# FCC RADIO TEST REPORT

| | | |
|---|---|---|
| **FCC ID** | : | **A4RGKV4X** |
| **Equipment** | : | **Phone** |
| **Model Name** | : | **GKV4X** |
| **Applicant** | : | **Google LLC**<br>**1600 Amphitheatre Parkway, Mountain View, California, 94043 USA** |
| **Standard** | : | **FCC Part 15 Subpart C §15.247** |

**The product was received on Jul. 11, 2023 and testing was performed from Jul. 21, 2023 to Dec. 11, 2023. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.**

Louis Wu

**Approved by: Louis Wu**

***Sporton International Inc. Wensan Laboratory***
*No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)*

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# History of this test report

| Report No. | Version | Description | Issue Date |
|---|---|---|---|
| FR380307C | 01 | Initial issue of report | Dec. 12, 2023 |
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# Summary of Test Result

| Report Clause | Ref Std. Clause | Test Items | Result (PASS/FAIL) | Remark |
|---|---|---|---|---|
| 3.1 | 15.247(a)(2) | 6dB Bandwidth | Pass | - |
| 3.1 | 2.1049 | 99% Occupied Bandwidth | Reporting only | - |
| 3.2 | 15.247(b) | Power Output Measurement | Pass | - |
| 3.3 | 15.247(e) | Power Spectral Density | Pass | - |
| 3.4 | 15.247(d) | Conducted Band Edges | Pass | - |
| | | Conducted Spurious Emission | Pass | - |
| 3.5 | 15.247(d) | Radiated Band Edges and Radiated Spurious Emission | Pass | 1.54 dB under the limit at 2489.42 MHz |
| 3.6 | 15.207 | AC Conducted Emission | Pass | 20.49 dB under the limit at 0.51 MHz |
| 3.7 | 15.203 | Antenna Requirement | Pass | - |

**Conformity Assessment Condition:**

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”.

**Disclaimer:**

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

**Reviewed by: William Chen**
**Report Producer: Lucy Wu**

# 1 General Description

## 1.1 Product Feature of Equipment Under Test

| Product Feature |
|---|
| **General Specs**<br>GSM/WCDMA/LTE/5G NR, Bluetooth, BLE, BLE channel sounding, Wi-Fi 2.4GHz 802.11b/g/n/ac/ax, Wi-Fi 5GHz 802.11a/n/ac/ax, Wi-Fi 6GHz 802.11a/ax, NFC, WPC Rx and GNSS Rx.<br><br>**Antenna Type**<br>WLAN:<br>**<Ant. 4>:** ILA Antenna<br>**<Ant. 3>:** IFA Antenna |

| EUT Information List | |
|---|---|
| **S/N** | **Performed Test Item** |
| 36151JEKB12371 | RF Conducted Measurement |
| 38011JEKB00050<br>36151JEKB12241 | Radiated Spurious Emission |
| 38011JEKB00085 | Conducted Emission |

| Antenna information | | |
|---|---|---|
| **2400 MHz ~ 2483.5 MHz** | Peak Gain (dBi) | Ant. 4: -0.7<br>Ant. 3: -1.2 |

**Remark:** The EUT's information above is declared by manufacturer. Please refer to Disclaimer in report summary.

### 1.1.1 Antenna Directional Gain

Follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01 F)2)f)ii)

Directional gain = $G_{ANT}$ + Array Gain, where Array Gain is as follows:

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

$G_{ANT}$ is set equal to the gain of the antenna having the highest gain.

For PSD measurements, the directional gain calculation.

$$DirectionalGain = 10 \cdot \log \left[ \frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

*where*

Each antenna is driven by no more than one spatial stream;

$N_{SS}$ = the number of independent spatial streams of data;

$N_{ANT}$ = the total number of antennas

$g_{j,k} = 10^{G_k / 20}$ if the $k$th antenna is being fed by spatial stream $j$, or zero if it is not;

$G_k$ is the gain in dBi of the kth antenna.

As minimum $N_{SS}$=1 is supported by EUT, the formula can be simplified as:

Directional gain = $10*\log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi

Where G1, G2….GN denote single antenna gain.

The directional gain “DG” is calculated as following table.

| | | | DG for Power | DG for PSD | Power Limit Reduction | PSD Limit Reduction |
|---|---|---|---|---|---|---|
| | Ant 4 (dBi) | Ant 3 (dBi) | (dBi) | (dBi) | (dB) | (dB) |
| **2.4GHz** | -0.70 | -1.20 | -0.70 | 2.06 | 0.00 | 0.00 |

Calculation example:

If a device has two antenna, $G_{ANT3}$= -0.70dBi; $G_{ANT4}$=-1.20dBi

Directional gain of power measurement = max(-0.70, -1.20) + 0 = -0.70 dBi

Directional gain of PSD derived from formula which is

10 x log { { [ 10^ (-0.70 dBi / 20) + 10^ (-1.20 dBi / 20) ] ^ 2 } / 2 }

= 2.06 dBi

Power and PSD limit reduction = Composite gain – 6dBi, ( min = 0 )

## 1.2 Modification of EUT

No modifications made to the EUT during the testing.

## 1.3 Testing Location

| | |
|---|---|
| **Test Site** | Sporton International Inc. Wensan Laboratory |
| **Test Site Location** | No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist.,<br>Taoyuan City 333010, Taiwan (R.O.C.)<br>TEL: +886-3-327-0868<br>FAX: +886-3-327-0855 |
| **Test Site No.** | **Sporton Site No.** |
| | TH05-HY, CO07-HY, 03CH15-HY |

**Note:** The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW3786

## 1.4 Applicable Standards

According to the specifications declared by the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

**Remark:**

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The TAF code is not including all the FCC KDB listed without accreditation.

# 2 Test Configuration of Equipment Under Test

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and accessory (Adapter or Earphone), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and find X Plane with Adapter for <Ant. 4>, Z Plane with Adapter for <Ant. 3> and MIMO <Ant. 4+3> as worst plane.

b. AC power line Conducted Emission was tested under maximum output power.

## 2.1 Carrier Frequency and Channel

| Frequency Band | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|---|---|---|---|---|
| 2400-2483.5 MHz | 1 | 2412 | 8 | 2447 |
| | 2 | 2417 | 9 | 2452 |
| | 3 | 2422 | 10 | 2457 |
| | 4 | 2427 | 11 | 2462 |
| | 5 | 2432 | 12 | 2467 |
| | 6 | 2437 | 13 | 2472 |
| | 7 | 2442 | | |

## 2.2 Test Mode

This device support 26/52/106/242-tone RU.

The PSD of partial RU is reduced to be smaller than full RU according to TCB workshop interim guidance Oct. 2022.

The 802.11ax mode is investigated among different tones, full resource units (RU), partial resource units. The partial RU has no higher power than full RU's, thus the full RU is chosen as main test configuration.

The 242-tone RU is covered by 20MHz channel.

The SISO mode conducted power is covered by MIMO mode per chain, so only the MIMO mode is tested.

The power for 802.11ac mode is smaller than 802.11n mode, so all other conducted andradiated test is covered by 802.11n mode.

**The final test modes include the worst data rates for each modulation shown in the table below.**

**Single Antenna**

| Modulation | Data Rate |
|---|---|
| 802.11b | 1 Mbps |

**MIMO Antenna**

| Modulation | Data Rate |
|---|---|
| 802.11g | 6 Mbps |
| 802.11n HT20 | MCS0 |
| 802.11ac VHT20 (Covered by HT20) | MCS0 |
| 802.11ax HE20 | MCS0 |

**Remark:** The conducted power level of each chain in MIMO mode is equal or higher than SISO mode.

| Test Cases | |
|---|---|
| AC Conducted Emission | Mode 1 :5G NR n5 Link + WLAN (2.4GHz) Link + Bluetooth on + NFC on + USB Cable 3 (Charging from Adapter 2) + Handset mode; Battery < 50% |

**Remark:**
1. For Radiated Test Cases, the tests were performed with Adapter 1 and USB Cable 3.
2. During the preliminary test, both charging modes (Adapter mode and WPC Rx mode) were verified. It is determined that the adaptor mode is the worst case for official test.

**<Ant. 4>**

| Ch. # | 2400-2483.5 MHz |
|---|---|
| | 802.11b |
| Low | 01 |
| Middle | 06 |
| High | 11 |
| | 12 |
| | 13 |

**<Ant. 3>**

| Ch. # | 2400-2483.5 MHz |
|---|---|
| | 802.11b |
| Low | 01 |
| Middle | 06 |
| High | 11 |
| | 12 |
| | 13 |

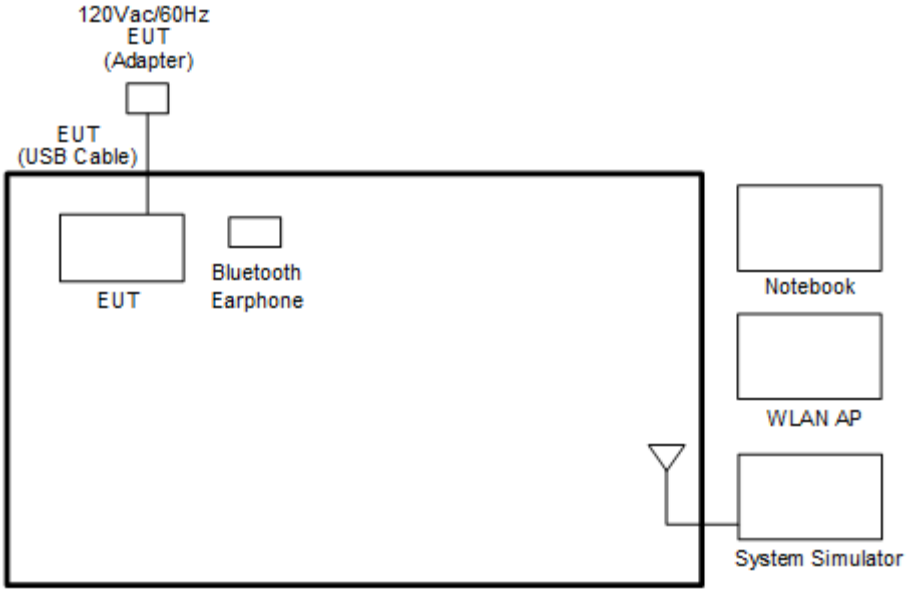
**MIMO <Ant. 4+3>**

| Ch. # | 2400-2483.5 MHz | |
|---|---|---|
| | 802.11g | 802.11ax HE20 |
| Low | 01 | 01 |
| | 02 | 02 |
| Middle | 06 | 06 |
| High | 10 | 10 |
| | 11 | 11 |
| | 12 | 12 |
| | 13 | 13 |

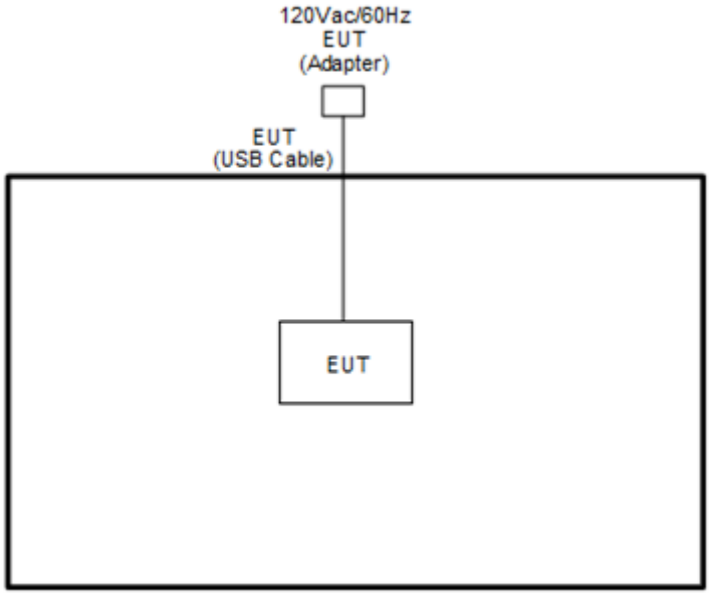
**Remark:** For radiation spurious emission, the modulation and the data rate picked for testing are determined by the Max. RF conducted power.

## 2.3 Connection Diagram of Test System

**<AC Conducted Emission Mode>**




**<WLAN Tx Mode>**



## 2.4 Support Unit used in test configuration and system

| Item | Equipment | Brand Name | Model Name | FCC ID | Data Cable | Power Cord |
|---|---|---|---|---|---|---|
| 1. | System Simulator | Anritsu | MT8820C | N/A | N/A | Unshielded, 1.8 m |
| 2. | Bluetooth Earphone | Sony Ericsson | MW600 | PY700A2029 | N/A | N/A |
| 3. | WLAN AP | Netgear | RAXE500 | PY320300508 | N/A | Unshielded, 1.8 m |
| 4. | Notebook | DELL | Latitude E3400 | PY320300320508 | N/A | AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m |

## 2.5 EUT Operation Test Setup

The RF test items, utility “cmd Ver.10.0.17134.1304” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

## 2.6 Measurement Results Explanation Example

**For all conducted test items:**

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
*Offset = RF cable loss + attenuator factor.*
Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

*Offset(dB) = RF cable loss(dB) + attenuator factor(dB).*
= 4.2 + 10 = 14.2 (dB)

# 3 Test Result

## 3.1 6dB and 99% Bandwidth Measurement

### 3.1.1 Limit of 6dB and 99% Bandwidth

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

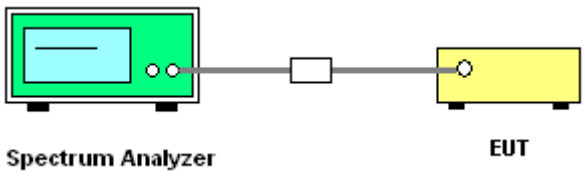
### 3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

### 3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) ≥ 3 * RBW.
6. Measure and record the results in the test report.

### 3.1.4 Test Setup




### 3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Please refer to Appendix A.

## 3.2 Output Power Measurement

### 3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5 MHz, the limit for output power is 30 dBm. If transmitting antenna with directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

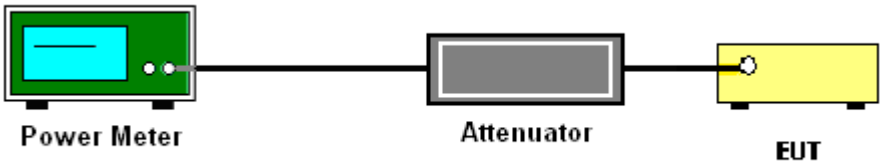
### 3.2.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

### 3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT is connected to the power meter by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Measure the conducted output power and record the results in the test report.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

### 3.2.4 Test Setup




### 3.2.5 Test Result of Average Output Power

Please refer to Appendix A.

# 3.3 Power Spectral Density Measurement

## 3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

## 3.3.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

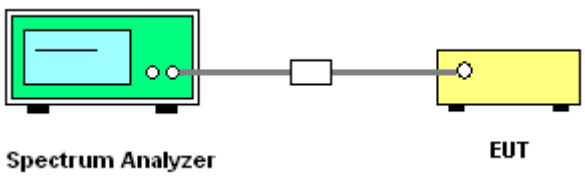
## 3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

   Method (c): Measure and add 10 log($N_{ANT}$) dB.

   With this technique, spectrum measurements are performed at each output of the device, but rather than summing the spectra or the spectral peaks across the outputs, the quantity 10 log($N_{ANT}$) dB is added to each spectrum value before comparing to the emission limit. The addition of 10 log($N_{ANT}$) dB serves to apportion the emission limit among the $N_{ANT}$ outputs so that each output is permitted to contribute no more than $1/N_{ANT}$ $^{th}$ of the PSD limit .

## 3.3.4 Test Setup




## 3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

# 3.4 Conducted Band Edges and Spurious Emission Measurement

## 3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

## 3.4.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

## 3.4.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

## 3.4.4 Test Setup


## 3.4.5 Test Result of Conducted Band Edges and Spurious Emission

Please refer to Appendix A.

# 3.5 Radiated Band Edges and Spurious Emission Measurement

## 3.5.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device is measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009 – 0.490 | 2400/F(kHz) | 300 |
| 0.490 – 1.705 | 24000/F(kHz) | 30 |
| 1.705 – 30.0 | 30 | 30 |
| 30 – 88 | 100 | 3 |
| 88 – 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

## 3.5.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

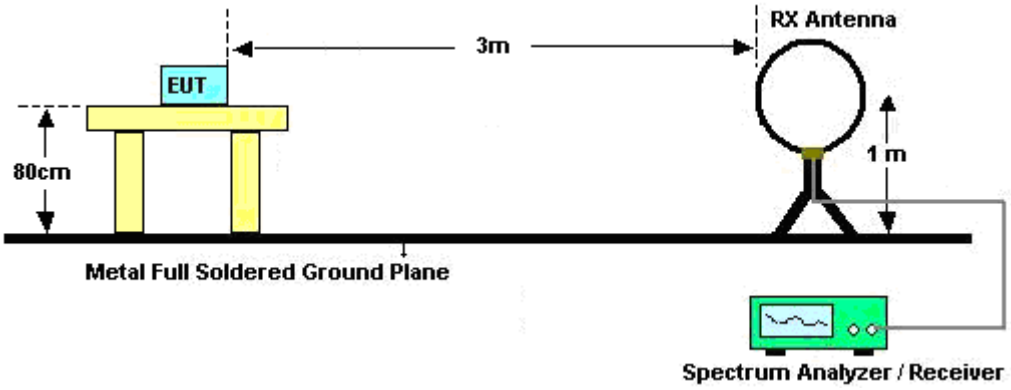
## 3.5.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as “-“.

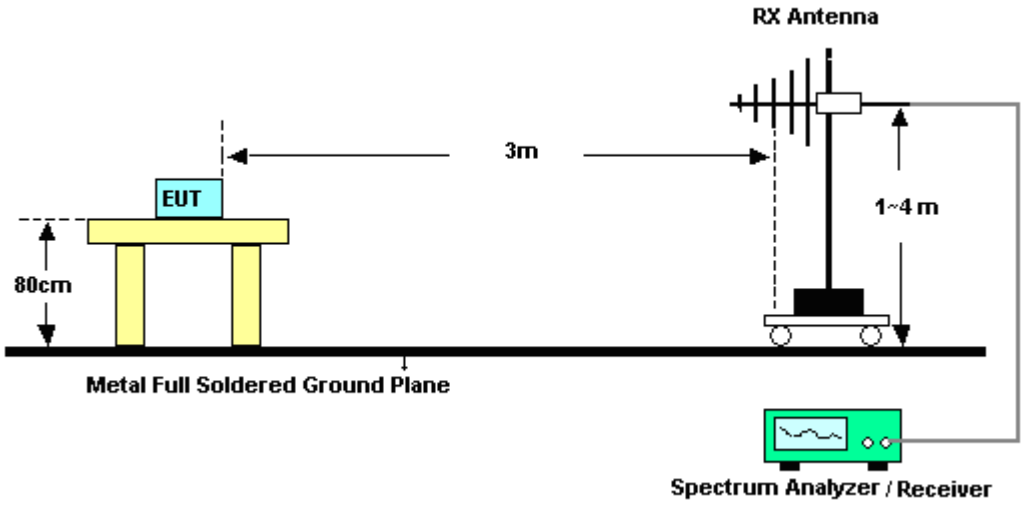
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as "-".
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW = 100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3 MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

## 3.5.4 Test Setup

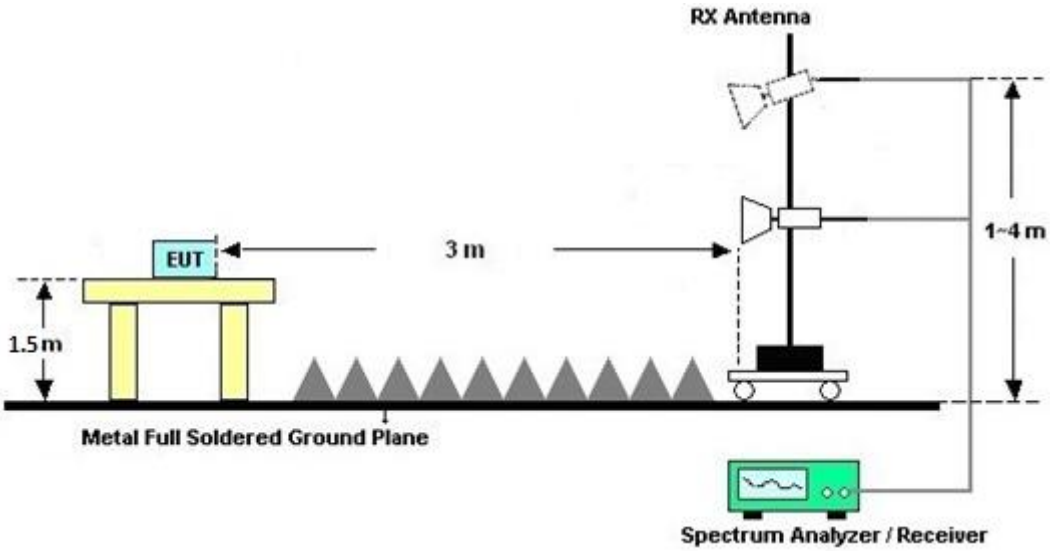
**For radiated emissions below 30MHz**



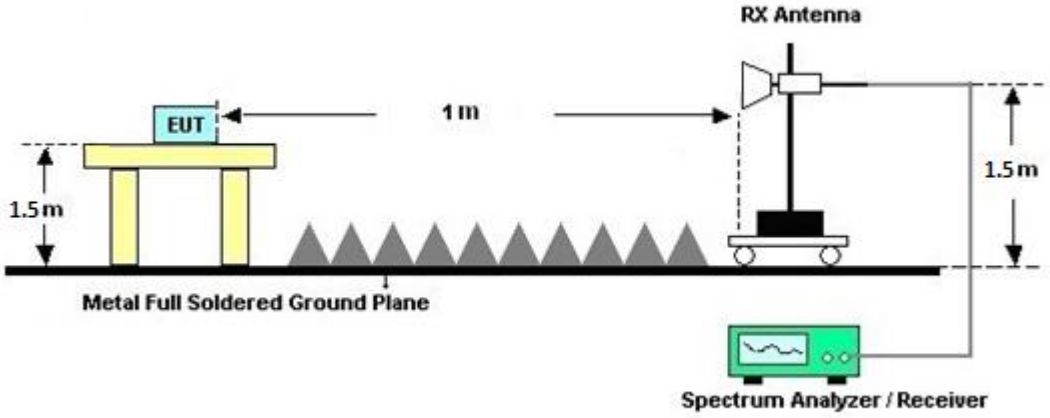
**For radiated emissions from 30MHz to 1GHz**




**For radiated test from 1GHz to 18GHz**



**For radiated test above 18GHz**




### 3.5.5 Test Results of Radiated Spurious Emissions (9kHz ~ 30MHz)

The low frequency, which starts from 9 kHz to 30 MHz, is pre-scanned and the result which is 20 dB lower than the limit line is not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

### 3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

### 3.5.7 Duty Cycle

Please refer to Appendix E.

