

# TEST REPORT

**Product Name** : Home Server  
**Model Number** : U130120  
**FCC ID** : 2BA7R-U130120

**Prepared for** : Umbrel, Inc.  
**Address** : 2093 Philadelphia Pike, #4269, Claymont, Delaware, US  
19703

**Prepared by** : EMTEK (SHENZHEN) CO., LTD.  
**Address** : Building 69, Majialong Industry Zone, Nanshan District,  
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**Report Number** : ENS2303140179W00501R  
**Date(s) of Tests** : March 17, 2023 to April 23, 2023  
**Date of issue** : April 24, 2023

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## 1 TEST RESULT CERTIFICATION

Applicant : Umbrel, Inc.  
Address : 2093 Philadelphia Pike, #4269, Claymont, Delaware, US 19703  
Manufacturer : ShenZhen ZhiWei Technology Co.,Ltd  
Address : 4th~5th floor ,Bld6 and East side of 3rd floor,Bld3,LiJinCheng Industrial Park,The East of GongYe Road,LongHua Street Office,  
EUT : Home Server  
Model Name : U130120  
Trademark : Umbrel

Measurement Procedure Used:

| APPLICABLE STANDARDS                                            |             |
|-----------------------------------------------------------------|-------------|
| STANDARD                                                        | TEST RESULT |
| FCC 47 CFR Part 2 , Subpart J<br>FCC 47 CFR Part 15 , Subpart C | PASS        |

The above equipment was tested by EMTEK (SHENZHEN) CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 2 and Part 15.247

The test results of this report relate only to the tested sample identified in this report.

Date of Test : March 17, 2023 to April 23, 2023

Prepared by :   
Una Yu /Editor

Reviewer :   
Joe Xia /Supervisor

Approve & Authorized Signer :   
Lisa Wang/Manager



## 2 EUT TECHNICAL DESCRIPTION

| Characteristics                 | Description                                                                                                                                                                                                                                |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product                         | Home Server                                                                                                                                                                                                                                |
| Model Number                    | U130120                                                                                                                                                                                                                                    |
| Sample Number                   | 2#                                                                                                                                                                                                                                         |
| IEEE 802.11 WLAN Mode Supported | <input checked="" type="checkbox"/> 802.11b<br><input checked="" type="checkbox"/> 802.11g<br><input checked="" type="checkbox"/> 802.11n(20MHz channel bandwidth)<br><input checked="" type="checkbox"/> 802.11n(40MHz channel bandwidth) |
| Modulation                      | DSSS with DBPSK/DQPSK/CCK for 802.11b;<br>OFDM with BPSK/QPSK/16QAM/64QAM for 802.11g/n;                                                                                                                                                   |
| Operating Frequency Range       | <input checked="" type="checkbox"/> 2412-2462MHz for 802.11b/g/n(HT20);<br><input checked="" type="checkbox"/> 2422-2452MHz for 802.11n(HT40);                                                                                             |
| Number of Channels              | <input checked="" type="checkbox"/> 11 channels for 802.11b/g n(HT20);<br><input checked="" type="checkbox"/> 7 Channels for 802.11n(HT40);                                                                                                |
| Transmit Power Max              | 15.41 dBm                                                                                                                                                                                                                                  |
| Antenna Type                    | Internal Antenna                                                                                                                                                                                                                           |
| Antenna Gain                    | 2.99 dBi                                                                                                                                                                                                                                   |
| Power supply                    | DC12V from adapter                                                                                                                                                                                                                         |
| Date of Received                | March 16, 2023                                                                                                                                                                                                                             |
| Temperature Range               | 0°C ~ 45°C                                                                                                                                                                                                                                 |

**Note:** for more details, please refer to the User's manual of the EUT.

### 3 SUMMARY OF TEST RESULT

| FCC PartClause      | Test Parameter                                                                                                                                                                                                                                                                                   | Verdict | Remark |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------|
| 15.247(a)(2)        | DTS (6dB) Bandwidth                                                                                                                                                                                                                                                                              | PASS    |        |
| 15.247(b)(3)        | Maximum Peak Conducted Output Power                                                                                                                                                                                                                                                              | PASS    |        |
| 15.247(e)           | Maximum Power Spectral Density Level                                                                                                                                                                                                                                                             | PASS    |        |
| 15.247(d)           | Unwanted Emission Into Non-Restricted Frequency Bands                                                                                                                                                                                                                                            | PASS    |        |
| 15.247(d)<br>15.209 | Unwanted Emission Into Restricted Frequency Bands (conducted)                                                                                                                                                                                                                                    | PASS    |        |
| 15.247(d)<br>15.209 | Radiated Spurious Emission                                                                                                                                                                                                                                                                       | PASS    |        |
| 15.207              | Conducted Emission Test                                                                                                                                                                                                                                                                          | PASS    |        |
| 15.247(b)           | Antenna Application                                                                                                                                                                                                                                                                              | PASS    |        |
|                     | NOTE1:N/A (Not Applicable)<br>NOTE2: According to FCC OET KDB 558074, the report use radiated measurements in the restricted frequency bands. In addition, the radiated test is also performed to ensure the emissions emanating from the device cabinet also comply with the applicable limits. |         |        |

#### RELATED SUBMITTAL(S) / GRANT(S):

This submittal(s) (test report) is intended for FCC ID: 2BA7R-U130120 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

## 4 TEST METHODOLOGY

### 4.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:

FCC 47 CFR Part 2, Subpart J

FCC 47 CFR Part 15, Subpart C

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

### 4.2 MEASUREMENT EQUIPMENT USED

#### 4.2.1 Conducted Emission Test Equipment

| EQUIPMENT TYPE           | MFR             | MODEL NUMBER | SERIAL NUMBER | LASTCAL.  | Cal. Interval |
|--------------------------|-----------------|--------------|---------------|-----------|---------------|
| EMI Test Receiver        | Rohde & Schwarz | ESCI         | 101384        | 2022/5/14 | 1Year         |
| AMN                      | Rohde & Schwarz | ESH3-Z5      | 100191        | 2022/5/15 | 1Year         |
| AMN                      | Schwarzbeck     | NNLK 8129    | 8129203       | 2022/5/15 | 1Year         |
| Pulse Limiter            | Rohde & Schwarz | ESH3-Z2      | 100107        | 2022/5/14 | 1Year         |
| Capacitive Voltage Probe | TESEQ           | CVP 2200 A   | 47173         | 2022/5/15 | 1Year         |

#### 4.2.2 Radiated Emission Test Equipment

| EQUIPMENT TYPE    | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | Cal. Interval |
|-------------------|-----------------|--------------|---------------|-----------|---------------|
| EMI Test Receiver | Rohde & Schwarz | ESCI         | 101414        | 2022/5/14 | 1Year         |
| Pre-Amplifier     | HP              | 8447F        | 2944A07999    | 2022/5/14 | 1Year         |
| Bilog Antenna     | Schwarzbeck     | VULB9163     | 712           | 2021/7/5  | 2Year         |
| Loop Antenna      | Schwarzbeck     | FMZB1519     | 1519-012      | 2021/6/12 | 2Year         |
| Horn Antenna      | Schwarzbeck     | BBHA 9170    | 9170-399      | 2021/6/12 | 2Year         |
| Horn Antenna      | Schwarzbeck     | BBHA9120D    | 9120D-1198    | 2021/6/15 | 2Year         |
| Cable             | Schwarzbeck     | AK9513       | ACRX1         | 2022/5/14 | 1Year         |
| Cable             | Rosenberger     | N/A          | FP2RX2        | 2022/5/14 | 1Year         |
| Cable             | Schwarzbeck     | AK9513       | CRPX1         | 2022/5/14 | 1Year         |
| Cable             | Schwarzbeck     | AK9513       | CRRX2         | 2022/5/14 | 1Year         |

#### 4.2.3 Radio Frequency Test Equipment

| EQUIPMENT TYPE                      | MFR      | MODEL NUMBER | SERIAL NUMBER | LASTCAL.  | Cal. Interval |
|-------------------------------------|----------|--------------|---------------|-----------|---------------|
| Wideband Radio Communication Tester | R&S      | CMW500       | 171168        | 2022/11/2 | 1Year         |
| Frequency Extender                  | R&S      | CMW-Z800A    | 100430        | 2022/11/2 | 1Year         |
| Spectrum Analyzer                   | R&S      | FSV3044      | MY60242456    | 2022/11/2 | 1Year         |
| Analog Signal Generator             | R&S      | SMB100A      | MY61252625    | 2022/11/2 | 1Year         |
| Vector Signal Generator             | R&S      | SMM100A      | MY61252674    | 2022/11/2 | 1Year         |
| RF Control Unit                     | Tonscend | JS0806-2     | 22C8060567    | 2022/11/2 | 1Year         |
| Temperature&Humidity Chamber        | ESPEC    | EL-02KA      | 12107166      | 2022/7/2  | 1 Year        |

**Remark:** Each piece of equipment is scheduled for calibration once a year.

### 4.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition.

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Those data rates (☒ 802.11b:1 Mbps; ☒ 802.11g: 6 Mbps; ☒ 802.11n(HT20): MCS0; ☒ 802.11n(HT40): MCS0) were used for all test.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

☒ Frequency and Channel list for 802.11b/g/n (HT20):

| Channel | Frequency<br>(MHz) | Channel | Frequency<br>(MHz) | Channel | Frequency<br>(MHz) |
|---------|--------------------|---------|--------------------|---------|--------------------|
| 1       | 2412               | 6       | 2437               | 11      | 2462               |
| 2       | 2417               | 7       | 2442               |         |                    |
| 3       | 2422               | 8       | 2447               |         |                    |
| 4       | 2427               | 9       | 2452               |         |                    |
| 5       | 2432               | 10      | 2457               |         |                    |

