



## FCC PART 15.247

## TEST REPORT

For

### Crestron Electronics Inc

15 Volvo Drive, Rockleigh, New Jersey, 07647, USA

**FCC ID: EROAM-3100**

|   |  |
|---|--|
| <b>Report Type:</b><br>Original Report  | <b>Product Type:</b><br>Wireless Presentation System |
| <b>Report Number:</b> RSZ210118001-00B  |  |
| <b>Report Date:</b> 2021-04-08  |  |
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## GENERAL INFORMATION

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

|                                     |  |
|-------------------------------------|--|
| Product                             | Wireless Presentation System   |
| Tested Model                        | M202018001   |
| SKU                                 | AM-3100-WF(For US), AM-3100-WF-I(For World)  |
| Frequency Range                     | BLE: 2402-2480MHz<br>Wi-Fi: 2412-2462MHz   |
| Maximum Conducted Peak Output Power | BLE: 7.51Bm(LE 1M), 7.54dBm(LE 2M)<br>Wi-Fi: 24.5dBm(802.11b), 25.7dBm(802.11g),<br>25.8dBm(802.11n-HT20), 23.8dBm(802.11ax20) |
| Modulation Technique                | BLE: GFSK<br>Wi-Fi: DSSS, OFDM   |
| Antenna Specification*              | ANT 1: 4dBi<br>ANT 2: 4dBi(provided by the applicant)  |
| Voltage Range                       | DC 24V from adapter or DC 48V from POE   |
| Date of Test                        | 2021-01-24 to 2021-04-08   |
| Sample serial number                | RSZ210118001-RF-S1(Assigned by BACL, Shenzhen)   |
| Received date                       | 2021-01-18   |
| Sample/EUT Status                   | Good condition   |
| Applicant                           | Crestron Electronics Inc   |
| Applicant Address                   | 15 Volvo Drive, Rockleigh, New Jersey, 07647, USA  |
| Manufacturer                        | Crestron Electronics Inc   |
| Manufacturer Address                | 15 Volvo Drive, Rockleigh, New Jersey, 07647, USA  |

### Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## Measurement Uncertainty

| Parameter                          |            | Uncertainty |
|------------------------------------|------------|-------------|
| Occupied Channel Bandwidth         |            | ±5%         |
| RF Output Power with Power meter   |            | ±0.73dB     |
| RF conducted test with spectrum    |            | ±1.6dB      |
| AC Power Lines Conducted Emissions |            | ±1.95dB     |
| Emissions,<br>Radiated             | Below 1GHz | ±4.75dB     |
|                                    | Above 1GHz | ±4.88dB     |
| Temperature                        |            | ±1°C        |
| Humidity                           |            | ±6%         |
| Supply voltages                    |            | ±0.4%       |

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

## Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) ,6F,7F,the 3rd Phase of Wan Li Industrial Building D,Shihua Rd, FuTian Free Trade Zone, Shenzhen, China .

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

For 802.11b, 802.11g, 802.11n-HT20 and 802.11ax20 mode, 11 channels are provided to testing:

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

For 802.11b, 802.11g, 802.11n-HT20, 802.11ax20 EUT was tested with Channel 1, 6 and 11.

For LE 1M&LE 2M mode, 40 channels are provided to testing:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 0       | 2402            | 20      | 2442            |
| 1       | 2404            | 21      | 2444            |
| 2       | 2406            | 22      | 2446            |
| 3       | 2408            | 23      | 2448            |
| 4       | 2410            | 24      | 2450            |
| 5       | 2412            | 25      | 2452            |
| 6       | 2414            | 26      | 2454            |
| 7       | 2416            | 27      | 2456            |
| 8       | 2418            | 28      | 2458            |
| 9       | 2420            | 29      | 2460            |
| 10      | 2422            | 30      | 2462            |
| 11      | 2424            | 31      | 2464            |
| 12      | 2426            | 32      | 2466            |
| 13      | 2428            | 33      | 2468            |
| 14      | 2430            | 34      | 2470            |
| 15      | 2432            | 35      | 2472            |
| 16      | 2434            | 36      | 2474            |
| 17      | 2436            | 37      | 2476            |
| 18      | 2438            | 38      | 2478            |
| 19      | 2440            | 39      | 2480            |

EUT was tested with Channel 0, 19 and 39.

The EUT has two integral antennas arrangement, the BLE only transmit on antenna 1, the Wi-Fi can transmit on both antennas in MIMO mode.

## Equipment Modifications

No modification was made to the EUT tested.

## EUT Exercise Software

“SecureCRT\*” was use to the EUT tested and power level is default\*. The software and power level was provided by the applicant.

## Duty cycle

The test result please refer to the Appendix BLE& Appendix Wi-Fi.

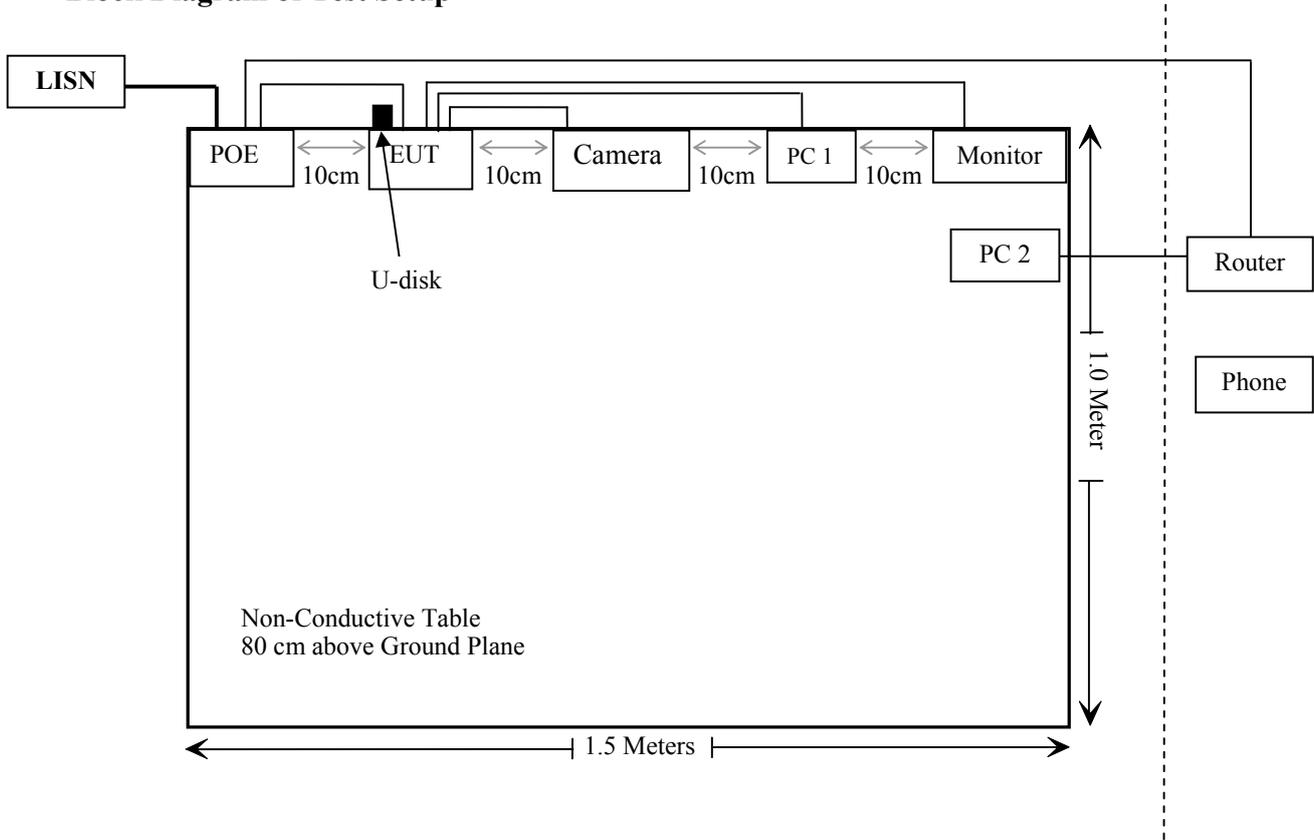
## Support Equipment List and Details

| Manufacturer                       | Description | Model          | Serial Number   |
|------------------------------------|-------------|----------------|-----------------|
| GOSPELL                            | POE         | G0720-480-050  | G0720-480-050   |
| Dell                               | PC 1        | Latitude E5430 | 26913508589     |
| Dell                               | PC 2        | Latitude E5430 | 42332463482     |
| HIKVISION                          | Router      | DS-3WR03-E     | 10021642429     |
| SAMSUNG                            | Monitor     | S24E390HL      | ZZFRH4ZN303357K |
| IN ONE SMART TECHNOLOGY (H.K.) LTD | Phone       | E11            | 101642          |
| Grandstream                        | Camera      | GUV3105        | Grandstream     |
| Kingston                           | USB disk    | DTSE9H/16G     | Kingston        |

## External I/O Cable

| Cable Description                 | Length (m) | From Port | To      |
|-----------------------------------|------------|-----------|---------|
| Un-shielded Detachable AC Cable   | 1.0        | LISN      | POE     |
| Un-shielded Detachable RJ45Cable  | 1.0        | POE       | EUT     |
| Un-shielded Detachable RJ45 Cable | 1.0        | Router    | PC 2    |
| Un-shielded Detachable RJ45 Cable | 5.0        | POE       | Router  |
| UnShielded Detachable HDMI Cable  | 1.0        | EUT       | Monitor |
| Un-shielded Detachable USB Cable  | 1.2        | EUT       | Camera  |
| Un-shielded Detachable USB Cable  | 2.0        | EUT       | PC 1    |

**Block Diagram of Test Setup**



**SUMMARY OF TEST RESULTS**

| FCC Rules                       | Description of Test                      | Result     |
|---------------------------------|--|------------|
| §15.247 (i), §2.1091            | Maximum Permissible Exposure(MPE)        | Compliance |
| §15.203                         | Antenna Requirement                      | Compliance |
| §15.207 (a)                     | AC Line Conducted Emissions              | Compliance |
| §15.205, §15.209,<br>§15.247(d) | Spurious Emissions                       | Compliance |
| §15.247 (a)(2)                  | 6 dB Emission Bandwidth                  | Compliance |
| §15.247(b)(3)                   | Maximum Conducted Output Power           | Compliance |
| §15.247(d)                      | 100 kHz Bandwidth of Frequency Band Edge | Compliance |
| §15.247(e)                      | Power Spectral Density                   | Compliance |

Note: the EUT has two types power supply, the adapter and POE, according the test result of FCC Part 15B test result, the POE power supply is worsen, so worst case POE power test data was record in report.

**TEST EQUIPMENT LIST**

| Manufacturer                    | Description                  | Model                   | Serial Number          | Calibration Date | Calibration Due Date |
|---------------------------------|------------------------------|-------------------------|------------------------|------------------|----------------------|
| <b>Conducted Emissions Test</b> |                              |                         |                        |                  |                      |
| Rohde & Schwarz                 | EMI Test Receiver            | ESCI                    | 101120                 | 2020/08/04       | 2021/08/03           |
| Rohde & Schwarz                 | LISN                         | ENV216                  | 101613                 | 2020/08/04       | 2021/08/03           |
| Rohde & Schwarz                 | Transient Limiter            | ESH3Z2                  | DE25985                | 2020/11/29       | 2021/11/28           |
| Unknown                         | CE Cable                     | CE Cable                | UF A210B-1-0720-504504 | 2020/11/29       | 2021/11/28           |
| Rohde & Schwarz                 | CE Test software             | EMC 32                  | V8.53.0                | NCR              | NCR                  |
| <b>Radiated Emission Test</b>   |                              |                         |                        |                  |                      |
| R&S                             | EMI Test Receiver            | ESR3                    | 102455                 | 2020/08/04       | 2021/08/03           |
| Sonoma instrument               | Pre-amplifier                | 310 N                   | 186238                 | 2020/08/04       | 2021/08/03           |
| Sunol Sciences                  | Broadband Antenna            | JB1                     | A040904-2              | 2020/12/22       | 2023/12/21           |
| Unknown                         | Cable 2                      | RF Cable 2              | F-03-EM197             | 2020/11/29       | 2021/11/28           |
| Unknown                         | Cable                        | Chamber Cable 1         | F-03-EM236             | 2020/11/29       | 2021/11/28           |
| Rohde & Schwarz                 | Auto test software           | EMC 32                  | V9.10                  | NCR              | NCR                  |
| Rohde & Schwarz                 | Spectrum Analyzer            | FSV40-N                 | 102259                 | 2020/08/04       | 2021/08/03           |
| COM-POWER                       | Pre-amplifier                | PA-122                  | 181919                 | 2020/11/29       | 2021/11/28           |
| Quinstar                        | Amplifier                    | QLW-18405536-J0         | 15964001002            | 2020/11/29       | 2021/11/28           |
| Sunol Sciences                  | Horn Antenna                 | 3115                    | 9107-3694              | 2021/01/15       | 2024/01/14           |
| Insulated Wire Inc.             | RF Cable                     | SPS-2503-3150           | 02222010               | 2020/11/29       | 2021/11/28           |
| Unknown                         | RF Cable                     | W1101-EQ1 OUT           | F-19-EM005             | 2020/11/29       | 2021/11/28           |
| SNSD                            | Band Reject filter           | BSF2402-2480MN-0898-001 | 2.4G filter            | 2020/04/20       | 2021/04/20           |
| Ducommun Technologies           | Horn antenna                 | ARH-4223-02             | 1007726-021304         | 2020/12/06       | 2023/12/05           |
| <b>RF Conducted Test</b>        |                              |                         |                        |                  |                      |
| Tonscend Corporation            | RF control Unit              | JS0806-2                | 19D8060154             | 2020/08/04       | 2021/08/03           |
| Rohde & Schwarz                 | Signal and Spectrum Analyzer | FSV40                   | 101473                 | 2020/08/04       | 2021/08/03           |
| Unknown                         | RF Cable                     | Unknown                 | 2301 276               | 2020/11/29       | 2021/11/28           |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

**FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

**Applicable Standard**

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

Limits for General Population/Uncontrolled Exposure

| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (Minutes) |
| 0.3-1.34  | 614                           | 1.63                          | *(100)                              | 30                       |
| 1.34-30   | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 30                       |
| 30-300  | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300-1500  | /                             | /                             | f/1500                              | 30                       |
| 1500-100,000  | /                             | /                             | 1.0                                 | 30                       |

f = frequency in MHz

\* = Plane-wave equivalent power density

**Result**

**Calculated Formulary:**

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

| Mode       | Frequency (MHz) | Antenna Gain |           | Tune up conducted power |        | Evaluation Distance (cm) | Power Density (mW/cm <sup>2</sup> ) | MPE Limit (mW/cm <sup>2</sup> ) |
|------------|-----------------|--------------|-----------|-------------------------|--------|--------------------------|-------------------------------------|---------------------------------|
|            |                 | (dBi)        | (numeric) | (dBm)                   | (mW)   |                          |                                     |                                 |
| Bluetooth  | 2402-2480       | 4.0          | 2.51      | 9.0                     | 7.94   | 20                       | 0.004                               | 1                               |
| BLE        | 2402-2480       | 4.0          | 2.51      | 8.0                     | 6.31   | 20                       | 0.003                               | 1                               |
| 2.4G Wi-Fi | 2412-2462       | 4.0          | 2.51      | 26.0                    | 398.11 | 20                       | 0.199                               | 1                               |
| 5G Wi-Fi   | 5150-5250       | 5.5          | 3.55      | 19.0                    | 79.43  | 20                       | 0.056                               | 1                               |
|            | 5250-5350       | 5.5          | 3.55      | 19.0                    | 79.43  | 20                       | 0.056                               | 1                               |
|            | 5470-5725       | 5.5          | 3.55      | 19.0                    | 79.43  | 20                       | 0.056                               | 1                               |
|            | 5725-5850       | 5.5          | 3.55      | 18.0                    | 63.10  | 20                       | 0.045                               | 1                               |

Note: 1. the tune up conducted power was declared by the applicant  
 2. The Bluetooth can transmit at the same time with Wi-Fi, the 2.4G Wi-Fi can't transmit at the same time with the 5G Wi-Fi.

**Simultaneous transmitting consideration:**

The ratio=MPEWi-Fi/limit + MPEBT/limit=0.199/1+0.004/1=0.203 < 1.0

So simultaneous exposure comply with the limit.

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

**Result: Compliance**

## **FCC §15.203 - ANTENNA REQUIREMENT**

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### **Applicable Standard**

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### **Antenna Connector Construction**

The EUT has two integral antennas arrangement, the BLE only transmit on antenna 1, the Wi-Fi can transmit on both antennas. The antenna gain is 4.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

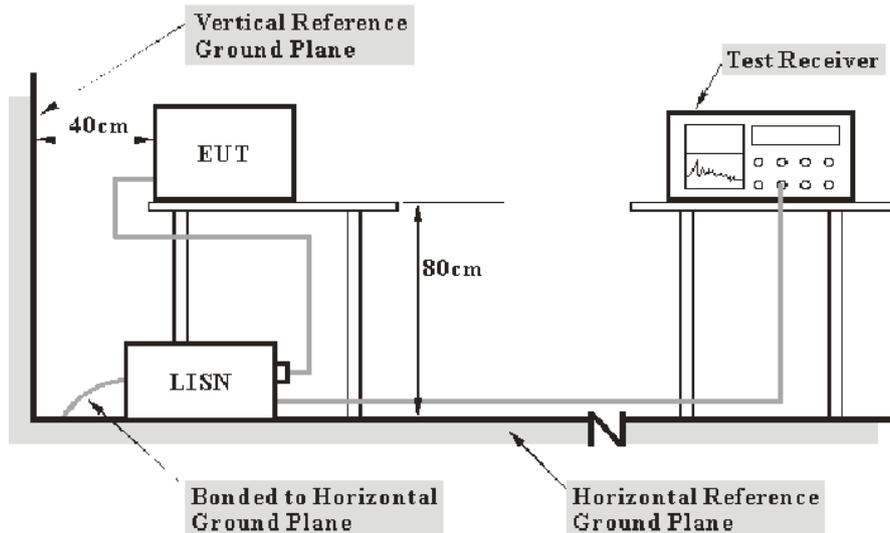
**Result:** Compliance.

## FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

### Applicable Standard

FCC§15.207

### EUT Setup



- Note: 1. Support units were connected to second LISN.  
 2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

### EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

| Frequency Range  | IF B/W |
|------------------|--------|
| 150 kHz – 30 MHz | 9 kHz  |

### Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

## Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

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

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

## Test Data

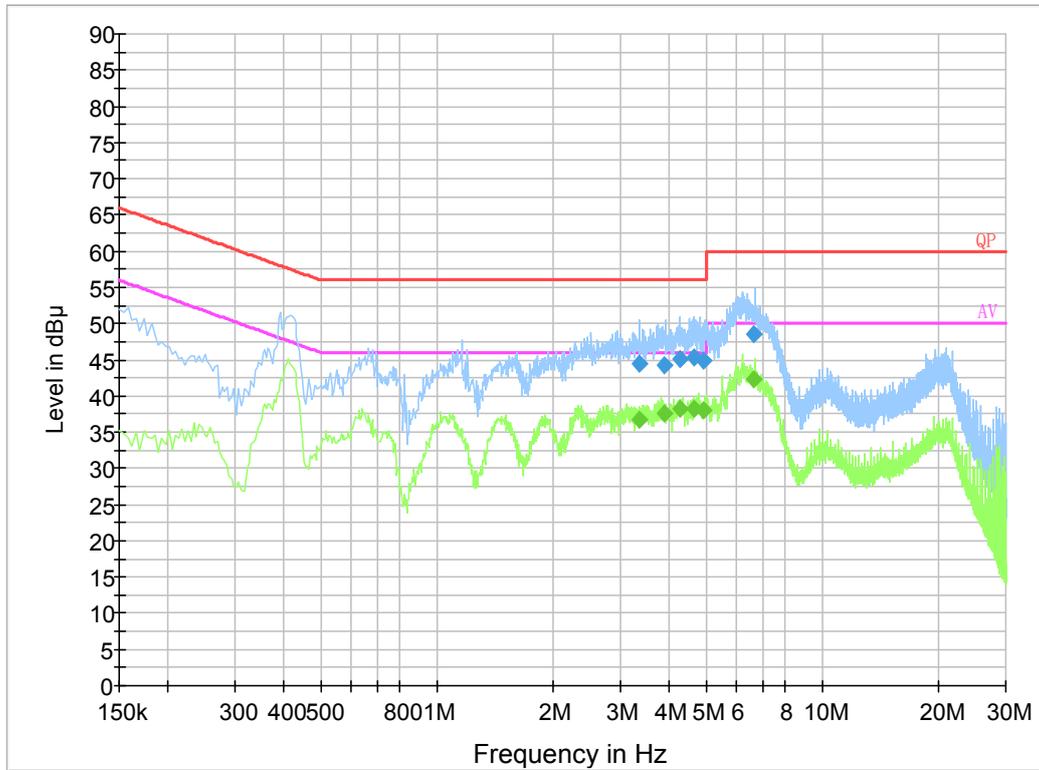
### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 25°C      |
| <b>Relative Humidity:</b> | 65%       |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Haiguo Li on 2021-03-12.*

*EUT operation mode: BT&Wi-Fi Link (the worst case is powered by the POE)*

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



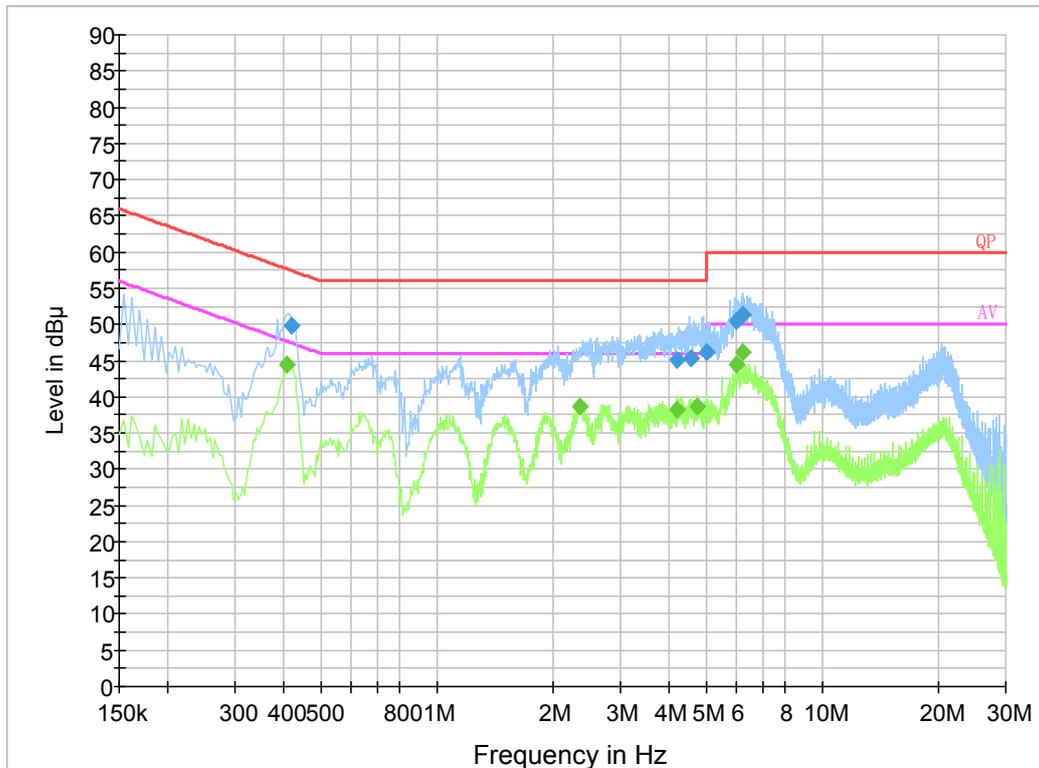
**Final Result 1**

| Frequency (MHz) | QuasiPeak (dB µ V) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dB µ V) |
|-----------------|--------------------|-----------------|------|------------|-------------|----------------|
| 3.363630        | 44.5               | 9.000           | L1   | 19.9       | 11.5        | 56.0           |
| 3.886870        | 44.3               | 9.000           | L1   | 19.9       | 11.7        | 56.0           |
| 4.269830        | 45.2               | 9.000           | L1   | 19.9       | 10.8        | 56.0           |
| 4.660190        | 45.3               | 9.000           | L1   | 19.9       | 10.7        | 56.0           |
| 4.947270        | 44.8               | 9.000           | L1   | 19.9       | 11.2        | 56.0           |
| 6.617290        | 48.5               | 9.000           | L1   | 19.9       | 11.5        | 60.0           |

**Final Result 2**

| Frequency (MHz) | Average (dB µ V) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dB µ V) |
|-----------------|------------------|-----------------|------|------------|-------------|----------------|
| 3.363630        | 36.8             | 9.000           | L1   | 19.9       | 9.2         | 46.0           |
| 3.886870        | 37.7             | 9.000           | L1   | 19.9       | 8.3         | 46.0           |
| 4.269830        | 38.3             | 9.000           | L1   | 19.9       | 7.7         | 46.0           |
| 4.660190        | 38.3             | 9.000           | L1   | 19.9       | 7.7         | 46.0           |
| 4.947270        | 38.0             | 9.000           | L1   | 19.9       | 8.0         | 46.0           |
| 6.617290        | 42.3             | 9.000           | L1   | 19.9       | 7.7         | 50.0           |

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



**Final Result 1**

| Frequency (MHz) | QuasiPeak (dB µ V) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dB µ V) |
|-----------------|--------------------|-----------------|------|------------|-------------|----------------|
| 0.419790        | 49.9               | 9.000           | N    | 19.8       | 7.6         | 57.5           |
| 4.214190        | 45.2               | 9.000           | N    | 19.9       | 10.8        | 56.0           |
| 4.554170        | 45.3               | 9.000           | N    | 19.9       | 10.7        | 56.0           |
| 5.039450        | 46.1               | 9.000           | N    | 19.9       | 13.9        | 60.0           |
| 5.997290        | 50.4               | 9.000           | N    | 19.9       | 9.6         | 60.0           |
| 6.236370        | 51.4               | 9.000           | N    | 19.9       | 8.6         | 60.0           |

**Final Result 2**

| Frequency (MHz) | Average (dB µ V) | Bandwidth (kHz) | Line | Corr. (dB) | Margin (dB) | Limit (dB µ V) |
|-----------------|------------------|-----------------|------|------------|-------------|----------------|
| 0.410000        | 44.5             | 9.000           | N    | 19.8       | 3.1         | 47.6           |
| 2.358000        | 38.6             | 9.000           | N    | 19.8       | 7.4         | 46.0           |
| 4.218000        | 38.3             | 9.000           | N    | 19.9       | 7.7         | 46.0           |
| 4.762000        | 38.8             | 9.000           | N    | 19.9       | 7.2         | 46.0           |
| 5.998000        | 44.5             | 9.000           | N    | 19.9       | 5.5         | 50.0           |
| 6.238000        | 46.2             | 9.000           | N    | 19.9       | 3.8         | 50.0           |

