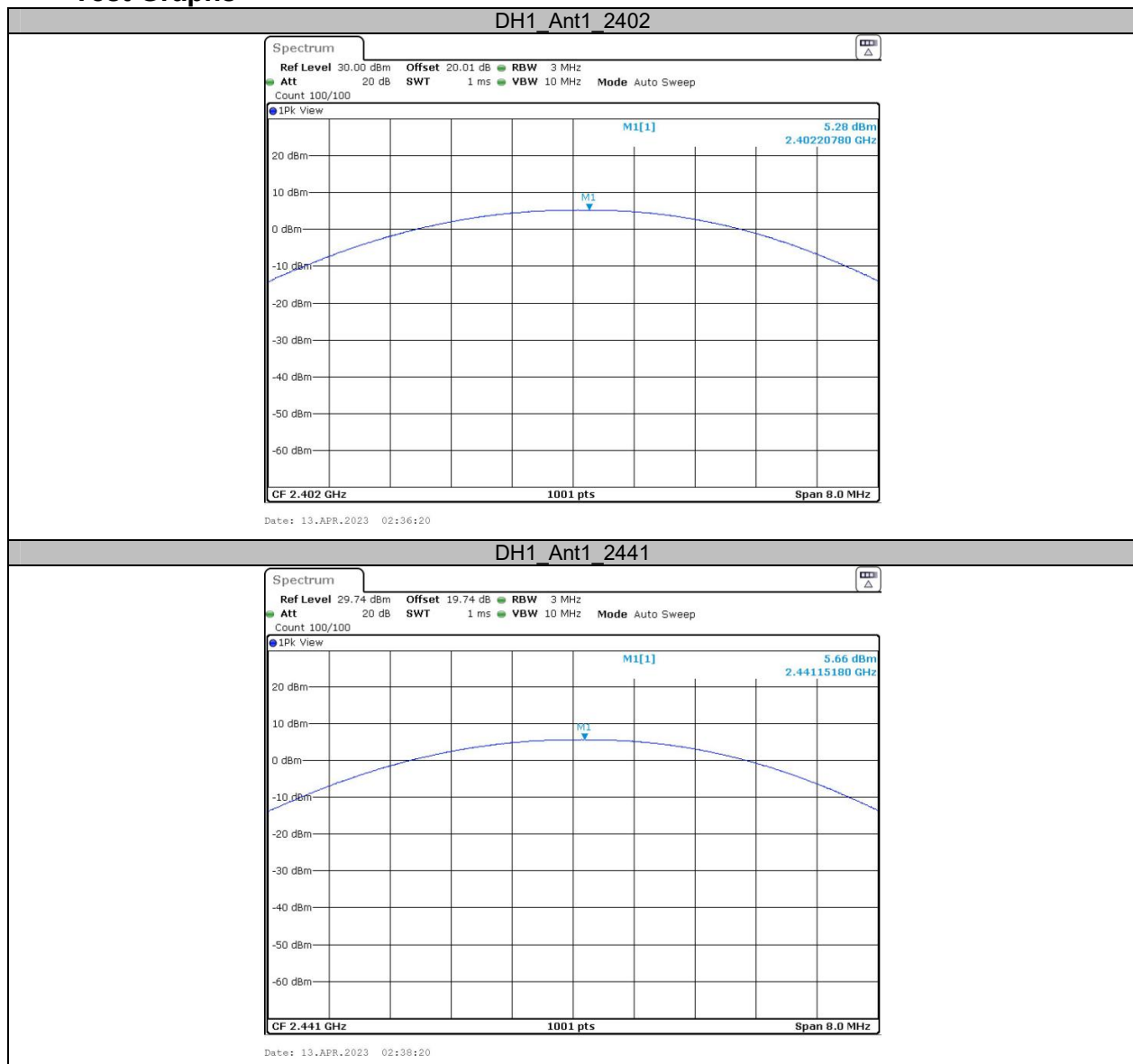


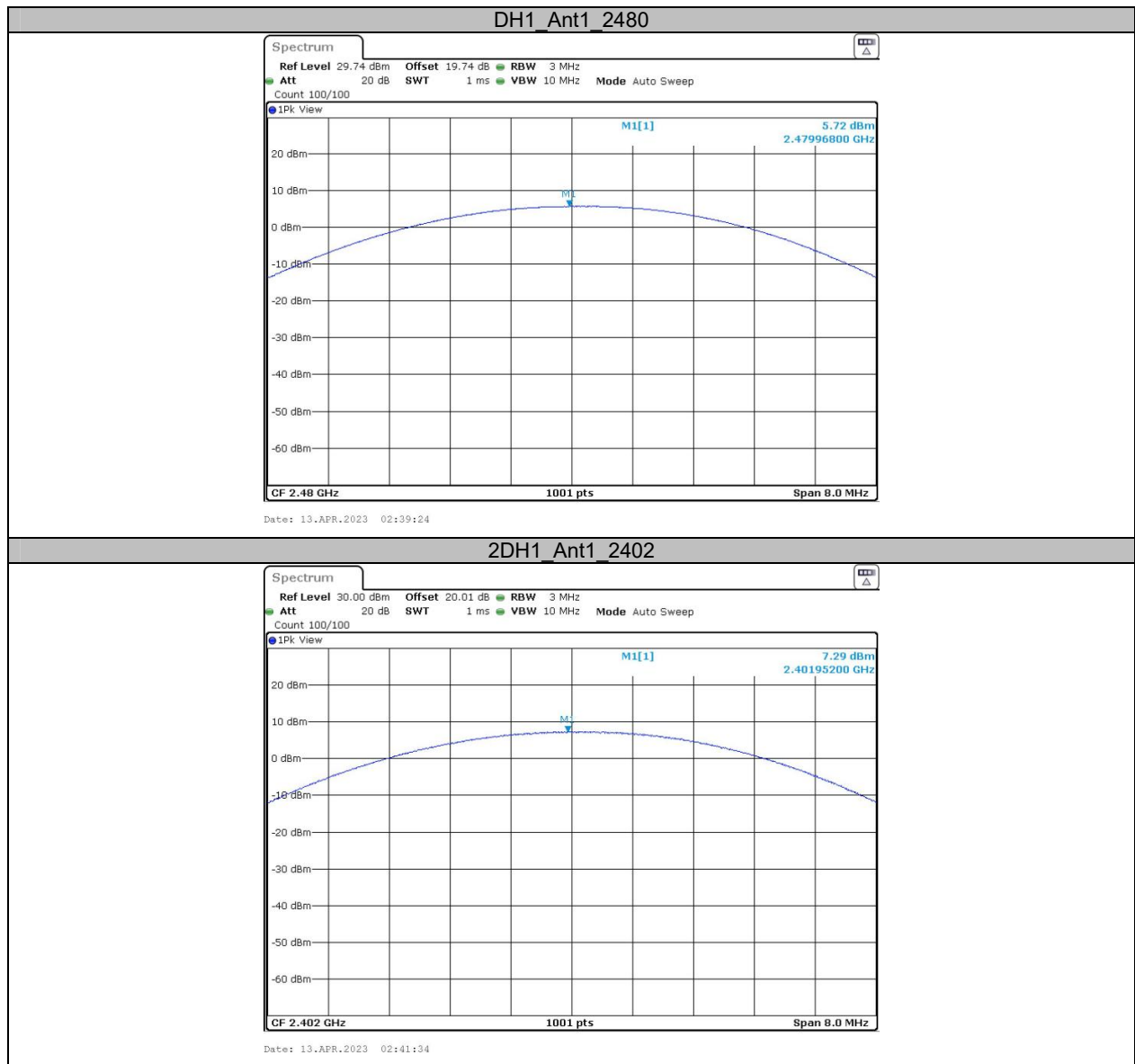


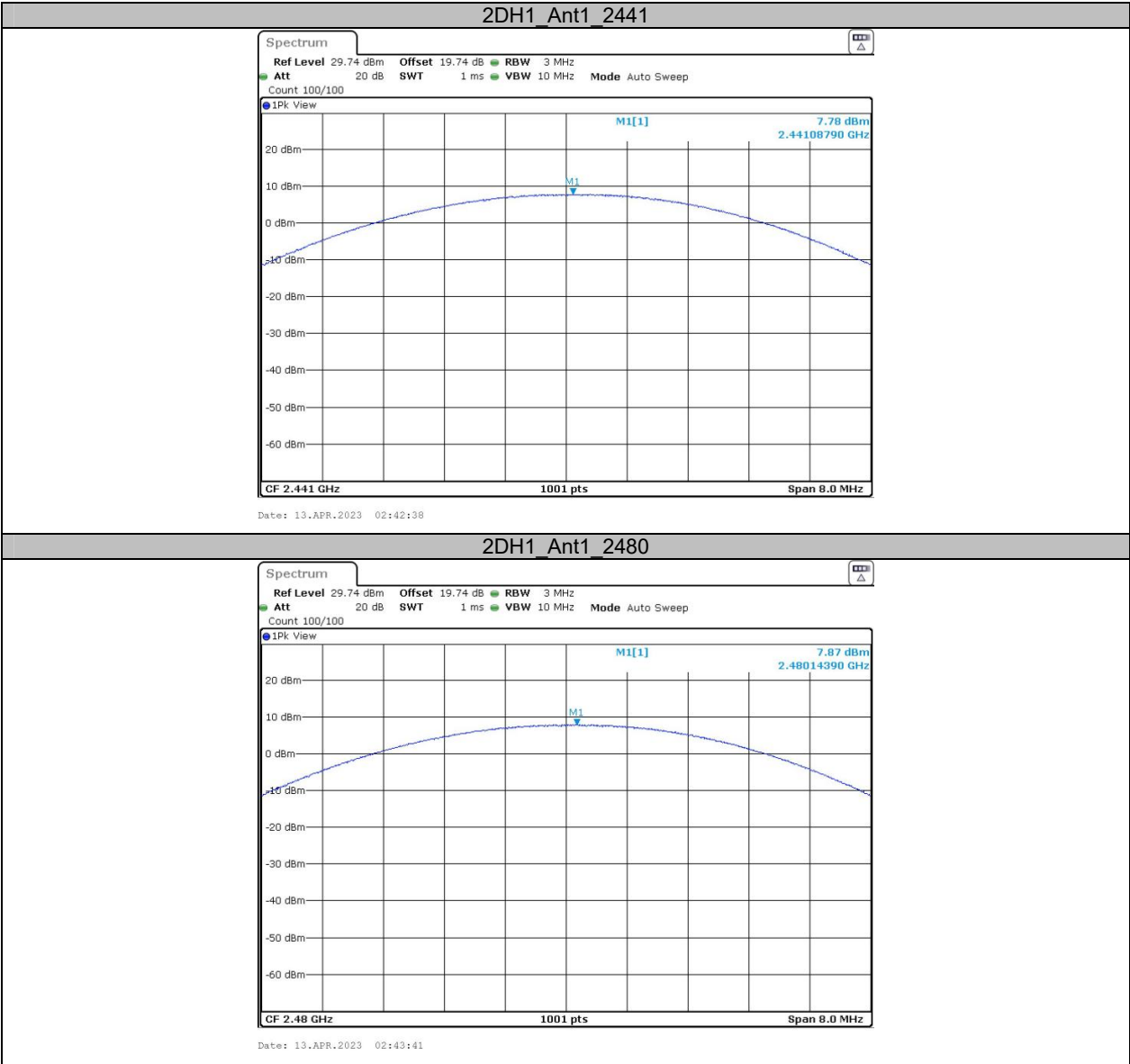
**Appendix C: Maximum conducted output power****Test Result Peak**

