

# FCC CERTIFICATION TEST REPORT

## FOR

|                             |   |                                         |
|-----------------------------|---|-----------------------------------------|
| <b>Applicant</b>            | : | PEAG, LLC dba JLab Audio                |
| <b>Address</b>              | : | 5927 Landau Ct. Carlsbad, CA 92008, USA |
| <b>Equipment under Test</b> | : | TWS Earbuds                             |
| <b>Model No.</b>            | : | JBuds Air Pro ANC                       |
| <b>Trade Mark</b>           | : | JLab                                    |
| <b>FCC ID</b>               | : | 2AHYV-JAPNC                             |
| <b>Manufacturer</b>         | : | PEAG, LLC dba JLab Audio                |
| <b>Address</b>              | : | 5927 Landau Ct. Carlsbad, CA 92008, USA |

**Issued By: Dongguan Dongdian Testing Service Co., Ltd.**

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# REPORT

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## Test Report Declare

|                             |   |                                         |
|-----------------------------|---|-----------------------------------------|
| <b>Applicant</b>            | : | PEAG, LLC dba JLab Audio                |
| <b>Address</b>              | : | 5927 Landau Ct. Carlsbad, CA 92008, USA |
| <b>Equipment under Test</b> | : | TWS Earbuds                             |
| <b>Model No.</b>            | : | JBuds Air Pro ANC                       |
| <b>Trade Mark</b>           | : | JLab                                    |
| <b>Manufacturer</b>         | : | PEAG, LLC dba JLab Audio                |
| <b>Address</b>              | : | 5927 Landau Ct. Carlsbad, CA 92008, USA |

**Test Standard Used:**

FCC Rules and Regulations Part 15 Subpart C.

**Test Procedure Used:**

ANSI C63.10:2013.

**We Declare:**

The equipment described above is tested by Dongguan Dongdian Testing Service Co., Ltd. and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and Dongguan Dongdian Testing Service Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

**After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above FCC standards.**

|                         |                    |                      |                               |
|-------------------------|--------------------|----------------------|-------------------------------|
| <b>Report No.:</b>      | DDT-R22120512-2E01 |                      |                               |
| <b>Date of Receipt:</b> | Feb. 09, 2023      | <b>Date of Test:</b> | Feb. 09, 2023 ~ Mar. 08, 2023 |

**Prepared By:****Johnny Wang/Engineer****Approved By:****Damon Hu/EMC Manager**

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Dongguan Dongdian Testing Service Co., Ltd.

## Revision History

| Rev. | Revisions     | Issue Date    | Revised By |
|------|---------------|---------------|------------|
| ---  | Initial issue | Mar. 08, 2023 |            |
|      |               |               |            |

## 1. Summary of Test Results

| Description of Test Item          | Standard                                                                                       | Verdict |
|-----------------------------------|------------------------------------------------------------------------------------------------|---------|
| Maximum Peak Output Power         | FCC Part 15: 15.247(b)(1)<br>ANSI C63.10:2013                                                  | Pass    |
| 20 dB Bandwidth and 99% Bandwidth | FCC Part 15: 15.247(a)(1)<br>ANSI C63.10:2013                                                  | Pass    |
| Carrier Frequency Separation      | FCC Part 15: 15.247(a)(1)<br>ANSI C63.10:2013                                                  | Pass    |
| Number of Hopping Channel         | FCC Part 15: 15.247(a)(1)(iii)<br>ANSI C63.10:2013                                             | Pass    |
| Dwell Time                        | FCC Part 15: 15.247(a)(1)(iii)<br>ANSI C63.10:2013                                             | Pass    |
| RF Conducted Spurious Emissions   | FCC Part 15: 15.247(d)                                                                         | Pass    |
| Radiated Emission                 | FCC Part 15: 15.205(a)<br>FCC Part 15: 15.209(a)<br>FCC Part 15: 15.247(d)<br>ANSI C63.10:2013 | Pass    |
| Band Edge Compliance              | FCC Part 15: 15.205(a)<br>FCC Part 15: 15.209(a)<br>FCC Part 15: 15.247(d)<br>ANSI C63.10:2013 | Pass    |
| Power Line Conducted Emissions    | FCC Part 15: 15.207(a)<br>ANSI C63.10:2013                                                     | Pass    |
| Antenna Requirement               | FCC Part 15: 15.203                                                                            | Pass    |



## 2. General Test Information

### 2.1. Description of EUT

|                          |                                                                                                                                         |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| EUT* Name                | : TWS Earbuds                                                                                                                           |
| Model Number             | : JBuds Air Pro ANC                                                                                                                     |
| EUT Function Description | : Please reference user manual of this device                                                                                           |
| Power supply             | : Charging case: DC 5V by external AC Adapter or 3.7V built-in lithium battery<br>Wireless Headphones: DC 3.7V built-in lithium battery |
| Radio Specification      | : Bluetooth V5.0                                                                                                                        |
| Operation Frequency      | : 2402 MHz - 2480 MHz                                                                                                                   |
| Modulation               | : GFSK, $\pi/4$ -DQPSK, 8DPSK                                                                                                           |
| Data Rate                | : 1 Mbps, 2 Mbps, 3 Mbps                                                                                                                |
| Antenna Gain             | : Left side: -2.05 dBi<br>Right side: -2.05 dBi                                                                                         |
| Sample Number            | : S22120512-02 for conductive,<br>S22120512-03 for radiation                                                                            |

Note: EUT is the abbreviation of equipment under test.

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

## 2.2. Accessories of EUT

| Description of Accessories | Manufacturer | Model number | Description | Remark |
|----------------------------|--------------|--------------|-------------|--------|
| N/A                        | N/A          | N/A          | N/A         | N/A    |

## 2.3. Assistant equipment used for test

| Assistant equipment | Manufacturer | Model number | EMC Compliance     | SN  |
|---------------------|--------------|--------------|--------------------|-----|
| Adapter             | SAMSUNG      | EP-TA200     | R37R41C1CF2S<br>E3 | N/A |

## 2.4. Block diagram of EUT configuration for test

EUT

Test software: FCC\_assist\_1.0.2.2.exe

The test software was used to control EUT work in Continuous Tx mode, and select test channel, wireless mode as below table.

| Tested mode, channel, information  |                  |             |                 |
|------------------------------------|------------------|-------------|-----------------|
| Mode                               | Setting Tx Power | Channel     | Frequency (MHz) |
| GFSK hopping on Tx mode            | 10               | CH0 to CH78 | 2402 to 2480    |
| $\pi/4$ -DQPSK hopping on Tx mode  | 10               | CH0 to CH78 | 2402 to 2480    |
| 8DPSK hopping on Tx mode           | 10               | CH0 to CH78 | 2402 to 2480    |
| GFSK hopping off Tx mode           | 10               | CH0         | 2402            |
|                                    | 10               | CH39        | 2441            |
|                                    | 10               | CH78        | 2480            |
| $\pi/4$ -DQPSK hopping off Tx mode | 10               | CH0         | 2402            |
|                                    | 10               | CH39        | 2441            |
|                                    | 10               | CH78        | 2480            |
| 8DPSK hopping off Tx mode          | 10               | CH0         | 2402            |
|                                    | 10               | CH39        | 2441            |
|                                    | 10               | CH78        | 2480            |

## 2.5. Deviations of test standard

No deviation.



## 2.6. Test environment conditions

During the measurement the environmental conditions were within the listed ranges:

|                    |            |
|--------------------|------------|
| Temperature range: | 21-25 °C   |
| Humidity range:    | 40-75%     |
| Pressure range:    | 86-106 kPa |

## 2.7. Test laboratory

Dongguan Dongdian Testing Service Co., Ltd.

Add.: No. 17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China, 523808.

Tel.: +86-0769-38826678, <http://www.dgddt.com>, Email: [ddt@dgddt.com](mailto:ddt@dgddt.com).

CNAS Accreditation No. L6451; A2LA Accreditation Number: 3870.01

FCC Designation Number: CN1182, Test Firm Registration Number: 540522

Innovation, Science and Economic Development Canada Site Registration Number: 10288A

Conformity Assessment Body identifier: CN0048

VCCI facility registration number: C-20087, T-20088, R-20123, R-20155, G-20118

## 2.8. Measurement uncertainty

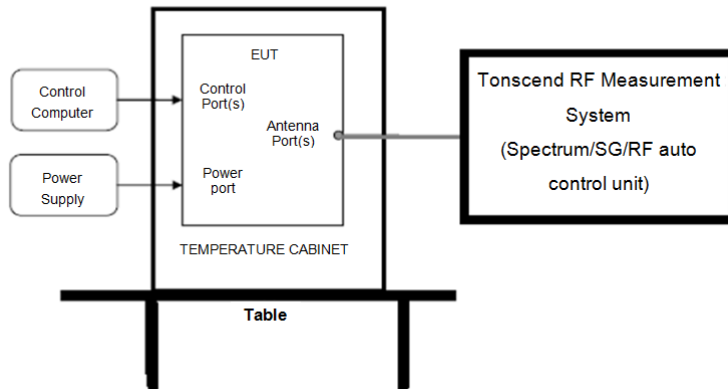
| Test Item                                                                                                                                     | Uncertainty                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Bandwidth                                                                                                                                     | 1.1%                                                                                                      |
| Peak Output Power (Conducted) (Spectrum analyzer)                                                                                             | 0.86 dB (10 MHz ≤ f < 3.6 GHz);<br>1.38 dB (3.6 GHz ≤ f < 8 GHz)                                          |
| Peak Output Power (Conducted) (Power Sensor)                                                                                                  | 0.74 dB                                                                                                   |
| Power Spectral Density                                                                                                                        | 0.74 dB (10 MHz ≤ f < 3.6 GHz);<br>1.38 dB (3.6 GHz ≤ f < 8 GHz)                                          |
| Frequencies Stability                                                                                                                         | 6.7 × 10 <sup>-8</sup> (Antenna couple method)<br>5.5 × 10 <sup>-8</sup> (Conducted method)               |
| Conducted spurious emissions                                                                                                                  | 0.86 dB (10 MHz ≤ f < 3.6 GHz);<br>1.40 dB (3.6 GHz ≤ f < 8 GHz)<br>1.66 dB (8 GHz ≤ f < 26.5 GHz)        |
| Uncertainty for radio frequency (RBW < 20 kHz)                                                                                                | 3×10 <sup>-8</sup>                                                                                        |
| Temperature                                                                                                                                   | 0.4 °C                                                                                                    |
| Humidity                                                                                                                                      | 2 %                                                                                                       |
| Uncertainty for Radiation Emission test<br>(30 MHz - 1 GHz)                                                                                   | 4.70 dB (Antenna Polarize: V)<br>4.84 dB (Antenna Polarize: H)                                            |
| Uncertainty for Radiation Emission test<br>(1 GHz - 40 GHz)                                                                                   | 4.10 dB (1 - 6 GHz)<br>4.40 dB (6 GHz - 18 GHz)<br>3.54 dB (18 GHz - 26 GHz)<br>4.30 dB (26 GHz - 40 GHz) |
| Uncertainty for Power line conduction emission test                                                                                           | 3.32 dB (150 kHz - 30 MHz)                                                                                |
| Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. |                                                                                                           |

### 3. Equipment Used During Test

| Equipment                                                     | Manufacturer    | Model No.                                                                                  | Serial No.        | Last Cal.     | Cal. Interval |
|---------------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------------|-------------------|---------------|---------------|
| <b>☑RF Connected Test (Tonscend RF Measurement System 3#)</b> |                 |                                                                                            |                   |               |               |
| Signal & Spectrum analyzer                                    | R&S             | FSV40                                                                                      | 101407            | Jul. 21, 2022 | 1 Year        |
| Wideband Radio Communication tester                           | R&S             | CMW500                                                                                     | 117491            | May 18, 2022  | 1 Year        |
| Vector Signal Generator                                       | Agilent         | N5182A                                                                                     | MY19060405        | May 18, 2022  | 1 Year        |
| Vector Signal Generator                                       | Agilent         | N5182A                                                                                     | MY48180912        | May 18, 2022  | 1 Year        |
| RF Control Unit                                               | Tonscend        | JS0806-2                                                                                   | 20C8060230        | May 18, 2022  | 1 Year        |
| Temp&Humi Programmable                                        | ZHIXIANG        | ZXGDJS-150L                                                                                | ZX170110-A        | May 26, 2022  | 1 Year        |
| Test Software                                                 | JS Tonscend     | JS1120-3                                                                                   | Ver.3.2.22        | N/A           | N/A           |
| <b>☑Radiation 3#chamber</b>                                   |                 |                                                                                            |                   |               |               |
| EMI Test Receiver                                             | R&S             | ESU26                                                                                      | 100472            | May 19, 2022  | 1 Year        |
| Spectrum analyzer                                             | Agilent         | E4447A                                                                                     | MY50180031        | May 17, 2022  | 1 Year        |
| Active Loop antenna                                           | Schwarzbeck     | FMZB-1519                                                                                  | 1519-038          | Sep. 29, 2022 | 1 Year        |
| Trilog Broadband Antenna                                      | Schwarzbeck     | VULB 9163                                                                                  | 01429             | Jul. 22, 2022 | 1 Year        |
| Double Ridged Horn Antenna                                    | Schwarzbeck     | BBHA9120 D                                                                                 | 02468             | Sep. 29, 2022 | 1 Year        |
| Broad Band Horn Antenna                                       | Schwarzbeck     | BBHA 9170                                                                                  | 790               | May 06, 2022  | 1 Year        |
| Pre-amplifier                                                 | COM-POWER       | PAM-118A                                                                                   | 18040084          | Aug.17, 2022  | 1 Year        |
| Pre-amplifier                                                 | COM-POWER       | PAM-840A                                                                                   | 461369            | Apr. 11, 2022 | 1 Year        |
| RE Cable                                                      | N/A             | W23.02<br>CP1-X2 +<br>W23.09<br>AP1-X8+<br>JCT26S-NJ-<br>NJ-1.5M+<br>JCT26S-NJ-<br>NJ-1.5M | 4.5M+8M+1.5M+1.5M | Aug.17, 2022  | 1 Year        |
| RF Cable                                                      | Yuhu Technology | JCTB810-NJ-NJ-9M                                                                           | 21123964          | May. 19, 2022 | 1 Year        |
| RF Cable                                                      | Yuhu Technology | ZT26S-SMAJ-SMAJ-1M                                                                         | 21073466          | Aug.17, 2022  | 1 Year        |
| Test software                                                 | Tonscend        | JS32-RE                                                                                    | V 5.0.0.1         | N/A           | N/A           |
| <b>☑Power Line Conducted Emissions Test 1#</b>                |                 |                                                                                            |                   |               |               |
| Test Receiver                                                 | R&S             | ESCI                                                                                       | 100551            | Aug. 26, 2022 | 1 Year        |
| LISN 1                                                        | R&S             | ENV216                                                                                     | 101109            | Aug. 26, 2022 | 1 Year        |
| LISN 2                                                        | R&S             | ESH2-Z5                                                                                    | 100309            | Aug. 26, 2022 | 1 Year        |
| Pulse Limiter                                                 | R&S             | ESH3-Z2                                                                                    | 101242            | Aug. 26, 2022 | 1 Year        |
| CE Cable 1                                                    | HUBSER          | N/A                                                                                        | W10.01            | Aug. 26, 2022 | 1 Year        |
| Test software                                                 | Audix           | E3                                                                                         | V 6.11111b        | N/A           | N/A           |
| Test Receiver                                                 | R&S             | ESCI                                                                                       | 100551            | Aug. 26, 2022 | 1 Year        |

## 4. Maximum Peak Output Power

### 4.1. Block diagram of test setup



### 4.2. Limits

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. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts, the e.i.r.p shall not exceed 4W.

### 4.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) Measure the maximum output power of EUT by spectrum analyzer with PK detector and RBW = 3 MHz (above 20 dB bandwidth of measured signal), VBW = 10 MHz

Note: The attenuator loss was inputted into spectrum analyzer as amplitude offset.