### 3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10$^{th}$ Harmonic)

Please refer to Appendix C and D.

# 3.6 AC Conducted Emission Measurement

## 3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

| Frequency of Emission (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

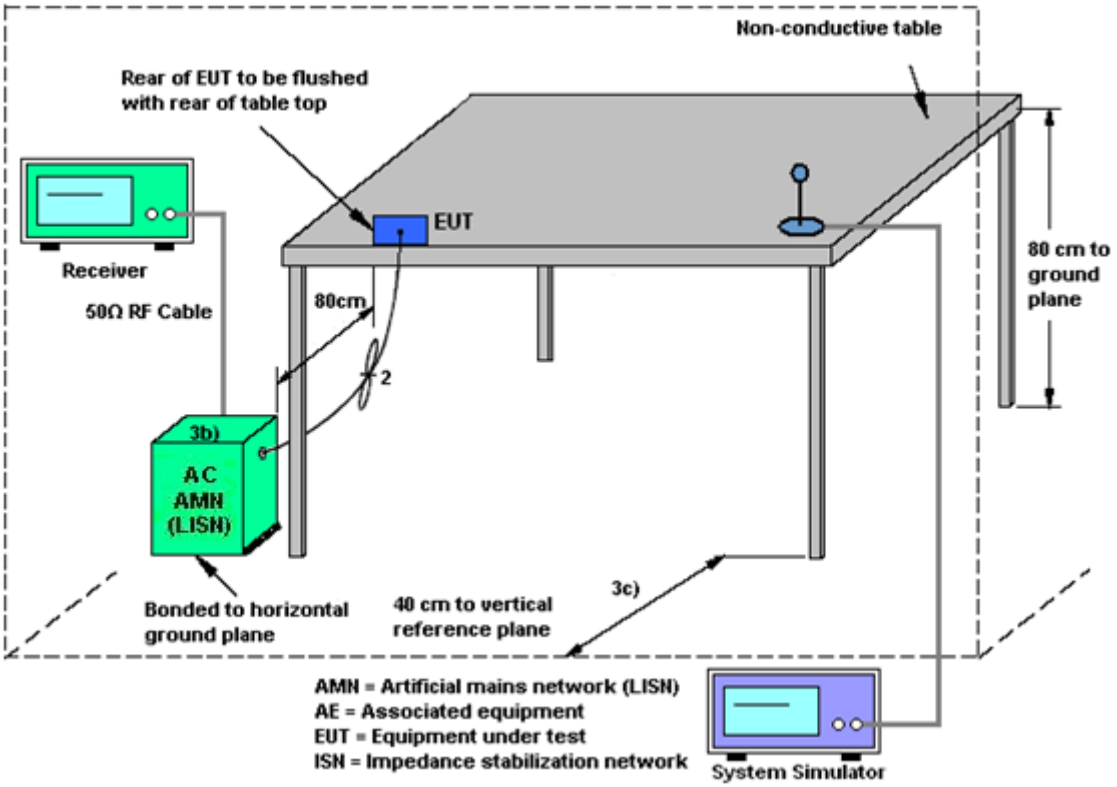
## 3.6.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

## 3.6.3 Test Procedures

1. The EUT is placed 0.4 meter away from the conducting wall of the shielding room, and is kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN shall be used.
6. Both Line and Neutral shall be tested in order to find out the maximum conducted emission.
7. The frequency range from 150 kHz to 30 MHz is scanned.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9kHz) with Maximum Hold Mode.

### 3.6.4 Test Setup




### 3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

# 3.7 Antenna Requirements

## 3.7.1 Standard Applicable

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 rule.

## 3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

# 4 List of Measuring Equipment

| Instrument | Brand Name | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|---|---|---|---|---|---|---|---|---|
| Loop Antenna | Rohde & Schwarz | HFH2-Z2 | 100315 | 9kHz~30 MHz | Feb. 28, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Feb. 27, 2024 | Radiation (03CH15-HY) |
| Bilog Antenna | TESEQ | CBL 6111D & 00800N1D01N-06 | 41912 & 05 | 30MHz~1GHz | Feb. 05, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Feb. 04, 2024 | Radiation (03CH15-HY) |
| Horn Antenna | SCHWARZBECK | BBHA 9120 D | 9120D-1212 | 1GHz~18GHz | Mar. 23, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Mar. 22, 2024 | Radiation (03CH15-HY) |
| SHF-EHF Horn Antenna | SCHWARZBECK | BBHA 9170 | 00993 | 18GHz~40GHz | Nov. 24, 2022 | Aug. 02, 2023~ Nov. 22, 2023 | Nov. 23, 2023 | Radiation (03CH15-HY) |
| SHF-EHF Horn Antenna | SCHWARZBECK | BBHA 9170 | 00991 | 18GHz~40GHz | Jun. 01, 2023 | Nov. 23, 2023~ Dec. 07, 2023 | May 31, 2024 | Radiation (03CH15-HY) |
| Amplifier | SONOMA | 310N | 363440 | 9kHz~1GHz | Dec. 26, 2022 | Aug. 02, 2023~ Dec. 07, 2023 | Dec. 25, 2023 | Radiation (03CH15-HY) |
| Preamplifier | EMEC | EM01G18G | 060837 | 1GHz~18GHz | Feb. 16, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Feb. 15, 2024 | Radiation (03CH15-HY) |
| Preamplifier | EM Electronics | EM01G18G | 060802 | 1GHz~18GHz | Mar. 03, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Mar. 02, 2024 | Radiation (03CH15-HY) |
| Preamplifier | EMEC | EM18G40G | 060801 | 18GHz~40GHz | Jun. 27, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Jun. 26, 2024 | Radiation (03CH15-HY) |
| EMI Test Receiver | Keysight | N9038A(MXE) | MY53290045 | 20MHz~8.4GHz | Apr. 25, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Apr. 24, 2024 | Radiation (03CH15-HY |
| Spectrum Analyzer | Keysight | N9010A | MY54200485 | 10Hz~44GHz | Mar. 20, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Mar. 19, 2024 | Radiation (03CH15-HY) |
| Antenna Mast | ChainTek | MBS-520-1 | N/A | 1m~4m | N/A | Aug. 02, 2023~ Dec. 07, 2023 | N/A | Radiation (03CH15-HY) |
| Turn Table | ChainTek | T-200-S-1 | N/A | 0~360 Degree | N/A | Aug. 02, 2023~ Dec. 07, 2023 | N/A | Radiation (03CH15-HY) |
| Software | Audix | E3 6.2009-8-24(k5) | RK-000451 | N/A | N/A | Aug. 02, 2023~ Dec. 07, 2023 | N/A | Radiation (03CH15-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 104, 102E | MY582185/4,519228/2,803950/2 | N/A | Jun. 13, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Jun. 12, 2024 | Radiation (03CH15-HY) |
| Filter | Wainwright | WLJ4-1000-1530-6000-40ST | SN4 | 1.53GHz Low Pass Filter | Jun. 14, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Jun. 13, 2024 | Radiation (03CH15-HY) |
| Filter | Wainwright | WHKX12-2700-3000-18000-60ST | SN4 | 3GHz High Pass Filter | Jun. 14, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Jun. 13, 2024 | Radiation (03CH15-HY) |
| Hygrometer | TECPEL | DTM-302 | SN4 | N/A | Jul. 26, 2023 | Aug. 02, 2023~ Dec. 07, 2023 | Jul. 25, 2024 | Radiation (03CH15-HY) |
| Hygrometer | TECPEL | DTM-303A | TP201996 | N/A | Nov. 17, 2022 | Jul. 21, 2023~ Nov. 06, 2023 | Nov. 16, 2023 | Conducted (TH05-HY) |
| Hygrometer | TECPEL | DTM-303A | TP201996 | N/A | Nov. 07, 2023 | Nov. 07, 2023~ Dec. 11, 2023 | Nov. 06, 2024 | Conducted (TH05-HY) |
| Power Sensor | DARE | RPR3006W | 16I00054SNO12 (NO:113) | 10MHz~6GHz | Dec. 13, 2022 | Jul. 21, 2023~ Dec. 11, 2023 | Dec. 12, 2023 | Conducted (TH05-HY) |
| Signal Analyzer | Rohde & Schwarz | FSV40 | 101565 | 10Hz ~ 40GHz | Dec. 26, 2022 | Jul. 21, 2023~ Dec. 11, 2023 | Dec. 25, 2023 | Conducted (TH05-HY) |

| Instrument | Brand Name | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|---|---|---|---|---|---|---|---|---|
| AC Power Source | ACPOWER | AFC-11003G | F317040033 | N/A | N/A | Sep. 28, 2023 | N/A | Conduction (CO07-HY) |
| Software | Rohde & Schwarz | EMC32 V10.30 | N/A | N/A | N/A | Sep. 28, 2023 | N/A | Conduction (CO07-HY) |
| Pulse Limiter | SCHWARZBECK | VTSD 9561-F N | 9561-F N00373 | 9kHz-200MHz | Nov. 01, 2022 | Sep. 28, 2023 | Oct. 31, 2023 | Conduction (CO07-HY) |
| RF Cable | HUBER + SUHNER | RG 214/U | 1358175 | 9kHz~30MHz | Mar. 15, 2023 | Sep. 28, 2023 | Mar. 14, 2024 | Conduction (CO07-HY) |
| Two-Line V-Network | TESEQ | NNB 51 | 45051 | N/A | Mar. 05, 2023 | Sep. 28, 2023 | Mar. 04, 2024 | Conduction (CO07-HY) |
| Four-Line V-Network | TESEQ | NNB 52 | 36122 | N/A | Mar. 13, 2023 | Sep. 28, 2023 | Mar. 12, 2024 | Conduction (CO07-HY) |
| EMI Test Receiver | Rohde & Schwarz | ESCI7 | 100724 | 9kHz~7GHz | Feb. 24, 2023 | Sep. 28, 2023 | Feb. 23, 2024 | Conduction (CO07-HY) |

# 5 Measurement Uncertainty

**Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **3.46 dB** |

**Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **6.3 dB** |

**Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **4.5 dB** |

**Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.5 dB** |

**Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.4 dB** |

# Appendix A. Test Result of Conducted Test Items

| | | | | |
|---|---|---|---|---|
| Test Engineer: | Henry Ke / Hank Hsu/Junyu Jhou | Temperature: | 21~25 | °C |
| Test Date: | 2023/7/21~2023/12/11 | Relative Humidity: | 51~54 | % |

## ***TEST RESULTS DATA***
## ***6dB and 99% Occupied Bandwidth***

| 2.4GHz Band Single Antenna | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | 99% Occupied BW (MHz) | | 6dB BW (MHz) | | 6dB BW Limit (MHz) | Pass/Fail |
| | | | | | Ant4 | Ant3 | Ant4 | Ant3 | | |
| 11b | 1Mbps | 1 | 1 | 2412 | 13.04 | 13.14 | 8.60 | 8.10 | 0.50 | Pass |
| 11b | 1Mbps | 1 | 6 | 2437 | 13.14 | 13.14 | 8.60 | 8.06 | 0.50 | Pass |
| 11b | 1Mbps | 1 | 11 | 2462 | 13.14 | 13.09 | 8.58 | 8.08 | 0.50 | Pass |
| 11b | 1Mbps | 1 | 12 | 2467 | 13.09 | 13.04 | 8.10 | 8.08 | 0.50 | Pass |
| 11b | 1Mbps | 1 | 13 | 2472 | 12.99 | 13.04 | 8.08 | 8.58 | 0.50 | Pass |

| 2.4GHz Band MIMO | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | 99% Occupied BW (MHz) | | 6dB BW (MHz) | | 6dB BW Limit (MHz) | Pass/Fail |
| | | | | | Ant4 | Ant3 | Ant4 | Ant3 | | |
| 11g | 6Mbps | 2 | 1 | 2412 | 17.08 | 16.98 | 16.38 | 16.38 | 0.50 | Pass |
| 11g | 6Mbps | 2 | 6 | 2437 | 17.43 | 17.03 | 16.40 | 16.40 | 0.50 | Pass |
| 11g | 6Mbps | 2 | 11 | 2462 | 17.13 | 16.83 | 16.40 | 16.38 | 0.50 | Pass |
| 11g | 6Mbps | 2 | 12 | 2467 | 17.08 | 16.78 | 16.36 | 16.38 | 0.50 | Pass |
| 11g | 6Mbps | 2 | 13 | 2472 | 16.98 | 16.83 | 16.38 | 16.38 | 0.50 | Pass |
| HT20 | MCS0 | 2 | 1 | 2412 | 18.13 | 18.03 | 17.60 | 17.64 | 0.50 | Pass |
| HT20 | MCS0 | 2 | 6 | 2437 | 21.13 | 18.23 | 17.58 | 17.64 | 0.50 | Pass |
| HT20 | MCS0 | 2 | 11 | 2462 | 18.23 | 17.88 | 17.66 | 17.62 | 0.50 | Pass |
| HT20 | MCS0 | 2 | 12 | 2467 | 18.08 | 17.88 | 17.62 | 17.64 | 0.50 | Pass |
| HT20 | MCS0 | 2 | 13 | 2472 | 18.18 | 17.93 | 17.22 | 17.64 | 0.50 | Pass |

## *TEST RESULTS DATA*
## *Average Output Power*

| 2.4GHz Band Single Antenna | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Average Conducted Power (dBm) | | | Conducted Power Limit (dBm) | | DG (dBi) | | EIRP Power (dBm) | | EIRP Power Limit (dBm) | | Pass /Fail |
| | | | | | Ant4 | Ant3 | SUM | Ant4 | Ant3 | Ant4 | Ant3 | Ant4 | Ant3 | Ant4 | Ant3 | |
| 11b | 1Mbps | 1 | 1 | 2412 | 20.80 | 20.95 | | 30.00 | 30.00 | -0.70 | -1.20 | 20.10 | 19.75 | 36.00 | 36.00 | Pass |
| 11b | 1Mbps | 1 | 6 | 2437 | 20.80 | 20.95 | | 30.00 | 30.00 | -0.70 | -1.20 | 20.10 | 19.75 | 36.00 | 36.00 | Pass |
| 11b | 1Mbps | 1 | 11 | 2462 | 20.80 | 20.95 | | 30.00 | 30.00 | -0.70 | -1.20 | 20.10 | 19.75 | 36.00 | 36.00 | Pass |
| 11b | 1Mbps | 1 | 12 | 2467 | 20.90 | 20.95 | | 30.00 | 30.00 | -0.70 | -1.20 | 20.20 | 19.75 | 36.00 | 36.00 | Pass |
| 11b | 1Mbps | 1 | 13 | 2472 | 19.70 | 20.05 | | 30.00 | 30.00 | -0.70 | -1.20 | 19.00 | 18.85 | 36.00 | 36.00 | Pass |

| 2.4GHz Band MIMO | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Average Conducted Power (dBm) | | | Conducted Power Limit (dBm) | | DG (dBi) | | EIRP Power (dBm) | | EIRP Power Limit (dBm) | | Pass /Fail |
| | | | | | Ant4 | Ant3 | SUM | Ant4 | Ant3 | Ant4 | Ant3 | Ant4 | Ant3 | Ant4 | Ant3 | |
| 11g | 6Mbps | 2 | 1 | 2412 | 17.80 | 17.65 | 20.74 | 30.00 | | -0.70 | | 20.04 | | 36.00 | | Pass |
| 11g | 6Mbps | 2 | 2 | 2417 | 19.50 | 19.15 | 22.34 | 30.00 | | -0.70 | | 21.64 | | 36.00 | | Pass |
| 11g | 6Mbps | 2 | 6 | 2437 | 20.70 | 19.95 | 23.35 | 30.00 | | -0.70 | | 22.65 | | 36.00 | | Pass |
| 11g | 6Mbps | 2 | 10 | 2457 | 18.20 | 17.85 | 21.04 | 30.00 | | -0.70 | | 20.34 | | 36.00 | | Pass |
| 11g | 6Mbps | 2 | 11 | 2462 | 16.10 | 16.45 | 19.29 | 30.00 | | -0.70 | | 18.59 | | 36.00 | | Pass |
| 11g | 6Mbps | 2 | 12 | 2467 | 14.40 | 14.95 | 17.69 | 30.00 | | -0.70 | | 16.99 | | 36.00 | | Pass |
| 11g | 6Mbps | 2 | 13 | 2472 | 4.70 | 4.65 | 7.69 | 30.00 | | -0.70 | | 6.99 | | 36.00 | | Pass |
| HT20 | MCS0 | 2 | 1 | 2412 | 17.50 | 17.75 | 20.64 | 30.00 | | -0.70 | | 19.94 | | 36.00 | | Pass |
| HT20 | MCS0 | 2 | 2 | 2417 | 17.90 | 17.45 | 20.69 | 30.00 | | -0.70 | | 19.99 | | 36.00 | | Pass |
| HT20 | MCS0 | 2 | 6 | 2437 | 20.90 | 20.05 | 23.51 | 30.00 | | -0.70 | | 22.81 | | 36.00 | | Pass |
| HT20 | MCS0 | 2 | 10 | 2457 | 16.80 | 16.25 | 19.54 | 30.00 | | -0.70 | | 18.84 | | 36.00 | | Pass |
| HT20 | MCS0 | 2 | 11 | 2462 | 15.40 | 15.85 | 18.64 | 30.00 | | -0.70 | | 17.94 | | 36.00 | | Pass |
| HT20 | MCS0 | 2 | 12 | 2467 | 14.50 | 15.45 | 18.01 | 30.00 | | -0.70 | | 17.31 | | 36.00 | | Pass |
| HT20 | MCS0 | 2 | 13 | 2472 | 6.20 | 6.15 | 9.19 | 30.00 | | -0.70 | | 8.49 | | 36.00 | | Pass |
| VHT20 | MCS0 | 2 | 1 | 2412 | 17.50 | 17.75 | 20.64 | 30.00 | | -0.70 | | 19.94 | | 36.00 | | Pass |
| VHT20 | MCS0 | 2 | 2 | 2417 | 17.90 | 17.45 | 20.69 | 30.00 | | -0.70 | | 19.99 | | 36.00 | | Pass |
| VHT20 | MCS0 | 2 | 6 | 2437 | 20.90 | 20.05 | 23.51 | 30.00 | | -0.70 | | 22.81 | | 36.00 | | Pass |
| VHT20 | MCS0 | 2 | 10 | 2457 | 16.80 | 16.25 | 19.54 | 30.00 | | -0.70 | | 18.84 | | 36.00 | | Pass |
| VHT20 | MCS0 | 2 | 11 | 2462 | 15.40 | 15.85 | 18.64 | 30.00 | | -0.70 | | 17.94 | | 36.00 | | Pass |
| VHT20 | MCS0 | 2 | 12 | 2467 | 14.50 | 15.45 | 18.01 | 30.00 | | -0.70 | | 17.31 | | 36.00 | | Pass |
| VHT20 | MCS0 | 2 | 13 | 2472 | 6.20 | 6.15 | 9.19 | 30.00 | | -0.70 | | 8.49 | | 36.00 | | Pass |