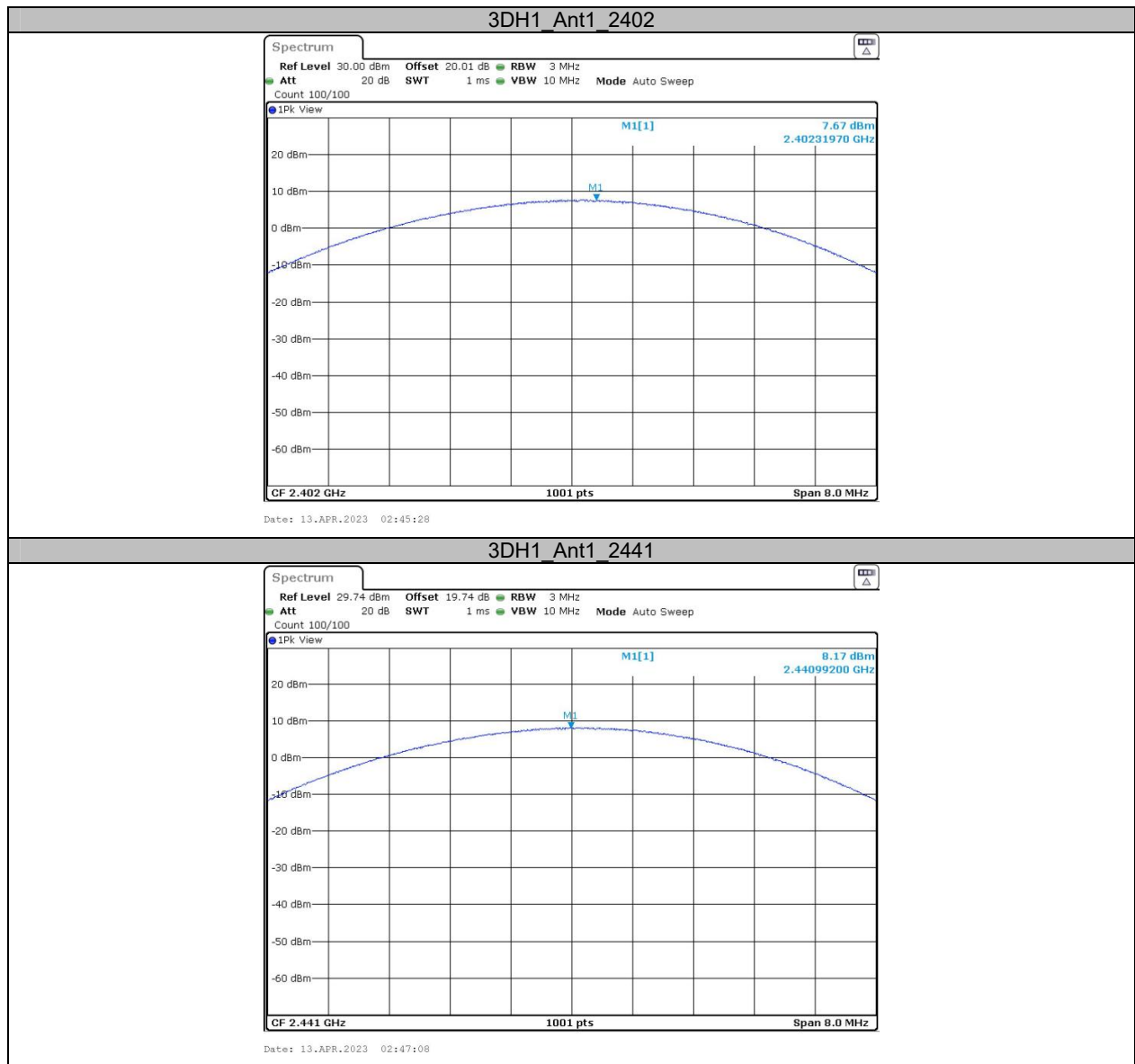
| Test Mode | Antenna | Frequency[MHz] | Conducted Peak Power[dBm] | Conducted Limit[dBm] | Verdict |
|-----------|---------|----------------|---------------------------|----------------------|---------|
| DH1       | Ant1    | 2402           | 5.28                      | ≤20.97               | PASS    |
|           |         | 2441           | 5.66                      | ≤20.97               | PASS    |
|           |         | 2480           | 5.72                      | ≤20.97               | PASS    |
| 2DH1      | Ant1    | 2402           | 7.29                      | ≤20.97               | PASS    |
|           |         | 2441           | 7.78                      | ≤20.97               | PASS    |
|           |         | 2480           | 7.87                      | ≤20.97               | PASS    |
| 3DH1      | Ant1    | 2402           | 7.67                      | ≤20.97               | PASS    |
|           |         | 2441           | 8.17                      | ≤20.97               | PASS    |
|           |         | 2480           | 8.54                      | ≤20.97               | PASS    |

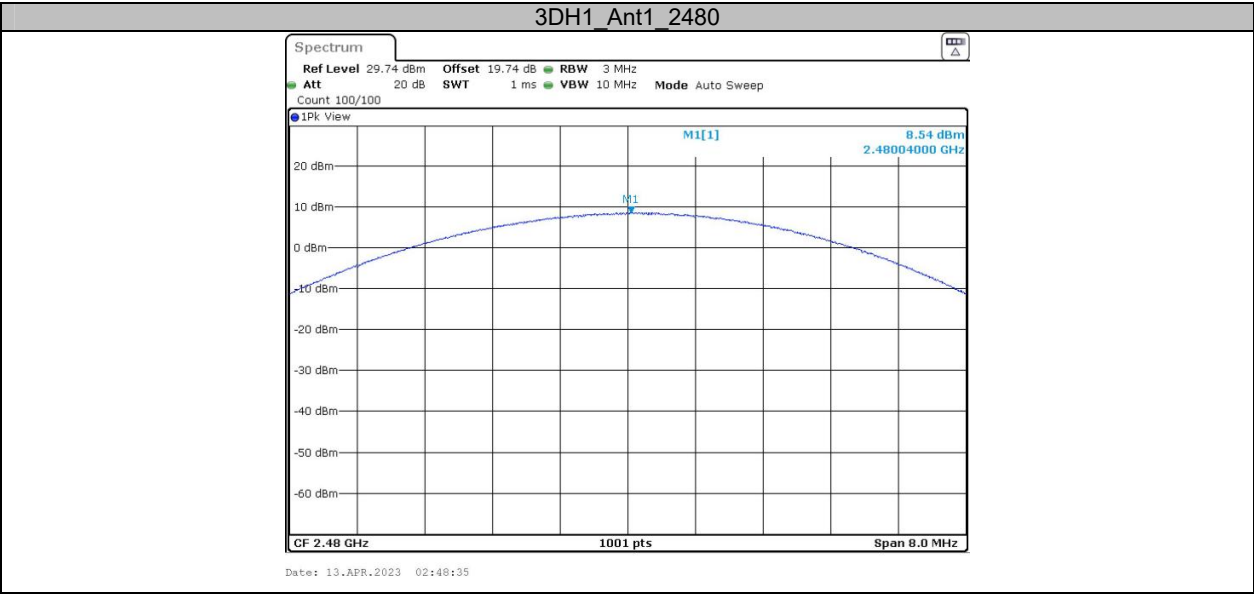
Note: Antenna Gain is 3.42 dBi, the max. EIRP is 11.96 dBm, the RSS-247 limit is 36dBm