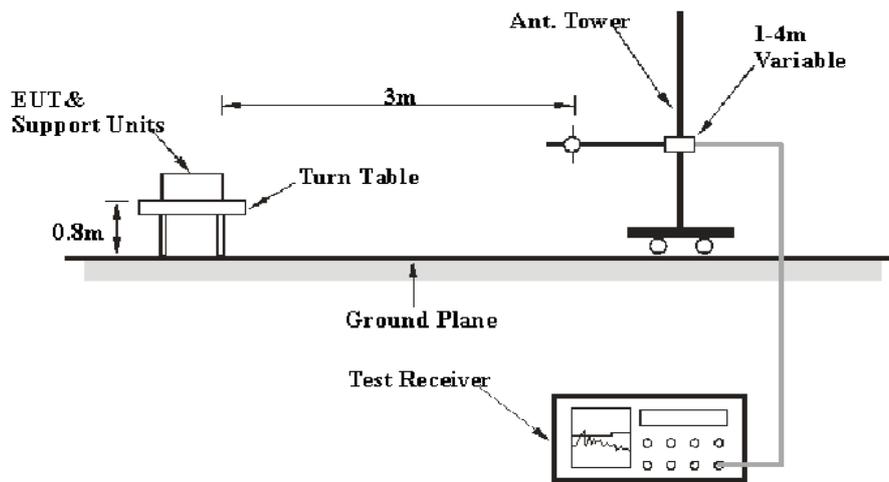
**FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS**

**Applicable Standard**

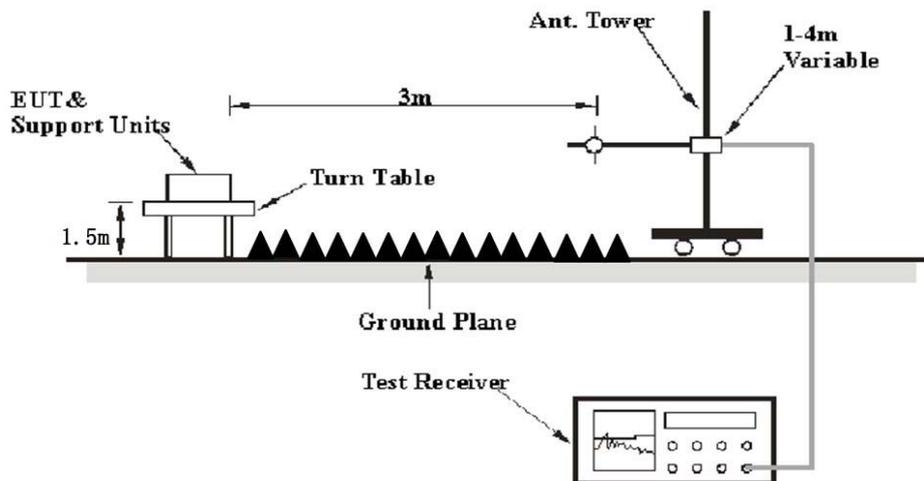
FCC §15.247 (d); §15.209; §15.205;

**EUT Setup**

**Below 1 GHz:**



**Above 1GHz:**



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

## EMI Test Receiver & Spectrum Analyzer Setup

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

| Frequency Range   | RBW     | Video B/W               | IF B/W  | Measurement |
|-------------------|---------|-------------------------|---------|-------------|
| 30 MHz – 1000 MHz | 100 kHz | 300 kHz                 | 120 kHz | QP          |
| Above 1 GHz       | 1MHz    | 3 MHz                   | /       | PK          |
|                   | 1MHz    | 10 Hz <sup>Note 1</sup> | /       | Average     |
|                   | 1MHz    | > 1/T <sup>Note 2</sup> | /       | Average     |

Note 1: when duty cycle is no less than 98%

Note 2: when duty cycle is less than 98%

## Test Procedure

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

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

## Corrected Amplitude & Margin Calculation

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

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

## Test Data

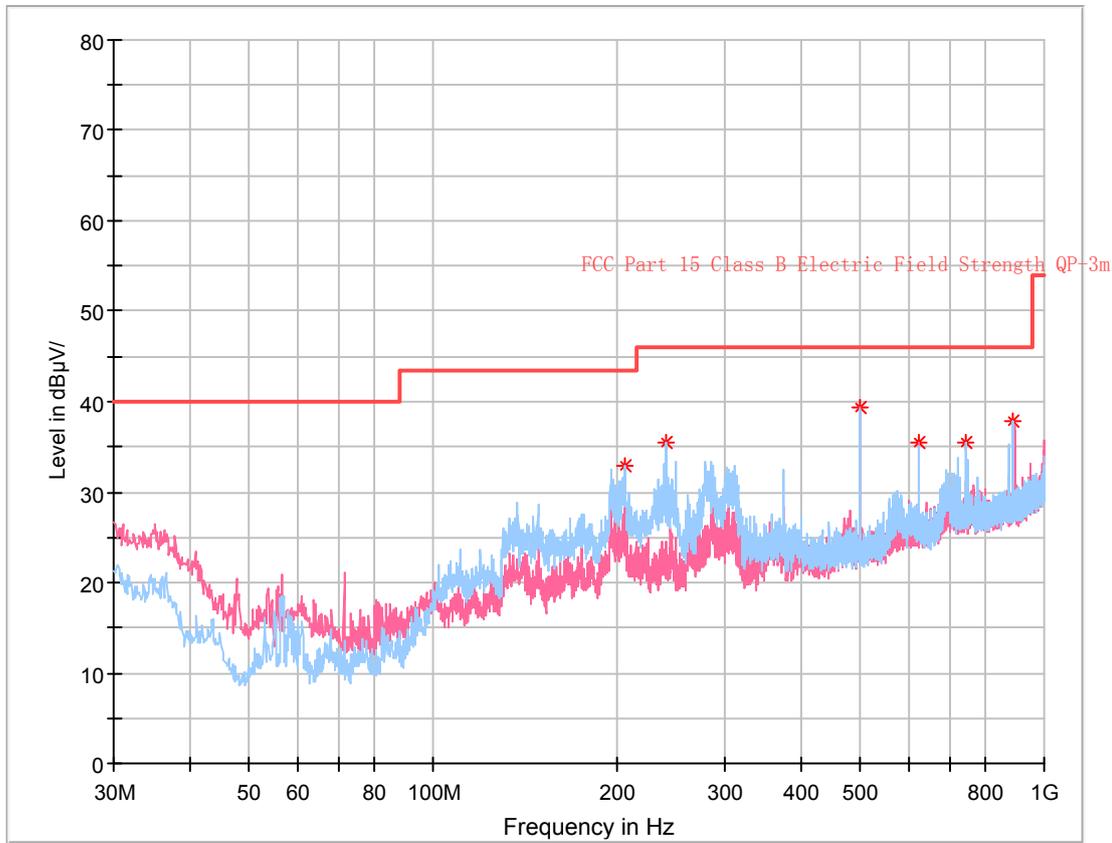
### Environmental Conditions

|                           |                 |
|---------------------------|-----------------|
| <b>Temperature:</b>       | 21.7~24 °C      |
| <b>Relative Humidity:</b> | 44~55 %         |
| <b>ATM Pressure:</b>      | 100.9~101.2 kPa |

*The testing was performed by Kilroy Deng on 2021-04-08 for below 1GHz and Leven Gan on 2021-01-24 for above 1GHz.*

*EUT operation mode: Transmitting*

30 MHz~1 GHz: (EUT operation mode: BT&Wi-Fi Link, the worst case is powered by the POE)



**Critical\_Freqs**

| Frequency (MHz) | MaxPeak (dB µ V/m) | Limit (dB µ V/m) | Margin (dB) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|-----------------|--------------------|------------------|-------------|-------------|-----|---------------|------------|
| 205.691250      | 32.96              | 43.50            | 10.54       | 100.0       | H   | 172.0         | -11.1      |
| 240.247500      | 35.58              | 46.00            | 10.42       | 200.0       | H   | 247.0         | -11.7      |
| 499.965000      | 39.28              | 46.00            | 6.72        | 200.0       | V   | 182.0         | -5.1       |
| 625.095000      | 35.54              | 46.00            | 10.46       | 100.0       | V   | 209.0         | -2.7       |
| 742.465000      | 35.44              | 46.00            | 10.56       | 100.0       | H   | 235.0         | -0.7       |
| 890.996250      | 37.83              | 46.00            | 8.17        | 100.0       | H   | 339.0         | 0.9        |

**1 GHz-25 GHz (Wi-Fi):**

**802.11b Mode:**

| Frequency (MHz)          | Receiver       |            | Turntable Degree | Rx Antenna |             | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|--------------------------|----------------|------------|------------------|------------|-------------|-------------------------|------------------------------|----------------|-------------|
|                          | Reading (dBμV) | PK/QP/Ave. |                  | Height (m) | Polar (H/V) |                         |                              |                |             |
| Low Channel (2412 MHz)   |                |            |                  |            |             |                         |                              |                |             |
| 2389.12                  | 31.29          | PK         | 314              | 2.2        | V           | 31.87                   | 63.16                        | 74             | 10.84       |
| 2389.12                  | 17.97          | Ave.       | 314              | 2.2        | V           | 31.87                   | 49.84                        | 54             | 4.16        |
| 2485.43                  | 29.14          | PK         | 12               | 2.2        | V           | 32.13                   | 61.27                        | 74             | 12.73       |
| 2485.43                  | 14.39          | Ave.       | 12               | 2.2        | V           | 32.13                   | 46.52                        | 54             | 7.48        |
| 4824.00                  | 45.46          | PK         | 53               | 1.9        | V           | 6.28                    | 51.74                        | 74             | 22.26       |
| 4824.00                  | 33.83          | Ave.       | 53               | 1.9        | V           | 6.28                    | 40.11                        | 54             | 13.89       |
| Middle Channel (2437MHz) |                |            |                  |            |             |                         |                              |                |             |
| 4874.00                  | 45.35          | PK         | 276              | 1.6        | V           | 6.76                    | 52.11                        | 74             | 21.89       |
| 4874.00                  | 33.87          | Ave.       | 276              | 1.6        | V           | 6.76                    | 40.63                        | 54             | 13.37       |
| High Channel (2462 MHz)  |                |            |                  |            |             |                         |                              |                |             |
| 2386.64                  | 29.36          | PK         | 241              | 1.0        | V           | 31.87                   | 61.23                        | 74             | 12.77       |
| 2386.64                  | 14.44          | Ave.       | 241              | 1.0        | V           | 31.87                   | 46.31                        | 54             | 7.69        |
| 2485.43                  | 32.81          | PK         | 149              | 2.0        | V           | 32.13                   | 64.94                        | 74             | 9.06        |
| 2485.43                  | 18.05          | Ave.       | 149              | 2.0        | V           | 32.13                   | 50.18                        | 54             | 3.82        |
| 4924.00                  | 45.42          | PK         | 51               | 1.4        | V           | 6.76                    | 52.18                        | 74             | 21.82       |
| 4924.00                  | 33.92          | Ave.       | 51               | 1.4        | V           | 6.76                    | 40.68                        | 54             | 13.32       |

**802.11g Mode:**

| Frequency (MHz)          | Receiver       |            | Turntable Degree | Rx Antenna |             | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|--------------------------|----------------|------------|------------------|------------|-------------|-------------------------|------------------------------|----------------|-------------|
|                          | Reading (dBμV) | PK/QP/Ave. |                  | Height (m) | Polar (H/V) |                         |                              |                |             |
| Low Channel (2412MHz)    |                |            |                  |            |             |                         |                              |                |             |
| 2389.47                  | 40.83          | PK         | 135              | 1.7        | V           | 31.87                   | 72.70                        | 74             | 1.30        |
| 2389.47                  | 19.84          | Ave.       | 135              | 1.7        | V           | 31.87                   | 51.71                        | 54             | 2.29        |
| 2485.65                  | 29.24          | PK         | 165              | 1.1        | V           | 32.13                   | 61.37                        | 74             | 12.63       |
| 2485.65                  | 15.37          | Ave.       | 165              | 1.1        | V           | 32.13                   | 47.50                        | 54             | 6.50        |
| 4824.00                  | 43.75          | PK         | 243              | 1.1        | V           | 6.28                    | 50.03                        | 74             | 23.97       |
| 4824.00                  | 30.49          | Ave.       | 243              | 1.1        | V           | 6.28                    | 36.77                        | 54             | 17.23       |
| Middle Channel (2437MHz) |                |            |                  |            |             |                         |                              |                |             |
| 4874.00                  | 44.24          | PK         | 261              | 2.1        | V           | 6.76                    | 51.00                        | 74             | 23.00       |
| 4874.00                  | 30.78          | Ave.       | 261              | 2.1        | V           | 6.76                    | 37.54                        | 54             | 16.46       |
| High Channel (2462MHz)   |                |            |                  |            |             |                         |                              |                |             |
| 2388.71                  | 28.92          | PK         | 357              | 2.1        | V           | 31.87                   | 60.79                        | 74             | 13.21       |
| 2388.71                  | 15.23          | Ave.       | 357              | 2.1        | V           | 31.87                   | 47.10                        | 54             | 6.90        |
| 2483.53                  | 40.41          | PK         | 190              | 1.6        | V           | 32.13                   | 72.54                        | 74             | 1.46        |
| 2483.53                  | 19.31          | Ave.       | 190              | 1.6        | V           | 32.13                   | 51.44                        | 54             | 2.56        |
| 4924.00                  | 43.84          | PK         | 107              | 1.8        | V           | 6.76                    | 50.60                        | 74             | 23.40       |
| 4924.00                  | 30.43          | Ave.       | 107              | 1.8        | V           | 6.76                    | 37.19                        | 54             | 16.81       |

**802.11n-HT20 Mode:**

| Frequency (MHz)          | Receiver       |            | Turntable Degree | Rx Antenna |             | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|--------------------------|----------------|------------|------------------|------------|-------------|-------------------------|------------------------------|----------------|-------------|
|                          | Reading (dBμV) | PK/QP/Ave. |                  | Height (m) | Polar (H/V) |                         |                              |                |             |
| Low Channel (2412MHz)    |                |            |                  |            |             |                         |                              |                |             |
| 2389.91                  | 41.04          | PK         | 3                | 2.0        | V           | 31.87                   | 72.91                        | 74             | 1.09        |
| 2389.91                  | 18.12          | Ave.       | 3                | 2.0        | V           | 31.87                   | 49.99                        | 54             | 4.01        |
| 2485.67                  | 29.24          | PK         | 320              | 2.5        | V           | 32.13                   | 61.37                        | 74             | 12.63       |
| 2485.67                  | 15.28          | Ave.       | 320              | 2.5        | V           | 32.13                   | 47.41                        | 54             | 6.59        |
| 4824.00                  | 43.84          | PK         | 100              | 1.4        | V           | 6.28                    | 50.12                        | 74             | 23.88       |
| 4824.00                  | 30.51          | Ave.       | 100              | 1.4        | V           | 6.28                    | 36.79                        | 54             | 17.21       |
| Middle Channel (2437MHz) |                |            |                  |            |             |                         |                              |                |             |
| 4874.00                  | 44.53          | PK         | 29               | 1.2        | V           | 6.76                    | 51.29                        | 74             | 22.71       |
| 4874.00                  | 30.85          | Ave.       | 29               | 1.2        | V           | 6.76                    | 37.61                        | 54             | 16.39       |
| High Channel (2462MHz)   |                |            |                  |            |             |                         |                              |                |             |
| 2389.91                  | 28.99          | PK         | 252              | 1.9        | V           | 31.87                   | 60.86                        | 74             | 13.14       |
| 2389.91                  | 15.25          | Ave.       | 252              | 1.9        | V           | 31.87                   | 47.12                        | 54             | 6.88        |
| 2483.52                  | 40.76          | PK         | 342              | 1.9        | V           | 32.13                   | 72.89                        | 74             | 1.11        |
| 2483.52                  | 18.24          | Ave.       | 342              | 1.9        | V           | 32.13                   | 50.37                        | 54             | 3.63        |
| 4924.00                  | 43.69          | PK         | 291              | 1.4        | V           | 6.76                    | 50.45                        | 74             | 23.55       |
| 4924.00                  | 30.48          | Ave.       | 291              | 1.4        | V           | 6.76                    | 37.24                        | 54             | 16.76       |

**802.11ax20 Mode:**

| Frequency (MHz)          | Receiver       |            | Turntable Degree | Rx Antenna |             | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|--------------------------|----------------|------------|------------------|------------|-------------|-------------------------|------------------------------|----------------|-------------|
|                          | Reading (dBμV) | PK/QP/Ave. |                  | Height (m) | Polar (H/V) |                         |                              |                |             |
| Low Channel (2412MHz)    |                |            |                  |            |             |                         |                              |                |             |
| 2389.37                  | 41.08          | PK         | 248              | 1.4        | V           | 31.87                   | 72.95                        | 74             | 1.05        |
| 2389.37                  | 20.56          | Ave.       | 248              | 1.4        | V           | 31.87                   | 52.43                        | 54             | 1.57        |
| 2485.52                  | 29.07          | PK         | 247              | 1.4        | V           | 32.13                   | 61.20                        | 74             | 12.80       |
| 2485.52                  | 15.24          | Ave.       | 247              | 1.4        | V           | 32.13                   | 47.37                        | 54             | 6.63        |
| 4824.00                  | 43.93          | PK         | 272              | 1.8        | V           | 6.28                    | 50.21                        | 74             | 23.79       |
| 4824.00                  | 30.49          | Ave.       | 272              | 1.8        | V           | 6.28                    | 36.77                        | 54             | 17.23       |
| Middle Channel (2437MHz) |                |            |                  |            |             |                         |                              |                |             |
| 4874.00                  | 44.39          | PK         | 192              | 1.7        | V           | 6.76                    | 51.15                        | 74             | 22.85       |
| 4874.00                  | 30.77          | Ave.       | 192              | 1.7        | V           | 6.76                    | 37.53                        | 54             | 16.47       |
| High Channel (2462MHz)   |                |            |                  |            |             |                         |                              |                |             |
| 2388.45                  | 29.25          | PK         | 249              | 2.4        | V           | 31.87                   | 61.12                        | 74             | 12.88       |
| 2388.45                  | 15.29          | Ave.       | 249              | 2.4        | V           | 31.87                   | 47.16                        | 54             | 6.84        |
| 2483.62                  | 40.89          | PK         | 106              | 2.4        | V           | 32.13                   | 73.02                        | 74             | 0.98        |
| 2483.62                  | 20.72          | Ave.       | 106              | 2.4        | V           | 32.13                   | 52.85                        | 54             | 1.15        |
| 4924.00                  | 44.05          | PK         | 259              | 1.6        | V           | 6.76                    | 50.81                        | 74             | 23.19       |
| 4924.00                  | 30.51          | Ave.       | 259              | 1.6        | V           | 6.76                    | 37.27                        | 54             | 16.73       |

**1 GHz-25 GHz (LE 1M):**

| Frequency (MHz)           | Receiver       |            | Turntable Degree | Rx Antenna |             | Corrected Factor (dB/m) | Corrected Amplitude (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---------------------------|----------------|------------|------------------|------------|-------------|-------------------------|------------------------------|----------------|-------------|
|                           | Reading (dBµV) | PK/QP/Ave. |                  | Height (m) | Polar (H/V) |                         |                              |                |             |
| Low Channel (2402 MHz)    |                |            |                  |            |             |                         |                              |                |             |
| 2389.45                   | 28.76          | PK         | 100              | 2.3        | V           | 31.87                   | 60.63                        | 74             | 13.37       |
| 2389.45                   | 14.83          | Ave.       | 100              | 2.3        | V           | 31.87                   | 46.70                        | 54             | 7.30        |
| 2484.36                   | 29.12          | PK         | 263              | 1.8        | V           | 32.13                   | 61.25                        | 74             | 12.75       |
| 2484.36                   | 14.85          | Ave.       | 263              | 1.8        | V           | 32.13                   | 46.98                        | 54             | 7.02        |
| 4804.00                   | 44.30          | PK         | 33               | 1.0        | V           | 6.28                    | 50.58                        | 74             | 23.42       |
| 4804.00                   | 30.88          | Ave.       | 33               | 1.0        | V           | 6.28                    | 37.16                        | 54             | 16.84       |
| Middle Channel (2440 MHz) |                |            |                  |            |             |                         |                              |                |             |
| 4880.00                   | 44.24          | PK         | 184              | 1.8        | V           | 6.76                    | 51.00                        | 74             | 23.00       |
| 4880.00                   | 30.92          | Ave.       | 184              | 1.8        | V           | 6.76                    | 37.68                        | 54             | 16.32       |
| High Channel (2480 MHz)   |                |            |                  |            |             |                         |                              |                |             |
| 2387.27                   | 29.13          | PK         | 155              | 1.3        | V           | 31.87                   | 61.00                        | 74             | 13.00       |
| 2387.27                   | 14.83          | Ave.       | 155              | 1.3        | V           | 31.87                   | 46.70                        | 54             | 7.30        |
| 2484.10                   | 29.24          | PK         | 344              | 1.6        | V           | 32.13                   | 61.37                        | 74             | 12.63       |
| 2484.10                   | 14.87          | Ave.       | 344              | 1.6        | V           | 32.13                   | 47.00                        | 54             | 7.00        |
| 4960.00                   | 44.47          | PK         | 20               | 2.0        | V           | 6.80                    | 51.27                        | 74             | 22.73       |
| 4960.00                   | 31.04          | Ave.       | 20               | 2.0        | V           | 6.80                    | 37.84                        | 54             | 16.16       |

**1 GHz-25 GHz (LE 2M):**

| Frequency (MHz)           | Receiver       |            | Turntable Degree | Rx Antenna |             | Corrected Factor (dB/m) | Corrected Amplitude (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---------------------------|----------------|------------|------------------|------------|-------------|-------------------------|------------------------------|----------------|-------------|
|                           | Reading (dBµV) | PK/QP/Ave. |                  | Height (m) | Polar (H/V) |                         |                              |                |             |
| Low Channel (2402 MHz)    |                |            |                  |            |             |                         |                              |                |             |
| 2388.65                   | 29.31          | PK         | 317              | 2.0        | V           | 31.87                   | 61.18                        | 74             | 12.82       |
| 2388.65                   | 14.89          | Ave.       | 317              | 2.0        | V           | 31.87                   | 46.76                        | 54             | 7.24        |
| 2484.53                   | 29.53          | PK         | 225              | 1.1        | V           | 32.13                   | 61.66                        | 74             | 12.34       |
| 2484.53                   | 14.91          | Ave.       | 225              | 1.1        | V           | 32.13                   | 47.04                        | 54             | 6.96        |
| 4804.00                   | 44.24          | PK         | 327              | 1.7        | V           | 6.28                    | 50.52                        | 74             | 23.48       |
| 4804.00                   | 30.71          | Ave.       | 327              | 1.7        | V           | 6.28                    | 36.99                        | 54             | 17.01       |
| Middle Channel (2440 MHz) |                |            |                  |            |             |                         |                              |                |             |
| 4880.00                   | 44.49          | PK         | 344              | 1.9        | V           | 6.76                    | 51.25                        | 74             | 22.75       |
| 4880.00                   | 30.85          | Ave.       | 344              | 1.9        | V           | 6.76                    | 37.61                        | 54             | 16.39       |
| High Channel (2480 MHz)   |                |            |                  |            |             |                         |                              |                |             |
| 2387.79                   | 29.24          | PK         | 146              | 1.5        | V           | 31.87                   | 61.11                        | 74             | 12.89       |
| 2387.79                   | 14.88          | Ave.       | 146              | 1.5        | V           | 31.87                   | 46.75                        | 54             | 7.25        |
| 2484.02                   | 29.44          | PK         | 99               | 1.2        | V           | 32.13                   | 61.57                        | 74             | 12.43       |
| 2484.02                   | 14.96          | Ave.       | 99               | 1.2        | V           | 32.13                   | 47.09                        | 54             | 6.91        |
| 4960.00                   | 44.68          | PK         | 250              | 2.0        | V           | 6.80                    | 51.48                        | 74             | 22.52       |
| 4960.00                   | 30.87          | Ave.       | 250              | 2.0        | V           | 6.80                    | 37.67                        | 54             | 16.33       |

**Note:**

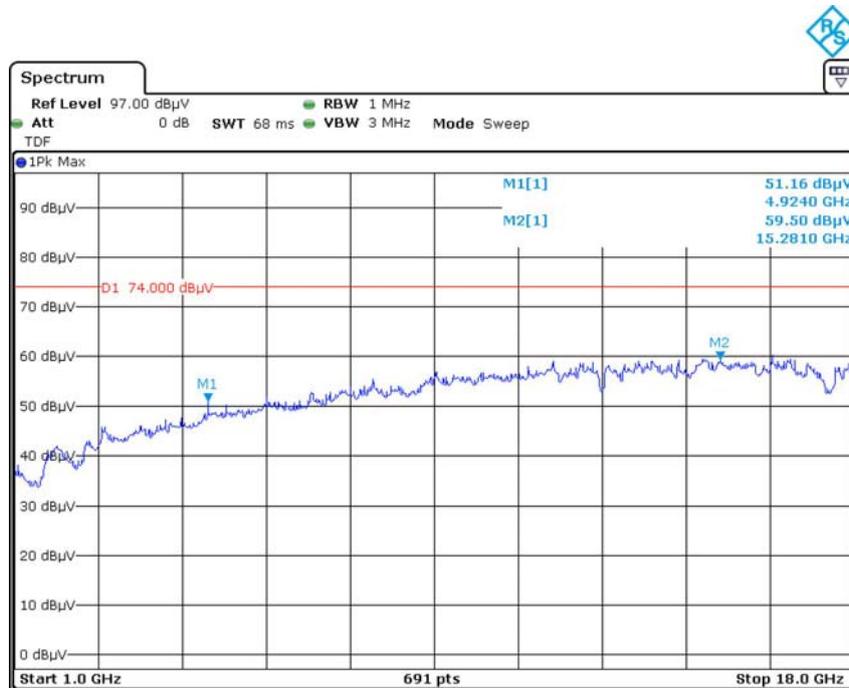
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