### 4.4. Test result

Left side:

| Mode           | Antenna | Freq. (MHz) | Result (dBm) | Limit (dBm) | Verdict |
|----------------|---------|-------------|--------------|-------------|---------|
| GFSK           | ANT1    | 2402        | 3.51         | 21          | Pass    |
|                | ANT1    | 2441        | 3.23         | 21          | Pass    |
|                | ANT1    | 2480        | 2.05         | 21          | Pass    |
| $\pi/4$ -DQPSK | ANT1    | 2402        | 4.24         | 21          | Pass    |
|                | ANT1    | 2441        | 3.83         | 21          | Pass    |
|                | ANT1    | 2480        | 2.69         | 21          | Pass    |
| 8DPSK          | ANT1    | 2402        | <b>4.49</b>  | 21          | Pass    |
|                | ANT1    | 2441        | 4.28         | 21          | Pass    |
|                | ANT1    | 2480        | 3.07         | 21          | Pass    |

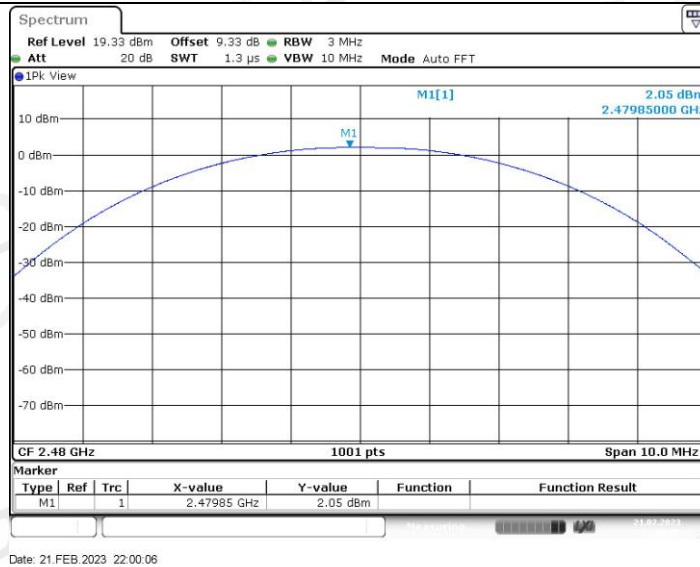
Right side:

| Mode           | Antenna | Freq. (MHz) | Result (dBm) | Limit (dBm) | Verdict |
|----------------|---------|-------------|--------------|-------------|---------|
| GFSK           | ANT1    | 2402        | 3.35         | 21          | Pass    |
|                | ANT1    | 2441        | 2.83         | 21          | Pass    |
|                | ANT1    | 2480        | 1.45         | 21          | Pass    |
| $\pi/4$ -DQPSK | ANT1    | 2402        | 3.97         | 21          | Pass    |
|                | ANT1    | 2441        | 3.50         | 21          | Pass    |
|                | ANT1    | 2480        | 2.14         | 21          | Pass    |
| 8DPSK          | ANT1    | 2402        | <b>4.05</b>  | 21          | Pass    |
|                | ANT1    | 2441        | 3.63         | 21          | Pass    |
|                | ANT1    | 2480        | 2.32         | 21          | Pass    |

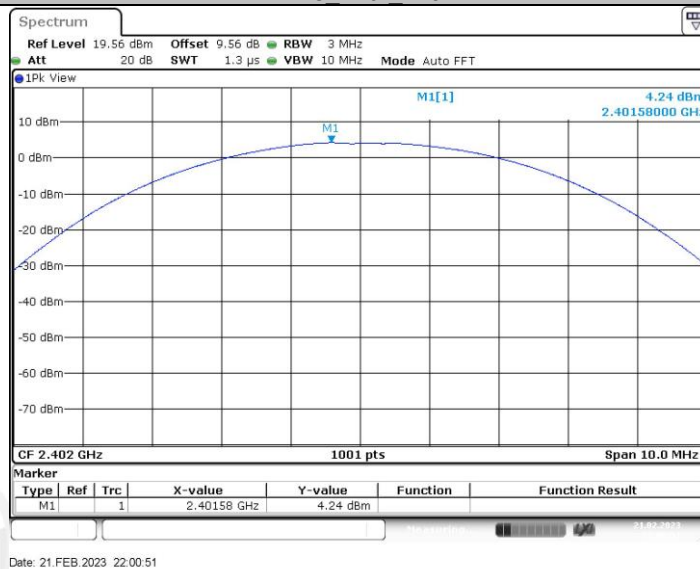
#### 4.5. Original test data

Left side:

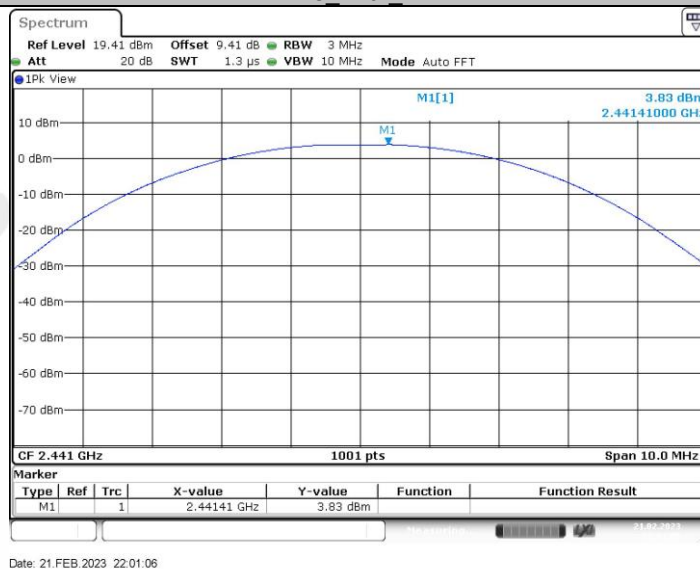




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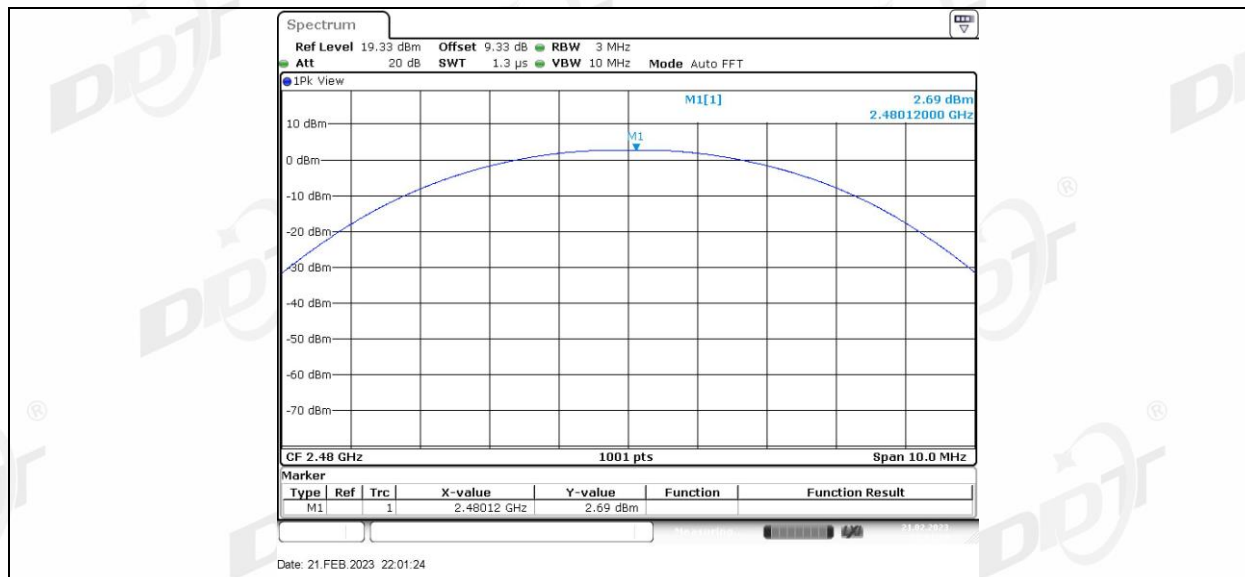


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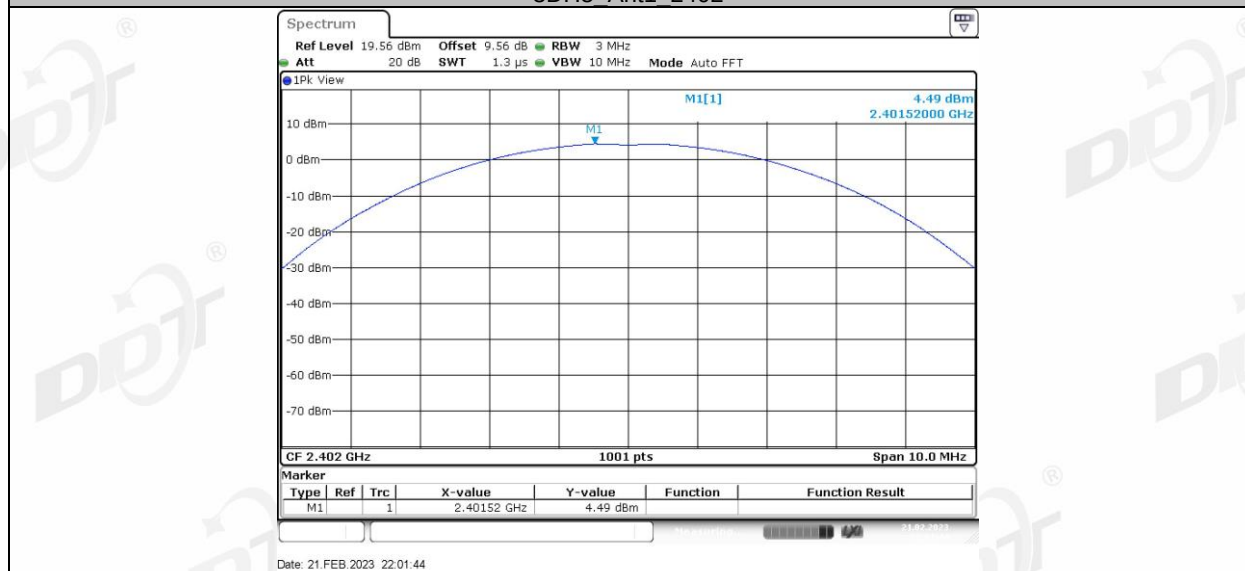


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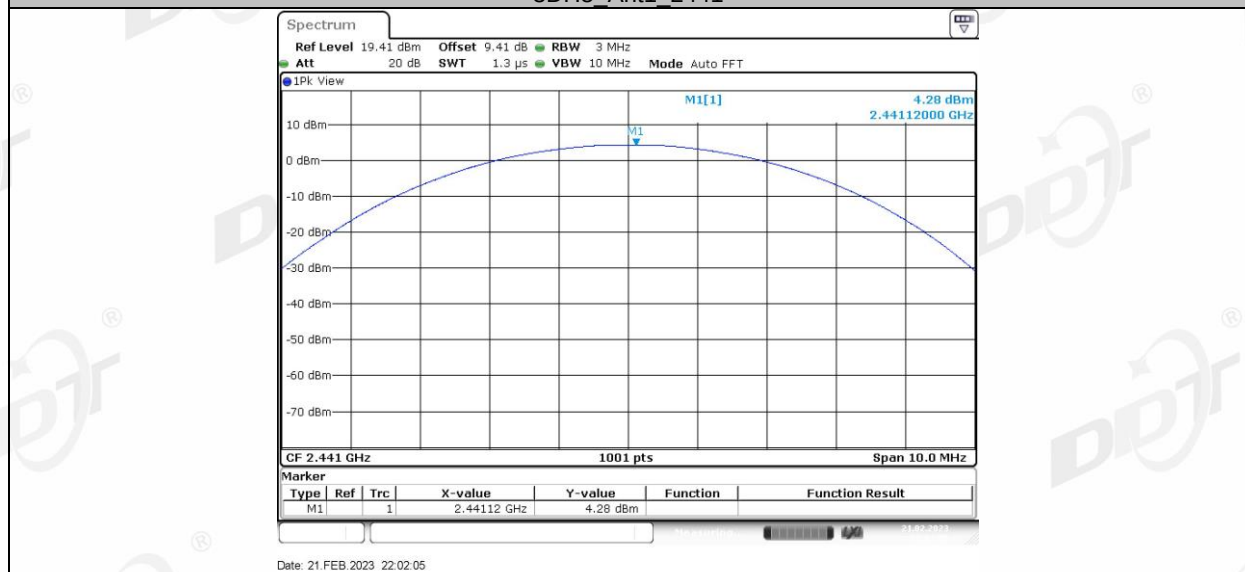




3DH5 Ant1 2402

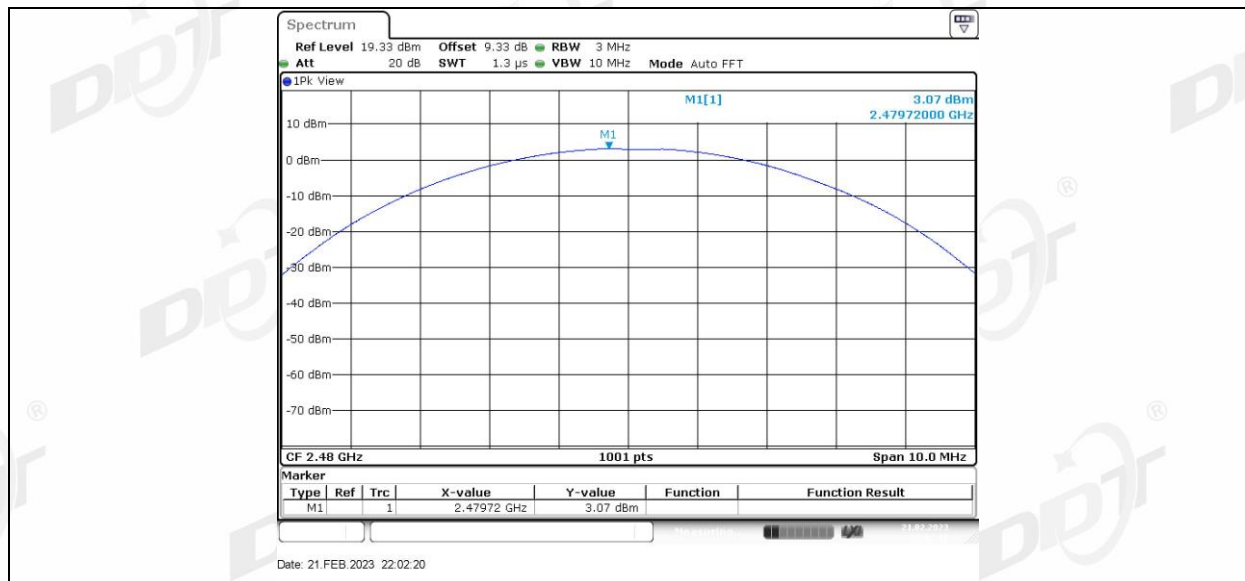


3DH5 Ant1 2441

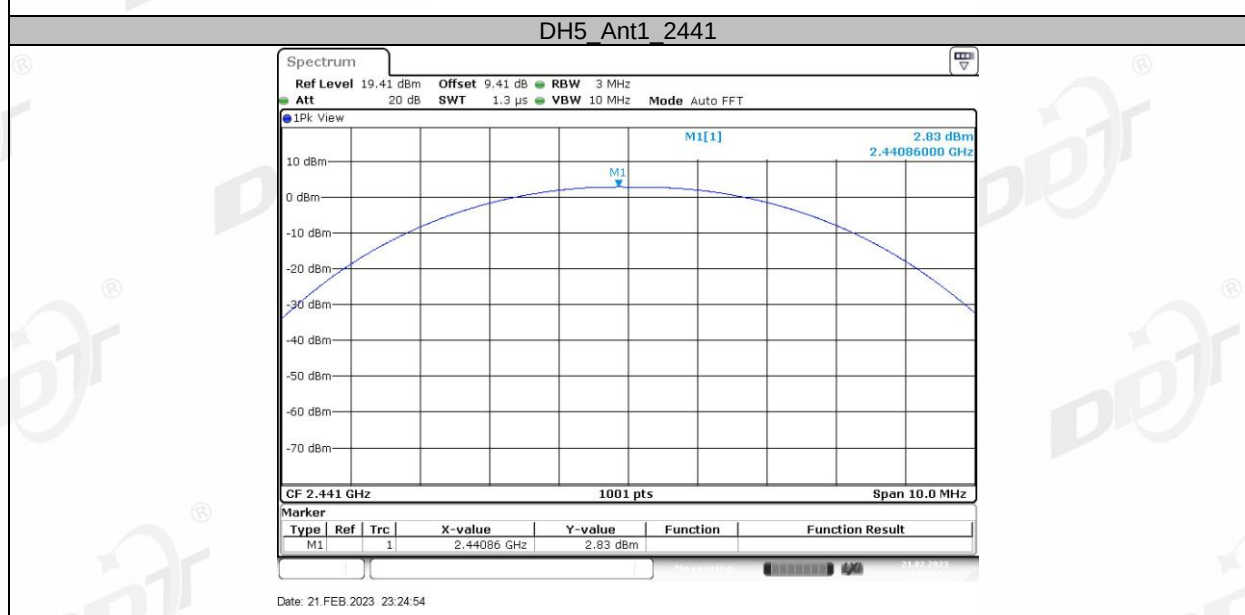
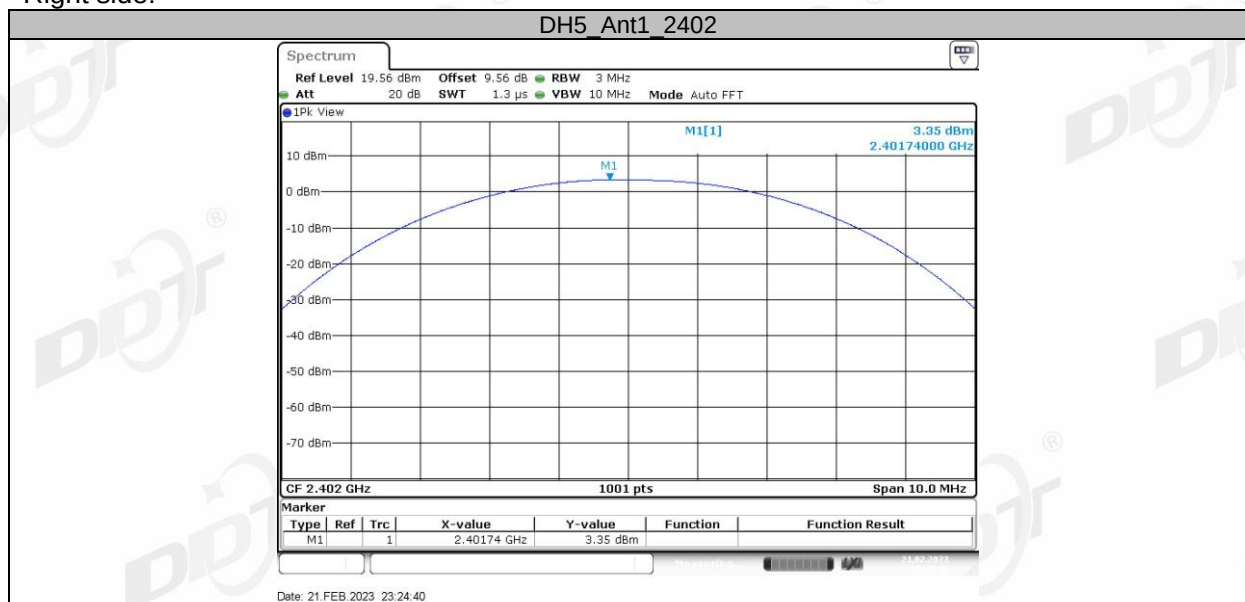