**Test Graphs**





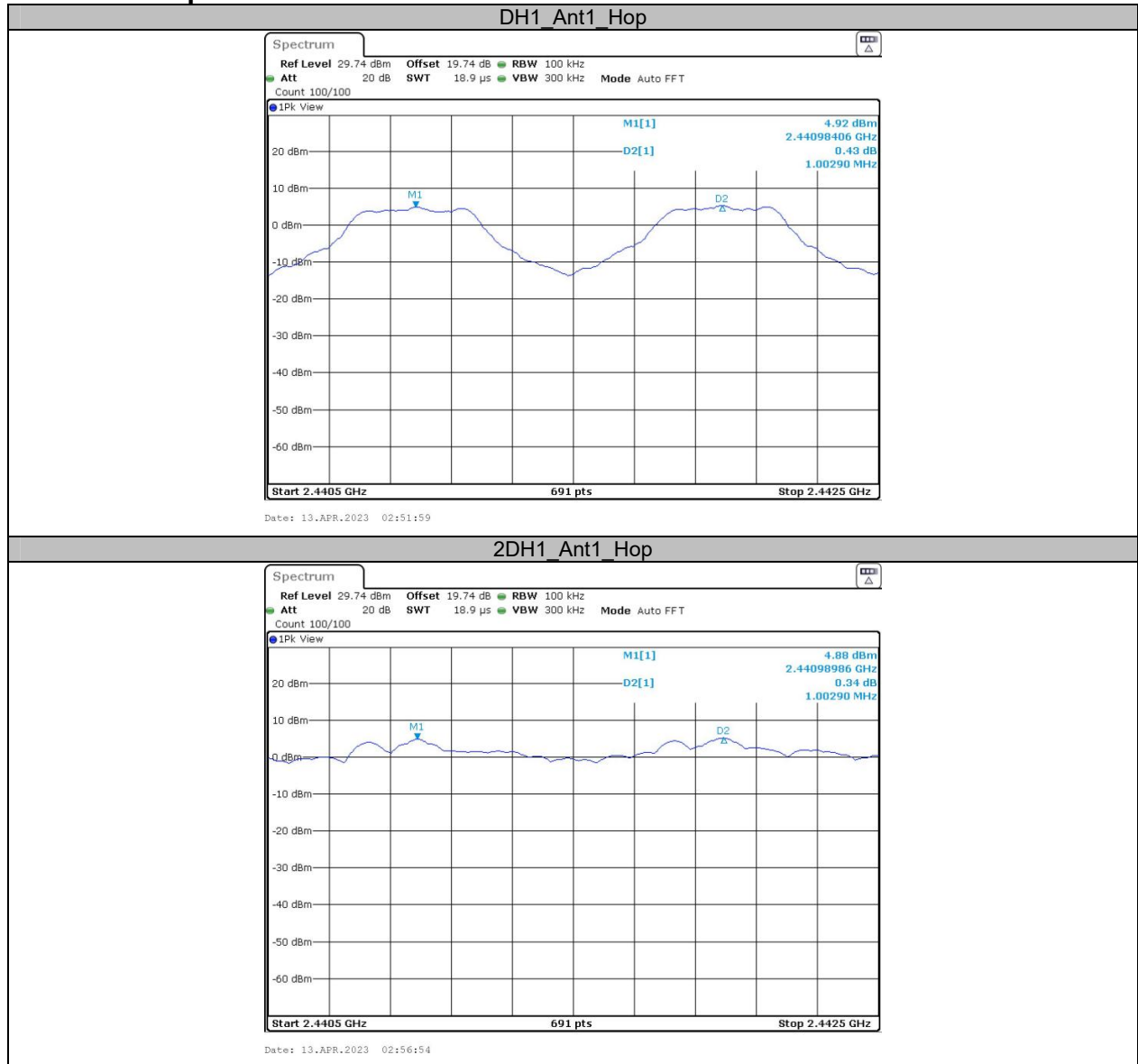


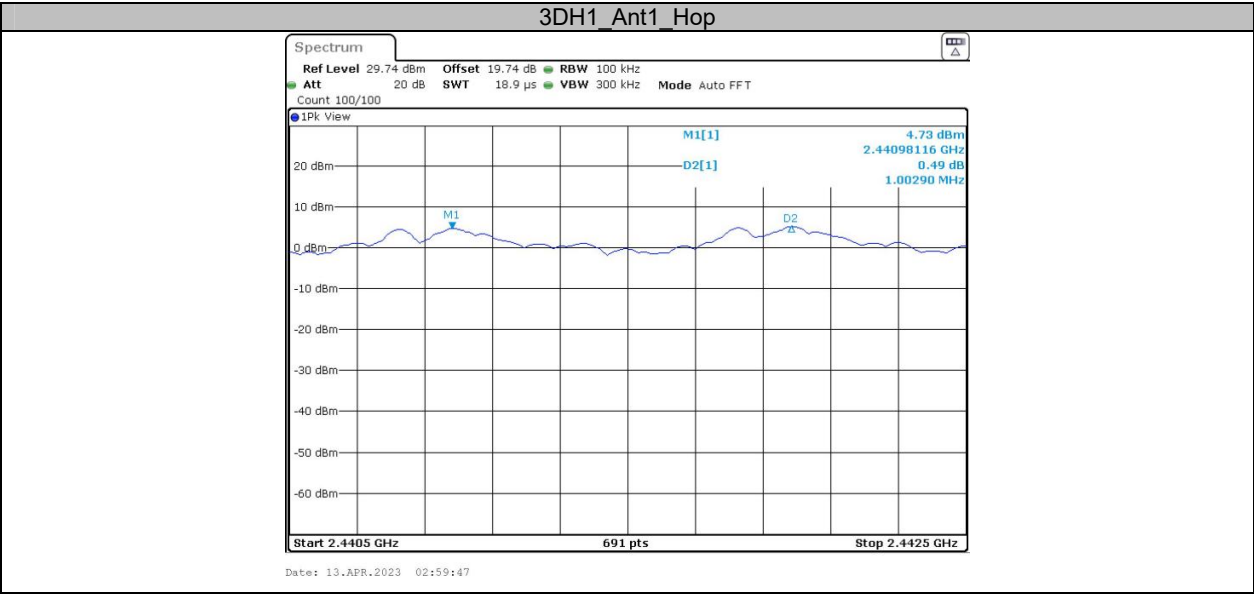


**Appendix D: Carrier frequency separation  
Test Result**

| Test Mode | Antenna | Frequency[MHz] | Result[MHz] | Limit[MHz]   | Verdict |
|-----------|---------|----------------|-------------|--------------|---------|
| DH1       | Ant1    | Hop            | 1.003       | $\geq 0.627$ | PASS    |
| 2DH1      | Ant1    | Hop            | 1.003       | $\geq 0.867$ | PASS    |
| 3DH1      | Ant1    | Hop            | 1.003       | $\geq 0.853$ | PASS    |