☒ Frequency and Channel list for 802.11n (HT40):

| Channel | Frequency<br>(MHz) | Channel | Frequency<br>(MHz) | Channel | Frequency<br>(MHz) |
|---------|--------------------|---------|--------------------|---------|--------------------|
|         |                    | 6       | 2437               |         |                    |
|         |                    | 7       | 2442               |         |                    |
| 3       | 2422               | 8       | 2447               |         |                    |
| 4       | 2427               | 9       | 2452               |         |                    |
| 5       | 2432               |         |                    |         |                    |

☒ Test Frequency and Channel for 802.11b/g/n (HT20):

| Lowest Frequency |                    | Middle Frequency |                    | Highest Frequency |                    |
|------------------|--------------------|------------------|--------------------|-------------------|--------------------|
| Channel          | Frequency<br>(MHz) | Channel          | Frequency<br>(MHz) | Channel           | Frequency<br>(MHz) |
| 1                | 2412               | 6                | 2437               | 11                | 2462               |

☒ Test Frequency and channel for 802.11n (HT40):

| Lowest Frequency |                    | Middle Frequency |                    | Highest Frequency |                    |
|------------------|--------------------|------------------|--------------------|-------------------|--------------------|
| Channel          | Frequency<br>(MHz) | Channel          | Frequency<br>(MHz) | Channel           | Frequency<br>(MHz) |
| 3                | 2422               | 6                | 2437               | 9                 | 2452               |

## 5 FACILITIES AND ACCREDITATIONS

### 5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

Building 69, Majialong Industry Zone District, Nanshan District, Shenzhen, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

### 5.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description

EMC Lab.

: **Accredited by CNAS**

The Certificate Registration Number is L2291.

The Laboratory has been assessed and proved to be in compliance with CNAS-CL01 (identical to ISO/IEC 17025:2017)

**Accredited by FCC**

Designation Number: CN1204

Test Firm Registration Number: 882943

**Accredited by A2LA**

The Certificate Number is 4321.01.

**Accredited by Industry Canada**

The Conformity Assessment Body Identifier is CN0008

Name of Firm

: EMTEK (SHENZHEN) CO., LTD.

Site Location

: Building 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China

## 6 TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

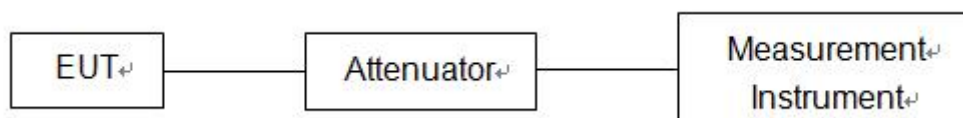
| Parameter                      | Uncertainty             |
|--------------------------------|-------------------------|
| Radio Frequency                | $\pm 1 \times 10^{-5}$  |
| Maximum Peak Output Power Test | $\pm 1.0\text{dB}$      |
| Conducted Emissions Test       | $\pm 2.0\text{dB}$      |
| Radiated Emission Test         | $\pm 2.0\text{dB}$      |
| Power Density                  | $\pm 2.0\text{dB}$      |
| Occupied Bandwidth Test        | $\pm 1.0\text{dB}$      |
| Band Edge Test                 | $\pm 3\text{dB}$        |
| All emission, radiated         | $\pm 3\text{dB}$        |
| Antenna Port Emission          | $\pm 3\text{dB}$        |
| Temperature                    | $\pm 0.5^\circ\text{C}$ |
| Humidity                       | $\pm 3\%$               |

Measurement Uncertainty for a level of Confidence of 95%

## 7 SETUP OF EQUIPMENT UNDER TEST

### 7.1 RADIO FREQUENCY TEST SETUP 1

The WLAN component's antenna ports(s) of the EUT are connected to the measurement instrument per an appropriate attenuator. The EUT is controlled by PC/software to emit the specified signals for the purpose of measurements.



### 7.2 RADIO FREQUENCY TEST SETUP 2

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10. The test distance is 3m. The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 and CAN/CSA-CEI/IEC CISPR 22.

Below 30MHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The Antenna should be positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop shall be 1 m above the ground. For certain applications, the loop antennaplane may also need to be positioned horizontally at the specified distance from the EUT.

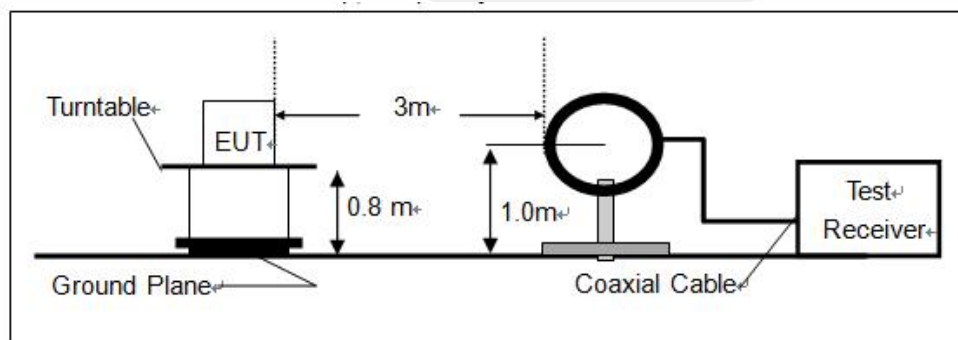
30MHz-1GHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

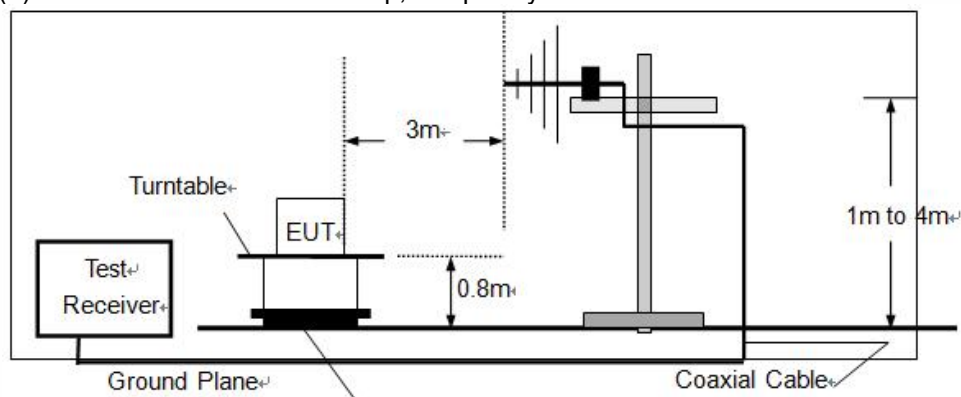
Above 1GHz:

The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

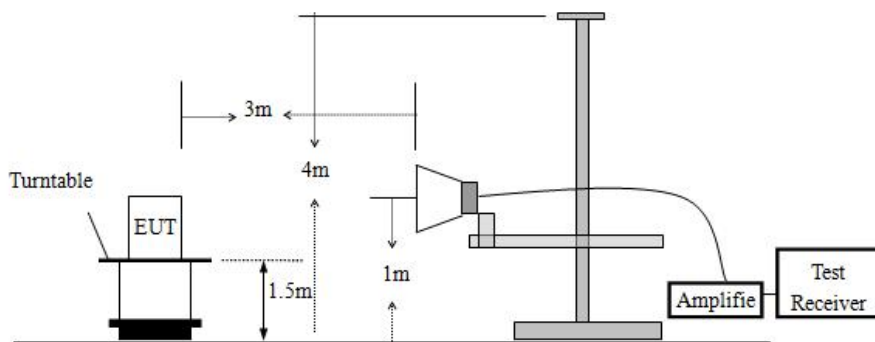
(a) Radiated Emission Test Set-Up, Frequency Below 30MHz



(b) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(c) Radiated Emission Test Set-Up, Frequency above 1000MHz

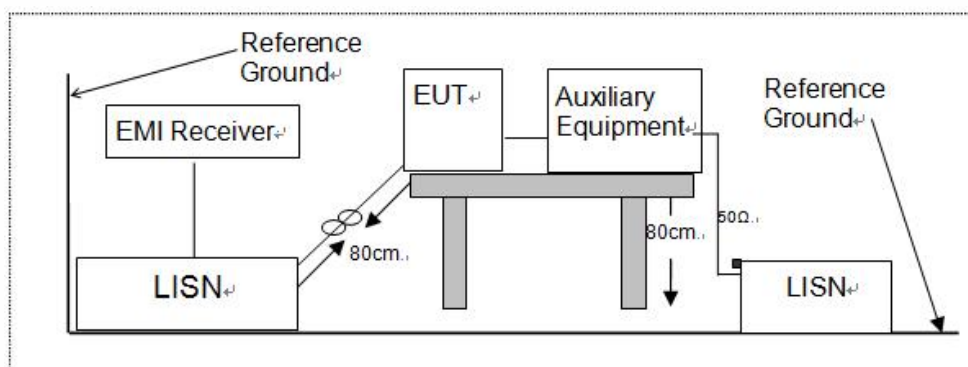


### 7.3 CONDUCTED EMISSION TEST SETUP

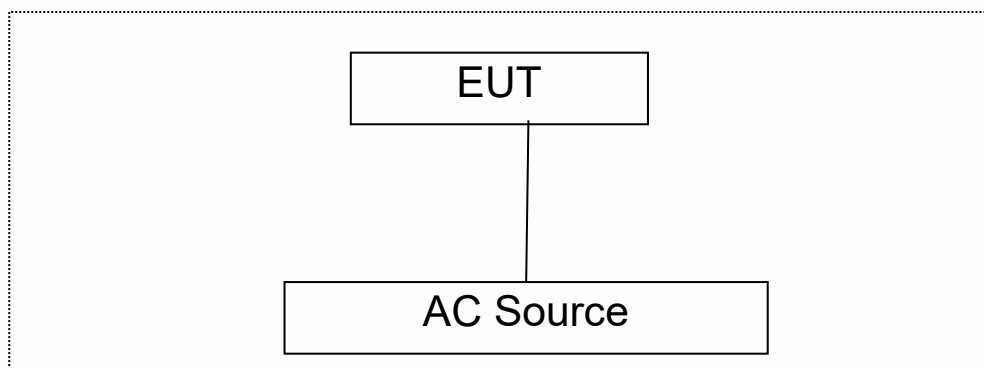
The mains cable of the EUT (maybe per AC/DC Adapter) must be connected to LISN. The LISN shall be placed 0.8 m from the boundary of EUT and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance is between the closest points of the LISN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8m from the LISN.