**Note:** Measured power (dBm) has offset with cable loss.

## ***TEST RESULTS DATA***
## ***Peak Power Spectral Density***

| 2.4GHz Band Single Antenna | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Peak PSD (dBm/3kHz) | | | DG (dBi) | | Peak PSD Limit (dBm/3kHz) | | Pass/Fail |
| | | | | | Ant4 | Ant3 | Worse + 3.01 | Ant4 | Ant3 | Ant4 | Ant3 | |
| 11b | 1Mbps | 1 | 1 | 2412 | -1.83 | -1.97 | | -0.70 | -1.20 | 8.00 | 8.00 | Pass |
| 11b | 1Mbps | 1 | 6 | 2437 | -1.96 | -1.84 | | -0.70 | -1.20 | 8.00 | 8.00 | Pass |
| 11b | 1Mbps | 1 | 11 | 2462 | -1.87 | -1.91 | | -0.70 | -1.20 | 8.00 | 8.00 | Pass |
| 11b | 1Mbps | 1 | 12 | 2467 | -1.91 | -1.81 | | -0.70 | -1.20 | 8.00 | 8.00 | Pass |
| 11b | 1Mbps | 1 | 13 | 2472 | -2.78 | -2.47 | | -0.70 | -1.20 | 8.00 | 8.00 | Pass |

| 2.4GHz Band MIMO | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Peak PSD (dBm/3kHz) | | | DG (dBi) | | Peak PSD Limit (dBm/3kHz) | | Pass/Fail |
| | | | | | Ant4 | Ant3 | Worse + 3.01 | Ant4 | Ant3 | Ant4 | Ant3 | |
| 11g | 6Mbps | 2 | 1 | 2412 | -7.29 | -7.72 | -4.28 | 2.06 | | 8.00 | | Pass |
| 11g | 6Mbps | 2 | 2 | 2417 | -6.12 | -6.17 | -3.11 | 2.06 | | 8.00 | | Pass |
| 11g | 6Mbps | 2 | 6 | 2437 | -4.72 | -6.07 | -1.71 | 2.06 | | 8.00 | | Pass |
| 11g | 6Mbps | 2 | 10 | 2457 | -6.76 | -7.80 | -3.75 | 2.06 | | 8.00 | | Pass |
| 11g | 6Mbps | 2 | 11 | 2462 | -9.63 | -8.36 | -5.35 | 2.06 | | 8.00 | | Pass |
| 11g | 6Mbps | 2 | 12 | 2467 | -10.95 | -10.55 | -7.54 | 2.06 | | 8.00 | | Pass |
| 11g | 6Mbps | 2 | 13 | 2472 | -20.43 | -20.94 | -17.42 | 2.06 | | 8.00 | | Pass |
| HT20 | MCS0 | 2 | 1 | 2412 | -8.98 | -8.22 | -5.21 | 2.06 | | 8.00 | | Pass |
| HT20 | MCS0 | 2 | 2 | 2417 | -8.88 | -7.66 | -4.65 | 2.06 | | 8.00 | | Pass |
| HT20 | MCS0 | 2 | 6 | 2437 | -4.00 | -5.52 | -0.99 | 2.06 | | 8.00 | | Pass |
| HT20 | MCS0 | 2 | 10 | 2457 | -9.84 | -9.20 | -6.19 | 2.06 | | 8.00 | | Pass |
| HT20 | MCS0 | 2 | 11 | 2462 | -11.54 | -9.63 | -6.62 | 2.06 | | 8.00 | | Pass |
| HT20 | MCS0 | 2 | 12 | 2467 | -12.11 | -10.59 | -7.58 | 2.06 | | 8.00 | | Pass |
| HT20 | MCS0 | 2 | 13 | 2472 | -20.27 | -19.57 | -16.56 | 2.06 | | 8.00 | | Pass |

**Note:** Measured power density (dBm) has offset with cable loss.

***TEST RESULTS DATA***
***6dB and 99% Occupied Bandwidth***

| 2.4GHz Band MIMO | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | RU Config. | 99% Occupied BW (MHz) | | 6dB BW (MHz) | | 6dB BW Limit (MHz) | Pass/Fail |
| | | | | | | Ant4 | Ant3 | Ant4 | Ant3 | | |
| HE20 | MCS0 | 2 | 1 | 2412 | Full | 19.13 | 19.13 | 19.03 | 18.98 | 0.50 | Pass |
| HE20 | MCS0 | 2 | 6 | 2437 | Full | 19.38 | 19.28 | 18.95 | 19.00 | 0.50 | Pass |
| HE20 | MCS0 | 2 | 11 | 2462 | Full | 19.18 | 19.08 | 19.03 | 19.00 | 0.50 | Pass |
| HE20 | MCS0 | 2 | 12 | 2467 | Full | 19.13 | 19.08 | 19.13 | 19.00 | 0.50 | Pass |
| HE20 | MCS0 | 2 | 13 | 2472 | Full | 19.03 | 19.13 | 19.00 | 18.93 | 0.50 | Pass |

## ***TEST RESULTS DATA***
## ***Average Output Power***

| 2.4GHz Band MIMO | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | RU Config. | Average Conducted Power (dBm) | | | Conducted Power Limit (dBm) | | DG (dBi) | | EIRP Power (dBm) | | EIRP Power Limit (dBm) | | Pass /Fail |
| | | | | | | Ant4 | Ant3 | SUM | Ant4 | Ant3 | Ant4 | Ant3 | Ant4 | Ant3 | Ant4 | Ant3 | |
| HE20 | MCS0 | 2 | 1 | 2412 | Full | 17.60 | 17.85 | 20.74 | 30.00 | | -0.70 | | 20.04 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 1 | 2412 | 26/0 | 9.50 | 9.15 | 12.34 | 30.00 | | -0.70 | | 11.64 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 1 | 2412 | 52/37 | 10.90 | 11.05 | 13.99 | 30.00 | | -0.70 | | 13.29 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 1 | 2412 | 106/53 | 14.20 | 14.25 | 17.24 | 30.00 | | -0.70 | | 16.54 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 2 | 2417 | Full | 18.00 | 17.55 | 20.79 | 30.00 | | -0.70 | | 20.09 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 2 | 2417 | 26/0 | 10.00 | 8.15 | 12.18 | 30.00 | | -0.70 | | 11.48 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 2 | 2417 | 52/37 | 10.90 | 9.65 | 13.33 | 30.00 | | -0.70 | | 12.63 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 2 | 2417 | 106/53 | 13.80 | 12.75 | 16.32 | 30.00 | | -0.70 | | 15.62 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 6 | 2437 | Full | 21.00 | 20.15 | 23.61 | 30.00 | | -0.70 | | 22.91 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 6 | 2437 | 26/4 | 12.00 | 11.85 | 14.94 | 30.00 | | -0.70 | | 14.24 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 6 | 2437 | 52/38 | 13.70 | 13.75 | 16.74 | 30.00 | | -0.70 | | 16.04 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 6 | 2437 | 106/53 | 17.20 | 17.15 | 20.19 | 30.00 | | -0.70 | | 19.49 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 10 | 2457 | Full | 16.90 | 16.35 | 19.64 | 30.00 | | -0.70 | | 18.94 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 10 | 2457 | 26/8 | 8.80 | 8.95 | 11.89 | 30.00 | | -0.70 | | 11.19 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 10 | 2457 | 52/40 | 10.60 | 10.55 | 13.59 | 30.00 | | -0.70 | | 12.89 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 10 | 2457 | 106/54 | 13.50 | 13.45 | 16.49 | 30.00 | | -0.70 | | 15.79 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 11 | 2462 | Full | 15.50 | 15.95 | 18.74 | 30.00 | | -0.70 | | 18.04 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 11 | 2462 | 26/8 | 7.90 | 8.45 | 11.19 | 30.00 | | -0.70 | | 10.49 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 11 | 2462 | 52/40 | 9.40 | 10.35 | 12.91 | 30.00 | | -0.70 | | 12.21 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 11 | 2462 | 106/54 | 12.20 | 13.25 | 15.77 | 30.00 | | -0.70 | | 15.07 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 12 | 2467 | Full | 14.60 | 15.45 | 18.06 | 30.00 | | -0.70 | | 17.36 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 12 | 2467 | 26/8 | 6.00 | 6.55 | 9.29 | 30.00 | | -0.70 | | 8.59 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 12 | 2467 | 52/40 | 8.10 | 8.95 | 11.56 | 30.00 | | -0.70 | | 10.86 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 12 | 2467 | 106/54 | 11.00 | 11.95 | 14.51 | 30.00 | | -0.70 | | 13.81 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 13 | 2472 | Full | 6.30 | 6.25 | 9.29 | 30.00 | | -0.70 | | 8.59 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 13 | 2472 | 26/8 | -1.30 | -1.25 | 1.74 | 30.00 | | -0.70 | | 1.04 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 13 | 2472 | 52/40 | 0.80 | 0.85 | 3.84 | 30.00 | | -0.70 | | 3.14 | | 36.00 | | Pass |
| HE20 | MCS0 | 2 | 13 | 2472 | 106/54 | 3.90 | 3.95 | 6.94 | 30.00 | | -0.70 | | 6.24 | | 36.00 | | Pass |

**Note:** Measured power (dBm) has offset with cable loss.

## ***TEST RESULTS DATA***
## ***Peak Power Spectral Density***

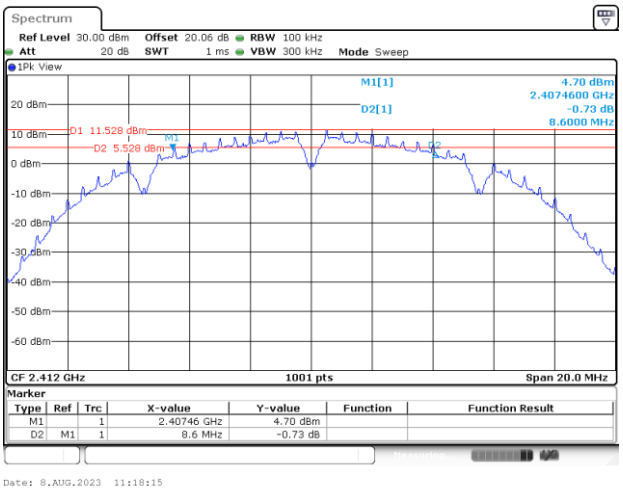
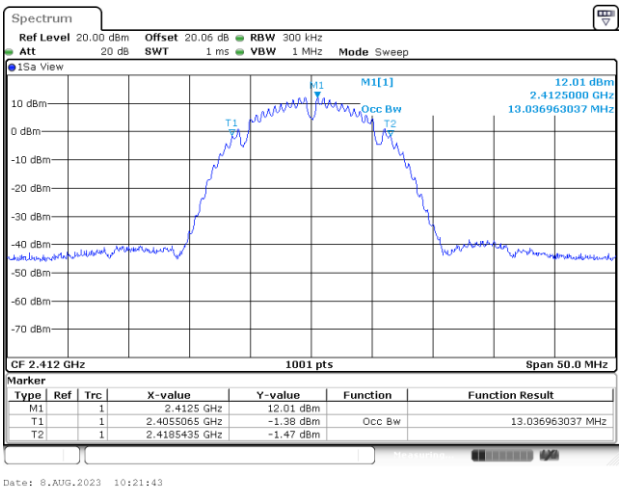
| 2.4GHz Band MIMO | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | RU Config. | Peak PSD (dBm/3kHz) | | | DG (dBi) | | Peak PSD Limit (dBm/3kHz) | | Pass/Fail |
| | | | | | | Ant4 | Ant3 | Worse + 3.01 | Ant4 | Ant3 | Ant4 | Ant3 | |
| HE20 | MCS0 | 2 | 1 | 2412 | Full | -8.96 | -8.85 | -5.84 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 1 | 2412 | 26/0 | -9.00 | -8.90 | -5.89 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 1 | 2412 | 52/37 | -9.10 | -8.88 | -5.87 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 1 | 2412 | 106/53 | -9.04 | -8.92 | -5.91 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 2 | 2417 | Full | -9.17 | -9.39 | -6.16 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 2 | 2417 | 26/0 | -9.30 | -9.48 | -6.29 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 2 | 2417 | 52/37 | -9.25 | -10.77 | -6.24 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 2 | 2417 | 106/53 | -9.47 | -10.75 | -6.46 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 6 | 2437 | Full | -6.38 | -7.26 | -3.37 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 6 | 2437 | 26/4 | -6.42 | -7.35 | -3.41 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 6 | 2437 | 52/38 | -6.59 | -7.35 | -3.58 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 6 | 2437 | 106/53 | -6.46 | -7.30 | -3.45 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 10 | 2457 | Full | -9.62 | -9.81 | -6.61 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 10 | 2457 | 26/8 | -9.74 | -10.13 | -6.73 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 10 | 2457 | 52/40 | -9.80 | -9.95 | -6.79 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 10 | 2457 | 106/54 | -9.74 | -10.09 | -6.73 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 11 | 2462 | Full | -10.70 | -9.79 | -6.78 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 11 | 2462 | 26/8 | -10.88 | -9.85 | -6.84 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 11 | 2462 | 52/40 | -10.82 | -9.83 | -6.82 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 11 | 2462 | 106/54 | -10.77 | -9.85 | -6.84 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 12 | 2467 | Full | -12.30 | -11.23 | -8.22 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 12 | 2467 | 26/8 | -12.57 | -11.30 | -8.29 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 12 | 2467 | 52/40 | -12.55 | -11.31 | -8.30 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 12 | 2467 | 106/54 | -12.48 | -11.29 | -8.28 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 13 | 2472 | Full | -19.32 | -19.68 | -16.31 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 13 | 2472 | 26/8 | -19.36 | -19.69 | -16.35 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 13 | 2472 | 52/40 | -19.48 | -19.73 | -16.47 | 2.06 | | 8.00 | | Pass |
| HE20 | MCS0 | 2 | 13 | 2472 | 106/54 | -19.40 | -19.71 | -16.39 | 2.06 | | 8.00 | | Pass |

**Note:** Measured power density (dBm) has offset with cable loss.

# 6dB and 99% Occupied Bandwidth

**<Ant. 4>**

**<802.11b>**

| 6dB Bandwidth | 99% Occupied Bandwidth |
|---|---|
|  |  |

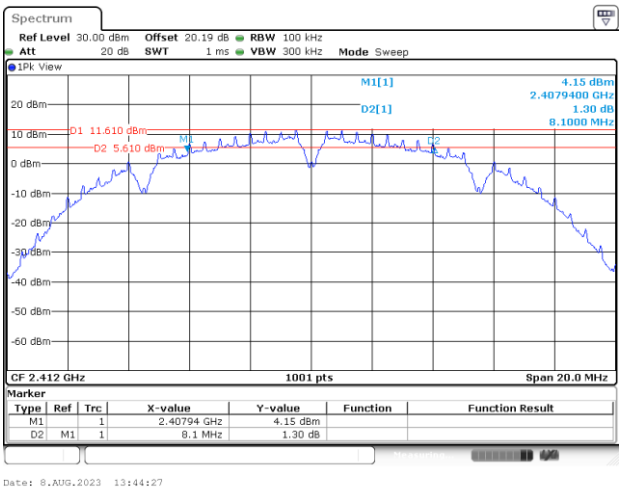
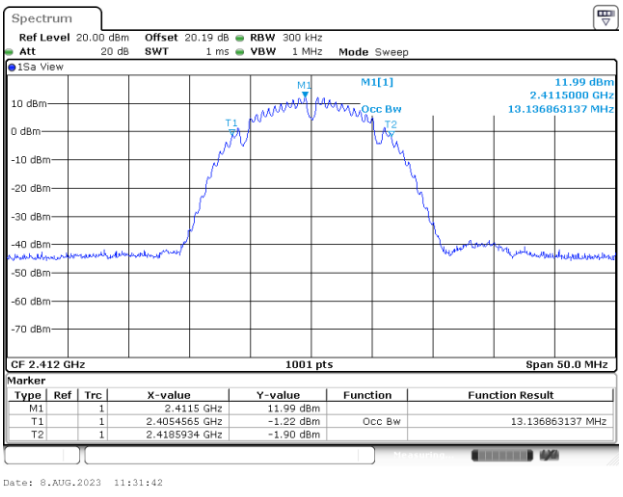




Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

**<Ant. 3>**

**<802.11b>**

| 6dB Bandwidth | 99% Occupied Bandwidth |
|---|---|
|  |  |

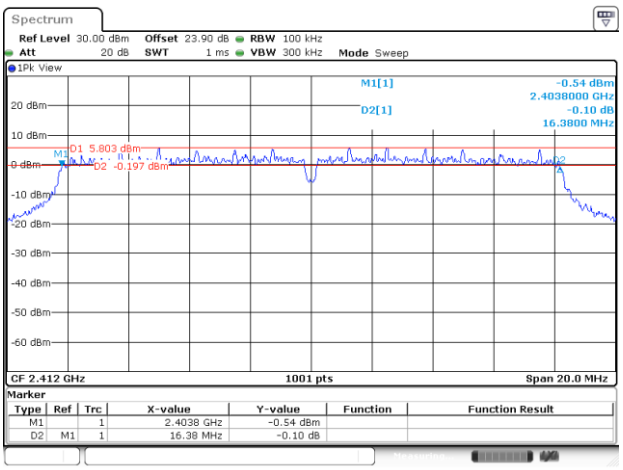
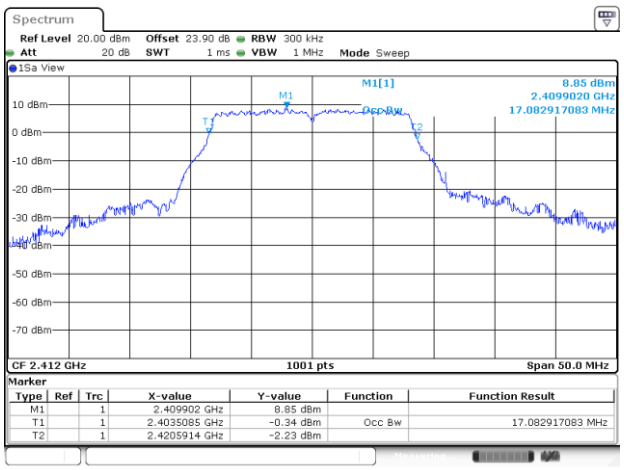




Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

**MIMO <Ant. 4+3>**

**<802.11g>**

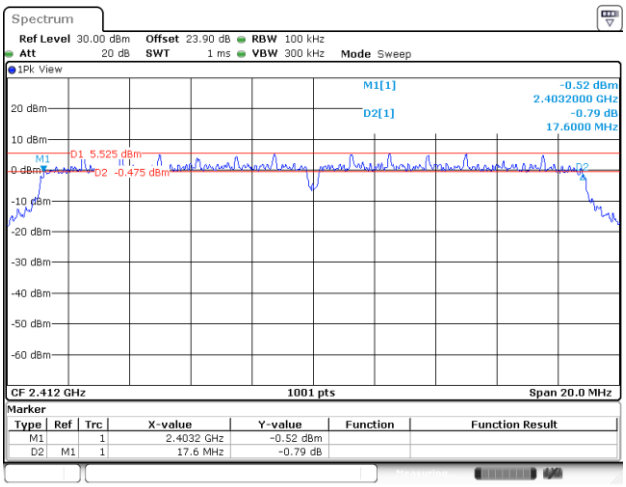
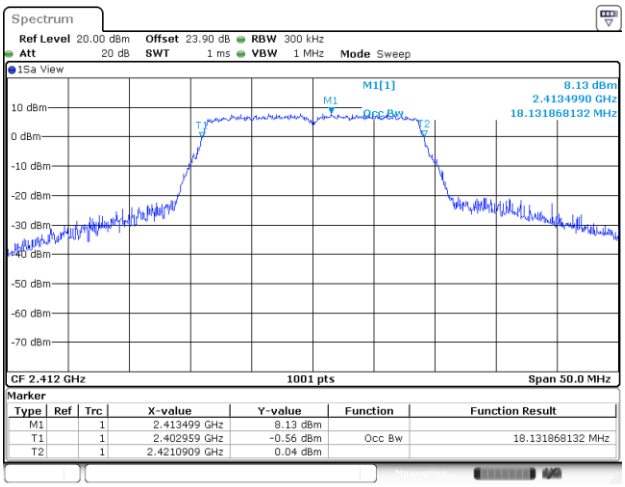
| 6dB Bandwidth | 99% Occupied Bandwidth |
|---|---|
|  |  |





Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

**<802.11n HT20>**

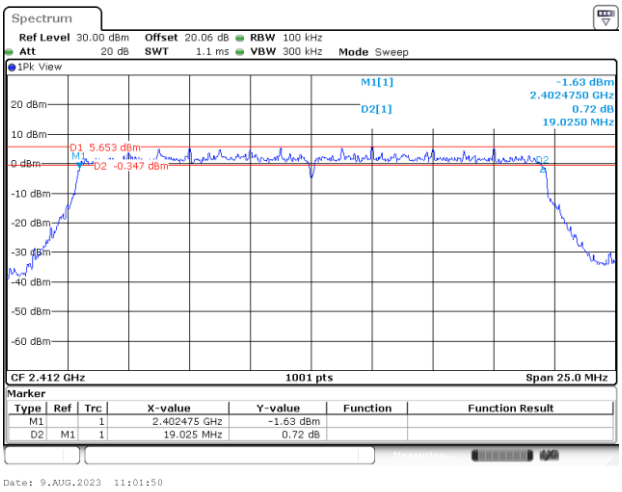
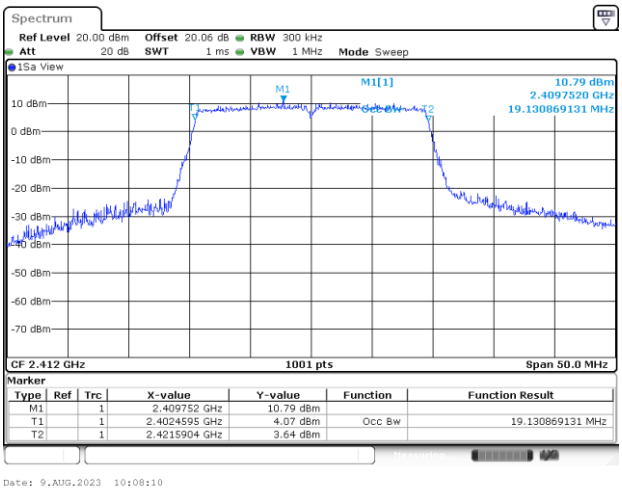
| 6dB Bandwidth | 99% Occupied Bandwidth |
|---|---|
|  |  |





Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

**<802.11ax HE20>**

| 6dB Bandwidth | 99% Occupied Bandwidth |
|---|---|
|  |  |

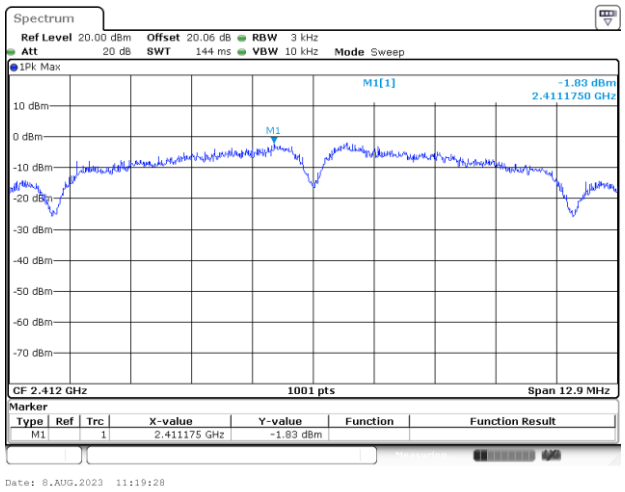
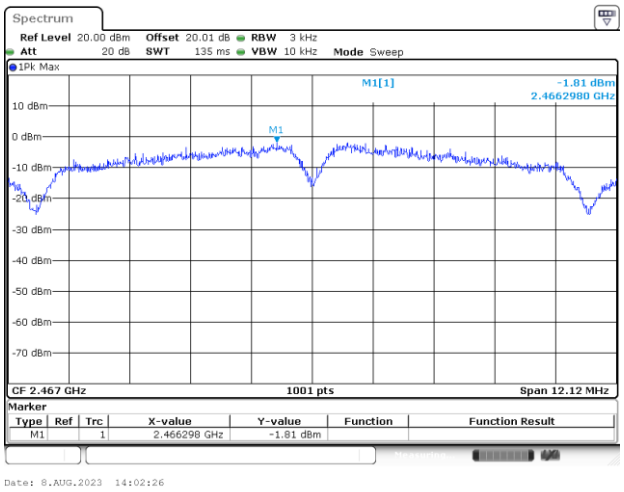




Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

# Power Spectral Density(dBm/3kHz)

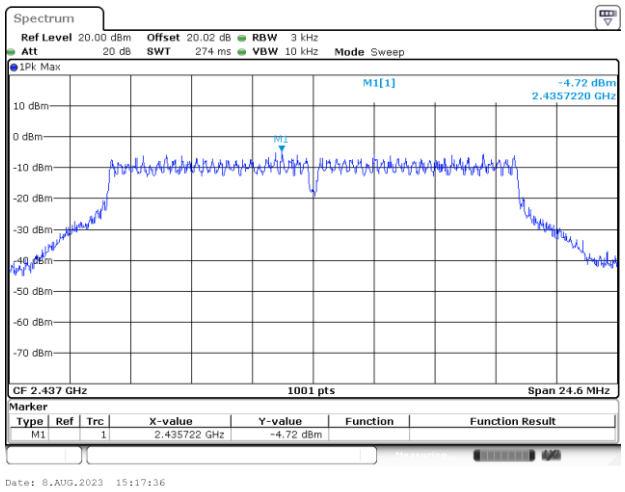
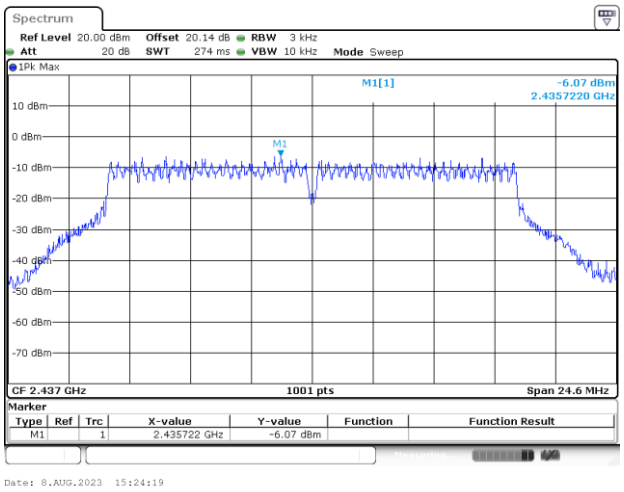
**<802.11b>**

| Maximum Power Density Plot (dBm/3kHz) | |
|---|---|
| **Ant. 4** | **Ant. 3** |
|  |  |

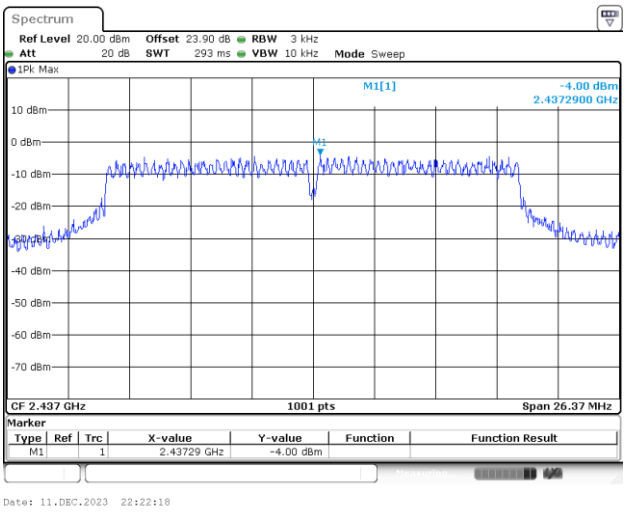
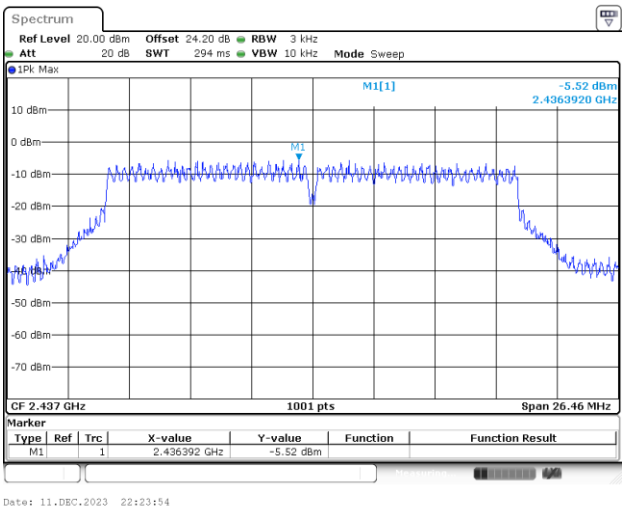




**<802.11g>**

| Maximum Power Density Plot (dBm/3kHz) | |
|---|---|
| **MIMO Ant. 4** | **MIMO Ant. 3** |
|  |  |

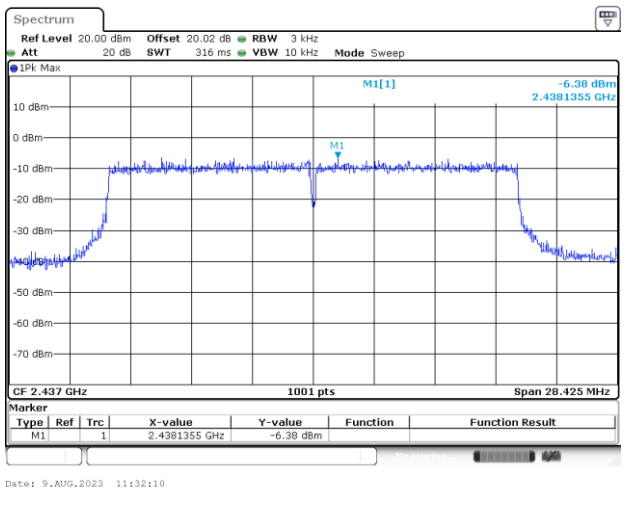
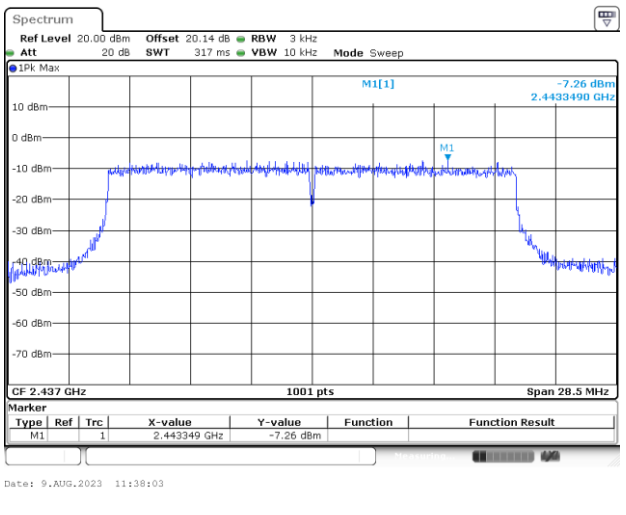
**<802.11n HT20>**

| Maximum Power Density Plot (dBm/3kHz) | |
|---|---|
| **MIMO Ant. 4** | **MIMO Ant. 3** |
|  |  |





**<802.11ax HE20>**

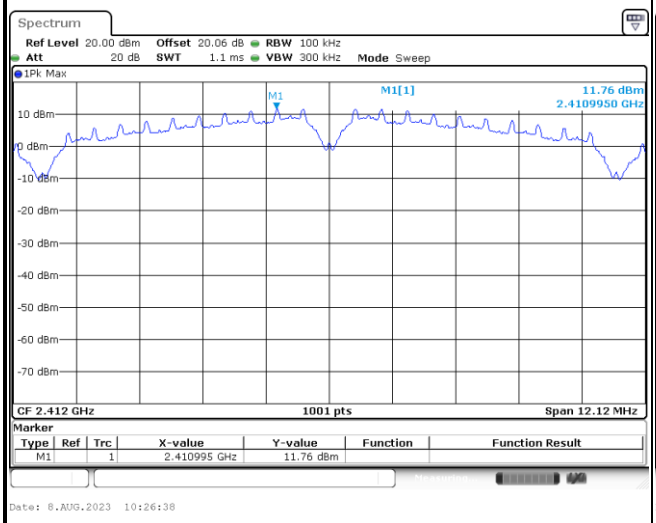
| Maximum Power Density Plot (dBm/3kHz) | |
|---|---|
| **MIMO Ant. 4** | **MIMO Ant. 3** |
|  |  |

# Band Edges and Spurious Emission

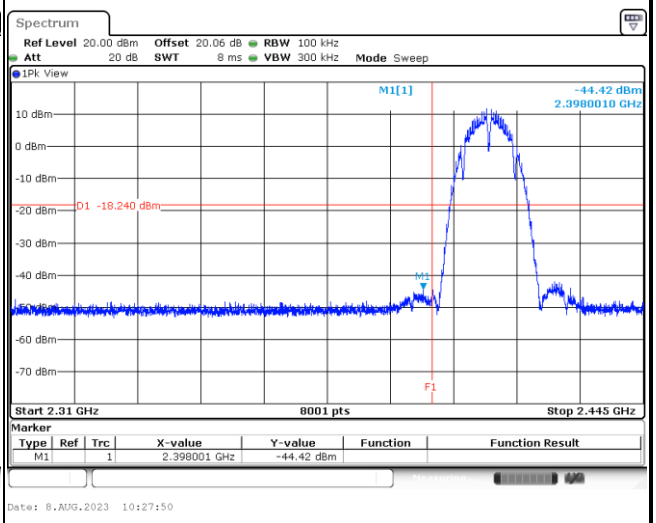
**Number of TX = 1, Ant. 4 (Measured)**

| Test Mode : | 802.11b | Test Channel : | 01 |
|---|---|---|---|

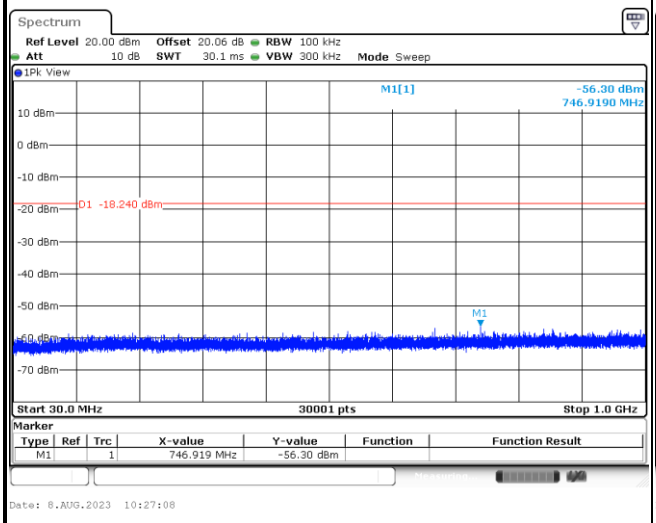
## 100kHz PSD reference Level



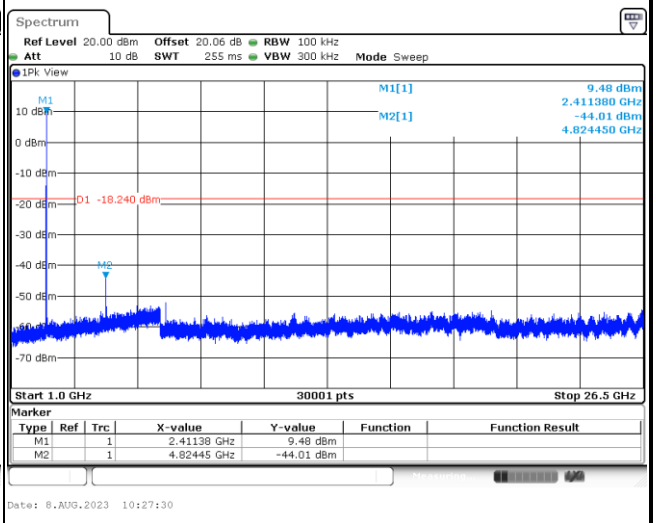

## Low Channel Plot



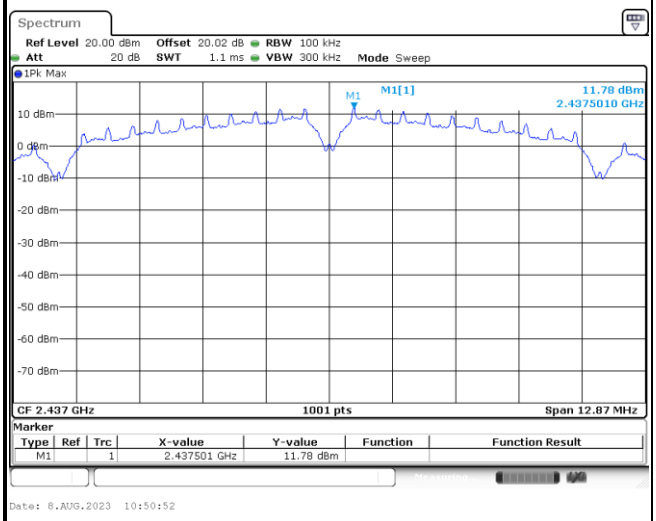

## Spurious Emission 30MHz~1GHz

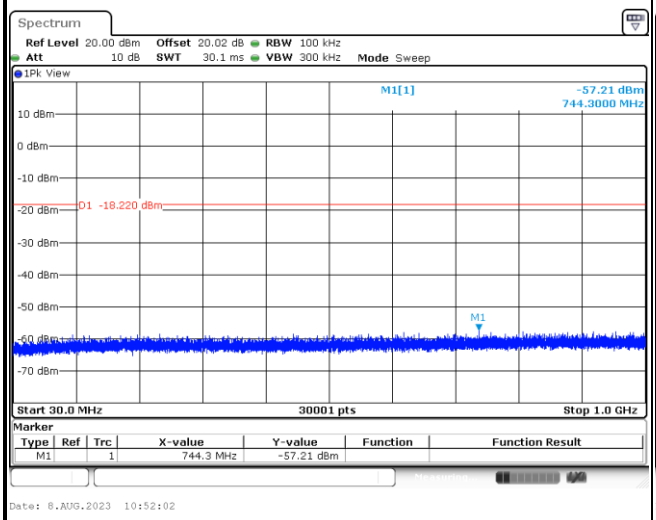
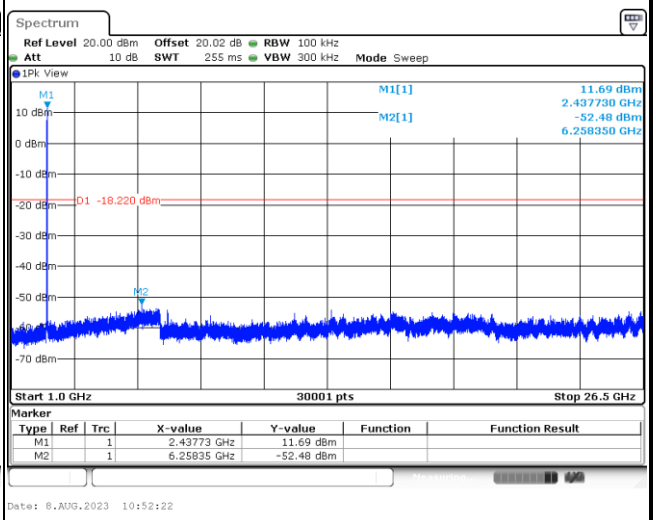



