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FCC DTS REPORT

Certification

Applicant Name:
SAMSUNG Electronics Co., Ltd.

Address:
129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

Date of Issue:
July 13, 2023

Test Site/Location:
74, Seoicheon-ro 578 beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA

Report No.: HCT-RF-2307-FC021

FCC ID:	**A3LSMX616B**
APPLICANT:	**SAMSUNG Electronics Co., Ltd.**

Model:	SM-X616B
Additional Model:	-
EUT Type:	Tablet
Average Output Power:	SISO (Ant.1) : 802.11b : 17.64 dBm 802.11g : 16.54 dBm 802.11n(HT20) : 16.57 dBm MIMO (Ant.1 + Ant.2): 802.11b : 20.54 dBm 802.11g : 19.41 dBm 802.11n(HT20) : 19.22 dBm
Frequency Range:	2 412 MHz ~ 2 472 MHz
Modulation type:	CCK/DSSS/OFDM
FCC Classification:	Digital Transmission System(DTS)
FCC Rule Part(s):	Part 15.247

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

REVIEWED BY

Report prepared by : Chang Hee Hwang
Engineer of Telecommunication Testing Center

Report approved by : Jong Seok Lee
Manager of Telecommunication Testing Center

This test results were applied only to the test methods required by the standard.

This laboratory is not accredited for the test results marked *.
The above Test Report is the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA. (HCT Accreditation No.: KT197)

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-2307-FC021	July 13, 2023	- First Approval Report

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1. EUT DESCRIPTION

Model	SM-X616B		
Additional Model	-		
EUT Type	Tablet		
Power Supply	DC 3.85 V		
Frequency Range	2 412 MHz ~ 2 472 MHz		
Max. RF Output Power	Average Power	SISO(Ant.1)	802.11b : 17.64 dBm 802.11g : 16.54 dBm 802.11n(HT20) : 16.57 dBm
		MIMO (Ant.1 +Ant.2)	802.11b : 20.54 dBm 802.11g : 19.41 dBm 802.11n(HT20) : 19.22 dBm
	Peak Power	SISO(Ant.1)	802.11b : 23.90 dBm 802.11g : 25.22 dBm 802.11n(HT20) : 25.20 dBm
		MIMO (Ant.1 +Ant.2)	802.11b : 26.25 dBm 802.11g : 27.60 dBm 802.11n(HT20) : 27.35 dBm
Modulation Type	DSSS/CCK : 802.11b OFDM : 802.11g, 802.11n		
Number of Channels	13 Channels		
Date(s) of Tests	May 24, 2023 ~ July 13, 2023		
Serial number	Radiated: R32W500WXYD Conducted : R32W500WYVV		

ANTENNA CONFIGURATIONS

1. Antenna configuration

Configurations	SISO		MIMO	
	Ant1	Ant2	CDD	SDM
802.11b	O	X	O	X
802.11g	O	X	O	X
802.11n(HT20)	O	X	X	O

Note:

(1) O = Support, X = Not Support

(2) SISO = Single Input Single Output

(3) SDM = Spatial Diversity Multiplexing

(4) CDD = Cyclic Delay Diversity

2. Directional Gain Calculation

According to KDB 662911 D01 Multiple Transmitter Output v02r01 F) 2) e) (iii), f) ii)

$$\text{Directional Gain(CDD)} = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\{\sum_{k=1}^{N_{ANT}} g_{j,k}\}^2}{N_{ANT}}\right]$$

Directional gain(SDM) = $G_{max} + 10 \cdot \log(N_{ANT}/ N_{ss})$,

Ant Gain (dBi)		N_{ANT}/ N_{ss}	Directional Gain (dBi)	
			SDM	CDD
ANT1	-2.84	2 / 2	-2.78	0.20
ANT2	-2.78			

Note

According to Ansi C63.10-2013 section 14.4.3, the directional gain is calculated using the formula, where G_N is the gain of the nth antenna and N_{ANT} is the total number of antennas used.

Directional gain(CDD) = $10 \cdot \log(((10^{(\text{ANT1 Gain}/20)}+10^{(\text{ANT2 Gain}/20)})^2)/2)$ dBi

Directional gain(SDM) = $G_{max} + 10 \cdot \log(N_{ANT}/ N_{ss})$

Sample MIMO Calculation:

Ex) Ant 1 : 11.58 dBm Ant 2 : 12.08 dBm

Ant1 + Ant 2 = MIMO

(11.58 dBm + 12.08 dBm) = (14.387 mW + 16.143 mW) = 30.53 mW = 14.88 dBm

2. TEST METHODOLOGY

FCC KDB 558074 D01 15.247 Meas Guidance v05r02 dated April 02, 2019 entitled “guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices and the measurement procedure described in ANSI C63.10(Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’.

EUT CONFIGURATION

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

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1 GHz. Above 1 GHz with 1.5 m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.6.5 of ANSI C63.10. (Version: 2013)

DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards.

Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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."

(1) The antennas of this E.U.T are permanently attached.

(2) The E.U.T Complies with the requirement of §15.203

6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

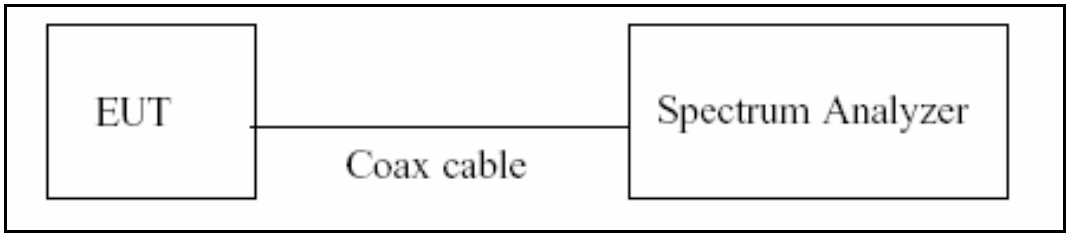
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.90 (Confidence level about 95 %, k=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.14 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.82 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.74 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.76 (Confidence level about 95 %, k=2)
Radiated Disturbance (Above 40 GHz)	5.52 (Confidence level about 95 %, k=2)

7. DESCRIPTION OF TESTS

7.1. Duty Cycle

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to the zero-span measurement method.

The largest available value of RBW is 8 MHz and VBW is 50 MHz.

The zero-span method of measuring duty cycle shall not be used if T ≤ 6.25 microseconds. (50/6.25 = 8)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are > 50/*T*.

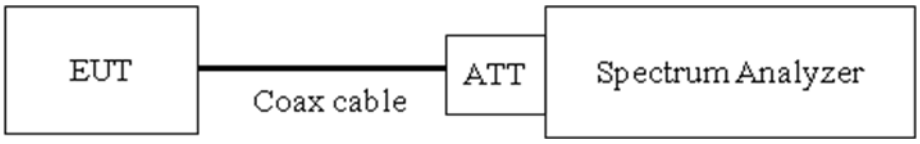
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on} / T_{total} and Duty Cycle Factor = 10log(1/Duty Cycle)

7.2. 6 dB Bandwidth

Limit

The minimum permissible 6 dB bandwidth is 500 kHz.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Procedure 11.8.1 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Detector = Peak
4) Trace mode = max hold
5) Sweep = auto couple
6) Allow the trace to stabilize
7) We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

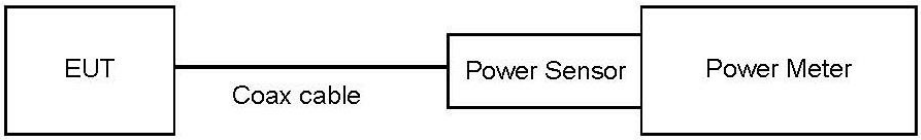
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

7.3. Output Power

Limit

The maximum permissible conducted output power is 1 Watt.

Test Configuration



Test Procedure

The transmitter output is connected to the Power Meter.

▪ Peak Power (Procedure 11.9.1.3 in ANSI 63.10-2013)

: Measure the peak power of the transmitter.