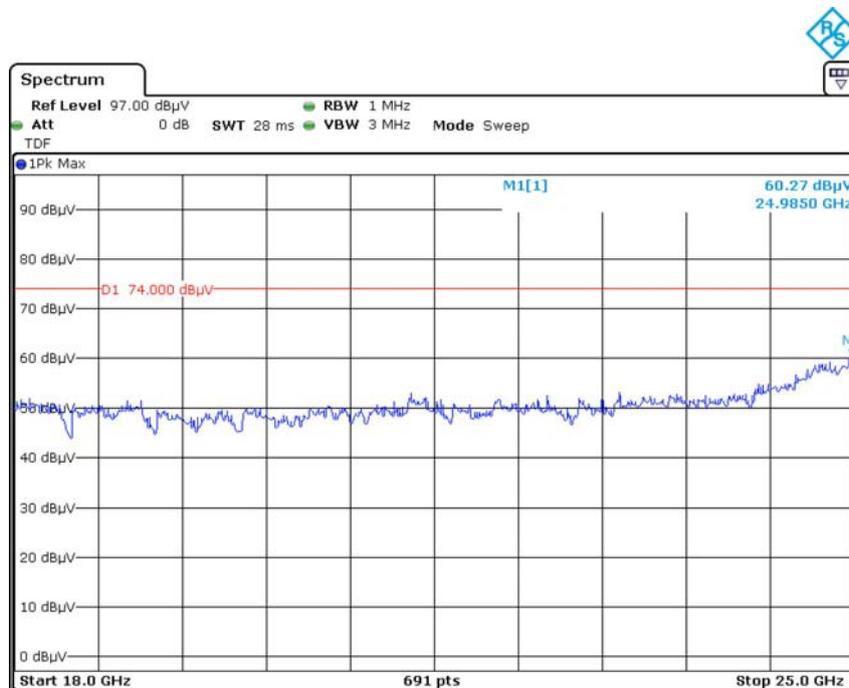
Margin = Limit - Corrected. Amplitude

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

### Pre-scan with Wi-Fi high channel in 802.11b mode Horizontal

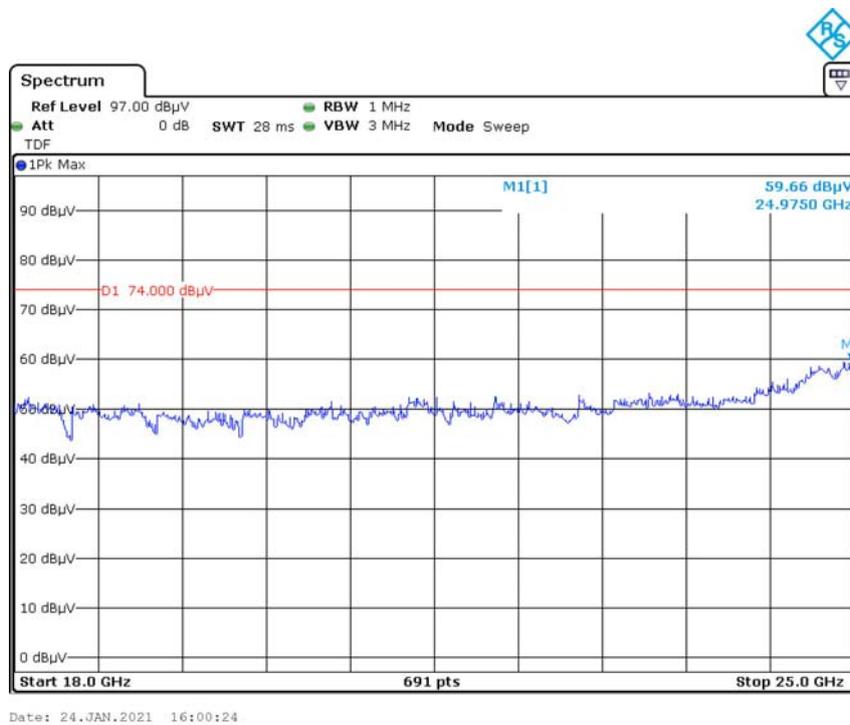
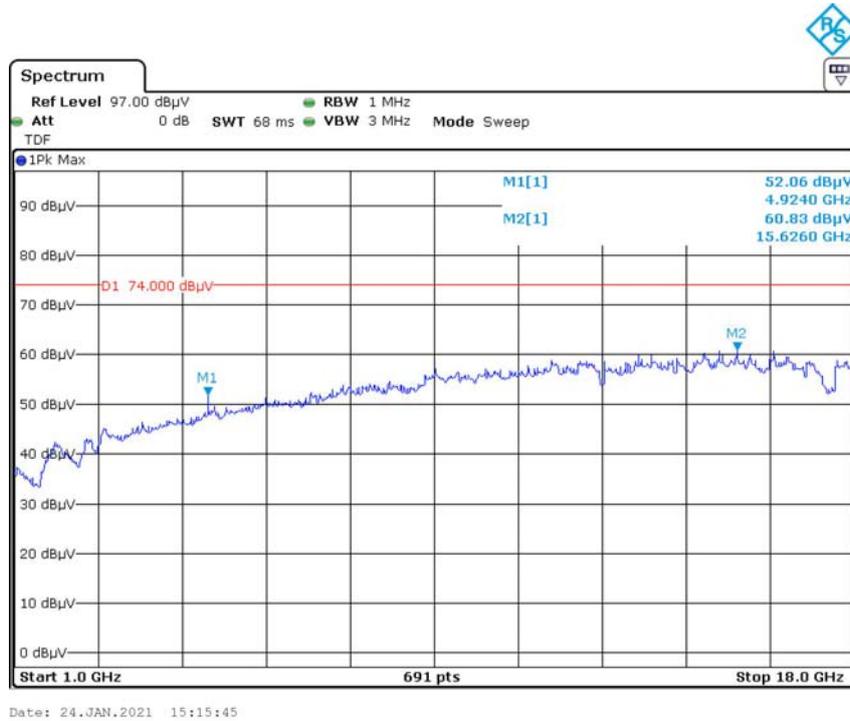


Date: 24.JAN.2021 15:26:30

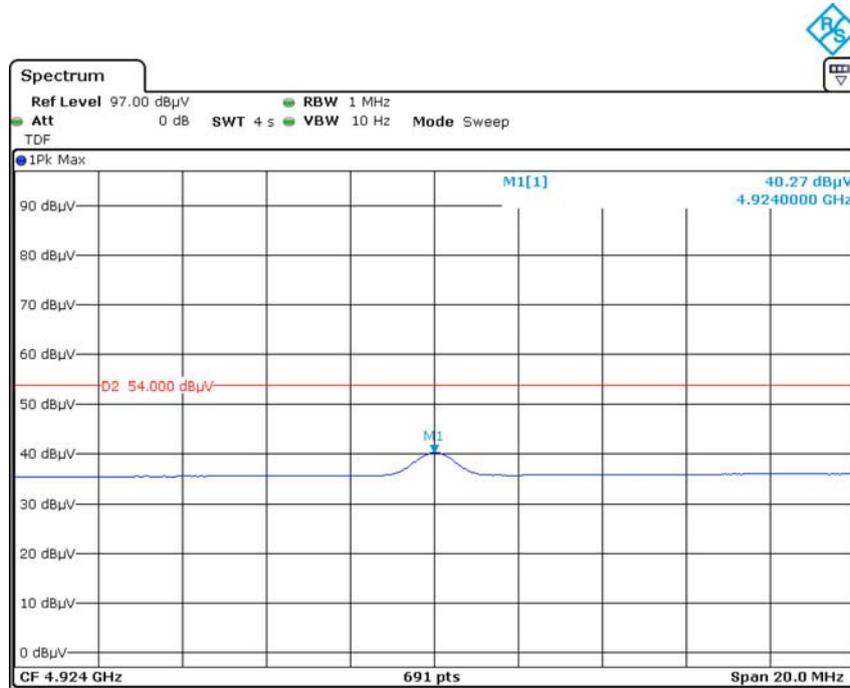


Date: 24.JAN.2021 16:08:02

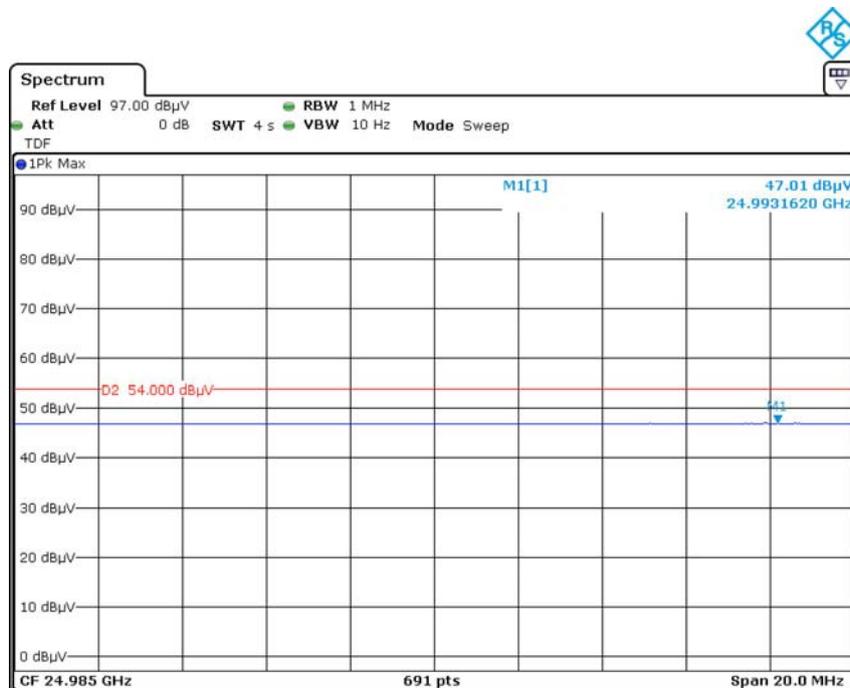
Vertical



### Average Horizontal

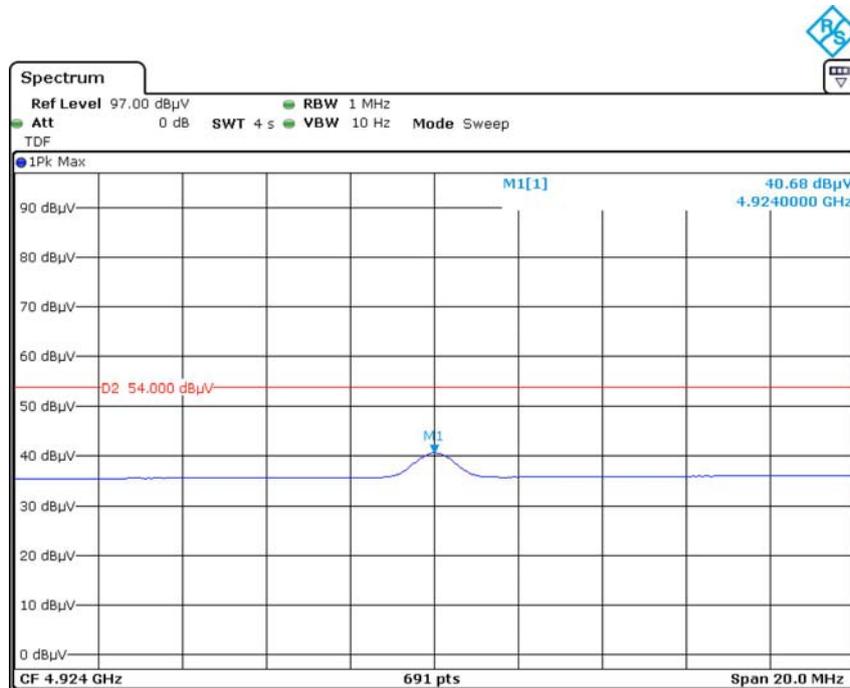


Date: 24.JAN.2021 15:29:49

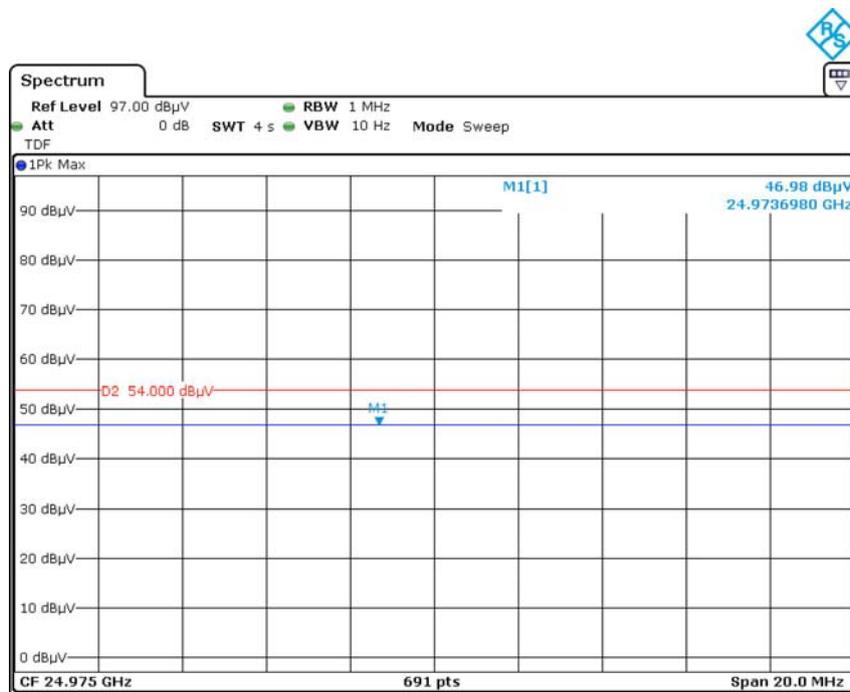


Date: 24.JAN.2021 16:11:51

### Vertical



Date: 24.JAN.2021 15:19:22



Date: 24.JAN.2021 16:04:43

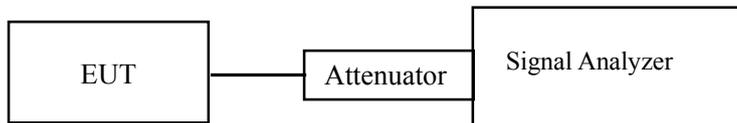
**FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH**

**Applicable Standard**

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

**Test Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



**Test Data**

**Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24 °C     |
| <b>Relative Humidity:</b> | 56 %-57%  |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Coco Liu on 2021-03-06.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix Wi-Fi and Appendix BLE.

*Note: for Wi-Fi mode, worst case is ANT 1 was recorded.*

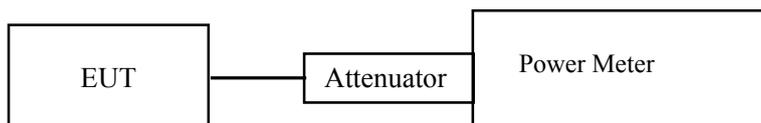
## FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

### Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

### Test Procedure

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



### Test Data

#### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24 °C     |
| <b>Relative Humidity:</b> | 56 %-57%  |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Coco Liu on 2021-03-06.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix Wi-Fi and Appendix BLE.

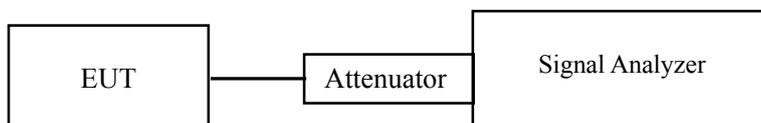
## **FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE**

### **Applicable Standard**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **Test Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



### **Test Data**

#### **Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24 °C     |
| <b>Relative Humidity:</b> | 56 %-57%  |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Coco Liu from 2021-03-06 to 2021-03-12.*

*EUT operation mode: Transmitting*

Test Result: Compliant. Please refer to the Appendix Wi-Fi and Appendix BLE.

Note: for Wi-Fi mode, the worst case is ANT 1 for higher output power in ANT 1

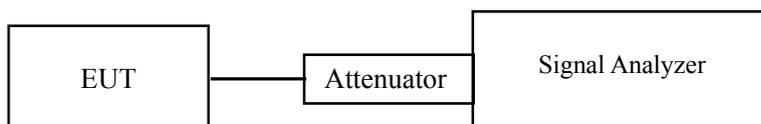
## FCC §15.247(e) - POWER SPECTRAL DENSITY

### Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to:  $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$ .
3. Set the VBW  $\geq 3 \times \text{RBW}$ .
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



### Test Data

#### Environmental Conditions

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 24 °C     |
| <b>Relative Humidity:</b> | 56 %-57%  |
| <b>ATM Pressure:</b>      | 101.0 kPa |

*The testing was performed by Coco Liu on 2021-03-06.*

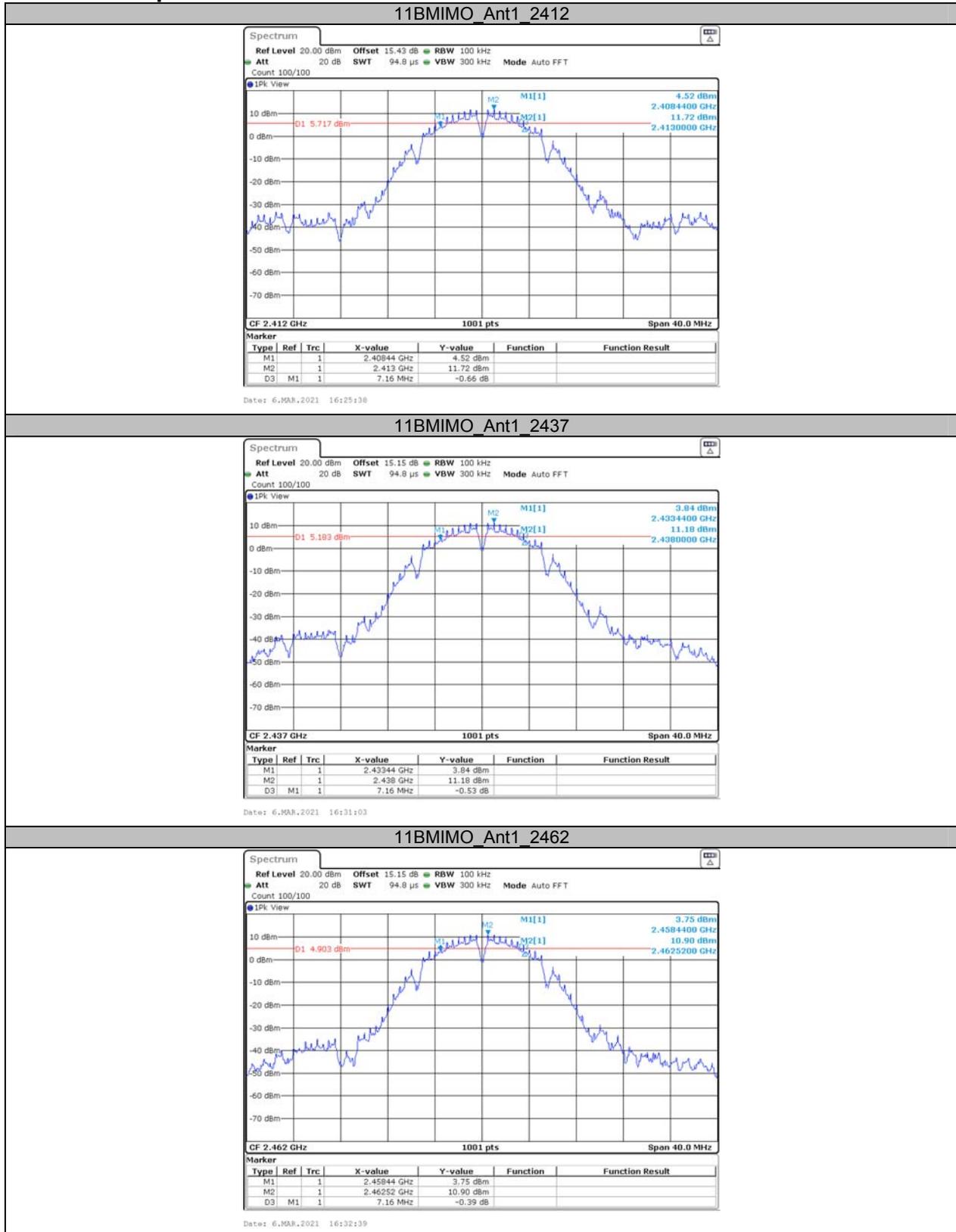
*EUT operation mode: Transmitting*

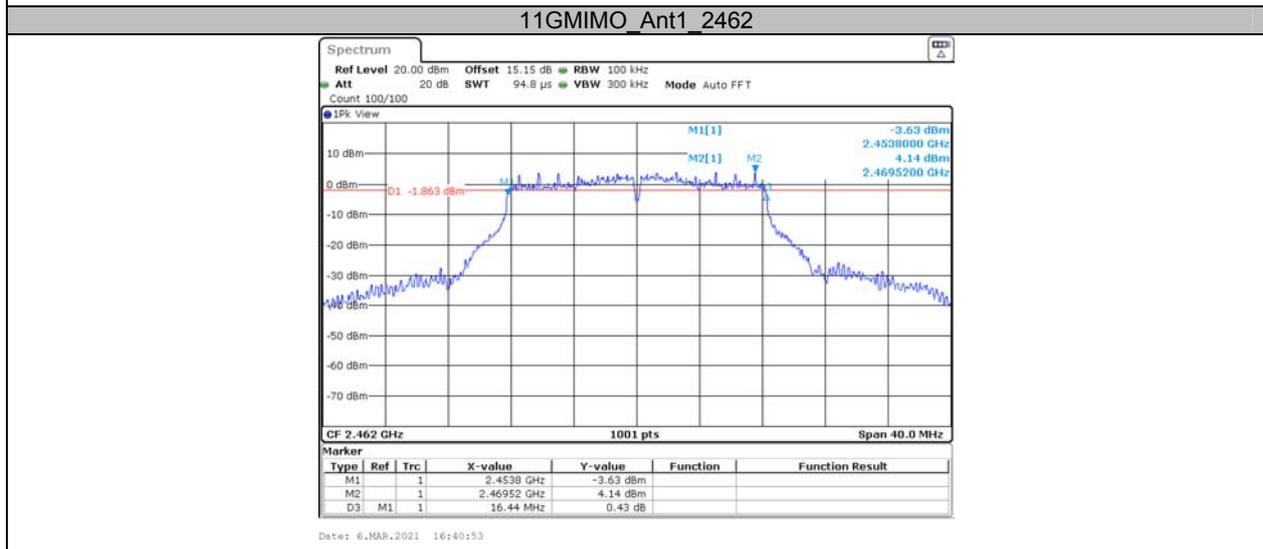
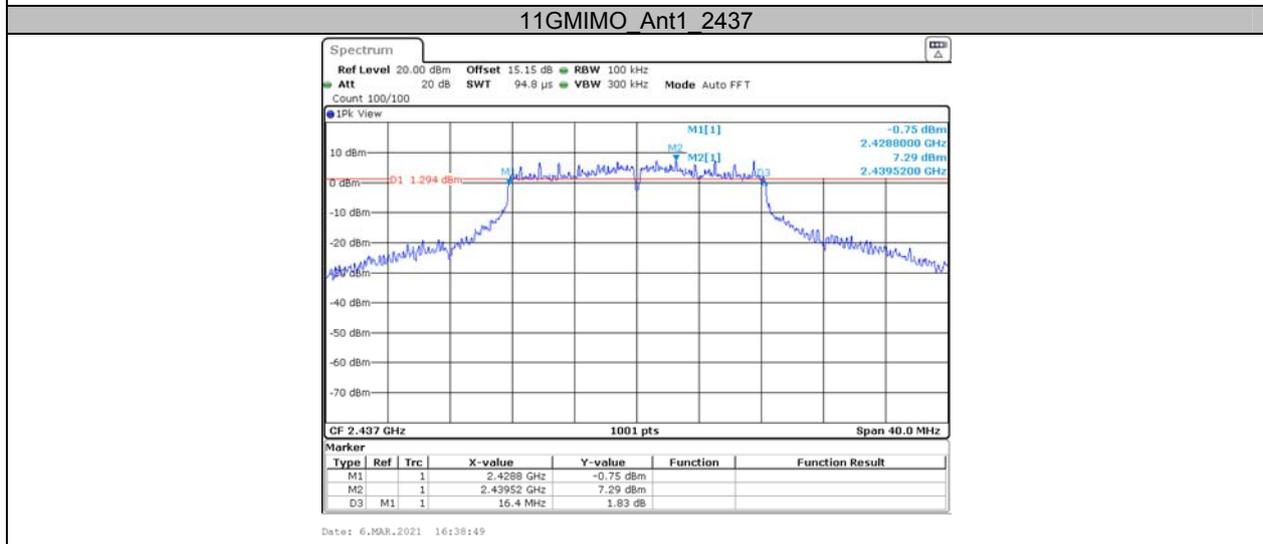
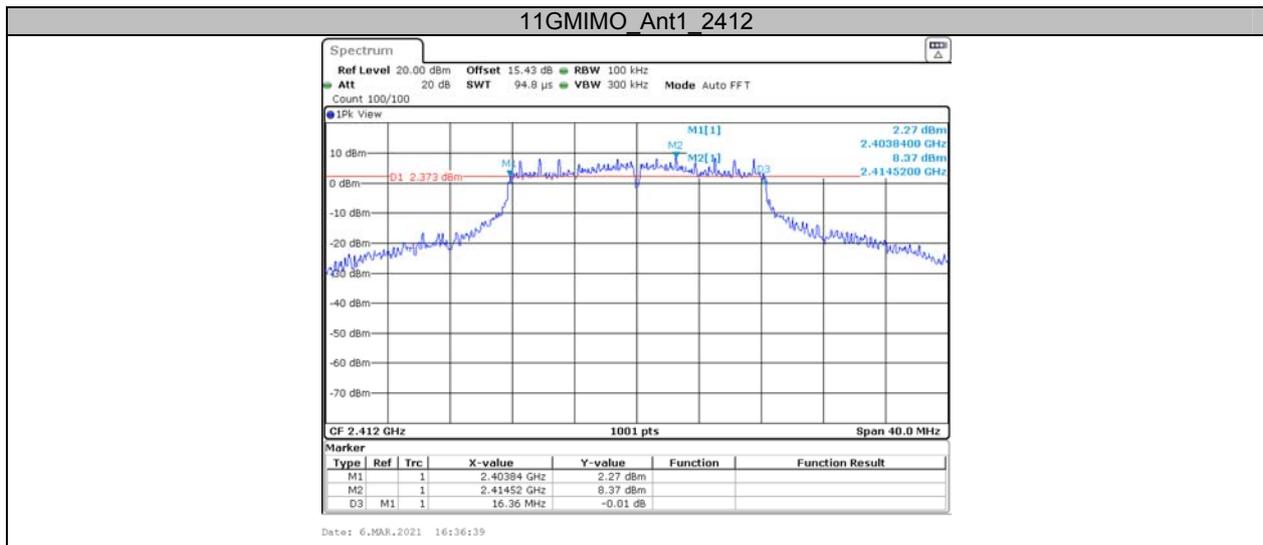
Test Result: Compliant. Please refer to the Appendix Wi-Fi and Appendix BLE.

