

## Test Report

**Report No. :** CQASZ20220901646E-01  
**Applicant:** GuangDong Substanbo Technology Co., Ltd.  
**Address of Applicant:** 2008, Building 4, Tianan Cloud Park Phase II, Bantian Street, Longgang District, Shenzhen, China  
**Equipment Under Test (EUT):**  
**Product:** 2.0 CH SOUNDBAR SYSTEM  
**Model No.:** Tapio I Pro  
**Test Model No.:** Tapio I Pro  
**Brand Name:** ULTIMEA  
**FCC ID:** 2AS9D-TAPIOS  
**Standards:** 47 CFR Part 15, Subpart C  
**Date of Receipt:** 2022-09-21  
**Date of Test:** 2022-09-21 to 2022-10-18  
**Date of Issue:** 2022-11-08  
**Test Result :** PASS\*

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

**Tested By:** Lewis Zhou  
( Lewis Zhou )

**Reviewed By:** Timo Lei  
( Timo Lei )

**Approved By:** Jack Ai  
( Jack Ai )



## 1 Version

### Revision History Of Report

| Report No.           | Version | Description    | Issue Date |
|----------------------|---------|----------------|------------|
| CQASZ20220901646E-01 | Rev.01  | Initial report | 2022-11-08 |

## 2 Test Summary

| Test Item                                                         | Test Requirement                                    | Test method        | Result |
|-------------------------------------------------------------------|-----------------------------------------------------|--------------------|--------|
| Antenna Requirement                                               | 47 CFR Part 15, Subpart C Section 15.203/15.247 (c) | ANSI C63.10 (2013) | PASS   |
| AC Power Line Conducted Emission                                  | 47 CFR Part 15, Subpart C Section 15.207            | ANSI C63.10 (2013) | PASS   |
| Conducted Peak Output Power                                       | 47 CFR Part 15, Subpart C Section 15.247 (b)(1)     | ANSI C63.10 (2013) | PASS   |
| 20dB Occupied Bandwidth                                           | 47 CFR Part 15, Subpart C Section 15.247 (a)(1)     | ANSI C63.10 (2013) | PASS   |
| Carrier Frequencies Separation                                    | 47 CFR Part 15, Subpart C Section 15.247 (a)(1)     | ANSI C63.10 (2013) | PASS   |
| Hopping Channel Number                                            | 47 CFR Part 15, Subpart C Section 15.247 (a)(1)     | ANSI C63.10 (2013) | PASS   |
| Dwell Time                                                        | 47 CFR Part 15, Subpart C Section 15.247 (a)(1)     | ANSI C63.10 (2013) | PASS   |
| Pseudorandom Frequency Hopping Sequence                           | 47 CFR Part 15, Subpart C Section 15.247(b)(4)      | ANSI C63.10 (2013) | PASS   |
| Band-edge for RF Conducted Emissions                              | 47 CFR Part 15, Subpart C Section 15.247(d)         | ANSI C63.10 (2013) | PASS   |
| RF Conducted Spurious Emissions                                   | 47 CFR Part 15, Subpart C Section 15.247(d)         | ANSI C63.10 (2013) | PASS   |
| Radiated Spurious emissions                                       | 47 CFR Part 15, Subpart C Section 15.205/15.209     | ANSI C63.10 (2013) | PASS   |
| Restricted bands around fundamental frequency (Radiated Emission) | 47 CFR Part 15, Subpart C Section 15.205/15.209     | ANSI C63.10 (2013) | PASS   |

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## 4 General Information

### 4.1 Client Information

|                          |                                                                                                                                        |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Applicant:               | GuangDong Substanbo Technology Co., Ltd.                                                                                               |
| Address of Applicant:    | 2008, Building 4, Tianan Cloud Park Phase II, Bantian Street, Longgang District, Shenzhen, China                                       |
| Manufacturer:            | GuangDong Substanbo Technology Co., Ltd.                                                                                               |
| Address of Manufacturer: | 2008, Building 4, Tianan Cloud Park Phase II, Bantian Street, Longgang District, Shenzhen, China                                       |
| Factory:                 | Shenzhen Hanhong Digital Technology Co., Ltd                                                                                           |
| Address of Factory:      | Building A Room #303, Huafeng Internet - Innovation Technology Park, Gonghe Industry Road 107#, Xixiang Street, Baoan, Shenzhen, China |

### 4.2 General Description of EUT

|                       |                                                                                                                    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------|
| Product Name:         | 2.0 CH SOUNDBAR SYSTEM                                                                                             |
| Model No.:            | Tapio I Pro                                                                                                        |
| Test Model No.:       | Tapio I Pro                                                                                                        |
| Trade Mark:           | ULTIMEA                                                                                                            |
| Software Version:     | V00001                                                                                                             |
| Hardware Version:     | V00001                                                                                                             |
| Operation Frequency:  | 2402MHz~2480MHz                                                                                                    |
| Bluetooth Version:    | V5.0                                                                                                               |
| Modulation Technique: | Frequency Hopping Spread Spectrum(FHSS)                                                                            |
| Modulation Type:      | GFSK, $\pi/4$ DQPSK, 8DPSK                                                                                         |
| Transfer Rate:        | 1Mbps/2Mbps/3Mbps                                                                                                  |
| Number of Channel:    | 79                                                                                                                 |
| Hopping Channel Type: | Adaptive Frequency Hopping systems                                                                                 |
| Product Type:         | <input checked="" type="checkbox"/> Mobile <input type="checkbox"/> Portable <input type="checkbox"/> Fix Location |
| Test Software of EUT: | FrequencyToolv_0.1.8                                                                                               |
| Antenna Type:         | PCB antenna                                                                                                        |
| Antenna Gain:         | 3.38dBi                                                                                                            |
| Power Supply:         | Power by DC 19V 1.5A for adapter                                                                                   |

| Operation Frequency each of channel |           |         |           |         |           |         |           |
|-------------------------------------|-----------|---------|-----------|---------|-----------|---------|-----------|
| Channel                             | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
| 0                                   | 2402MHz   | 20      | 2422MHz   | 40      | 2442MHz   | 60      | 2462MHz   |
| 1                                   | 2403MHz   | 21      | 2423MHz   | 41      | 2443MHz   | 61      | 2463MHz   |
| 2                                   | 2404MHz   | 22      | 2424MHz   | 42      | 2444MHz   | 62      | 2464MHz   |
| 3                                   | 2405MHz   | 23      | 2425MHz   | 43      | 2445MHz   | 63      | 2465MHz   |
| 4                                   | 2406MHz   | 24      | 2426MHz   | 44      | 2446MHz   | 64      | 2466MHz   |
| 5                                   | 2407MHz   | 25      | 2427MHz   | 45      | 2447MHz   | 65      | 2467MHz   |
| 6                                   | 2408MHz   | 26      | 2428MHz   | 46      | 2448MHz   | 66      | 2468MHz   |
| 7                                   | 2409MHz   | 27      | 2429MHz   | 47      | 2449MHz   | 67      | 2469MHz   |
| 8                                   | 2410MHz   | 28      | 2430MHz   | 48      | 2450MHz   | 68      | 2470MHz   |
| 9                                   | 2411MHz   | 29      | 2431MHz   | 49      | 2451MHz   | 69      | 2471MHz   |
| 10                                  | 2412MHz   | 30      | 2432MHz   | 50      | 2452MHz   | 70      | 2472MHz   |
| 11                                  | 2413MHz   | 31      | 2433MHz   | 51      | 2453MHz   | 71      | 2473MHz   |
| 12                                  | 2414MHz   | 32      | 2434MHz   | 52      | 2454MHz   | 72      | 2474MHz   |
| 13                                  | 2415MHz   | 33      | 2435MHz   | 53      | 2455MHz   | 73      | 2475MHz   |
| 14                                  | 2416MHz   | 34      | 2436MHz   | 54      | 2456MHz   | 74      | 2476MHz   |
| 15                                  | 2417MHz   | 35      | 2437MHz   | 55      | 2457MHz   | 75      | 2477MHz   |
| 16                                  | 2418MHz   | 36      | 2438MHz   | 56      | 2458MHz   | 76      | 2478MHz   |
| 17                                  | 2419MHz   | 37      | 2439MHz   | 57      | 2459MHz   | 77      | 2479MHz   |
| 18                                  | 2420MHz   | 38      | 2440MHz   | 58      | 2460MHz   | 78      | 2480MHz   |
| 19                                  | 2421MHz   | 39      | 2441MHz   | 59      | 2461MHz   |         |           |

Note:

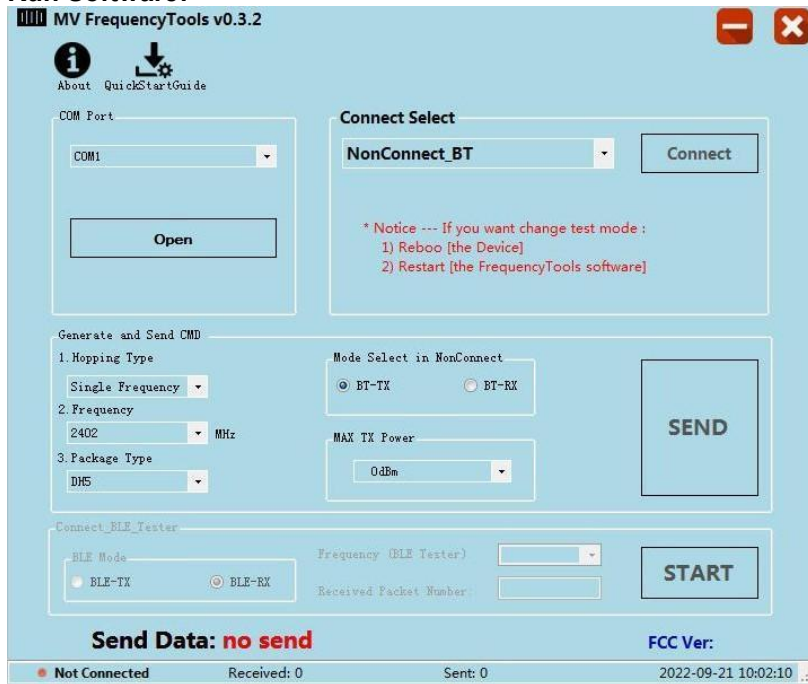
In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| Channel             | Frequency |
|---------------------|-----------|
| The Lowest channel  | 2402MHz   |
| The Middle channel  | 2441MHz   |
| The Highest channel | 2480MHz   |

### 4.3 Additional Instructions

| EUT Test Software Settings:                                                                                                 |                                                                                                                                                                                        |                |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Mode:                                                                                                                       | <input checked="" type="checkbox"/> Special software is used.<br><input type="checkbox"/> Through engineering command into the engineering mode.<br>engineering command: *##3646633##* |                |
| EUT Power level:                                                                                                            | Class2 (Power level is built-in set parameters and cannot be changed and selected)                                                                                                     |                |
| Use test software to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT. |                                                                                                                                                                                        |                |
| Mode                                                                                                                        | Channel                                                                                                                                                                                | Frequency(MHz) |
| DH1/DH3/DH5                                                                                                                 | CH0                                                                                                                                                                                    | 2402           |
|                                                                                                                             | CH39                                                                                                                                                                                   | 2441           |
|                                                                                                                             | CH78                                                                                                                                                                                   | 2480           |
| 2DH1/2DH3/2DH5                                                                                                              | CH0                                                                                                                                                                                    | 2402           |
|                                                                                                                             | CH39                                                                                                                                                                                   | 2441           |
|                                                                                                                             | CH78                                                                                                                                                                                   | 2480           |
| 3DH1/3DH3/3DH5                                                                                                              | CH0                                                                                                                                                                                    | 2402           |
|                                                                                                                             | CH39                                                                                                                                                                                   | 2441           |
|                                                                                                                             | CH78                                                                                                                                                                                   | 2480           |

#### Run Software:



**MV FrequencyTools v0.3.2**

About QuickStartGuide

COM Port: COM1 [Open]

**Connect Select**  
NonConnect\_BT [Connect]

\* Notice --- If you want change test mode :  
1) Reboot [the Device]  
2) Restart [the FrequencyTools software]

**Generate and Send CMD**

1. Hopping Type: Single Frequency  
2. Frequency: 2402 MHz  
3. Package Type: DH5

**Mode Select in NonConnect**  
☒ BT-TX ☐ BT-RX  
 MAX TX Power: 0dBm [SEND]

**Connect\_BLE\_Tester**  
 BLE Mode: ☐ BLE-TX ☒ BLE-RX  
 Frequency (BLE Tester): [ ]  
 Received Packet Number: [ ] [START]

**Send Data: no send** **FCC Ver:**

Not Connected Received: 0 Sent: 0 2022-09-21 10:02:10

#### 4.4 Test Environment

| Operating Environment: |                                                                                                                             |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Temperature:           | 25 °C                                                                                                                       |
| Humidity:              | 54% RH                                                                                                                      |
| Atmospheric Pressure:  | 1009mbar                                                                                                                    |
| Test Mode:             | Use test software to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT. |

#### 4.5 Description of Support Units

The EUT has been tested with associated equipment below.

| Description | Manufacturer | Model No. | Remark | FCC certification |
|-------------|--------------|-----------|--------|-------------------|
| /           | /            | /         | /      | /                 |

#### 4.6 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate.

The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities.

The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the **Shenzhen Huaxia Testing Technology Co., Ltd.** quality system acc. to DIN EN ISO/IEC 17025.

Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CQA laboratory is reported:

| No. | Item                               | Uncertainty        |
|-----|------------------------------------|--------------------|
| 1   | Radiated Emission (Below 1GHz)     | 5.12dB             |
| 2   | Radiated Emission (Above 1GHz)     | 4.60dB             |
| 3   | Conducted Disturbance (0.15~30MHz) | 3.34dB             |
| 4   | Radio Frequency                    | $3 \times 10^{-8}$ |
| 5   | Duty cycle                         | 0.6 %              |
| 6   | Occupied Bandwidth                 | 1.1%               |
| 7   | RF conducted power                 | 0.86dB             |
| 8   | RF power density                   | 0.74               |
| 9   | Conducted Spurious emissions       | 0.86dB             |
| 10  | Temperature test                   | 0.8℃               |
| 11  | Humidity test                      | 2.0%               |
| 12  | Supply voltages                    | 0.5 %              |
| 13  | Frequency Error                    | 5.5 Hz             |

#### 4.7 Test Location

All tests were performed at:

Shenzhen Huaxia Testing Technology Co., Ltd.

1F., Block A of Tongsheng Technology Building, Huahui Road, Dalang Street, Longhua District, Shenzhen, China

#### 4.8 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

**IC Registration No.: 22984-1**

The 3m Semi-anechoic chamber of Shenzhen Huaxia Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

The test facility is recognized, certified, or accredited by the following organizations:

• **CNAS (No. CNAS L5785)**

CNAS has accredited Shenzhen Huaxia Testing Technology Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• **A2LA (Certificate No. 4742.01)**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4742.01.

• **FCC Registration No.: 522263**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.:522263

#### 4.9 Abnormalities from Standard Conditions

None.

#### 4.10 Other Information Requested by the Customer

None.