▪ Average Power (Procedure 11.9.2.3 in ANSI 63.10-2013)

1) Measure the duty cycle.
2) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3) Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Sample Calculation

▪ Conducted Output Power(Peak) = Measured Value + ATT loss + Cable loss

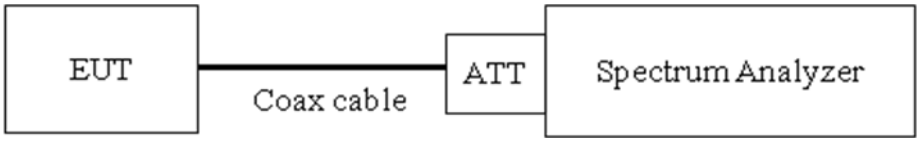
▪ Conducted Output Power(Average) = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

7.4. Power Spectral Density

Limit

The transmitter power density average over 1-second interval shall not be greater than 8 dBm in any 3 kHz BW.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure 8.4 in KDB 558074 v05r02, Procedure 11.10 in ANSI 63.10-2013.

The spectrum analyzer is set to :

1) Set analyzer center frequency to DTS channel center frequency.
2) Set span to at least 1.5 times the OBW.
3) RBW = 3 kHz ≤ RBW ≤ 100 kHz.
4) VBW ≥ 3 x RBW.
5) Sweep = auto couple
6) Detector = power averaging (rms) or sample detector (when rms not available).
7) Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
8) Employ trace averaging (rms) mode over a minimum of 100 traces
9) Use the peak marker function to determine the maximum amplitude level.
10) Use the peak marker function to determine the maximum amplitude level within the RBW.
    If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
11) if then duty factor shall be added to adjust the result if the duty cycle is less than 98 %

Sample Calculation

▪ Power Spectral Density = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

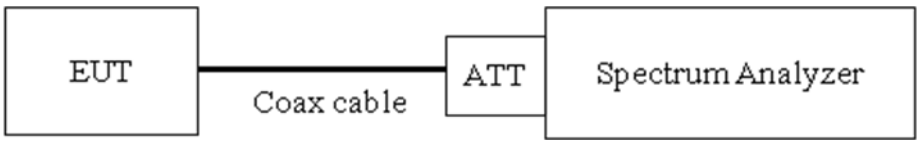
7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

Limit

The maximum conducted (Average) output power was used to demonstrate compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least relative to the maximum in-band peak PSD level in 100 kHz.

[Conducted > 30 dBc]

Test Configuration



Test Procedure

The transmitter output is connected to the spectrum analyzer.

(Procedure 11.11 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Set span to encompass the spectrum to be examined
4) Detector = Peak
5) Trace Mode = max hold
6) Sweep time = auto couple
7) Ensure that the number of measurement points ≥ 2 x Span/RBW
8) Allow trace to fully stabilize.
9) Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the lowest, middle, and highest channels.

Factors for frequency

Freq(MHz)	Factor(dB)
30	10.04
100	10.07
200	10.12
300	10.17
400	10.20
500	10.21
600	10.21
700	10.23
800	10.24
900	10.26
1000	10.27
2000	10.41
2400	10.43
2500	10.45
3000	10.52
4000	10.60
5000	10.71
6000	10.73
7000	10.80
8000	10.85
9000	10.91
10000	10.97
11000	11.02
12000	11.10
13000	11.19
14000	11.16
15000	11.21
16000	11.22
17000	11.25
18000	11.30
19000	11.32
20000	11.36
21000	11.48
22000	11.55
23000	11.55
24000	11.59
25000	11.68

Note : 1. 2400 ~ 2500 MHz is fundamental frequency range.

2. Factor = Attenuator loss + Cable loss

3. EUT cable loss = 0.68 dB

4. Total Port offest = 11.13 dB

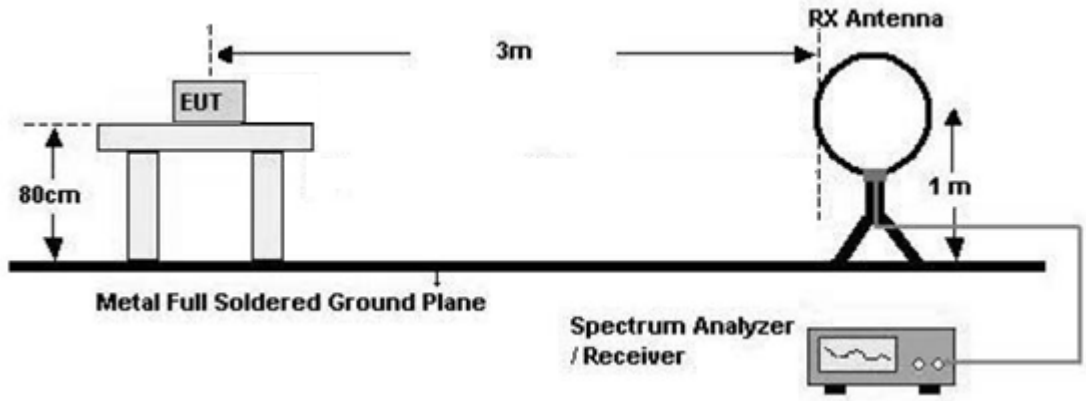
7.6. Radiated Test

Limit

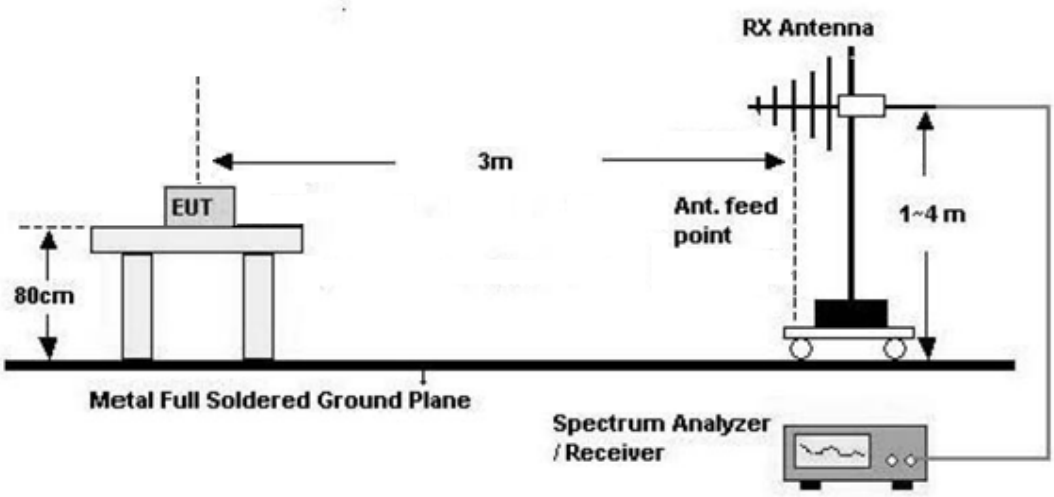
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

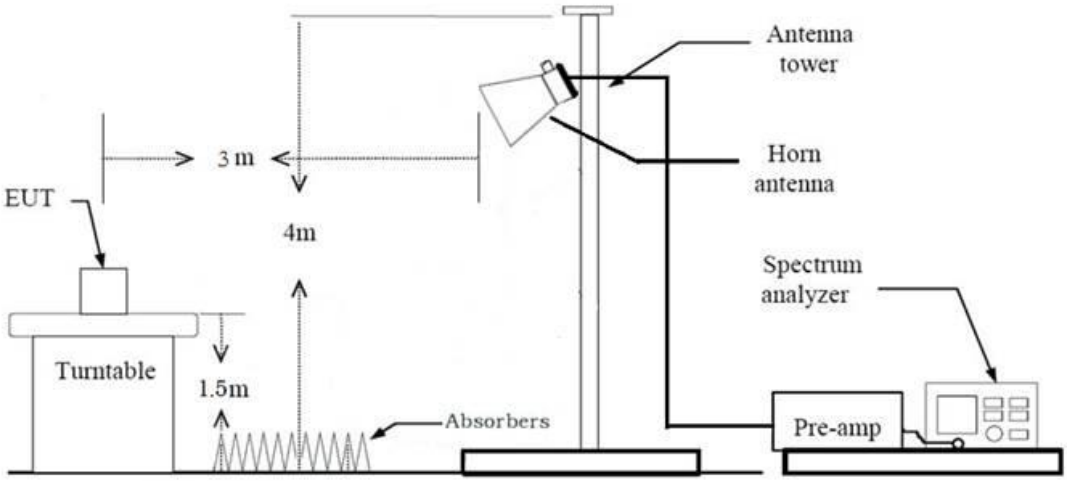
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions (Below 30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3 m from the EUT
3. The EUT is placed on a turntable, which is 0.8 m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) = 40log(3 m/300 m) = - 80 dB
   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = 40log(3 m/30 m) = - 40 dB
   Measurement Distance : 3 m
8. Spectrum Setting
   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 9 kHz
   - VBW ≥ 3 x RBW
9. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

KDB 414788 OFS and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

Test Procedure of Radiated spurious emissions (Below 1 GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8 m above ground plane.
3. The Hybrid antenna was placed at a location 3 m from the EUT, which is varied from 1 m to 4 m to find out the highest emissions.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 100 kHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Quasi-peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Quasi-Peak
      - RBW = 120 kHz

      In general, (1) is used mainly
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)
8. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting (Method 8.6 in KDB 558074 v05r02, Procedure 11.12 in ANSI 63.10-2013)
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = Peak

- Trace = Maxhold
- RBW = 1 MHz
- VBW ≥ 3 x RBW

(2) Measurement Type(Average): Duty cycle ≥ 98 %

- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = RMS
- Averaging type = power (*i.e.*, RMS)
- RBW = 1 MHz
- VBW ≥ 3 x RBW
- Sweep time = auto.
- Trace mode = average (at least 100 traces).