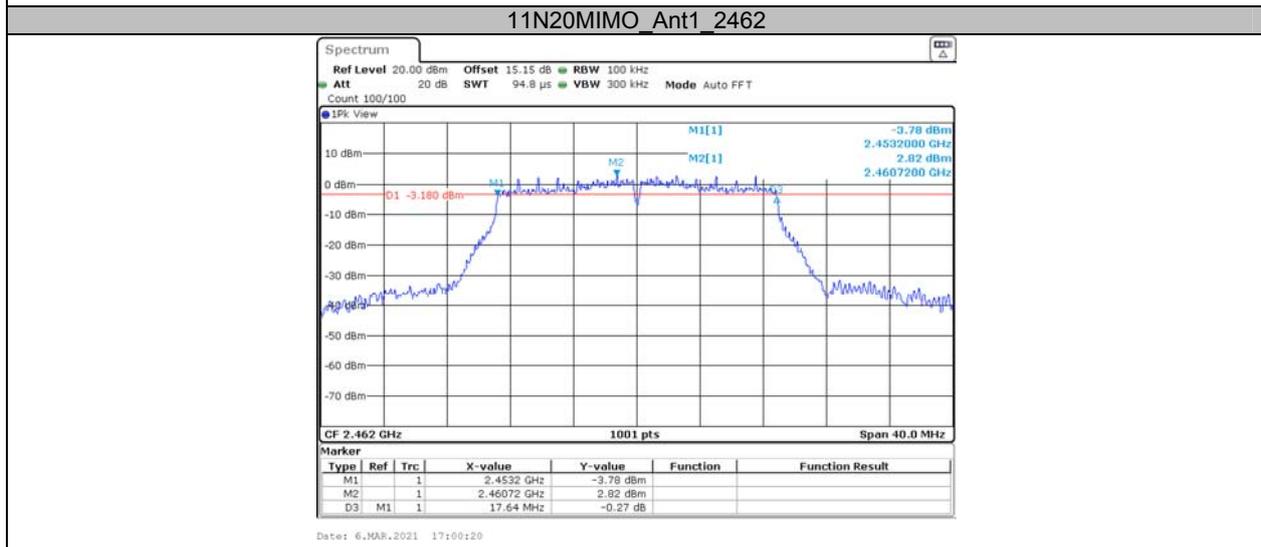
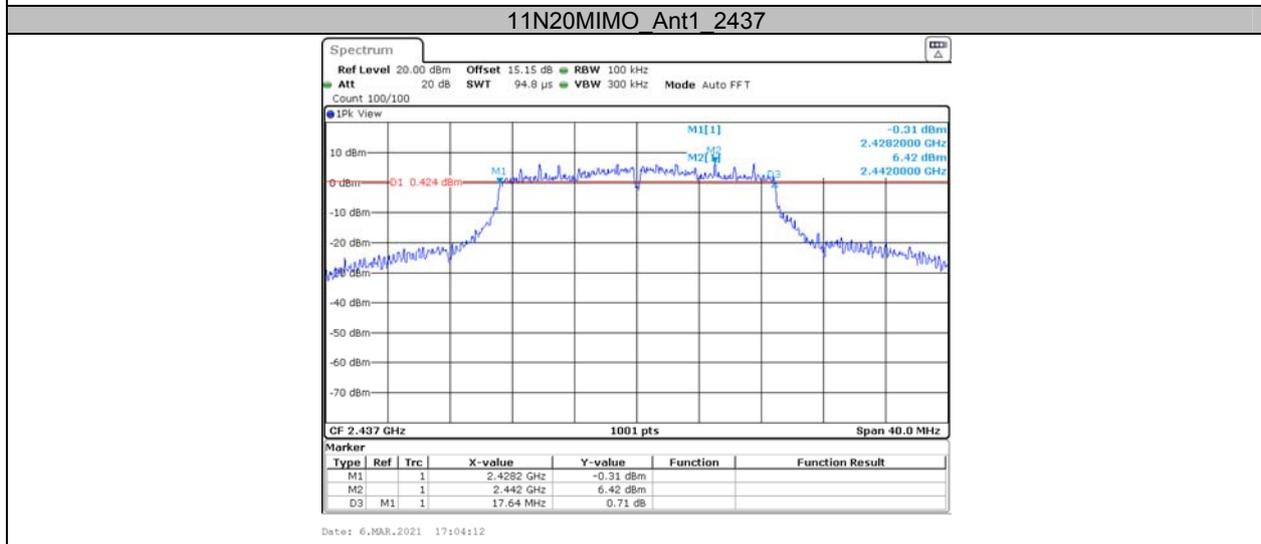
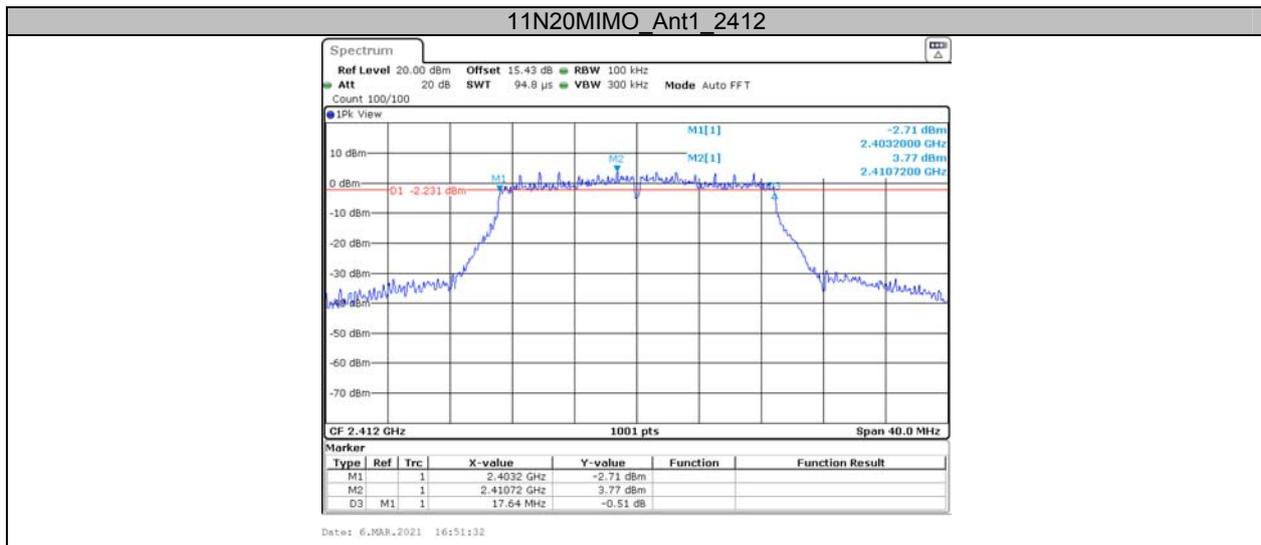
**APPENDIX Wi-Fi****Appendix A: DTS Bandwidth  
Test Result**

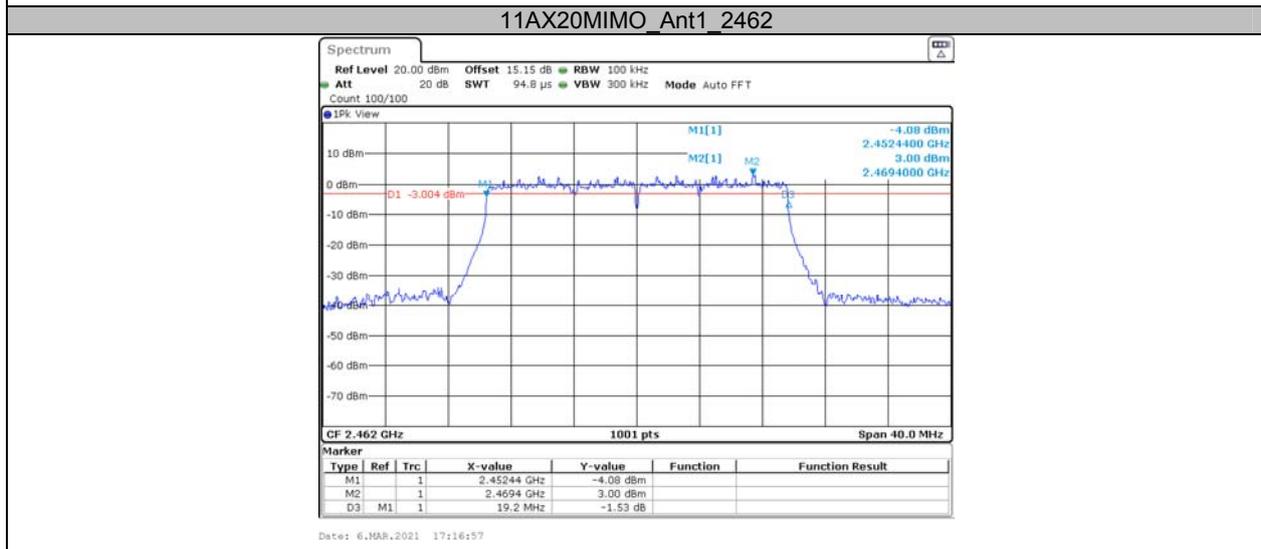
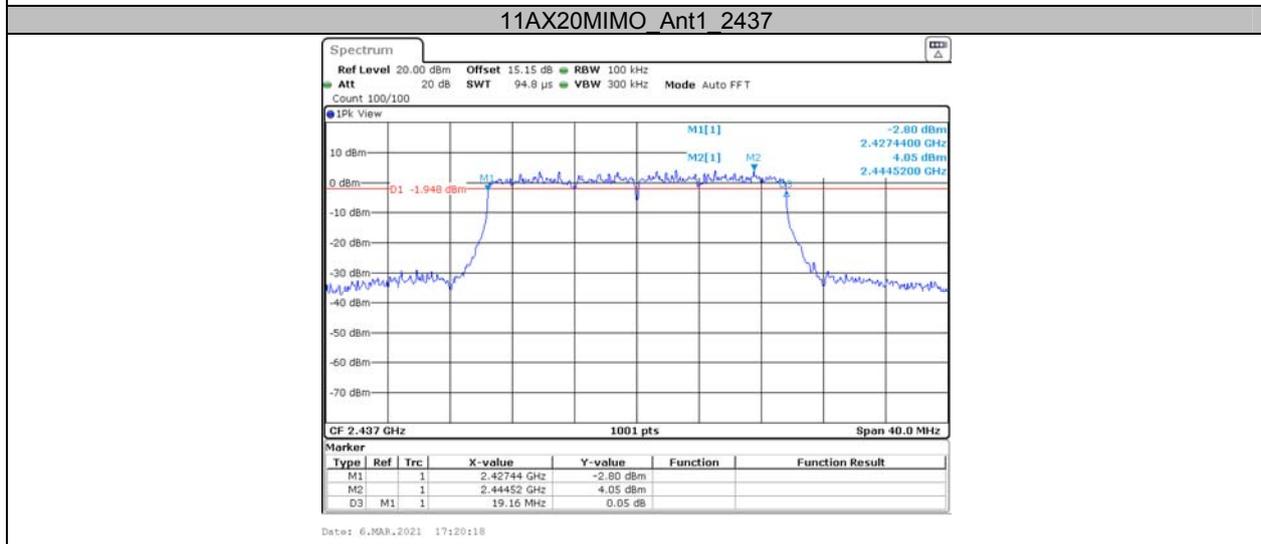
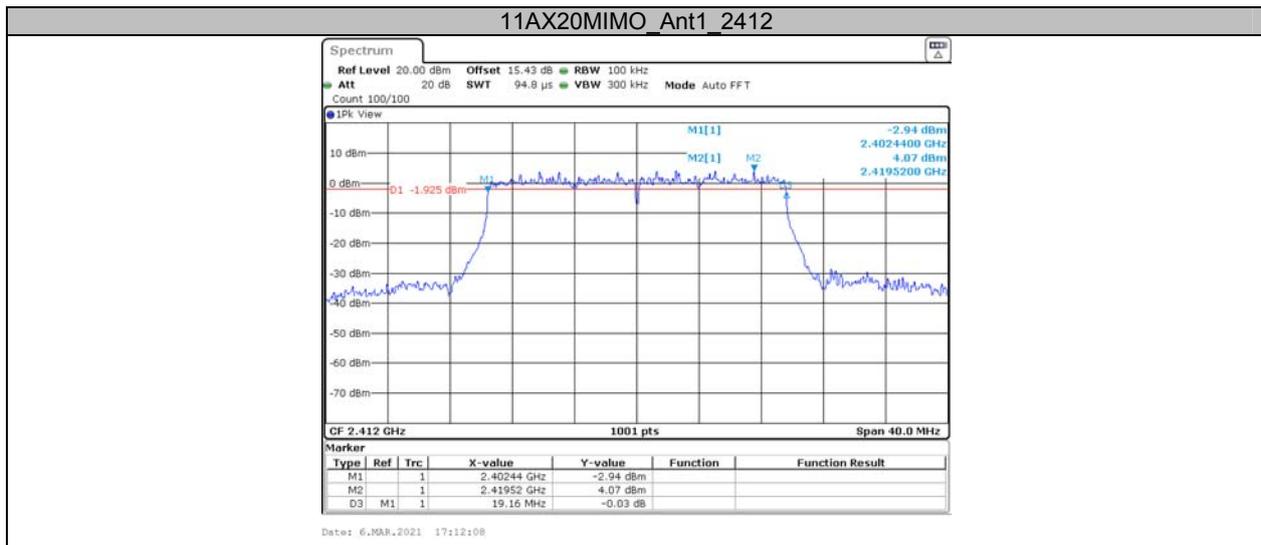
| TestMode   | Antenna | Channel | DTS BW [MHz] | Limit[MHz] | Verdict |
|------------|---------|---------|--------------|------------|---------|
| 11BMIMO    | Ant1    | 2412    | 7.160        | 0.5        | PASS    |
|            |         | 2437    | 7.160        | 0.5        | PASS    |
|            |         | 2462    | 7.160        | 0.5        | PASS    |
| 11GMIMO    | Ant1    | 2412    | 16.360       | 0.5        | PASS    |
|            |         | 2437    | 16.400       | 0.5        | PASS    |
|            |         | 2462    | 16.440       | 0.5        | PASS    |
| 11N20MIMO  | Ant1    | 2412    | 17.640       | 0.5        | PASS    |
|            |         | 2437    | 17.640       | 0.5        | PASS    |
|            |         | 2462    | 17.640       | 0.5        | PASS    |
| 11AX20MIMO | Ant1    | 2412    | 19.160       | 0.5        | PASS    |
|            |         | 2437    | 19.160       | 0.5        | PASS    |
|            |         | 2462    | 19.200       | 0.5        | PASS    |

Test Graphs









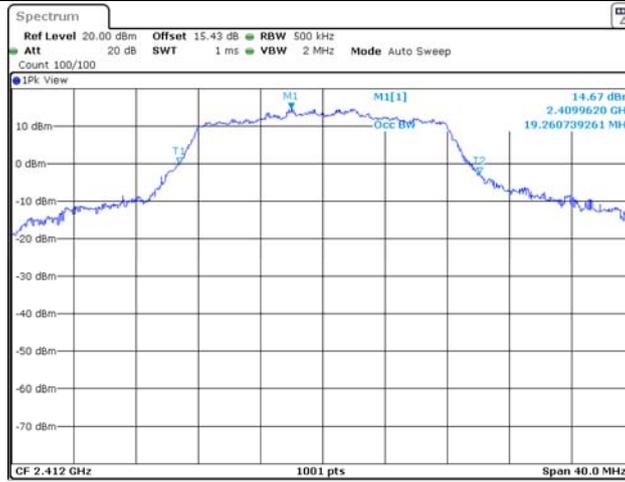
**Appendix B: Occupied Channel Bandwidth  
Test Result**

| TestMode   | Antenna | Channel | OCB [MHz] | Limit[MHz] | Verdict |
|------------|---------|---------|-----------|------------|---------|
| 11BMIMO    | Ant1    | 2412    | 11.988    | ---        | PASS    |
|            |         | 2437    | 11.788    | ---        | PASS    |
|            |         | 2462    | 11.548    | ---        | PASS    |
| 11GMIMO    | Ant1    | 2412    | 19.261    | ---        | PASS    |
|            |         | 2437    | 18.901    | ---        | PASS    |
|            |         | 2462    | 18.022    | ---        | PASS    |
| 11N20MIMO  | Ant1    | 2412    | 18.781    | ---        | PASS    |
|            |         | 2437    | 19.381    | ---        | PASS    |
|            |         | 2462    | 18.741    | ---        | PASS    |
| 11AX20MIMO | Ant1    | 2412    | 19.261    | ---        | PASS    |
|            |         | 2437    | 19.301    | ---        | PASS    |
|            |         | 2462    | 19.261    | ---        | PASS    |

Test Graphs



11GMIMO\_Ant1\_2412



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11GMIMO\_Ant1\_2437

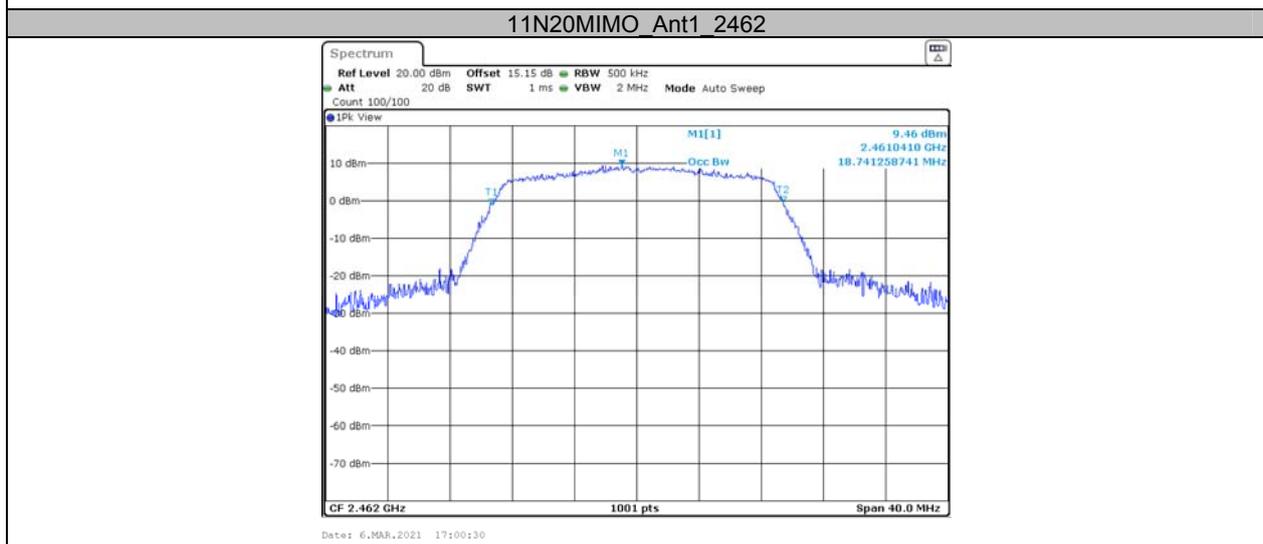
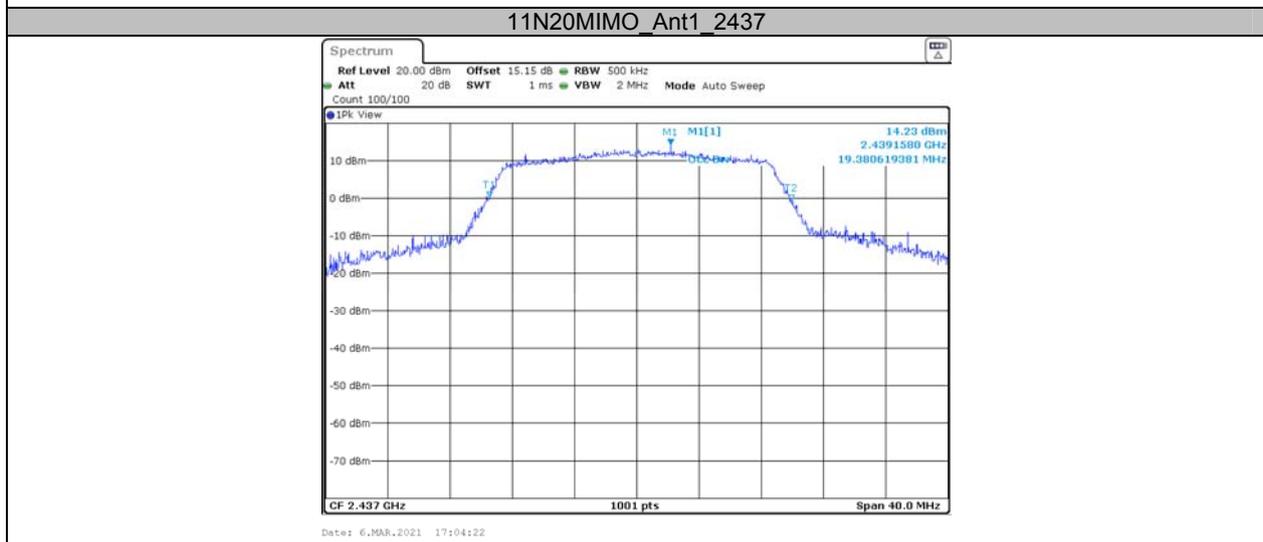


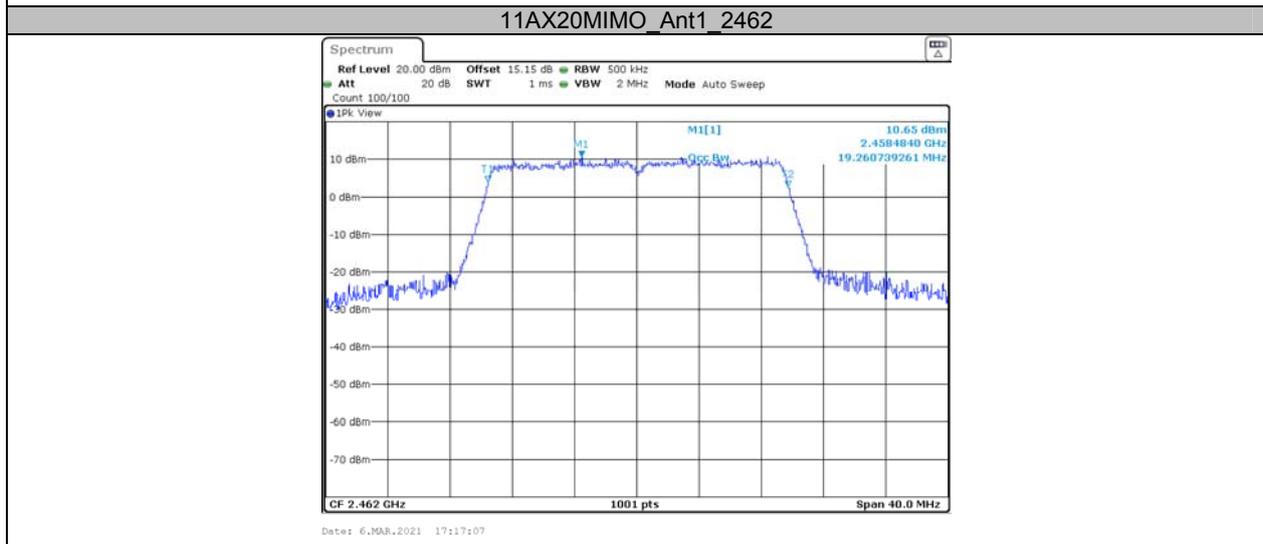
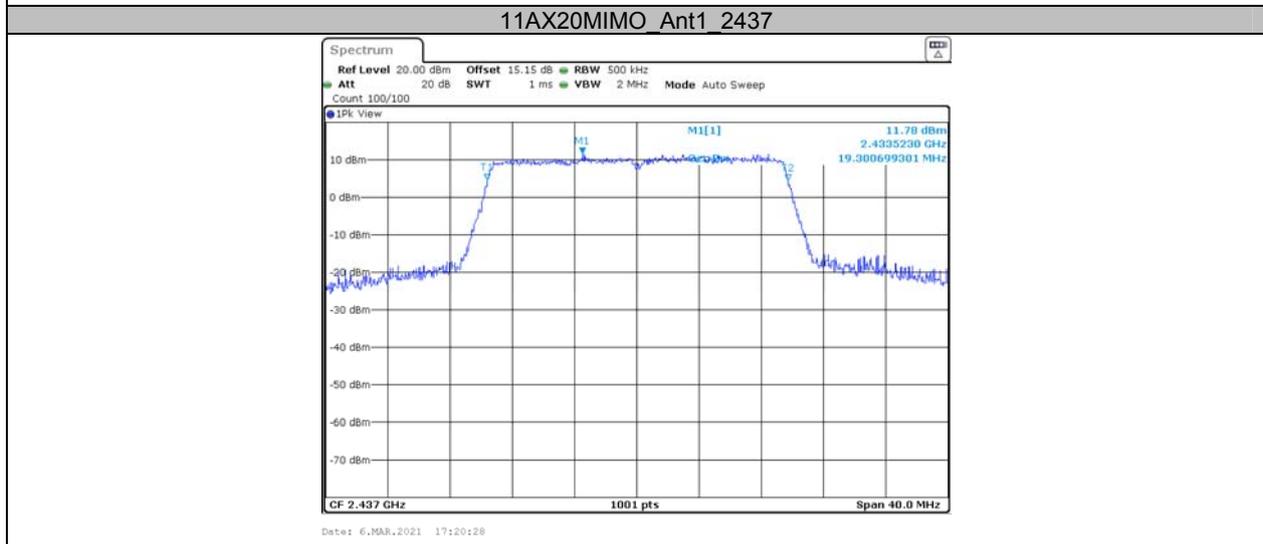
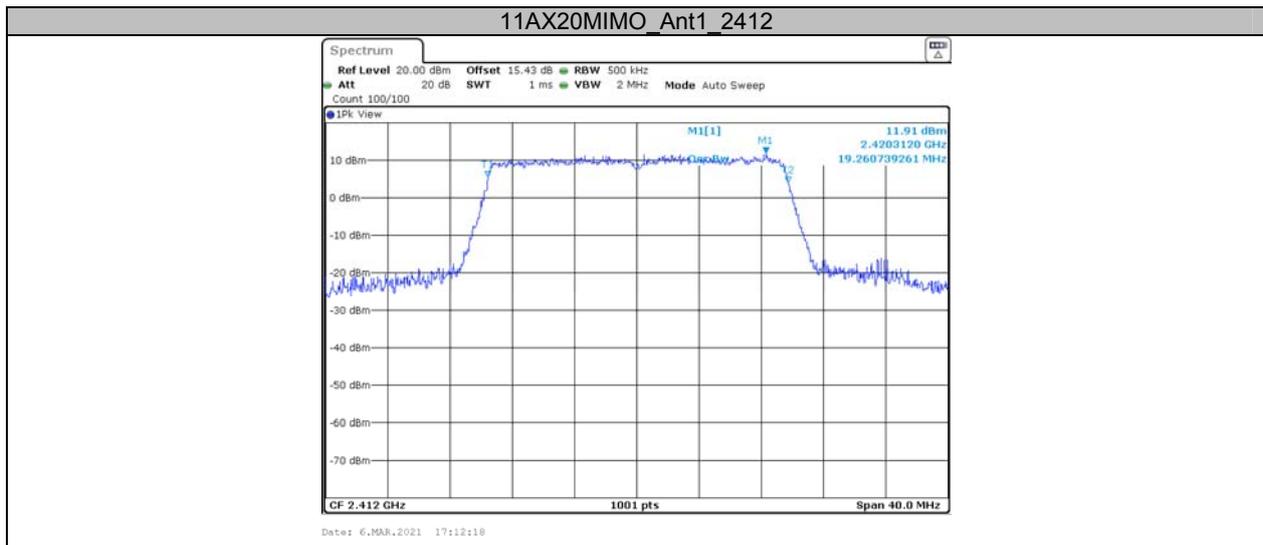
Date: 6.MAR.2021 16:38:59

11GMIMO\_Ant1\_2462



Date: 6.MAR.2021 16:41:03





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

| TestMode   | Antenna | Channel | Result[dBm] | Limit[dBm] | Verdict |
|------------|---------|---------|-------------|------------|---------|
| 11BMIMO    | Ant1    | 2412    | 21.86       | <=30       | PASS    |
|            | Ant2    | 2412    | 20.99       | <=30       | PASS    |
|            | total   | 2412    | 24.5        | <=30       | PASS    |
|            | Ant1    | 2437    | 21.40       | <=30       | PASS    |
|            | Ant2    | 2437    | 20.73       | <=30       | PASS    |
|            | total   | 2437    | 24.1        | <=30       | PASS    |
|            | Ant1    | 2462    | 21.60       | <=30       | PASS    |
|            | Ant2    | 2462    | 20.89       | <=30       | PASS    |
|            | total   | 2462    | 24.3        | <=30       | PASS    |
| 11GMIMO    | Ant1    | 2412    | 23.04       | <=30       | PASS    |
|            | Ant2    | 2412    | 22.37       | <=30       | PASS    |
|            | total   | 2412    | 25.7        | <=30       | PASS    |
|            | Ant1    | 2437    | 23.09       | <=30       | PASS    |
|            | Ant2    | 2437    | 22.33       | <=30       | PASS    |
|            | total   | 2437    | 25.7        | <=30       | PASS    |
|            | Ant1    | 2462    | 21.13       | <=30       | PASS    |
|            | Ant2    | 2462    | 21.76       | <=30       | PASS    |
|            | total   | 2462    | 24.5        | <=30       | PASS    |
| 11N20MIMO  | Ant1    | 2412    | 20.23       | <=30       | PASS    |
|            | Ant2    | 2412    | 20.92       | <=30       | PASS    |
|            | total   | 2412    | 23.6        | <=30       | PASS    |
|            | Ant1    | 2437    | 23.18       | <=30       | PASS    |
|            | Ant2    | 2437    | 22.84       | <=30       | PASS    |
|            | total   | 2437    | 25.8        | <=30       | PASS    |
|            | Ant1    | 2462    | 22.61       | <=30       | PASS    |
|            | Ant2    | 2462    | 22.23       | <=30       | PASS    |
|            | total   | 2462    | 25.4        | <=30       | PASS    |
| 11AX20MIMO | Ant1    | 2412    | 20.26       | <=30       | PASS    |
|            | Ant2    | 2412    | 20.13       | <=30       | PASS    |
|            | total   | 2412    | 23.2        | <=30       | PASS    |
|            | Ant1    | 2437    | 21.19       | <=30       | PASS    |
|            | Ant2    | 2437    | 20.39       | <=30       | PASS    |
|            | total   | 2437    | 23.8        | <=30       | PASS    |
|            | Ant1    | 2462    | 19.72       | <=30       | PASS    |
|            | Ant2    | 2462    | 19.99       | <=30       | PASS    |
|            | total   | 2462    | 22.9        | <=30       | PASS    |