#### 4.11 Equipment List

| Test Equipment             | Manufacturer | Model No.              | Instrument No. | Calibration Date | Calibration Due Date |
|----------------------------|--------------|------------------------|----------------|------------------|----------------------|
| EMI Test Receiver          | R&S          | ESR7                   | CQA-005        | 2022/9/9         | 2023/9/8             |
| Spectrum analyzer          | R&S          | FSU26                  | CQA-038        | 2022/9/9         | 2023/9/8             |
| Preamplifier               | MITEQ        | AFS4-00010300-18-10P-4 | CQA-035        | 2022/9/9         | 2023/9/8             |
| Preamplifier               | MITEQ        | AMF-6D-02001800-29-20P | CQA-036        | 2022/9/9         | 2023/9/8             |
| Loop antenna               | Schwarzbeck  | FMZB1516               | CQA-087        | 2021/9/16        | 2024/9/15            |
| Bilog Antenna              | R&S          | HL562                  | CQA-011        | 2021/9/16        | 2024/9/15            |
| Horn Antenna               | R&S          | HF906                  | CQA-012        | 2021/9/16        | 2024/9/15            |
| Horn Antenna               | Schwarzbeck  | BBHA 9170              | CQA-088        | 2021/9/16        | 2024/9/15            |
| Coaxial Cable (Above 1GHz) | CQA          | N/A                    | C019           | 2022/9/9         | 2023/9/8             |
| Coaxial Cable (Below 1GHz) | CQA          | N/A                    | C020           | 2022/9/9         | 2023/9/8             |
| Antenna Connector          | CQA          | RFC-01                 | CQA-080        | 2022/9/9         | 2023/9/8             |
| RF cable(9KHz~40GHz)       | CQA          | RF-01                  | CQA-079        | 2022/9/9         | 2023/9/8             |
| Power divider              | MIDWEST      | PWD-2533-02-SMA-79     | CQA-067        | 2022/9/9         | 2023/9/8             |
| EMI Test Receiver          | R&S          | ESPI3                  | CQA-013        | 2022/9/9         | 2023/9/8             |
| LISN                       | R&S          | ENV216                 | CQA-003        | 2022/9/9         | 2023/9/8             |
| Coaxial cable              | CQA          | N/A                    | CQA-C009       | 2022/9/9         | 2023/9/8             |

Note:

The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

## 5 Test results and Measurement Data

### 5.1 Antenna Requirement

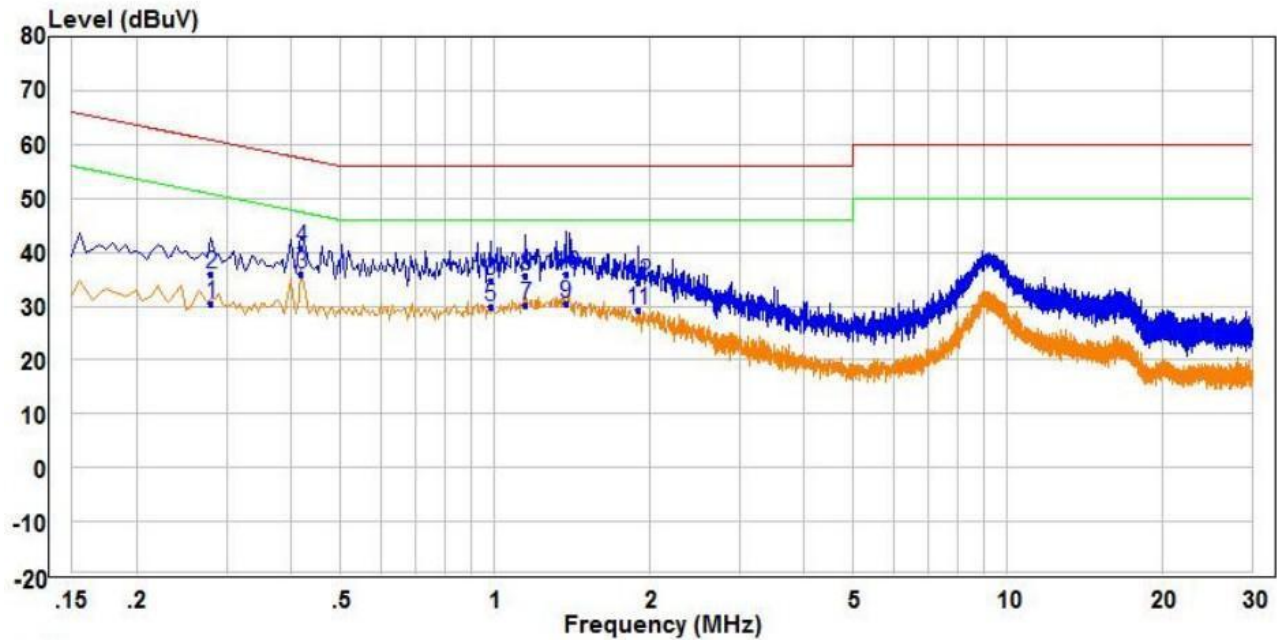
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <b>Standard requirement:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 47 CFR Part 15C Section 15.203 /247(c)                                             |
| <p>15.203 requirement:<br/>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, 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.</p> <p>15.247(b) (4) requirement:<br/>The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.</p> |                                                                                    |
| <b>EUT Antenna:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| <b>The antenna is PCB antenna. The best case gain of the antenna is 3.38 dBi.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                    |



|                        |                                                                                                                                                            |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Exploratory Test Mode: | Non-hopping transmitting mode with all kind of modulation and all kind of data type at the lowest, middle, high channel.                                   |
| Final Test Mode:       | Through Pre-scan, find the DH5 of data type and GFSK modulation at the lowest channel is the worst case.<br>Only the worst case is recorded in the report. |
| Test Voltage:          | AC 120V/60Hz                                                                                                                                               |
| Test Results:          | Pass                                                                                                                                                       |

## Measurement Data

Live line:

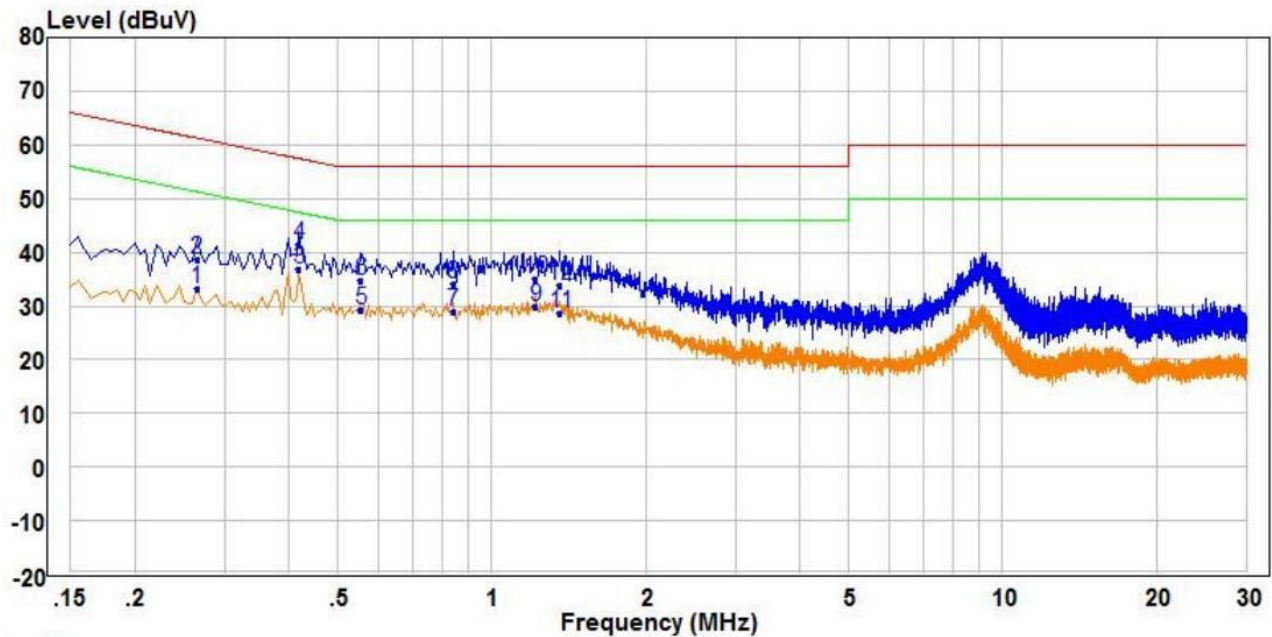


|      | Freq  | Read Level | Factor | Level | Limit Line | Over Limit | Remark  | Pol/Phase |
|------|-------|------------|--------|-------|------------|------------|---------|-----------|
|      | MHz   | dBuV       | dB     | dBuV  | dBuV       | dB         |         |           |
| 1    | 0.280 | 20.83      | 9.51   | 30.34 | 50.82      | -20.48     | Average | Line      |
| 2    | 0.280 | 26.41      | 9.51   | 35.92 | 60.82      | -24.90     | QP      | Line      |
| 3 PP | 0.420 | 26.26      | 9.63   | 35.89 | 47.45      | -11.56     | Average | Line      |
| 4 QP | 0.420 | 31.06      | 9.63   | 40.69 | 57.45      | -16.76     | QP      | Line      |
| 5    | 0.980 | 20.21      | 9.71   | 29.92 | 46.00      | -16.08     | Average | Line      |
| 6    | 0.980 | 24.94      | 9.71   | 34.65 | 56.00      | -21.35     | QP      | Line      |
| 7    | 1.150 | 20.04      | 10.09  | 30.13 | 46.00      | -15.87     | Average | Line      |
| 8    | 1.150 | 25.48      | 10.09  | 35.57 | 56.00      | -20.43     | QP      | Line      |
| 9    | 1.375 | 19.90      | 10.59  | 30.49 | 46.00      | -15.51     | Average | Line      |
| 10   | 1.375 | 25.38      | 10.59  | 35.97 | 56.00      | -20.03     | QP      | Line      |
| 11   | 1.905 | 17.82      | 11.52  | 29.34 | 46.00      | -16.66     | Average | Line      |
| 12   | 1.905 | 22.77      | 11.52  | 34.29 | 56.00      | -21.71     | QP      | Line      |

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level = Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

Neutral line:

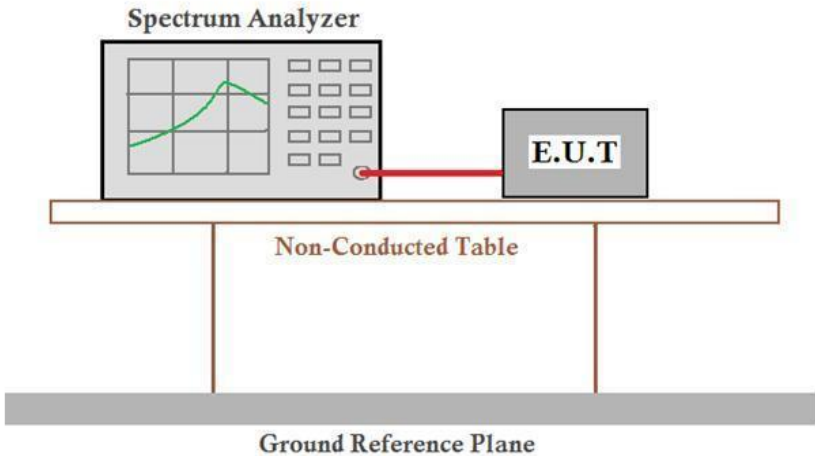


|      | Freq  | Read Level | Factor | Level | Limit Line | Over Limit | Remark  | Pol/Phase |
|------|-------|------------|--------|-------|------------|------------|---------|-----------|
|      | MHz   | dBuV       | dB     | dBuV  | dBuV       | dB         |         |           |
| 1    | 0.265 | 23.55      | 9.52   | 33.07 | 51.27      | -18.20     | Average | Neutral   |
| 2    | 0.265 | 29.15      | 9.52   | 38.67 | 61.27      | -22.60     | QP      | Neutral   |
| 3 PP | 0.420 | 27.36      | 9.62   | 36.98 | 47.45      | -10.47     | Average | Neutral   |
| 4 QP | 0.420 | 31.80      | 9.62   | 41.42 | 57.45      | -16.03     | QP      | Neutral   |
| 5    | 0.555 | 19.51      | 9.76   | 29.27 | 46.00      | -16.73     | Average | Neutral   |
| 6    | 0.555 | 25.03      | 9.76   | 34.79 | 56.00      | -21.21     | QP      | Neutral   |
| 7    | 0.840 | 19.17      | 9.81   | 28.98 | 46.00      | -17.02     | Average | Neutral   |
| 8    | 0.840 | 24.32      | 9.81   | 34.13 | 56.00      | -21.87     | QP      | Neutral   |
| 9    | 1.220 | 20.05      | 9.71   | 29.76 | 46.00      | -16.24     | Average | Neutral   |
| 10   | 1.220 | 25.27      | 9.71   | 34.98 | 56.00      | -21.02     | QP      | Neutral   |
| 11   | 1.360 | 19.00      | 9.72   | 28.72 | 46.00      | -17.28     | Average | Neutral   |
| 12   | 1.360 | 24.11      | 9.72   | 33.83 | 56.00      | -22.17     | QP      | Neutral   |

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

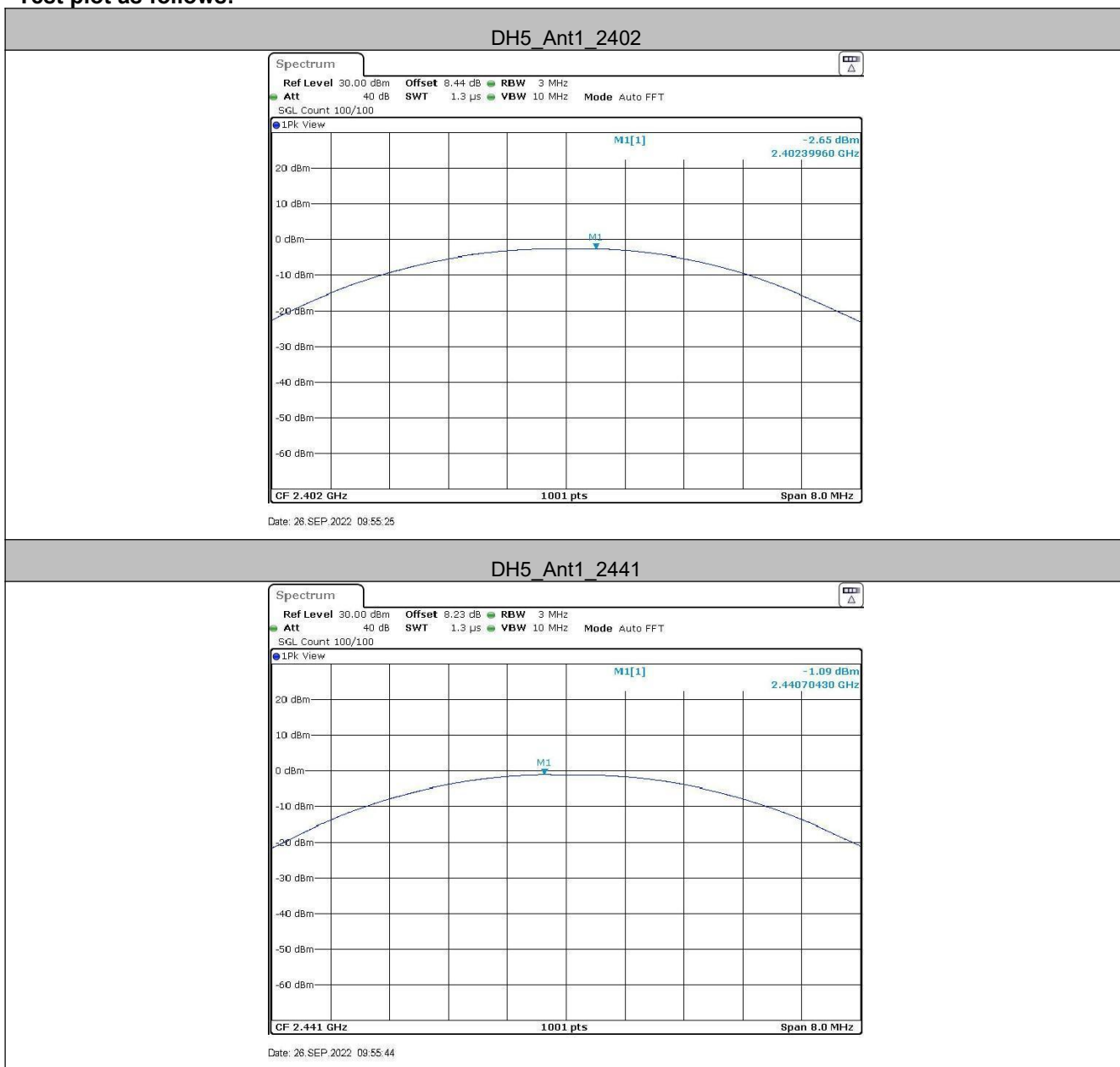
### 5.3 Conducted Peak Output Power

|                        |                                                                                                                                                                                                                                                                                |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (b)(1)                                                                                                                                                                                                                                          |
| Test Method:           | ANSI C63.10:2013                                                                                                                                                                                                                                                               |
| Test Setup:            |  <p>Remark: Offset=Cable loss+ attenuation factor.</p>                                                                                                                                       |
| Limit:                 | 21dBm                                                                                                                                                                                                                                                                          |
| Exploratory Test Mode: | Non-hopping transmitting with all kind of modulation and all kind of data type                                                                                                                                                                                                 |
| Final Test Mode:       | Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.<br>Only the worst case is recorded in the report. |
| Test Results:          | Pass                                                                                                                                                                                                                                                                           |