Ground connections, where required for safety purposes, shall be connected to the reference ground point of the LISN and, where not otherwise provided or specified by the manufacturer, shall be of same length as the mains cable and run parallel to the mains connection at a separation distance of not more than 0.1 m.

According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.



#### 7.4 BLOCK DIAGRAM CONFIGURATION OF TEST SYSTEM



#### 7.5 SUPPORT EQUIPMENT

| EUT Cable List and Details |            |                     |                        |
|----------------------------|------------|---------------------|------------------------|
| Cable Description          | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| /                          | /          | /                   | /                      |

| Auxiliary Cable List and Details |            |                     |                        |
|----------------------------------|------------|---------------------|------------------------|
| Cable Description                | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| /                                | /          | /                   | /                      |

| Auxiliary Equipment List and Details |              |       |                            |
|--------------------------------------|--------------|-------|----------------------------|
| Description                          | Manufacturer | Model | Serial Number              |
| Notebook                             | acer         | ZR1   | LXTECOCO76643158<br>372500 |

#### Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.
3. Unless otherwise denoted as EUT in 『Remark』 column , device(s) used in tested system is a support equipment

## 8 TEST REQUIREMENTS

### 8.1 DTS (6DB) BANDWIDTH

#### 8.1.1 Applicable Standard

According to FCC Part15.247 (a)(2) and KDB 558074 D01 15.247 Meas Guidance v05r02

#### 8.1.2 Conformance Limit

The minimum -6 dB bandwidth shall be at least 500 kHz.

#### 8.1.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

#### 8.1.4 Test Procedure

The EUT was operating in IEEE 802.11b/g/n mode and controlled its channel. Printed out the test result from the spectrum by hard copy function.

The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

Set to the maximum power setting and enable the EUT transmit continuously

Set RBW = 100 kHz.

Set the video bandwidth (VBW) =300kHz.

Set Span=2 times OBW

Set Detector = Peak.

Set Trace mode = max hold.

Set Sweep = auto couple.

Allow the trace to stabilize.

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

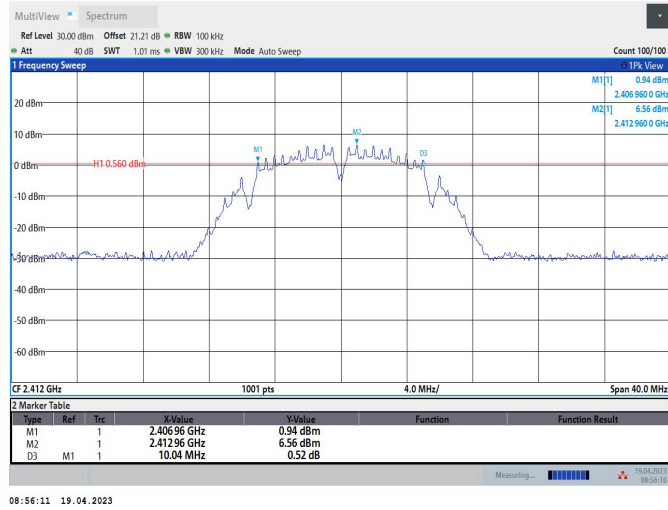
Measure and record the results in the test report.

#### 8.1.5 Test Results

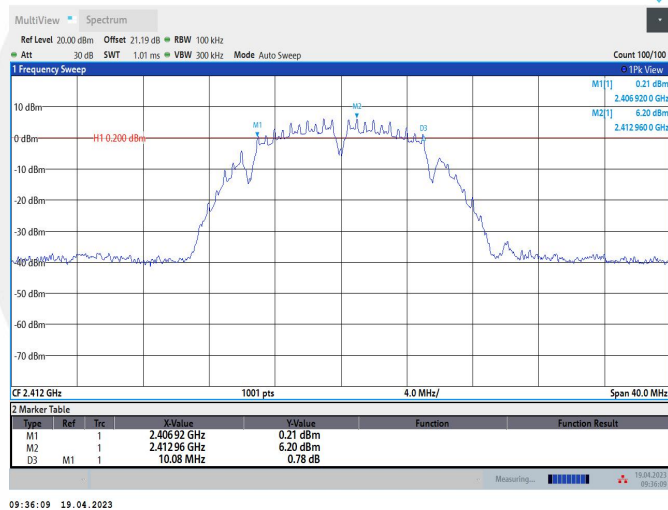
|                    |           |
|--------------------|-----------|
| Temperature:       | 25° C     |
| Relative Humidity: | 45%       |
| ATM Pressure:      | 1011 mbar |

| TestMode  | Antenna | Frequency[MHz] | DTS BW [MHz] | FL[MHz] | FH[MHz] | Limit[MHz] | Verdict |
|-----------|---------|----------------|--------------|---------|---------|------------|---------|
| 11B       | Ant1    | 2412           | 10.04        | 2406.96 | 2417.00 | 0.5        | PASS    |
|           | Ant2    | 2412           | 10.08        | 2406.92 | 2417.00 | 0.5        | PASS    |
|           | Ant1    | 2437           | 10.08        | 2431.92 | 2442.00 | 0.5        | PASS    |
|           | Ant2    | 2437           | 10.04        | 2431.96 | 2442.00 | 0.5        | PASS    |
|           | Ant1    | 2462           | 10.08        | 2456.92 | 2467.00 | 0.5        | PASS    |
|           | Ant2    | 2462           | 10.08        | 2456.92 | 2467.00 | 0.5        | PASS    |
| 11G       | Ant1    | 2412           | 15.16        | 2404.40 | 2419.56 | 0.5        | PASS    |
|           | Ant2    | 2412           | 15.12        | 2404.40 | 2419.52 | 0.5        | PASS    |
|           | Ant1    | 2437           | 15.12        | 2429.40 | 2444.52 | 0.5        | PASS    |
|           | Ant2    | 2437           | 15.36        | 2429.20 | 2444.56 | 0.5        | PASS    |
|           | Ant1    | 2462           | 15.08        | 2454.44 | 2469.52 | 0.5        | PASS    |
|           | Ant2    | 2462           | 15.12        | 2454.40 | 2469.52 | 0.5        | PASS    |
| 11N20MIMO | Ant1    | 2412           | 15.16        | 2404.40 | 2419.56 | 0.5        | PASS    |
|           | Ant2    | 2412           | 15.16        | 2404.40 | 2419.56 | 0.5        | PASS    |
|           | Ant1    | 2437           | 15.08        | 2429.48 | 2444.56 | 0.5        | PASS    |
|           | Ant2    | 2437           | 15.72        | 2429.40 | 2445.12 | 0.5        | PASS    |
|           | Ant1    | 2462           | 15.12        | 2454.44 | 2469.56 | 0.5        | PASS    |
|           | Ant2    | 2462           | 15.68        | 2453.84 | 2469.52 | 0.5        | PASS    |
| 11N40MIMO | Ant1    | 2422           | 35.12        | 2404.48 | 2439.60 | 0.5        | PASS    |
|           | Ant2    | 2422           | 35.12        | 2404.48 | 2439.60 | 0.5        | PASS    |
|           | Ant1    | 2437           | 35.12        | 2419.48 | 2454.60 | 0.5        | PASS    |
|           | Ant2    | 2437           | 35.12        | 2419.48 | 2454.60 | 0.5        | PASS    |
|           | Ant1    | 2452           | 35.12        | 2434.48 | 2469.60 | 0.5        | PASS    |
|           | Ant2    | 2452           | 35.12        | 2434.48 | 2469.60 | 0.5        | PASS    |