Note: EUT employ Cyclic Delay Diversity  
 Directional gain= $G_{ANT} + \text{Array Gain}$   
 For power measurements,  
 Array Gain=0dB for  $N_{ANT} \leq 4$ , so  
 Directional gain=4dBi<6dBi

**Appendix D: Maximum power spectral density  
Test Result**

| TestMode   | Antenna | Channel | Result[dBm/3kHz] | Limit[dBm/3kHz] | Verdict |
|------------|---------|---------|------------------|-----------------|---------|
| 11BMIMO    | Ant1    | 2412    | -0.24            | <=7             | PASS    |
|            | Ant2    | 2412    | -1.61            | <=7             | PASS    |
|            | total   | 2412    | 2.14             | <=7             | PASS    |
|            | Ant1    | 2437    | -1.85            | <=7             | PASS    |
|            | Ant2    | 2437    | -2.09            | <=7             | PASS    |
|            | total   | 2437    | 1.04             | <=7             | PASS    |
|            | Ant1    | 2462    | -2.31            | <=7             | PASS    |
|            | Ant2    | 2462    | -1.96            | <=7             | PASS    |
|            | total   | 2462    | 0.88             | <=7             | PASS    |
| 11GMIMO    | Ant1    | 2412    | -4.72            | <=7             | PASS    |
|            | Ant2    | 2412    | -5.94            | <=7             | PASS    |
|            | total   | 2412    | -2.28            | <=7             | PASS    |
|            | Ant1    | 2437    | -5.03            | <=7             | PASS    |
|            | Ant2    | 2437    | -6.97            | <=7             | PASS    |
|            | total   | 2437    | -2.88            | <=7             | PASS    |
|            | Ant1    | 2462    | -7.65            | <=7             | PASS    |
|            | Ant2    | 2462    | -7.1             | <=7             | PASS    |
|            | total   | 2462    | -4.36            | <=7             | PASS    |
| 11N20MIMO  | Ant1    | 2412    | -8.56            | <=7             | PASS    |
|            | Ant2    | 2412    | -9.09            | <=7             | PASS    |
|            | total   | 2412    | -5.81            | <=7             | PASS    |
|            | Ant1    | 2437    | -5.45            | <=7             | PASS    |
|            | Ant2    | 2437    | -6.85            | <=7             | PASS    |
|            | total   | 2437    | -3.25            | <=7             | PASS    |
|            | Ant1    | 2462    | -9.2             | <=7             | PASS    |
|            | Ant2    | 2462    | -9.42            | <=7             | PASS    |
|            | total   | 2462    | -6.30            | <=7             | PASS    |
| 11AX20MIMO | Ant1    | 2412    | -10.42           | <=7             | PASS    |
|            | Ant2    | 2412    | -11.67           | <=7             | PASS    |
|            | total   | 2412    | -7.99            | <=7             | PASS    |
|            | Ant1    | 2437    | -10.84           | <=7             | PASS    |
|            | Ant2    | 2437    | -11.83           | <=7             | PASS    |
|            | total   | 2437    | -8.30            | <=7             | PASS    |
|            | Ant1    | 2462    | -11.96           | <=7             | PASS    |
|            | Ant2    | 2462    | -11.71           | <=7             | PASS    |
|            | total   | 2462    | -8.82            | <=7             | PASS    |

Note: EUT employ Cyclic Delay Diversity

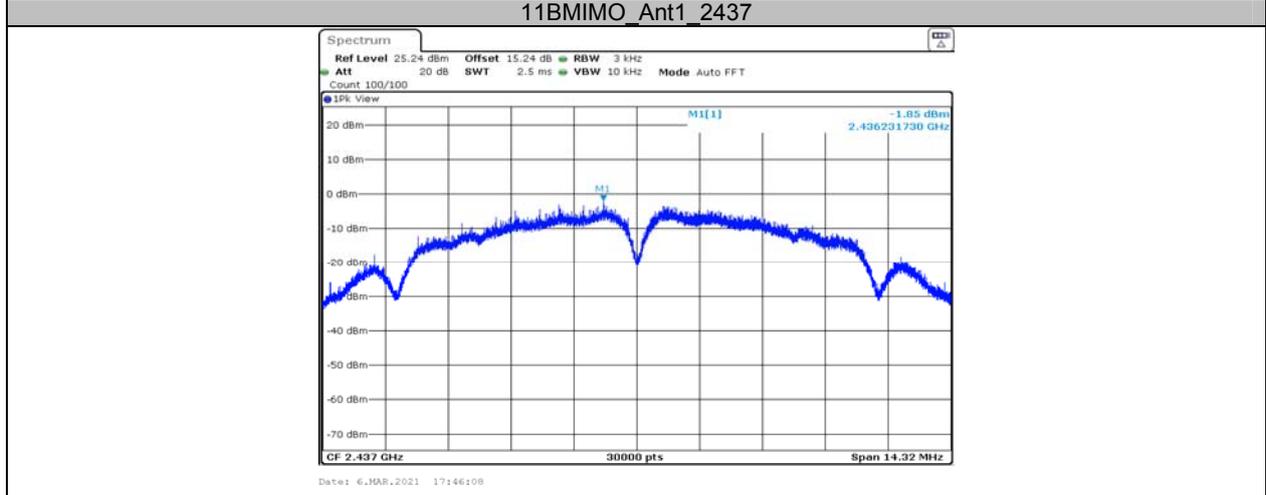
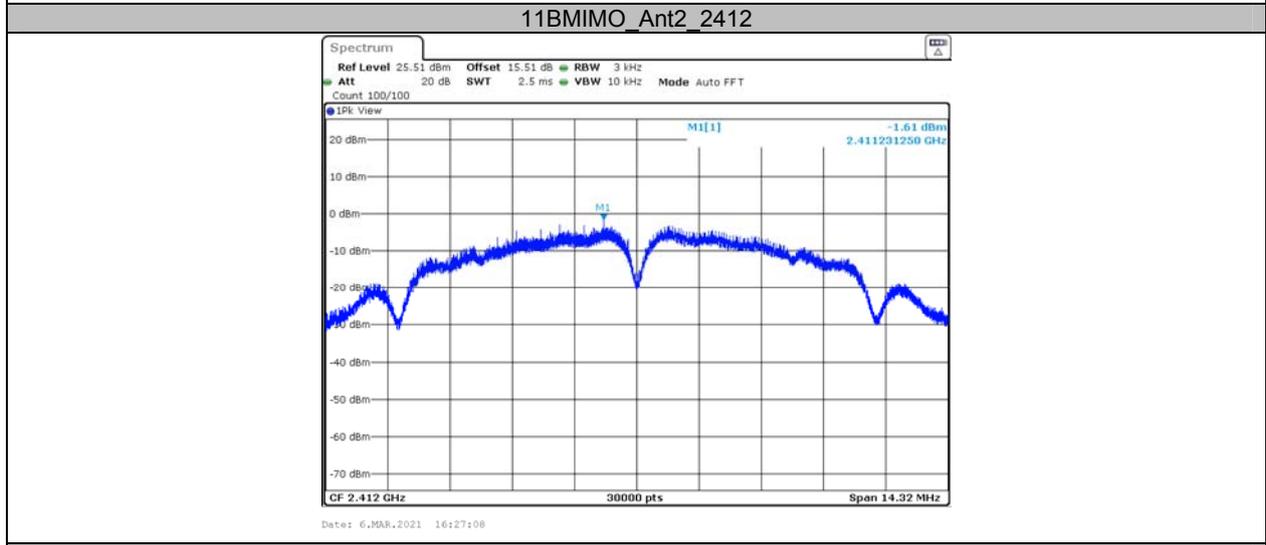
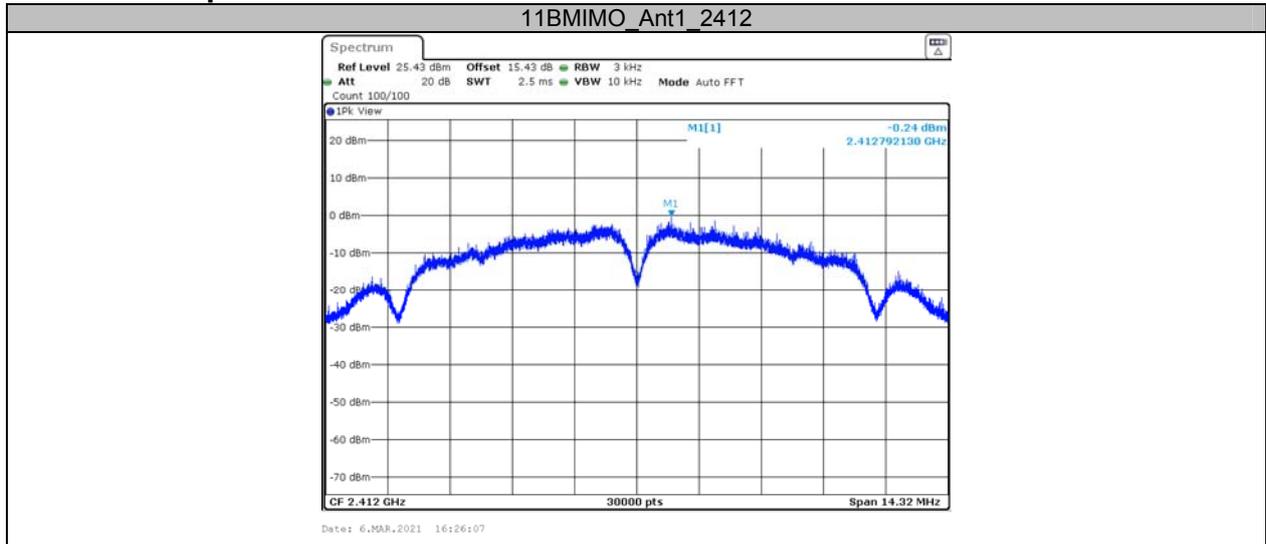
Directional gain= $G_{ANT}$  + Array Gain

For power spectral density measurements,

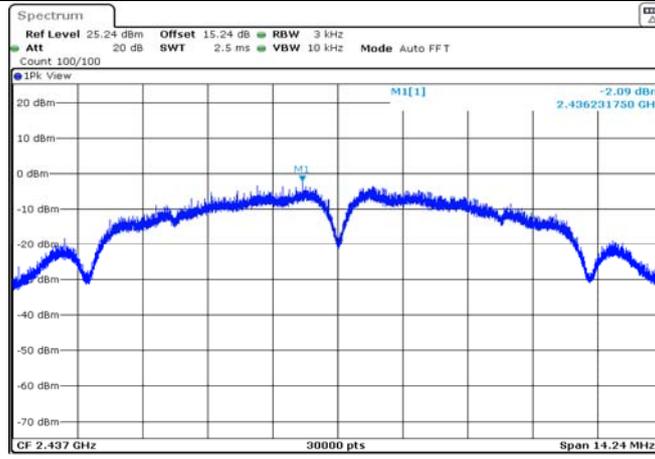
Array Gain= $10 \cdot \log(N_{ANT})dB$ , so

Directional gain= $4dBi + 10 \cdot \log(2)dB = 7dBi > 6dBi$ , the limit should reduced 1dB

### Test Graphs

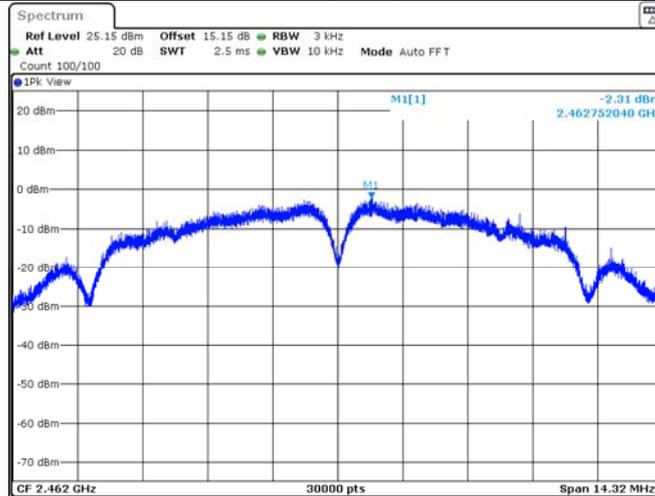


11BMIMO\_Ant2\_2437



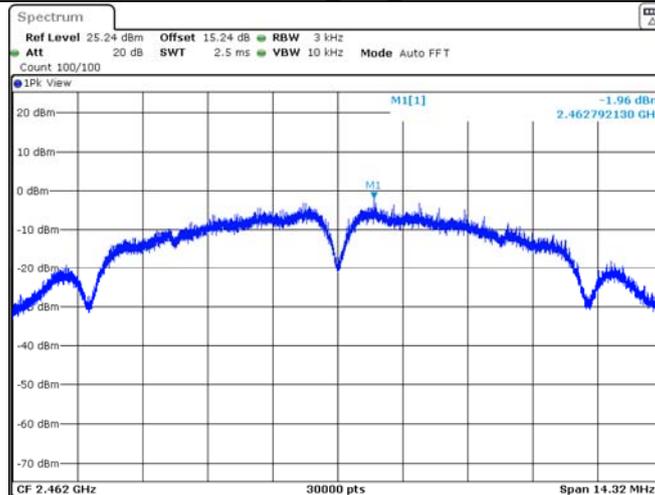
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11BMIMO\_Ant1\_2462

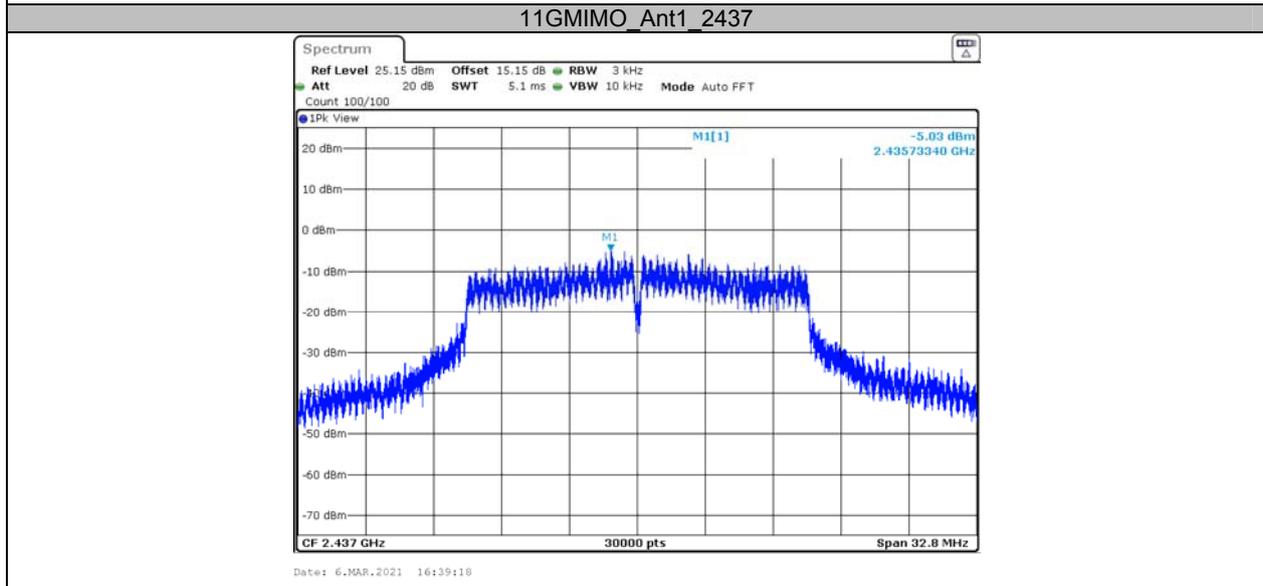
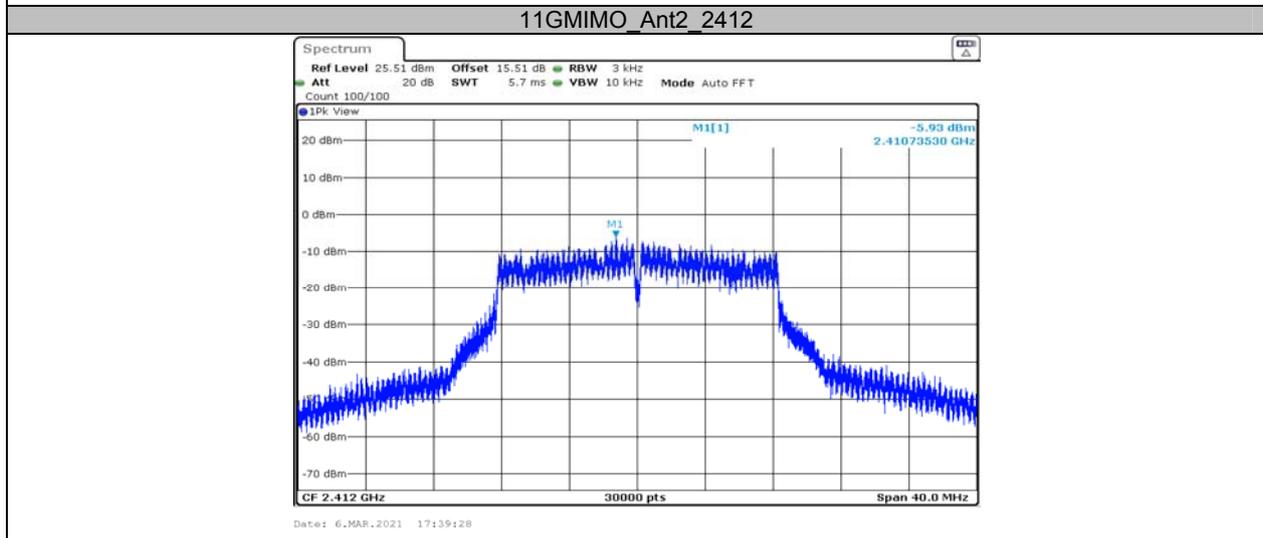
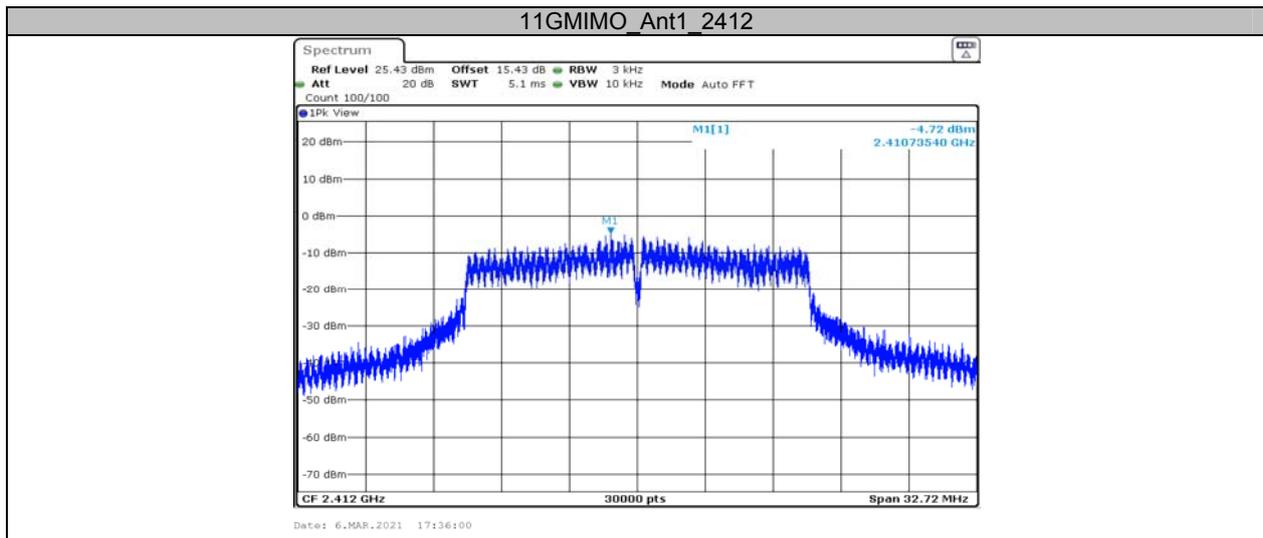