## Spurious Emission 1GHz~26.5GHz

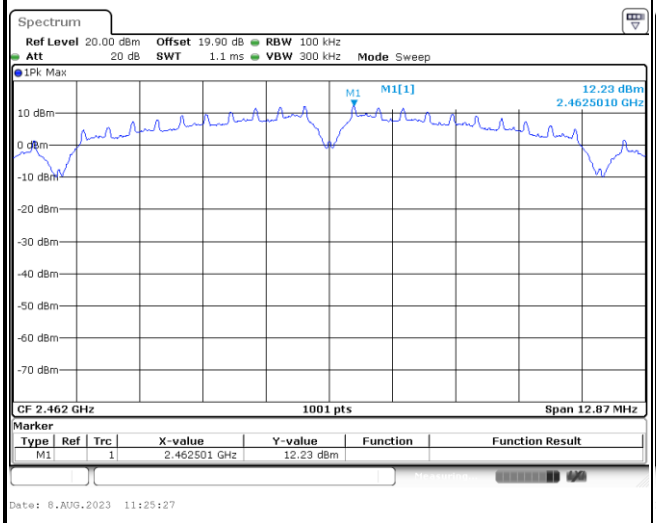
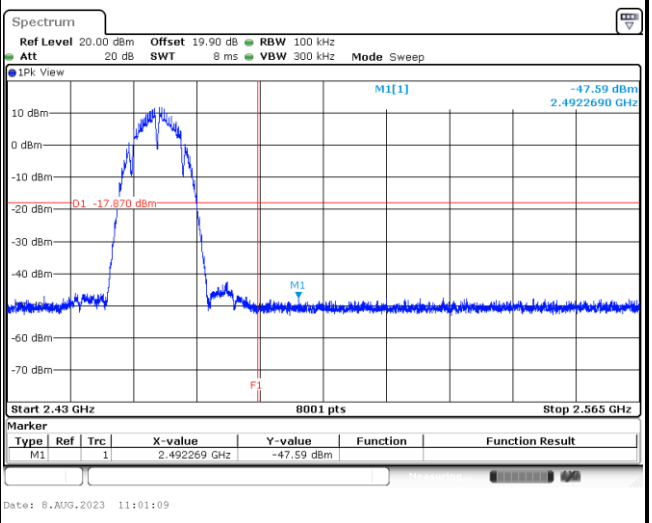
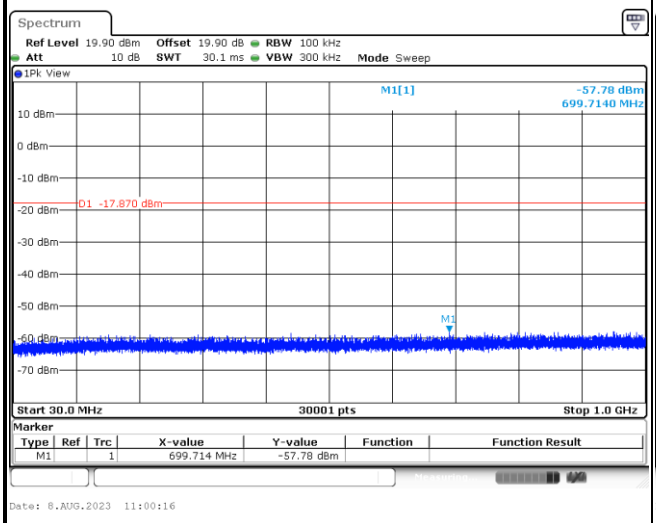
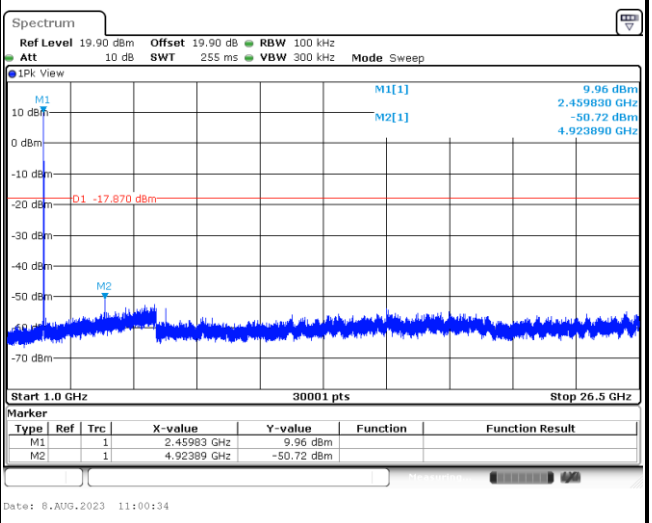


| Test Mode : | 802.11b | Test Channel : | 06 |
|---|---|---|---|

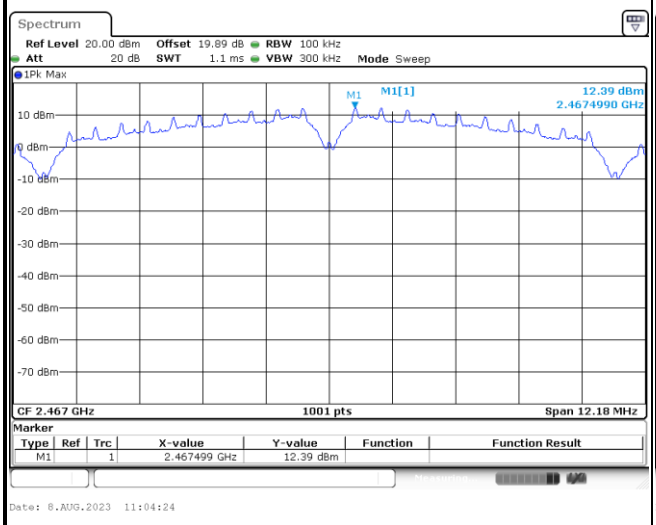
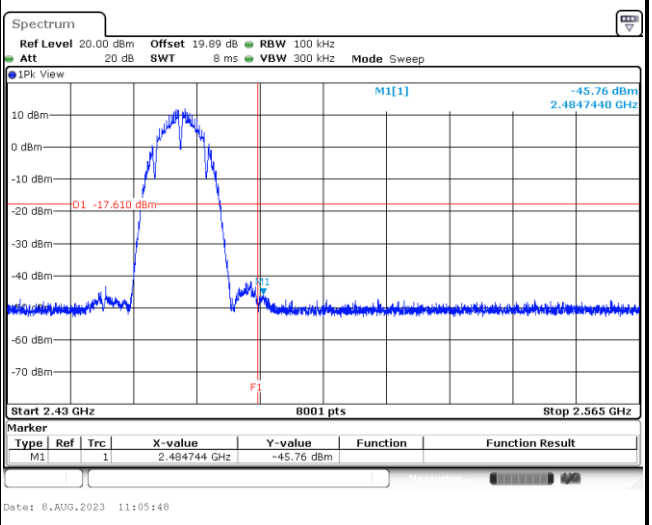
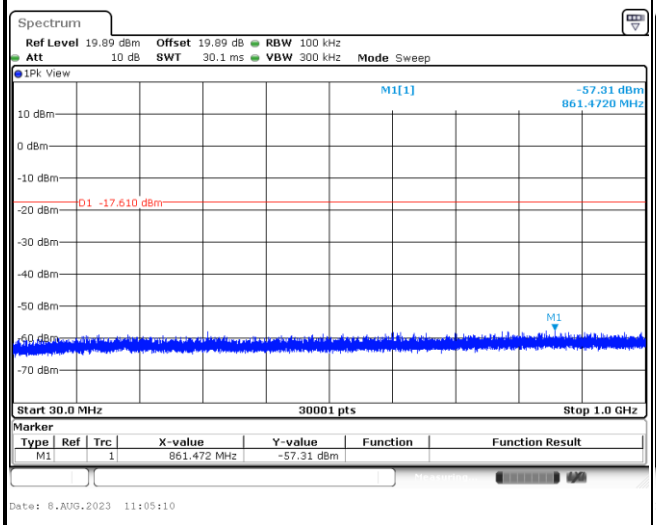
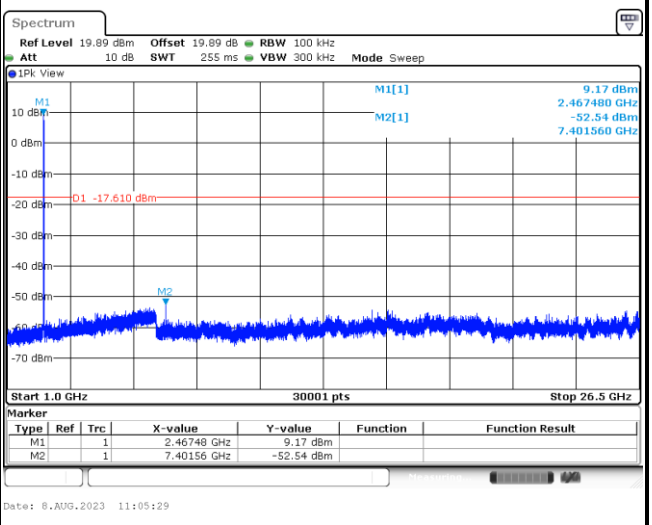
| 100kHz PSD reference Level | Mid Channel Plot |
|---|---|
|  | |

| Spurious Emission 30MHz~1GHz | Spurious Emission 1GHz~26.5GHz |
|---|---|
|  |  |

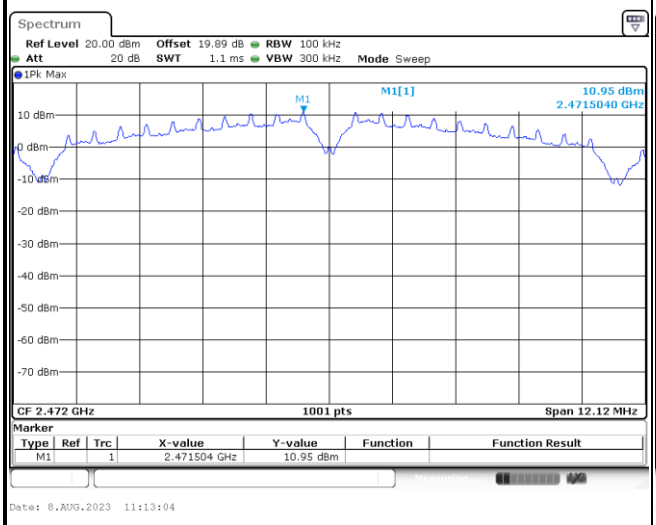
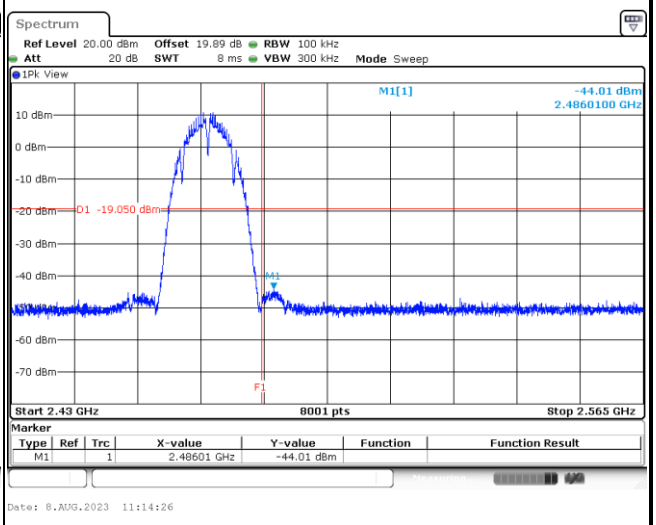
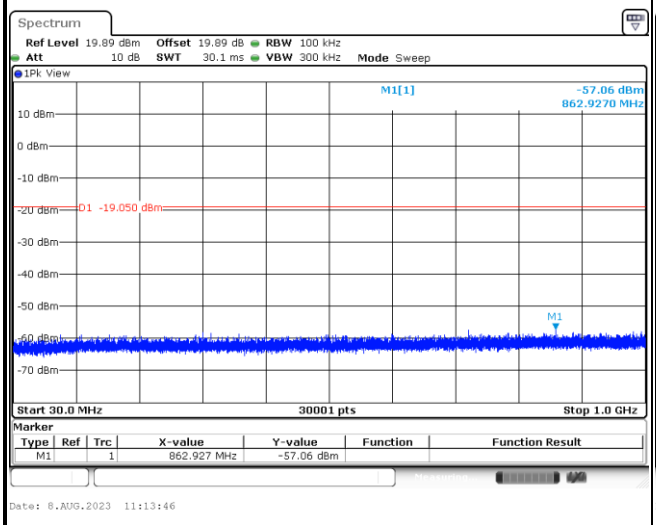
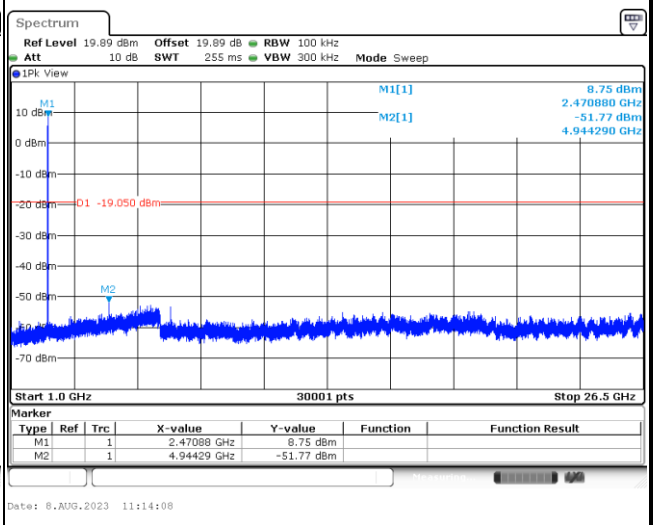
| Test Mode : | 802.11b | Test Channel : | 11 |
|---|---|---|---|

| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11b | Test Channel : | 12 |
|---|---|---|---|

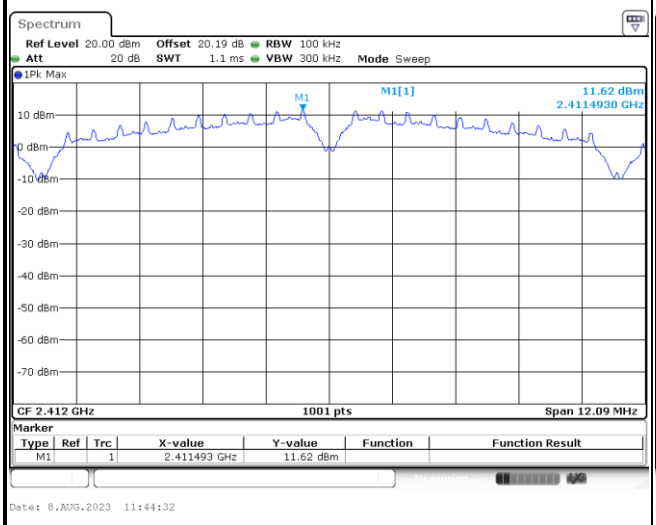
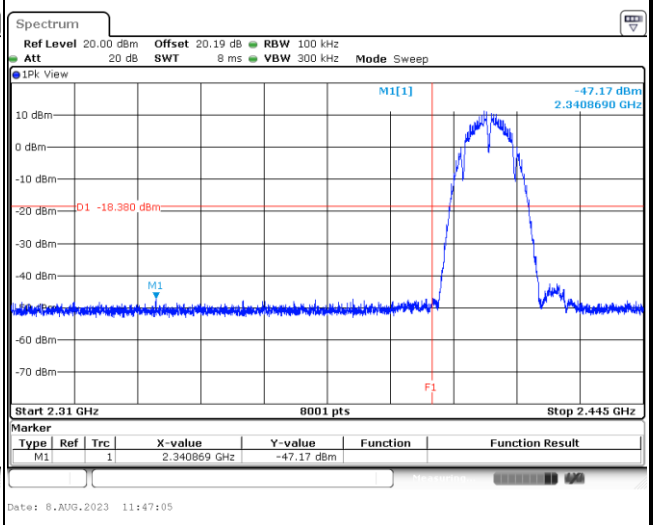
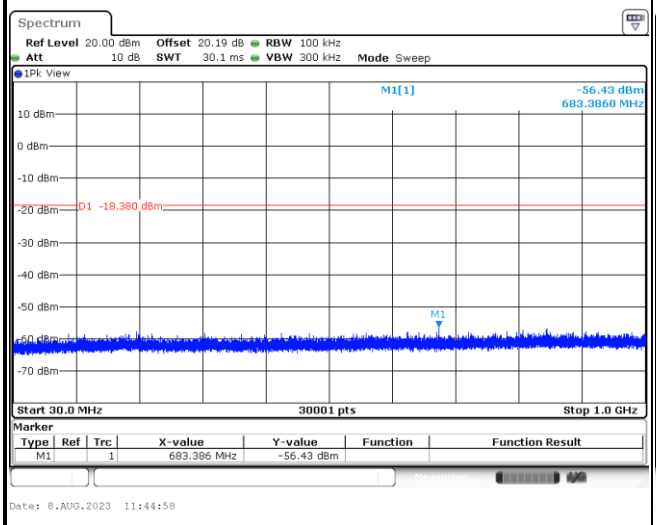
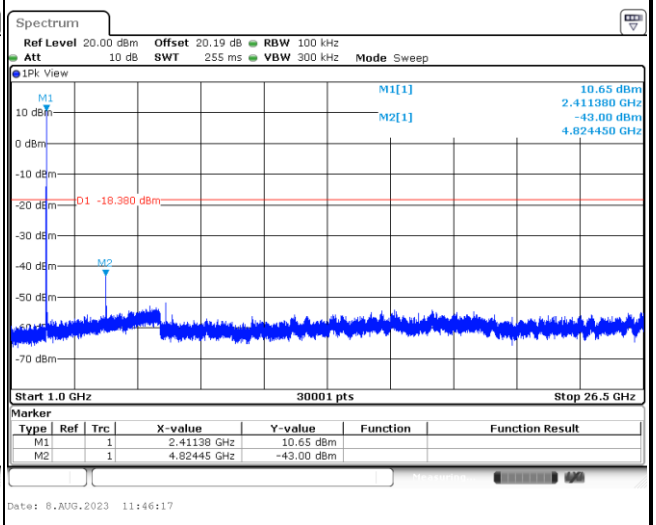
| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11b | Test Channel : | 13 |
|---|---|---|---|

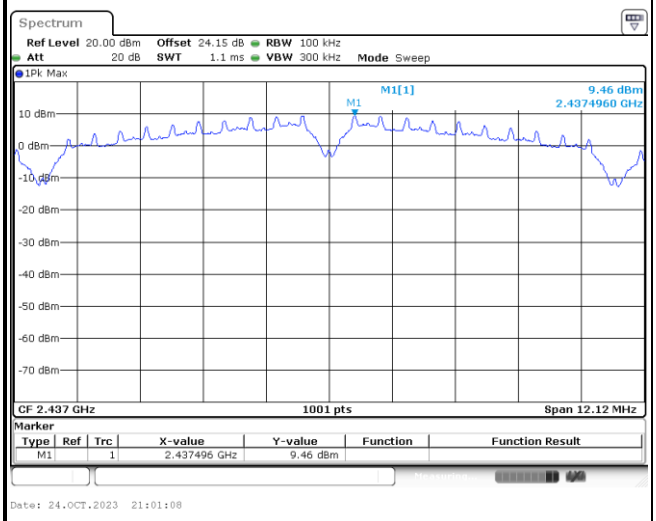
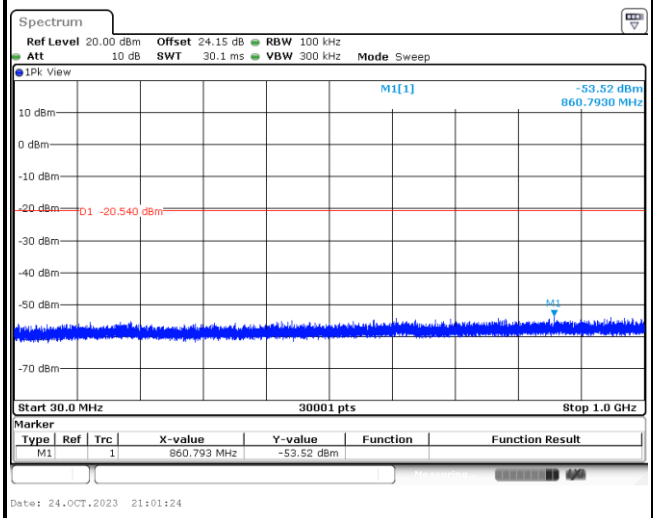
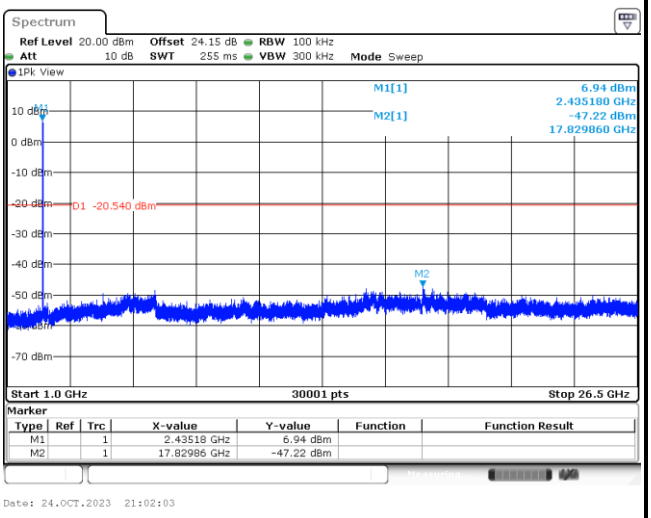
| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