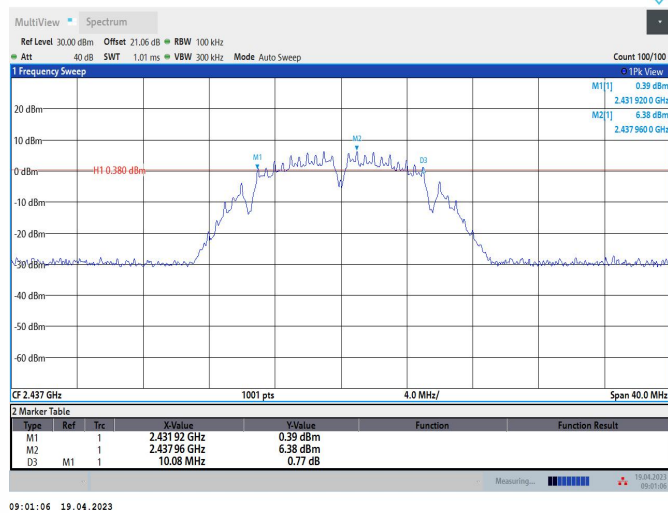
### 11B\_Ant1\_2412



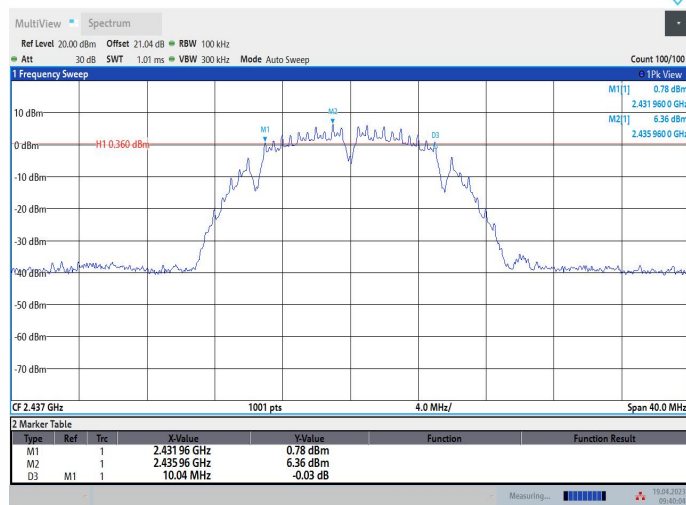
### 11B\_Ant2\_2412



### 11B\_Ant1\_2437

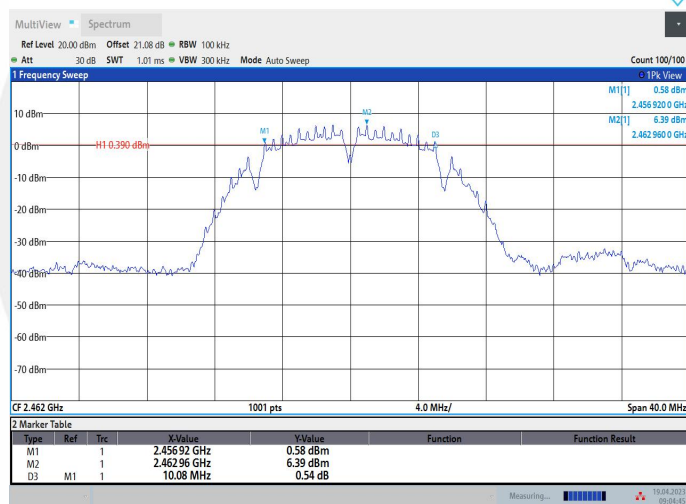


### 11B\_Ant2\_2437



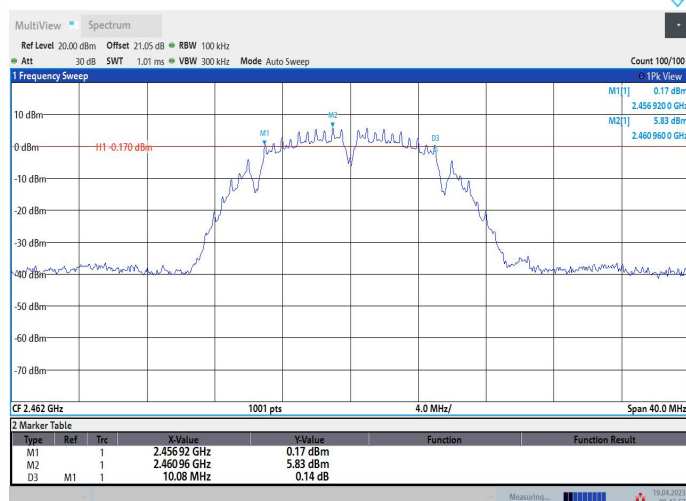
09:40:05 19.04.2023

### 11B\_Ant1\_2462



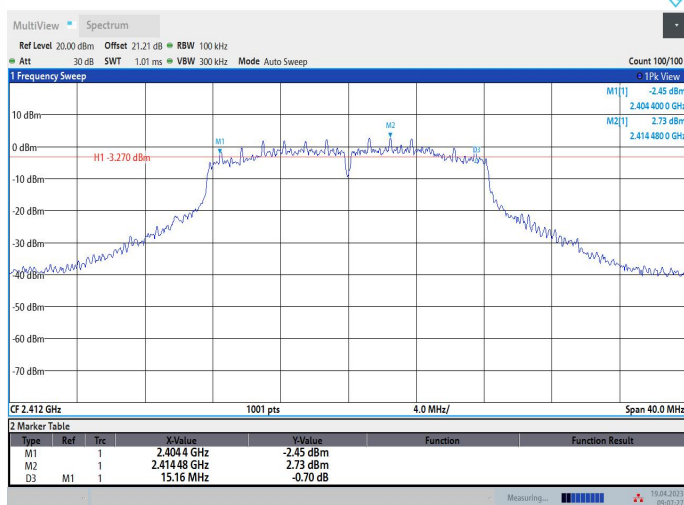
09:04:46 19.04.2023

### 11B\_Ant2\_2462



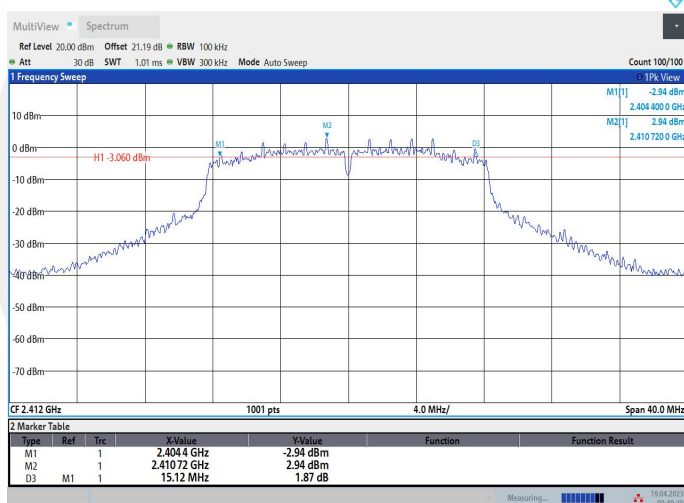
09:43:57 19.04.2023

## 11G\_Ant1\_2412



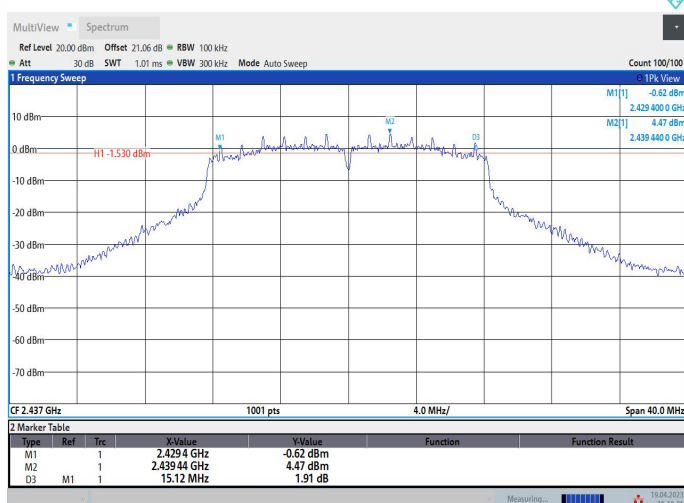
09:07:28 19.04.2023

## 11G\_Ant2\_2412



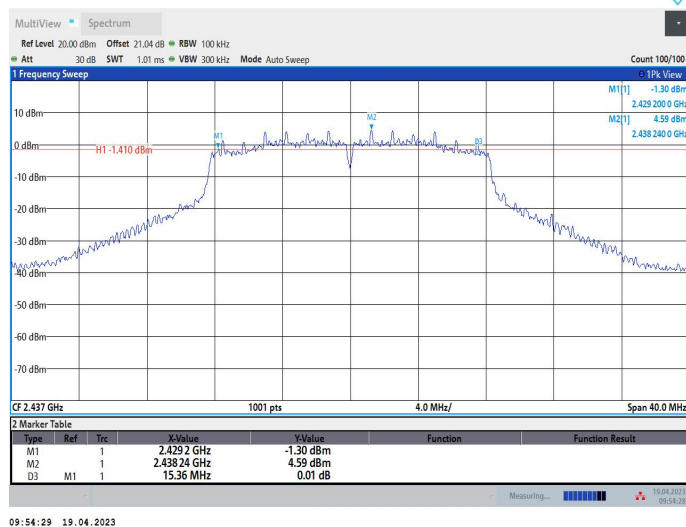
09:49:40 19.04.2023