(3) Measurement Type(Average): Duty cycle < 98 %, duty cycle variations are less than ±2 %

- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = RMS
- Averaging type = power (*i.e.*, RMS)
- RBW = 1 MHz
- VBW ≥ 3 x RBW
- Sweep time = auto.
- Trace mode = average (at least 100 traces).
- Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 % duty cycle.
- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.

9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total(Measurement Type : Peak)
    = Measured value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

    Total(Measurement Type : Average, Duty cycle ≥ 98 %)
    = Measured value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

    Total(Measurement Type : Average, Duty cycle < 98 %)
    = Measured value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)
    + Duty Cycle Factor

Test Procedure of Radiated Restricted Band Edge

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting
   (1) Measurement Type(Peak):
   - Measured Frequency Range : 2310 MHz ~ 2390 MHz / 2483.5 MHz ~ 2500 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 1 MHz
   - VBW ≥ 3 x RBW

   (2) Measurement Type(Average): Duty cycle ≥ 98 %,
   - Measured Frequency Range : 2310 MHz ~ 2390 MHz / 2483.5 MHz ~ 2500 MHz
   - Detector = RMS
   - Averaging type = power (*i.e.*, RMS)
   - RBW = 1 MHz
   - VBW ≥ 3 x RBW
   - Sweep time = auto.
   - Trace mode = average (at least 100 traces).

   (3) Measurement Type(Average): Duty cycle < 98 %, duty cycle variations are less than ± 2 %
   - Measured Frequency Range : 2310 MHz ~ 2390 MHz / 2483.5 MHz ~ 2500 MHz
   - Detector = RMS
   - Averaging type = power (*i.e.*, RMS)
   - RBW = 1 MHz
   - VBW ≥ 3 x RBW
   - Sweep time = auto.
   - Trace mode = average (at least 100 traces).
   - Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 % duty cycle.
   - Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.

9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total(Measurement Type : Peak)
    = Measured value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
    Total(Measurement Type : Average, Duty cycle ≥ 98 %)
    = Measured value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
    Total(Measurement Type : Average, Duty cycle < 98 %)
    = Measured value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F) + Duty Cycle Factor

7.7. AC Power line Conducted Emissions

Limit

For an intentional radiator 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, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56[a]	56 to 46[a]
0.50 to 5	56	46
5 to 30	60	50

[a]Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.

Sample Calculation

Quasi-peak(Final Result) = Measured Value + Correction Factor

7.8. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone, Stand alone + External accessories(Earphone, etc)
   - Worstcase : Stand alone
2. All Antenna of operation were investigated and the worst case results are reported
   - Mode : SISO(Ant.1), MIMO(SDM), MIMO(CDD)
   - Worst case : MIMO(CDD), MIMO(SDM)
3. EUT Axis
   - Radiated Spurious Emissions : Z
   - Radiated Restricted Band Edge : Z
4. Duty cycle factor applies only 802.11g/n (Duty cycle < 98 %).
5. All data rate of operation were investigated and the test results are worst case in lowest Data Rate of each mode.
   - 802.11b : 1 Mbps
   - 802.11g : 6 Mbps
   - 802.11n(HT20): MCS8
6. All position of loop antenna were investigated and the test result is a no critical peak found at all positions.
   - Position : Horizontal, Vertical, Parallel to the ground plane
7. Radiated Spurious Emission
   - All mode of operation were investigated and the worst case results are reported.
   - Mode: 802.11b, 802.11g, 802.11n(HT20)
   - Worstcase: 802.11b

AC Power line Conducted Emissions

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone + External accessories(Earphone, etc) + Travel Adapter,
     Stand alone + Travel Adapter
   - Worstcase : Stand alone + Travel Adapter

Conducted test

1. The EUT was configured with data rate of highest power.

8. SUMMARY TEST OF RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§15.247(a)(2)	> 500 kHz	Conducted	PASS
Conducted Maximum Output Power	§15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§15.247(d)	Conducted > 30 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 7.7		PASS
Radiated Spurious Emissions	§15.247(d), 15.205, 15.209	cf. Section 7.6	Radiated	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 7.6		PASS

9. TEST RESULT

9.1 DUTY CYCLE

[SISO]

Mode	Data Rate	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11b	1 Mbps	8.603	8.705	0.988	0.051
	2 Mbps	4.303	4.398	0.978	0.095
	5.5 Mbps	1.624	1.720	0.944	0.250
	11 Mbps	0.859	0.955	0.899	0.461
802.11g	6 Mbps	1.426	1.525	0.935	0.291
	9 Mbps	0.958	1.056	0.906	0.426
	12 Mbps	0.722	0.821	0.880	0.557
	18 Mbps	0.491	0.588	0.836	0.777
	24 Mbps	0.370	0.469	0.789	1.028
	36 Mbps	0.256	0.352	0.727	1.387
	48 Mbps	0.195	0.291	0.670	1.742
	54 Mbps	0.180	0.279	0.645	1.901
802.11n (HT20)	MCS0	1.333	1.434	0.929	0.318
	MCS1	0.684	0.783	0.874	0.586
	MCS2	0.469	0.567	0.826	0.831
	MCS3	0.362	0.461	0.786	1.047
	MCS4	0.256	0.352	0.727	1.387
	MCS5	0.198	0.299	0.661	1.798
	MCS6	0.182	0.281	0.649	1.880
	MCS7	0.167	0.263	0.635	1.975

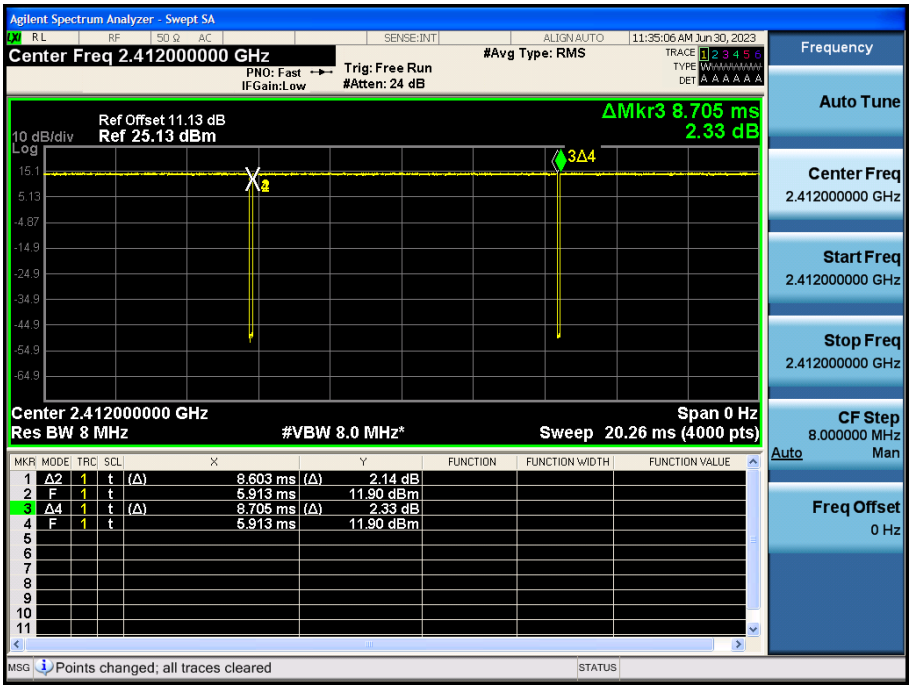
[MIMO]