**Number of TX = 1, Ant. 3 (Measured)**

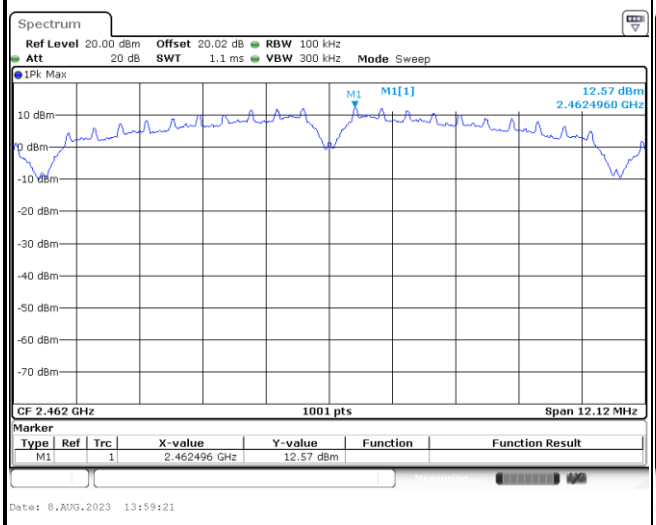
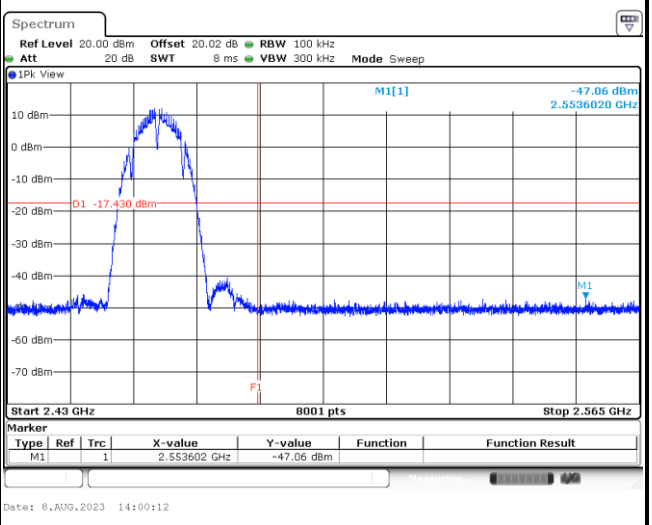
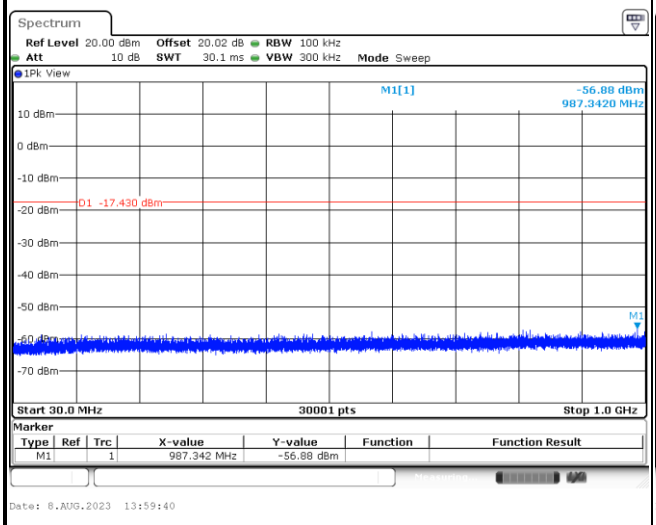
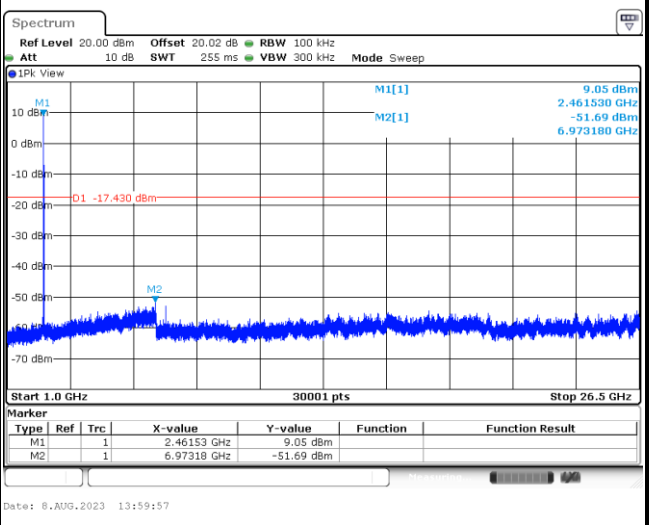
| Test Mode : | 802.11b | Test Channel : | 01 |
|---|---|---|---|

| 100kHz PSD reference Level | Low Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

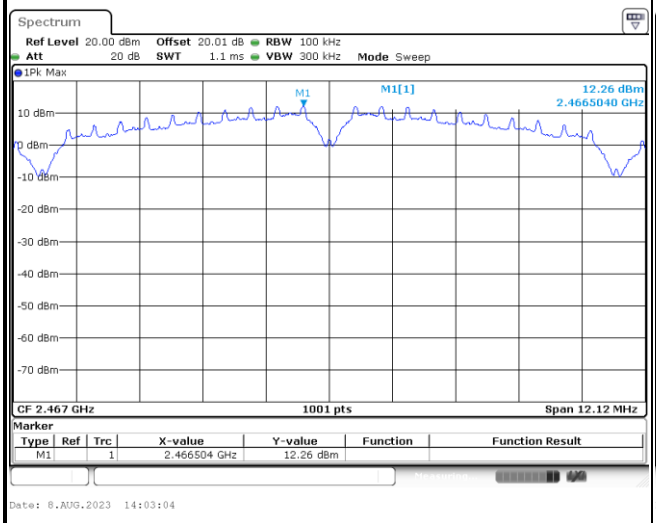
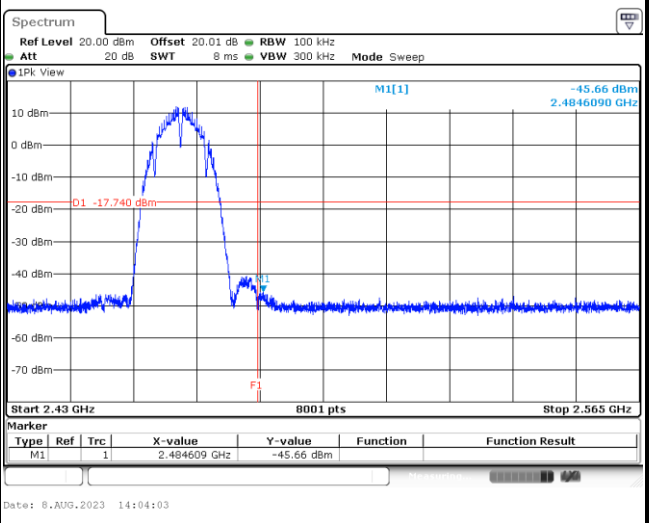
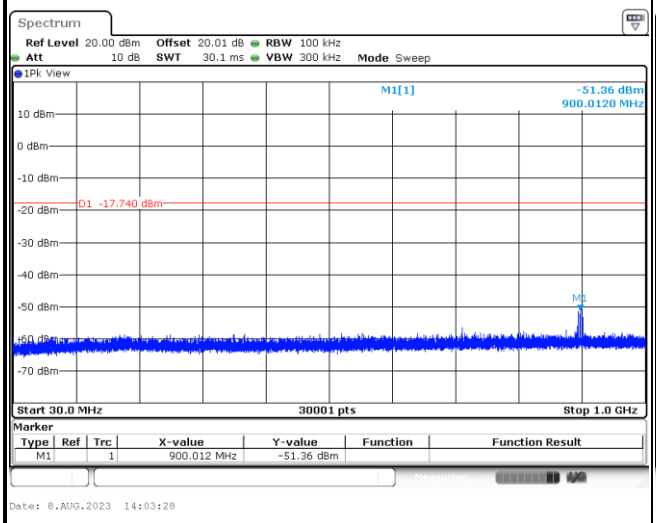
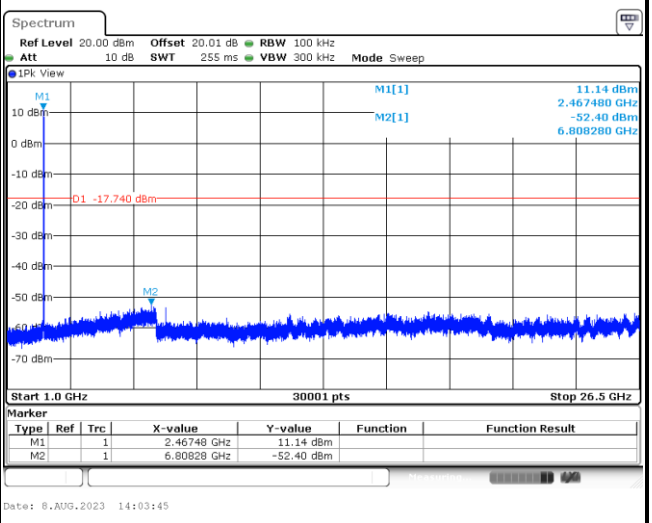
| Test Mode : | 802.11b | Test Channel : | 06 |
|---|---|---|---|

| 100kHz PSD reference Level | Mid Channel Plot |
|---|---|
|  | |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

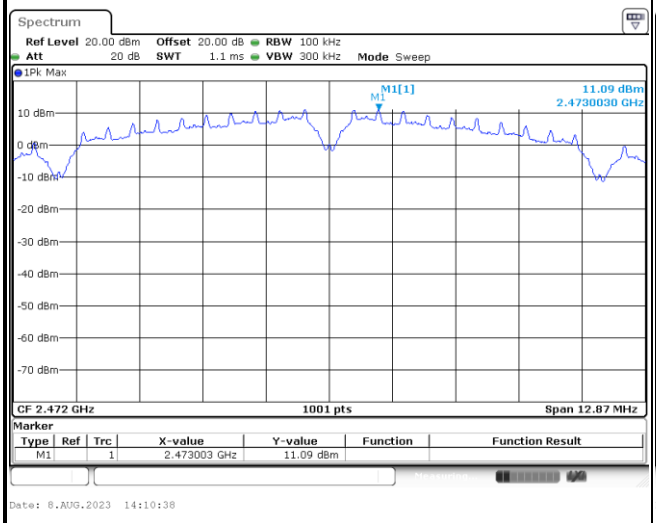
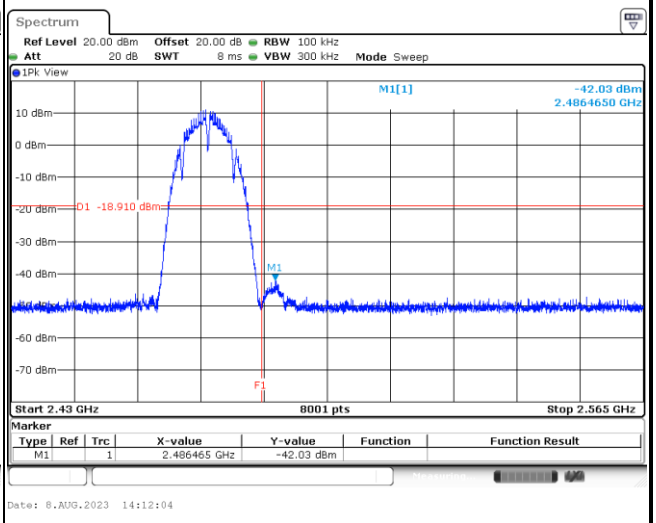
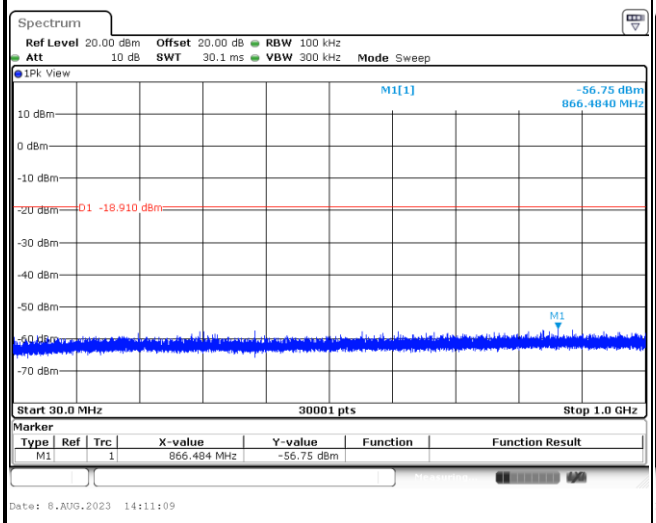
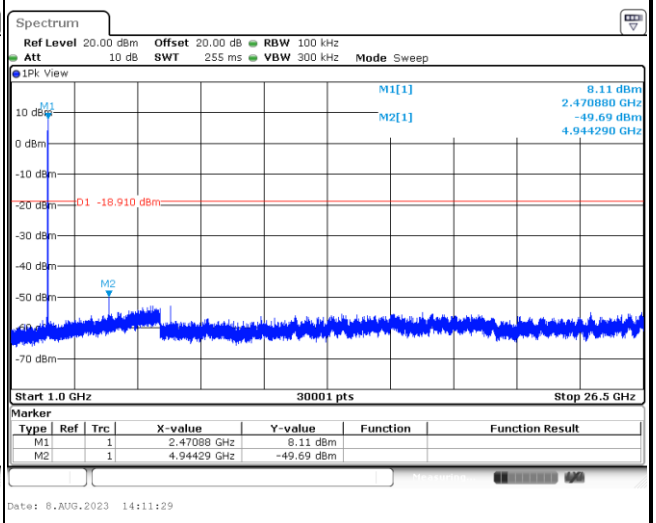
| Test Mode : | 802.11b | Test Channel : | 11 |
|---|---|---|---|

| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11b | Test Channel : | 12 |
|---|---|---|---|

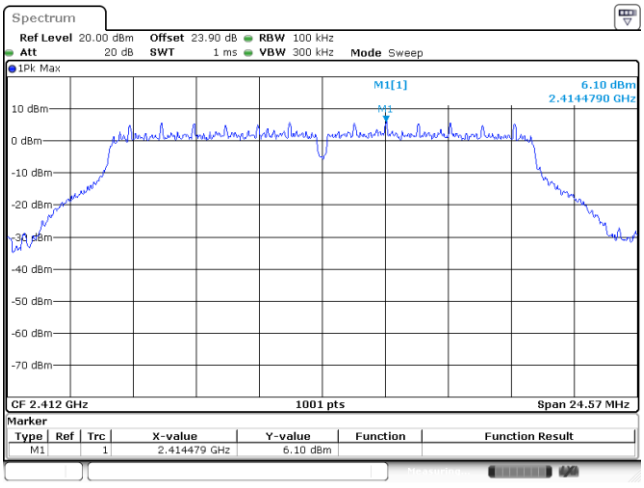
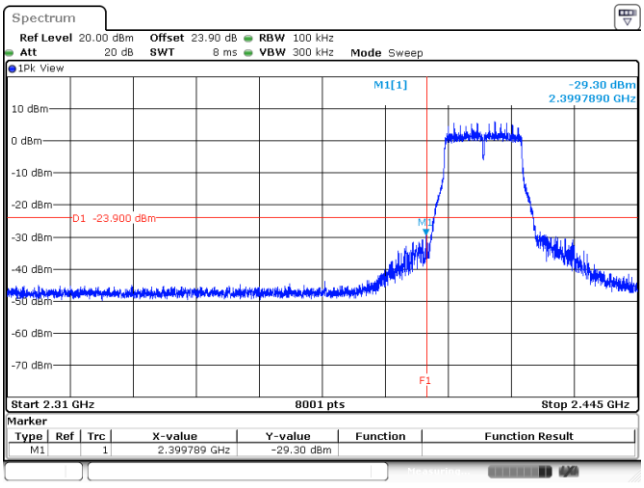
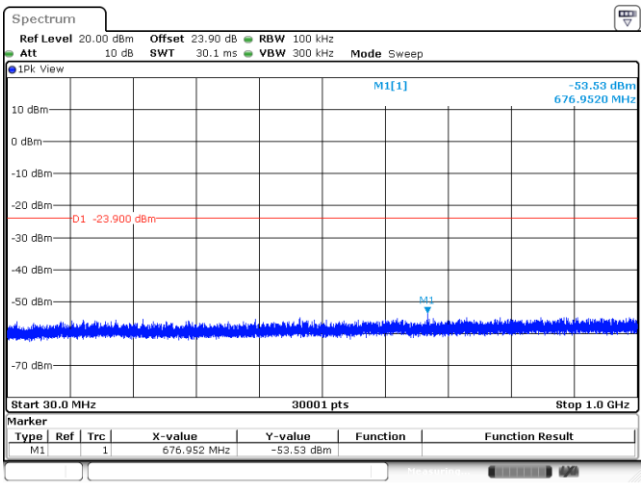
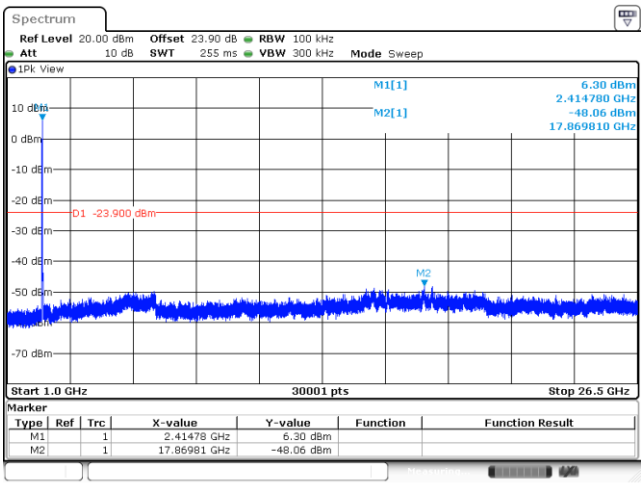
| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11b | Test Channel : | 13 |
|---|---|---|---|

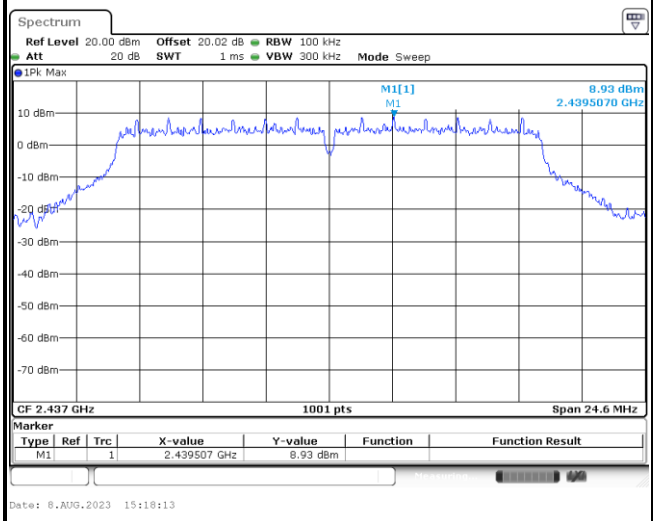
| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

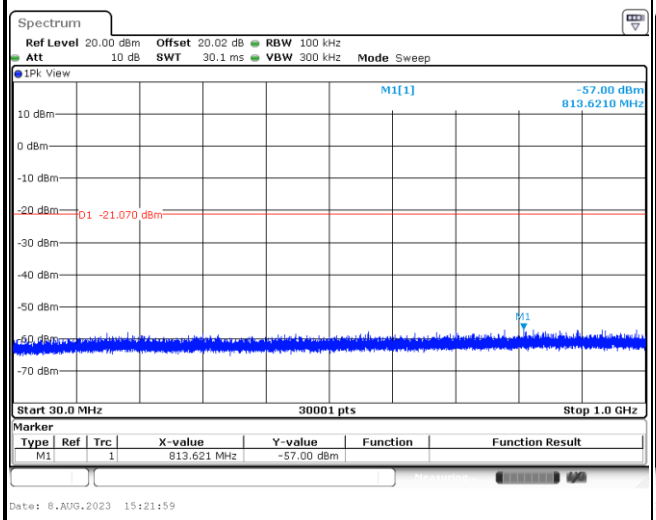
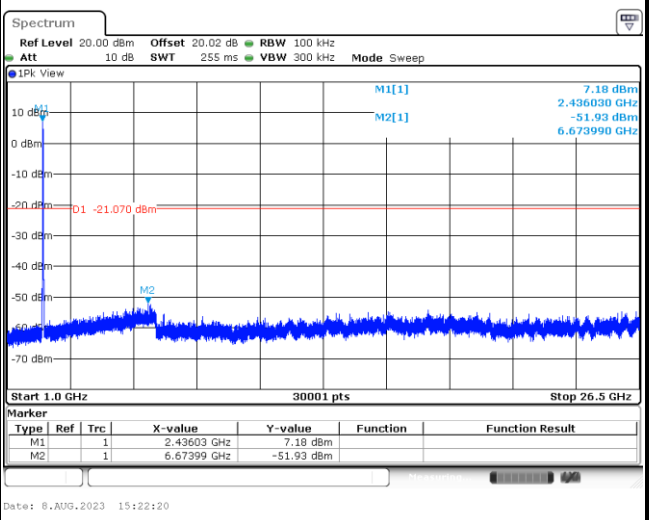
**Number of TX = 2, Ant. 4 (Measured)**