## 11G\_Ant1\_2437



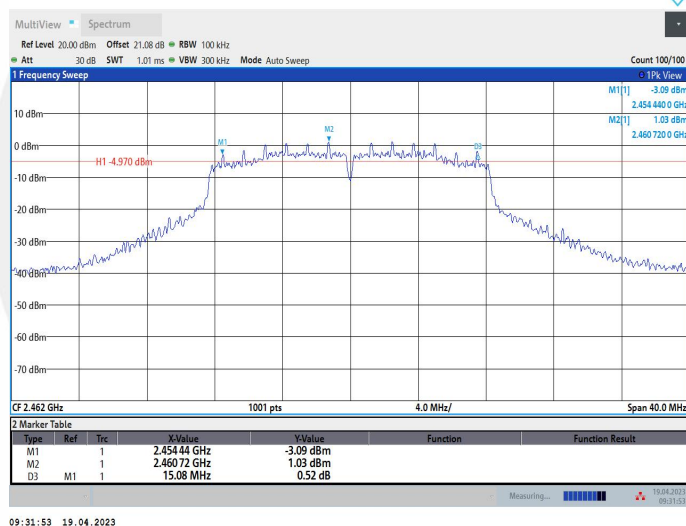
09:29:01 19.04.2023

### 11G\_Ant2\_2437



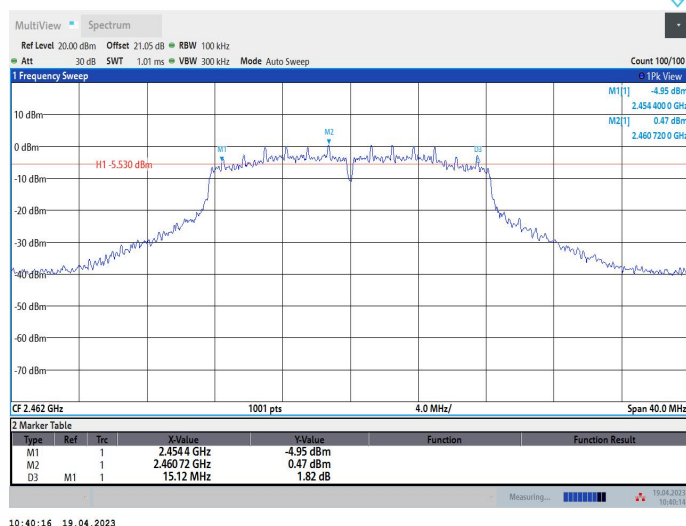
09:54:29 19.04.2023

### 11G\_Ant1\_2462



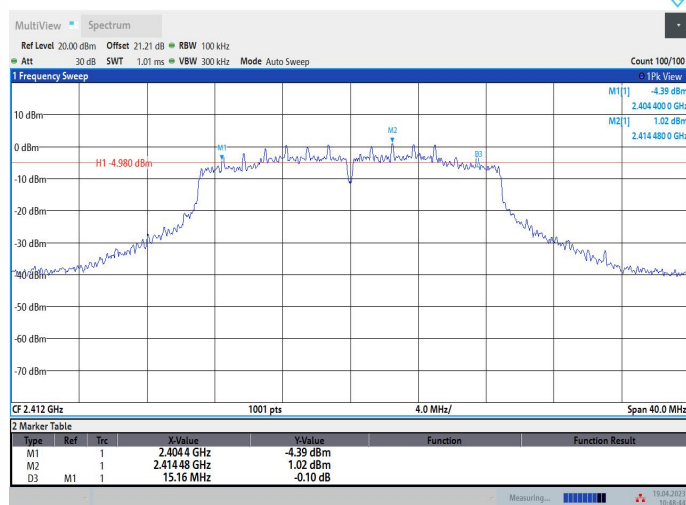
09:51:53 19.04.2023

### 11G\_Ant2\_2462



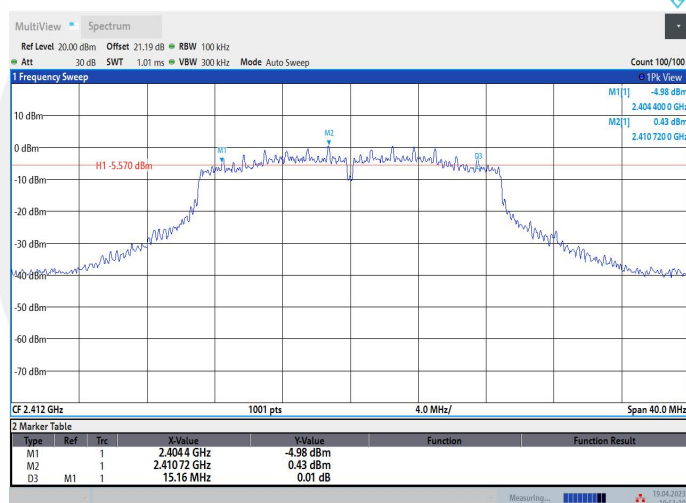
10:40:16 19.04.2023

## 11N20MIMO\_Ant1\_2412



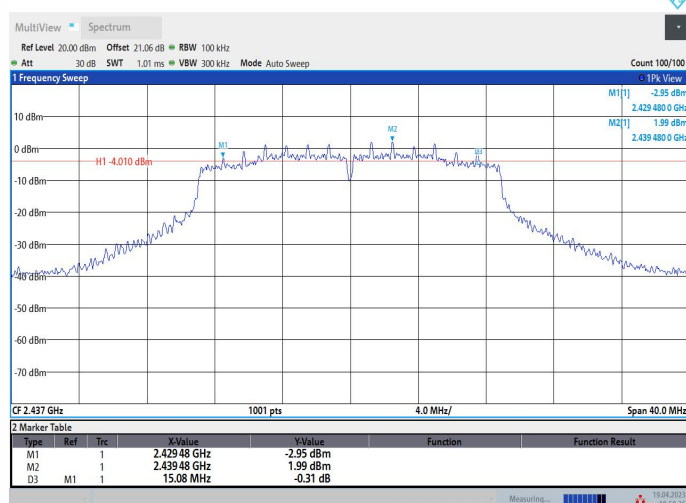
10:48:44 19.04.2023

## 11N20MIMO\_Ant2\_2412



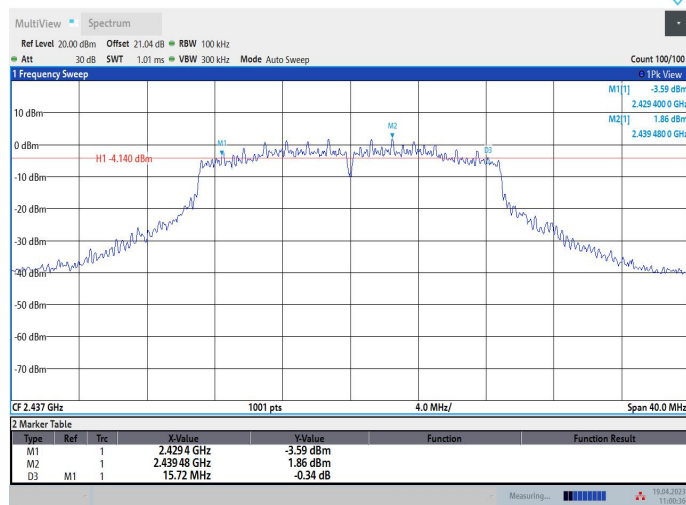
10:51:10 19.04.2023

## 11N20MIMO\_Ant1\_2437



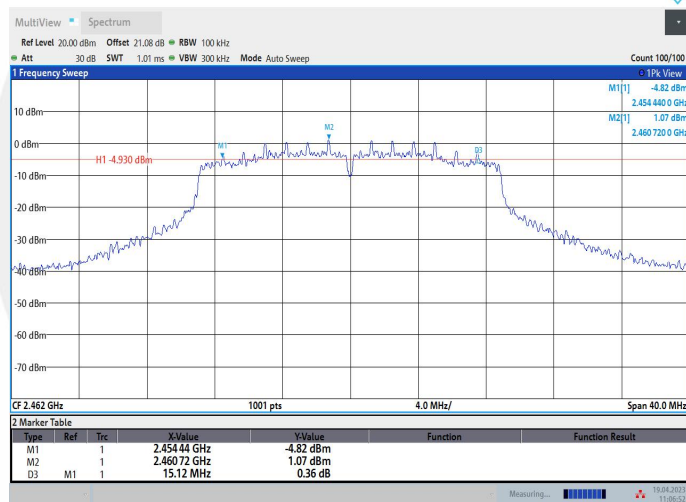
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## 11N20MIMO\_Ant2\_2437