Mode	Data Rate	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11b	1 Mbps	8.603	8.705	0.988	0.051
	2 Mbps	4.303	4.398	0.978	0.095
	5.5 Mbps	1.624	1.720	0.944	0.250
	11 Mbps	0.859	0.955	0.899	0.461
802.11g	6 Mbps	1.426	1.525	0.935	0.291
	9 Mbps	0.958	1.056	0.906	0.426
	12 Mbps	0.722	0.821	0.880	0.557
	18 Mbps	0.491	0.588	0.836	0.777
	24 Mbps	0.370	0.469	0.789	1.028
	36 Mbps	0.256	0.352	0.727	1.387
	48 Mbps	0.195	0.291	0.670	1.742
	54 Mbps	0.180	0.279	0.645	1.901
802.11n (HT20)	MCS8	0.692	0.788	0.878	0.566
	MCS9	0.365	0.464	0.787	1.041
	MCS10	0.258	0.357	0.723	1.406
	MCS11	0.203	0.299	0.678	1.688
	MCS12	0.149	0.248	0.602	2.204
	MCS13	0.122	0.220	0.552	2.583
	MCS14	0.114	0.213	0.536	2.711
	MCS15	0.106	0.205	0.519	2.852

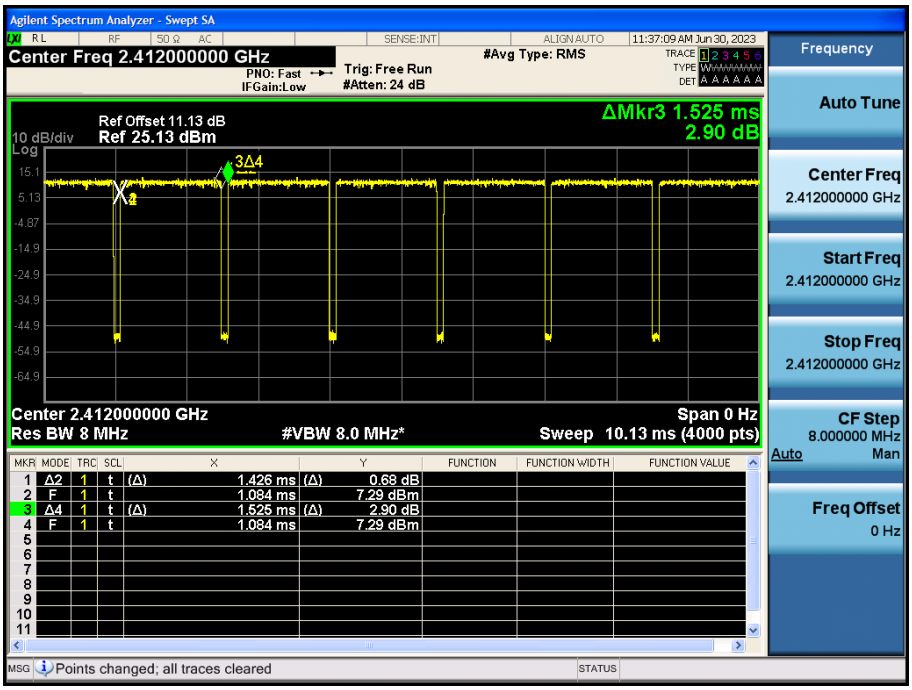
▣ Test Plots

[SISO]

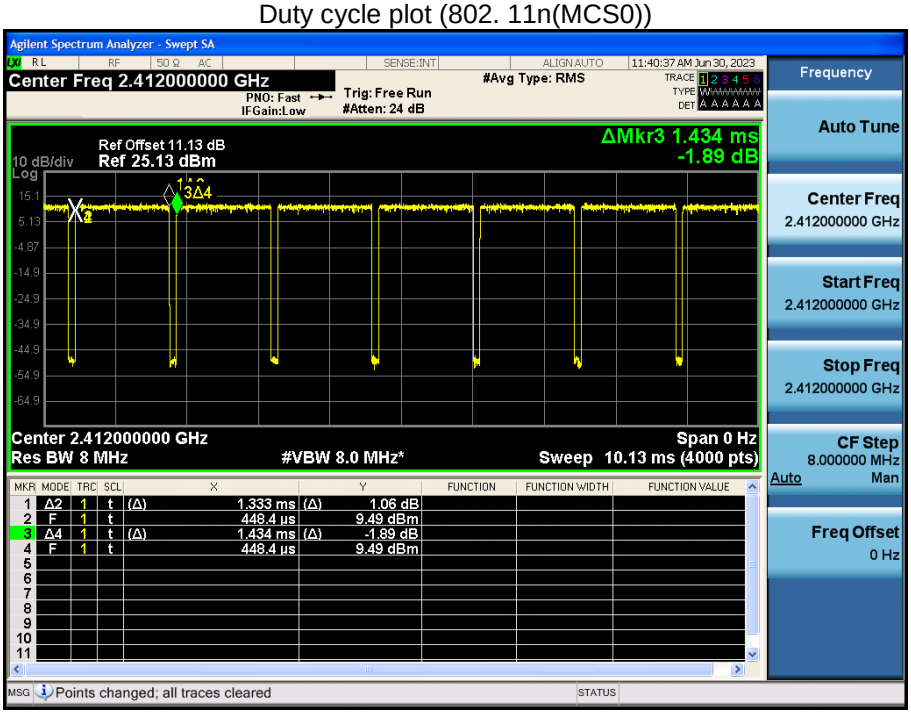
Duty cycle plot (802.11b(1 Mbps))



Duty cycle plot (802.11g(6 Mbps))

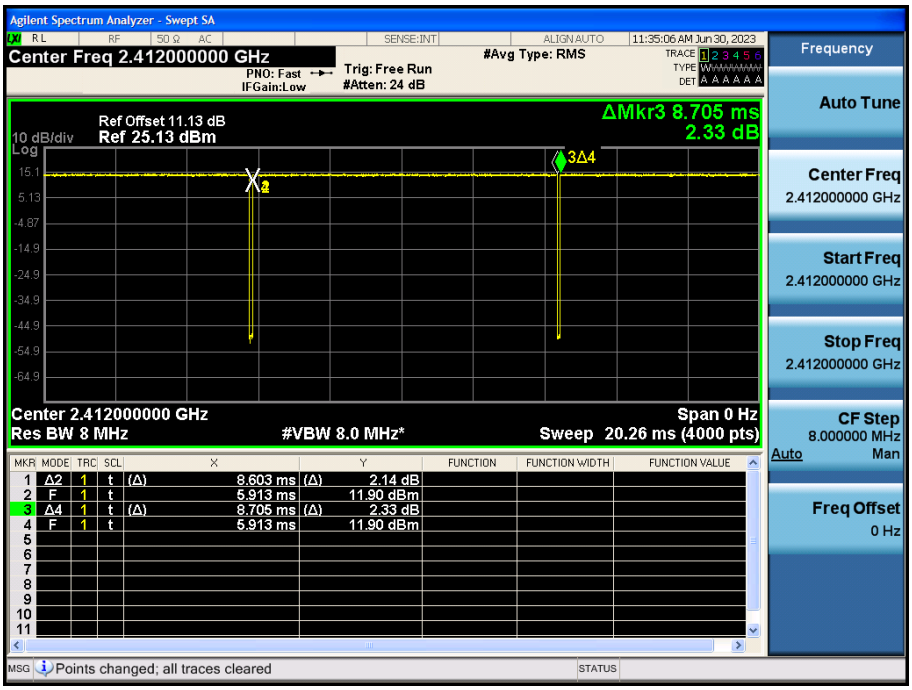


Duty cycle plot (802. 11n(MCS0))