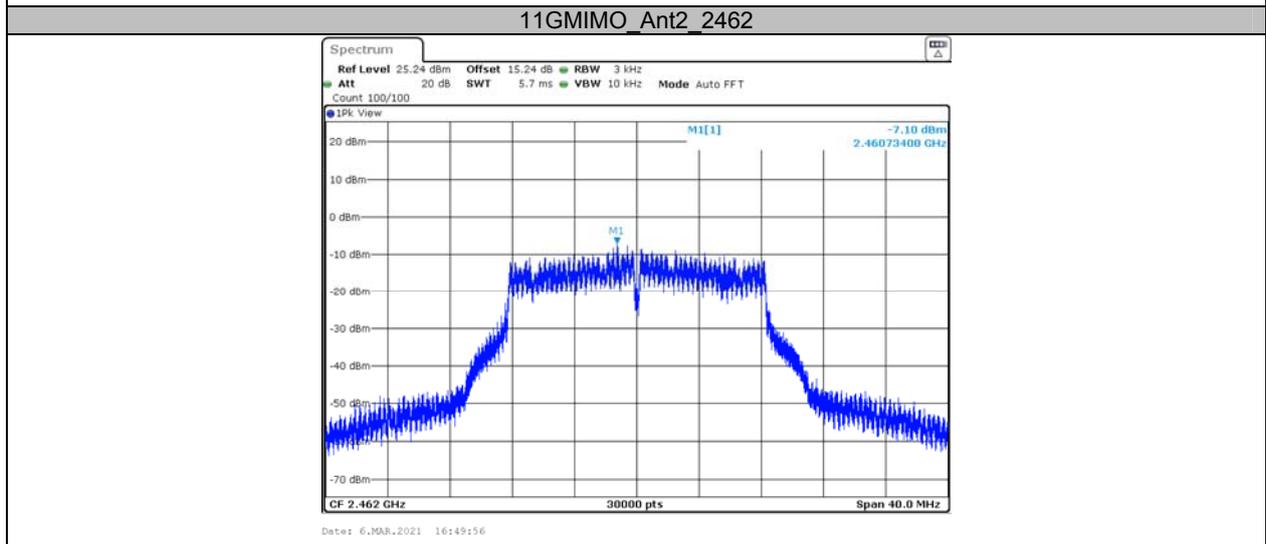
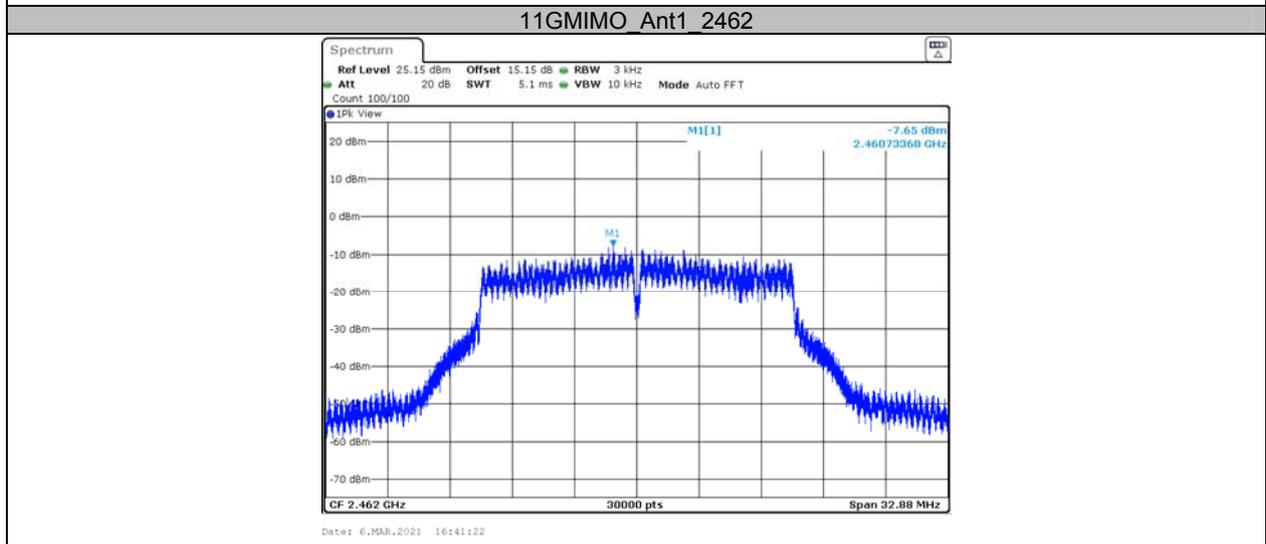
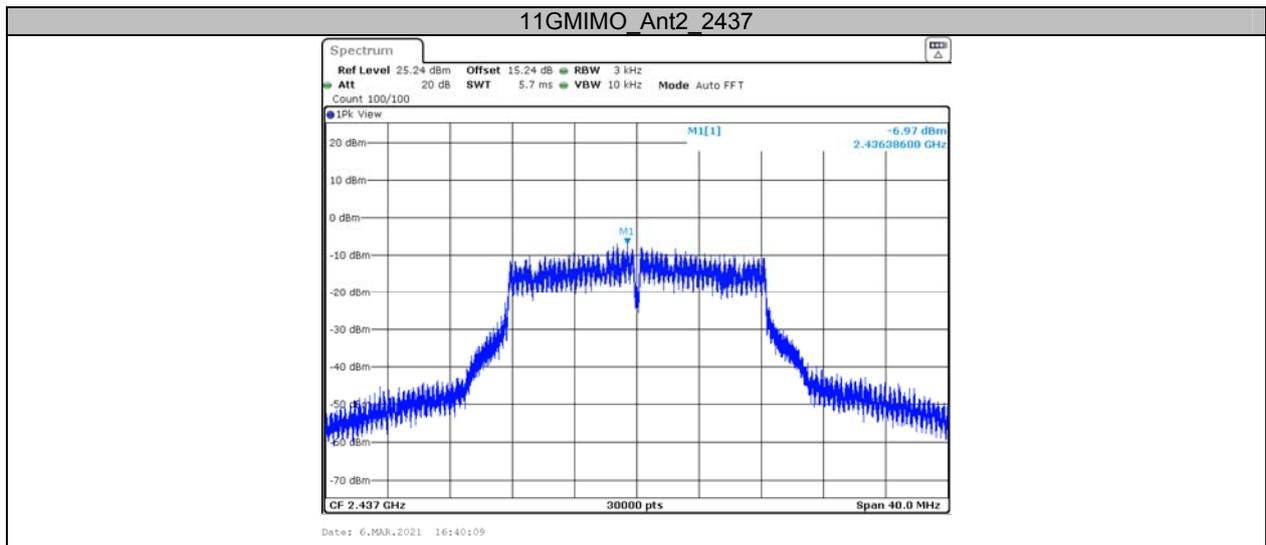
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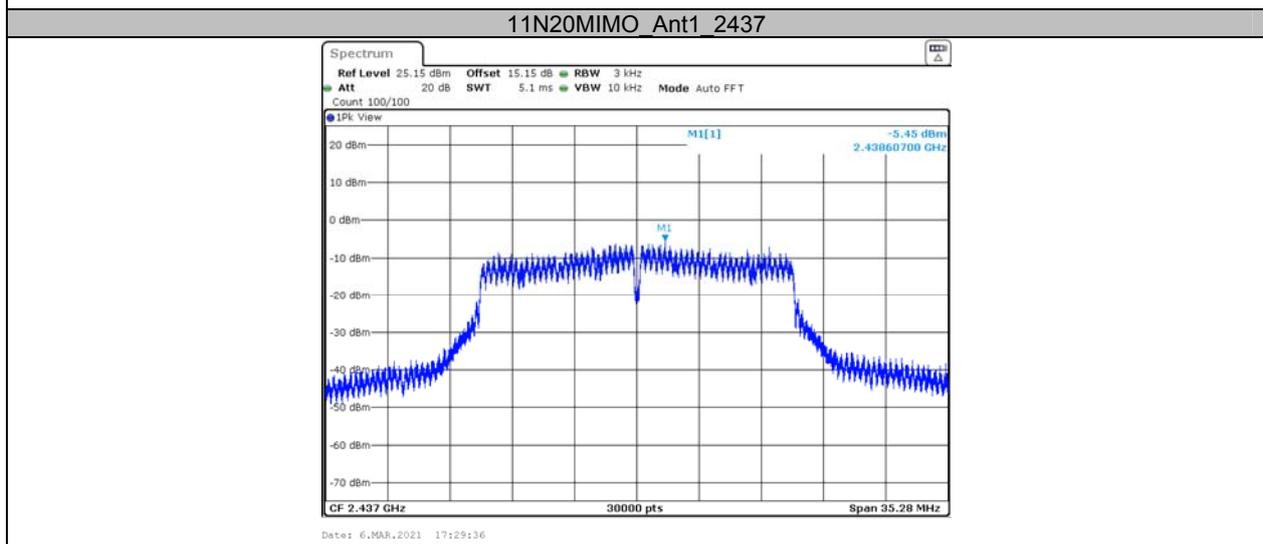
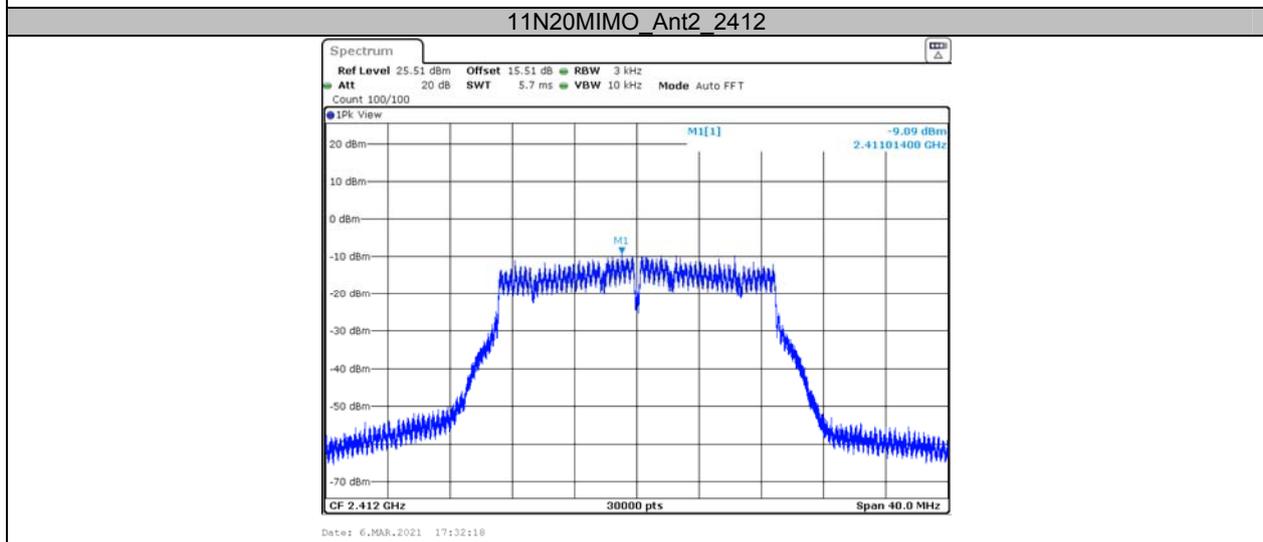
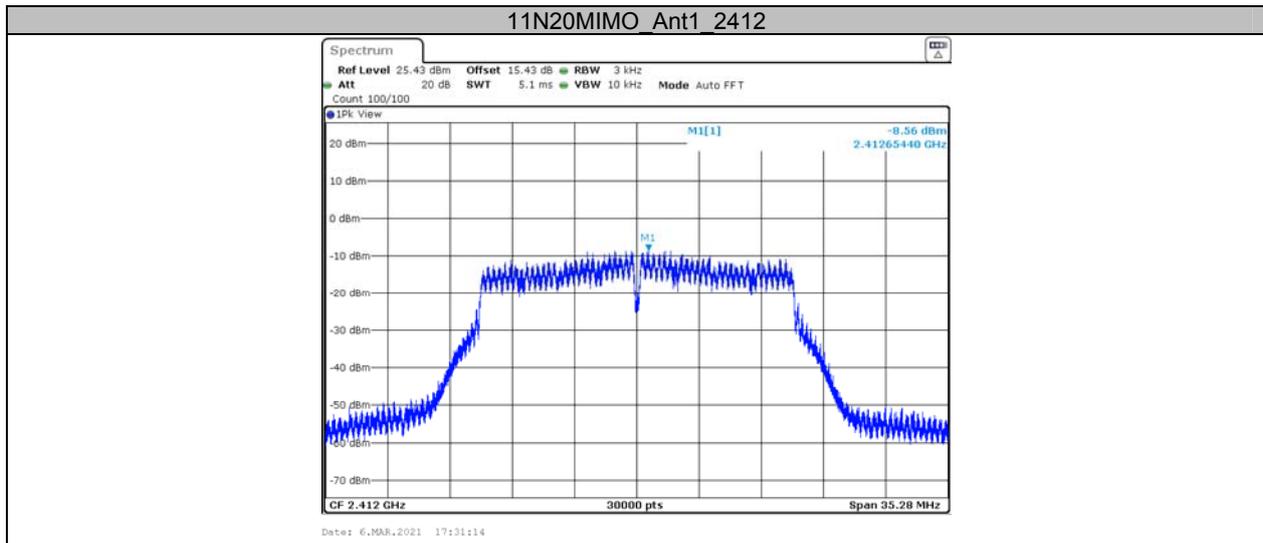
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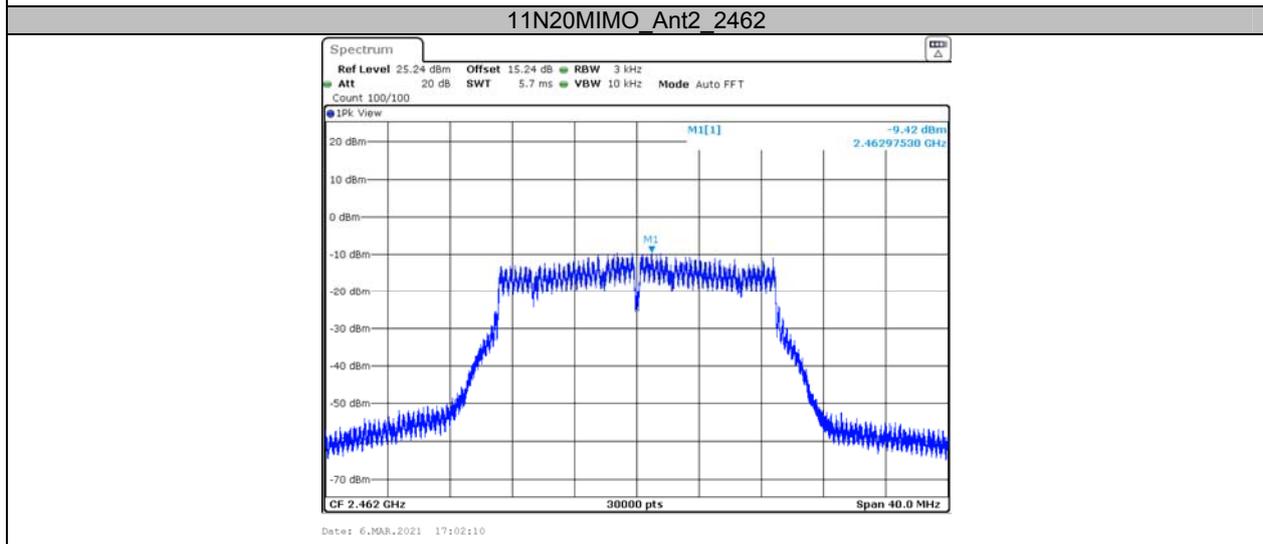
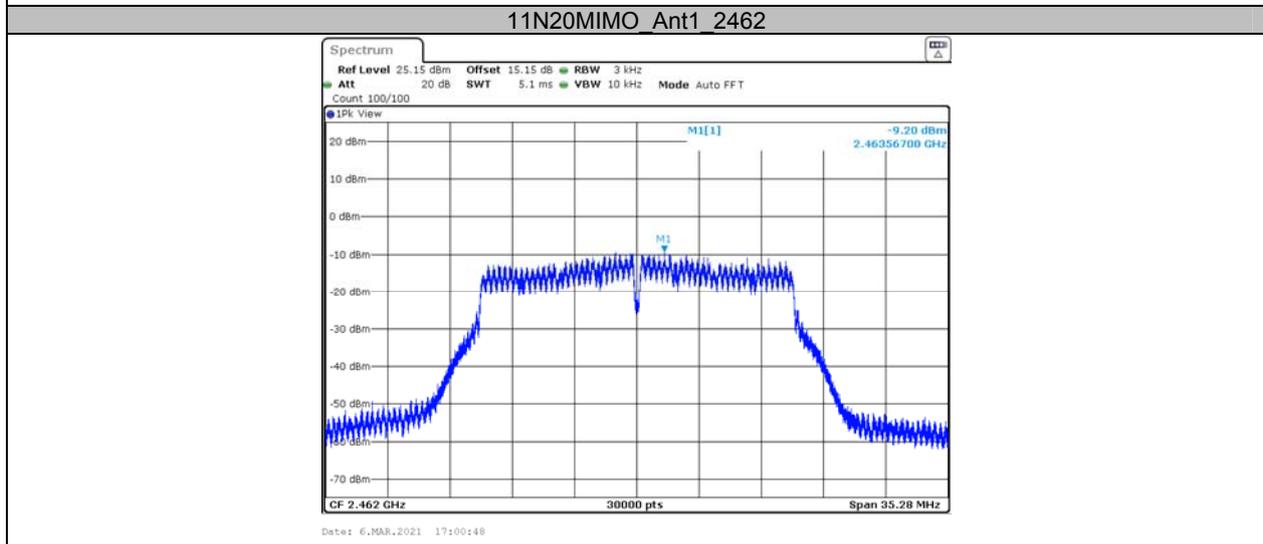
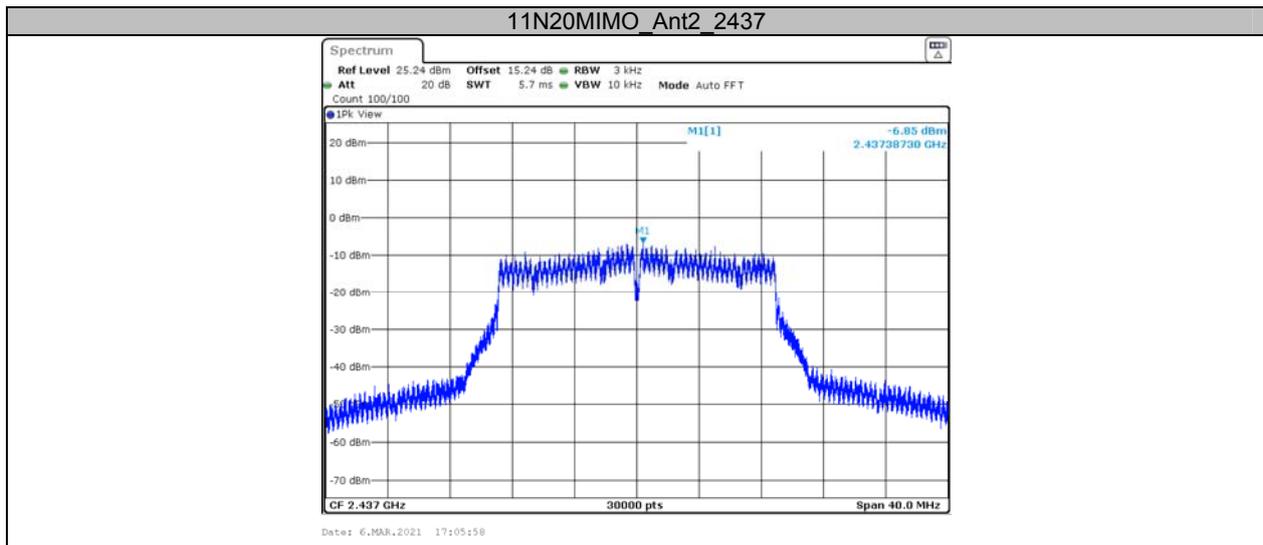


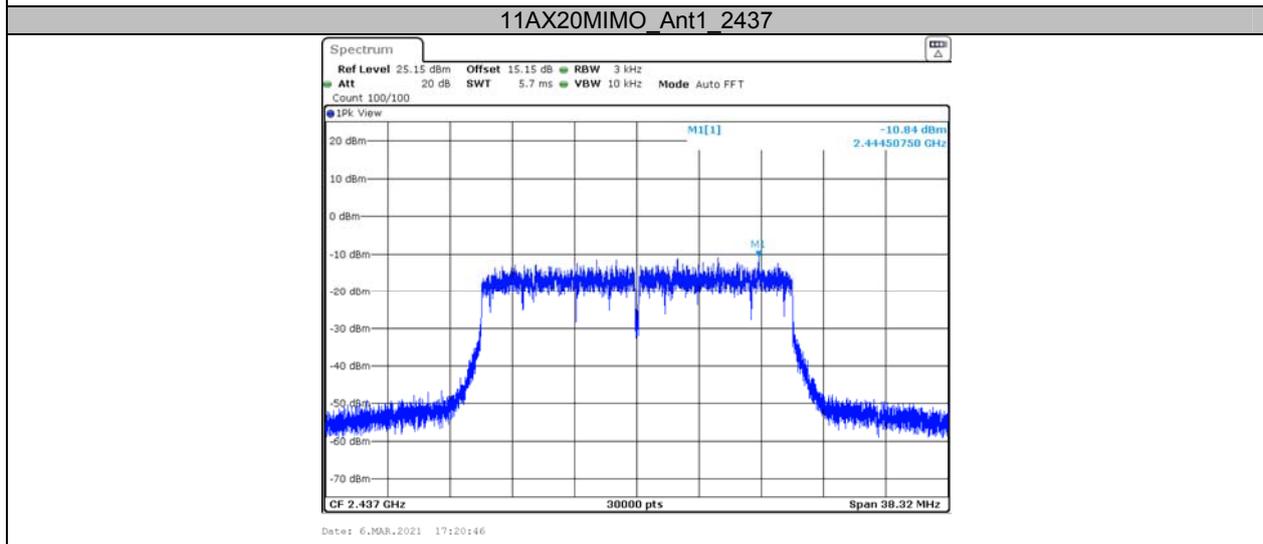
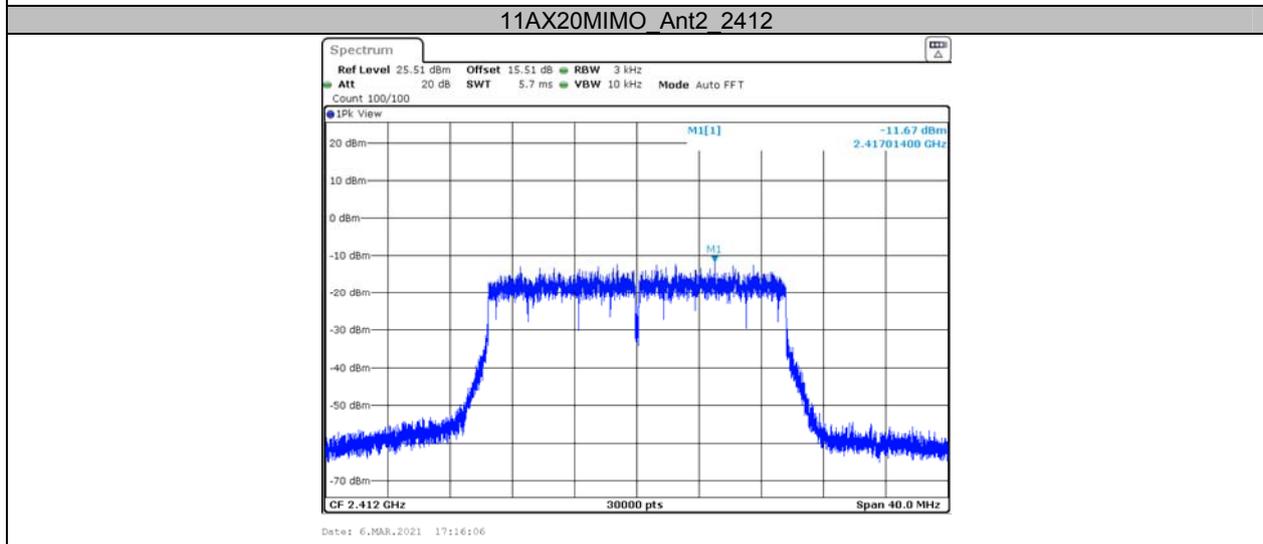
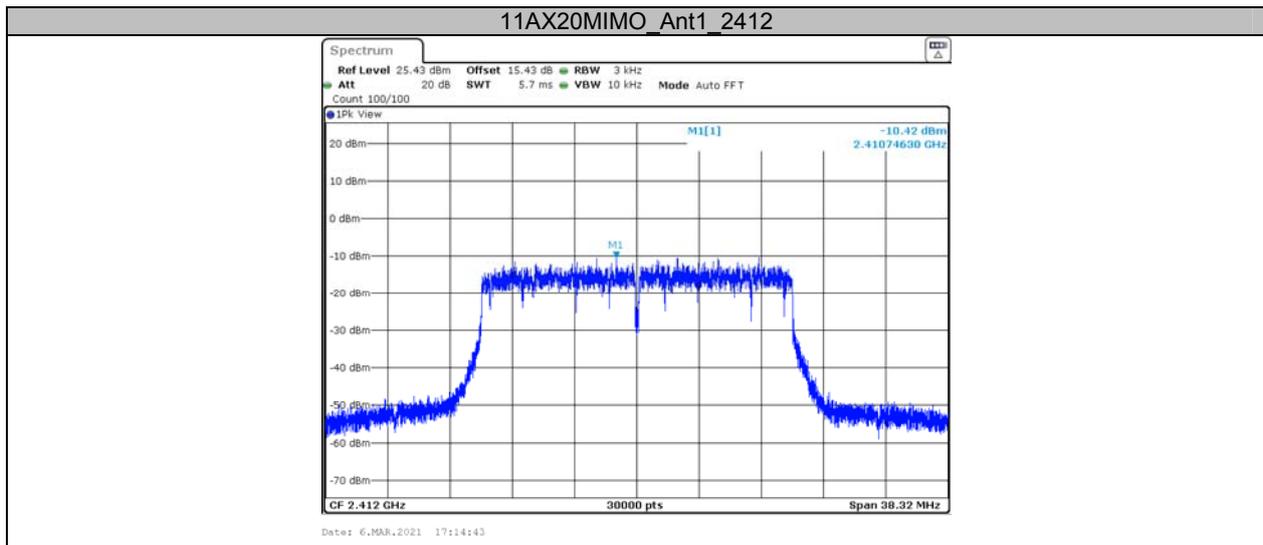
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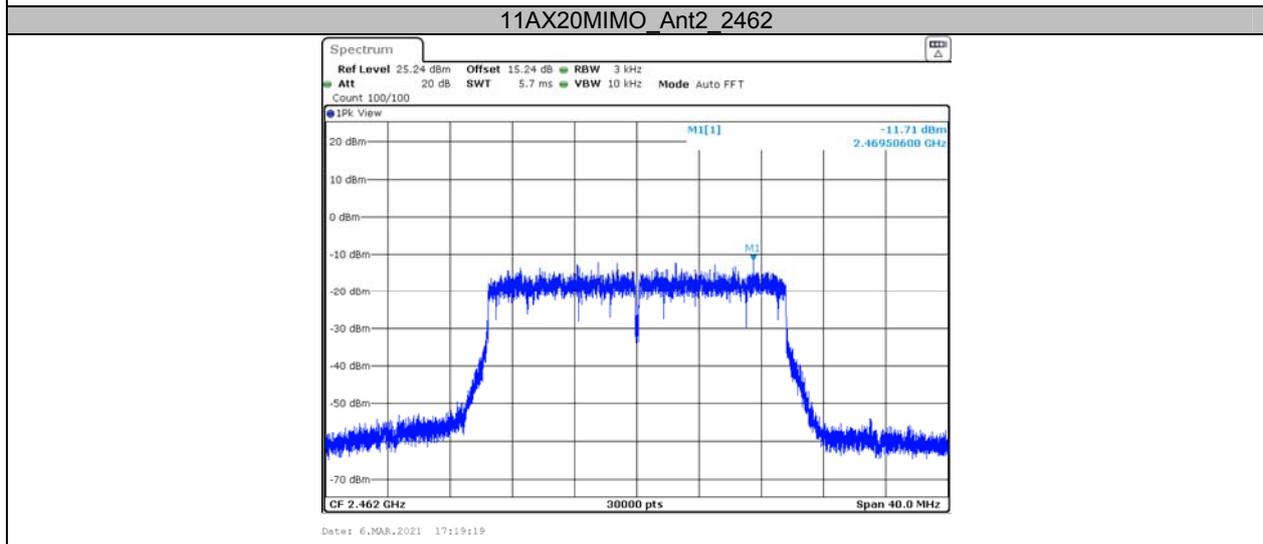
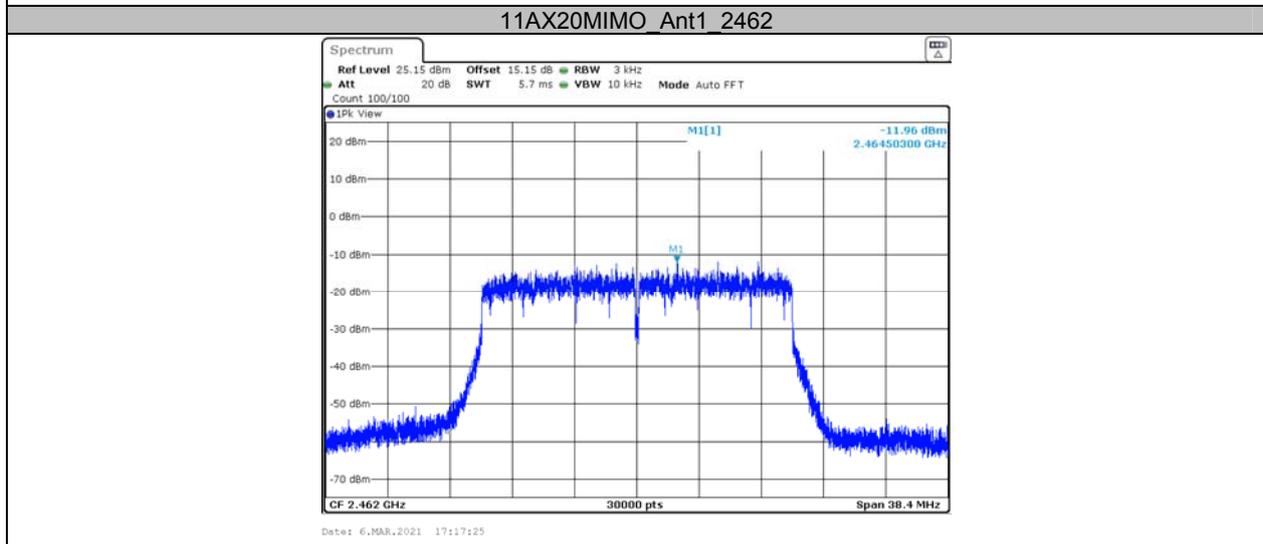
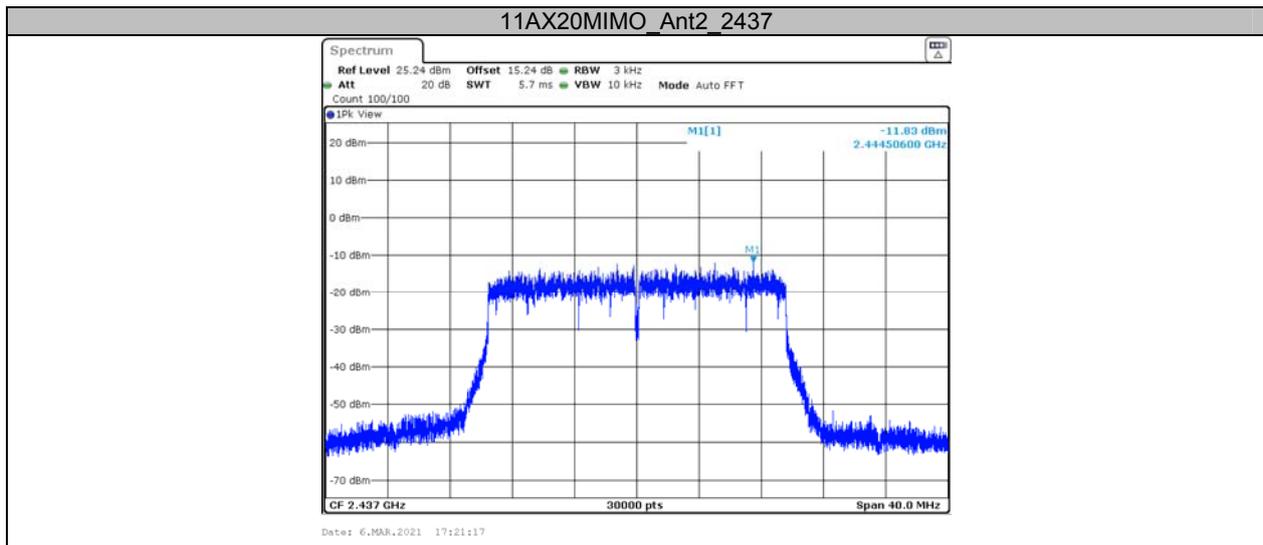