## Test Graphs



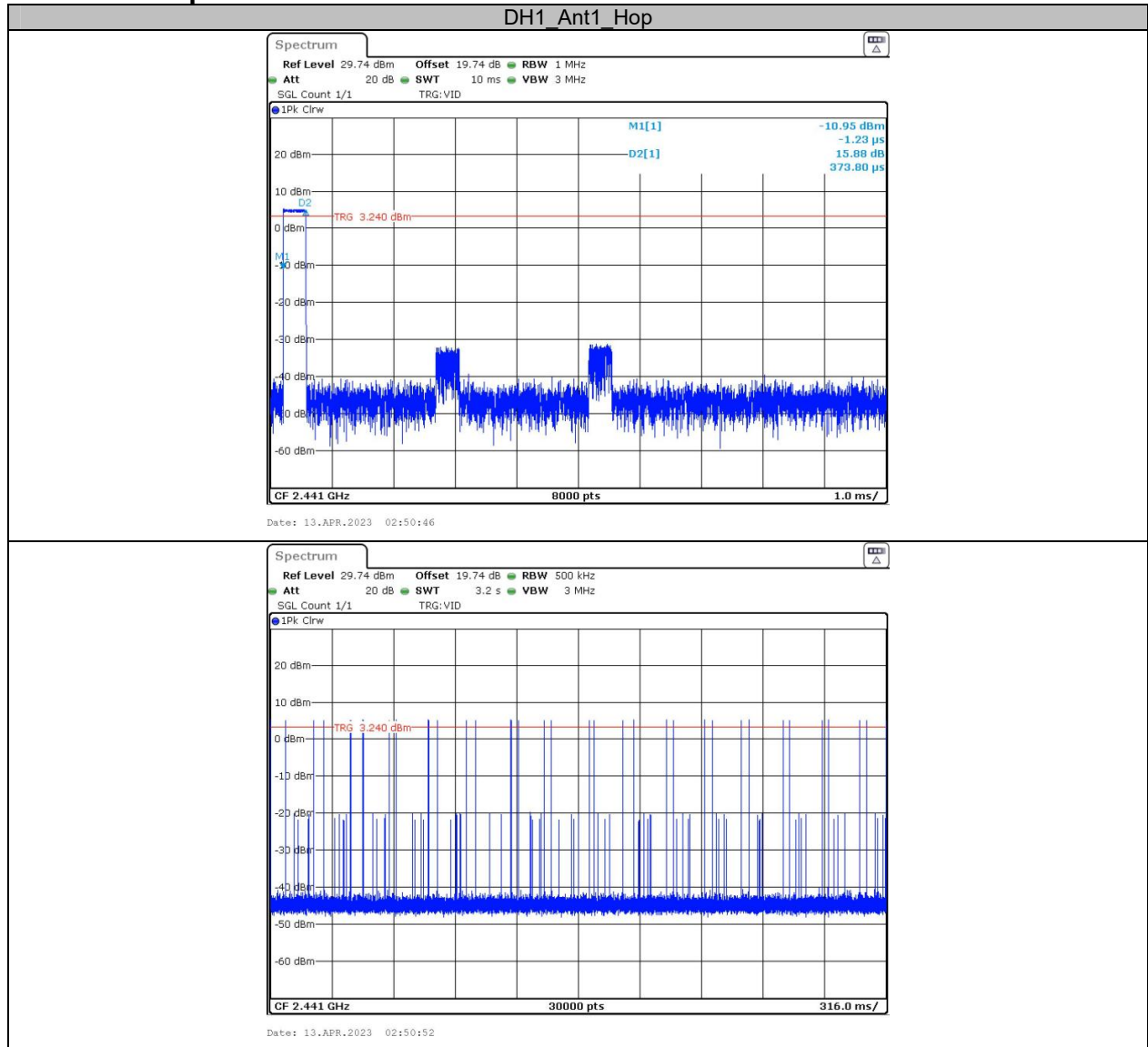


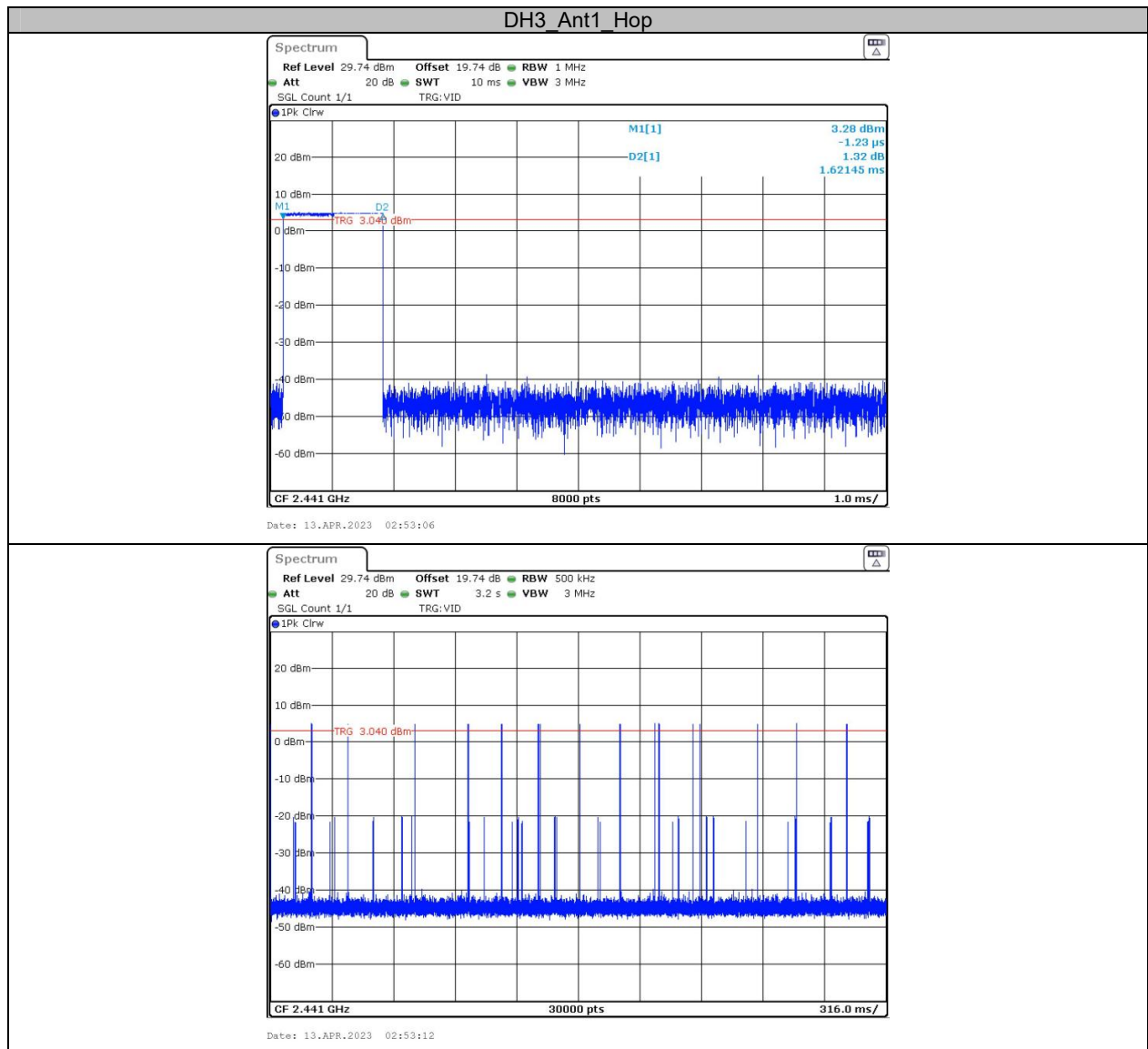


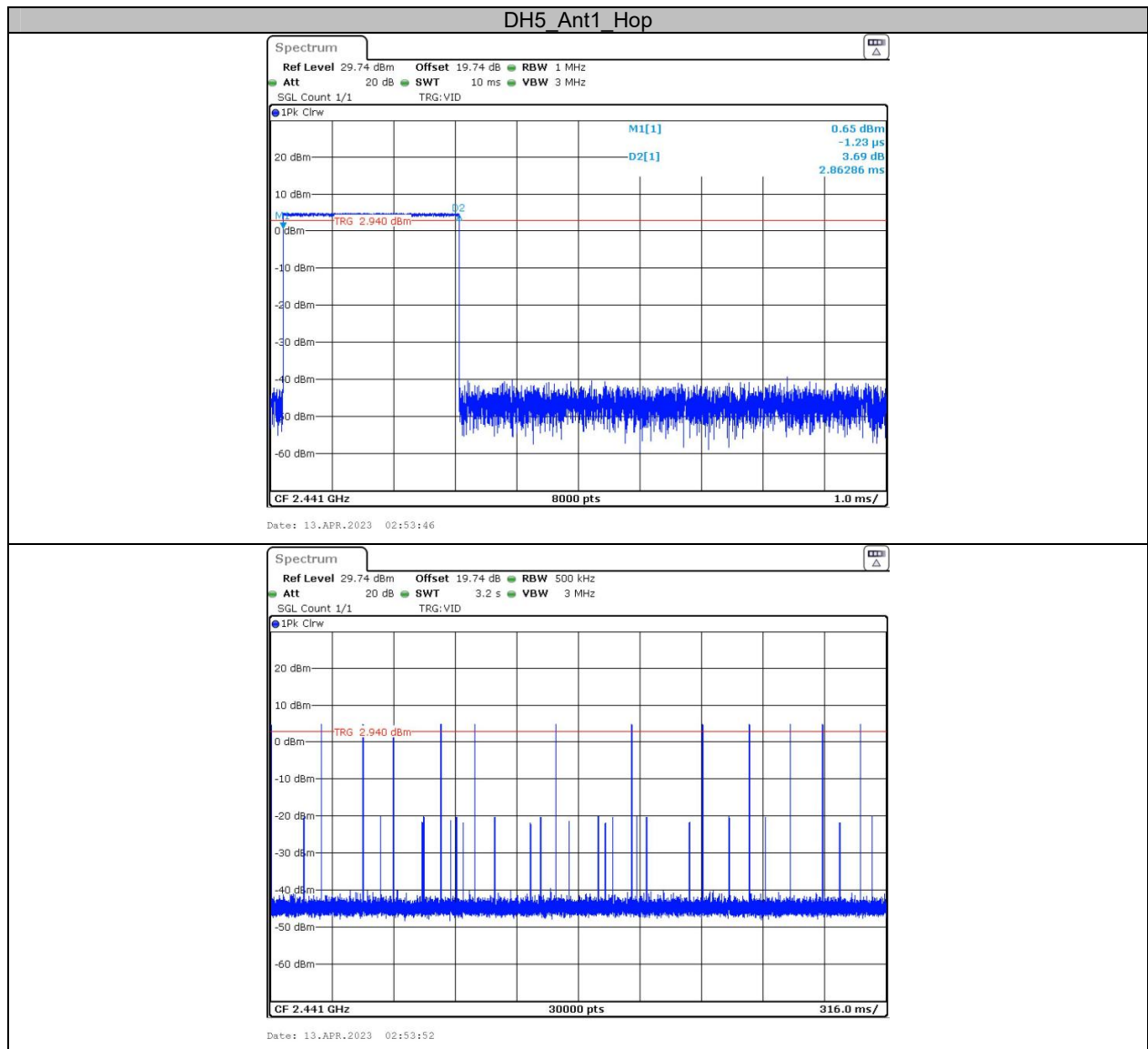
**Appendix E: Time of occupancy  
Test Result**

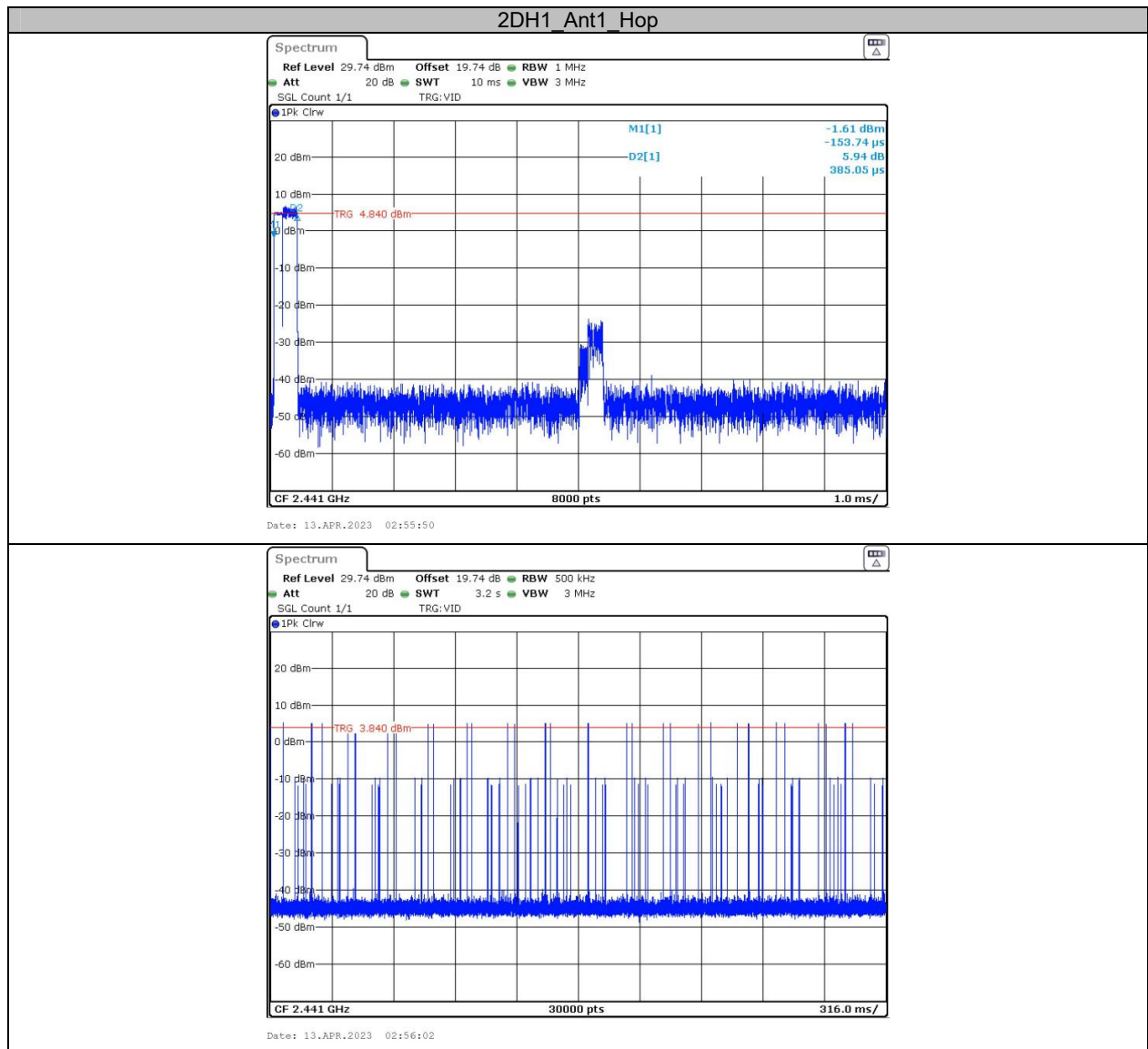
| Test Mode | Antenna | Frequency[MHz] | BurstWidth<br>[ms] | TotalHops<br>[Num] | Result[s] | Limit[s] | Verdict |
|-----------|---------|----------------|--------------------|--------------------|-----------|----------|---------|
| DH1       | Ant1    | Hop            | 0.37               | 320                | 0.118     | ≤0.4     | PASS    |
| DH3       | Ant1    | Hop            | 1.62               | 170                | 0.275     | ≤0.4     | PASS    |
| DH5       | Ant1    | Hop            | 2.86               | 130                | 0.372     | ≤0.4     | PASS    |
| 2DH1      | Ant1    | Hop            | 0.39               | 320                | 0.125     | ≤0.4     | PASS    |
| 2DH3      | Ant1    | Hop            | 1.63               | 160                | 0.261     | ≤0.4     | PASS    |
| 2DH5      | Ant1    | Hop            | 2.87               | 130                | 0.373     | ≤0.4     | PASS    |
| 3DH1      | Ant1    | Hop            | 0.39               | 320                | 0.125     | ≤0.4     | PASS    |
| 3DH3      | Ant1    | Hop            | 1.63               | 160                | 0.261     | ≤0.4     | PASS    |
| 3DH5      | Ant1    | Hop            | 2.87               | 120                | 0.344     | ≤0.4     | PASS    |