3DH5 Ant1 2480

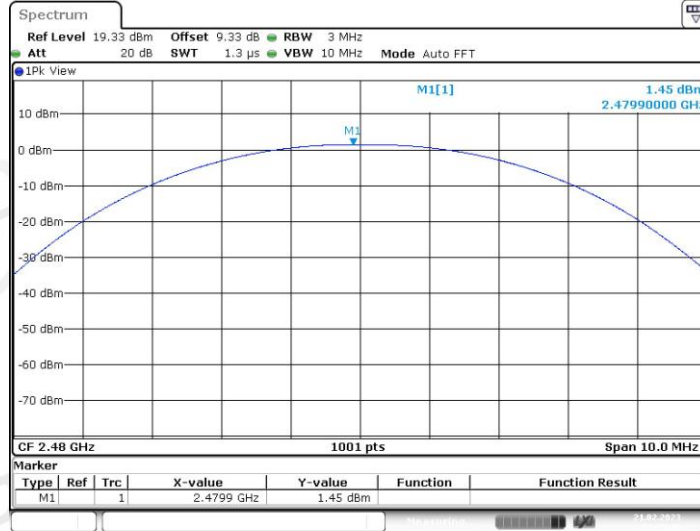




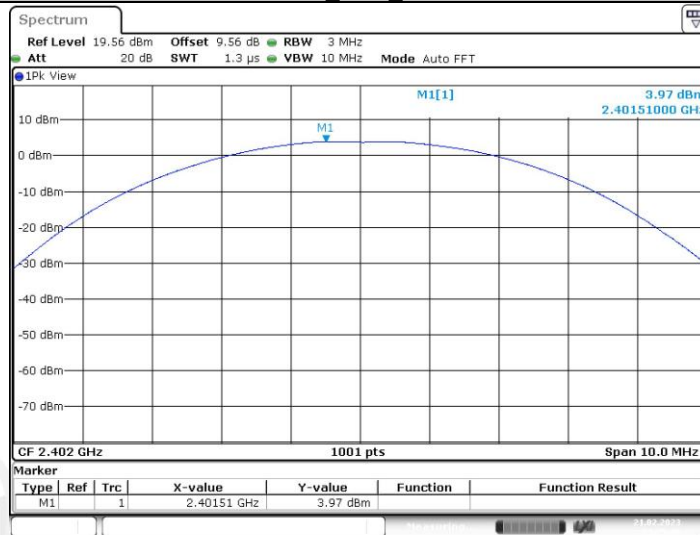
Right side:



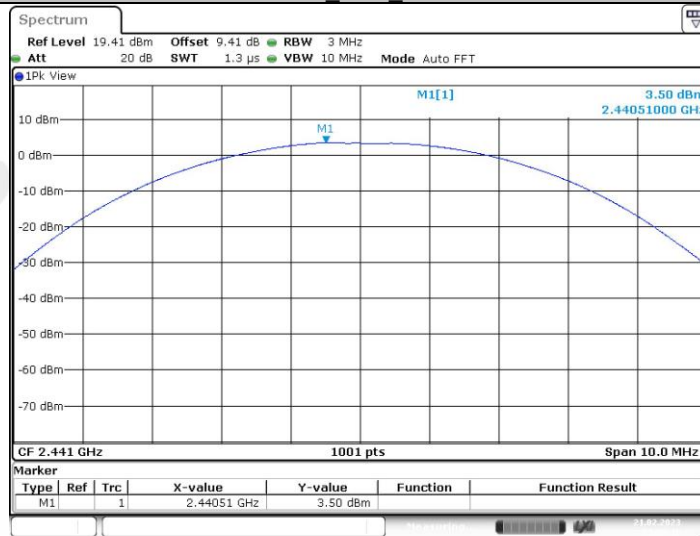
## DH5\_Ant1\_2480



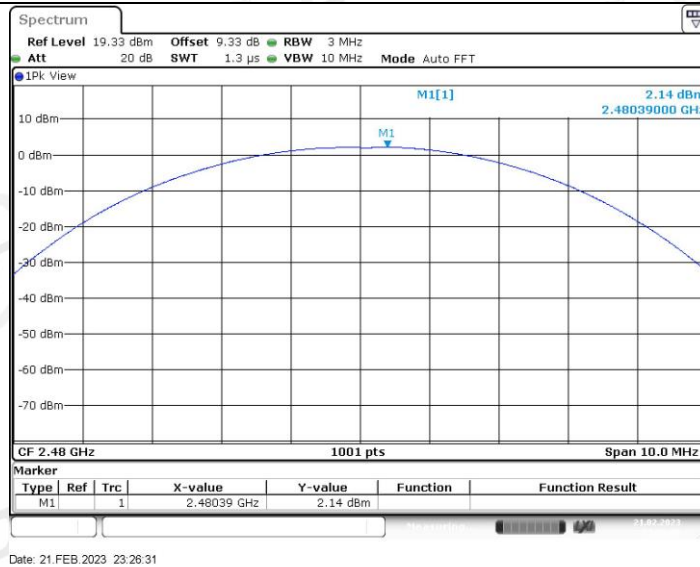
## 2DH5\_Ant1\_2402



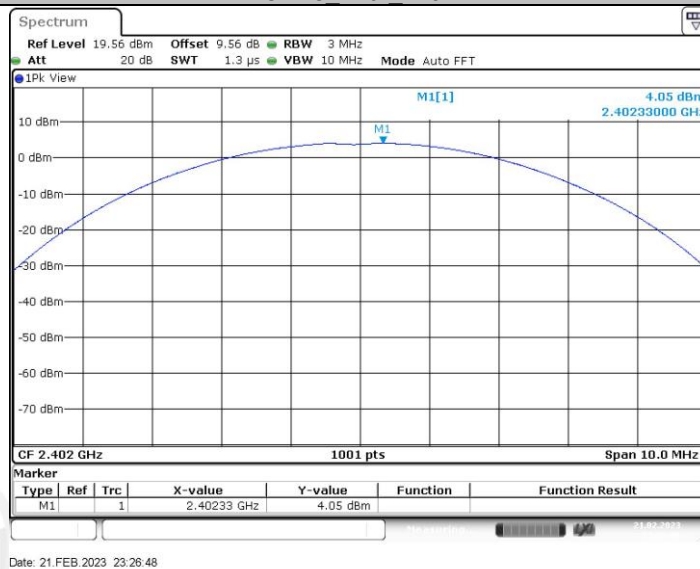
## 2DH5\_Ant1\_2441



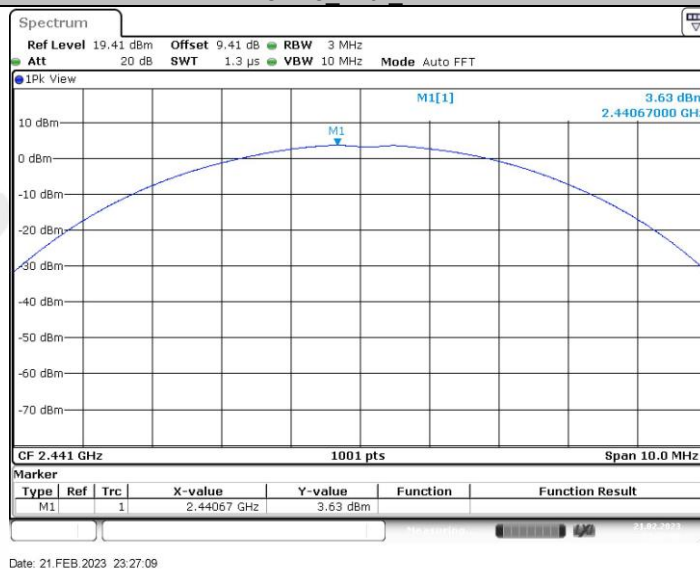
## 2DH5\_Ant1\_2480



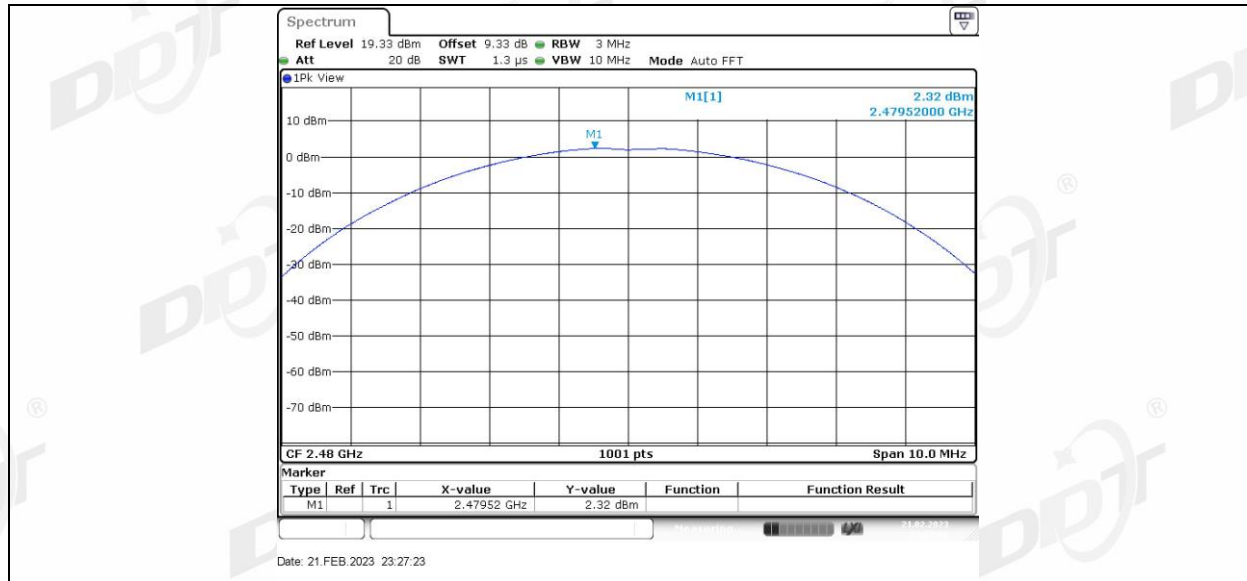
## 3DH5 Ant1 2402



## 3DH5 Ant1 2441



## 3DH5 Ant1 2480



## 5. 20 dB Bandwidth and 99% Bandwidth

### 5.1. Block diagram of test setup

Same as section 4.1

### 5.2. Limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### 5.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 kHz RBW and 100 kHz VBW. The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

### 5.4. Test result

Left side:

| Mode           | Freq. (MHz) | 20 dB bandwidth Result (MHz) | 99% bandwidth Result (MHz) | Verdict |
|----------------|-------------|------------------------------|----------------------------|---------|
| GFSK           | 2402        | 1.02                         | 0.902                      | Pass    |
|                | 2441        | 1.02                         | 0.905                      | Pass    |
|                | 2480        | 1.00                         | 0.899                      | Pass    |
| $\pi/4$ -DQPSK | 2402        | 1.32                         | 1.190                      | Pass    |
|                | 2441        | 1.32                         | 1.187                      | Pass    |
|                | 2480        | 1.30                         | 1.187                      | Pass    |
| 8DPSK          | 2402        | 1.30                         | 1.187                      | Pass    |
|                | 2441        | 1.30                         | 1.190                      | Pass    |
|                | 2480        | 1.30                         | 1.187                      | Pass    |

Right side:

| Mode           | Freq. (MHz) | 20 dB bandwidth Result (MHz) | 99% bandwidth Result (MHz) | Verdict |
|----------------|-------------|------------------------------|----------------------------|---------|
| GFSK           | 2402        | 1.01                         | 0.896                      | Pass    |
|                | 2441        | 1.01                         | 0.899                      | Pass    |
|                | 2480        | 0.99                         | 0.893                      | Pass    |
| $\pi/4$ -DQPSK | 2402        | 1.29                         | 1.187                      | Pass    |
|                | 2441        | 1.30                         | 1.187                      | Pass    |
|                | 2480        | 1.30                         | 1.181                      | Pass    |
| 8DPSK          | 2402        | 1.30                         | 1.184                      | Pass    |
|                | 2441        | 1.30                         | 1.187                      | Pass    |
|                | 2480        | 1.30                         | 1.184                      | Pass    |

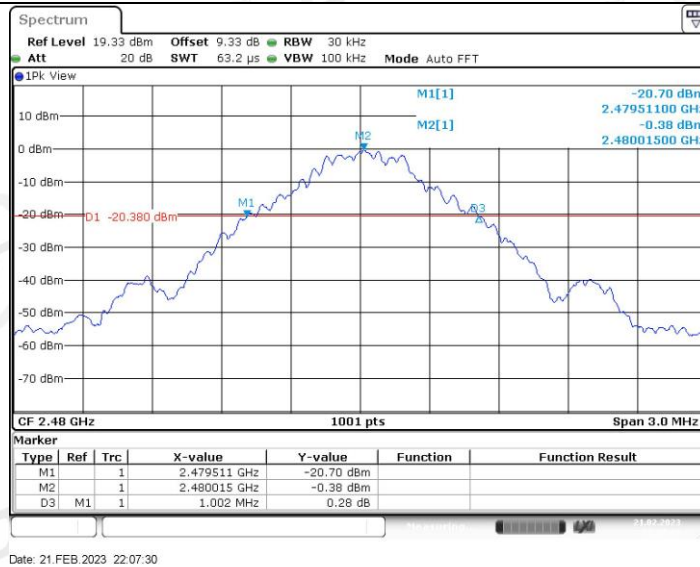


## 5.5. Original test data

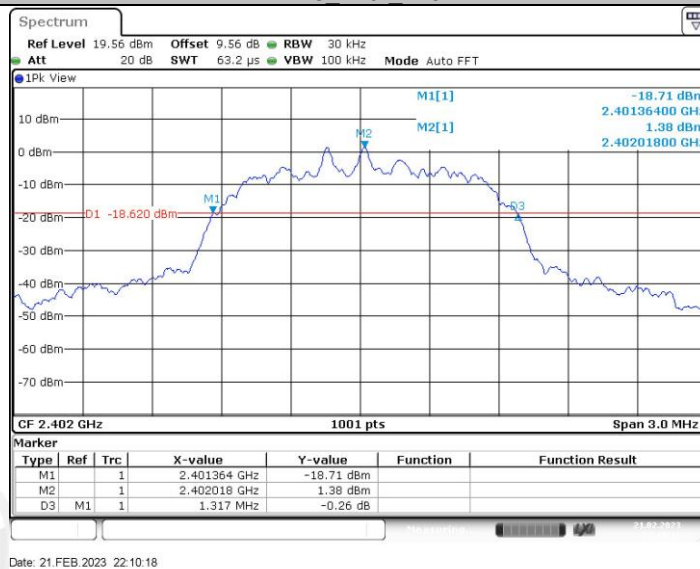
Left side:

20 dB bandwidth

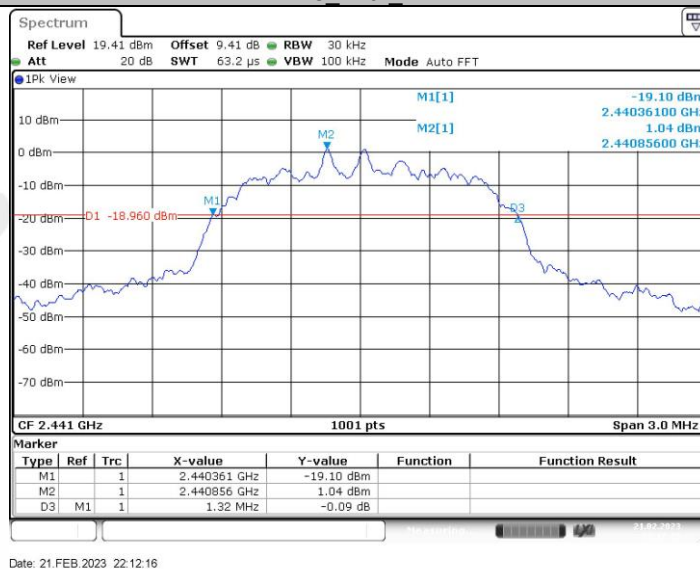




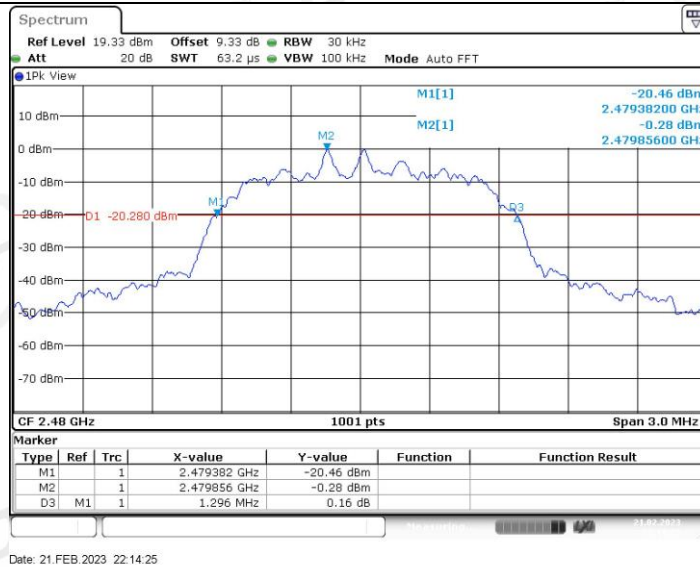
2DH5 Ant1 2402



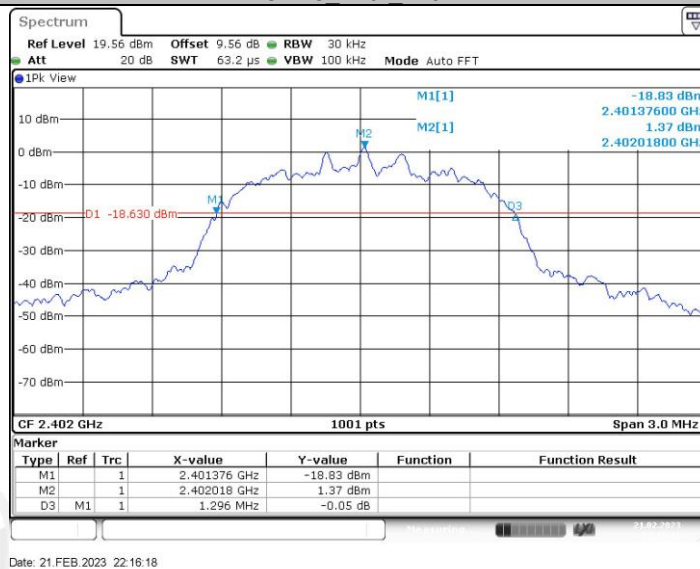
2DH5 Ant1 2441



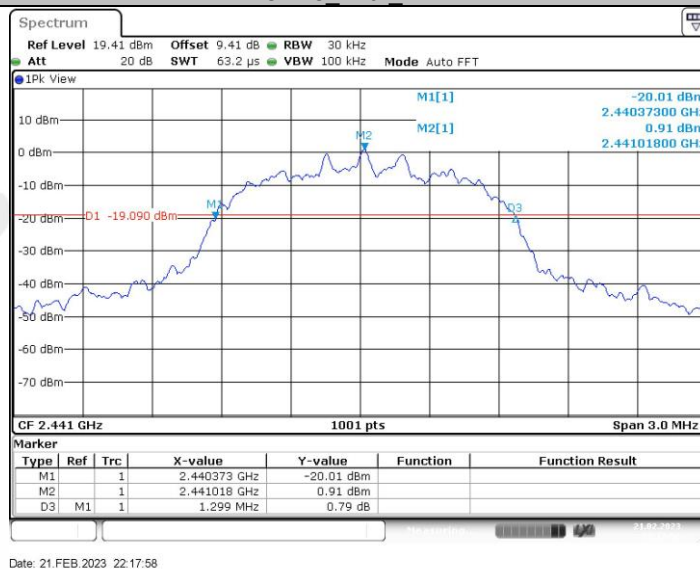
2DH5 Ant1 2480



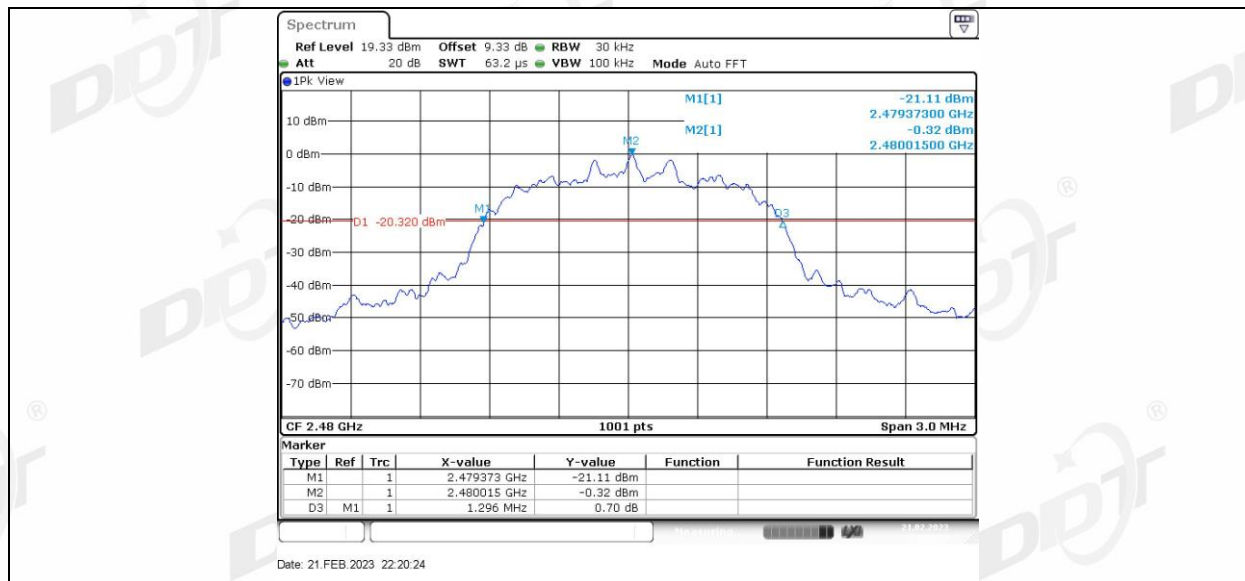
## 3DH5 Ant1 2402



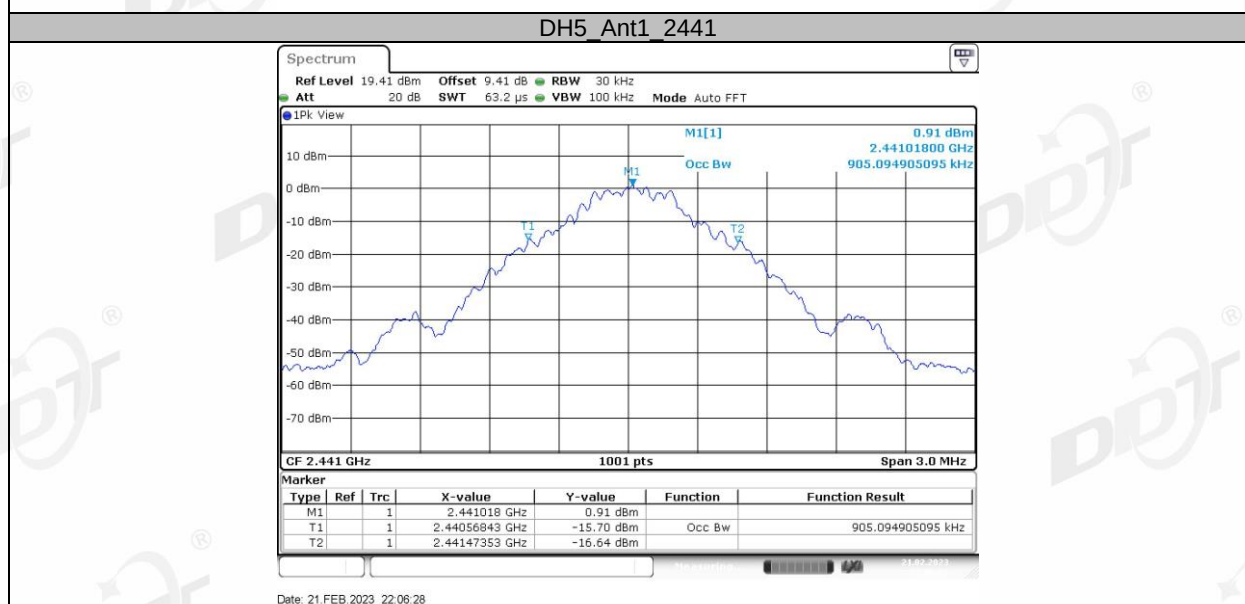
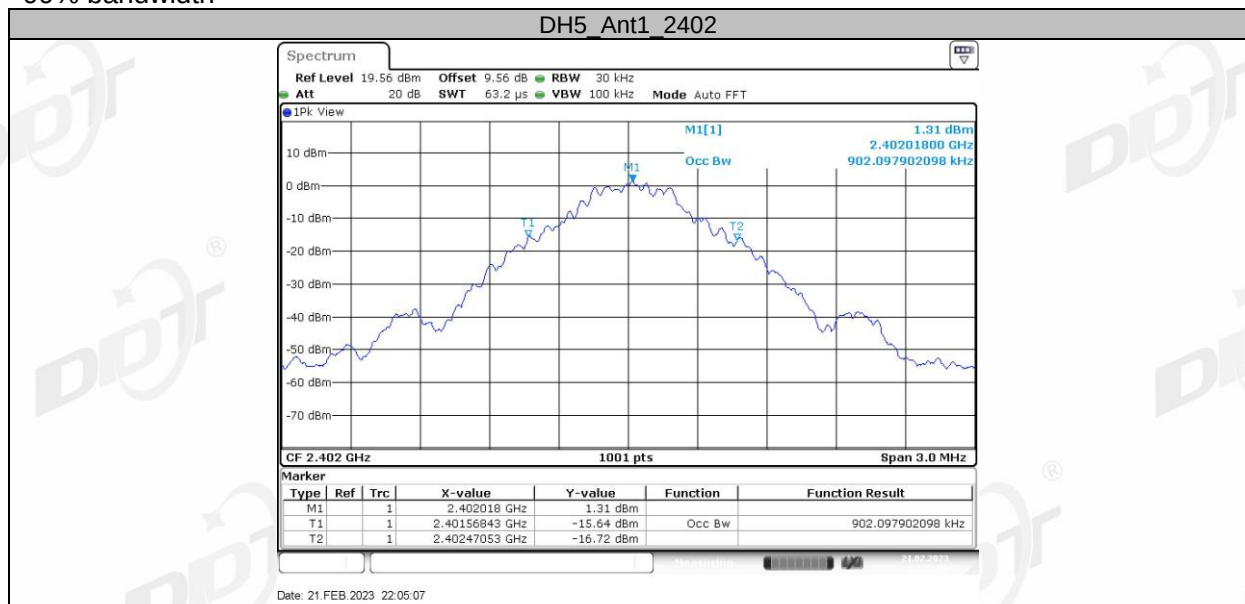
## 3DH5 Ant1 2441