| Test Mode : | 802.11g | Test Channel : | 01 |
|---|---|---|---|

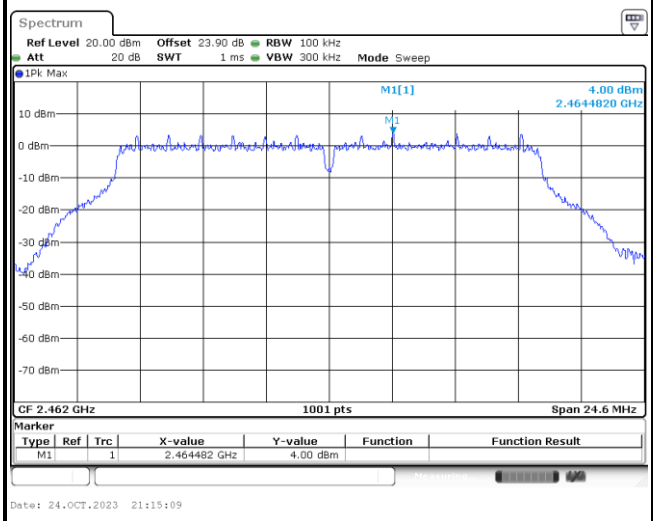
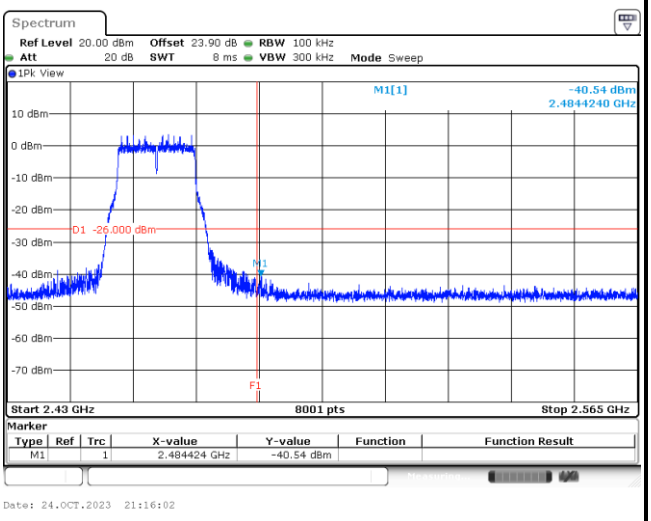
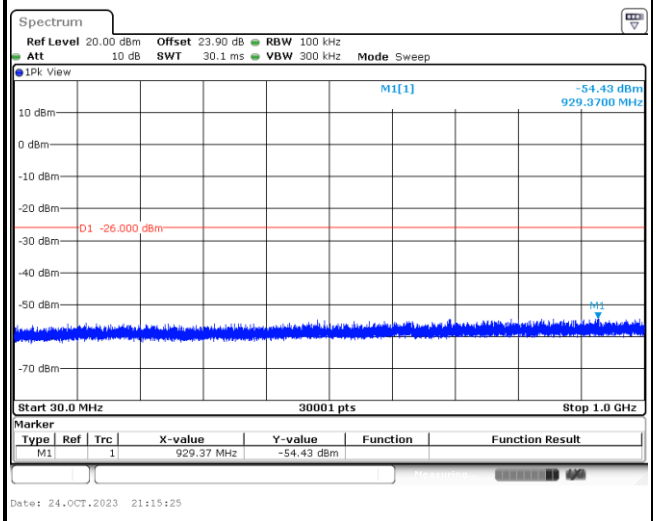
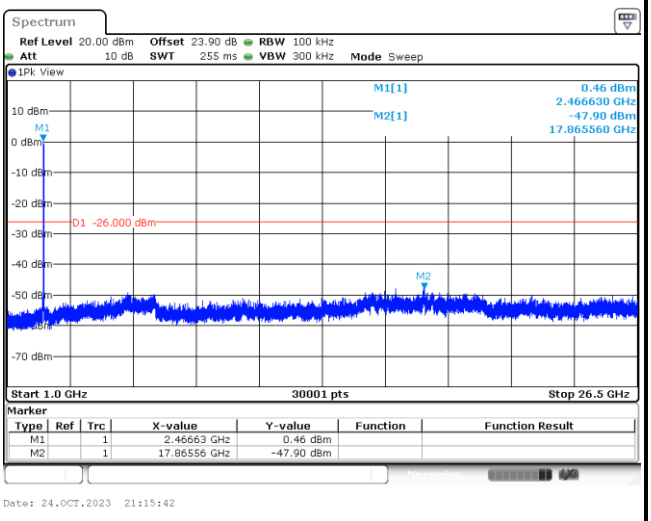
| 100kHz PSD reference Level | Low Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11g | Test Channel : | 06 |
|---|---|---|---|

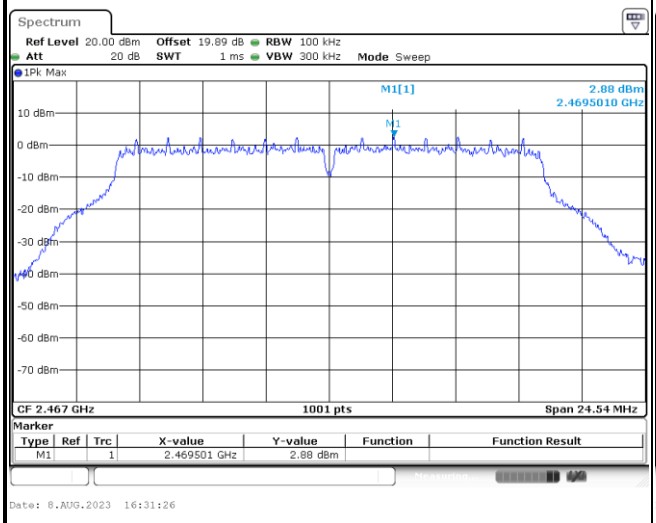
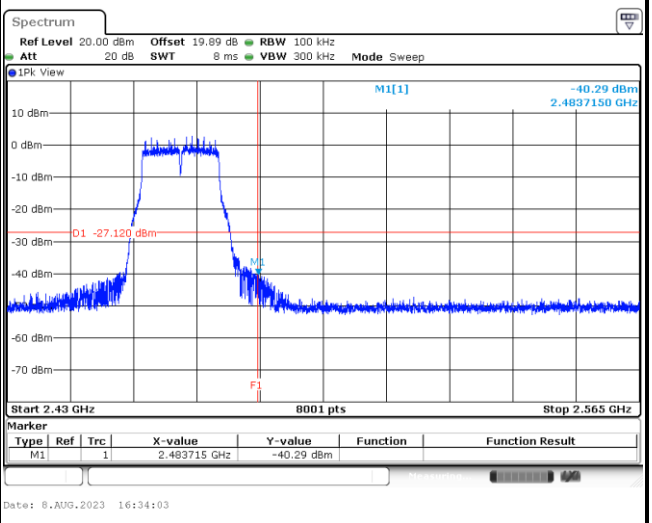
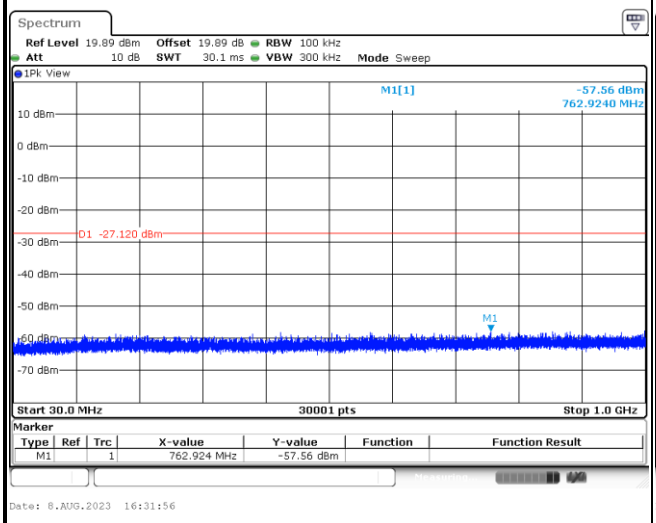
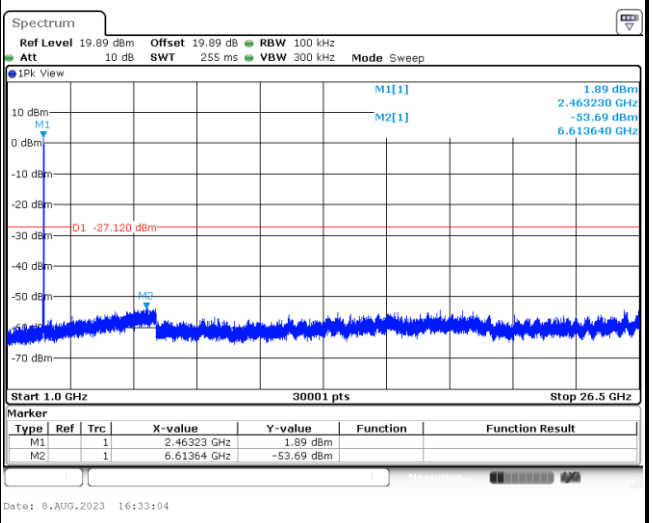
| 100kHz PSD reference Level | Mid Channel Plot |
|---|---|
|  | |

| Spurious Emission 30MHz~1GHz | Spurious Emission 1GHz~26.5GHz |
|---|---|
|  |  |

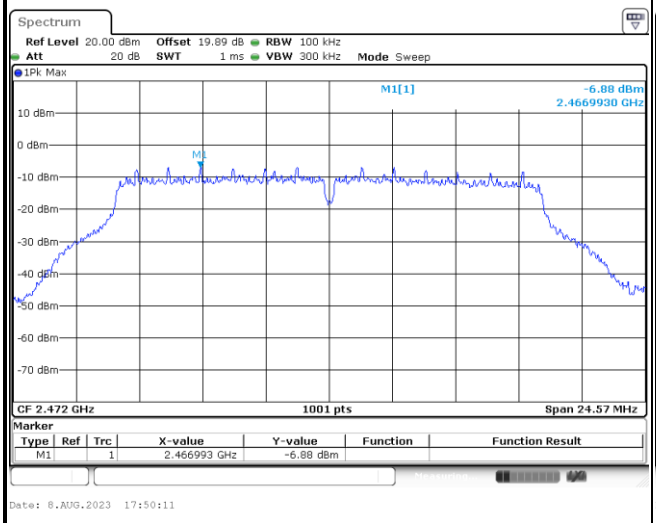
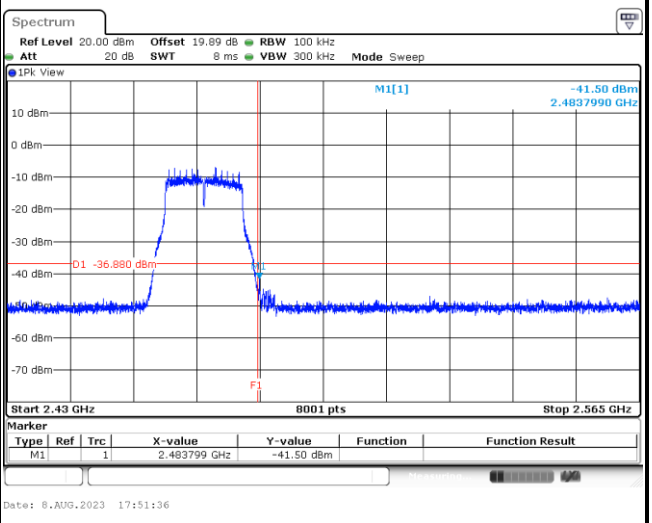
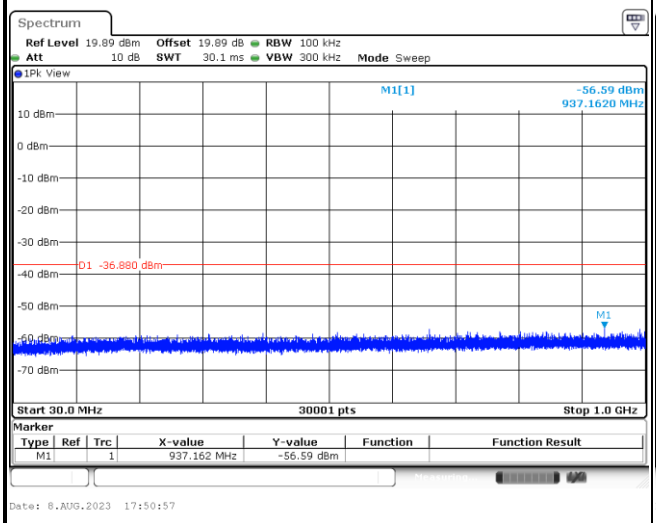
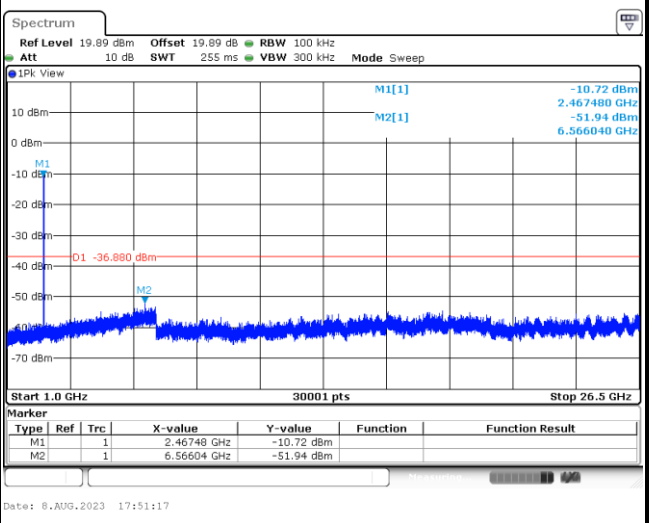
| Test Mode : | 802.11g | Test Channel : | 11 |
|---|---|---|---|

| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11g | Test Channel : | 12 |
|---|---|---|---|

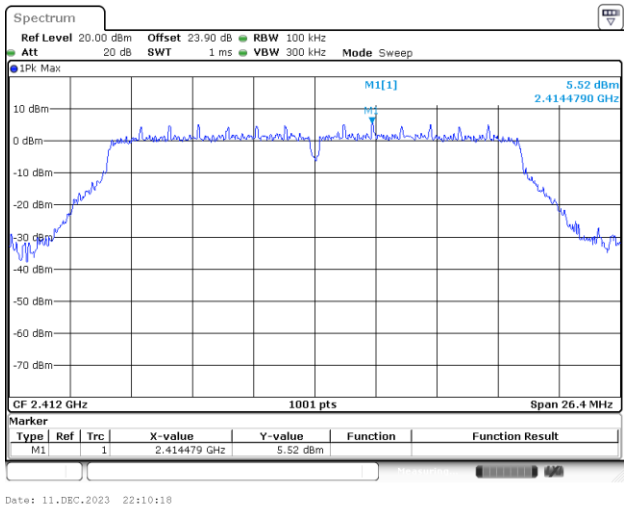
| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11g | Test Channel : | 13 |
|---|---|---|---|

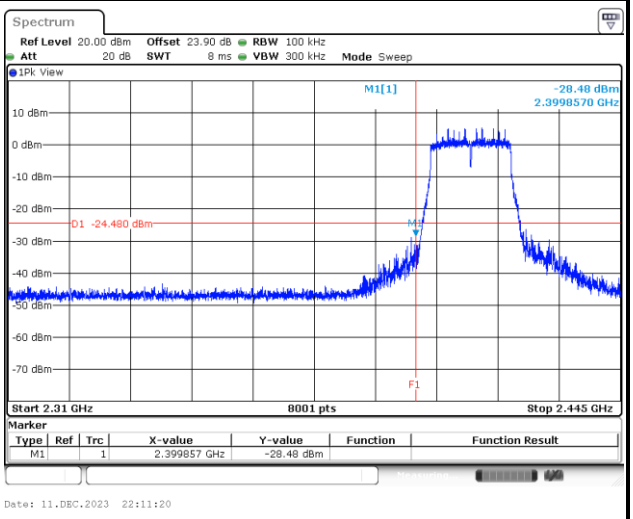
| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11n HT20 | Test Channel : | 01 |
|---|---|---|---|

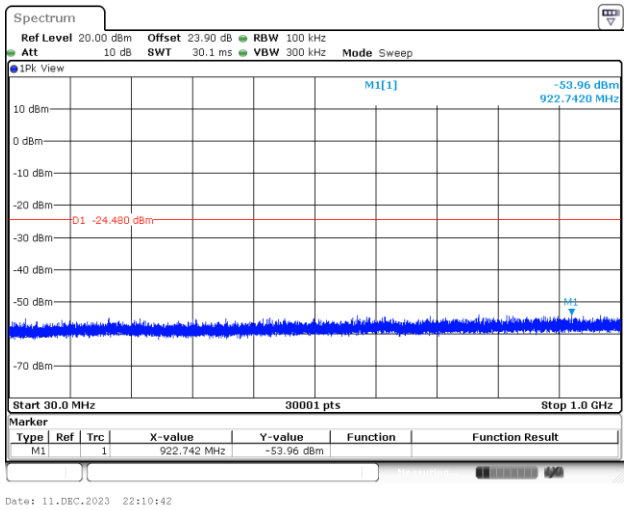
## 100kHz PSD reference Level



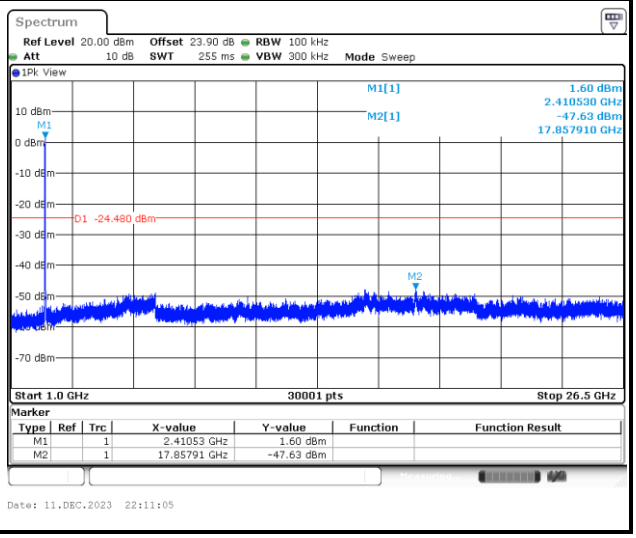

## Low Channel Plot



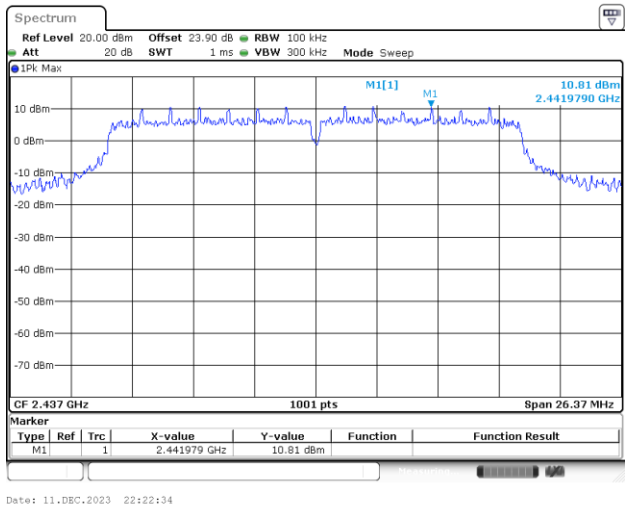

## Spurious Emission 30MHz~1GHz

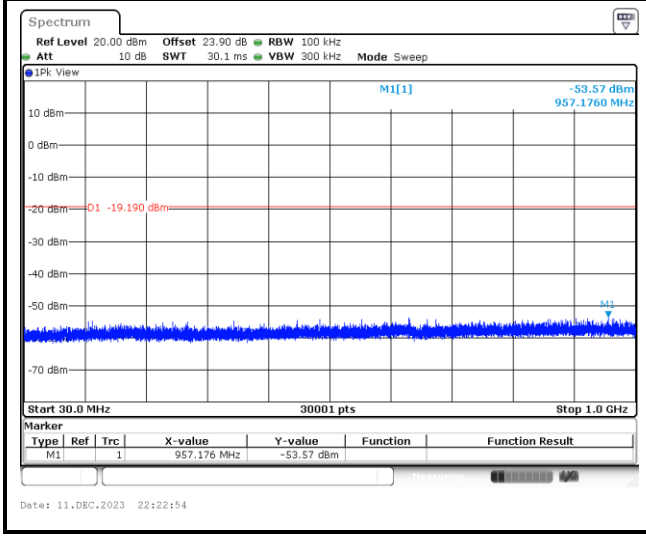
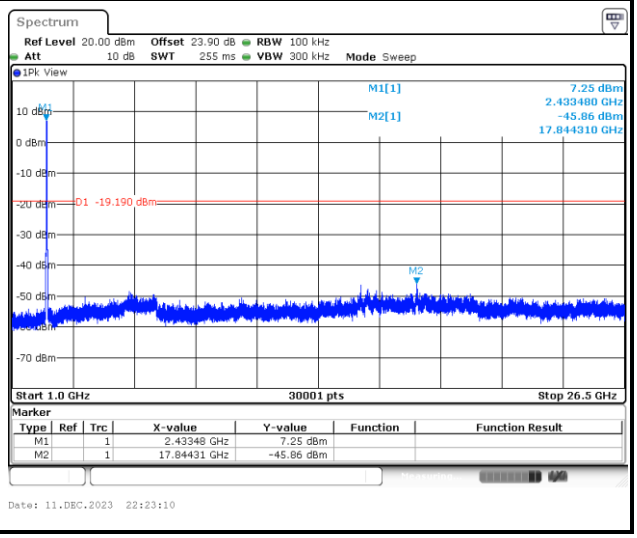