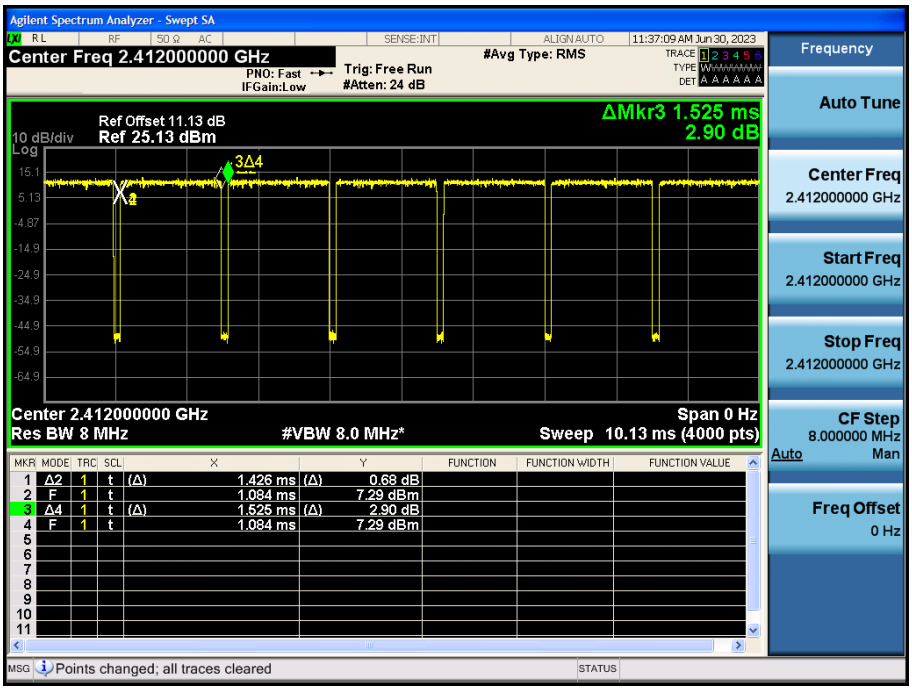


[MIMO]

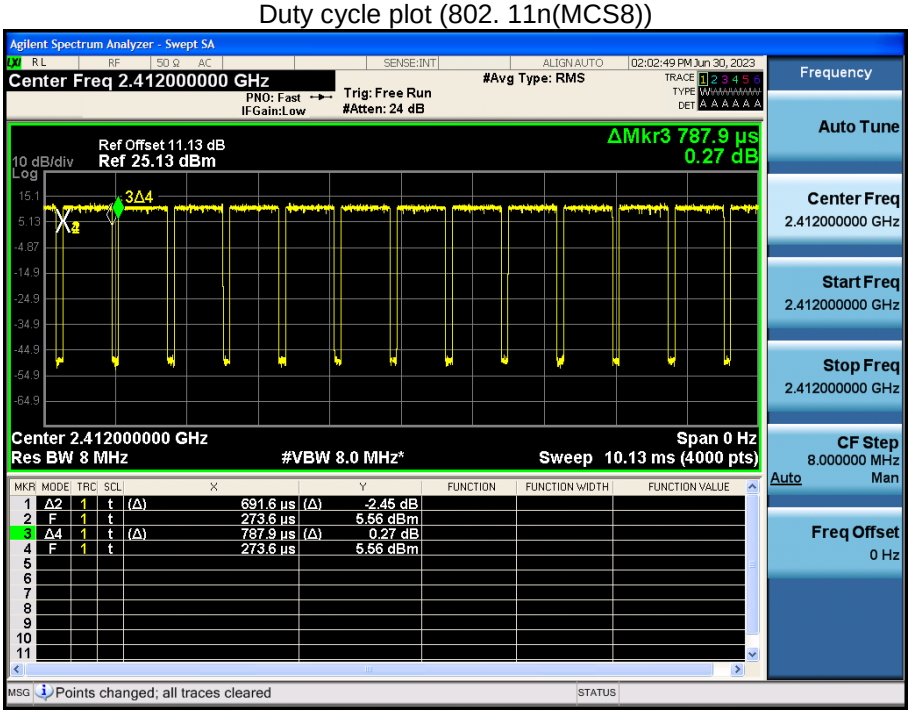
Duty cycle plot (802.11b(1 Mbps))



Duty cycle plot (802.11g(6 Mbps))



Duty cycle plot (802. 11n(MCS8))



Note:

In order to simplify the report, attached plots were only the lowest data rate.

9.2 6 dB BANDWIDTH

[SISO ANT. 1]

Mode	Frequency [MHz]	Channel No.	6dB Bandwidth [MHz]	Minimum Bandwidth [MHz]
802.11b	2412	1	10.09	0.50
	2437	6	10.09	0.50
	2462	11	10.10	0.50
	2467	12	10.10	0.50
	2472	13	10.08	0.50
802.11g	2412	1	16.51	0.50
	2437	6	16.51	0.50
	2462	11	16.53	0.50
	2467	12	16.53	0.50
	2472	13	16.42	0.50
802.11n(HT20)	2412	1	17.72	0.50
	2437	6	17.74	0.50
	2462	11	17.75	0.50
	2467	12	17.74	0.50
	2472	13	17.63	0.50

[MIMO ANT. 1]

Mode	Frequency [MHz]	Channel No.	6dB Bandwidth [MHz]	Minimum Bandwidth [MHz]
802.11b	2412	1	10.09	0.50
	2437	6	10.09	0.50
	2462	11	10.10	0.50
	2467	12	10.10	0.50
	2472	13	10.08	0.50
802.11g	2412	1	16.51	0.50
	2437	6	16.51	0.50
	2462	11	16.53	0.50
	2467	12	16.53	0.50
	2472	13	16.42	0.50
802.11n(HT20)	2412	1	17.71	0.50
	2437	6	17.73	0.50
	2462	11	17.73	0.50
	2467	12	17.71	0.50
	2472	13	17.61	0.50

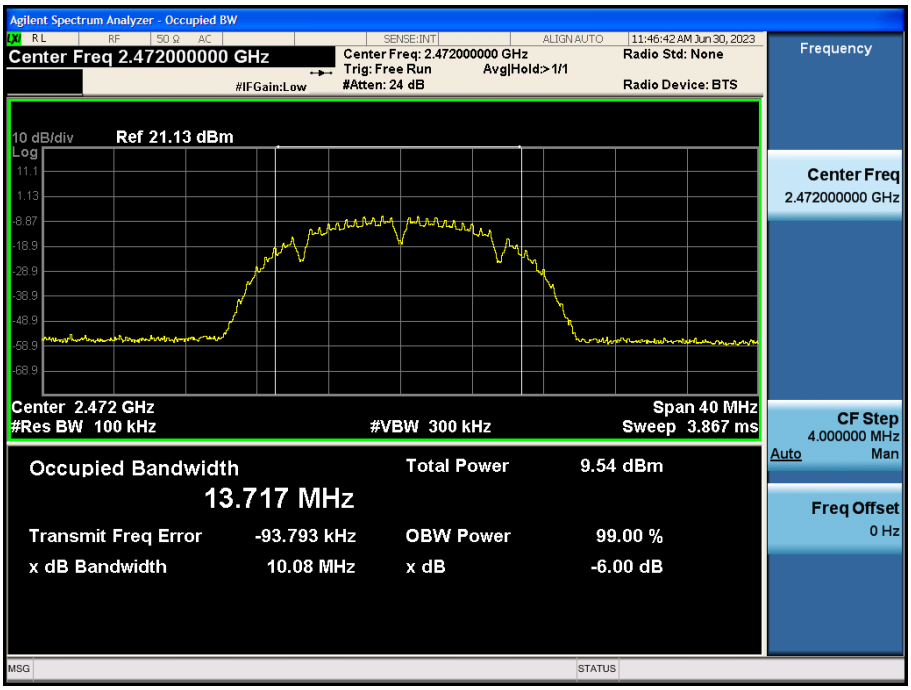
[MIMO ANT. 2]

Mode	Frequency [MHz]	Channel No.	6dB Bandwidth [MHz]	Minimum Bandwidth [MHz]
802.11b	2412	1	10.09	0.50
	2437	6	10.09	0.50
	2462	11	10.09	0.50
	2467	12	10.09	0.50
	2472	13	10.08	0.50
802.11g	2412	1	16.49	0.50
	2437	6	16.53	0.50
	2462	11	16.52	0.50
	2467	12	16.52	0.50
	2472	13	16.42	0.50
802.11n(HT20)	2412	1	17.69	0.50
	2437	6	17.69	0.50
	2462	11	17.70	0.50
	2467	12	17.70	0.50
	2472	13	17.66	0.50