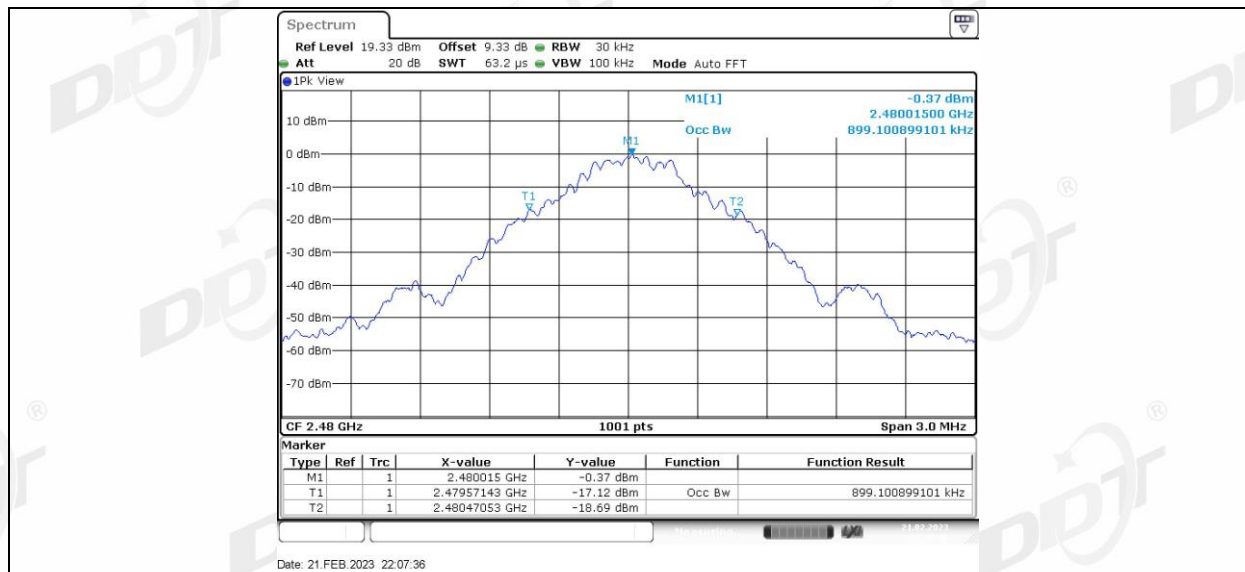
## 3DH5 Ant1 2480



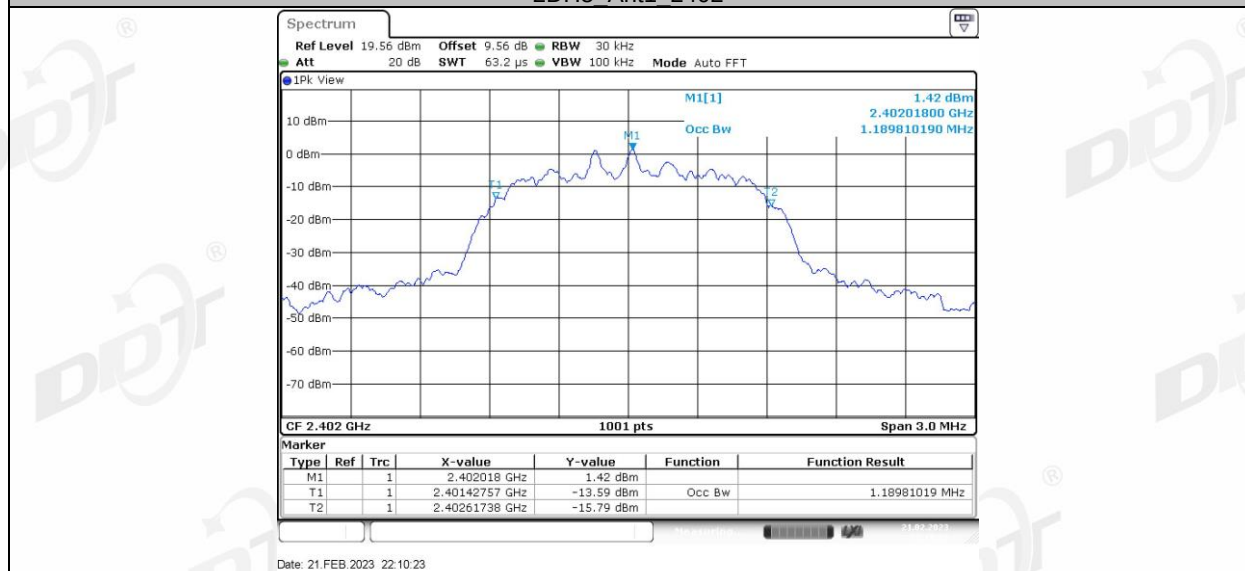
99% bandwidth



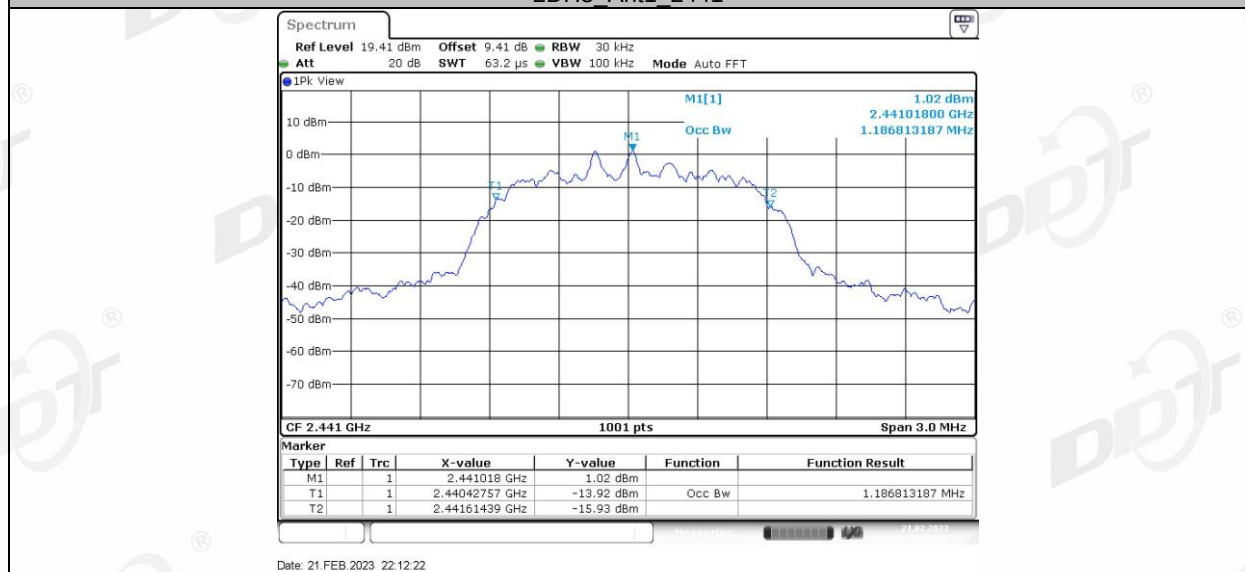
DH5\_Ant1\_2480



## 2DH5 Ant1 2402



## 2DH5 Ant1 2441

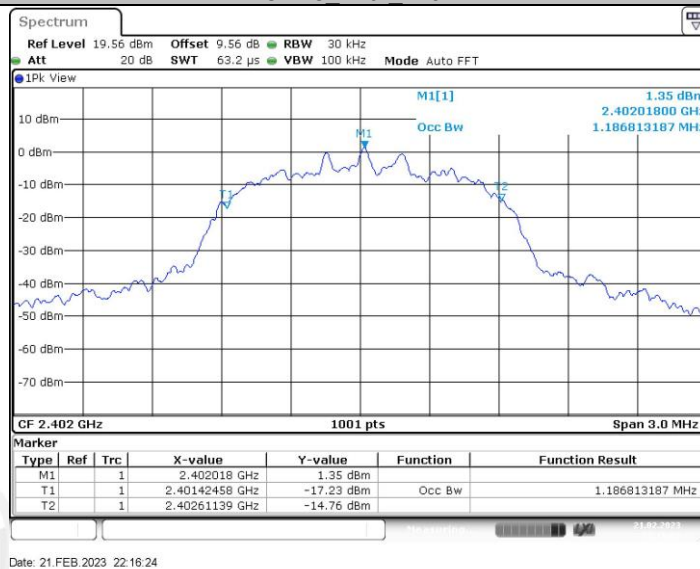


## 2DH5 Ant1 2480

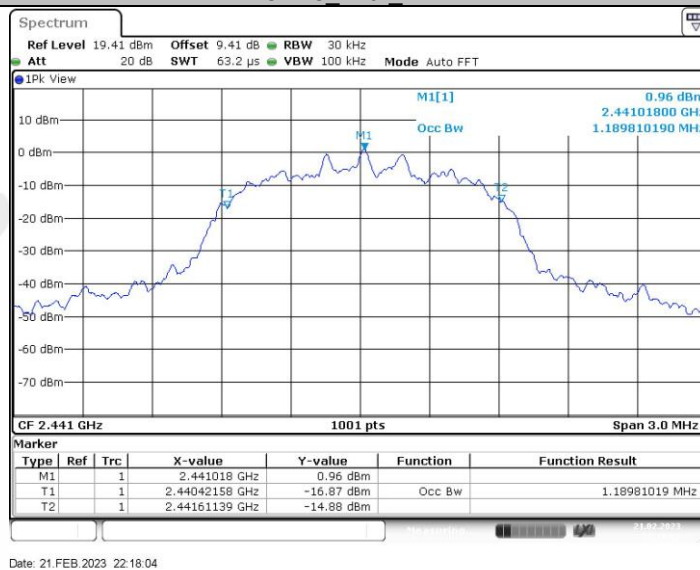




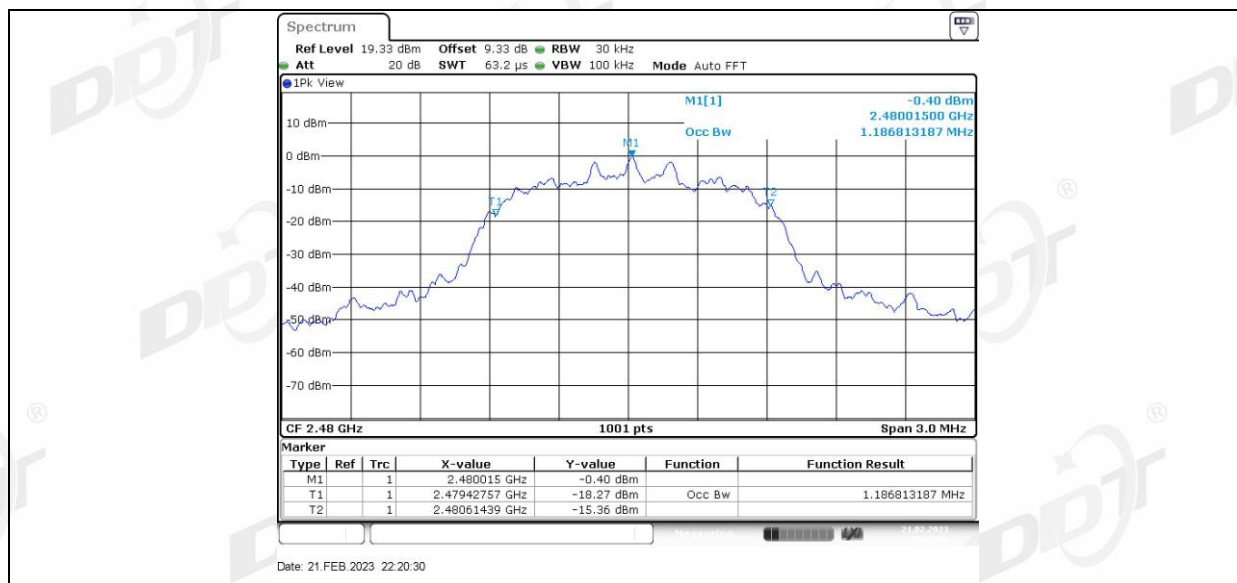
## 3DH5 Ant1 2402



## 3DH5 Ant1 2441



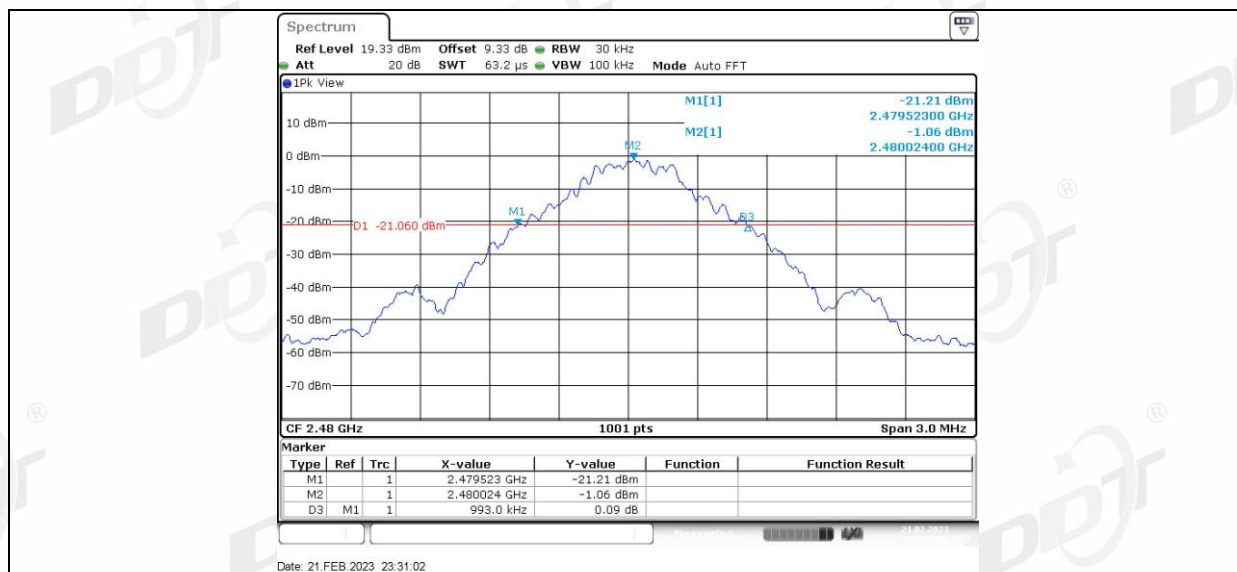
## 3DH5 Ant1 2480



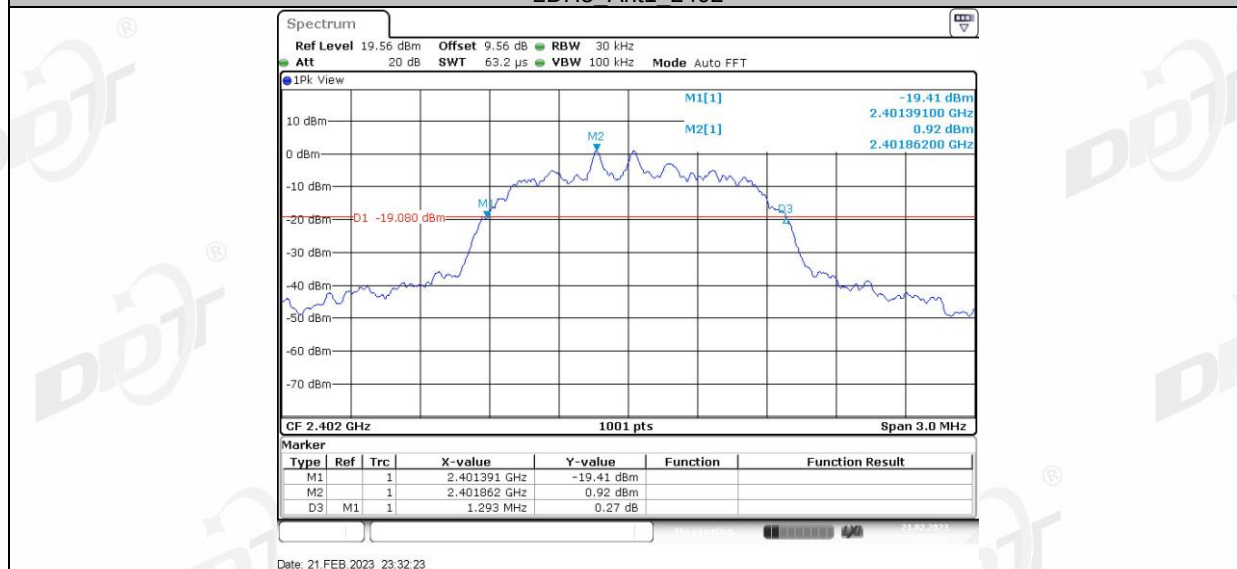
Right side:

20 dB bandwidth

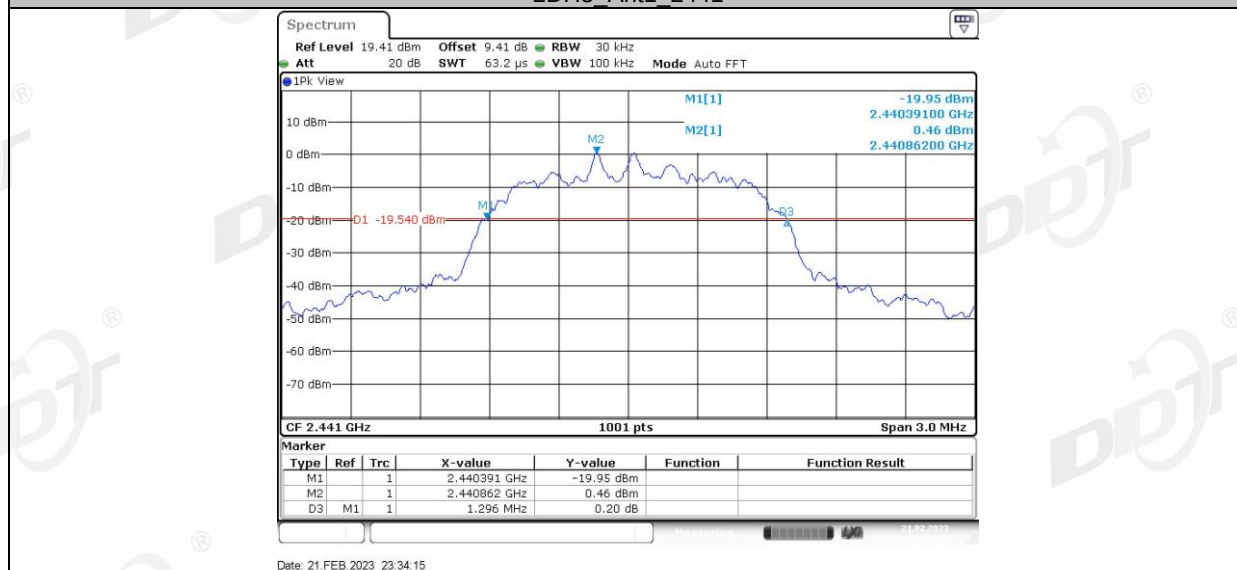




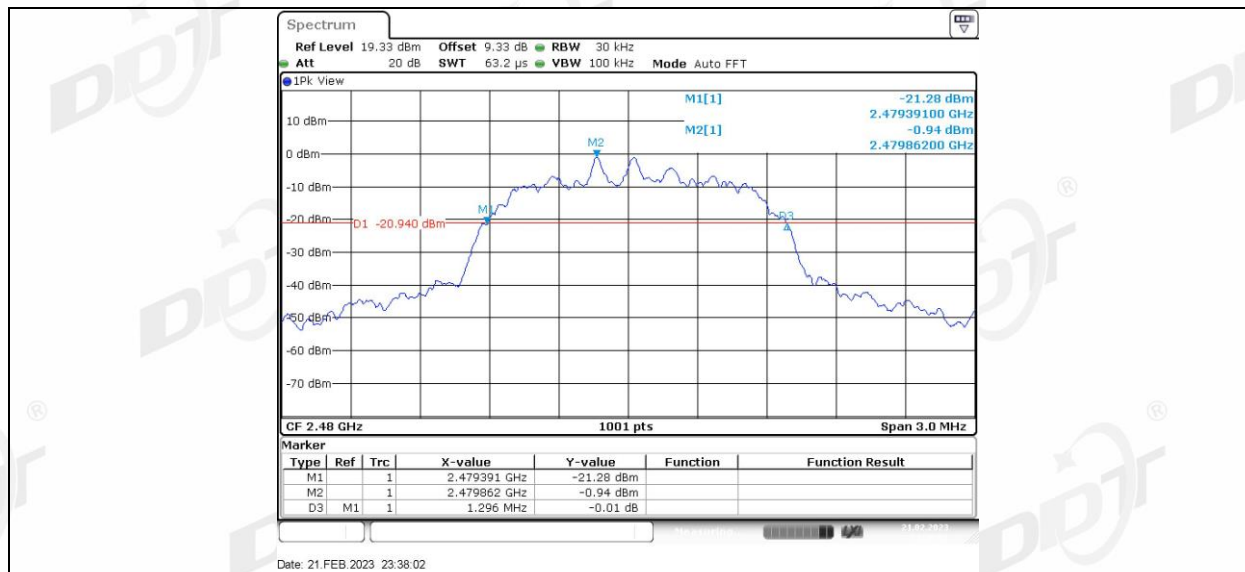
## 2DH5 Ant1 2402



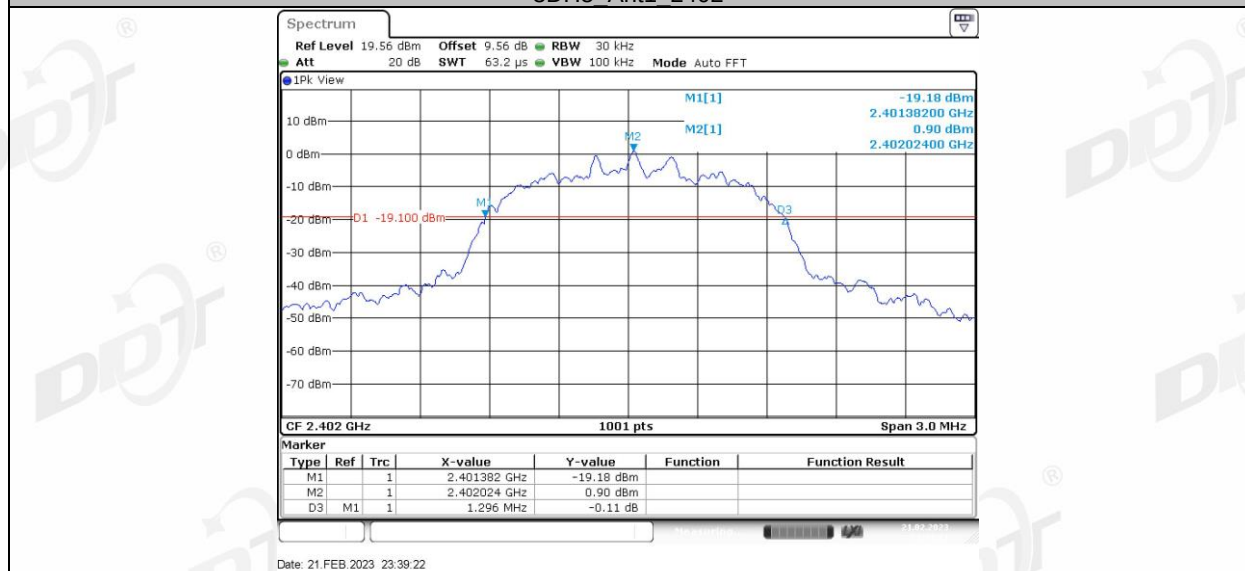
## 2DH5 Ant1 2441



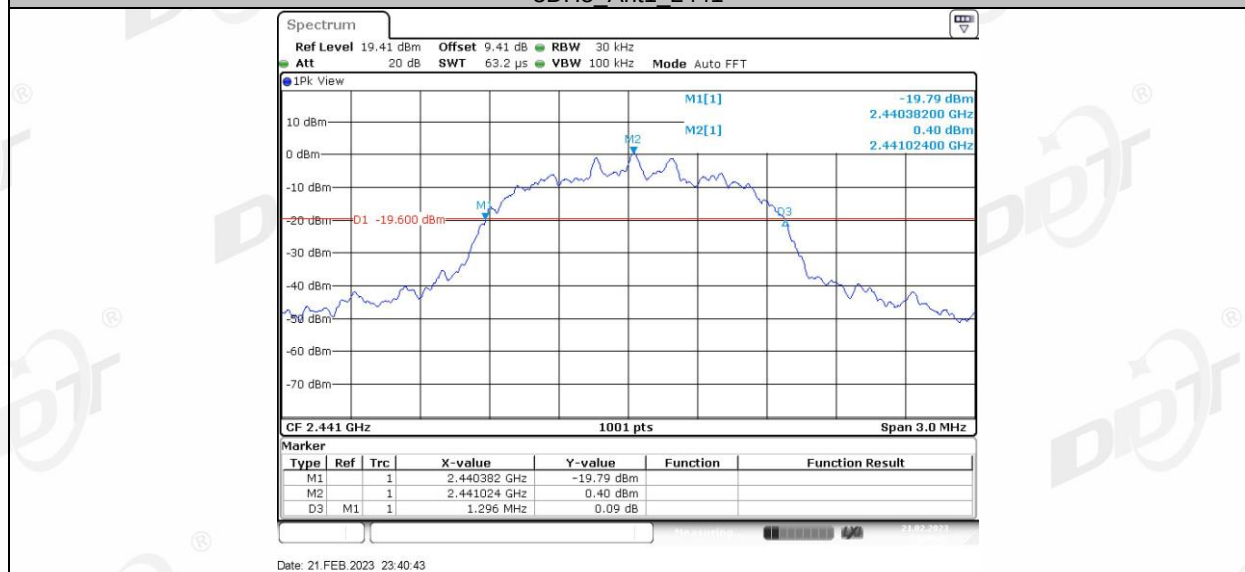
## 2DH5 Ant1 2480



## 3DH5 Ant1 2402

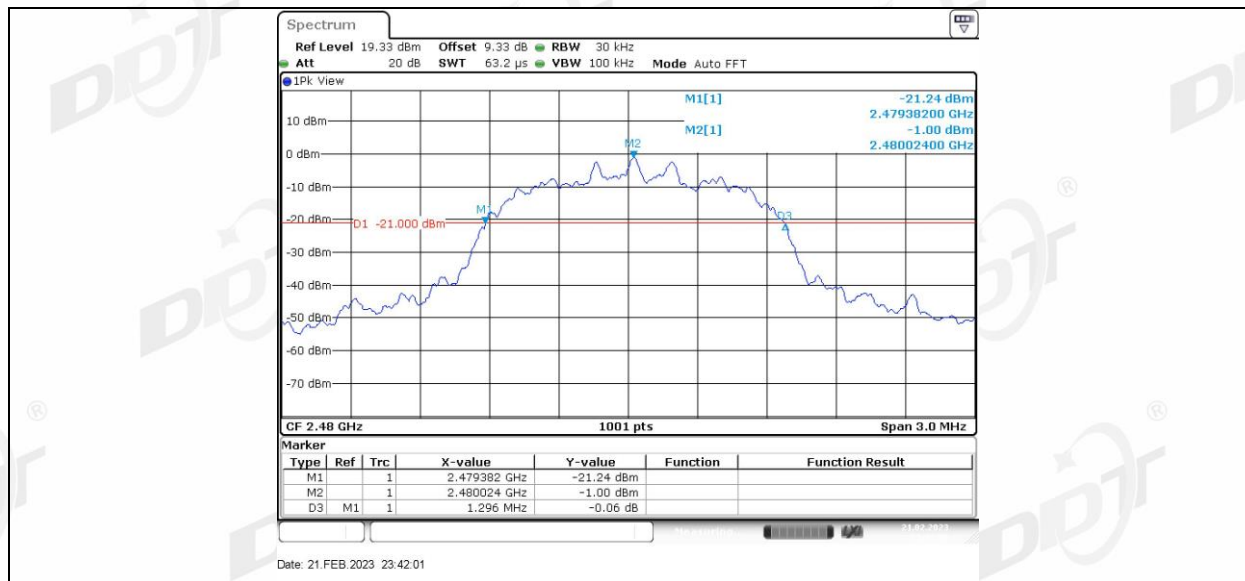


## 3DH5 Ant1 2441



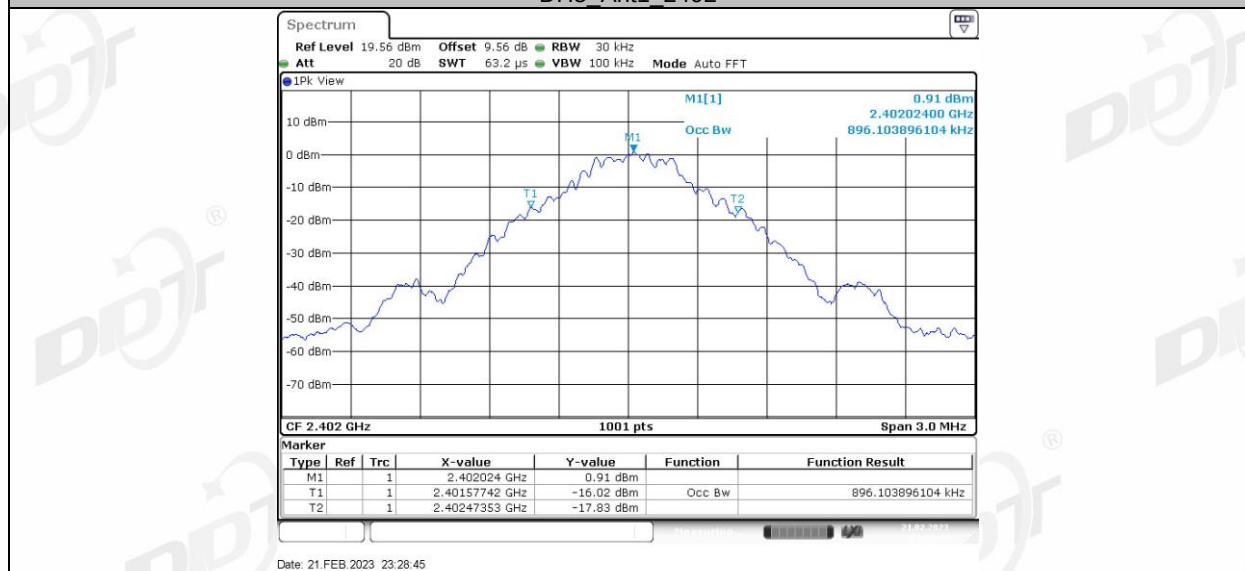
## 3DH5 Ant1 2480



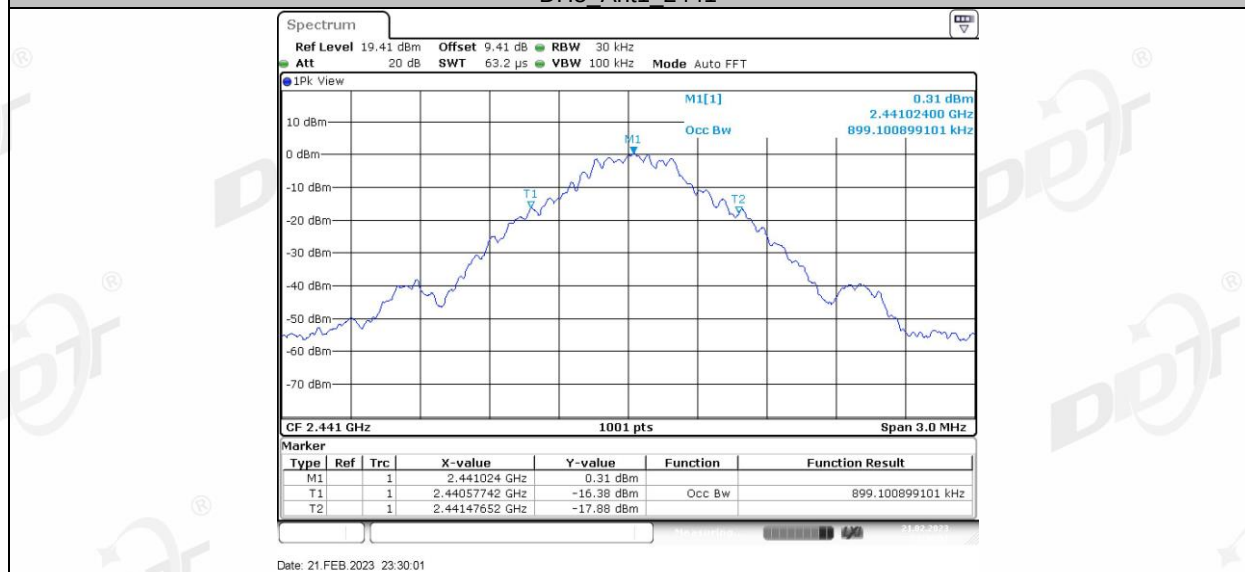


99% bandwidth

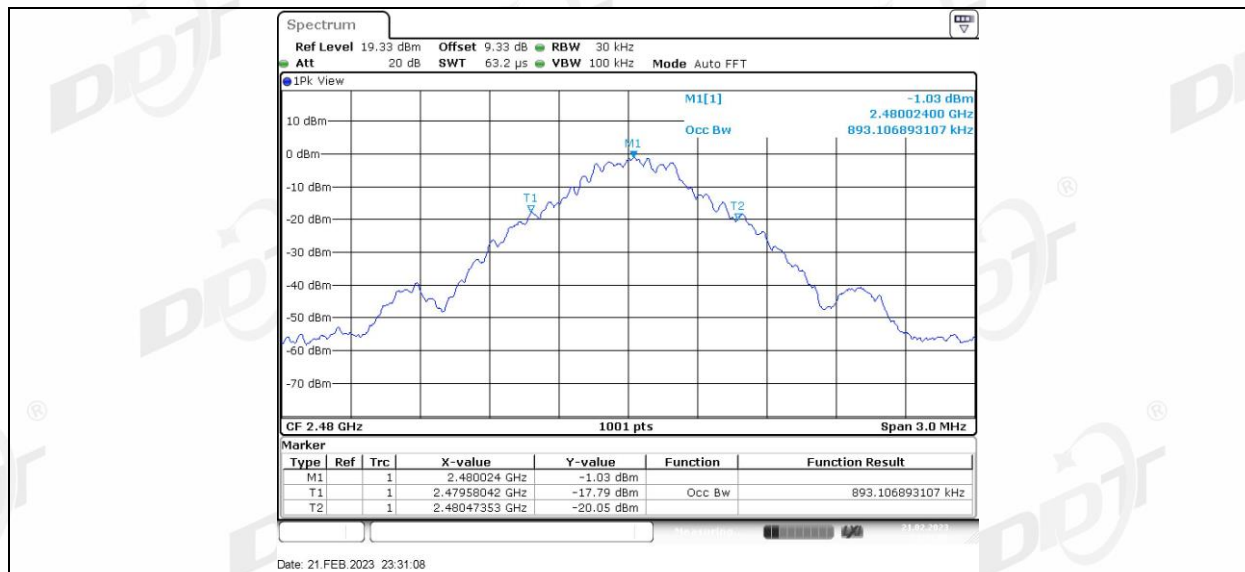
## DH5\_Ant1\_2402



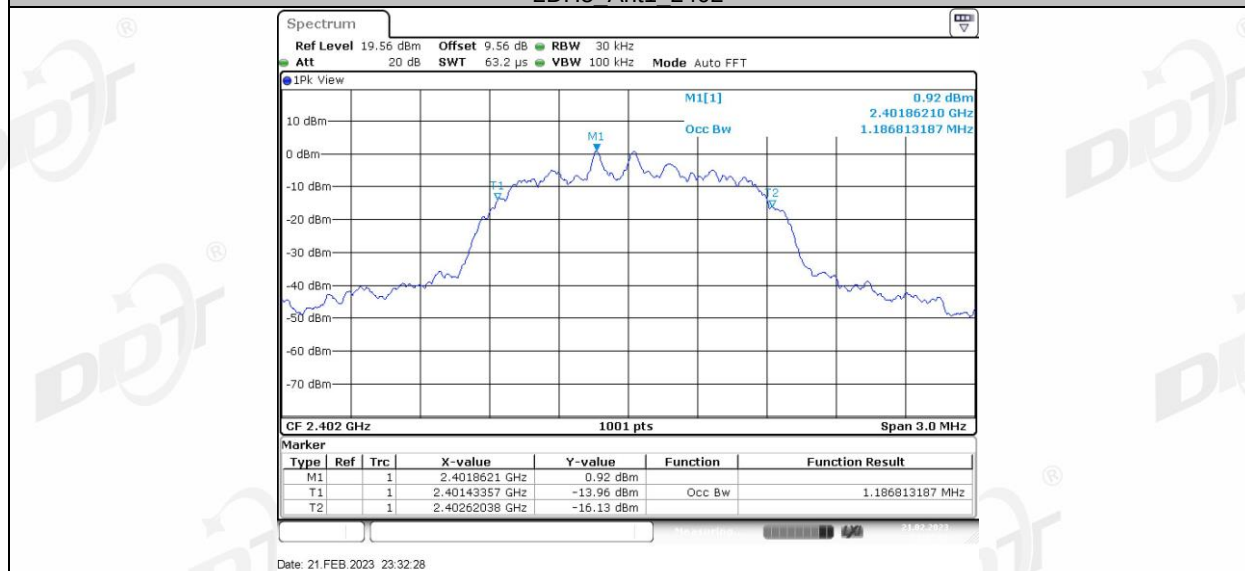
## DH5\_Ant1\_2441



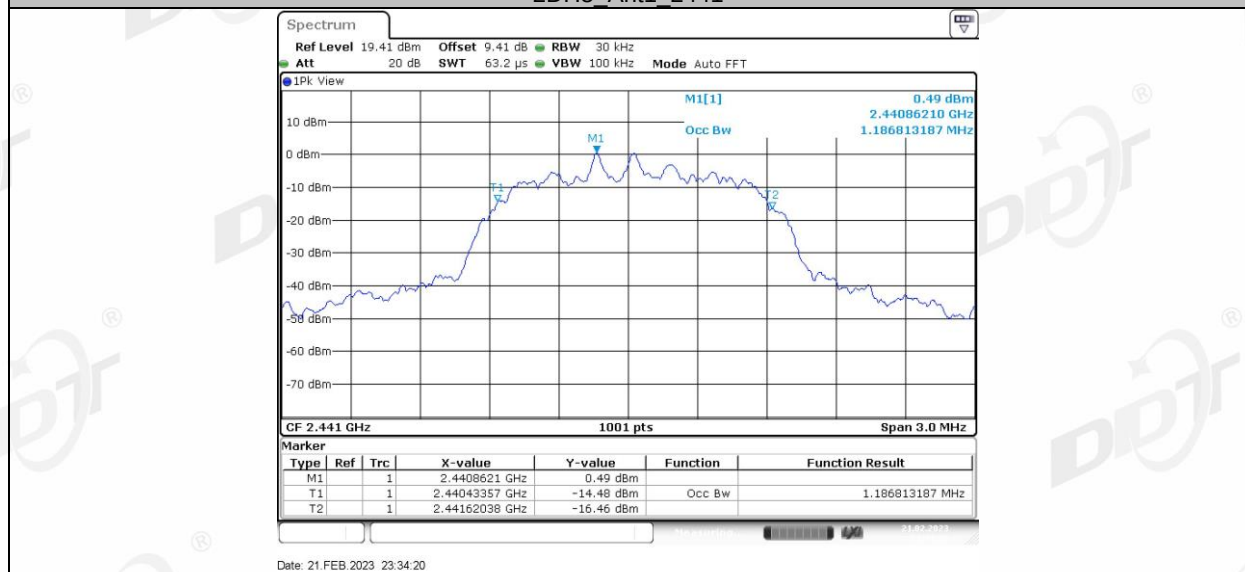
## DH5\_Ant1\_2480



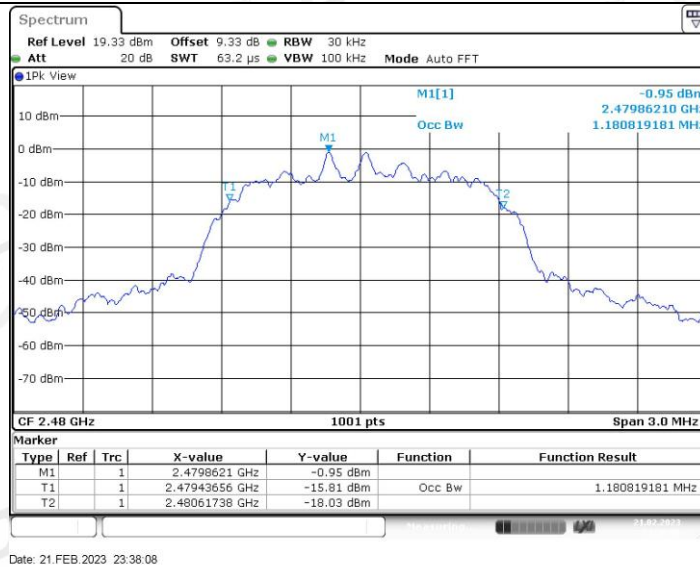
## 2DH5 Ant1 2402



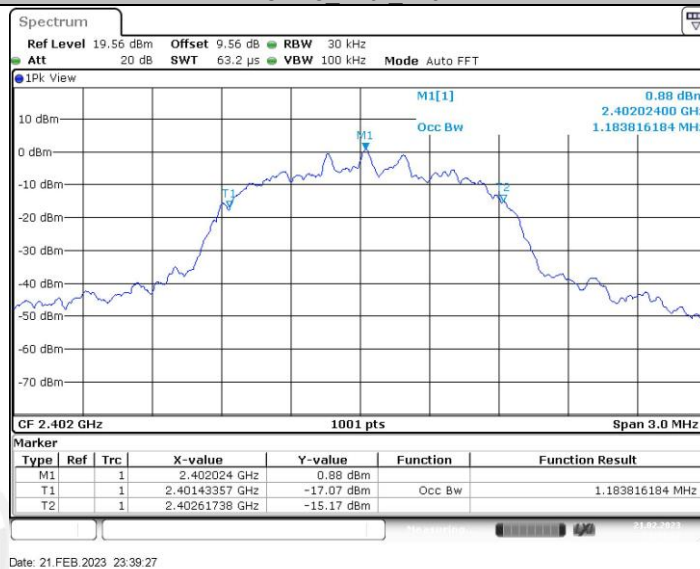
## 2DH5 Ant1 2441



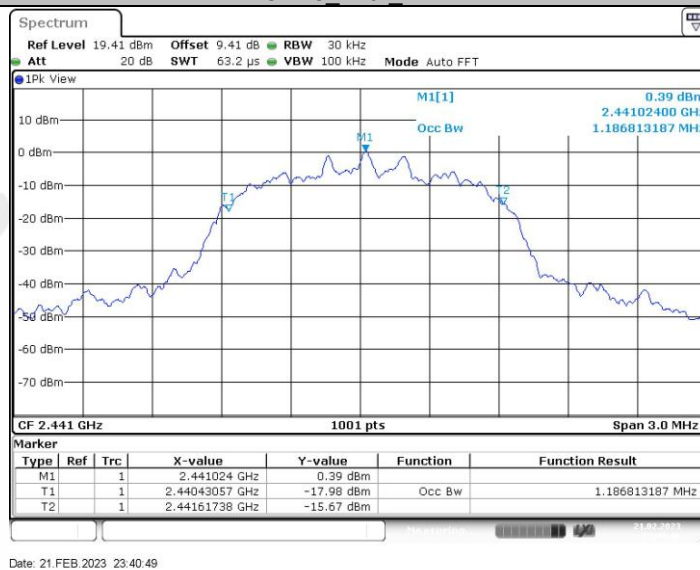
## 2DH5 Ant1 2480



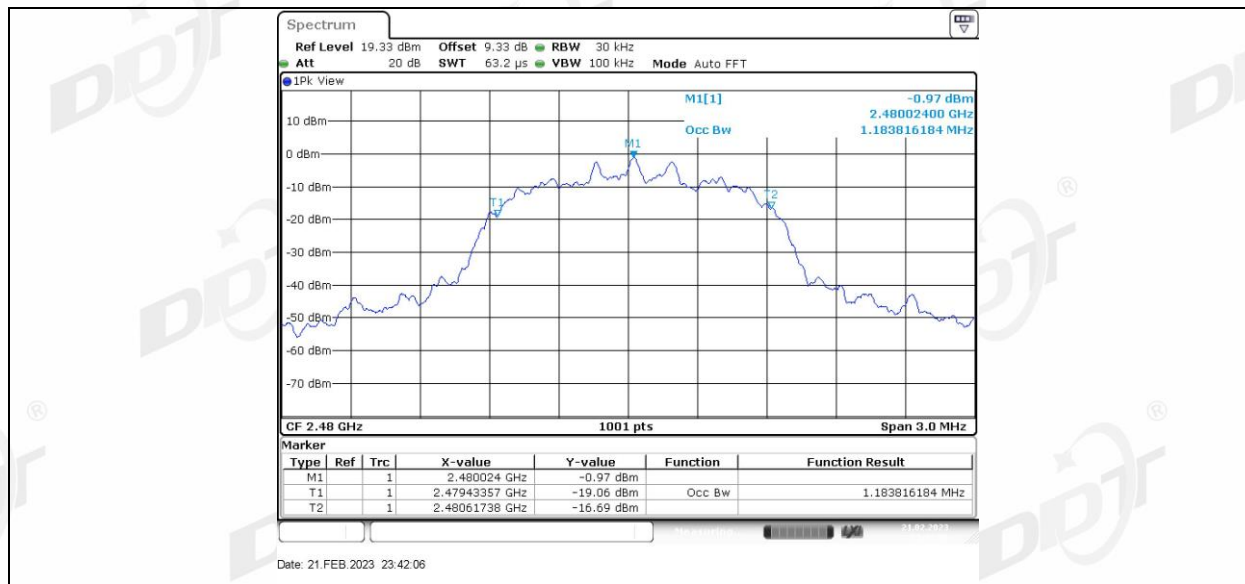
## 3DH5 Ant1 2402



## 3DH5 Ant1 2441



## 3DH5 Ant1 2480



## 6. Carrier Frequency Separation

### 6.1. Block diagram of test setup

Same as section 4.1

### 6.2. Limits

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.