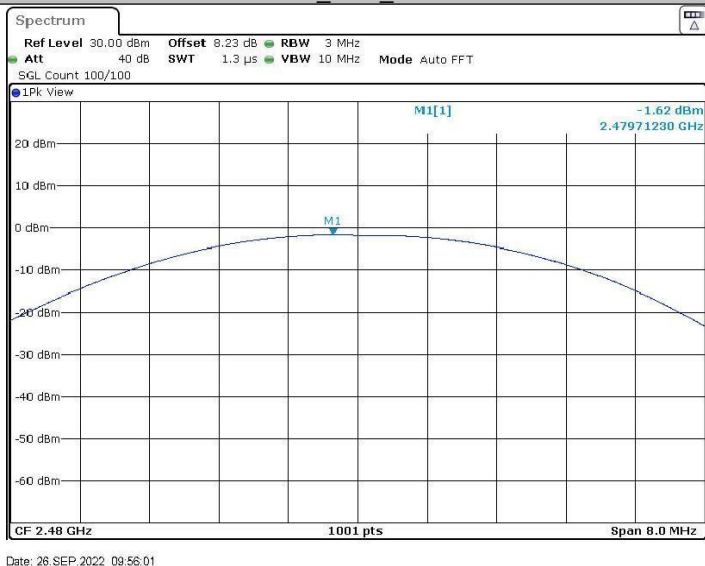
## Measurement Data

| TestMode | Antenna | Channel | Result[dBm] | Limit[dBm] | Verdict |
|----------|---------|---------|-------------|------------|---------|
| DH5      | Ant1    | 2402    | -2.65       | ≤30        | PASS    |
|          |         | 2441    | -1.09       | ≤30        | PASS    |
|          |         | 2480    | -1.62       | ≤30        | PASS    |
| 2DH5     | Ant1    | 2402    | -1.19       | ≤30        | PASS    |
|          |         | 2441    | 0.96        | ≤30        | PASS    |
|          |         | 2480    | 0.1         | ≤30        | PASS    |
| 3DH5     | Ant1    | 2402    | -1.12       | ≤30        | PASS    |
|          |         | 2441    | 1.01        | ≤30        | PASS    |
|          |         | 2480    | 0.69        | ≤30        | PASS    |

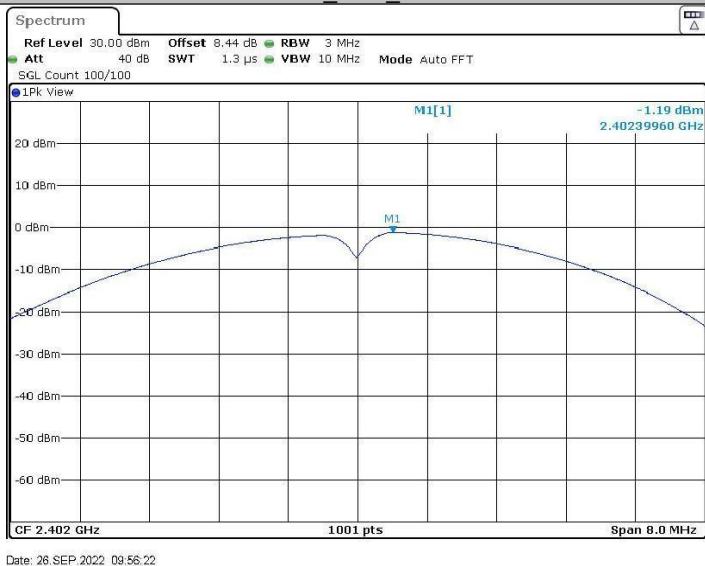
Test plot as follows:



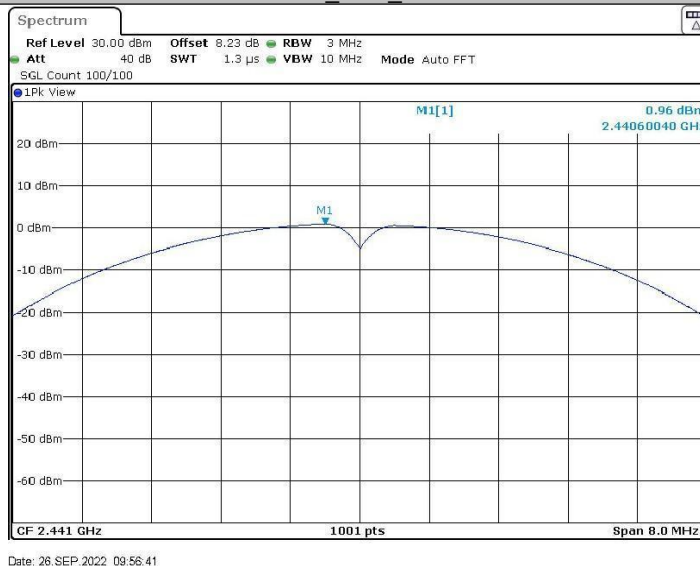
DH5\_Ant1\_2480



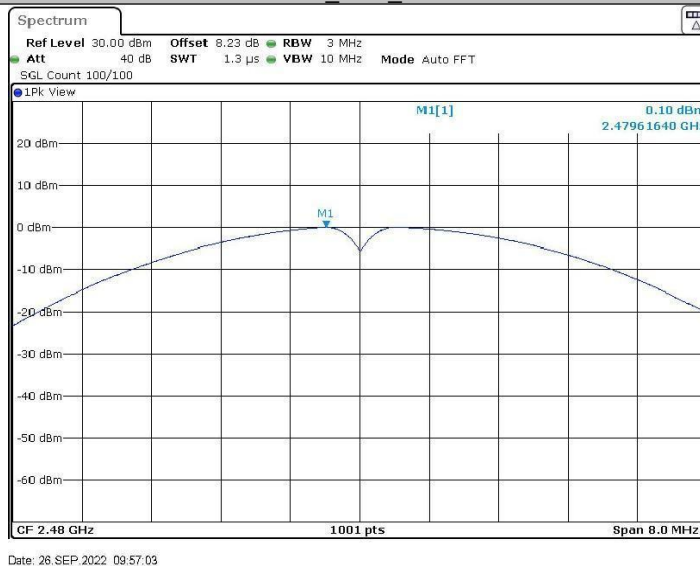
2DH5\_Ant1\_2402



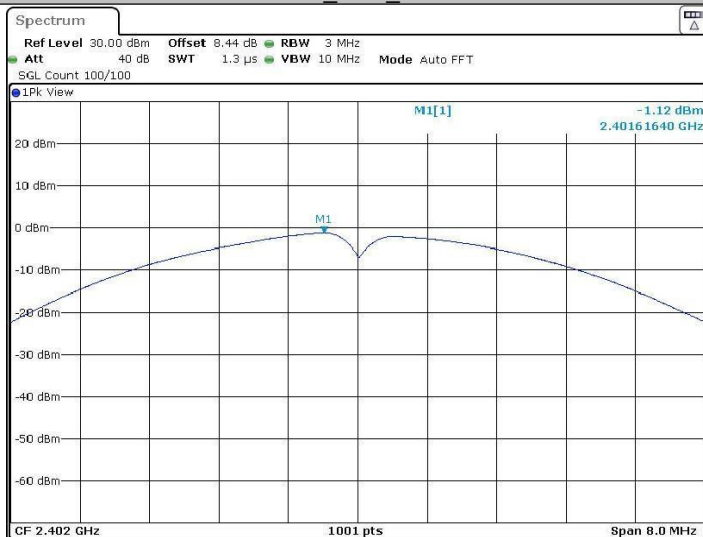
2DH5\_Ant1\_2441



2DH5\_Ant1\_2480

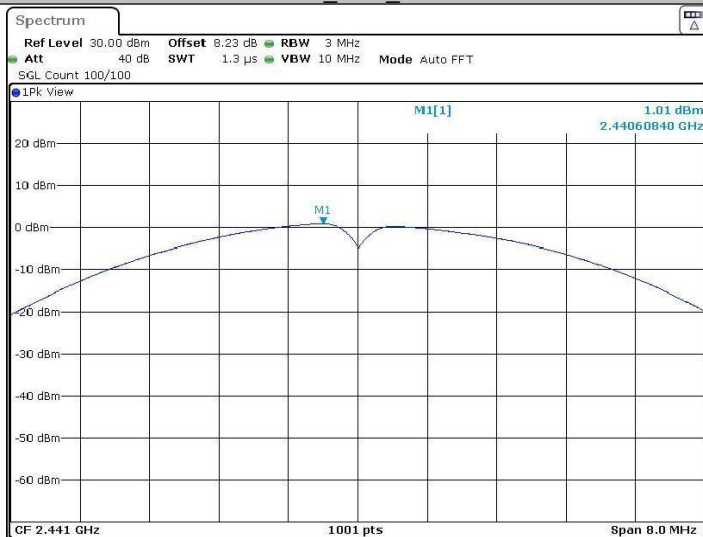


3DH5\_Ant1\_2402



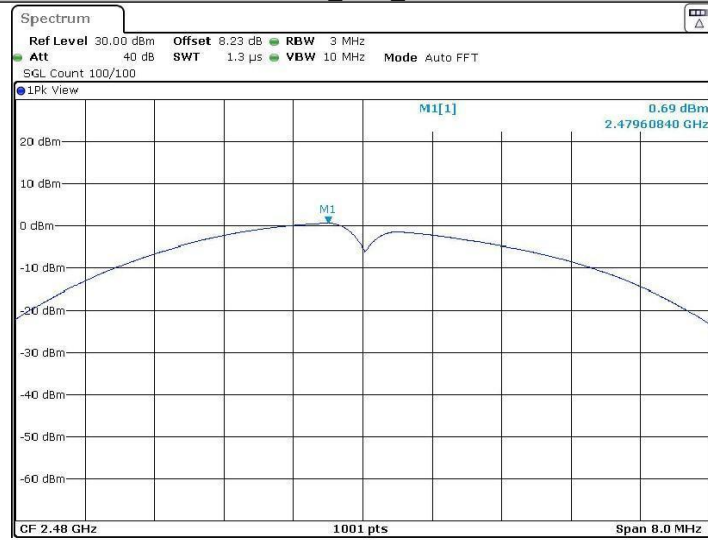
Date: 26 SEP 2022 09:57:22

3DH5\_Ant1\_2441



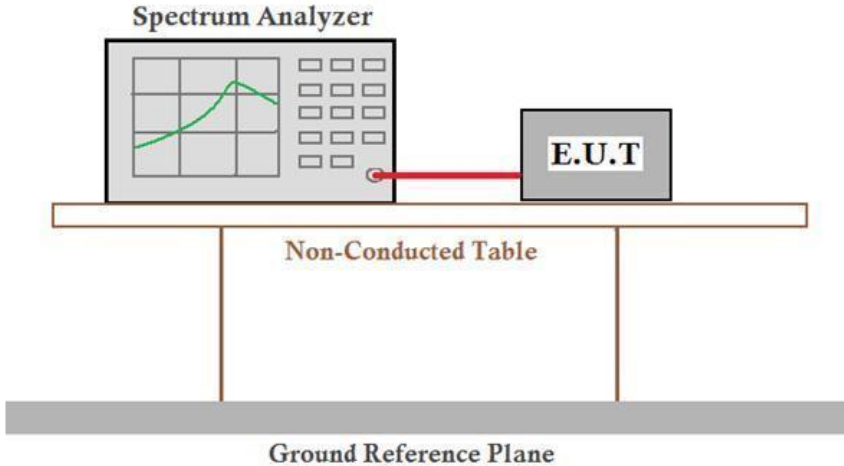
Date: 26 SEP 2022 09:57:41

3DH5\_Ant1\_2480



Date: 26 SEP 2022 09:58:00

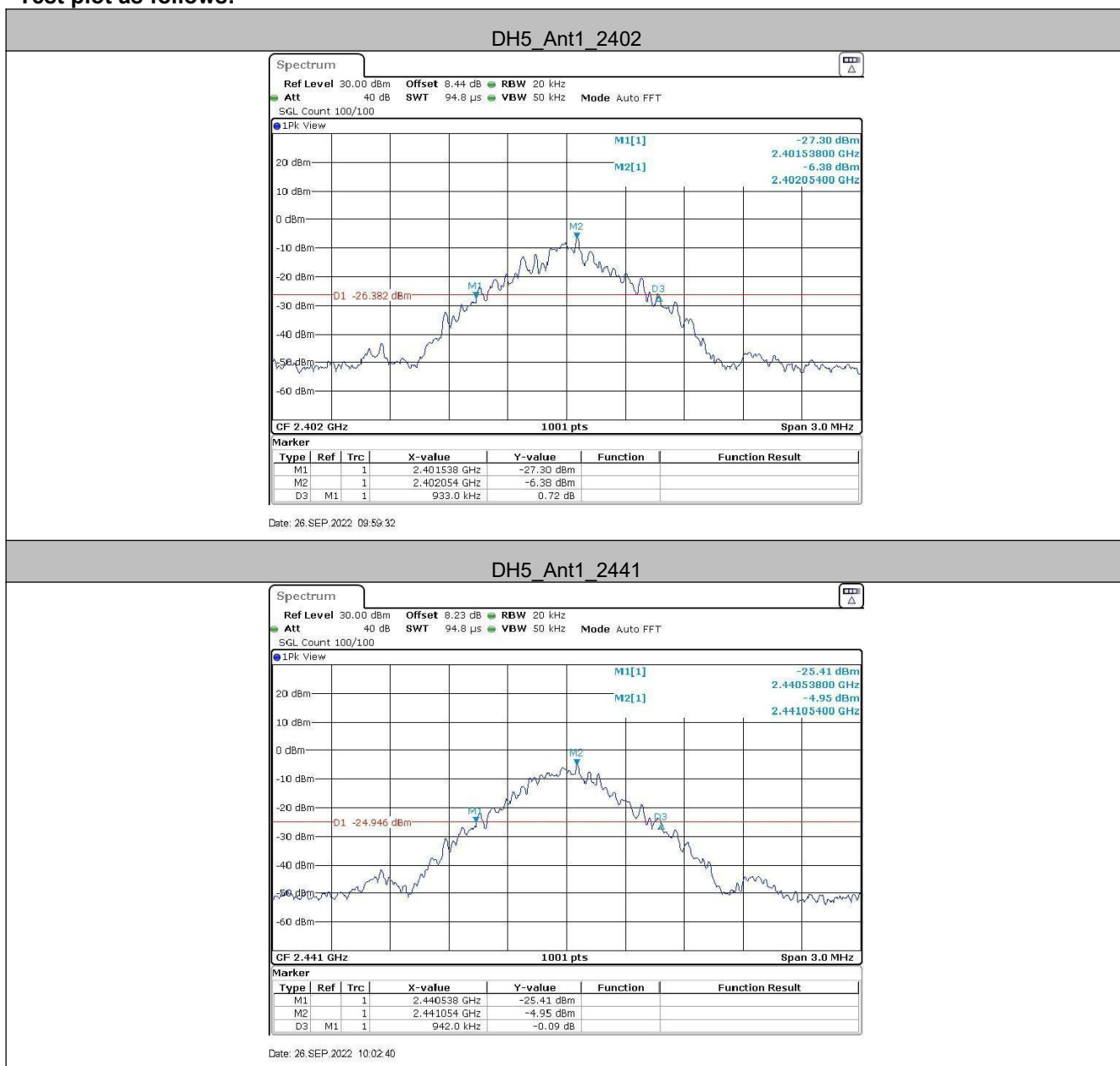
## 5.4 20dB Occupy Bandwidth

|                        |                                                                                                                                                                                                                                                                                |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (a)(1)                                                                                                                                                                                                                                          |
| Test Method:           | ANSI C63.10:2013                                                                                                                                                                                                                                                               |
| Test Setup:            |  <p>Remark: Offset=Cable loss+ attenuation factor.</p>                                                                                                                                       |
| Limit:                 | NA                                                                                                                                                                                                                                                                             |
| Exploratory Test Mode: | Non-hopping transmitting with all kind of modulation and all kind of data type                                                                                                                                                                                                 |
| Final Test Mode:       | Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.<br>Only the worst case is recorded in the report. |
| Test Results:          | Pass                                                                                                                                                                                                                                                                           |