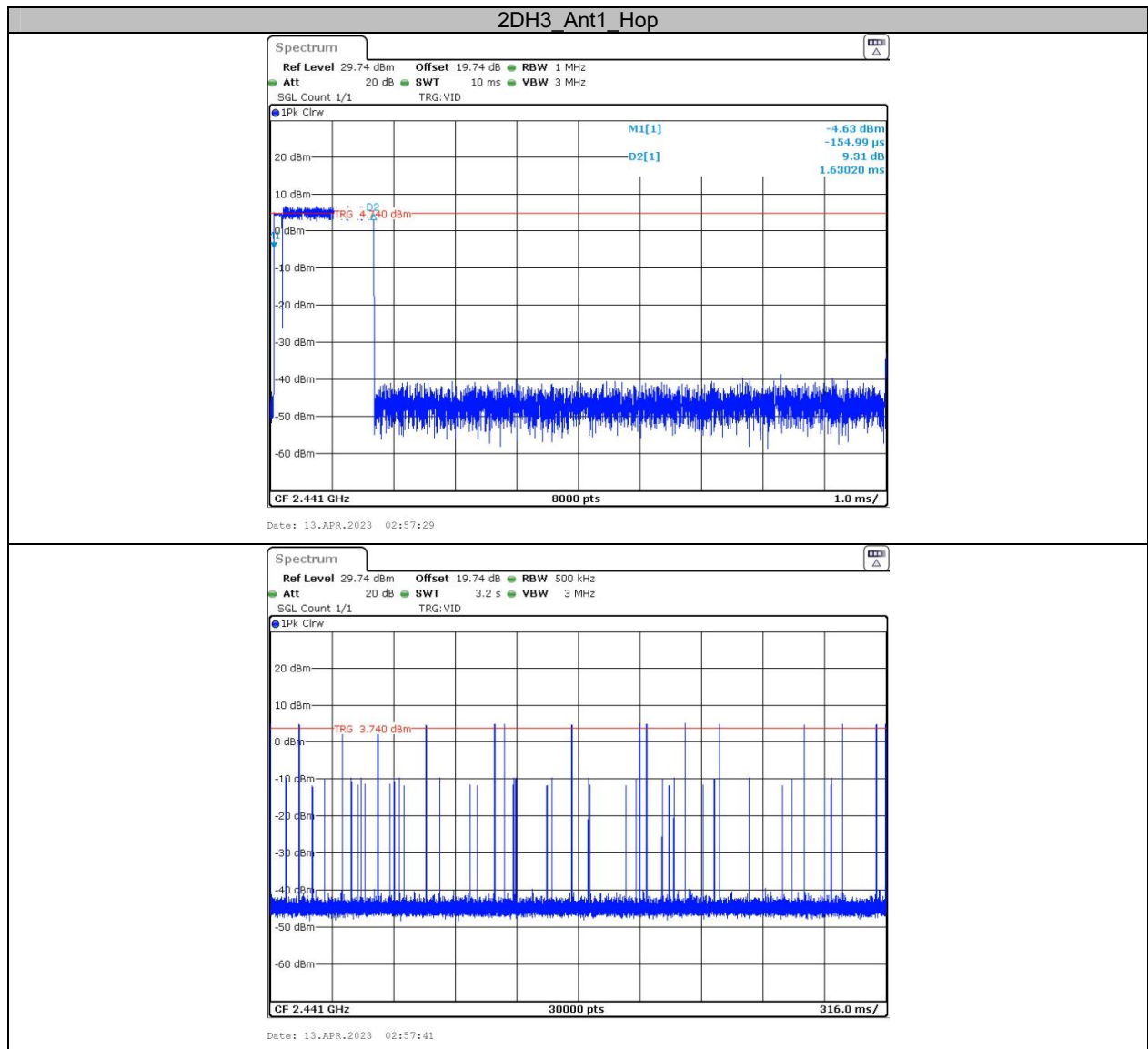
## Test Graphs

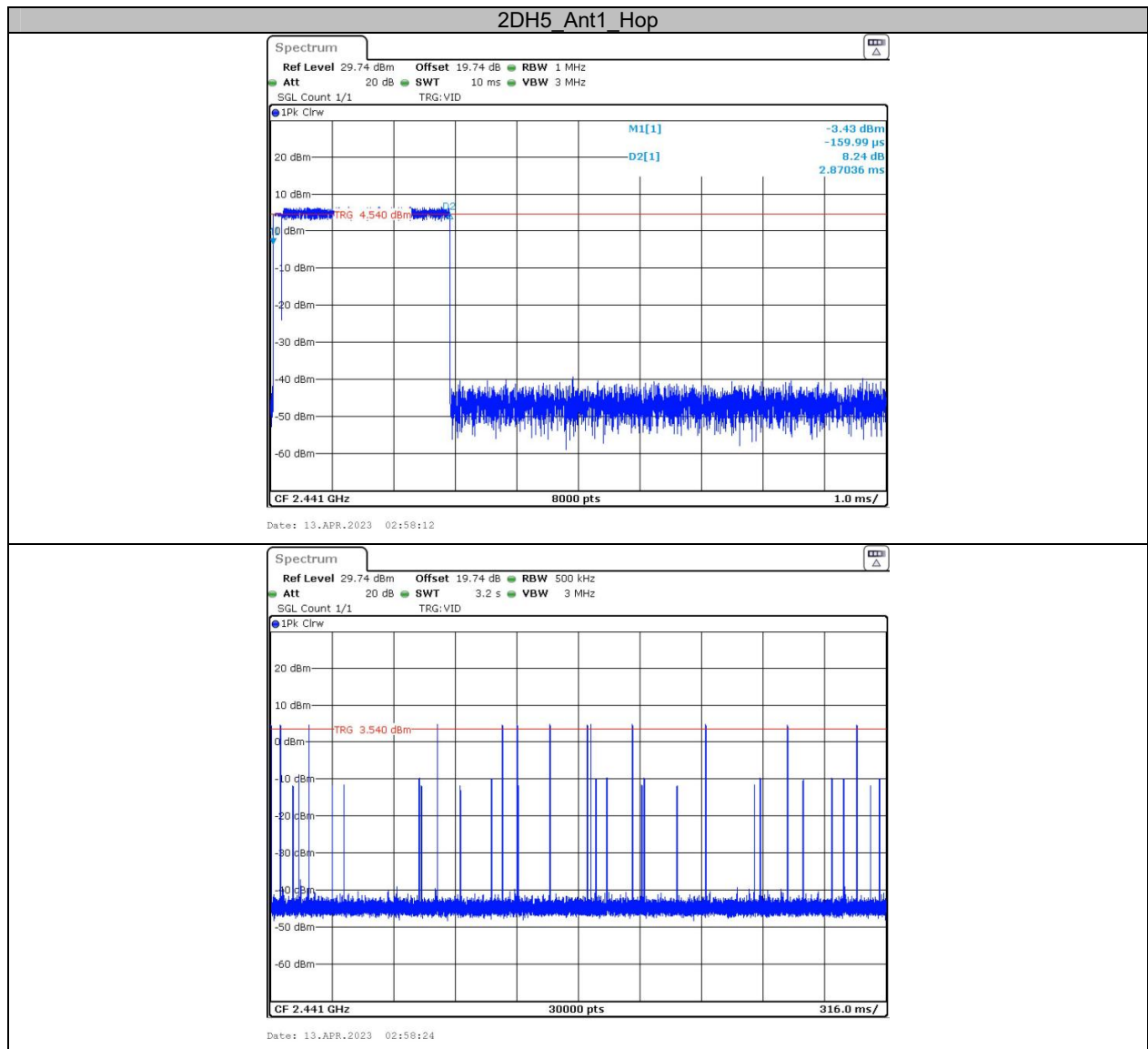


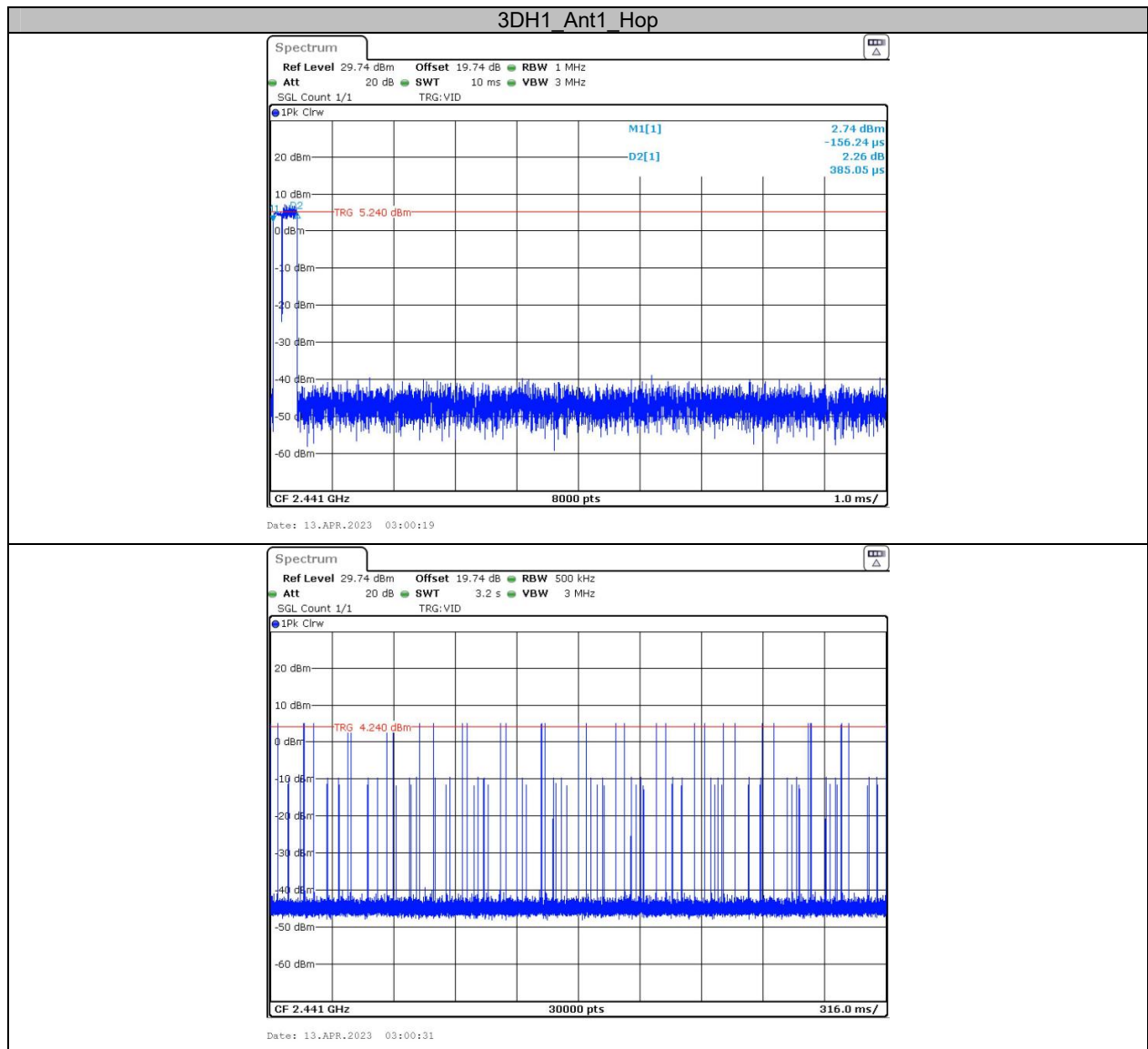




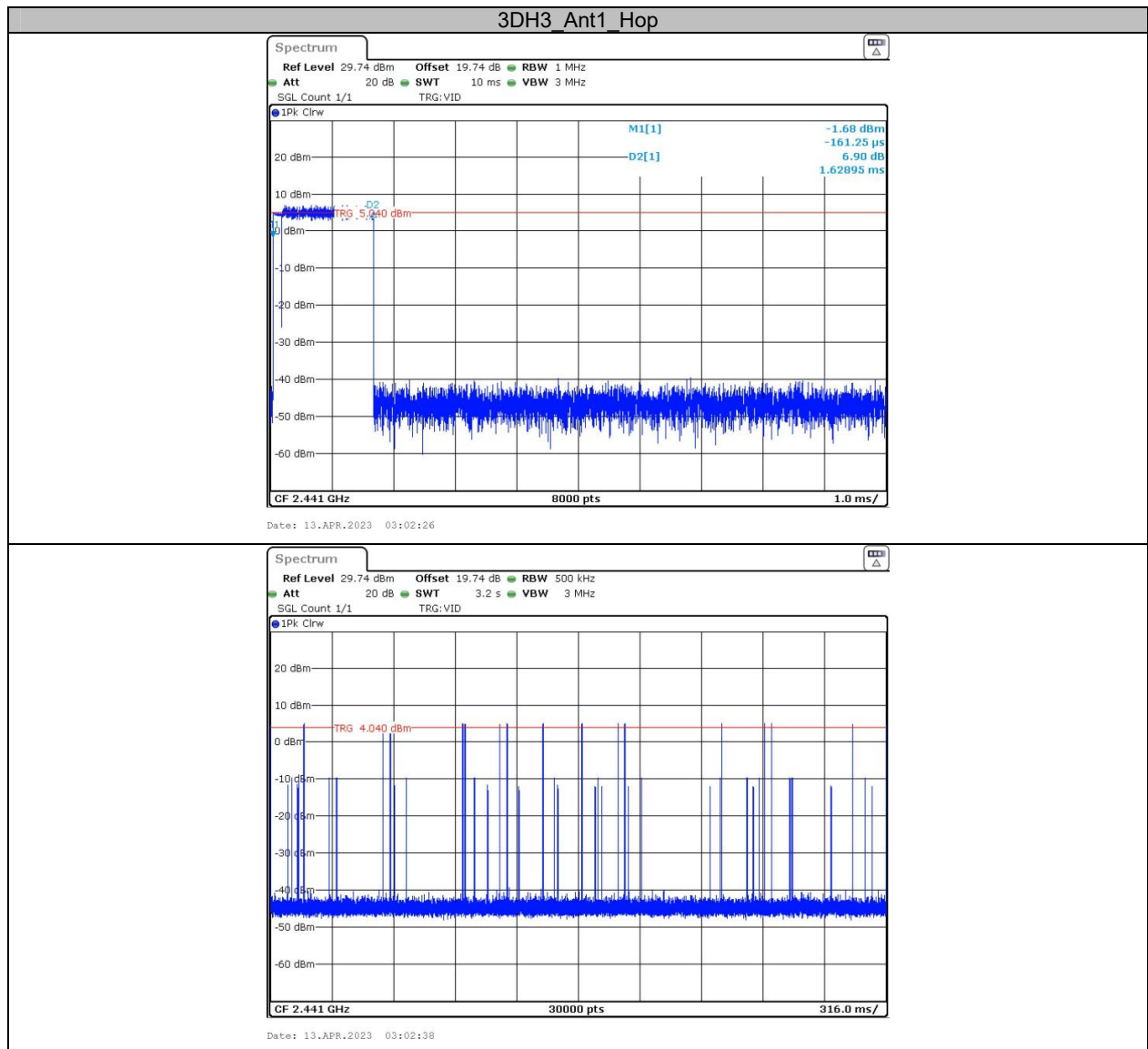


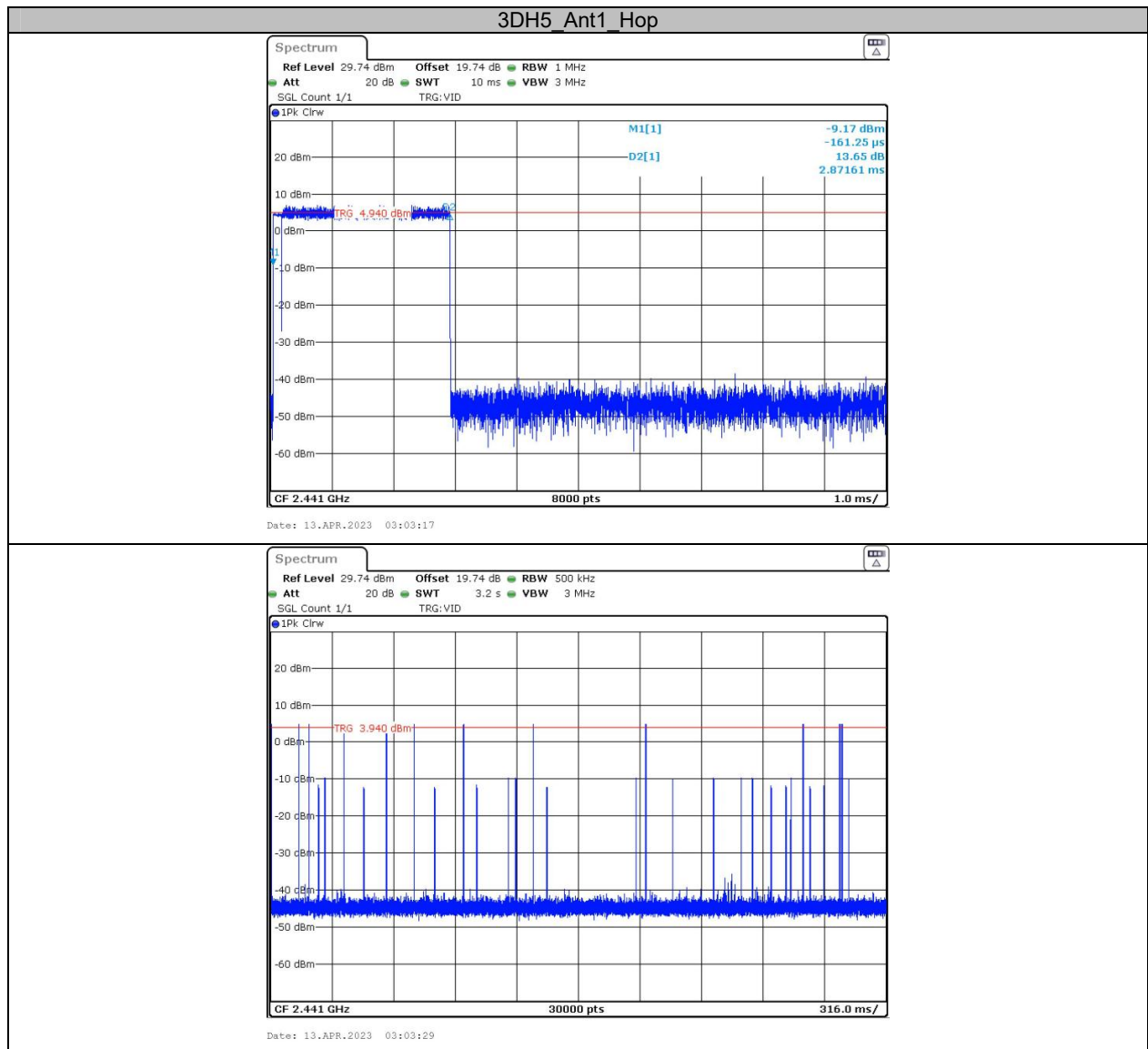






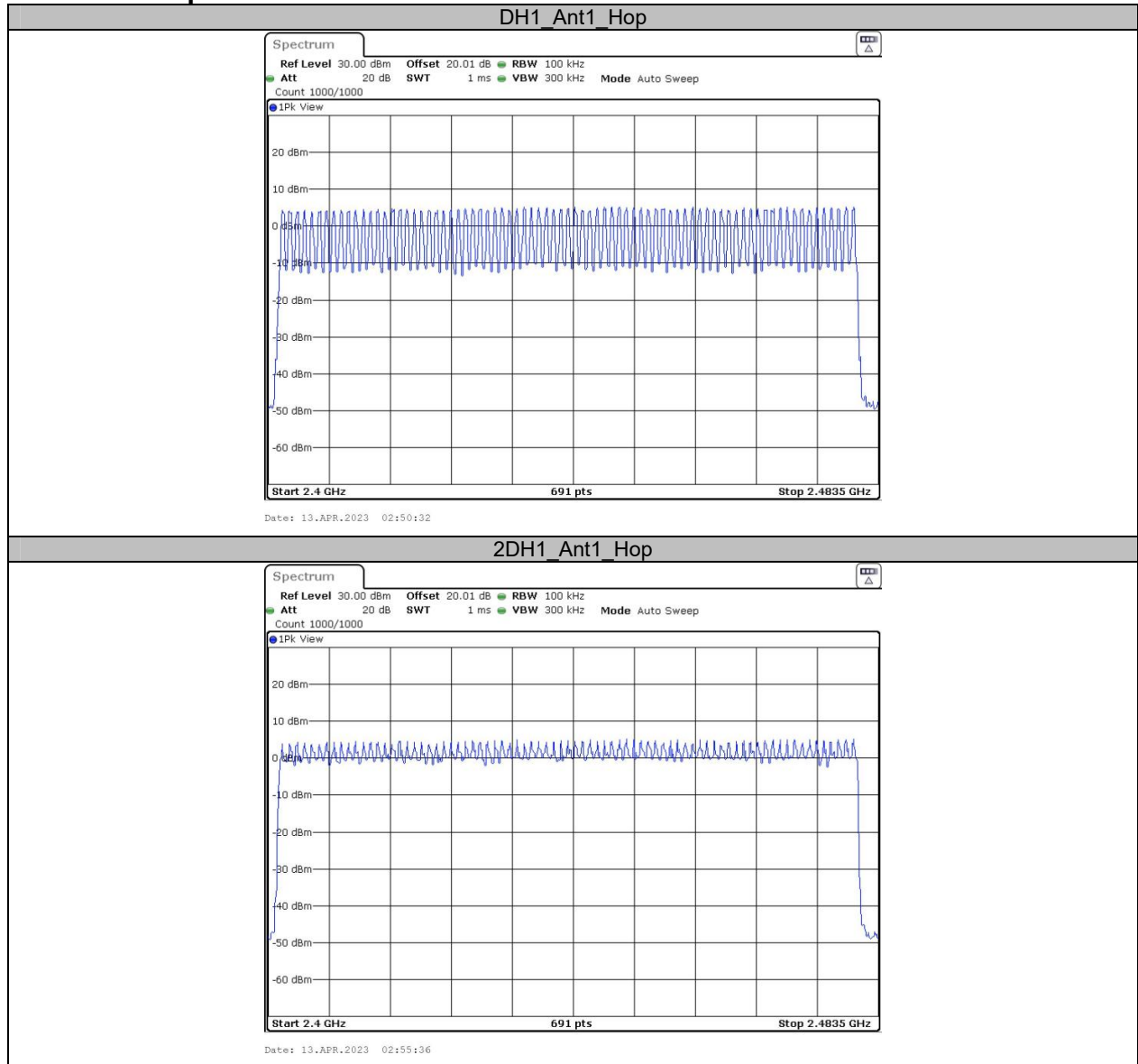


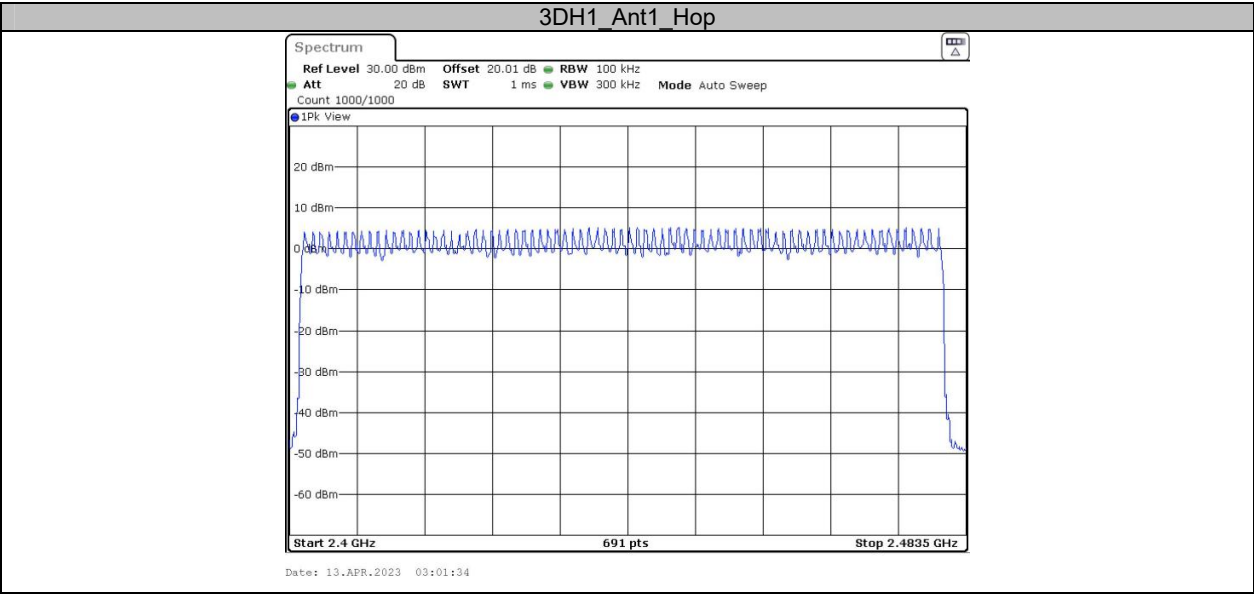




**Appendix F: Number of hopping channels  
Test Result**