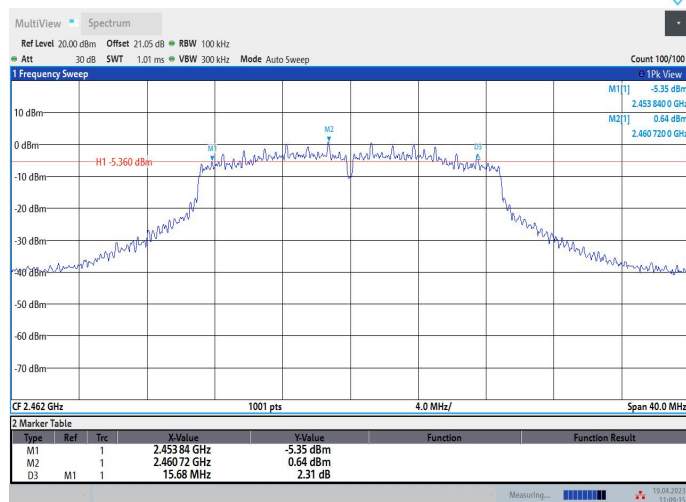
11:00:37 19.04.2023

## 11N20MIMO\_Ant1\_2462



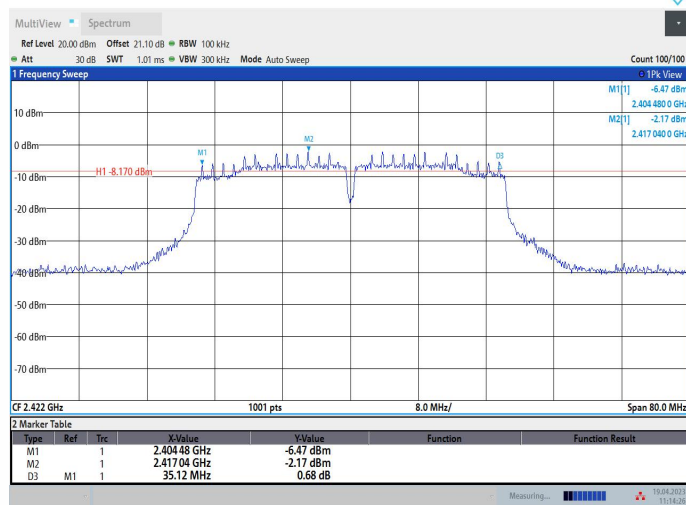
11:06:52 19.04.2023

## 11N20MIMO\_Ant2\_2462



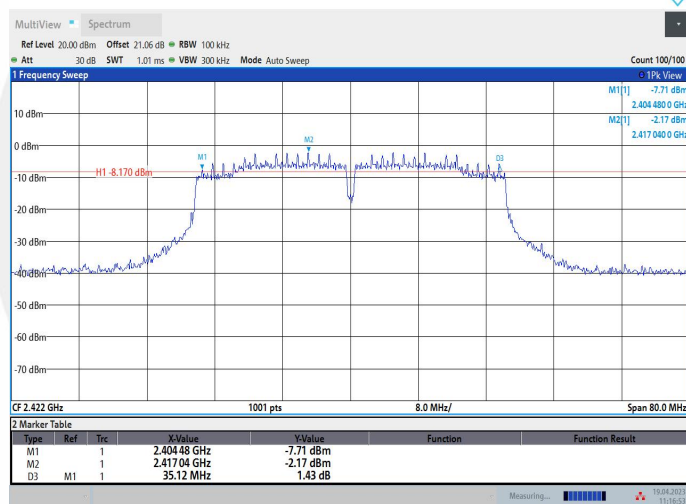
11:09:16 19.04.2023

### 11N40MIMO\_Ant1\_2422



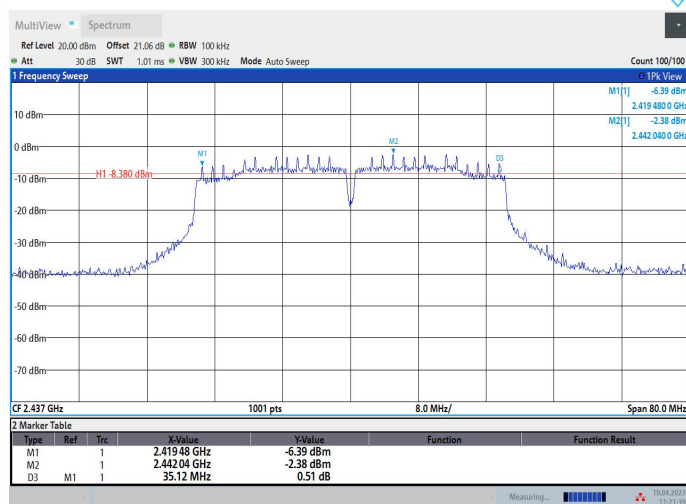
11:14:27 19.04.2023

### 11N40MIMO\_Ant2\_2422



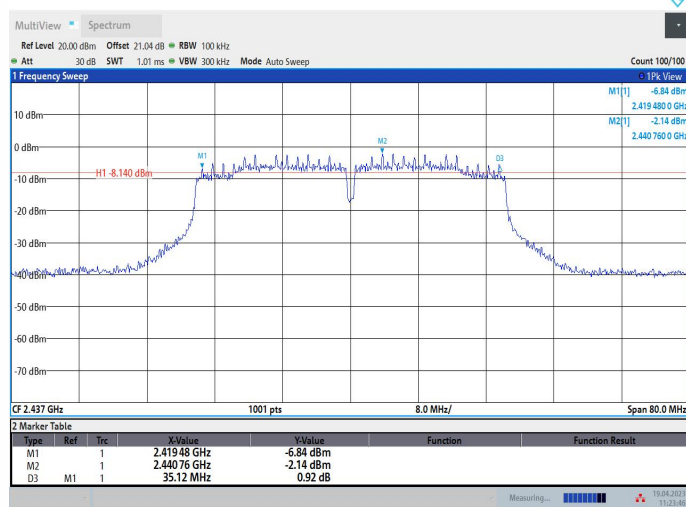
11:16:54 19.04.2023

### 11N40MIMO\_Ant1\_2437



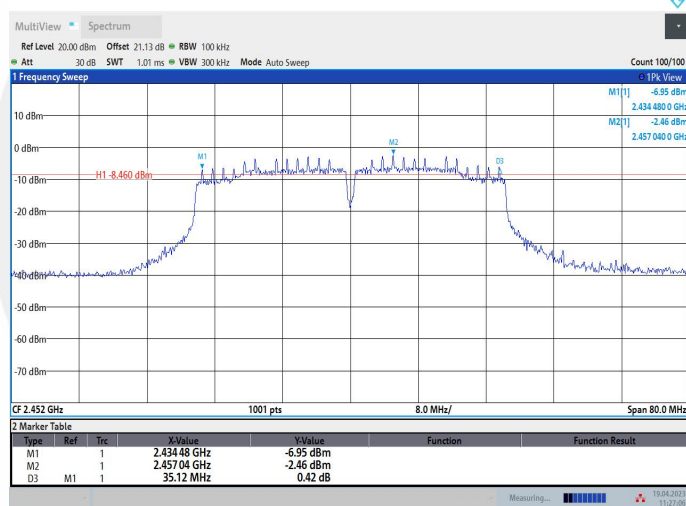
11:21:39 19.04.2023

### 11N40MIMO\_Ant2\_2437



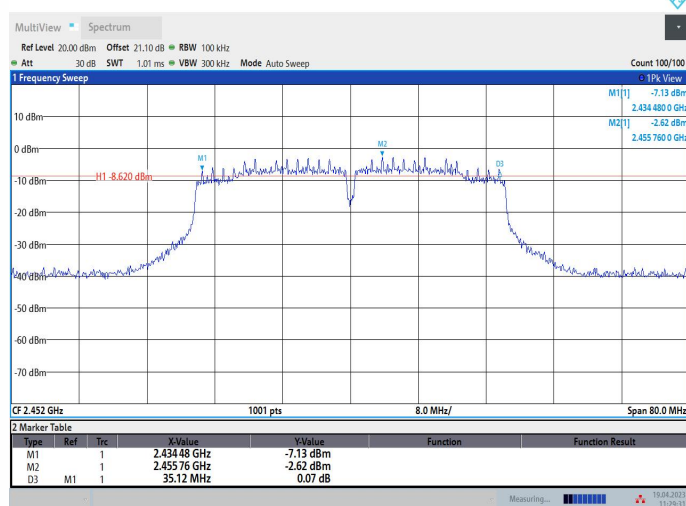
11:23:46 19.04.2023

### 11N40MIMO\_Ant1\_2452



11:27:06 19.04.2023

### 11N40MIMO\_Ant2\_2452



11:29:31 19.04.2023

## 8.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER

### 8.2.1 Applicable Standard

According to FCC Part15.247 (b)(3) and KDB 558074 D01 15.247 Meas Guidance v05r02

### 8.2.2 Conformance Limit

The maximum peak conducted output power of the intentional radiator for systems using digital modulation in the 2400 - 2483.5 MHz bands shall not exceed: 1 Watt (30dBm).

### 8.2.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

### 8.2.4 Test Procedure

■ According to FCC Part15.247(b)(3)

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

The testing follows FCC public Notice DA 00-705 Measurement Guidelines.

The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.

Set to the maximum output power setting and enable the EUT transmit continuously.

Measure the conducted output power with cable loss and record the results in the test report.

Measure and record the results in the report.

■ According to FCC Part 15.247(b)(4):

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. 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)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note: If antenna Gain exceeds 6 dBi, then Output power Limit=30-(Gain- 6)

### 8.2.5 Test Results

|                    |           |
|--------------------|-----------|
| Temperature:       | 25° C     |
| Relative Humidity: | 45%       |
| ATM Pressure:      | 1011 mbar |

| TestMode      | Antenna | Frequen<br>cy[MHz] | Peak<br>Power[dBm] | Conducted<br>Limit[dBm] | EIRP<br>[dBm] | EIRP<br>Limit[dBm] | Verdict |
|---------------|---------|--------------------|--------------------|-------------------------|---------------|--------------------|---------|
| 11B           | Ant1    | 2412               | 15.29              | ≤30.00                  | 18.28         | ≤36.00             | PASS    |
|               | Ant2    | 2412               | 14.95              | ≤30.00                  | 17.94         | ≤36.00             | PASS    |
|               | Ant1    | 2437               | 14.92              | ≤30.00                  | 17.91         | ≤36.00             | PASS    |
|               | Ant2    | 2437               | 14.78              | ≤30.00                  | 17.77         | ≤36.00             | PASS    |
|               | Ant1    | 2462               | 15.18              | ≤30.00                  | 18.17         | ≤36.00             | PASS    |
|               | Ant2    | 2462               | 14.55              | ≤30.00                  | 17.54         | ≤36.00             | PASS    |
| 11G           | Ant1    | 2412               | 13.17              | ≤30.00                  | 16.16         | ≤36.00             | PASS    |
|               | Ant2    | 2412               | 13.43              | ≤30.00                  | 16.42         | ≤36.00             | PASS    |
|               | Ant1    | 2437               | 15.41              | ≤30.00                  | 18.40         | ≤36.00             | PASS    |
|               | Ant2    | 2437               | 14.96              | ≤30.00                  | 17.95         | ≤36.00             | PASS    |
|               | Ant1    | 2462               | 12.09              | ≤30.00                  | 15.08         | ≤36.00             | PASS    |
|               | Ant2    | 2462               | 10.85              | ≤30.00                  | 13.84         | ≤36.00             | PASS    |
| 11N20MI<br>MO | Ant1    | 2412               | 10.99              | ≤30.00                  | 13.98         | ≤36.00             | PASS    |
|               | Ant2    | 2412               | 10.81              | ≤30.00                  | 13.80         | ≤36.00             | PASS    |
|               | total   | 2412               | 13.91              | ≤30.00                  | 16.90         | ≤36.00             | PASS    |
|               | Ant1    | 2437               | 12.18              | ≤30.00                  | 15.17         | ≤36.00             | PASS    |
|               | Ant2    | 2437               | 11.91              | ≤30.00                  | 14.90         | ≤36.00             | PASS    |
|               | total   | 2437               | 15.06              | ≤30.00                  | 18.05         | ≤36.00             | PASS    |
|               | Ant1    | 2462               | 11.18              | ≤30.00                  | 14.17         | ≤36.00             | PASS    |
|               | Ant2    | 2462               | 10.83              | ≤30.00                  | 13.82         | ≤36.00             | PASS    |
|               | total   | 2462               | 14.02              | ≤30.00                  | 17.01         | ≤36.00             | PASS    |
| 11N40MI<br>MO | Ant1    | 2422               | 10.68              | ≤30.00                  | 13.67         | ≤36.00             | PASS    |
|               | Ant2    | 2422               | 10.72              | ≤30.00                  | 13.71         | ≤36.00             | PASS    |
|               | total   | 2422               | 13.71              | ≤30.00                  | 16.70         | ≤36.00             | PASS    |
|               | Ant1    | 2437               | 10.65              | ≤30.00                  | 13.64         | ≤36.00             | PASS    |
|               | Ant2    | 2437               | 10.62              | ≤30.00                  | 13.61         | ≤36.00             | PASS    |
|               | total   | 2437               | 13.65              | ≤30.00                  | 16.64         | ≤36.00             | PASS    |
|               | Ant1    | 2452               | 10.98              | ≤30.00                  | 13.97         | ≤36.00             | PASS    |
|               | Ant2    | 2452               | 10.56              | ≤30.00                  | 13.55         | ≤36.00             | PASS    |
|               | total   | 2452               | 13.79              | ≤30.00                  | 16.78         | ≤36.00             | PASS    |