### 6.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) The carrier frequency was measured by spectrum analyzer with 300 kHz RBW and 300 kHz VBW.

### 6.4. Test result

Left side:

| Mode           | Channel separation (MHz) | 20 dB bandwidth (MHz) (worse case) | Limit (MHz) 2/3 of 20 dB bandwidth | Verdict |
|----------------|--------------------------|------------------------------------|------------------------------------|---------|
| GFSK           | 1.006                    | 1.02                               | $\geq 0.680$                       | Pass    |
| $\pi/4$ -DQPSK | 1.003                    | 1.32                               | $\geq 0.880$                       | Pass    |
| 8DPSK          | 1.012                    | 1.30                               | $\geq 0.867$                       | Pass    |

Right side:

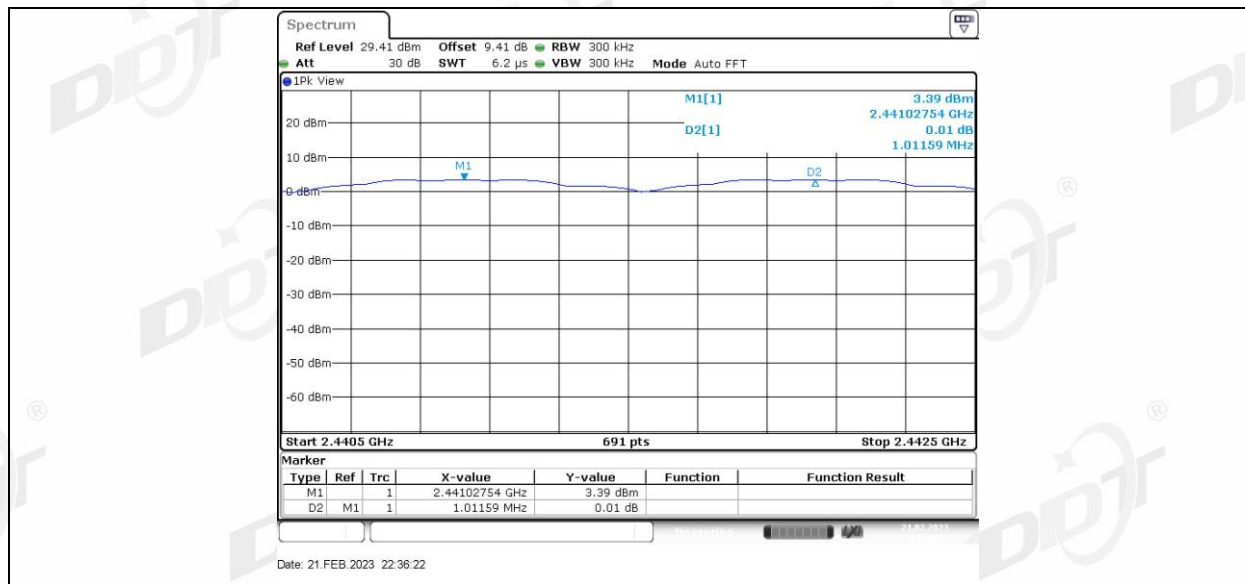
| Mode           | Channel separation (MHz) | 20 dB bandwidth (MHz) (worse case) | Limit (MHz) 2/3 of 20 dB bandwidth | Verdict |
|----------------|--------------------------|------------------------------------|------------------------------------|---------|
| GFSK           | 1.148                    | 1.01                               | $\geq 0.673$                       | Pass    |
| $\pi/4$ -DQPSK | 0.983                    | 1.30                               | $\geq 0.867$                       | Pass    |
| 8DPSK          | 1.009                    | 1.30                               | $\geq 0.867$                       | Pass    |



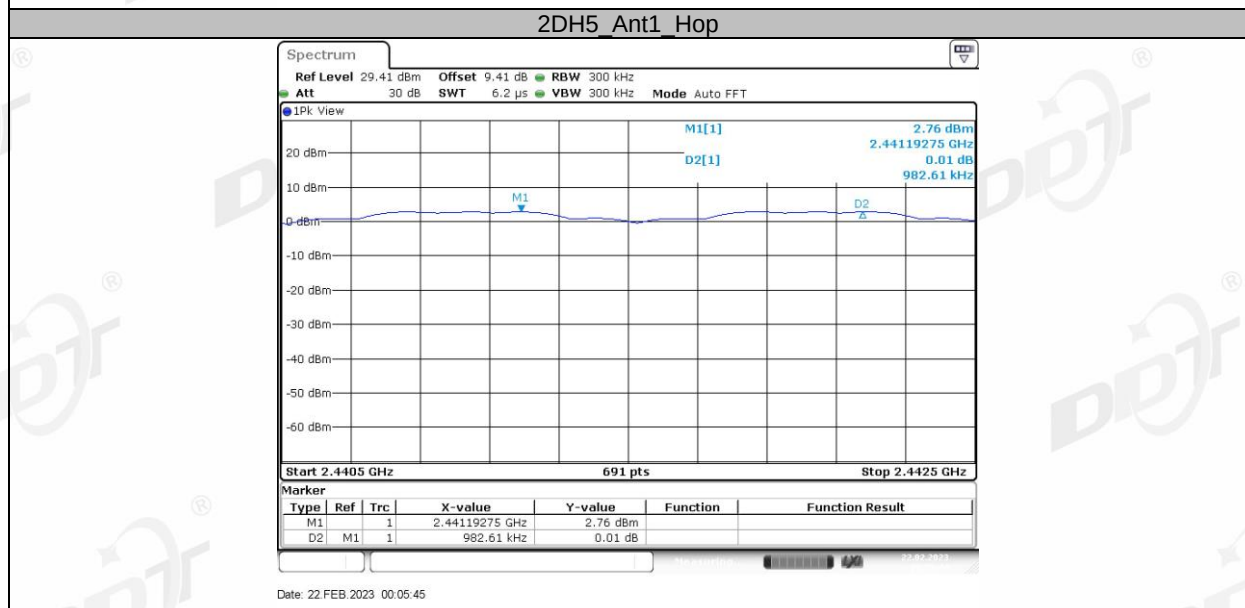
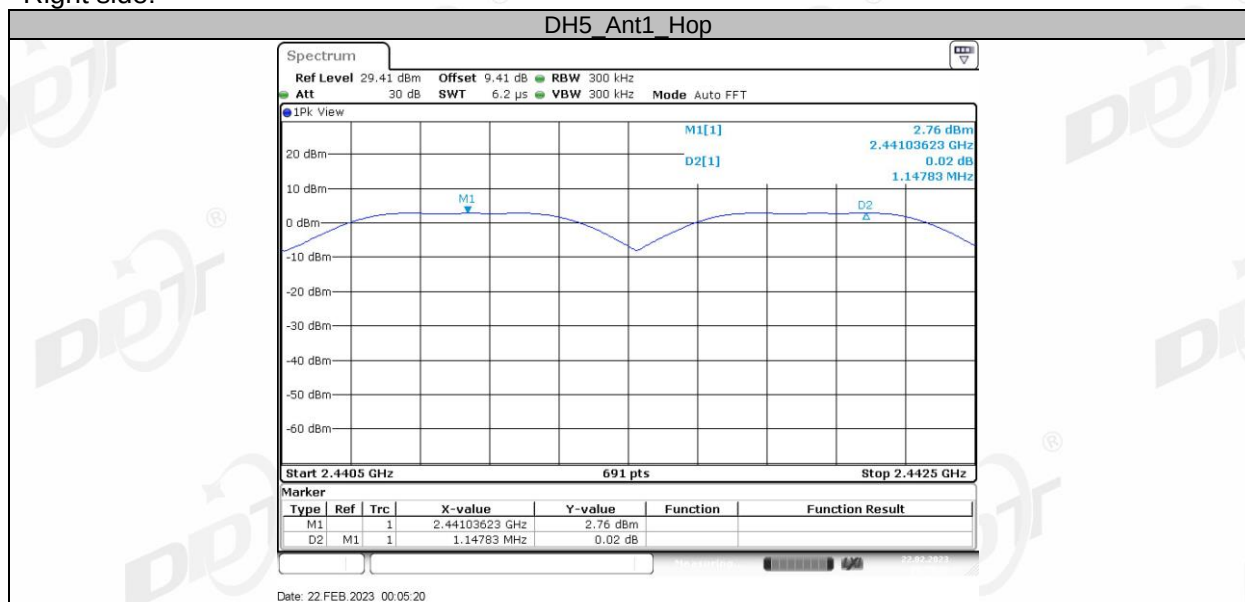
## 6.5. Original test data

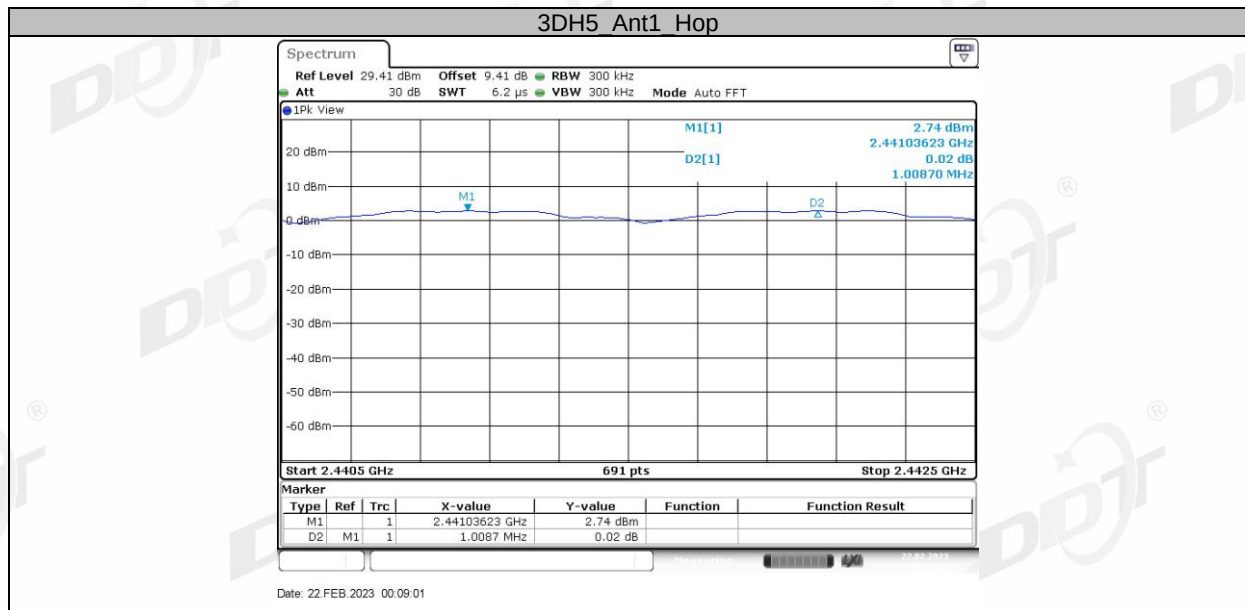
Left side:





Right side:





## 7. Number of Hopping Channel

### 7.1. Block diagram of test setup

Same as section 4.1

### 7.2. Limits

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

### 7.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) The number of hopping channels was measured by spectrum analyzer with 300 kHz RBW and 300 kHz VBW.

### 7.4. Test result

Left side:

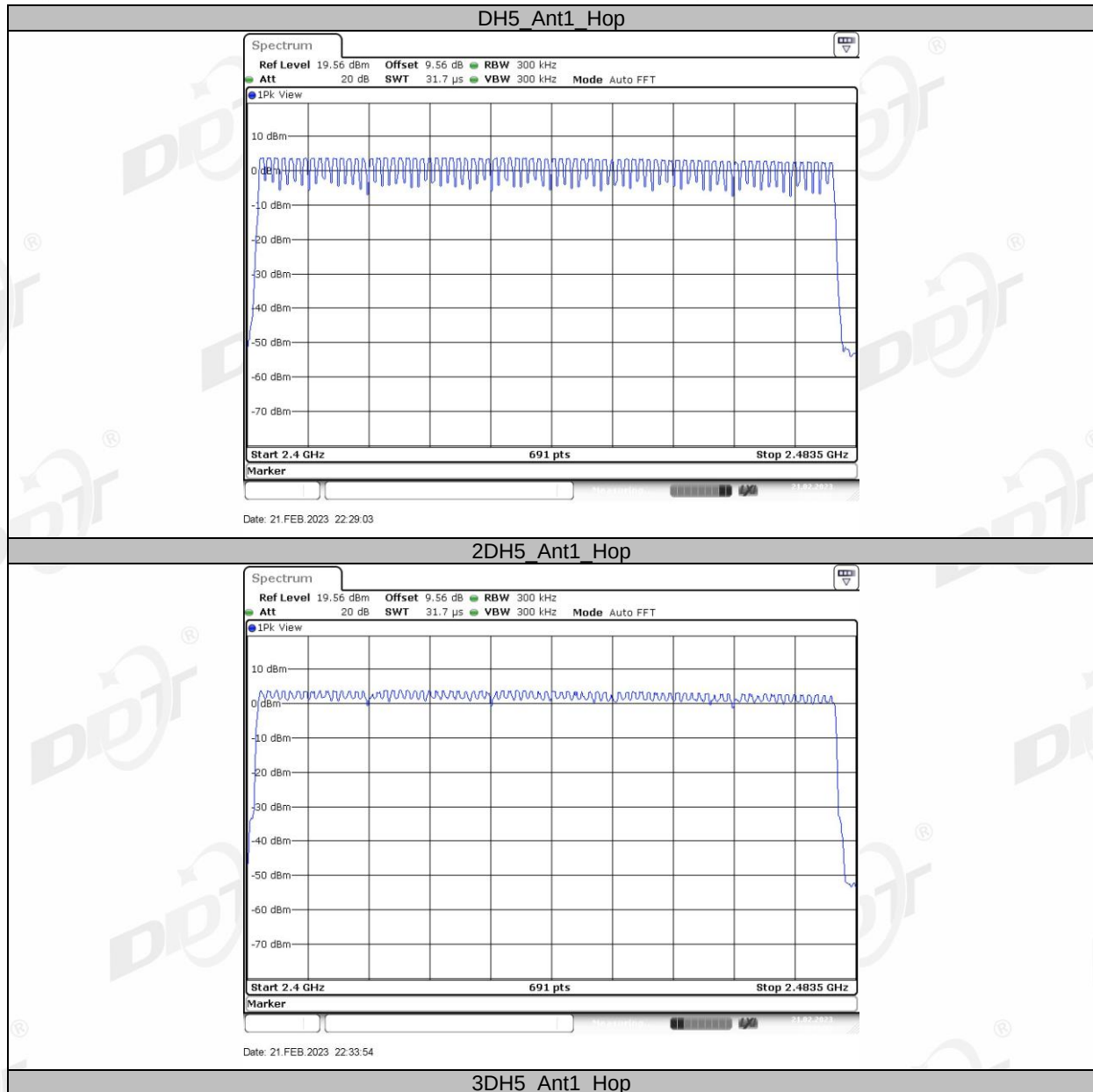
| Mode           | Number of hopping channels | Limit | Verdict |
|----------------|----------------------------|-------|---------|
| GFSK           | 79                         | >15   | Pass    |
| $\pi/4$ -DQPSK | 79                         | >15   | Pass    |
| 8DPSK          | 79                         | >15   | Pass    |

Right side:

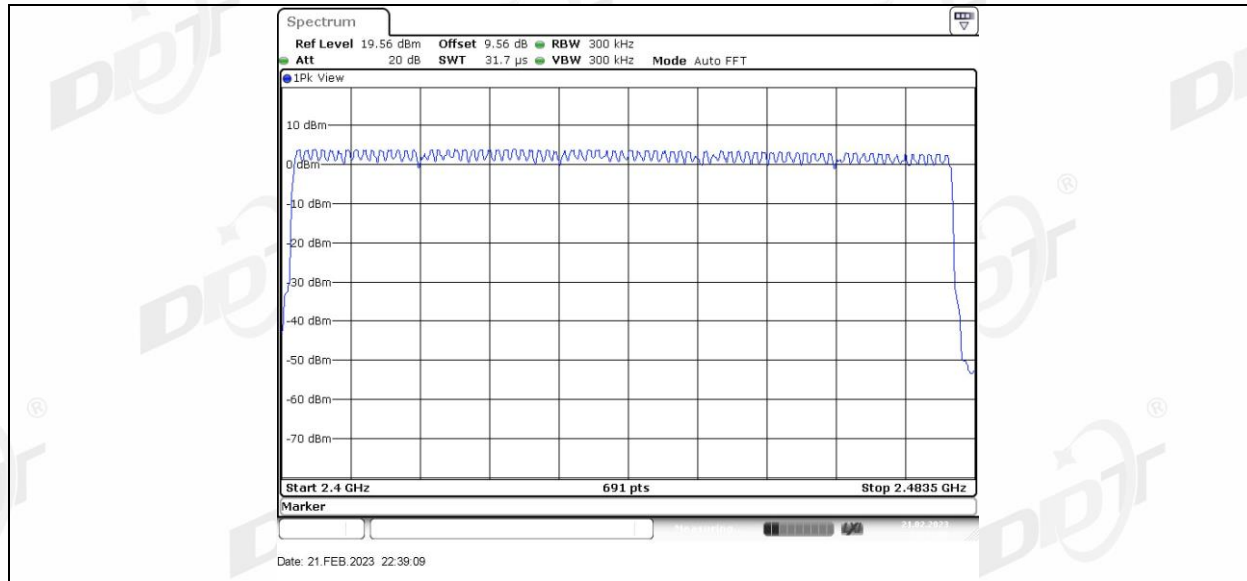
| Mode           | Number of hopping channels | Limit | Verdict |
|----------------|----------------------------|-------|---------|
| GFSK           | 79                         | >15   | Pass    |
| $\pi/4$ -DQPSK | 79                         | >15   | Pass    |
| 8DPSK          | 79                         | >15   | Pass    |