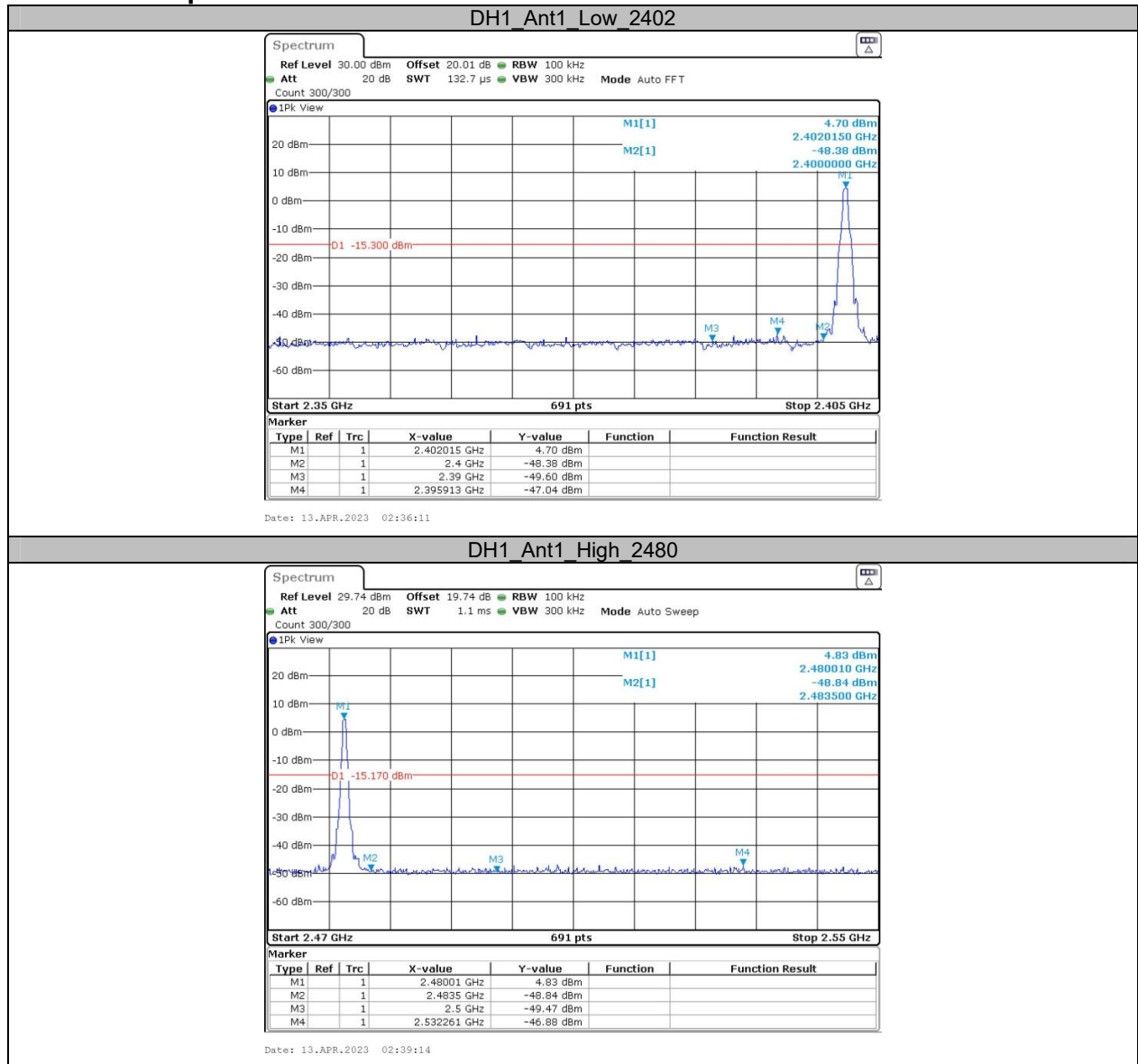
| Test Mode | Antenna | Frequency[MHz] | Result[Num] | Limit[Num] | Verdict |
|-----------|---------|----------------|-------------|------------|---------|
| DH1       | Ant1    | Hop            | 79          | ≥15        | PASS    |
| 2DH1      | Ant1    | Hop            | 79          | ≥15        |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