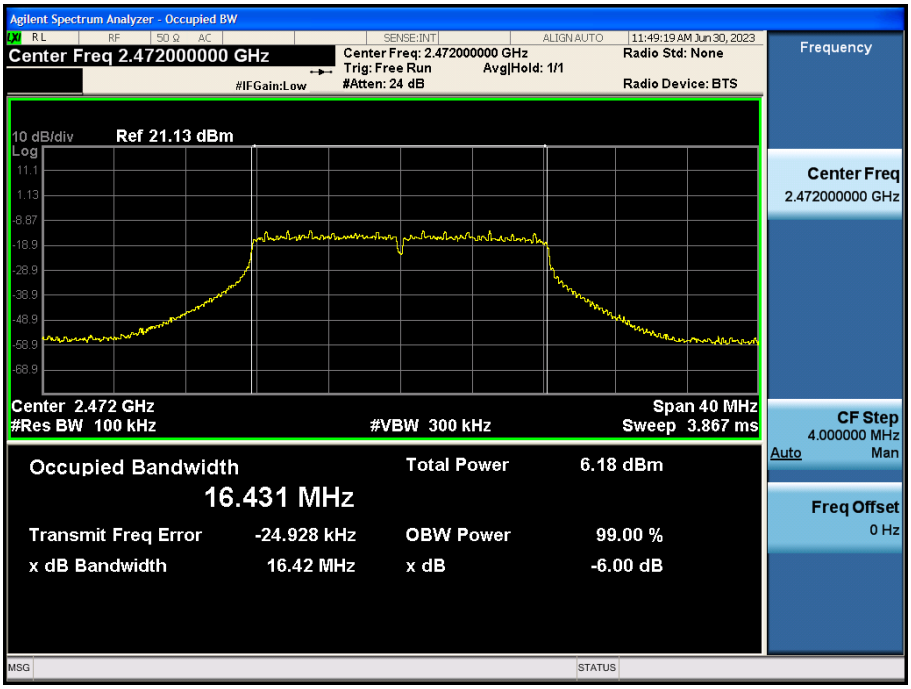
▣ Test Plots

[SISO ANT. 1]

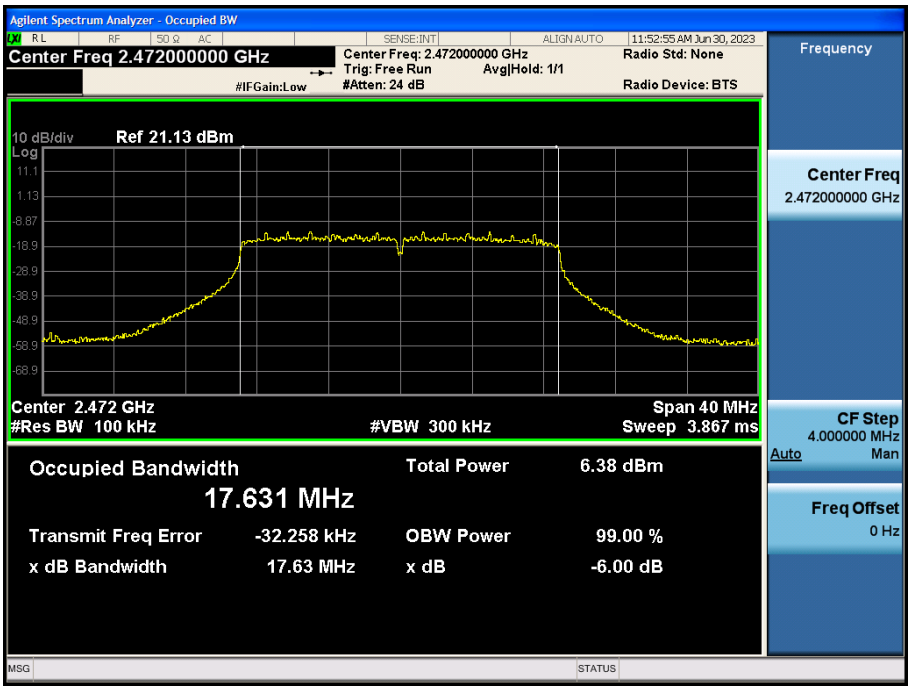
6 dB Bandwidth plot (802.11b-CH 13)



6 dB Bandwidth plot (802.11g-CH 13)

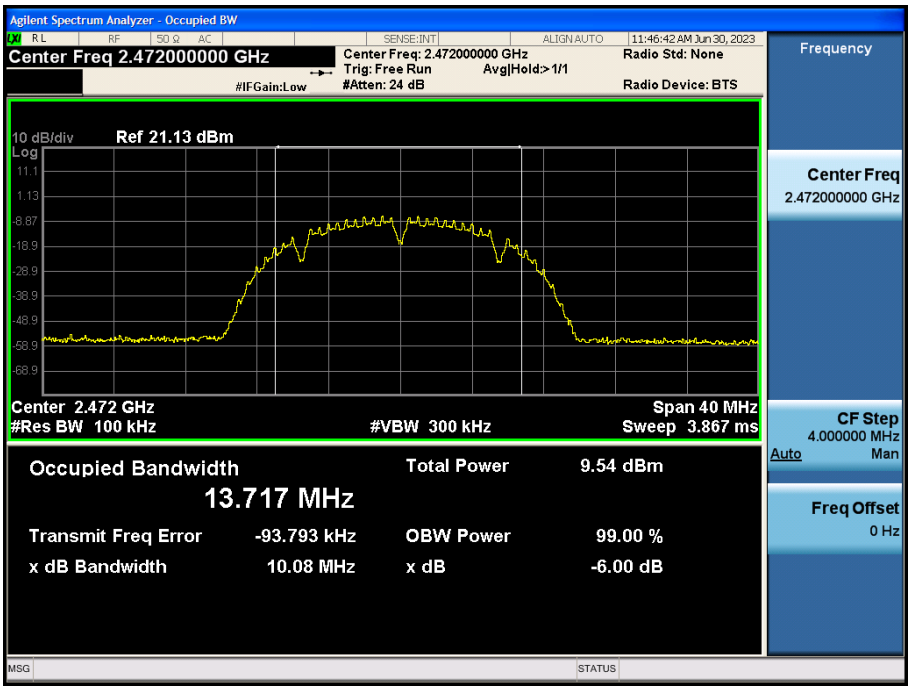


6 dB Bandwidth plot (802.11n_HT20-CH 13)

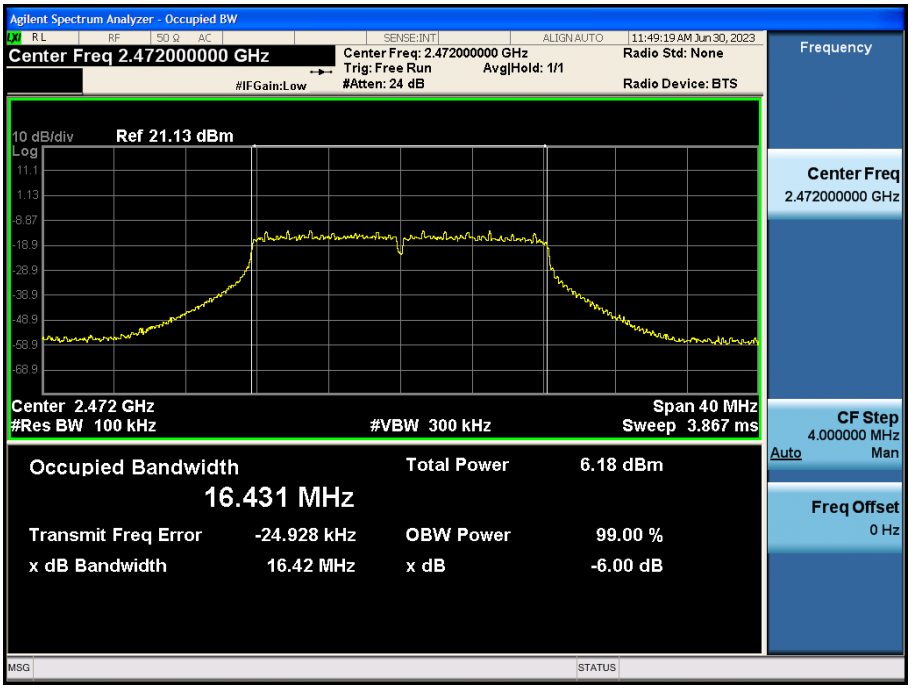


[MIMO ANT. 1]