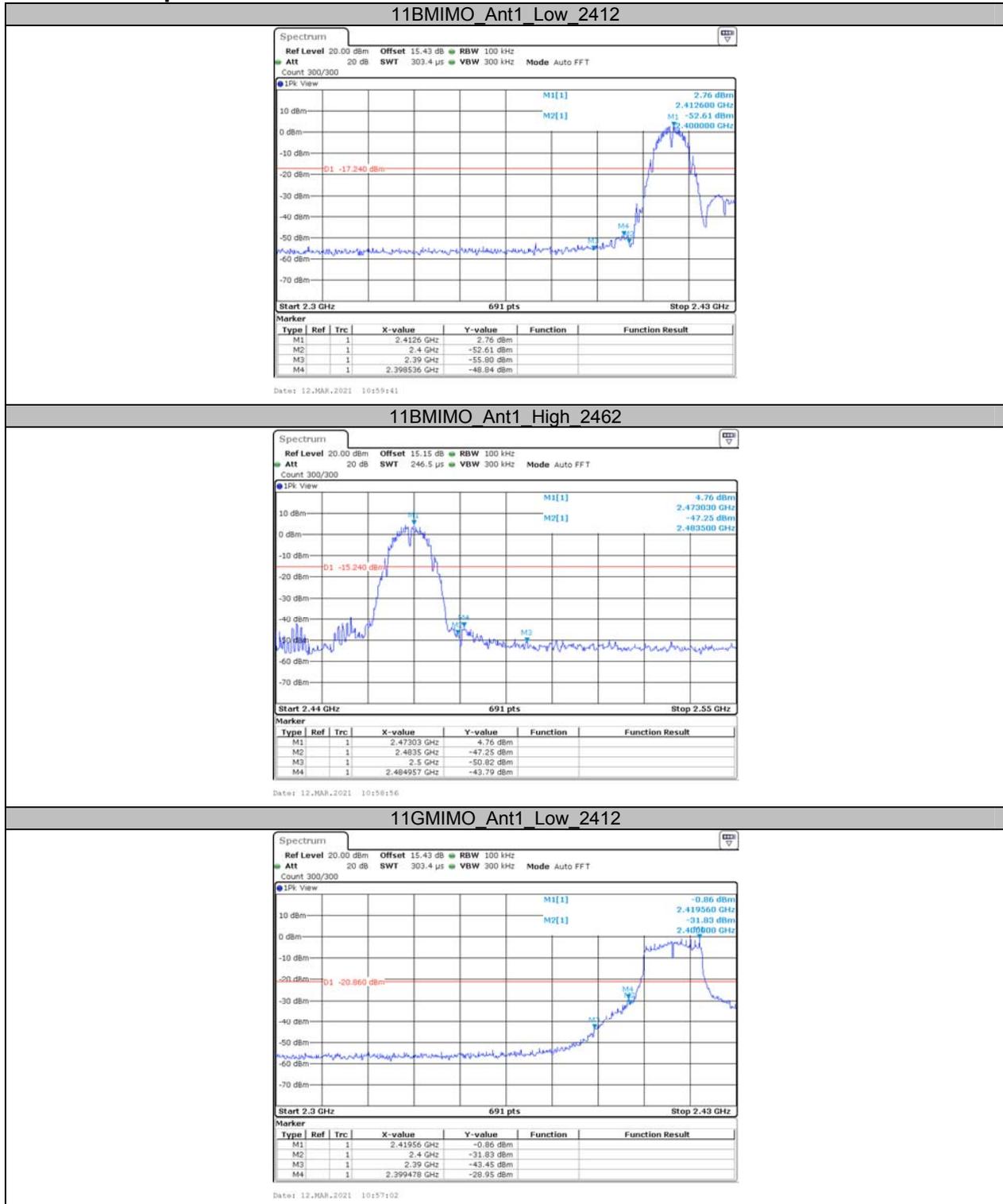




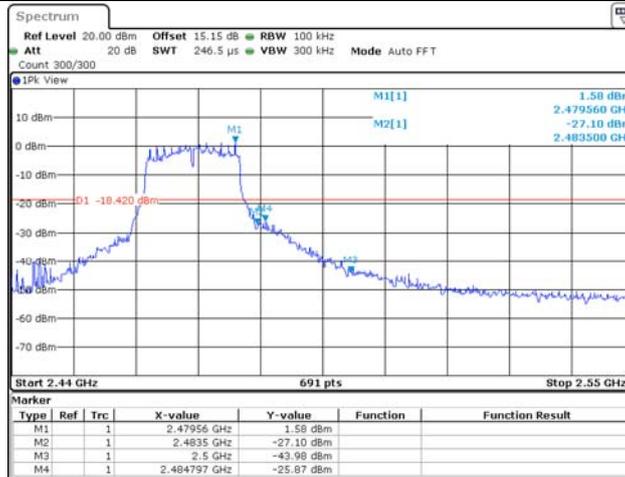




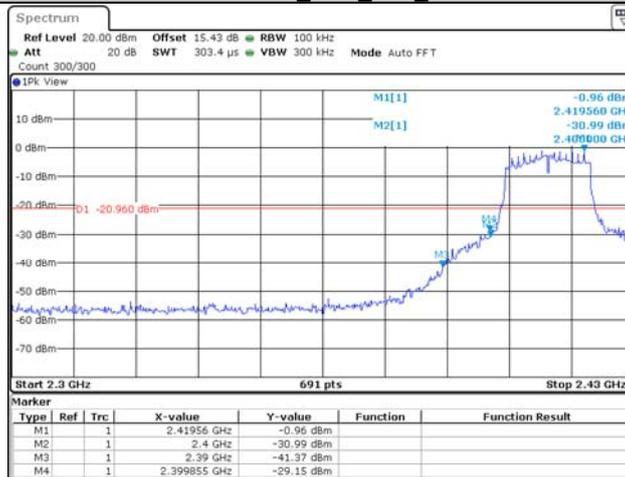
### Appendix E: Band edge measurements Test Graphs



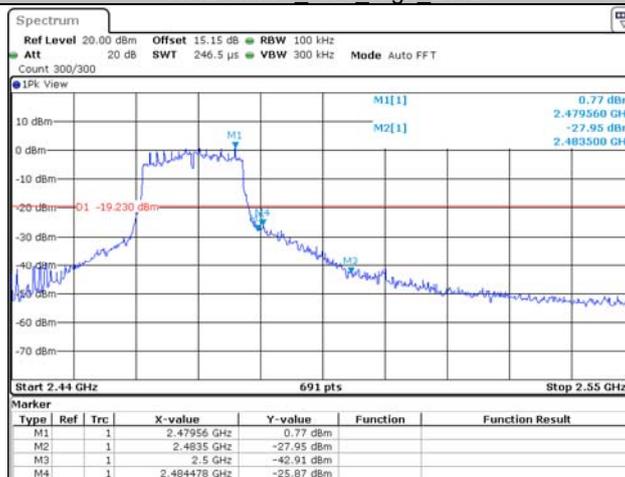
11GMIMO\_Ant1\_High\_2462



11N20MIMO\_Ant1\_Low\_2412



11N20MIMO\_Ant1\_High\_2462





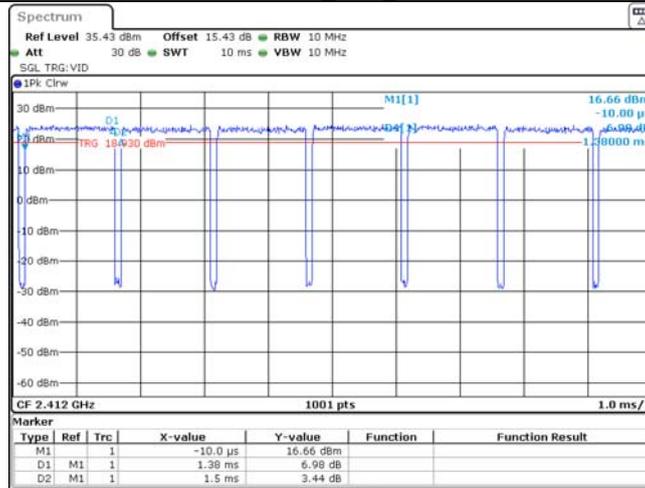
**Appendix F: Duty Cycle  
Test Result**

| TestMode   | Antenna | Channel | TransmissionDuration [ms] | Transmission Period [ms] | Duty Cycle [%] |
|------------|---------|---------|---------------------------|--------------------------|----------------|
| 11BMIMO    | Ant1    | 2412    | 8.38                      | 8.50                     | 98.59          |
|            |         | 2437    | 8.38                      | 8.52                     | 98.36          |
|            |         | 2462    | 8.38                      | 8.52                     | 98.36          |
| 11GMIMO    | Ant1    | 2412    | 1.38                      | 1.50                     | 92.00          |
|            |         | 2437    | 1.37                      | 1.49                     | 91.95          |
|            |         | 2462    | 1.37                      | 1.49                     | 91.95          |
| 11N20MIMO  | Ant1    | 2412    | 1.29                      | 1.41                     | 91.49          |
|            |         | 2437    | 1.29                      | 1.41                     | 91.49          |
|            |         | 2462    | 1.29                      | 1.41                     | 91.49          |
| 11AX20MIMO | Ant1    | 2412    | 1.00                      | 1.12                     | 89.29          |
|            |         | 2437    | 1.00                      | 1.12                     | 89.29          |
|            |         | 2462    | 1.00                      | 1.12                     | 89.29          |

Test Graphs

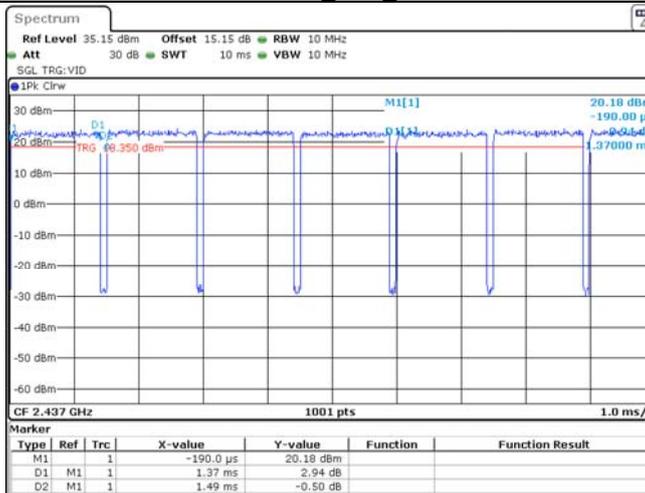


11GMIMO\_Ant1\_2412



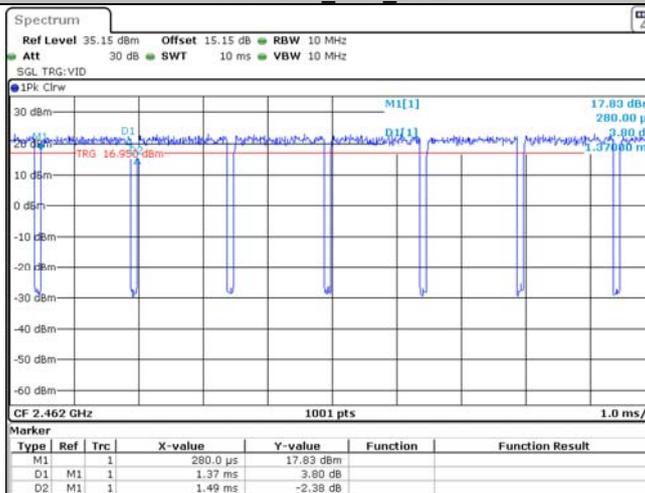
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11GMIMO\_Ant1\_2437

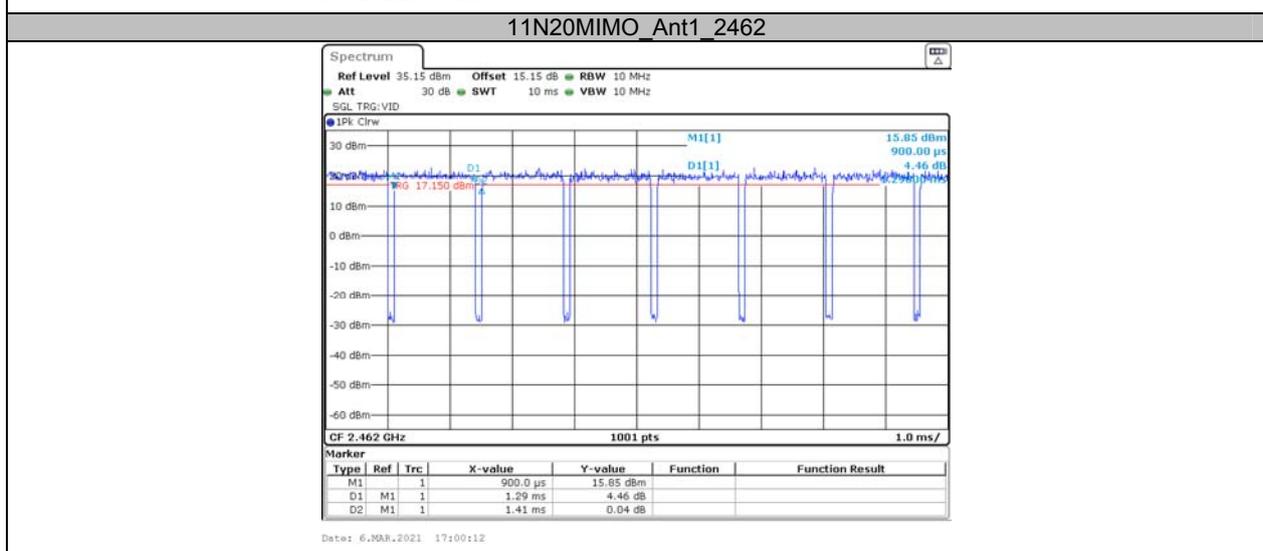
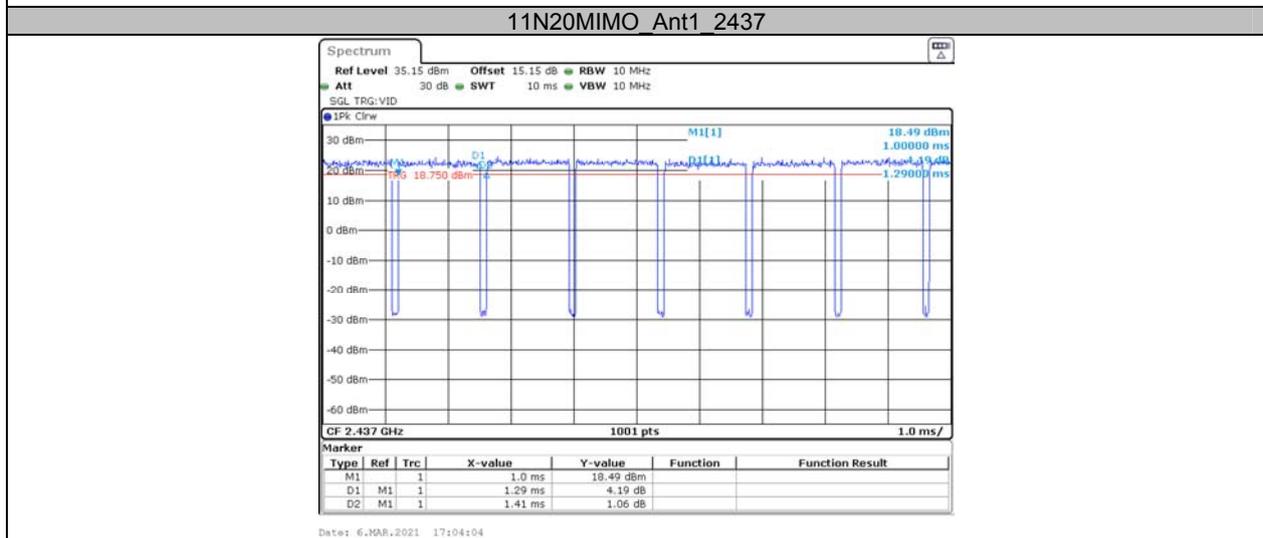
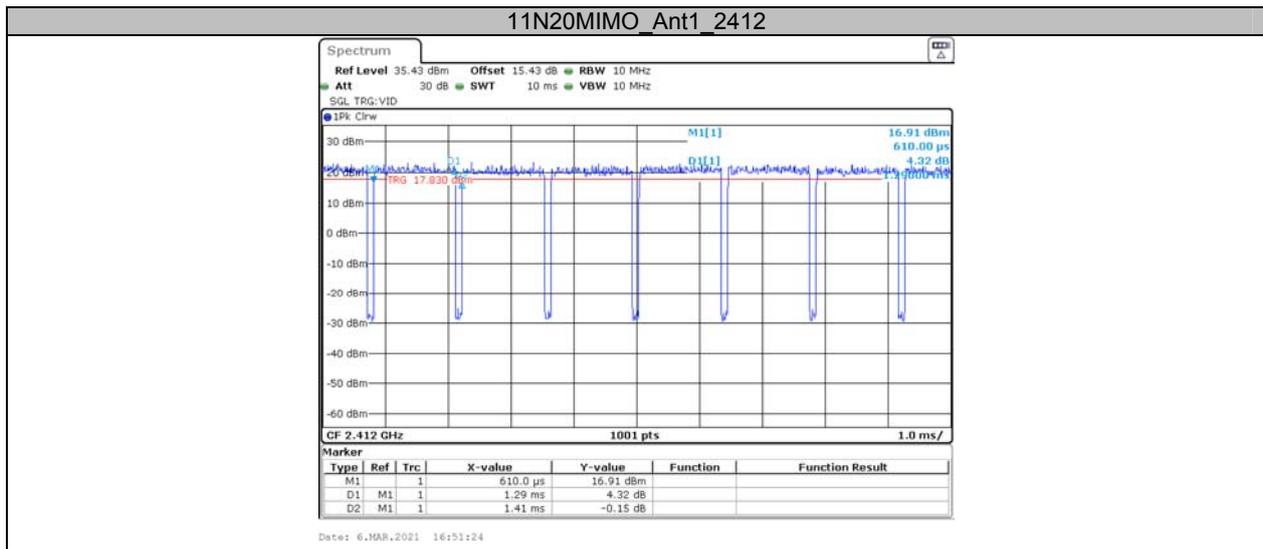


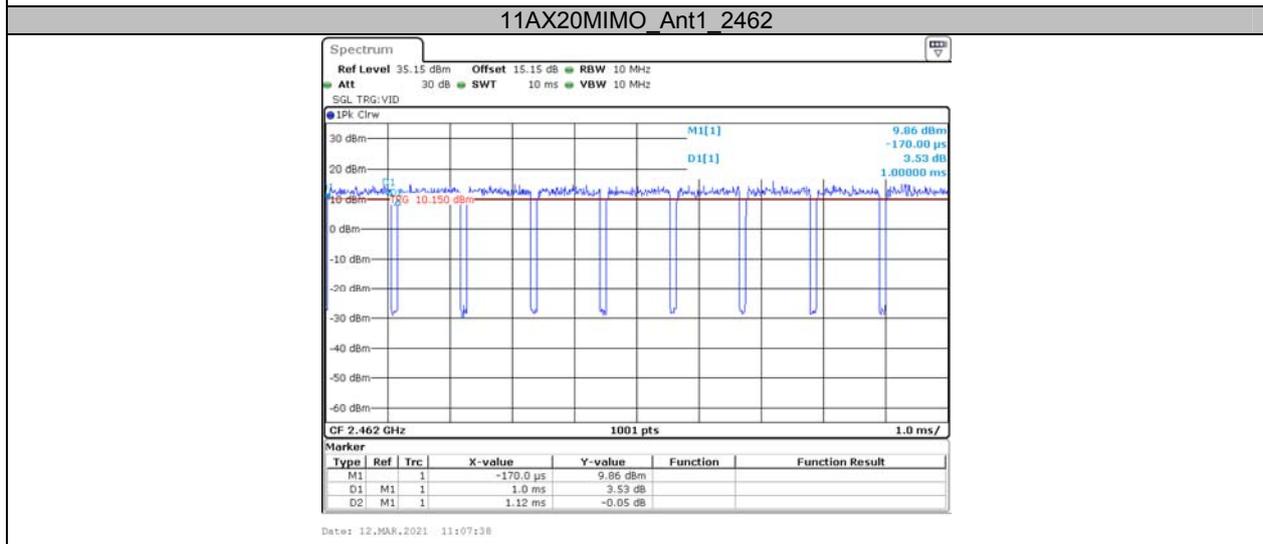
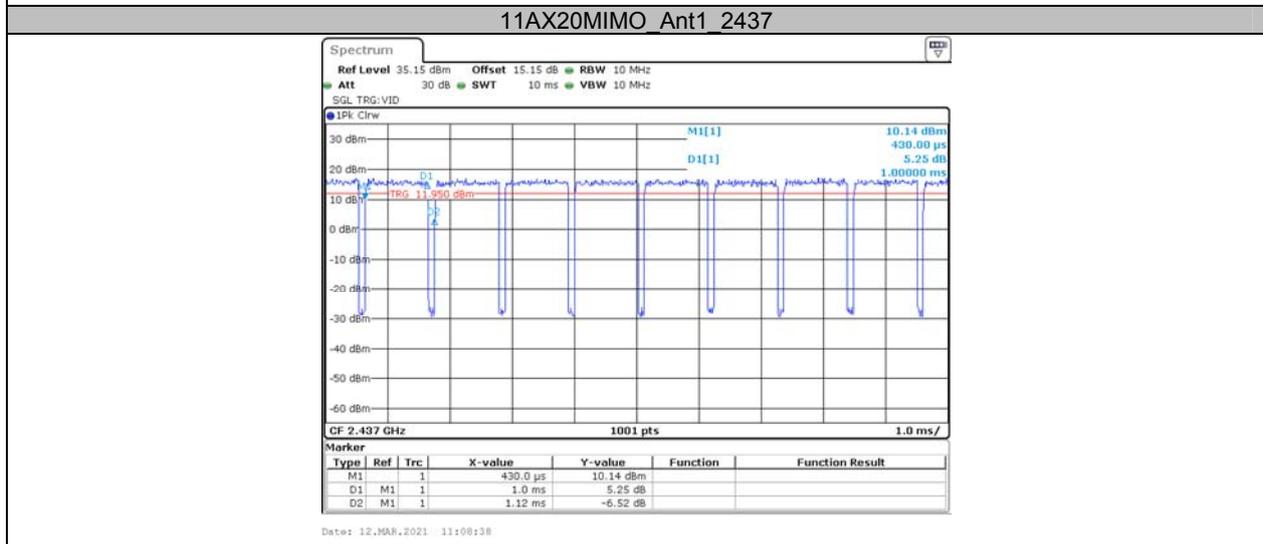
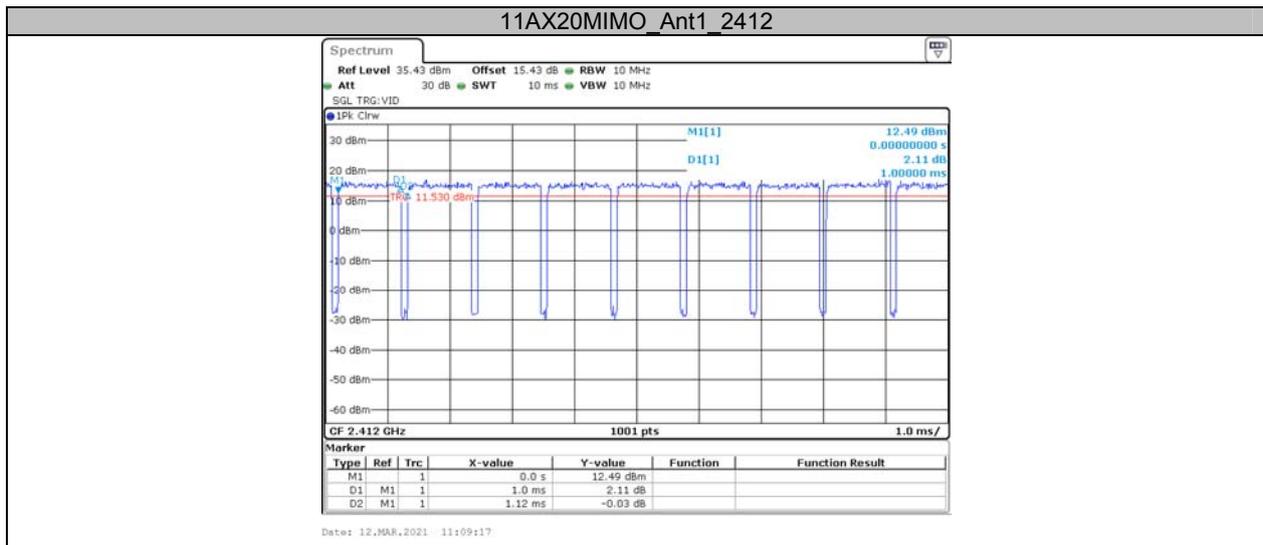
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11GMIMO\_Ant1\_2462



Date: 6.MAR.2021 16:40:45





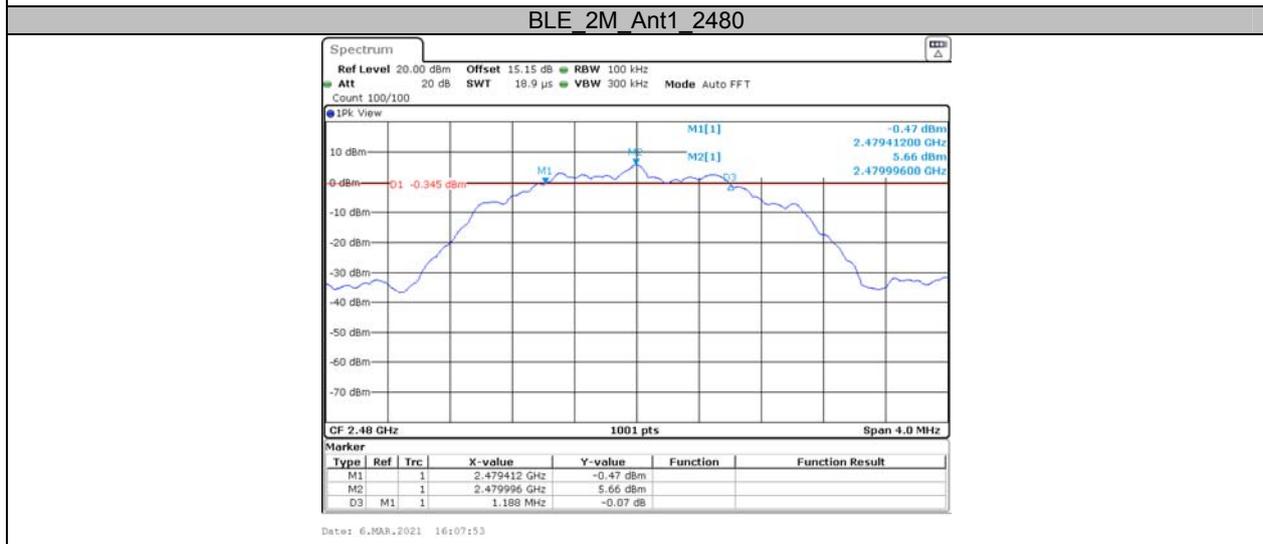
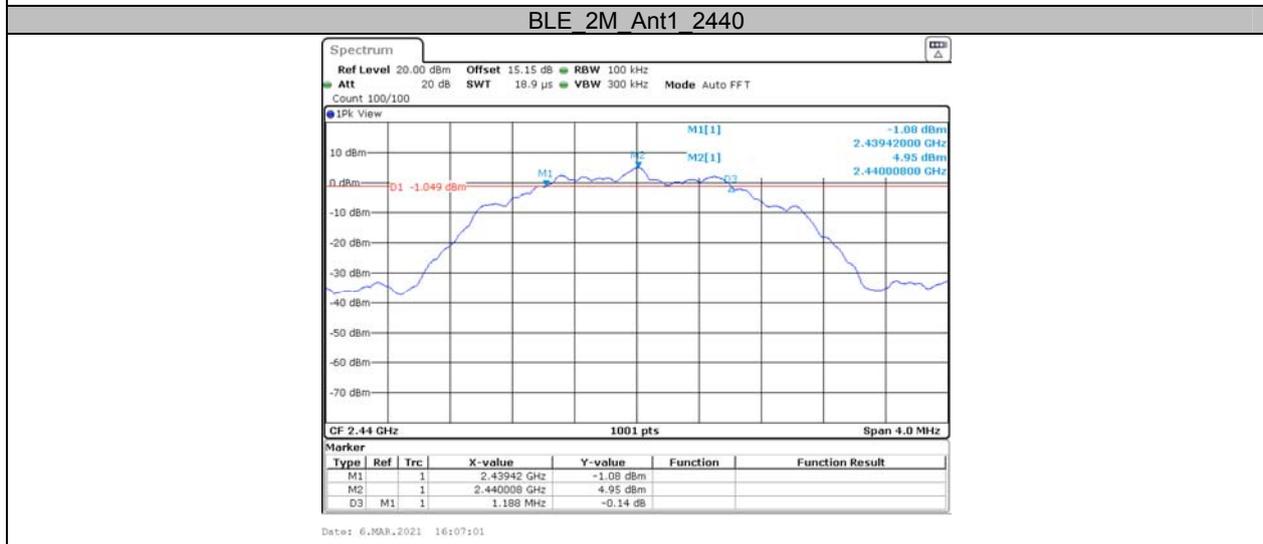
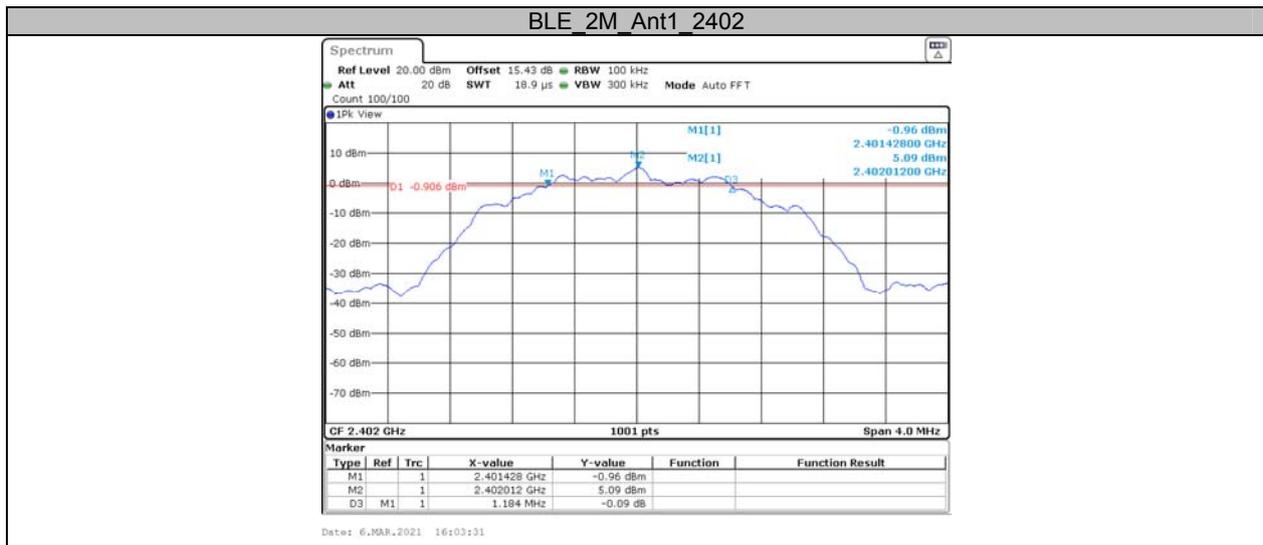
**APPENDIX BLE**