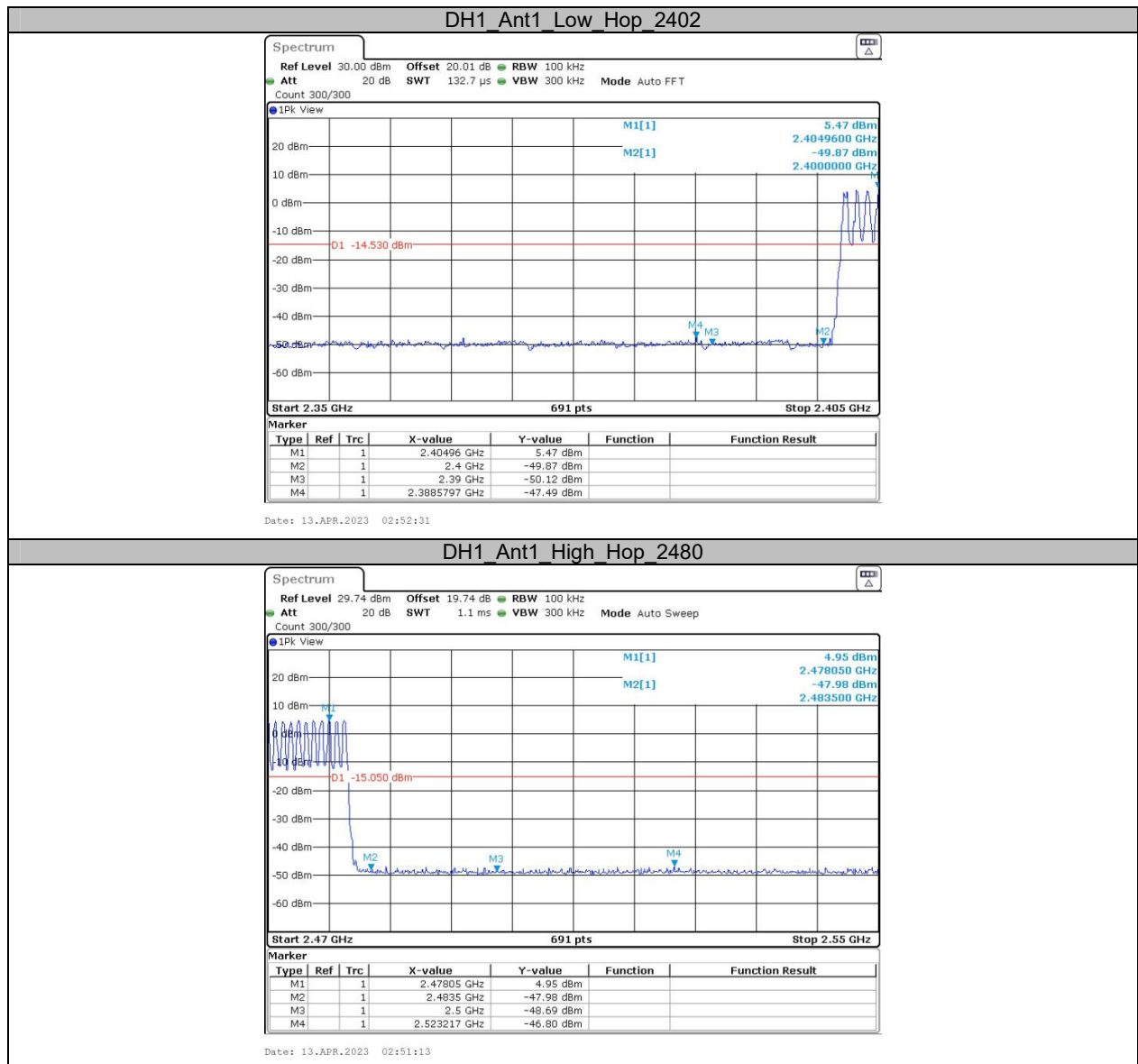
**Test Graphs**

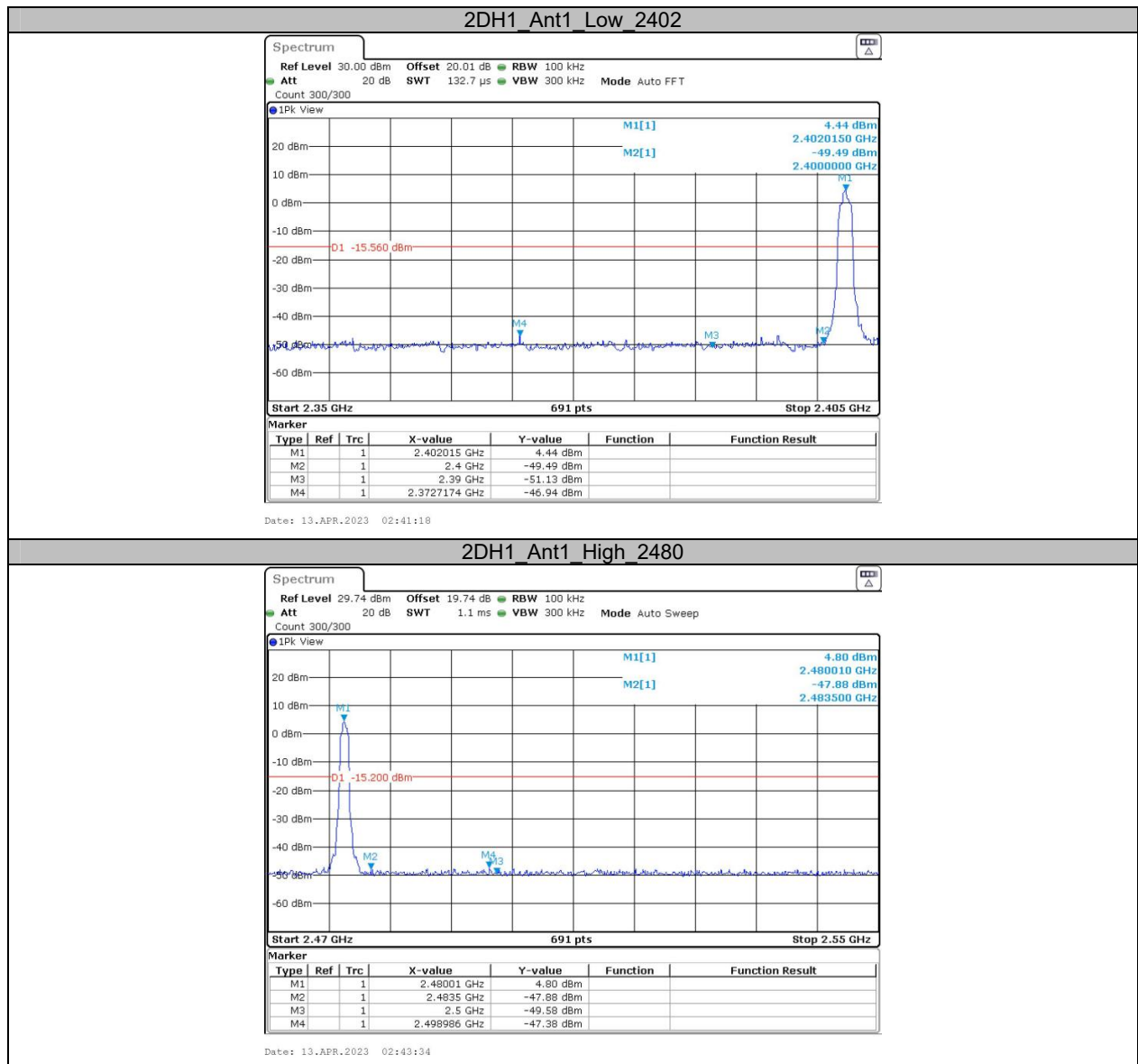


## Appendix G: Band edge measurements

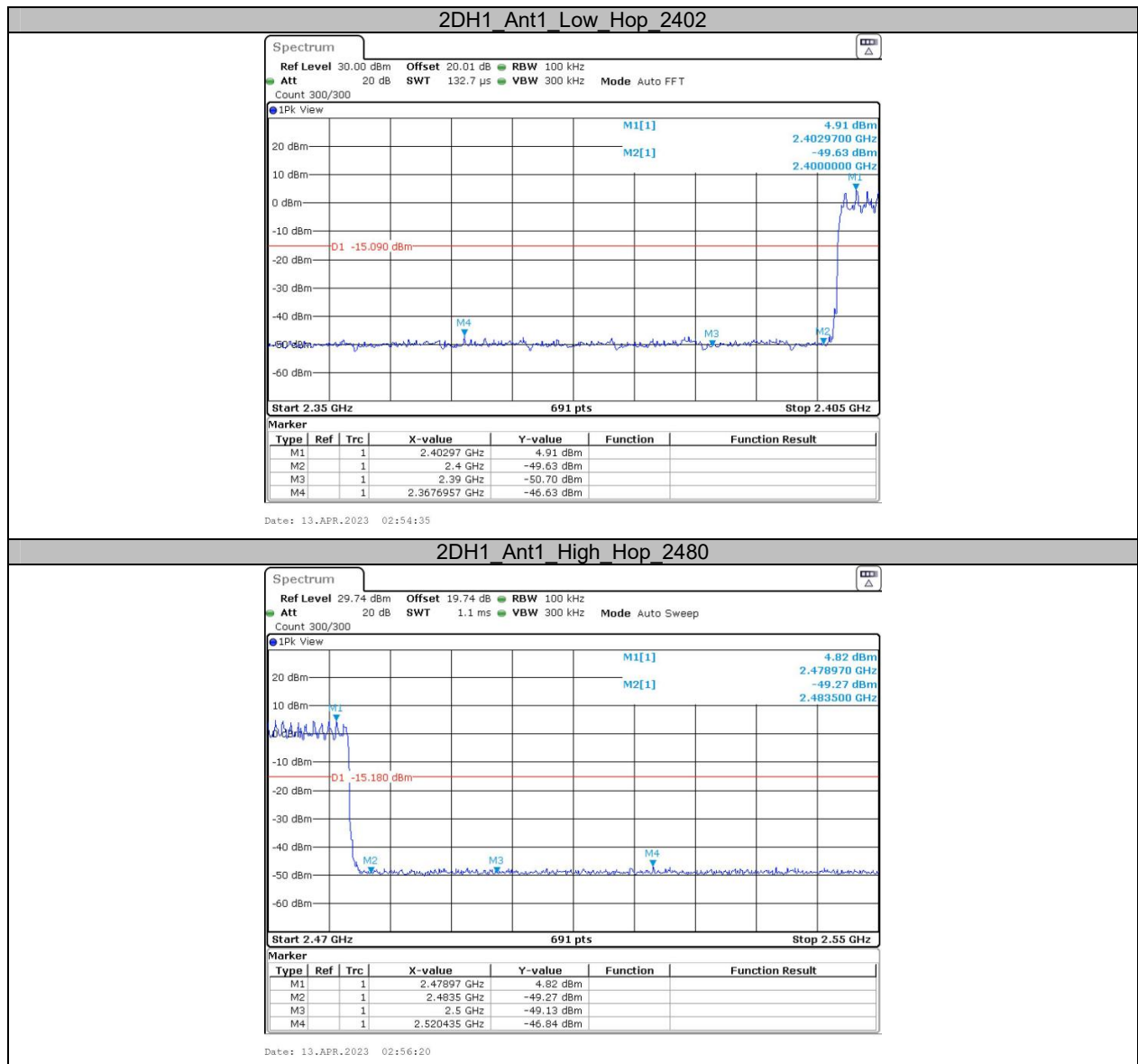