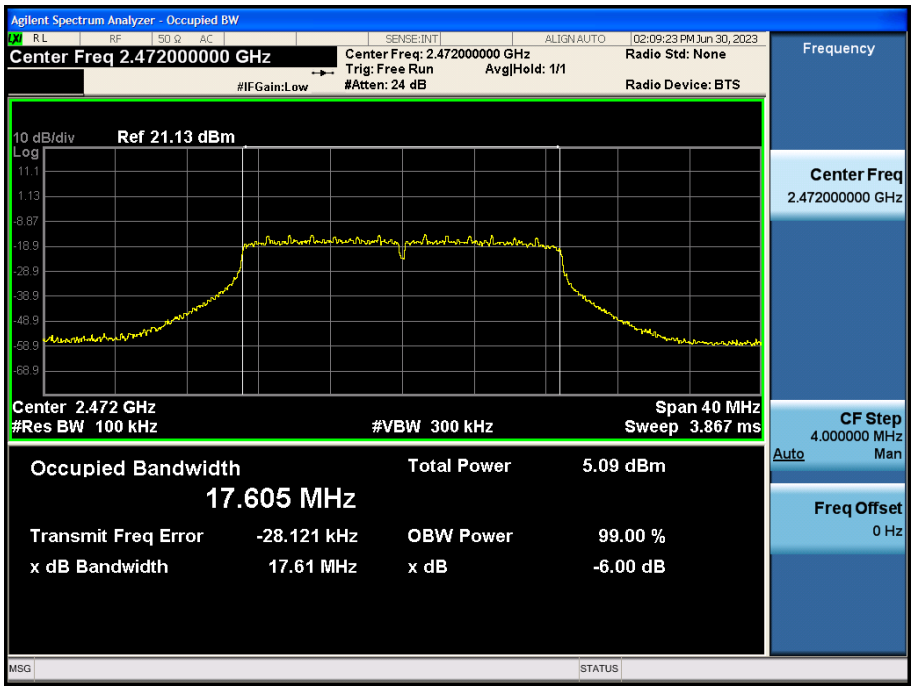
6 dB Bandwidth plot (802.11b-CH 13)



6 dB Bandwidth plot (802.11g-CH 13)

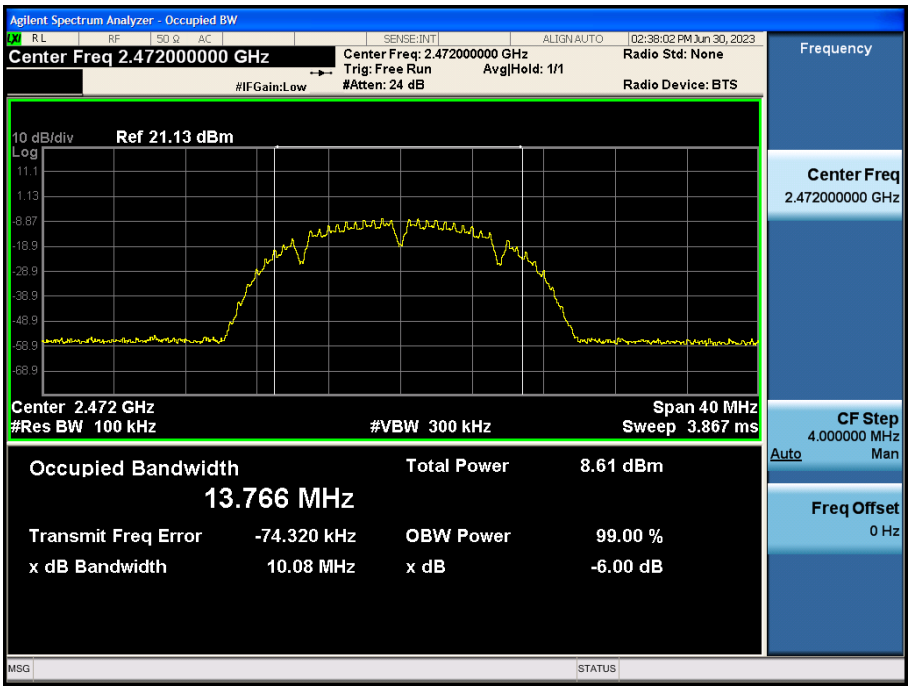


6 dB Bandwidth plot (802.11n_HT20-CH 13)

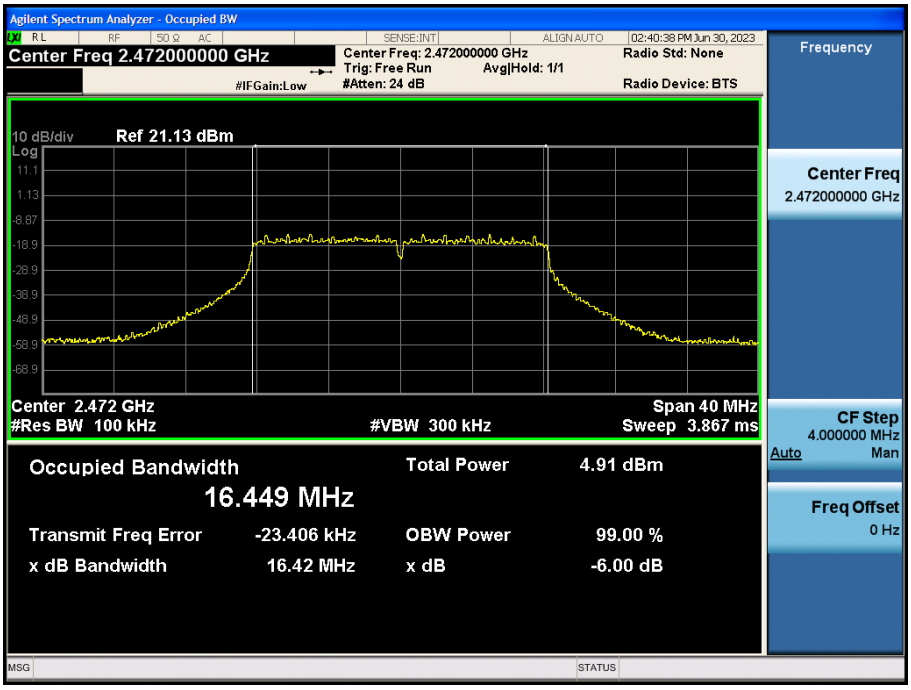


[MIMO ANT. 2]

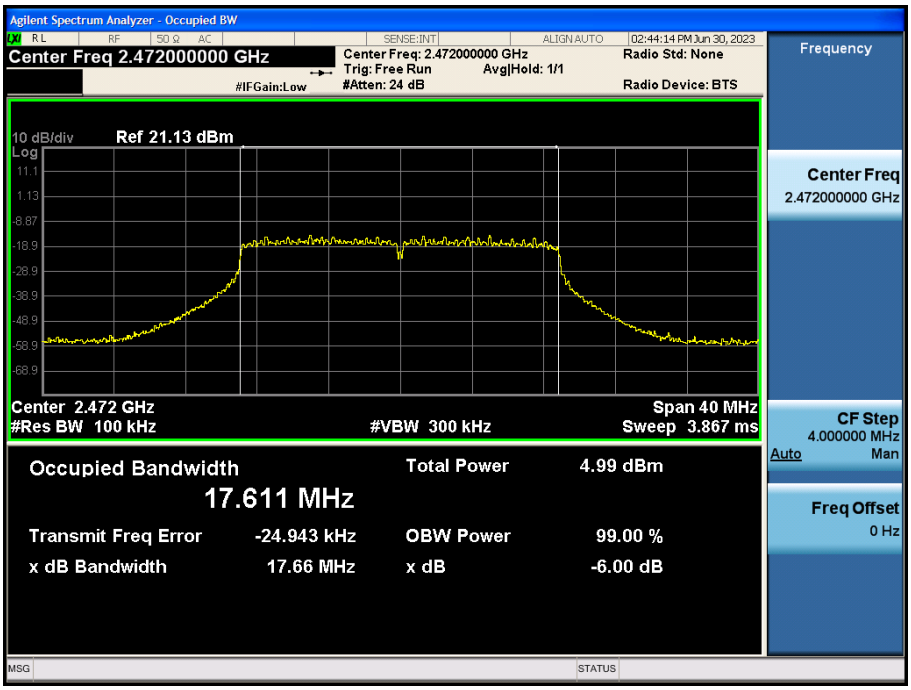
6 dB Bandwidth plot (802.11b-CH 13)



6 dB Bandwidth plot (802.11g-CH 13)



6 dB Bandwidth plot (802.11n_HT20-CH 13)



Note:

In order to simplify the report, attached plots were only the narrowest 6 dB BW channel.