**Appendix A: DTS Bandwidth  
Test Result**

| TestMode | Antenna | Channel | DTS BW [MHz] | Limit[MHz] | Verdict |
|----------|---------|---------|--------------|------------|---------|
| BLE_1M   | Ant1    | 2402    | 0.692        | 0.5        | PASS    |
|          |         | 2440    | 0.696        | 0.5        | PASS    |
|          |         | 2480    | 0.700        | 0.5        | PASS    |
| BLE_2M   | Ant1    | 2402    | 1.184        | 0.5        | PASS    |
|          |         | 2440    | 1.188        | 0.5        | PASS    |
|          |         | 2480    | 1.188        | 0.5        | PASS    |

### Test Graphs

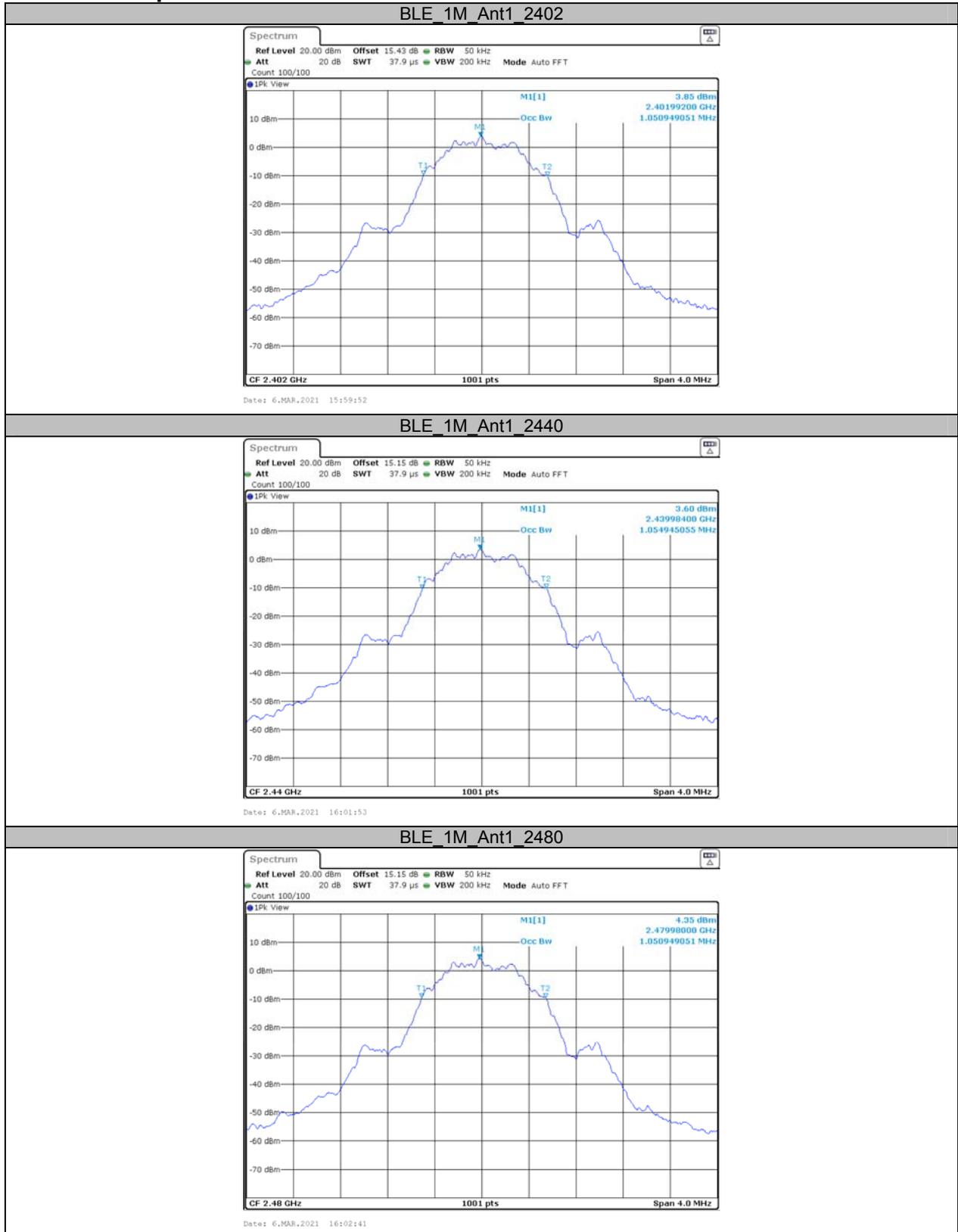




**Appendix B: Occupied Channel Bandwidth  
Test Result**

| TestMode | Antenna | Channel | OCB [MHz] | Limit[MHz] | Verdict |
|----------|---------|---------|-----------|------------|---------|
| BLE_1M   | Ant1    | 2402    | 1.051     | ---        | PASS    |
|          |         | 2440    | 1.055     | ---        | PASS    |
|          |         | 2480    | 1.051     | ---        | PASS    |
| BLE_2M   | Ant1    | 2402    | 2.046     | ---        | PASS    |
|          |         | 2440    | 2.042     | ---        | PASS    |
|          |         | 2480    | 2.046     | ---        | PASS    |

### Test Graphs





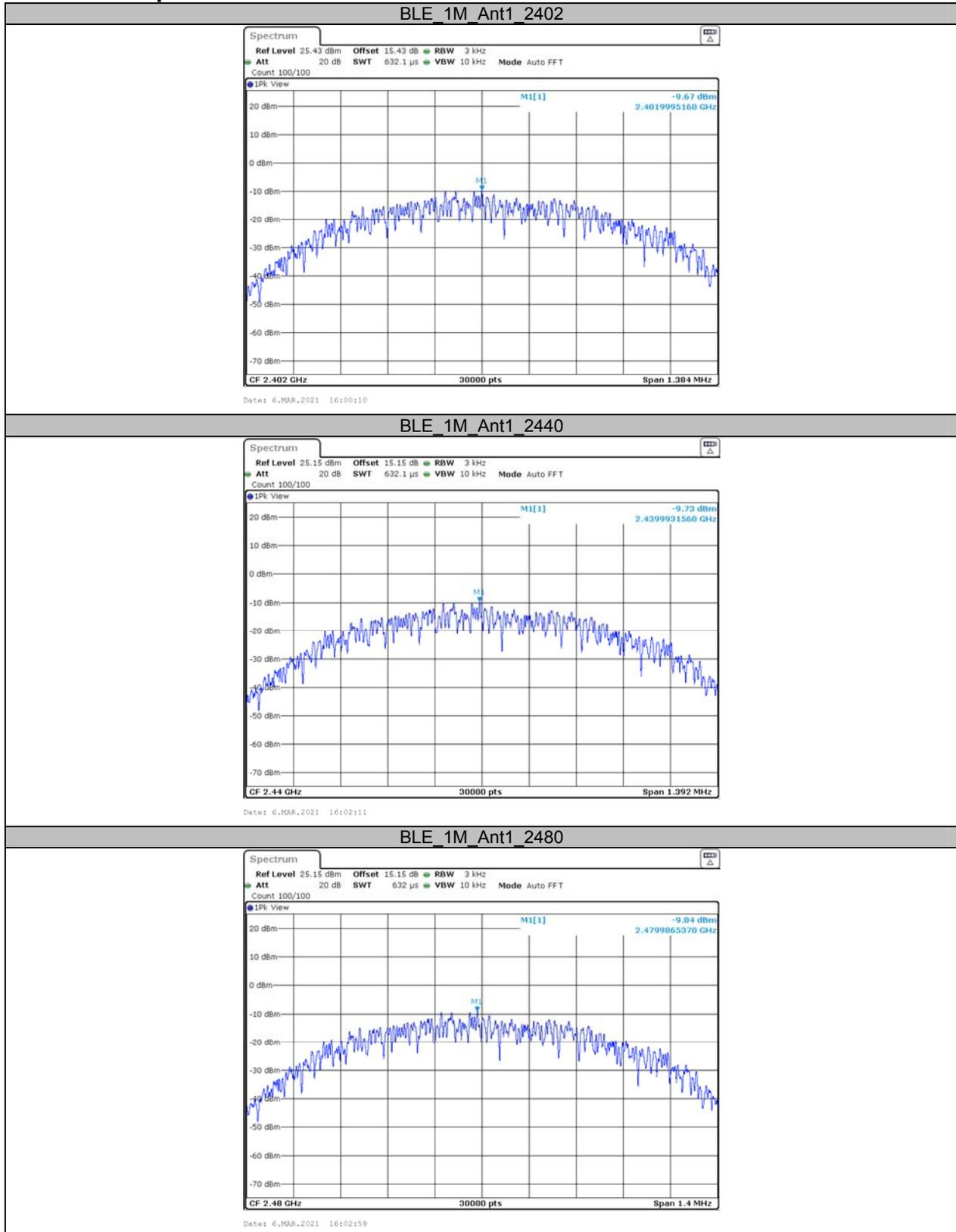
**Appendix C: Maximum conducted Peak output power****Test Result**

| TestMode | Antenna | Channel | Result[dBm] | Limit[dBm] | Verdict |
|----------|---------|---------|-------------|------------|---------|
| BLE_1M   | Ant1    | 2402    | 6.58        | <=30       | PASS    |
|          |         | 2440    | 6.92        | <=30       | PASS    |
|          |         | 2480    | 7.51        | <=30       | PASS    |
| BLE_2M   | Ant1    | 2402    | 6.61        | <=30       | PASS    |
|          |         | 2440    | 6.95        | <=30       | PASS    |
|          |         | 2480    | 7.54        | <=30       | PASS    |

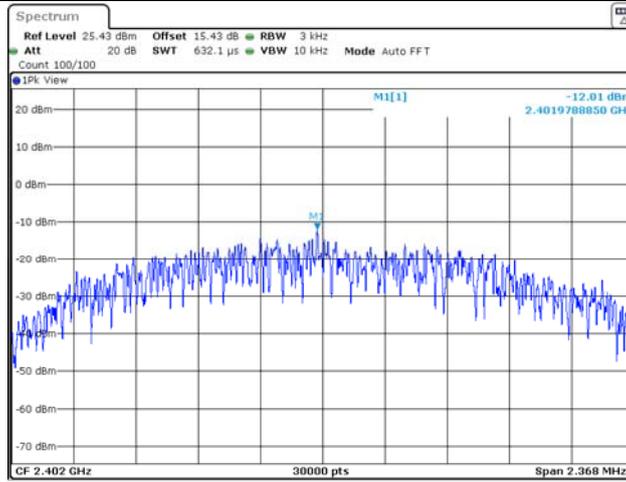
**Appendix D: Maximum power spectral density  
Test Result**

| TestMode | Antenna | Channel | Result[dBm/3kHz] | Limit[dBm/3kHz] | Verdict |
|----------|---------|---------|------------------|-----------------|---------|
| BLE_1M   | Ant1    | 2402    | -9.67            | <=8             | PASS    |
|          |         | 2440    | -9.73            | <=8             | PASS    |
|          |         | 2480    | -9.04            | <=8             | PASS    |
| BLE_2M   | Ant1    | 2402    | -12.01           | <=8             | PASS    |
|          |         | 2440    | -12.03           | <=8             | PASS    |
|          |         | 2480    | -11.34           | <=8             | PASS    |

### Test Graphs

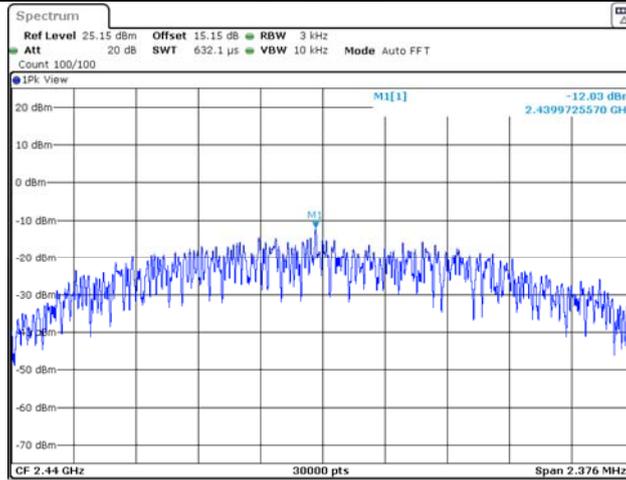


BLE 2M Ant1 2402



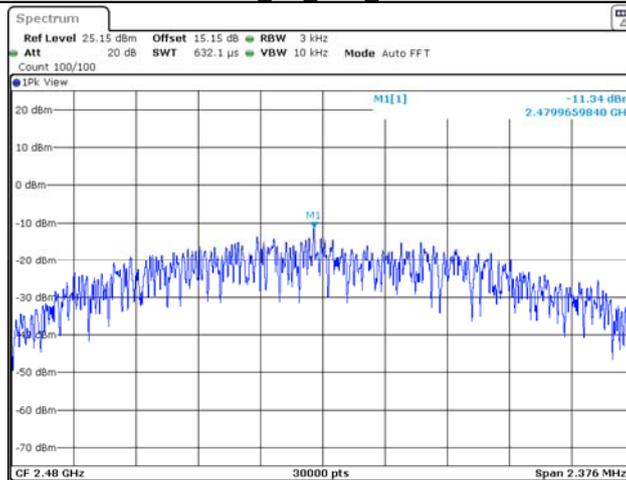
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BLE 2M Ant1 2440



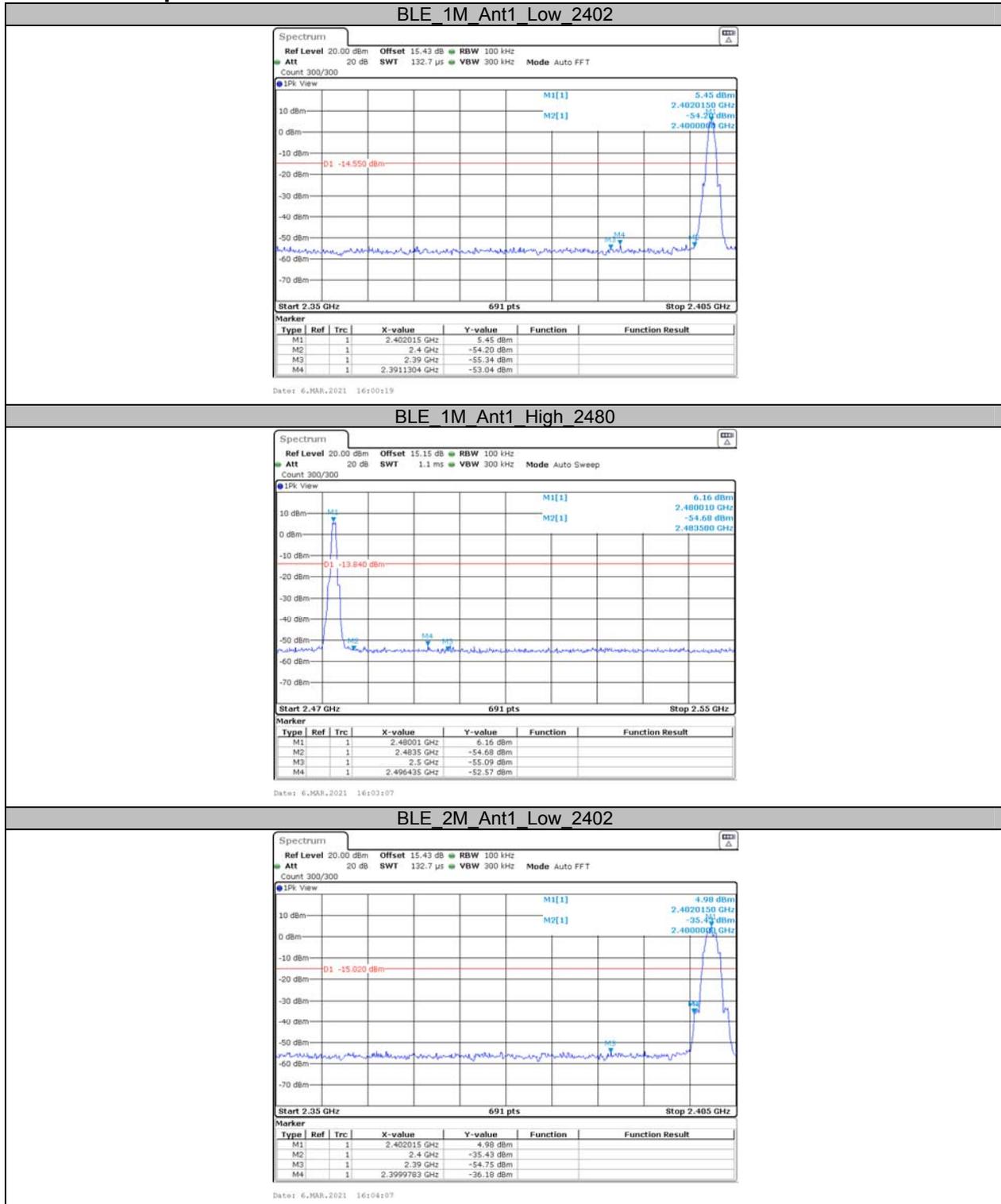
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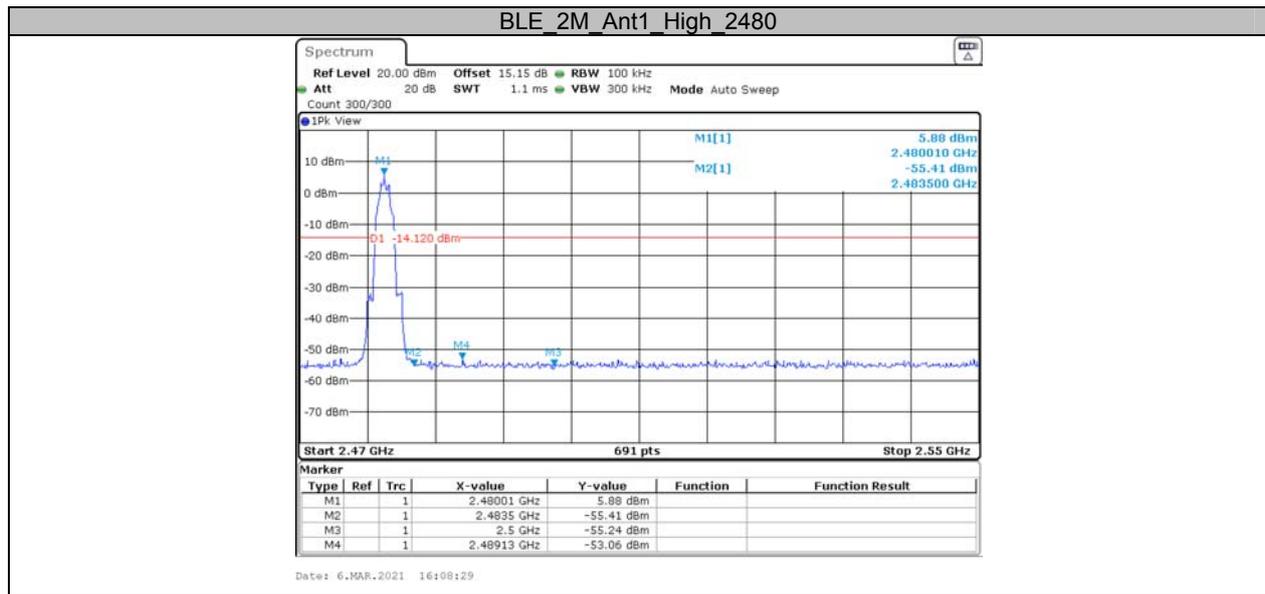
BLE 2M Ant1 2480



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### Appendix E: Band edge measurements Test Graphs

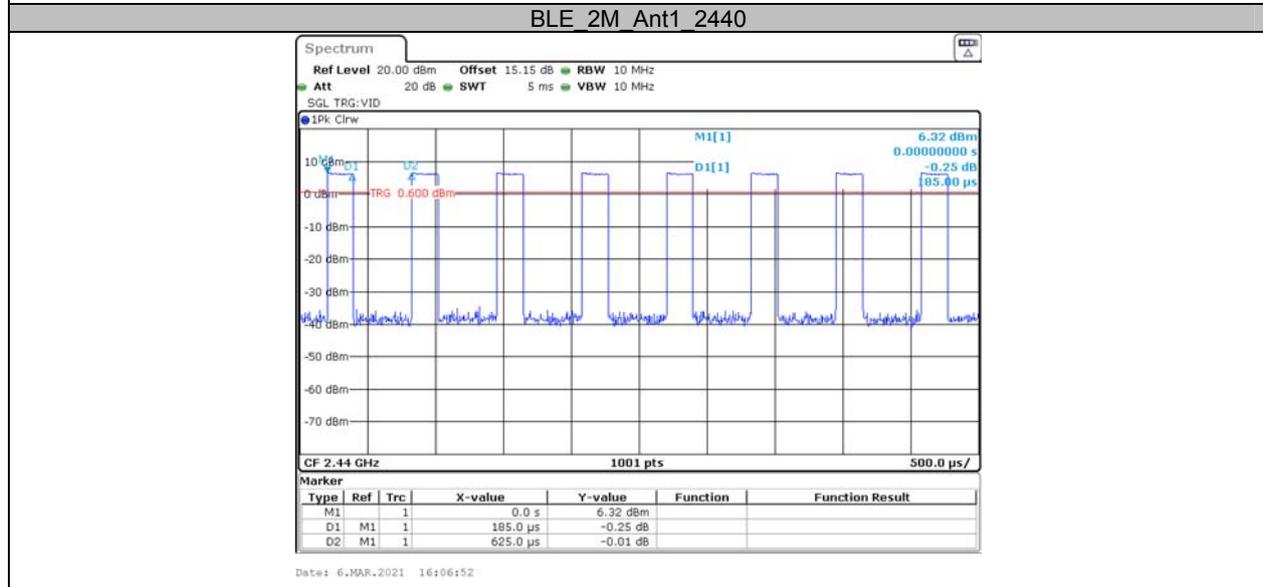
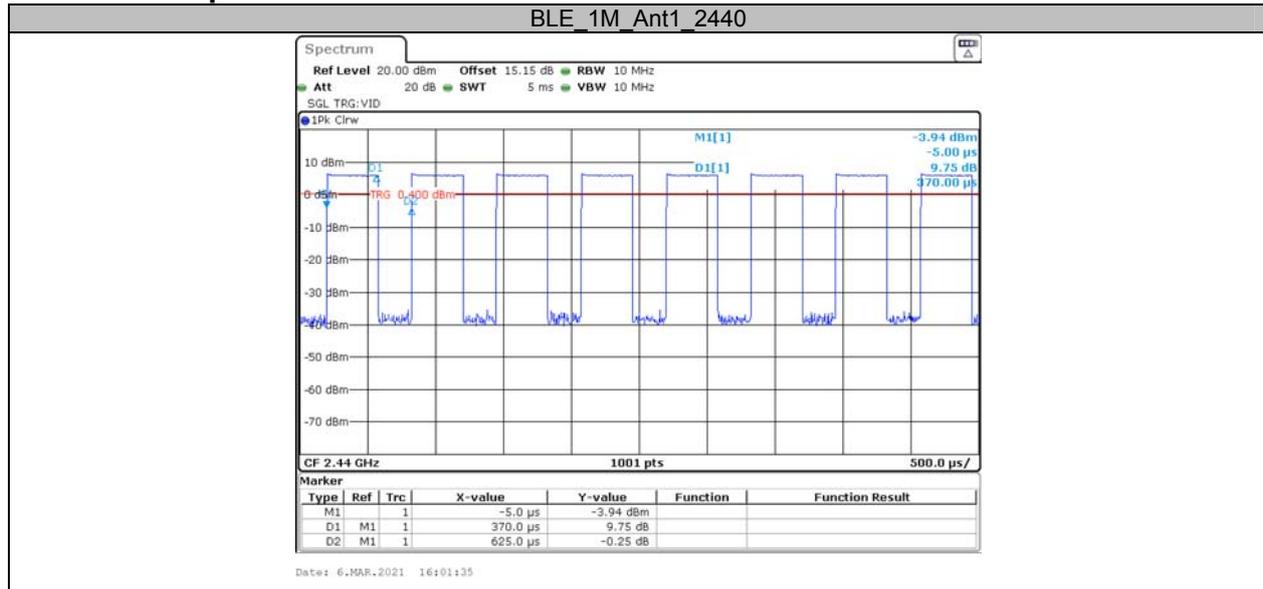




### Appendix F: Duty Cycle Test Result

| TestMode | Antenna | Channel | TransmissionDuration [ms] | Transmission Period [ms] | Duty Cycle [%] |
|----------|---------|---------|---------------------------|--------------------------|----------------|
| BLE_1M   | Ant1    | 2440    | 0.37                      | 0.63                     | 58.73          |
| BLE_2M   | Ant1    | 2440    | 0.19                      | 0.63                     | 30.16          |

### Test Graphs



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