### 8.3 MAXIMUM POWER SPECTRAL DENSITY

#### 8.3.1 Applicable Standard

According to FCC Part15.247(e) and KDB 558074 D01 15.247 Meas Guidance v05r02

#### 8.3.2 Conformance Limit

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

#### 8.3.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

#### 8.3.4 Test Procedure

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance

The transmitter output (antenna port) was connected to the spectrum analyzer

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: 3 kHz

Set the VBW to:10 kHz.

Set Detector = peak.

Set Sweep time = auto couple.

Set Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

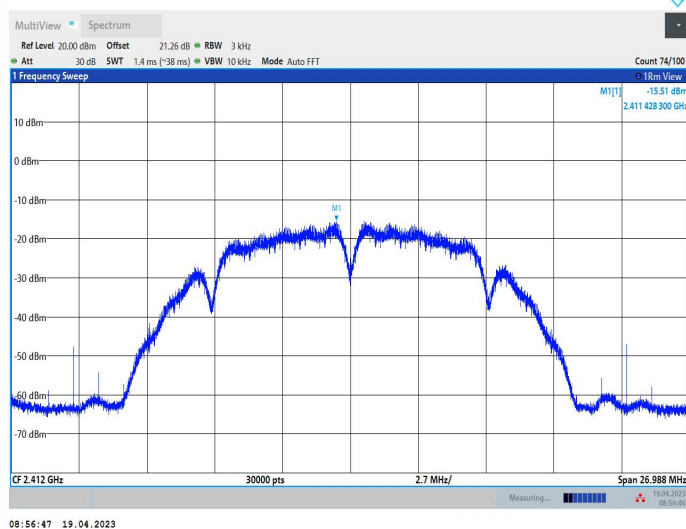
Note: If antenna Gain exceeds 6 dBi, then PSD Limit=8-(Gain- 6)

#### 8.3.5 Test Results

|                    |           |
|--------------------|-----------|
| Temperature:       | 25° C     |
| Relative Humidity: | 45%       |
| ATM Pressure:      | 1011 mbar |

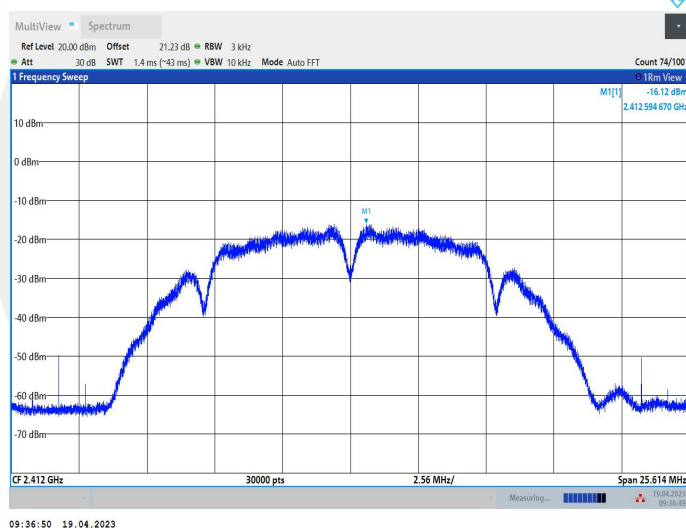
| TestMode  | Antenna | Frequency[MHz] | Result[dBm/3-100kHz] | Limit[dBm/3kHz] | Verdict |
|-----------|---------|----------------|----------------------|-----------------|---------|
| 11B       | Ant1    | 2412           | -15.51               | ≤8.00           | PASS    |
|           | Ant2    | 2412           | -16.12               | ≤8.00           | PASS    |
|           | Ant1    | 2437           | -16.02               | ≤8.00           | PASS    |
|           | Ant2    | 2437           | -16.46               | ≤8.00           | PASS    |
|           | Ant1    | 2462           | -15.79               | ≤8.00           | PASS    |
|           | Ant2    | 2462           | -16.73               | ≤8.00           | PASS    |
| 11G       | Ant1    | 2412           | -19.22               | ≤8.00           | PASS    |
|           | Ant2    | 2412           | -19.17               | ≤8.00           | PASS    |
|           | Ant1    | 2437           | -17.47               | ≤8.00           | PASS    |
|           | Ant2    | 2437           | -17.91               | ≤8.00           | PASS    |
|           | Ant1    | 2462           | -20.97               | ≤8.00           | PASS    |
|           | Ant2    | 2462           | -22.01               | ≤8.00           | PASS    |
| 11N20MIMO | Ant1    | 2412           | -21.79               | ≤8.00           | PASS    |
|           | Ant2    | 2412           | -21.6                | ≤8.00           | PASS    |
|           | total   | 2412           | -18.68               | ≤8.00           | PASS    |
|           | Ant1    | 2437           | -20.83               | ≤8.00           | PASS    |
|           | Ant2    | 2437           | -21.03               | ≤8.00           | PASS    |
|           | total   | 2437           | -17.92               | ≤8.00           | PASS    |
|           | Ant1    | 2462           | -21.67               | ≤8.00           | PASS    |
|           | Ant2    | 2462           | -22                  | ≤8.00           | PASS    |
| 11N40MIMO | total   | 2462           | -18.82               | ≤8.00           | PASS    |
|           | Ant1    | 2422           | -24.22               | ≤8.00           | PASS    |
|           | Ant2    | 2422           | -24.03               | ≤8.00           | PASS    |
|           | total   | 2422           | -21.11               | ≤8.00           | PASS    |
|           | Ant1    | 2437           | -23.1                | ≤8.00           | PASS    |
|           | Ant2    | 2437           | -24.47               | ≤8.00           | PASS    |
|           | total   | 2437           | -20.72               | ≤8.00           | PASS    |
|           | Ant1    | 2452           | -23.72               | ≤8.00           | PASS    |
|           | Ant2    | 2452           | -24.02               | ≤8.00           | PASS    |
|           | total   | 2452           | -20.86               | ≤8.00           | PASS    |