## Test Graphs

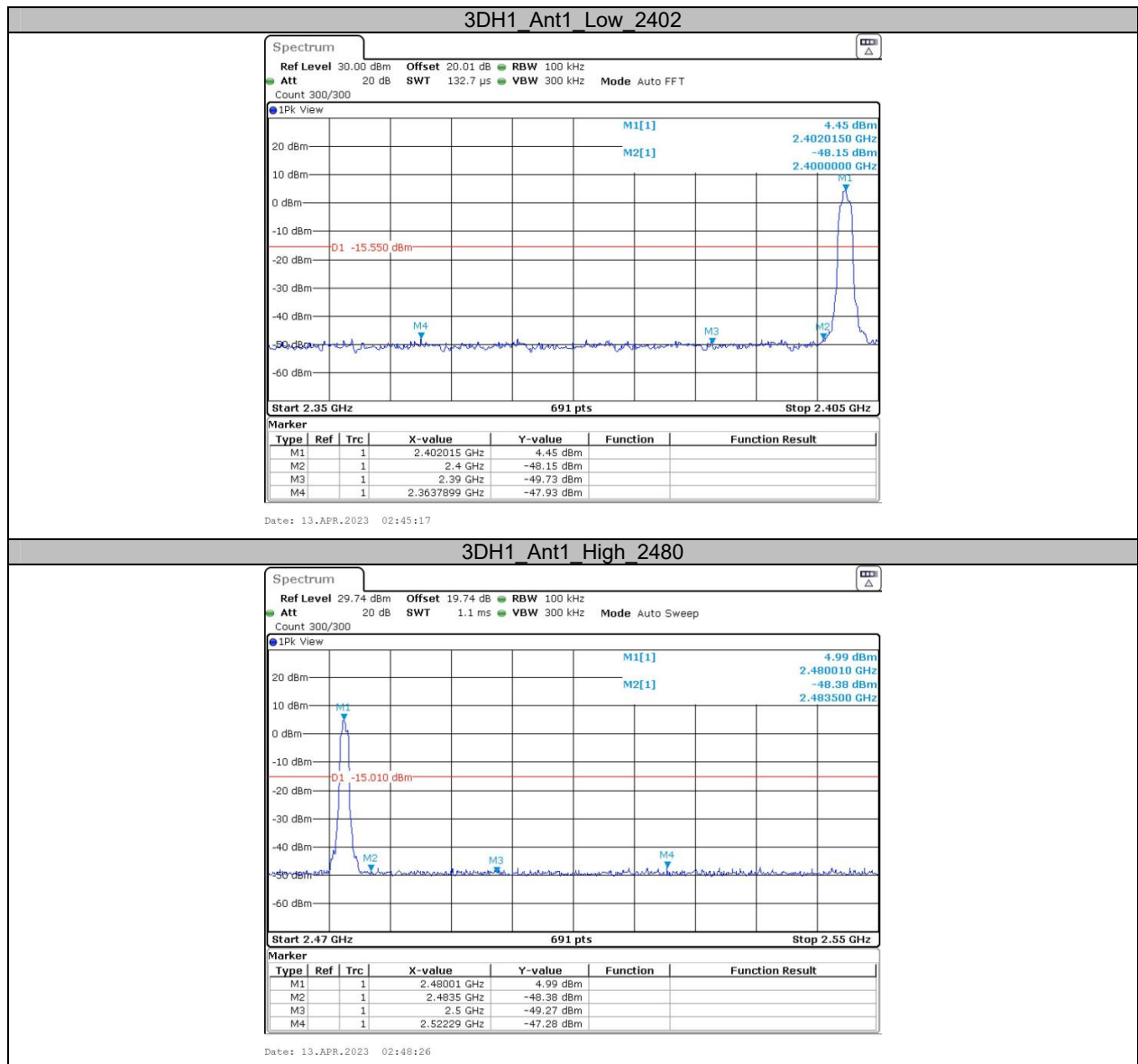


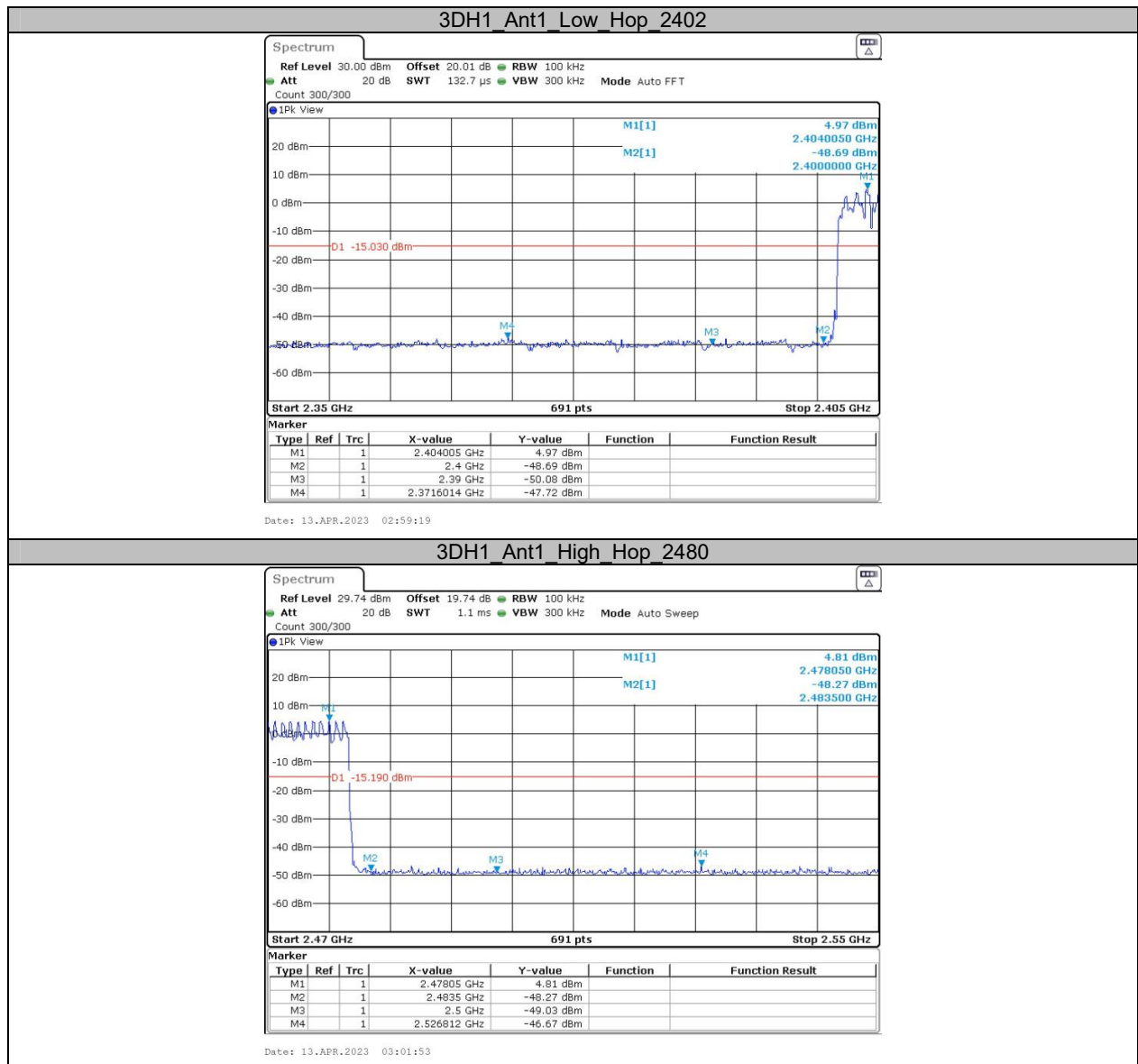












\*\*\*\*\* END OF REPORT \*\*\*\*\*