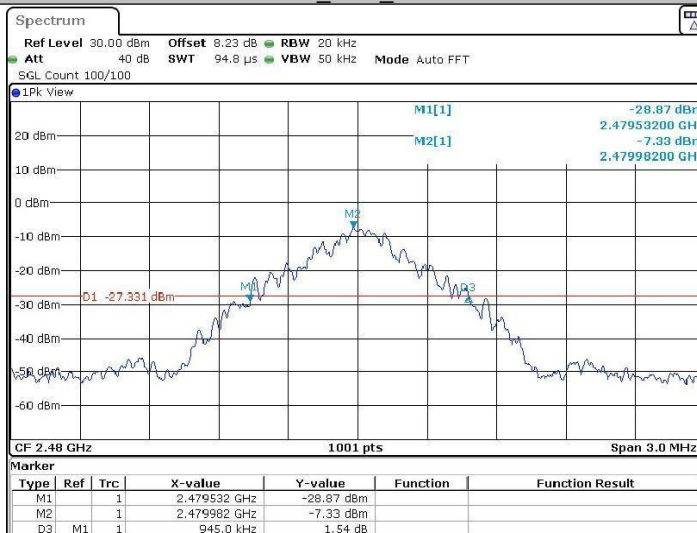
### Measurement Data

| TestMode | Antenna | Channel | 20db<br>EBW[MHz] | FL[MHz]  | FH[MHz]  | Limit[MHz] | Verdict |
|----------|---------|---------|------------------|----------|----------|------------|---------|
| DH5      | Ant1    | 2402    | 0.933            | 2401.538 | 2402.471 | ---        | PASS    |
|          |         | 2441    | 0.942            | 2440.538 | 2441.480 | ---        | PASS    |
|          |         | 2480    | 0.945            | 2479.532 | 2480.477 | ---        | PASS    |
| 2DH5     | Ant1    | 2402    | 1.332            | 2401.331 | 2402.663 | ---        | PASS    |
|          |         | 2441    | 1.320            | 2440.340 | 2441.660 | ---        | PASS    |
|          |         | 2480    | 1.353            | 2479.322 | 2480.675 | ---        | PASS    |
| 3DH5     | Ant1    | 2402    | 1.329            | 2401.331 | 2402.660 | ---        | PASS    |
|          |         | 2441    | 1.281            | 2440.355 | 2441.636 | ---        | PASS    |
|          |         | 2480    | 1.281            | 2479.355 | 2480.636 | ---        | PASS    |

Test plot as follows:

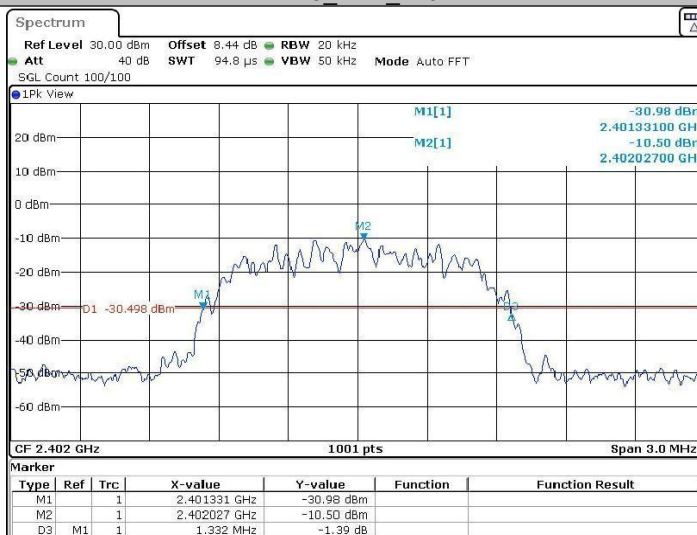


DH5\_Ant1\_2480



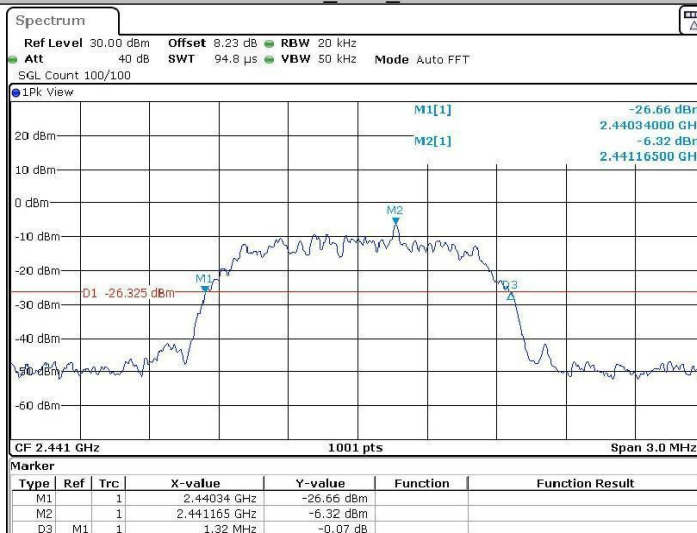
Date: 26.SEP.2022 10:04:31

2DH5\_Ant1\_2402



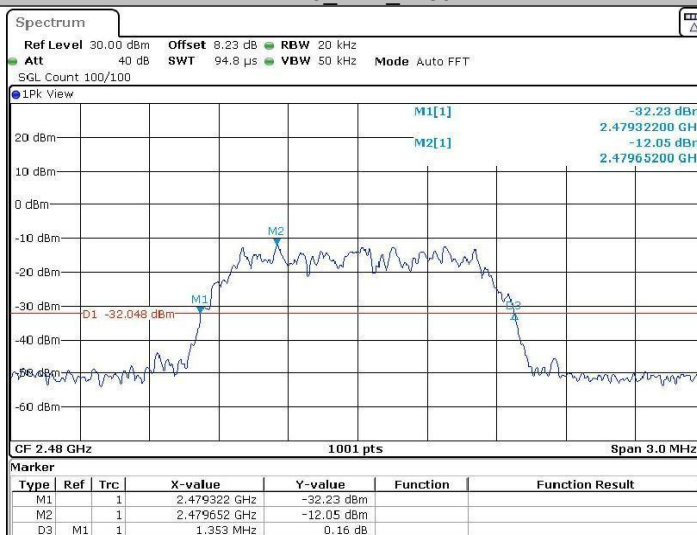
Date: 26.SEP.2022 10:07:45

2DH5\_Ant1\_2441



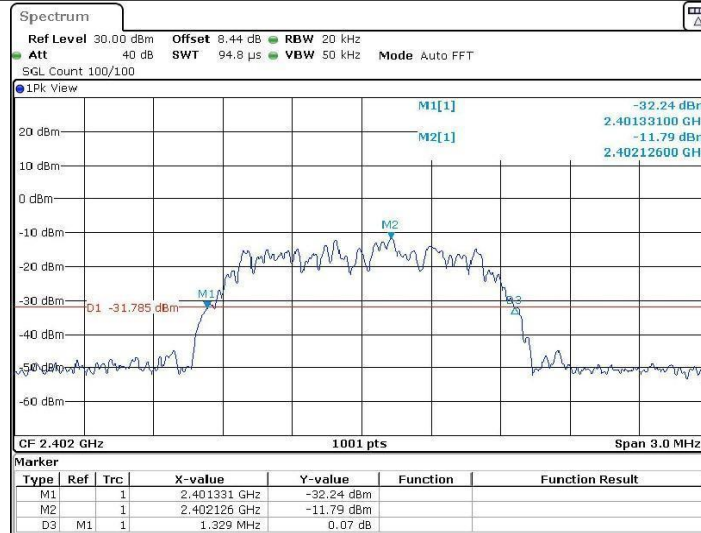
Date: 26.SEP.2022 10:12:42

2DH5\_Ant1\_2480



Date: 26.SEP.2022 10:13:56

3DH5\_Ant1\_2402



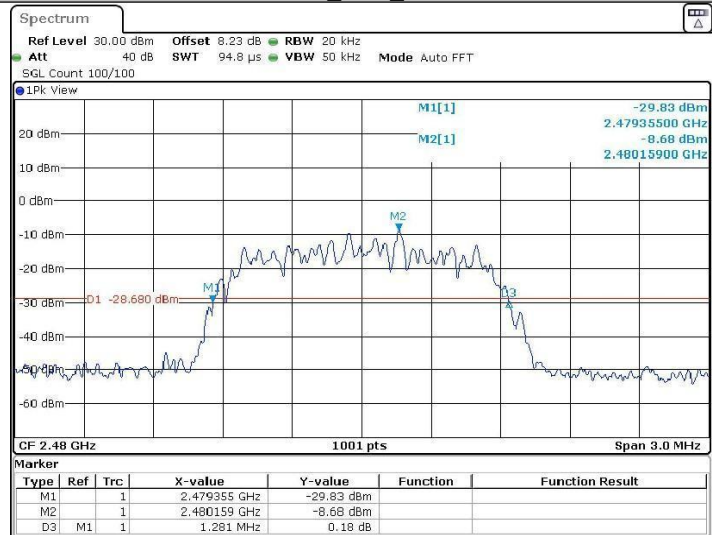
Date: 26.SEP.2022 10:18:07

3DH5\_Ant1\_2441



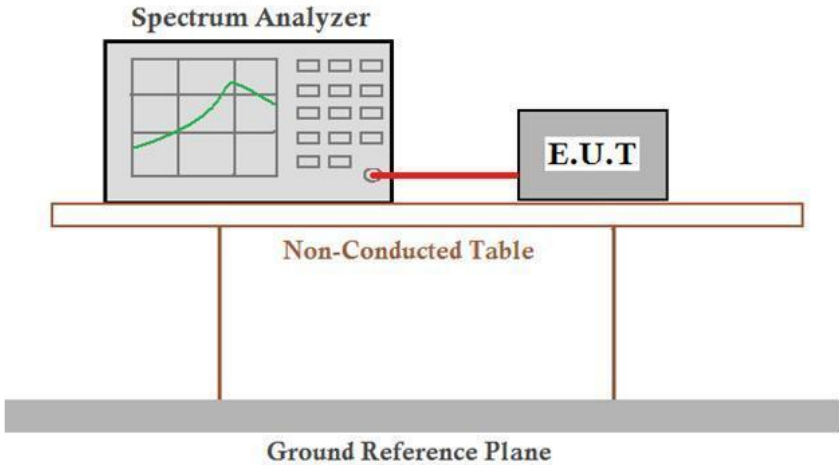
Date: 26.SEP.2022 10:24:42

3DH5\_Ant1\_2480



Date: 26 SEP 2022 10:26:07

## 5.5 Carrier Frequencies Separation

|                        |                                                                                                                                                                                                                                                                                |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (a)(1)                                                                                                                                                                                                                                          |
| Test Method:           | ANSI C63.10:2013                                                                                                                                                                                                                                                               |
| Test Setup:            |  <p>Remark: Offset=Cable loss+ attenuation factor.</p>                                                                                                                                       |
| Limit:                 | 2/3 of the 20dB bandwidth                                                                                                                                                                                                                                                      |
|                        | Remark: the transmission power is less than 0.125W.                                                                                                                                                                                                                            |
| Exploratory Test Mode: | Hopping transmitting with all kind of modulation and all kind of data type                                                                                                                                                                                                     |
| Final Test Mode:       | Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.<br>Only the worst case is recorded in the report. |
| Test Results:          | Pass                                                                                                                                                                                                                                                                           |

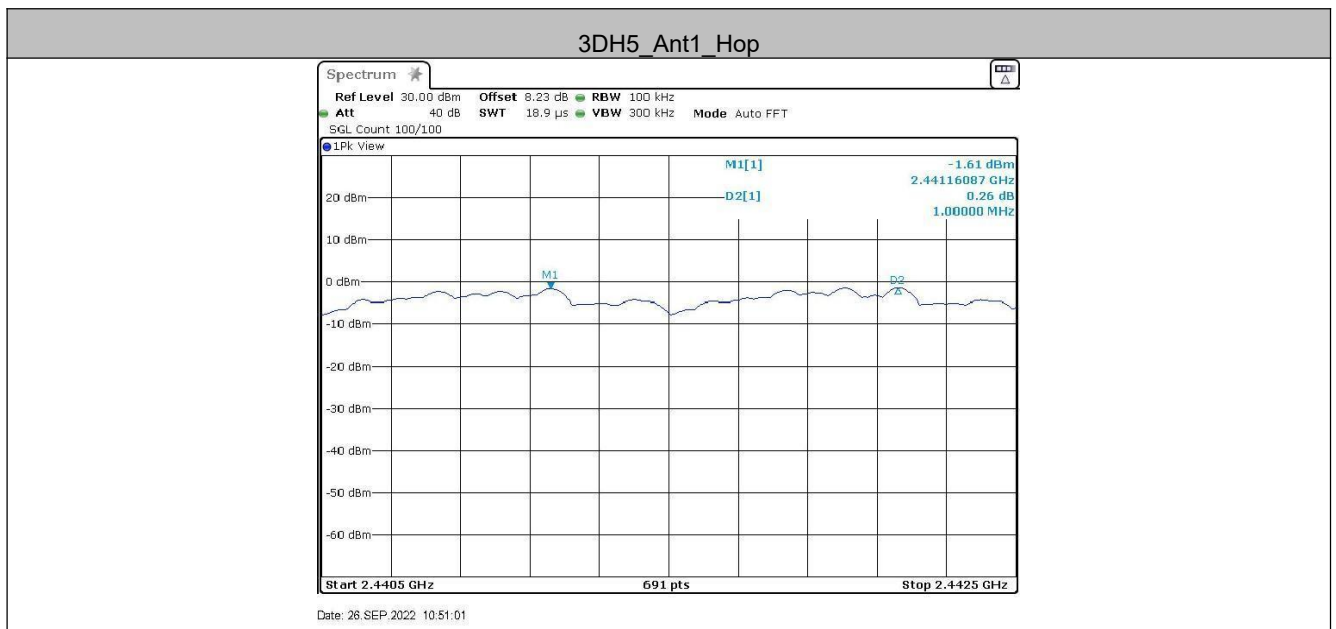
**Measurement Data**

| TestMode | Antenna | Channel | Result[MHz] | Limit[MHz] | Verdict |
|----------|---------|---------|-------------|------------|---------|
| DH5      | Ant1    | Hop     | 1.003       | ≥0.630     | PASS    |
| 2DH5     | Ant1    | Hop     | 1           | ≥0.902     | PASS    |
| 3DH5     | Ant1    | Hop     | 1           | ≥0.886     | PASS    |

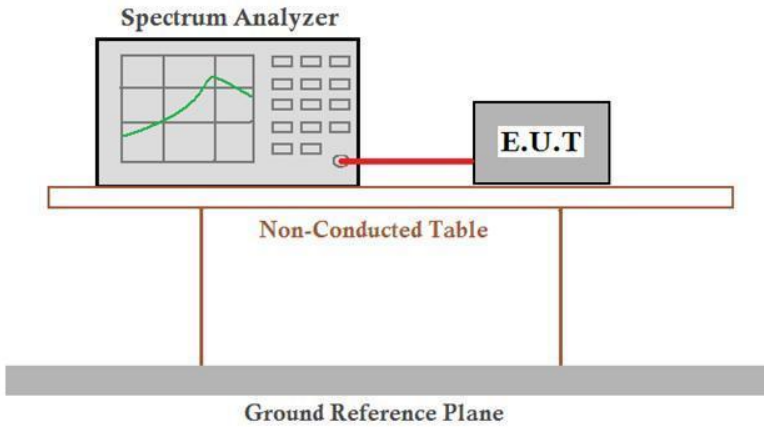
| Mode          | 20dB bandwidth (MHz)<br>(worse case) | Limit (MHz)<br>(Carrier Frequencies Separation) |
|---------------|--------------------------------------|-------------------------------------------------|
| GFSK          | 0.945                                | 0.630                                           |
| $\pi/4$ DQPSK | 1.353                                | 0.902                                           |
| 8DPSK         | 1.329                                | 0.886                                           |

Test plot as follows:





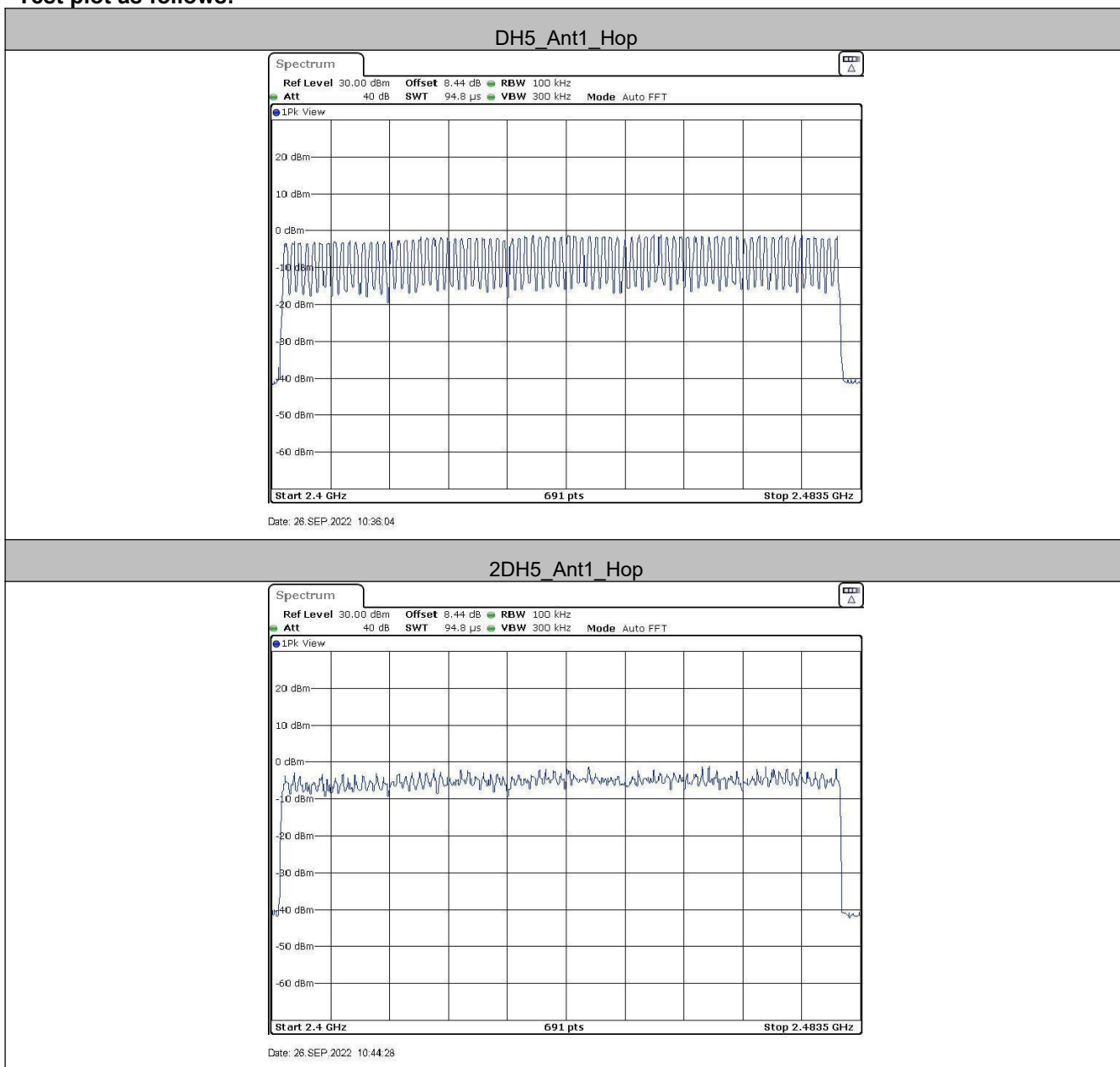
## 5.6 Hopping Channel Number

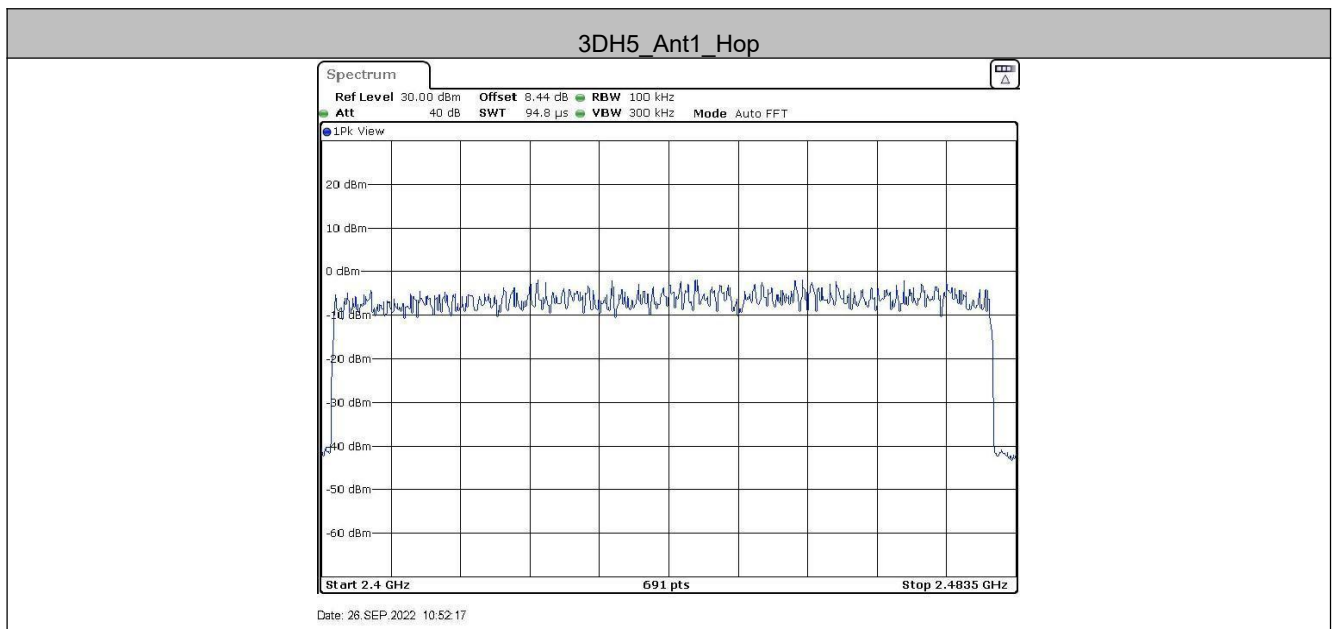
|                        |                                                                                                                                                                                                                                                                                |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (a)(1)                                                                                                                                                                                                                                          |
| Test Method:           | ANSI C63.10:2013                                                                                                                                                                                                                                                               |
| Test Setup:            |  <p>Remark: Offset=Cable loss+ attenuation factor.</p>                                                                                                                                       |
| Limit:                 | At least 15 channels                                                                                                                                                                                                                                                           |
| Exploratory Test Mode: | hopping transmitting with all kind of modulation and all kind of data type                                                                                                                                                                                                     |
| Final Test Mode:       | Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.<br>Only the worst case is recorded in the report. |
| Test Results:          | Pass                                                                                                                                                                                                                                                                           |

### Measurement Data

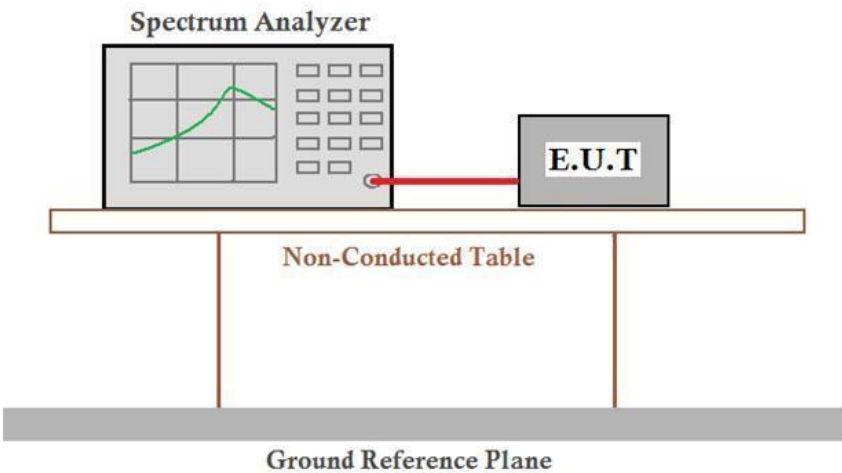
| TestMode | Antenna | Channel | Result[Num] | Limit[Num] | Verdict |
|----------|---------|---------|-------------|------------|---------|
| DH5      | Ant1    | Hop     | 79          | $\geq 15$  | PASS    |
| 2DH5     | Ant1    | Hop     | 79          | $\geq 15$  | PASS    |
| 3DH5     | Ant1    | Hop     | 79          | $\geq 15$  | PASS    |

Test plot as follows:





## 5.7 Dwell Time

|                   |                                                                                                                                                 |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(1)                                                                                                           |
| Test Method:      | ANSI C63.10:2013                                                                                                                                |
| Test Setup:       |  <p><i>Remark: Offset=Cable loss+ attenuation factor.</i></p> |
| Test Mode:        | Hopping transmitting with all kind of modulation and all kind of data type.                                                                     |
| Limit:            | 0.4 Second                                                                                                                                      |
| Test Results:     | Pass                                                                                                                                            |

#### Measurement Data

| TestMode | 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               | 170                | 0.278     | ≤0.4     | PASS    |
| DH5      | Ant1    | Hop     | 2.87               | 80                 | 0.23      | ≤0.4     | PASS    |
| 2DH1     | Ant1    | Hop     | 0.39               | 320                | 0.124     | ≤0.4     | PASS    |
| 2DH3     | Ant1    | Hop     | 1.63               | 170                | 0.277     | ≤0.4     | PASS    |
| 2DH5     | Ant1    | Hop     | 2.87               | 120                | 0.345     | ≤0.4     | PASS    |
| 3DH1     | Ant1    | Hop     | 0.39               | 330                | 0.128     | ≤0.4     | PASS    |
| 3DH3     | Ant1    | Hop     | 1.63               | 150                | 0.245     | ≤0.4     | PASS    |
| 3DH5     | Ant1    | Hop     | 2.87               | 110                | 0.316     | ≤0.4     | PASS    |

#### Remark:

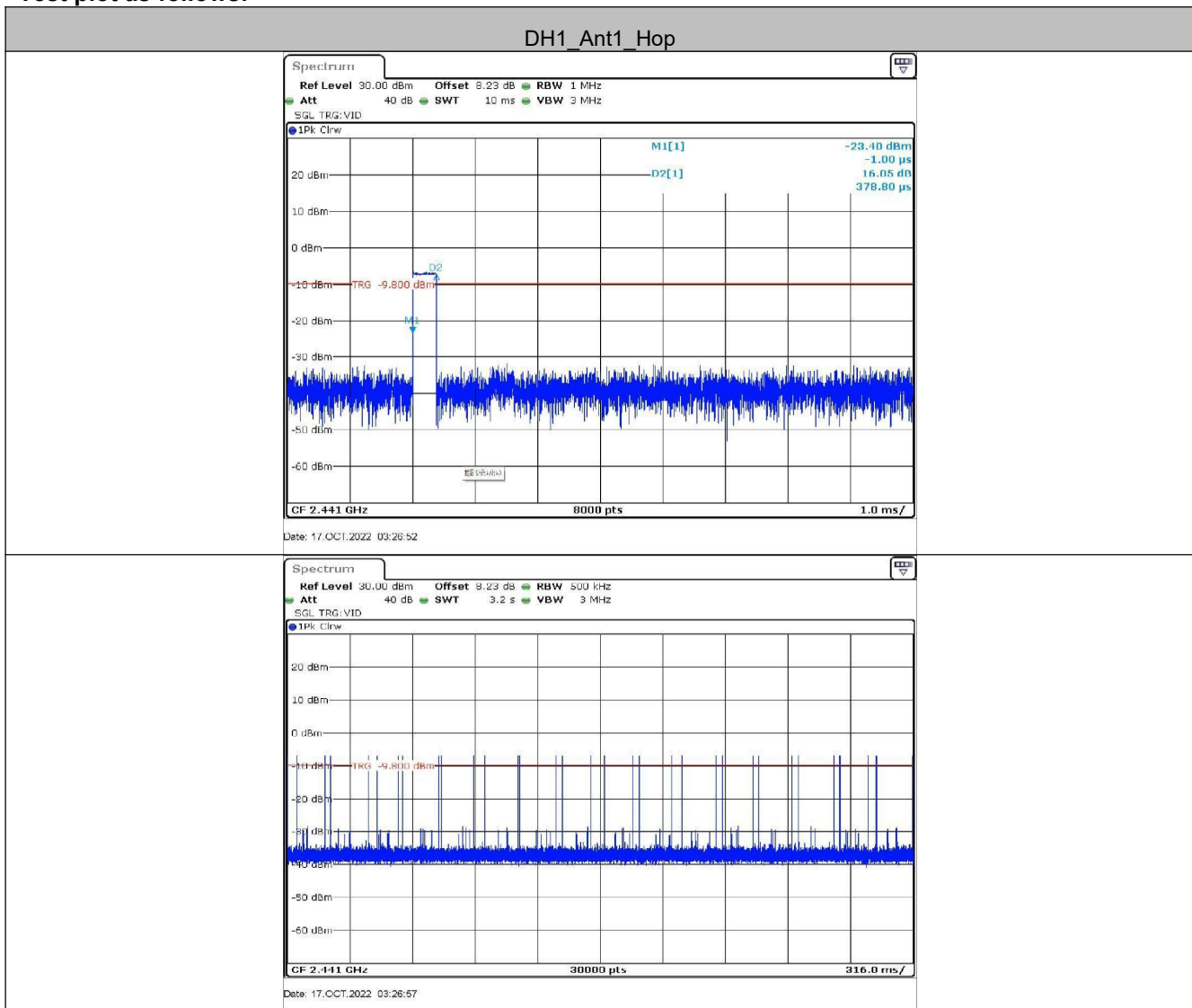
The test period:  $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$

DH1/2DH1/3DH1 Dwell time = Burst Width(ms)\*[1600/ (2\*79)]\*31.6

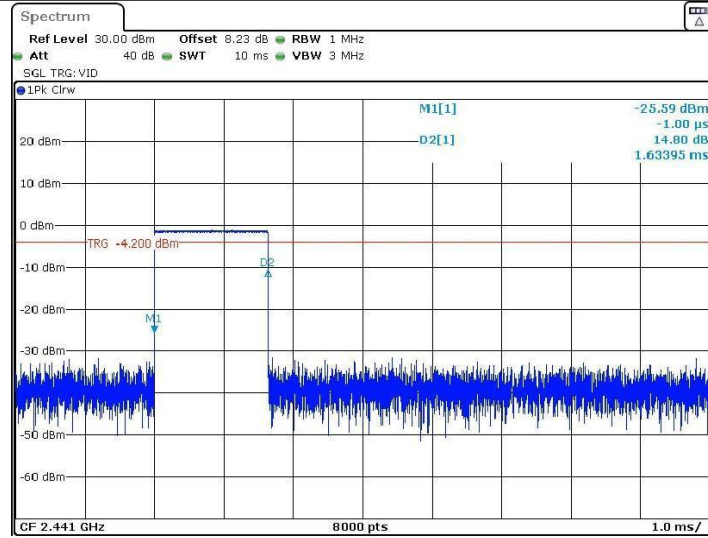
DH3/2DH3/3DH3 Dwell time = Burst Width (ms)\*[1600/ (4\*79)]\*31.6

DH5/2DH5/3DH5 Dwell time = Burst Width (ms)\*[1600/ (6\*79)]\*31.6

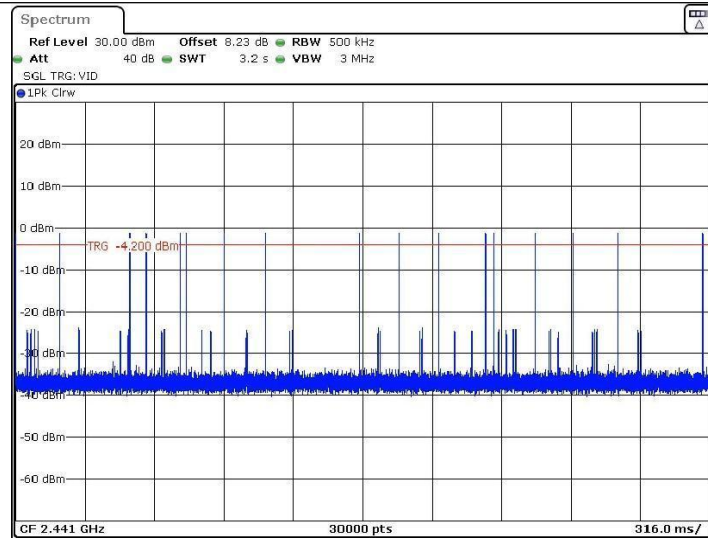
Test plot as follows:



DH3\_Ant1\_Hop

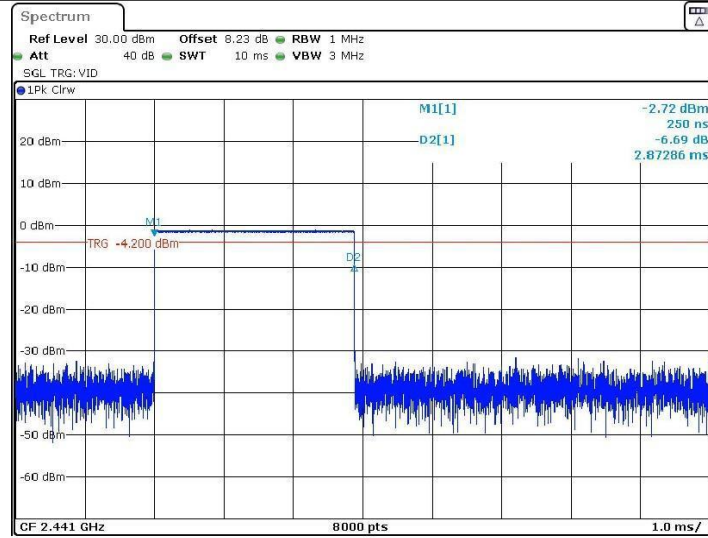


Date: 26 SEP 2022 10:40:55

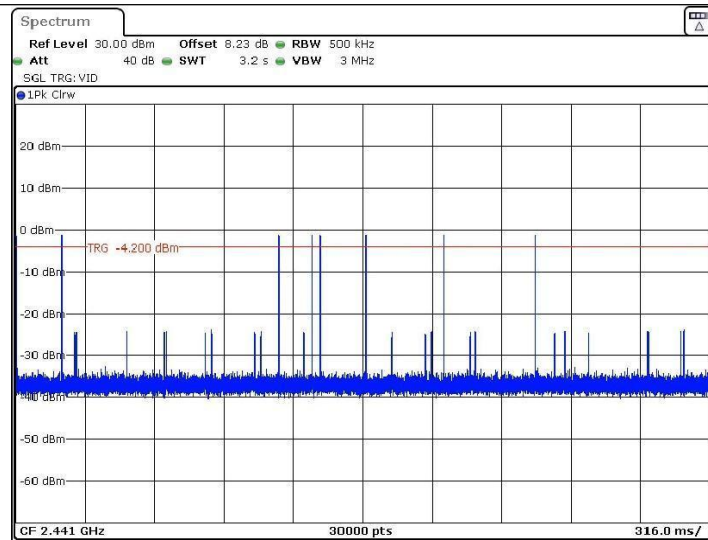


Date: 26 SEP 2022 10:41:01

DH5\_Ant1\_Hop

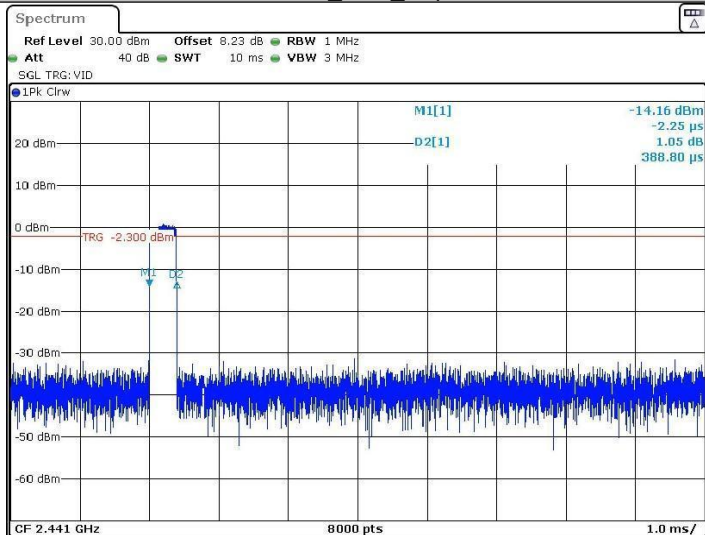


Date: 26 SEP 2022 10:37:13

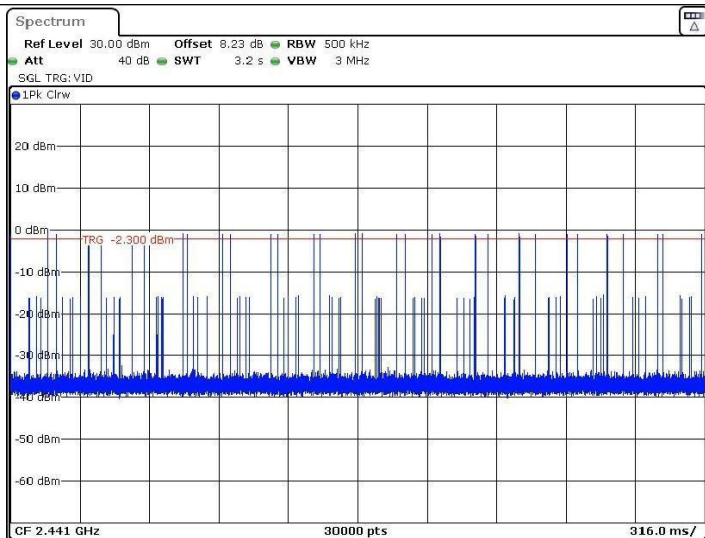


Date: 26 SEP 2022 10:37:19

2DH1\_Ant1\_Hop

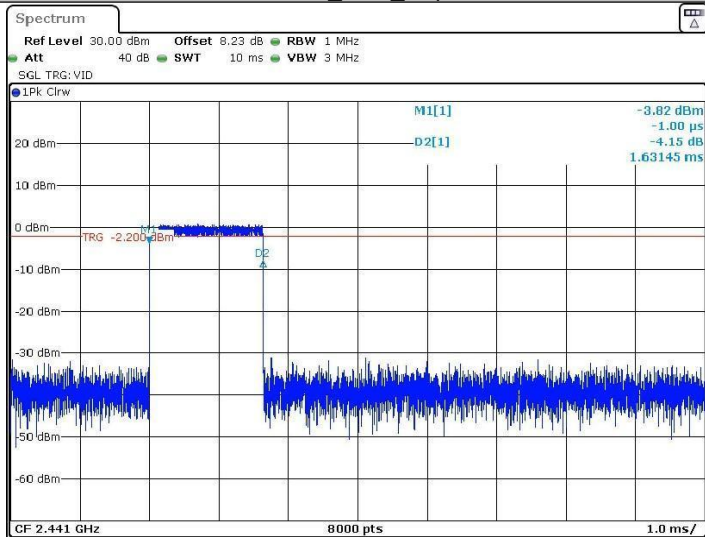


Date: 26 SEP 2022 10:48:03

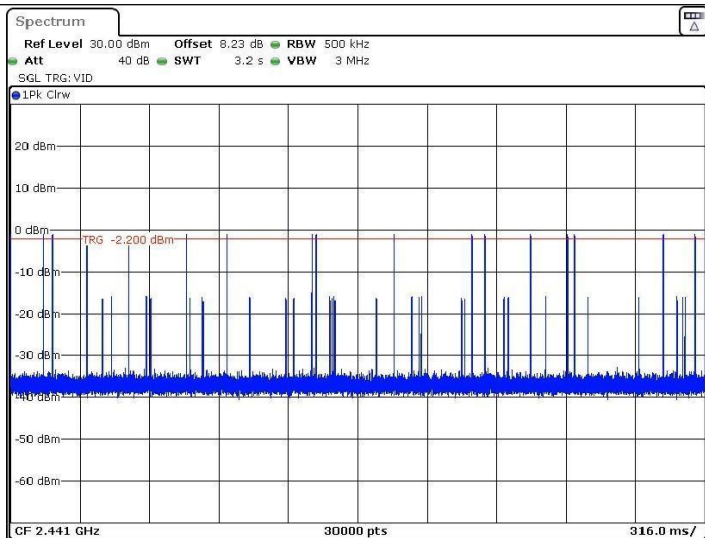


Date: 26 SEP 2022 10:48:09

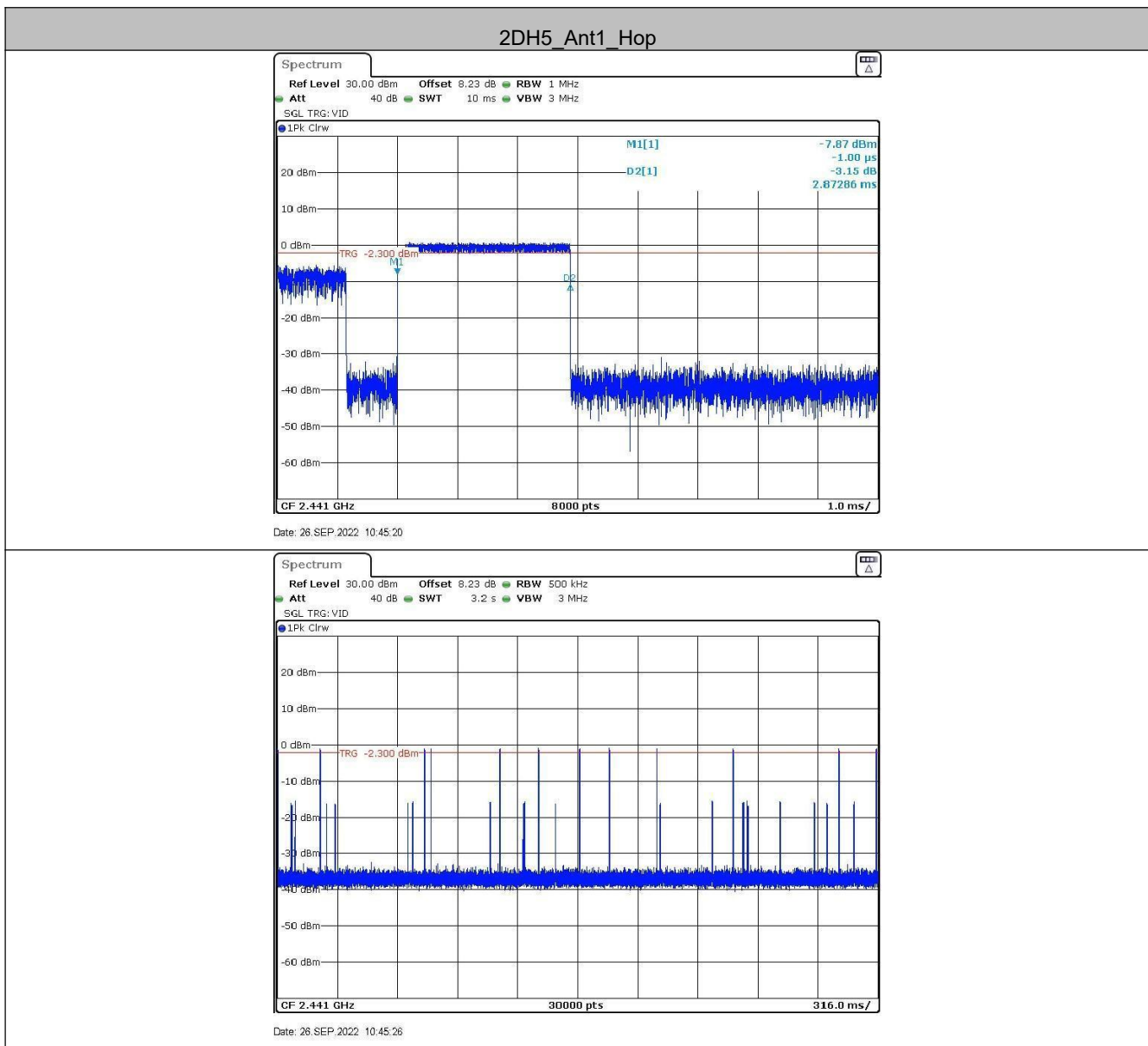
2DH3\_Ant1\_Hop



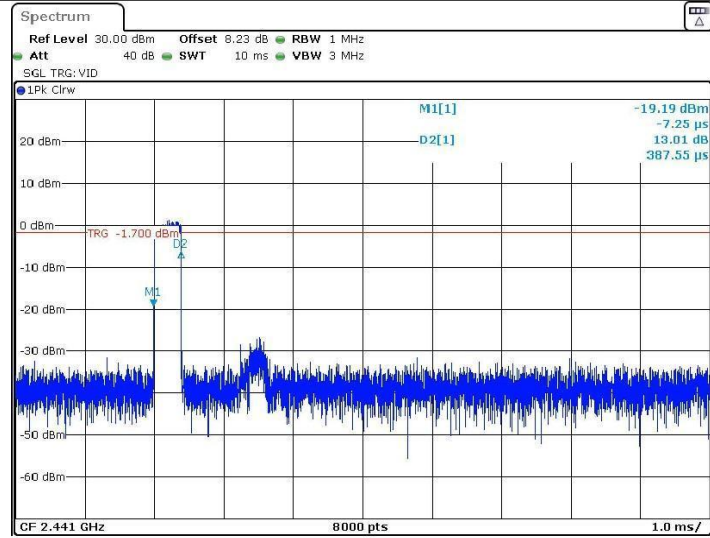
Date: 26 SEP 2022 10:48:32



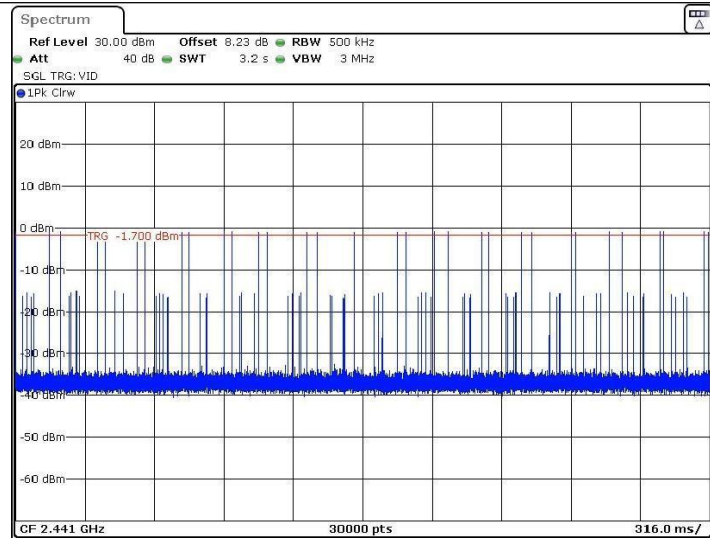
Date: 26 SEP 2022 10:48:37



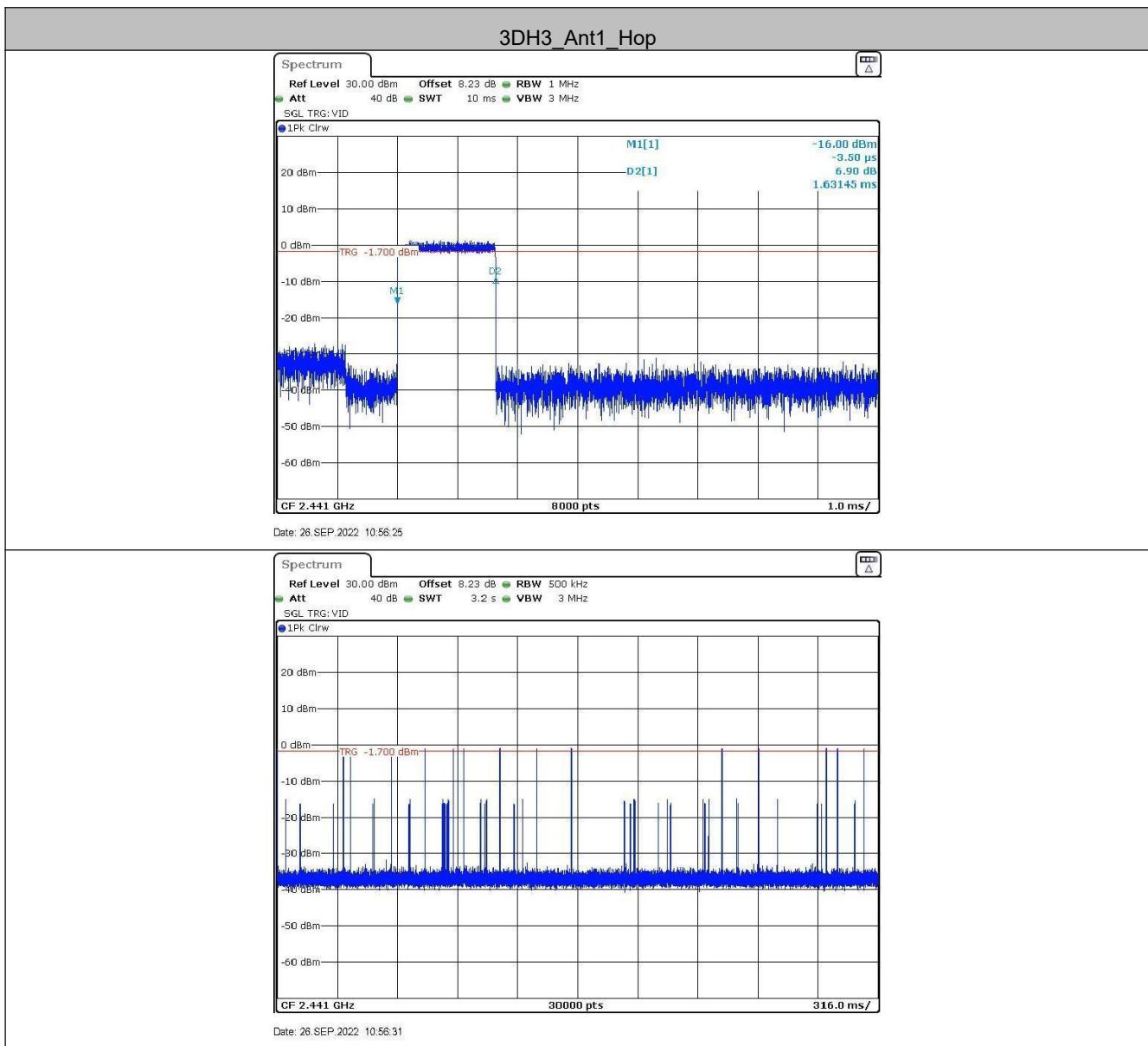
3DH1\_Ant1\_Hop



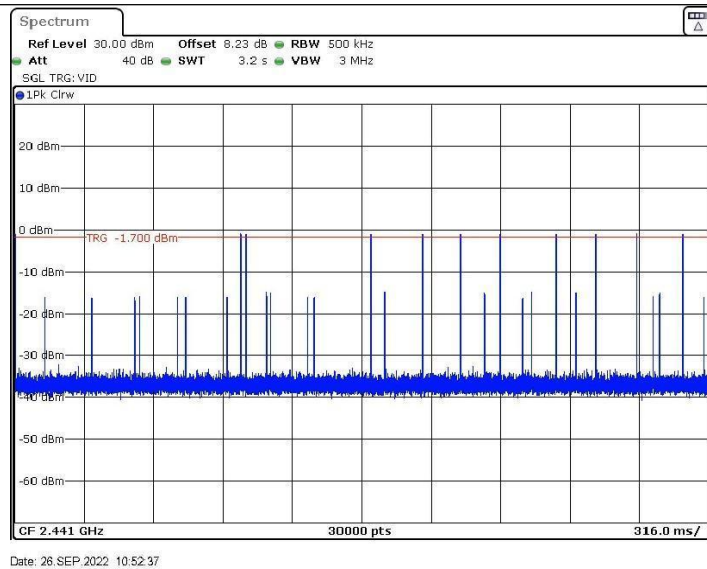
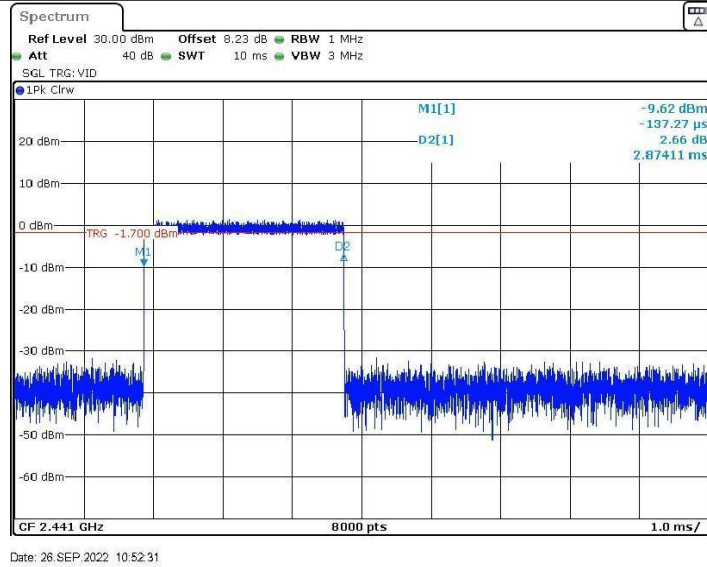
Date: 26 SEP 2022 10:56:01



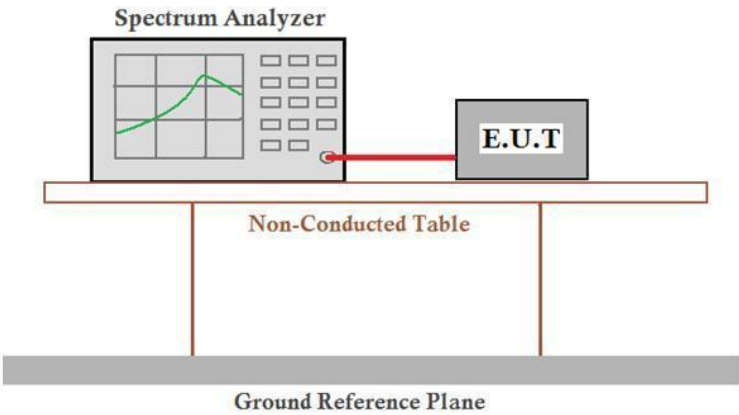
Date: 26 SEP 2022 10:56:07



3DH5\_Ant1\_Hop



## 5.8 Band-edge for RF Conducted Emissions

|                        |                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (d)                                                                                                                                                                                                                                                                                                                                                      |
| Test Method:           | ANSI C63.10:2013                                                                                                                                                                                                                                                                                                                                                                        |
| Test Setup:            |  <p><i>Remark: Offset=cable loss+ attenuation factor.</i></p>                                                                                                                                                                                                                                         |
| Limit:                 | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Exploratory Test Mode: | Hopping and Non-hopping transmitting with all kind of modulation and all kind of data type                                                                                                                                                                                                                                                                                              |