## Spurious Emission 1GHz~26.5GHz

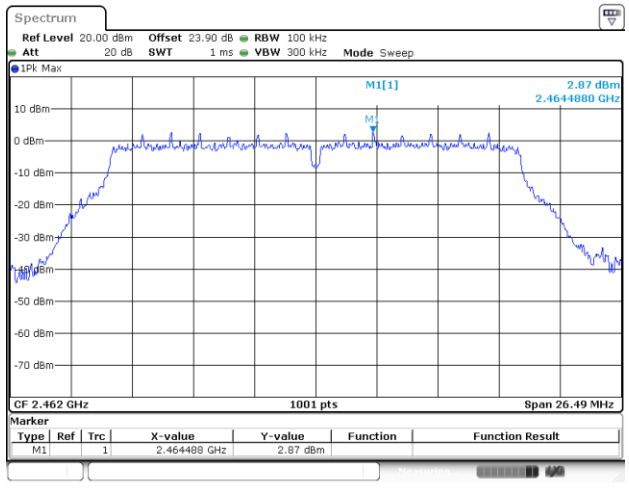
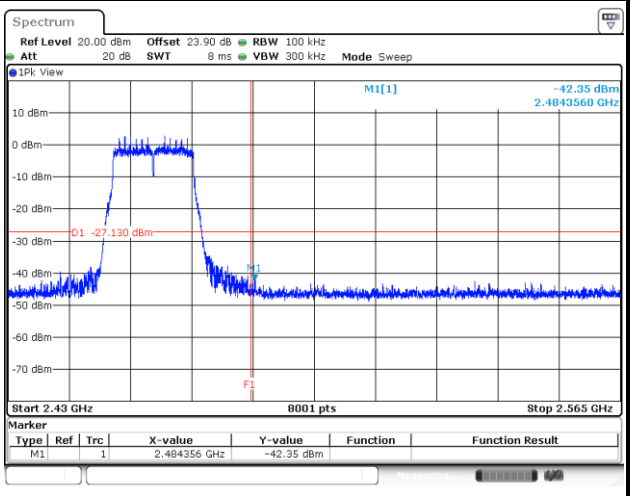
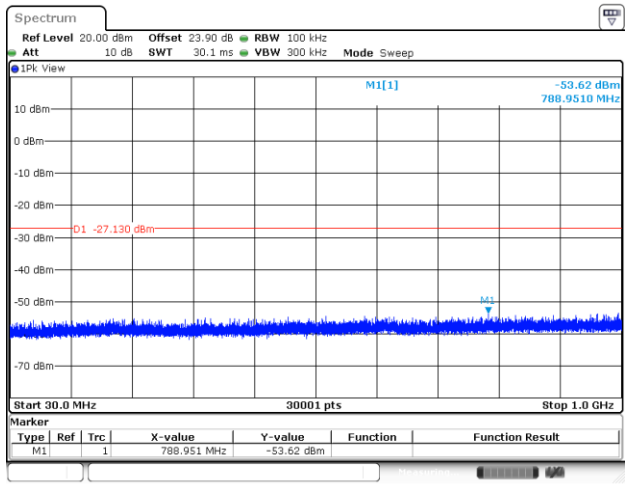
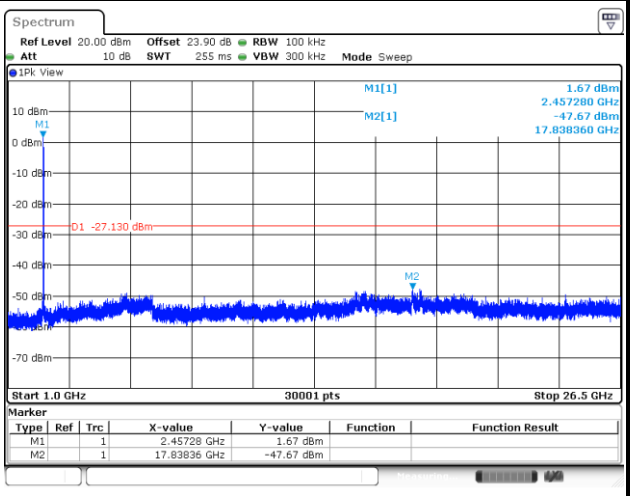


| Test Mode : | 802.11n HT20 | Test Channel : | 06 |
|---|---|---|---|

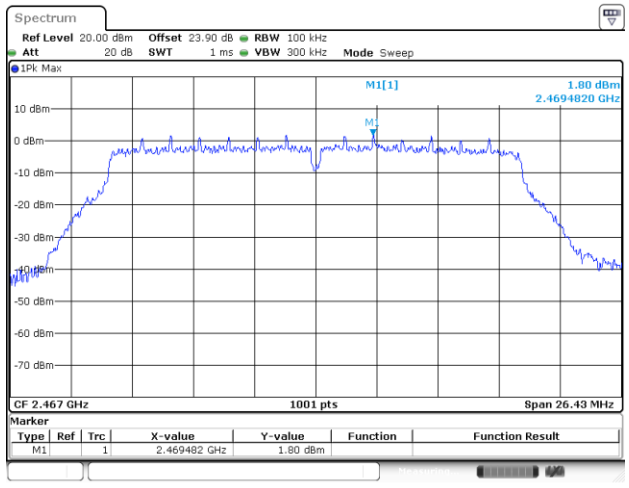
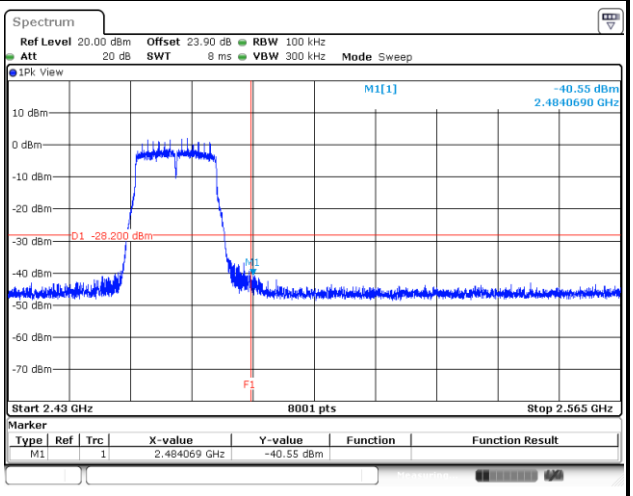
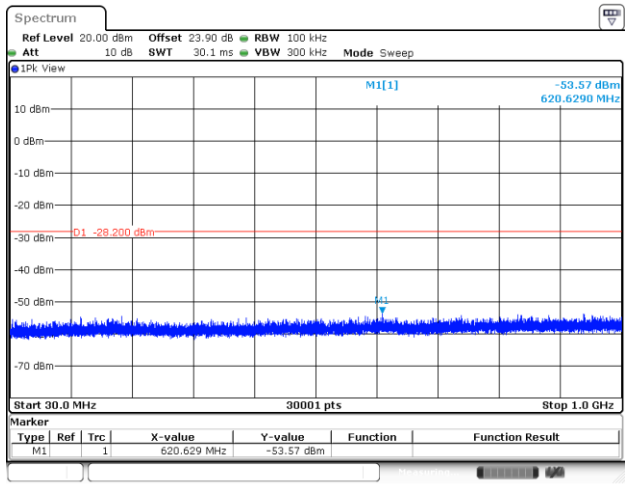
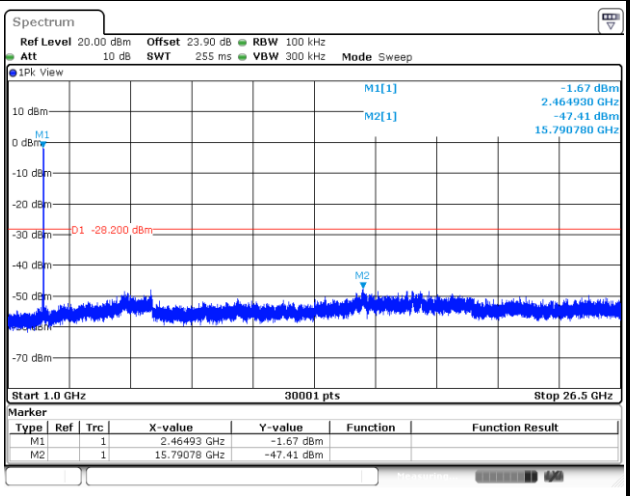
| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  | |

| Spurious Emission 30MHz~1GHz | Spurious Emission 1GHz~26.5GHz |
|---|---|
|  |  |

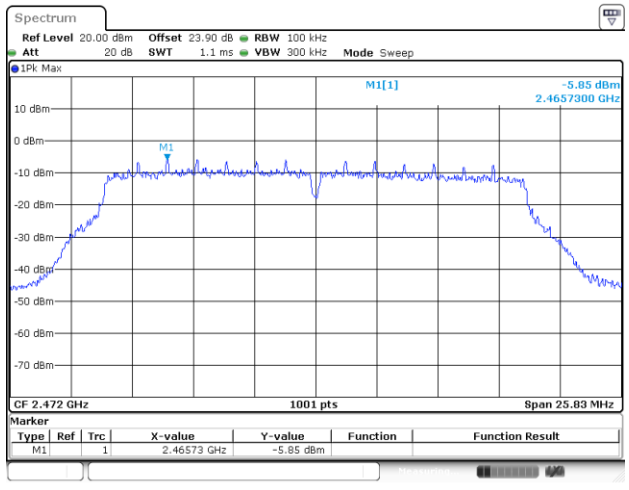
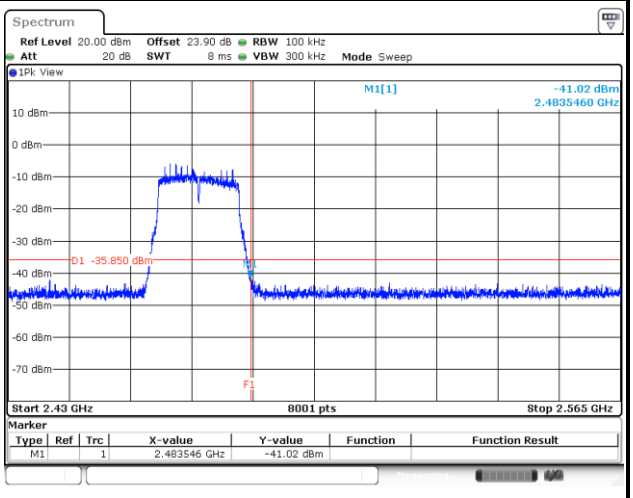
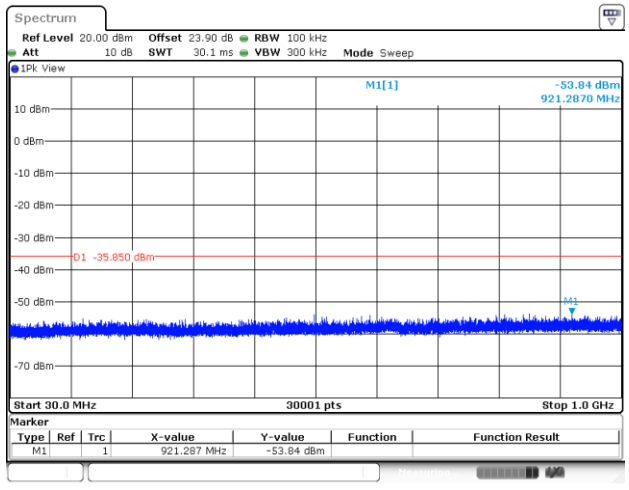
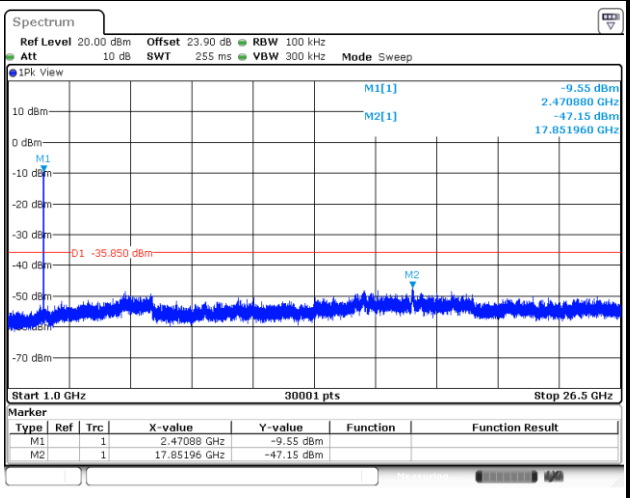
| Test Mode : | 802.11n HT20 | Test Channel : | 11 |
|---|---|---|---|

| 100kHz PSD reference Level | Middle Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

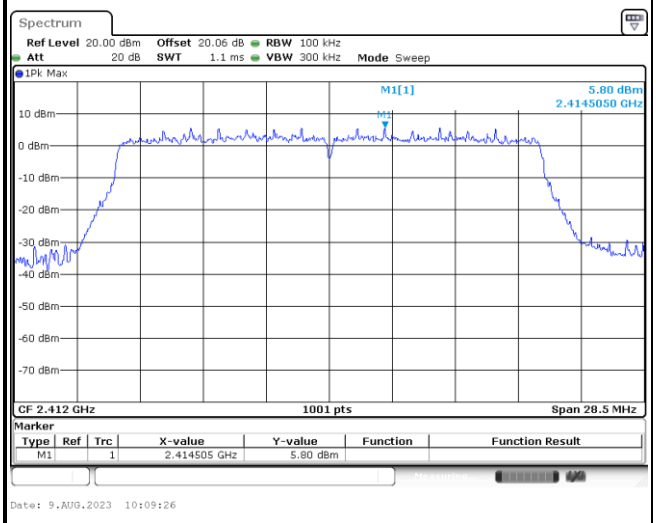
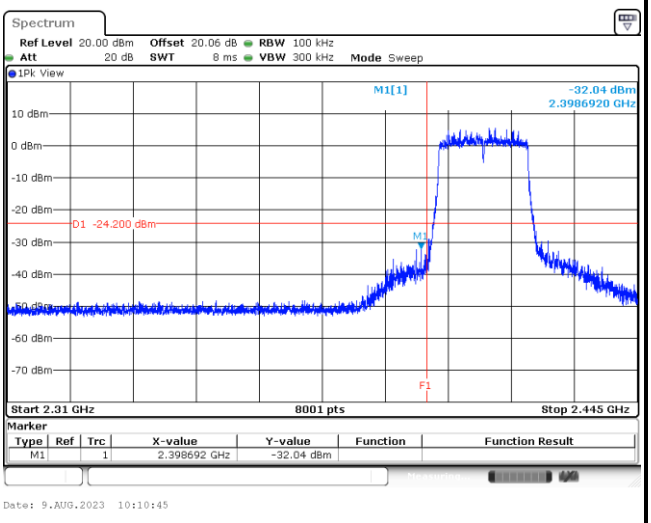
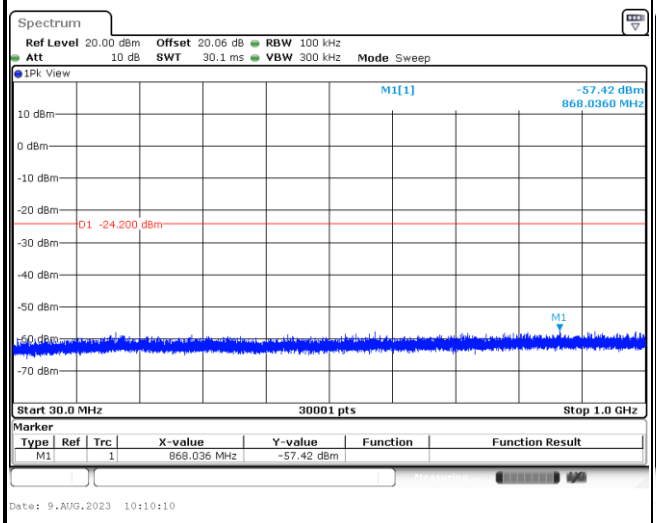
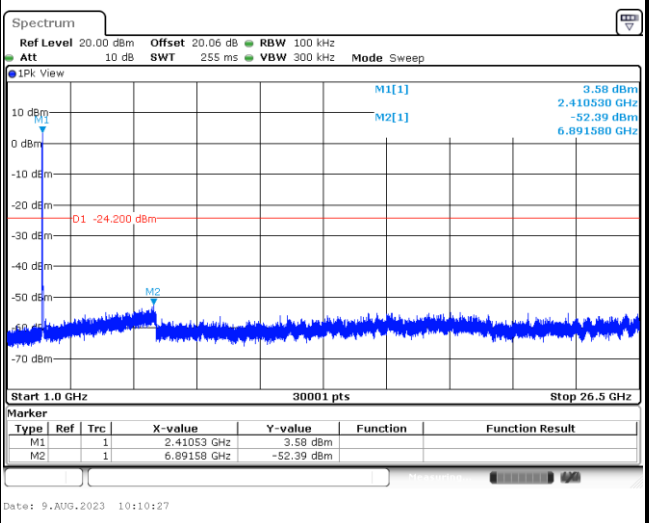
| Test Mode : | 802.11n HT20 | Test Channel : | 12 |
|---|---|---|---|

| 100kHz PSD reference Level | High Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

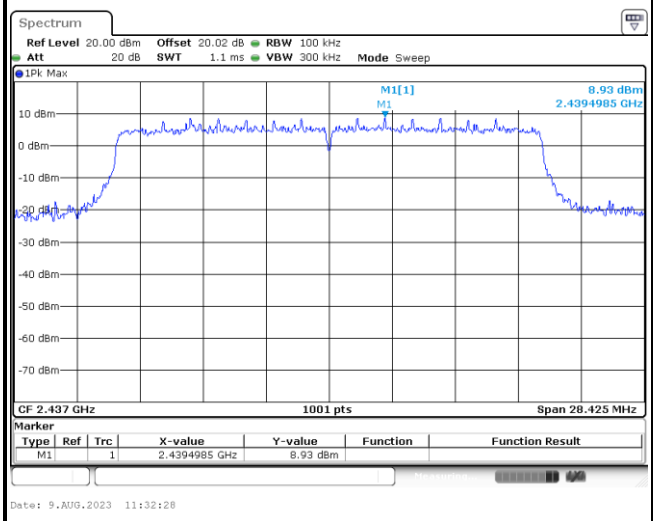
| Test Mode : | 802.11n HT20 | Test Channel : | 13 |
|---|---|---|---|

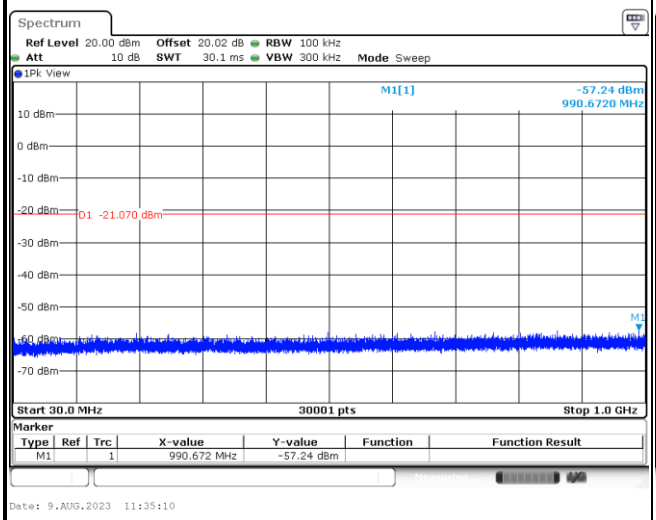
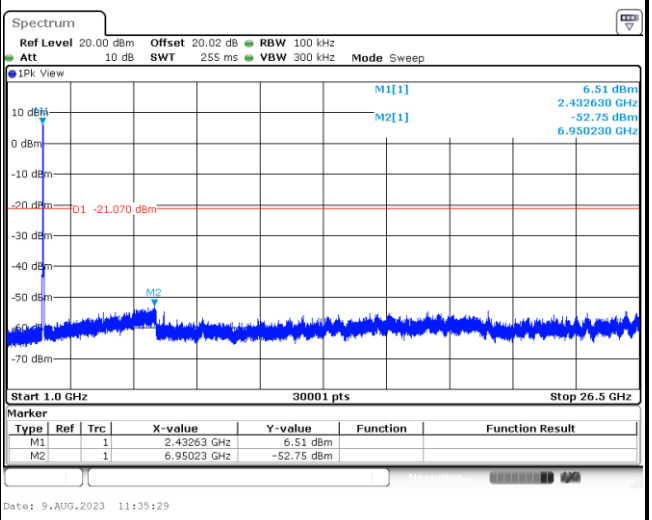
| 100kHz PSD reference Level | Low Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11ax HE20 | Test Channel : | 01 Full RU |
|---|---|---|---|

| 100kHz PSD reference Level | Low Channel Plot |
|---|---|
|  |  |
| **Spurious Emission 30MHz~1GHz** | **Spurious Emission 1GHz~26.5GHz** |
|  |  |

| Test Mode : | 802.11ax HE20 | Test Channel : | 06 Full RU |
|---|---|---|---|

| 100kHz PSD reference Level | Mid Channel Plot |
|---|---|
|  | |

| Spurious Emission 30MHz~1GHz | Spurious Emission 1GHz~26.5GHz |
|---|---|
|  |  |