## 7.5. Original test data

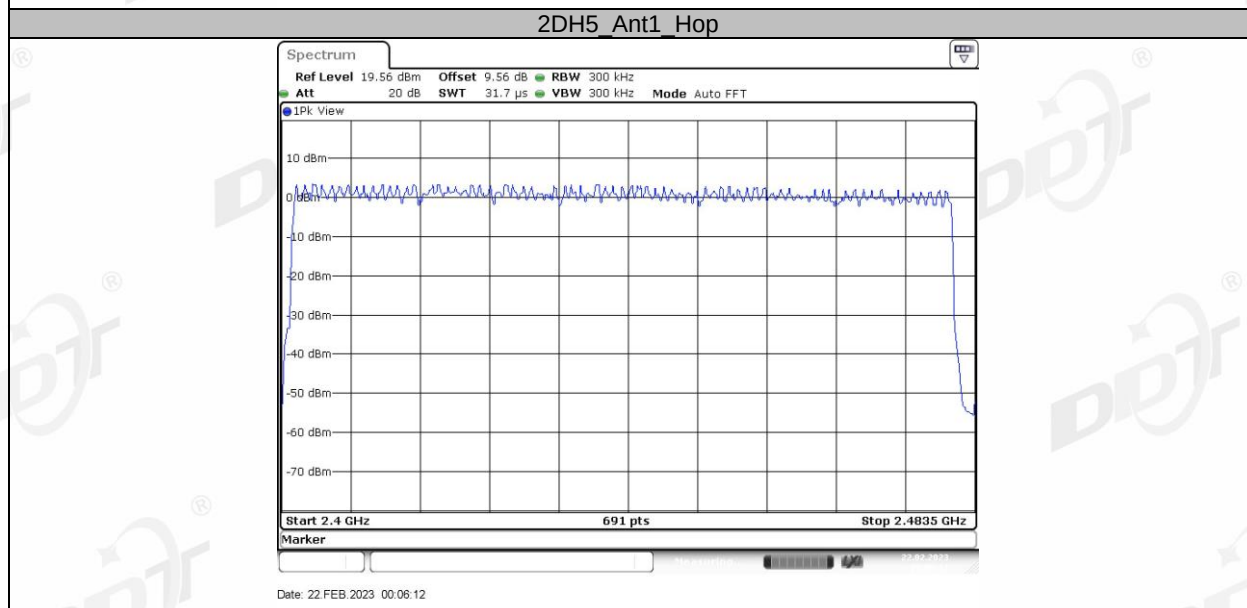
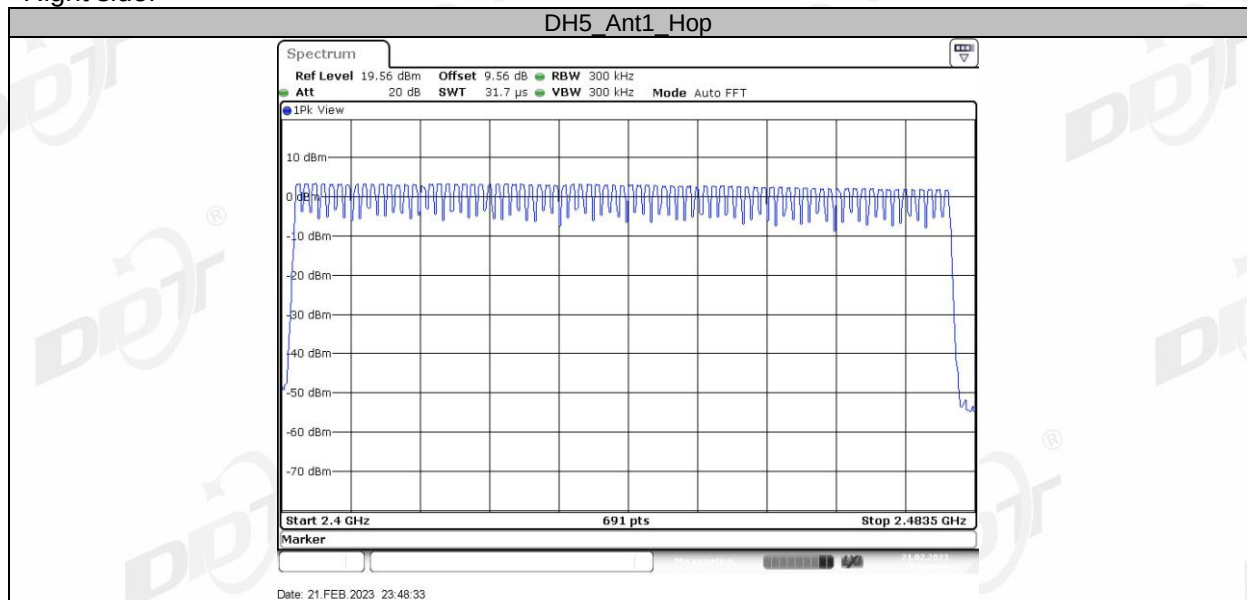
Left side:

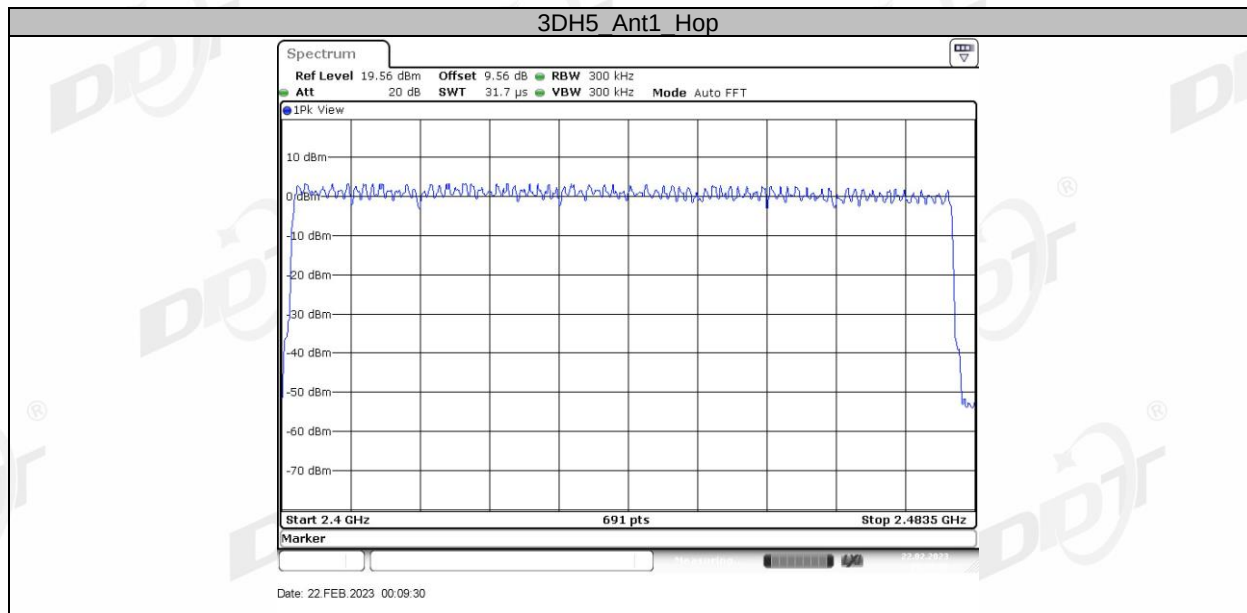






Right side:





## 8. Dwell Time

### 8.1. Block diagram of test setup

Same as section 4.1

### 8.2. Limits

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.

### 8.3. Test procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) The test period:  $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$
- (3) Measure the hopping number and on time of each pulse with spectrum analyzer in zero span set, and calculate dwell time with formula  $\text{Dwell time} = \text{total hops} \times \text{pulse's on time}$ .

### 8.4. Test result

Left side:

| Mode | Dwell time (s) | Pulse's on time (ms) | Total hops | Limit  | Verdict |
|------|----------------|----------------------|------------|--------|---------|
| DH1  | 0.114          | 0.36                 | 318        | <400ms | Pass    |
| DH3  | 0.266          | 1.62                 | 164        | <400ms | Pass    |
| DH5  | 0.307          | 2.87                 | 107        | <400ms | Pass    |
| 2DH1 | 0.118          | 0.37                 | 319        | <400ms | Pass    |
| 2DH3 | 0.267          | 1.63                 | 164        | <400ms | Pass    |
| 2DH5 | 0.307          | 2.87                 | 107        | <400ms | Pass    |
| 3DH1 | 0.119          | 0.37                 | 321        | <400ms | Pass    |
| 3DH3 | 0.262          | 1.63                 | 161        | <400ms | Pass    |
| 3DH5 | 0.296          | 2.87                 | 103        | <400ms | Pass    |

Note:  $\text{Dwell time} = \text{total hops} \times \text{pulse's on time}$ .

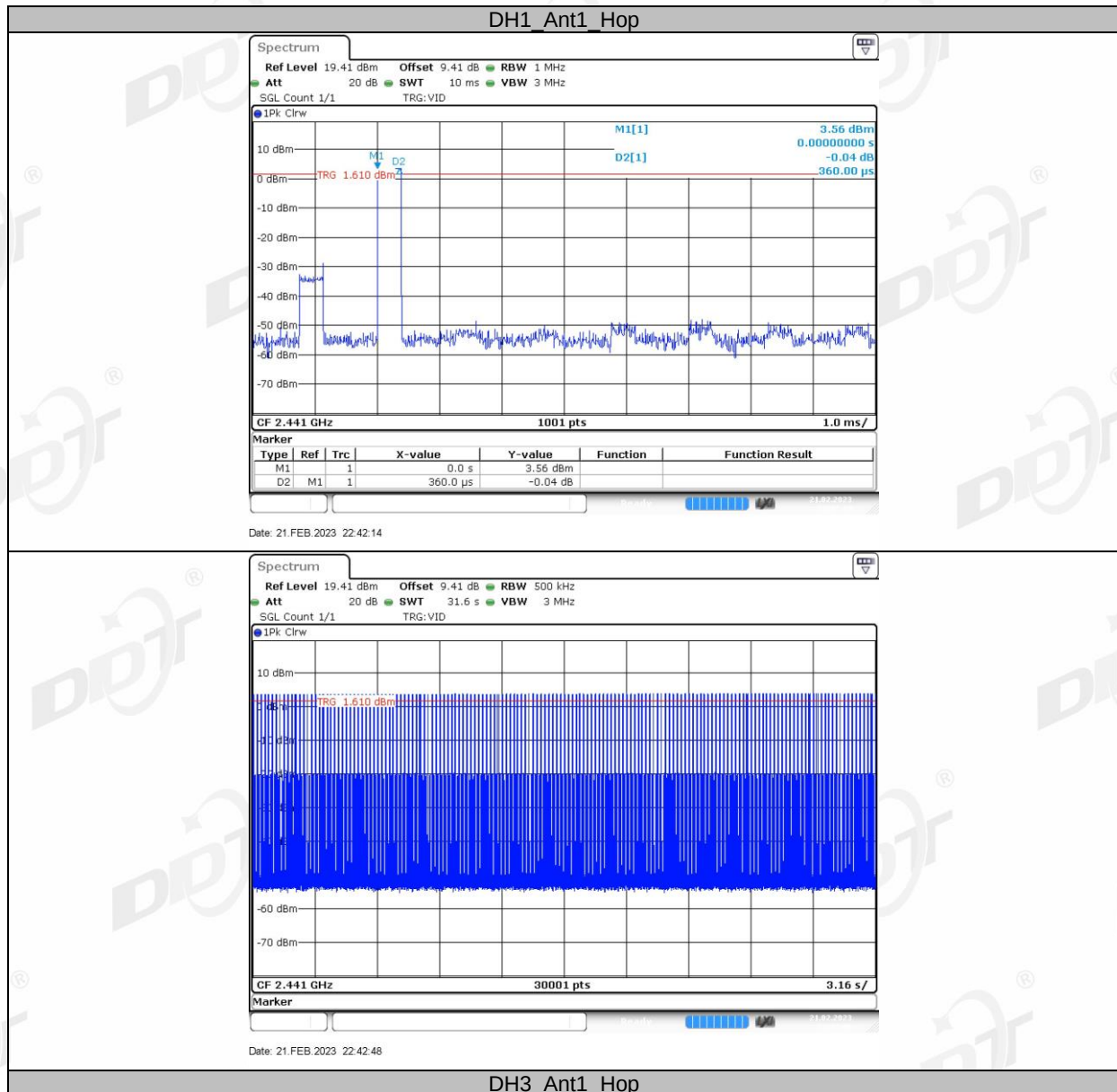
Right side:

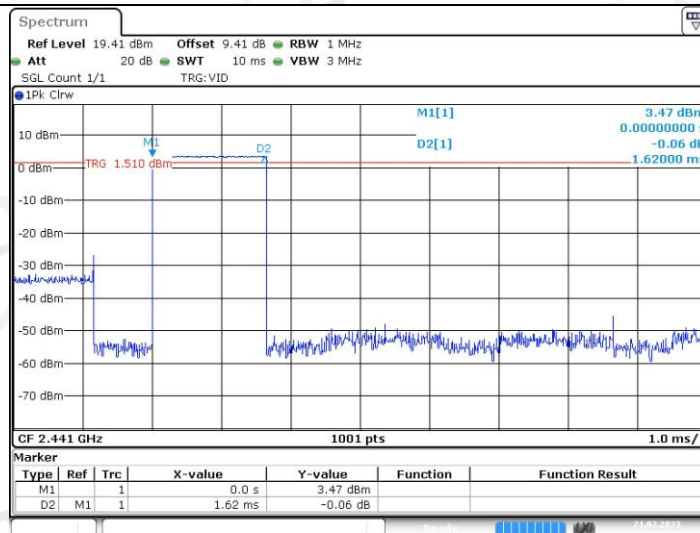
| Mode | Dwell time (s) | Pulse's on time (ms) | Total hops | Limit  | Verdict |
|------|----------------|----------------------|------------|--------|---------|
| DH1  | 0.114          | 0.36                 | 318        | <400ms | Pass    |
| DH3  | 0.258          | 1.62                 | 159        | <400ms | Pass    |
| DH5  | 0.296          | 2.87                 | 103        | <400ms | Pass    |
| 2DH1 | 0.118          | 0.37                 | 320        | <400ms | Pass    |
| 2DH3 | 0.254          | 1.63                 | 156        | <400ms | Pass    |
| 2DH5 | 0.317          | 2.88                 | 110        | <400ms | Pass    |
| 3DH1 | 0.118          | 0.37                 | 320        | <400ms | Pass    |
| 3DH3 | 0.262          | 1.62                 | 162        | <400ms | Pass    |
| 3DH5 | 0.34           | 2.88                 | 118        | <400ms | Pass    |

Note: Dwell time = total hops \* pulse's on time.

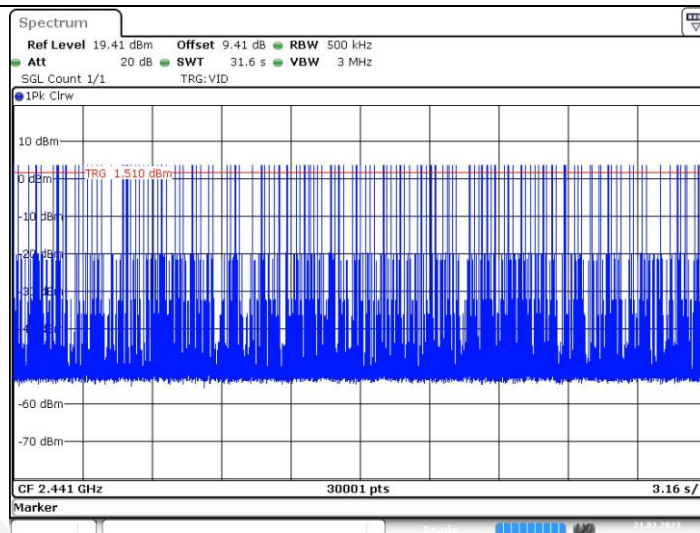
## 8.5. Original test data

Left side:



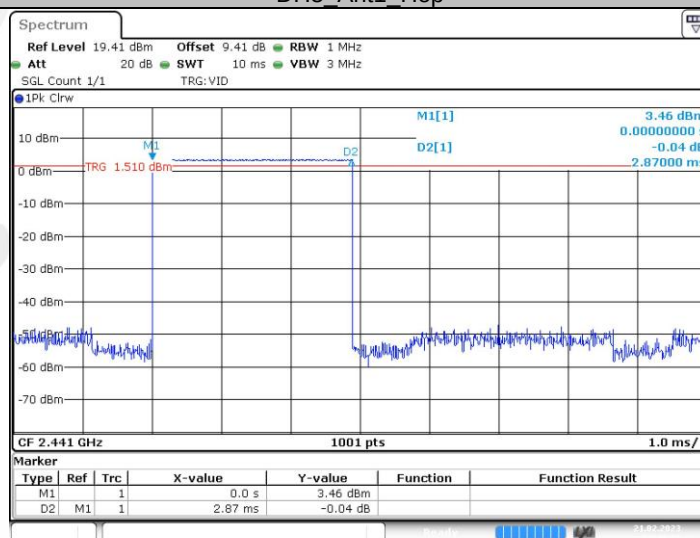


Date: 21 FEB 2023 22:41:20



Date: 21 FEB 2023 22:41:53

## DH5\_Ant1\_Hop



Date: 21 FEB 2023 22:40:25