## 11B\_Ant1\_2412



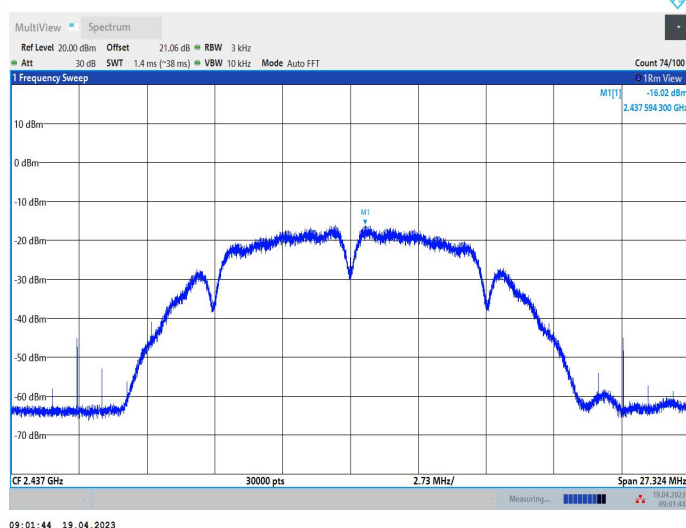
08:56:47 19.04.2023

## 11B\_Ant2\_2412



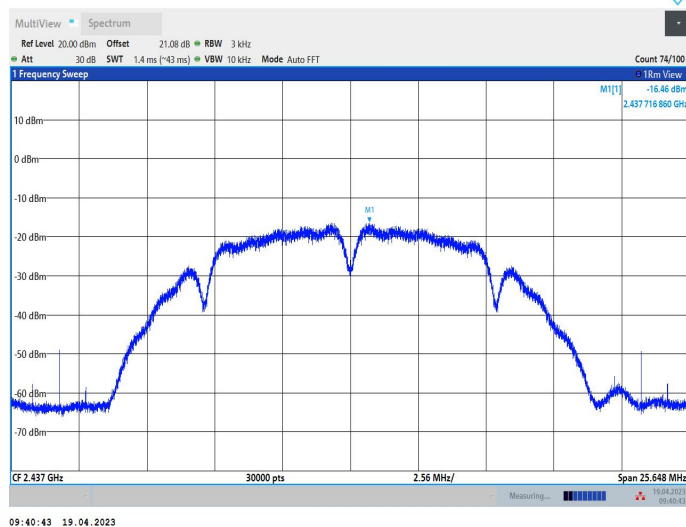
09:36:50 19.04.2023

## 11B\_Ant1\_2437

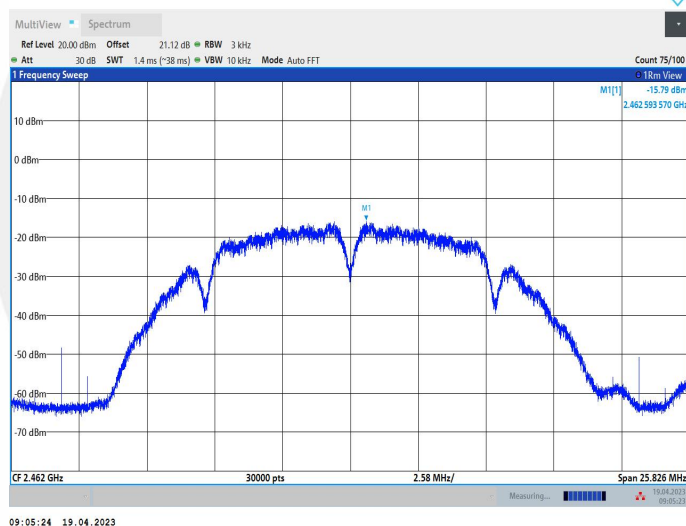


09:01:44 19.04.2023

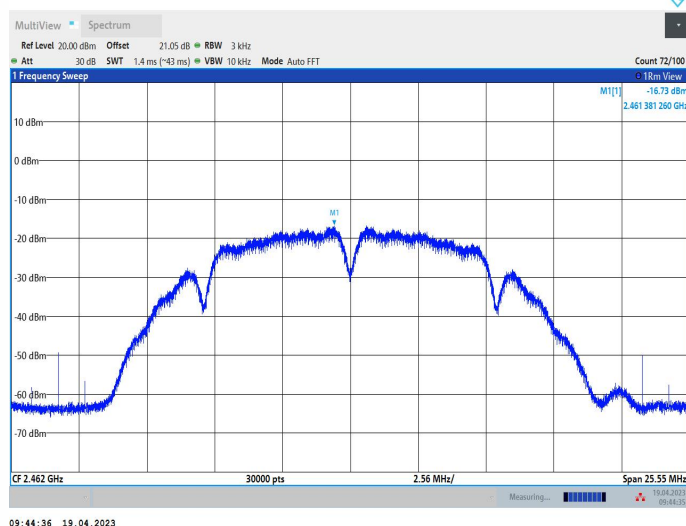
## 11B\_Ant2\_2437



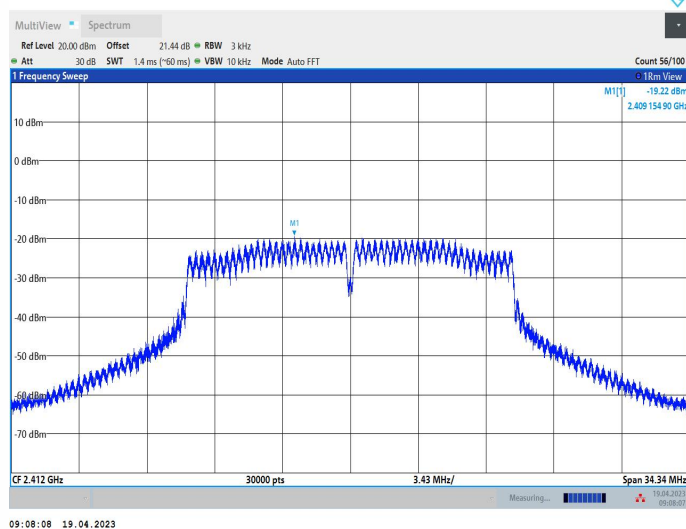
## 11B\_Ant1\_2462



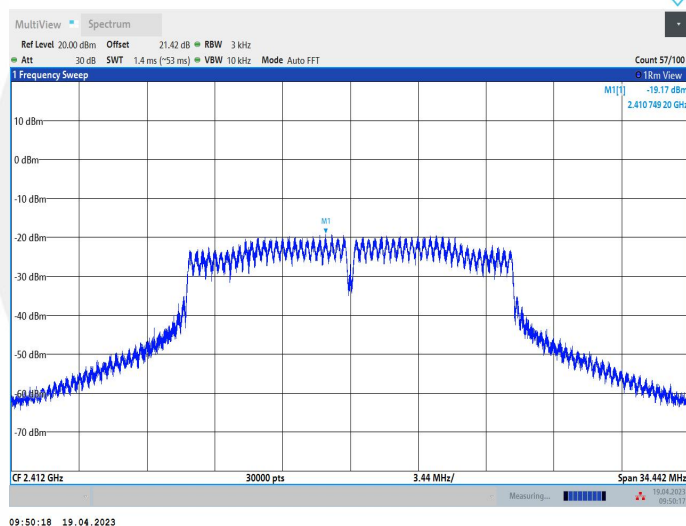
## 11B\_Ant2\_2462



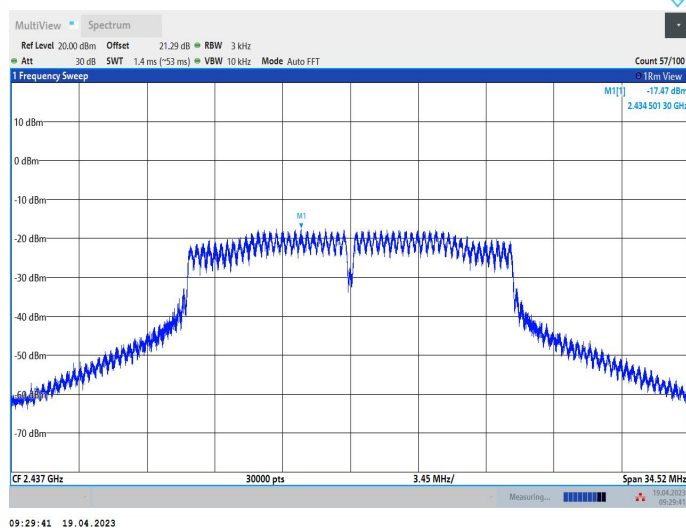
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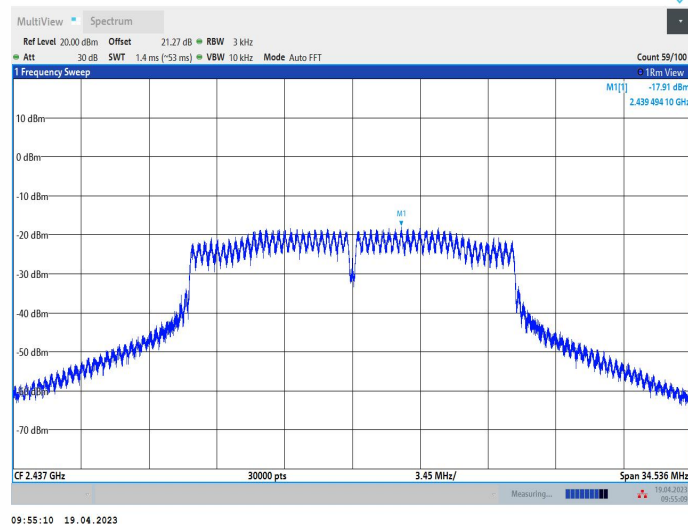
## 11G\_Ant2\_2412



## 11G\_Ant1\_2437

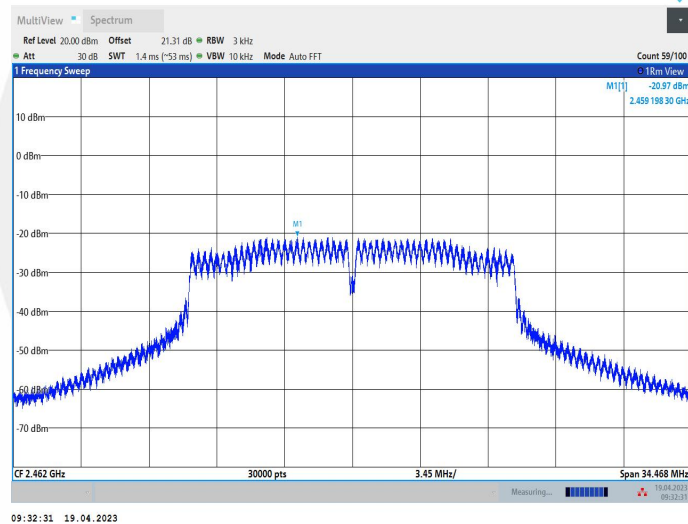


### 11G\_Ant2\_2437



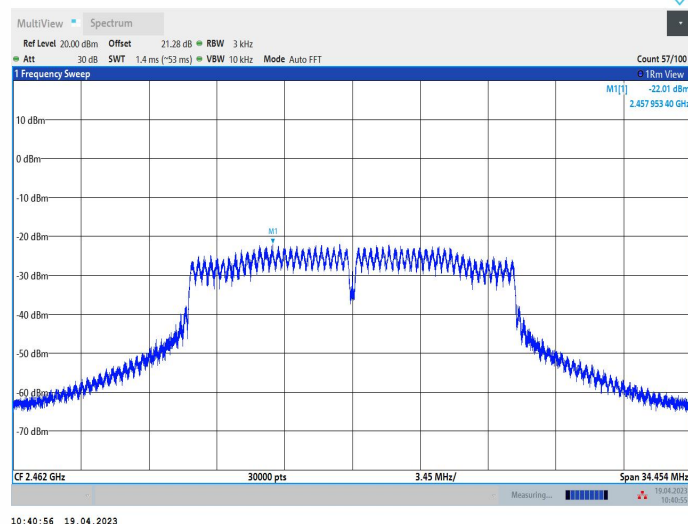
09:55:10 19.04.2023

### 11G\_Ant1\_2462



09:32:31 19.04.2023

### 11G\_Ant2\_2462



10:40:56 19.04.2023