| Final Test Mode:       | Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.<br>Only the worst case is recorded in the report.                                                                                                          |
| Test Results:          | Pass                                                                                                                                                                                                                                                                                                                                                                                    |

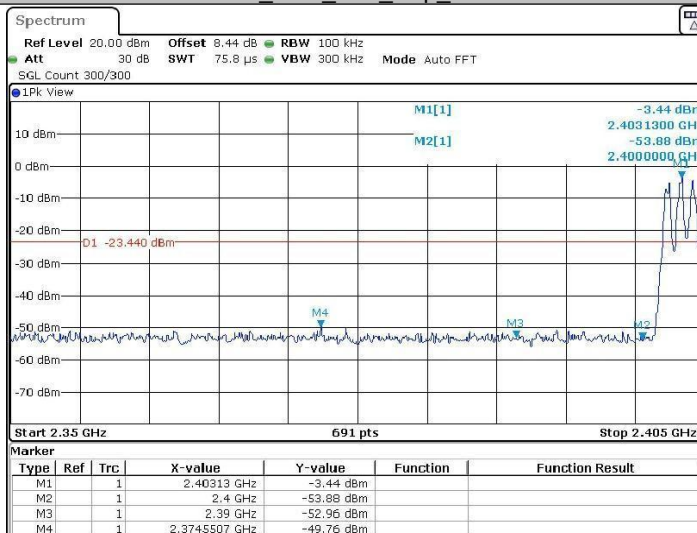
## Measurement Data

| TestMode | Antenna | ChName | Channel  | RefLevel<br>[dBm] | Result<br>[dBm] | Limit<br>[dBm] | Verdict |
|----------|---------|--------|----------|-------------------|-----------------|----------------|---------|
| DH5      | Ant1    | Low    | 2402     | -3.53             | -50.4           | $\leq -23.53$  | PASS    |
|          |         | High   | 2480     | -2.44             | -49.3           | $\leq -22.44$  | PASS    |
|          |         | Low    | Hop_2402 | -3.44             | -49.76          | $\leq -23.44$  | PASS    |
|          |         | High   | Hop_2480 | -1.79             | -48.84          | $\leq -21.79$  | PASS    |
| 2DH5     | Ant1    | Low    | 2402     | -2.86             | -50.47          | $\leq -22.86$  | PASS    |
|          |         | High   | 2480     | -2.78             | -49.13          | $\leq -22.78$  | PASS    |
|          |         | Low    | Hop_2402 | -5.92             | -49.86          | $\leq -25.92$  | PASS    |
|          |         | High   | Hop_2480 | -1.65             | -48.68          | $\leq -21.65$  | PASS    |
| 3DH5     | Ant1    | Low    | 2402     | -5.59             | -50.41          | $\leq -25.59$  | PASS    |
|          |         | High   | 2480     | -3.33             | -49.84          | $\leq -23.33$  | PASS    |
|          |         | Low    | Hop_2402 | -4.73             | -50.71          | $\leq -24.73$  | PASS    |
|          |         | High   | Hop_2480 | -1.62             | -49.84          | $\leq -21.62$  | PASS    |

Test plot as follows:

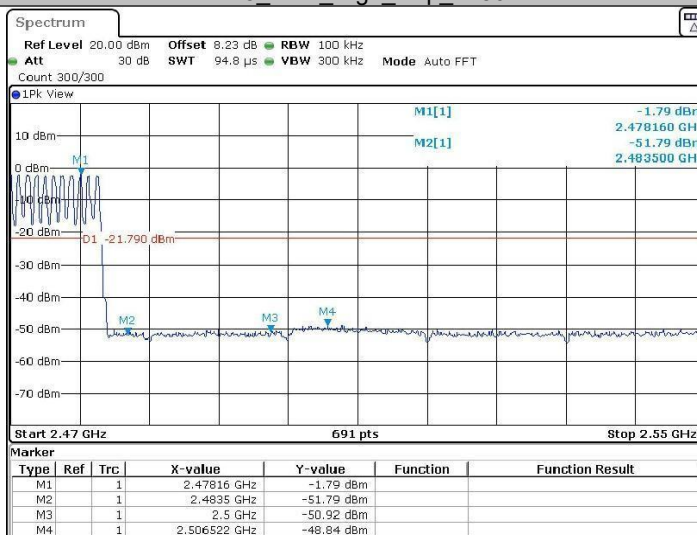


DH5\_Ant1\_Low\_Hop\_2402



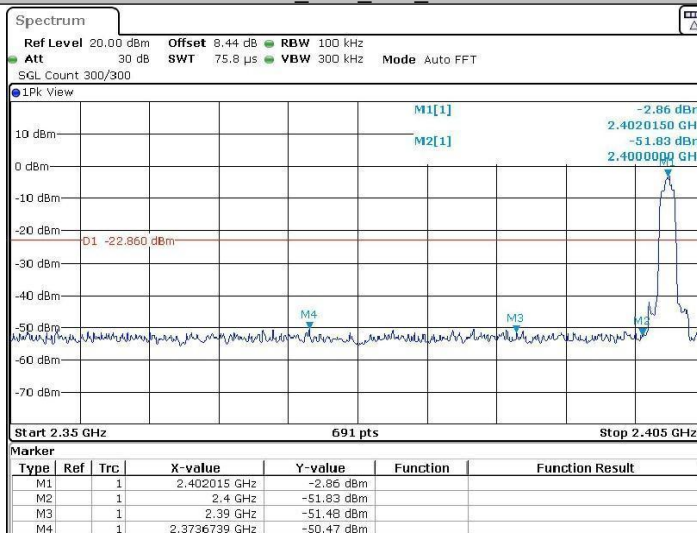
Date: 26.SEP.2022 10:31:42

DH5\_Ant1\_High\_Hop\_2480



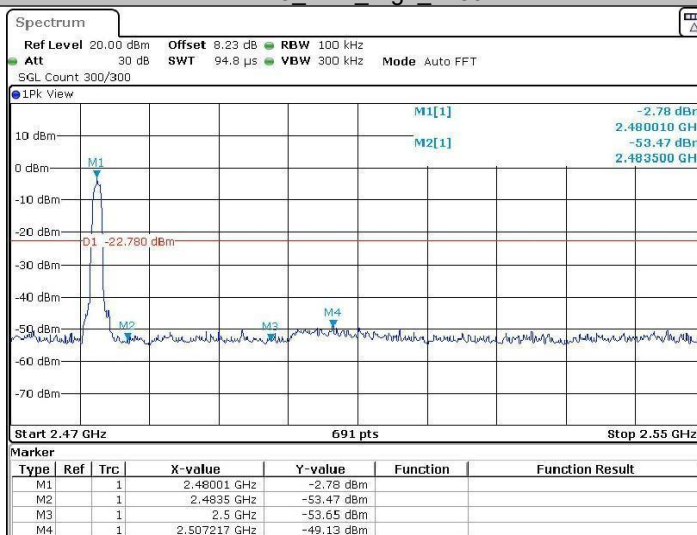
Date: 26.SEP.2022 10:37:59

2DH5\_Ant1\_Low\_2402



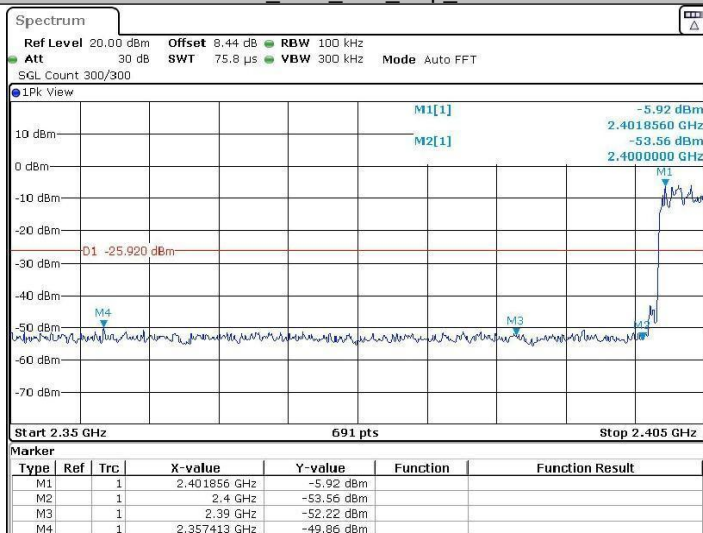
Date: 26.SEP.2022 10:08:06

2DH5\_Ant1\_High\_2480



Date: 26.SEP.2022 10:14:17

### 2DH5\_Ant1\_Low\_Hop\_2402



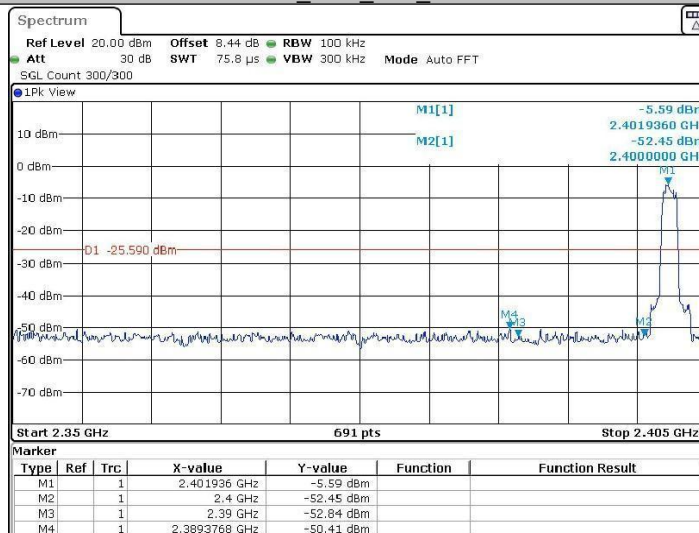
Date: 26.SEP.2022 10:41:19

### 2DH5\_Ant1\_High\_Hop\_2480



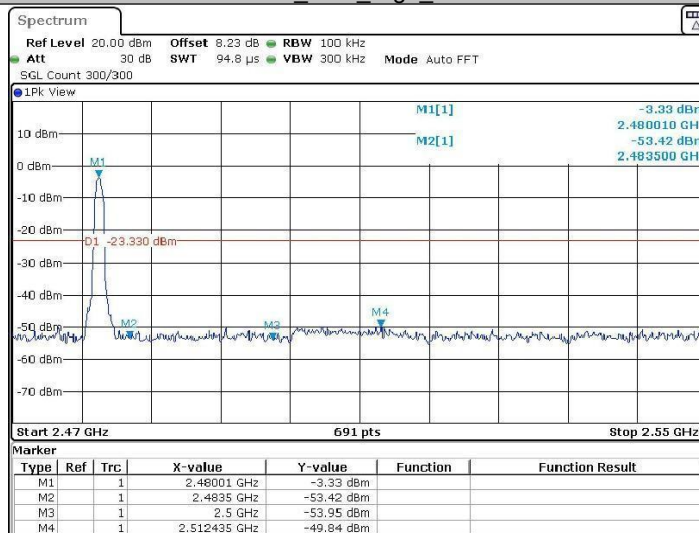
Date: 26.SEP.2022 10:46:01

### 3DH5\_Ant1\_Low\_2402



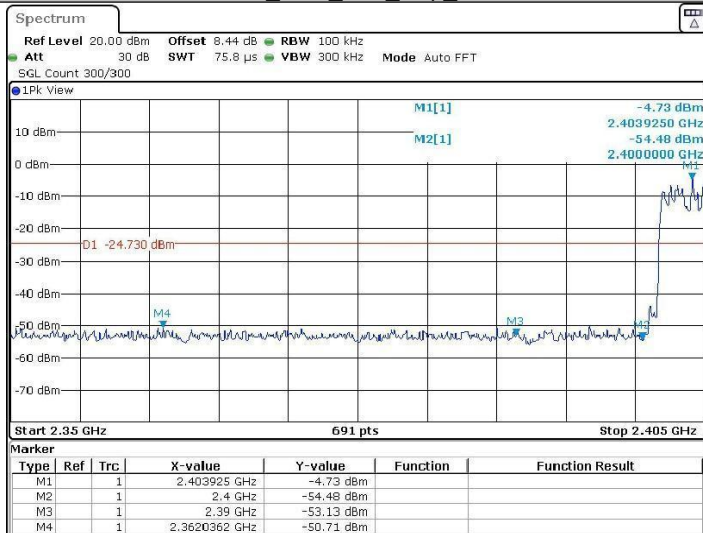
Date: 26.SEP.2022 10:18:28

### 3DH5\_Ant1\_High\_2480



Date: 26.SEP.2022 10:26:28

### 3DH5\_Ant1\_Low\_Hop\_2402



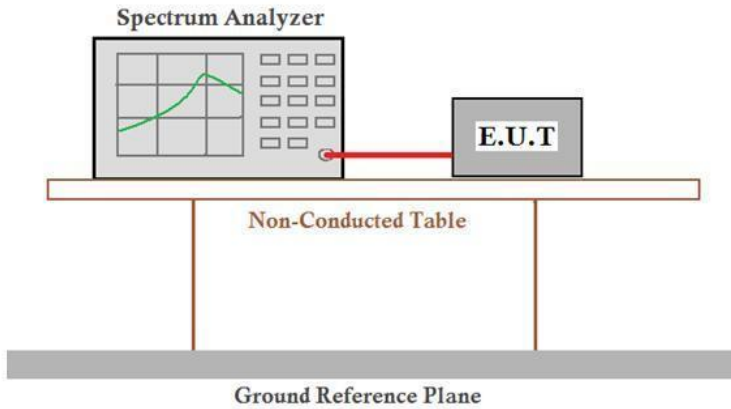
Date: 26.SEP.2022 10:49:02

### 3DH5\_Ant1\_High\_Hop\_2480



Date: 26.SEP.2022 10:54:12

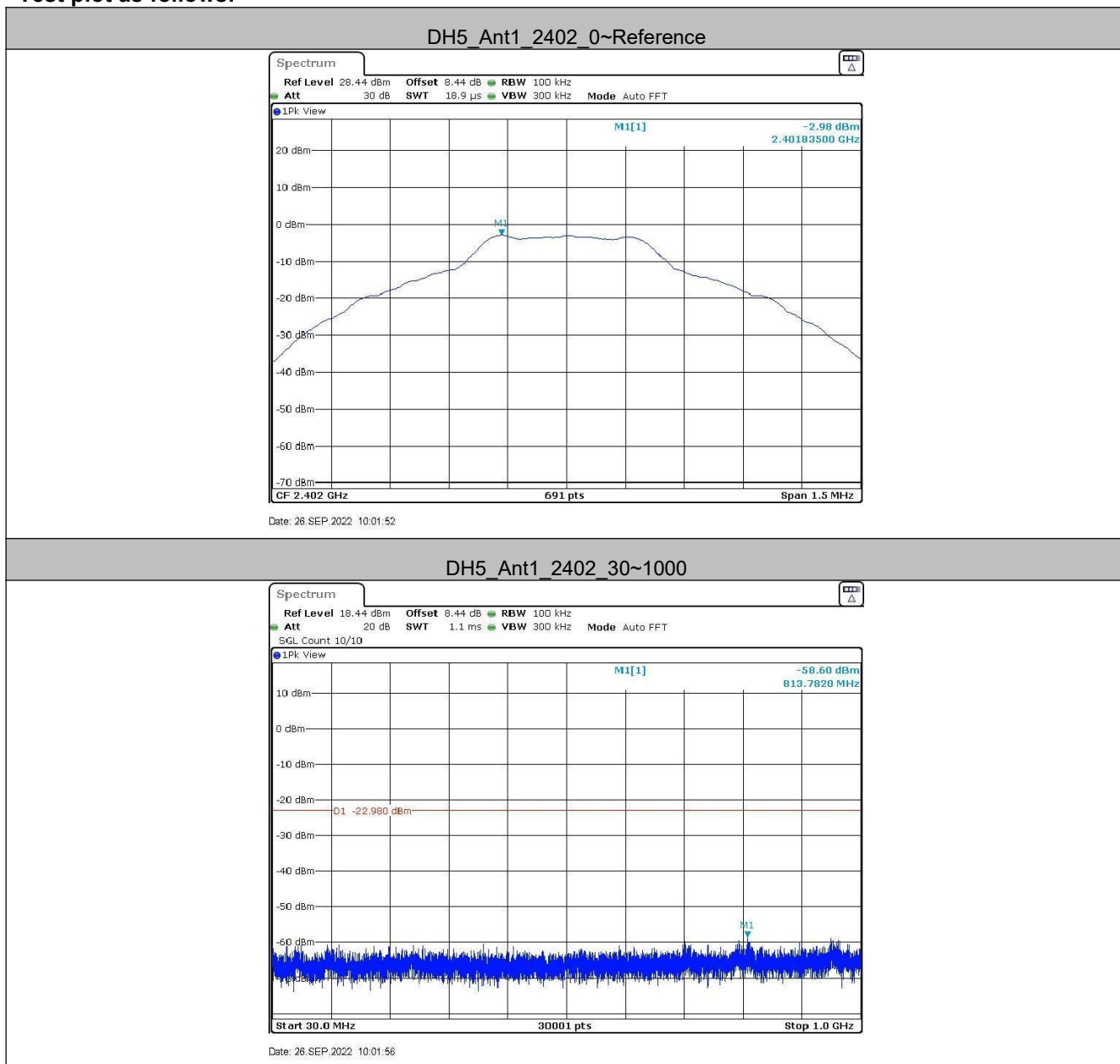
## 5.9 Spurious RF Conducted Emissions

|                        |                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Requirement:      | 47 CFR Part 15C Section 15.247 (d)                                                                                                                                                                                                                                                                                                                                                      |
| Test Method:           | ANSI C63.10:2013                                                                                                                                                                                                                                                                                                                                                                        |
| Test Setup:            |  <p><i>Remark: Offset=cable loss+ attenuation factor.</i></p>                                                                                                                                                                                                                                         |
| Limit:                 | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Exploratory Test Mode: | Non-hopping transmitting with all kind of modulation and all kind of data type                                                                                                                                                                                                                                                                                                          |
| Final Test Mode:       | Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of $\pi/4$ DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.                                                                                                                                                            |
| Test Results:          | Pass                                                                                                                                                                                                                                                                                                                                                                                    |

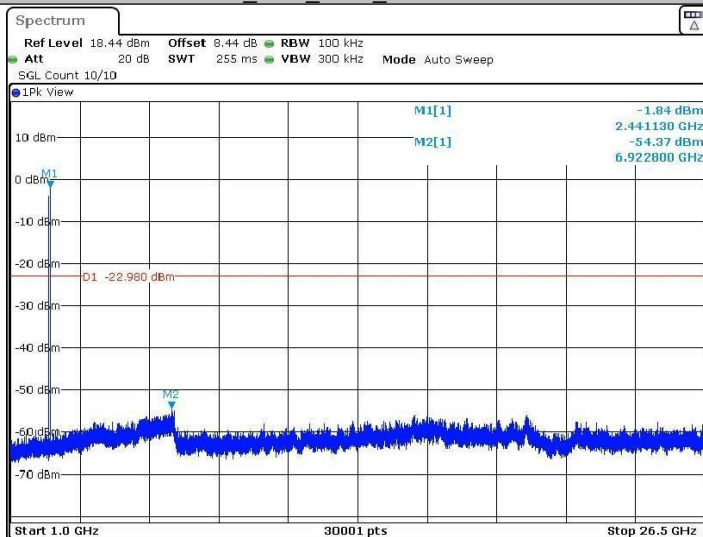
## Measurement Data

| TestMode | Antenna | Channel | FreqRange<br>[MHz] | RefLevel<br>[dBm] | Result<br>[dBm] | Limit<br>[dBm] | Verdict |
|----------|---------|---------|--------------------|-------------------|-----------------|----------------|---------|
| DH5      | Ant1    | 2402    | Reference          | -2.98             | -2.98           | ---            | PASS    |
|          |         |         | 30~1000            | -2.98             | -58.6           | $\leq -22.98$  | PASS    |
|          |         |         | 1000~26500         | -2.98             | -54.37          | $\leq -22.98$  | PASS    |
|          |         | 2441    | Reference          | -1.32             | -1.32           | ---            | PASS    |
|          |         |         | 30~1000            | -1.32             | -59.46          | $\leq -21.32$  | PASS    |
|          |         |         | 1000~26500         | -1.32             | -54.79          | $\leq -21.32$  | PASS    |
|          |         | 2480    | Reference          | -1.89             | -1.89           | ---            | PASS    |
|          |         |         | 30~1000            | -1.89             | -58.98          | $\leq -21.89$  | PASS    |
|          |         |         | 1000~26500         | -1.89             | -54.82          | $\leq -21.89$  | PASS    |
| 2DH5     | Ant1    | 2402    | Reference          | -2.91             | -2.91           | ---            | PASS    |
|          |         |         | 30~1000            | -2.91             | -58.36          | $\leq -22.91$  | PASS    |
|          |         |         | 1000~26500         | -2.91             | -54.46          | $\leq -22.91$  | PASS    |
|          |         | 2441    | Reference          | -1.42             | -1.42           | ---            | PASS    |
|          |         |         | 30~1000            | -1.42             | -58.94          | $\leq -21.42$  | PASS    |
|          |         |         | 1000~26500         | -1.42             | -55.1           | $\leq -21.42$  | PASS    |
|          |         | 2480    | Reference          | -1.99             | -1.99           | ---            | PASS    |
|          |         |         | 30~1000            | -1.99             | -59.08          | $\leq -21.99$  | PASS    |
|          |         |         | 1000~26500         | -1.99             | -55.52          | $\leq -21.99$  | PASS    |
| 3DH5     | Ant1    | 2402    | Reference          | -2.92             | -2.92           | ---            | PASS    |
|          |         |         | 30~1000            | -2.92             | -58.77          | $\leq -22.92$  | PASS    |
|          |         |         | 1000~26500         | -2.92             | -55.06          | $\leq -22.92$  | PASS    |
|          |         | 2441    | Reference          | -1.28             | -1.28           | ---            | PASS    |
|          |         |         | 30~1000            | -1.28             | -57.8           | $\leq -21.28$  | PASS    |
|          |         |         | 1000~26500         | -1.28             | -55.16          | $\leq -21.28$  | PASS    |
|          |         | 2480    | Reference          | -1.91             | -1.91           | ---            | PASS    |
|          |         |         | 30~1000            | -1.91             | -58.89          | $\leq -21.91$  | PASS    |
|          |         |         | 1000~26500         | -1.91             | -55.54          | $\leq -21.91$  | PASS    |

Test plot as follows:

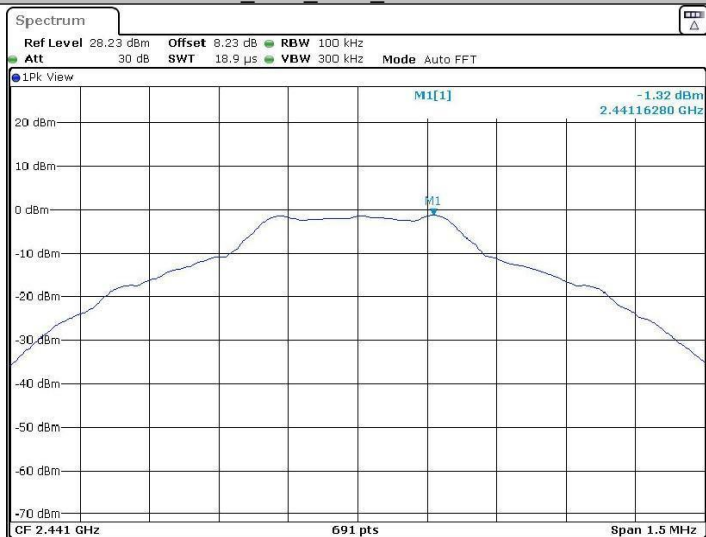


DH5\_Ant1\_2402\_1000~26500



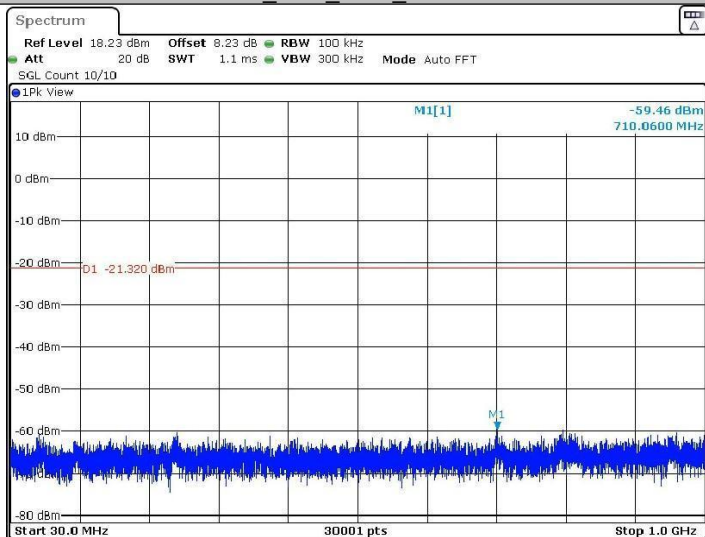
Date: 26 SEP.2022 10:02:18

DH5\_Ant1\_2441\_0~Reference



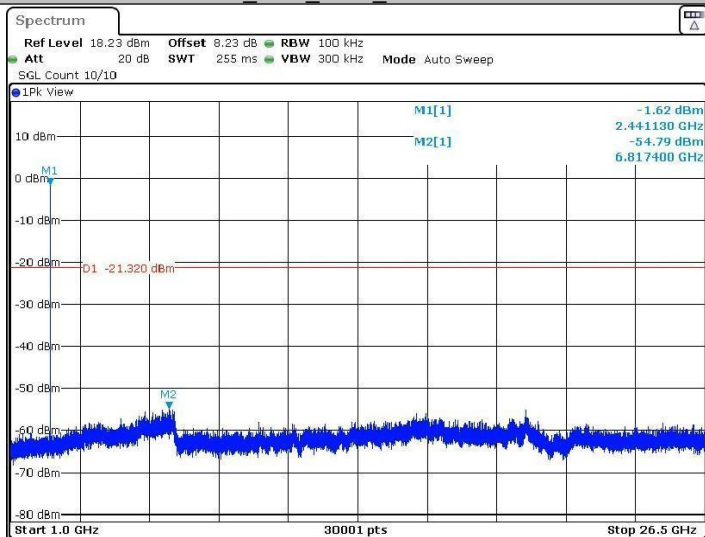
Date: 26 SEP.2022 10:03:44

DH5\_Ant1\_2441\_30~1000



Date: 26 SEP.2022 10:03:49

DH5\_Ant1\_2441\_1000~26500



Date: 26 SEP.2022 10:04:11