9.3 OUTPUT POWER

Note :

1. MIMO Power = 10·log((10^(Ant. 1 power /10))+(10^(Ant. 2 power /10)))

Peak Power

[SISO ANT. 1]

Mode	Frequency [MHz]	Channel No.	Data Rate	Conducted Peak Power [dBm]	Limit [dBm]
802.11b	2412	1	11M	23.67	30
	2437	6	11M	23.68	30
	2462	11	11M	23.90	30
	2467	12	11M	9.42	30
	2472	13	11M	7.64	30
802.11g	2412	1	24M	22.15	30
	2437	6	24M	25.22	30
	2462	11	24M	22.72	30
	2467	12	24M	11.73	30
	2472	13	24M	6.73	30
802.11n	2412	1	MCS4	22.13	30
	2437	6	MCS4	25.20	30
	2462	11	MCS3	22.68	30
	2467	12	MCS4	11.72	30
	2472	13	MCS4	6.64	30

[MIMO (MIMO ANT. 1+ MIMO ANT. 2)]

Mode	Frequency [MHz]	Channel No.	Data Rate	Conducted Peak Power [dBm]			Limit [dBm]
				ANT1	ANT2	MIMO	
802.11b	2412	1	11M	23.67	22.99	26.35	30
	2437	6	11M	23.68	22.76	26.25	30
	2462	11	11M	23.90	23.13	26.55	30
	2467	12	11M	9.42	8.49	11.99	30
	2472	13	11M	7.64	6.66	10.19	30
802.11g	2412	1	24M	22.15	21.49	24.84	30
	2437	6	24M	25.22	24.56	27.91	30
	2462	11	24M	22.72	21.55	25.19	30
	2467	12	24M	11.73	11.06	14.42	30
	2472	13	24M	6.73	6.07	9.42	30
802.11n	2412	1	MCS12	20.84	21.46	24.17	30
	2437	6	MCS12	24.18	24.50	27.35	30
	2462	11	MCS12	21.33	21.48	24.42	30
	2467	12	MCS12	10.75	10.77	13.77	30
	2472	13	MCS12	5.95	5.85	8.91	30

Average Power

Note :

1. Total Power [dBm] = Measured Power [dBm] + Duty Cycle Factor [dB]

[SISO ANT. 1]

Mode	Frequency [MHz]	Channel No.	Data Rate	Conducted Average Power [dBm]			Limit [dBm]
				Measured Value	D.C.F	Summed	
802.11b	2412	1	11M	17.01	0.46	17.47	30
	2437	6	11M	17.01	0.46	17.47	30
	2462	11	11M	17.18	0.46	17.64	30
	2467	12	11M	3.02	0.46	3.48	30
	2472	13	11M	1.18	0.46	1.64	30
802.11g	2412	1	18M	12.43	0.78	13.21	30
	2437	6	18M	15.76	0.78	16.54	30
	2462	11	18M	12.90	0.78	13.68	30
	2467	12	18M	2.47	0.78	3.25	30
	2472	13	18M	-2.63	0.78	-1.86	30
802.11n	2412	1	MCS2	12.39	0.83	13.22	30
	2437	6	MCS2	15.74	0.83	16.57	30
	2462	11	MCS2	12.57	0.83	13.41	30
	2467	12	MCS2	2.46	0.83	3.29	30
	2472	13	MCS2	-2.71	0.83	-1.88	30

[MIMO (MIMO ANT. 1+ MIMO ANT. 2)]

Mode	Frequency [MHz]	Channel No.	Data Rate	Conducted Average Power [dBm]			Limit [dBm]
				ANT1	ANT2	MIMO	
802.11b	2412	1	11M	17.47	17.59	20.54	30
	2437	6	11M	17.47	17.12	20.31	30
	2462	11	11M	17.64	17.41	20.54	30
	2467	12	11M	3.48	2.97	6.24	30
	2472	13	11M	1.64	1.00	4.34	30
802.11g	2412	1	18M	13.21	13.71	16.47	30
	2437	6	18M	16.54	16.26	19.41	30
	2462	11	18M	13.68	13.35	16.53	30
	2467	12	18M	3.25	2.73	6.00	30
	2472	13	18M	-1.86	-2.23	0.97	30
802.11n	2412	1	MCS12	13.46	13.32	16.40	30
	2437	6	MCS12	16.34	16.06	19.22	30
	2462	11	MCS12	13.79	13.55	16.69	30
	2467	12	MCS12	3.26	2.72	6.01	30
	2472	13	MCS12	-1.94	-2.23	0.93	30

9.4 POWER SPECTRAL DENSITY

Note :

1. MIMO PSD = 10·log((10^(Ant. 1 PSD /10))+(10^(Ant. 2 PSD /10)))
2. Total PSD = Measured Value + Duty Cycle Factor

[SISO ANT. 1]

BW	Frequency [MHz]	Channel No.	Data Rate	Power Spectral Density [dBm]			Limit [dBm/kHz]
				Measured Value	D.C.F	Summed	
802.11b	2412	1	11M	-3.934	0.461	-3.473	8 dBm / 3 kHz
	2437	6	11M	**-3.618**	**0.461**	**-3.157**	
	2462	11	11M	-3.725	0.461	-3.264	
	2467	12	11M	-17.727	0.461	-17.266	
	2472	13	11M	-19.783	0.461	-19.322	
802.11g	2412	1	18M	-11.922	0.777	-11.145	
	2437	6	18M	**-8.407**	**0.777**	**-7.630**	
	2462	11	18M	-10.658	0.777	-9.881	
	2467	12	18M	-21.408	0.777	-20.631	
	2472	13	18M	-26.485	0.777	-25.708	
802.11n	2412	1	MCS2	-11.924	0.831	-11.093	
	2437	6	MCS2	**-8.115**	**0.831**	**-7.284**	
	2462	11	MCS2	-10.609	0.831	-9.778	
	2467	12	MCS2	-22.178	0.831	-21.347	
	2472	13	MCS2	-26.741	0.831	-25.910	

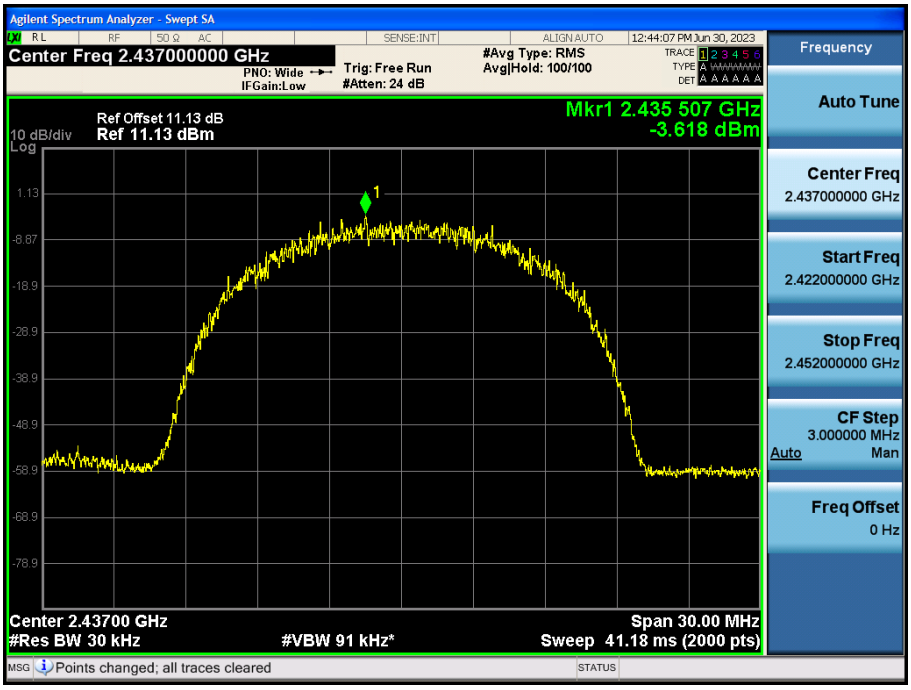
[MIMO (MIMO ANT. 1+ MIMO ANT. 2)]

BW	Frequency [MHz]	Channel No.	Data Rate	Power Spectral Density [dBm]			Limit [dBm/kHz]
				ANT1	ANT2	MIMO	
802.11b	2412	1	11M	-3.473	-4.042	-0.737	8 dBm / 3 kHz
	2437	6	11M	-3.157	-4.295	-0.678	
	2462	11	11M	**-3.264**	**-3.961**	**-0.588**	
	2467	12	11M	-17.266	-18.362	-14.769	
	2472	13	11M	-19.322	-20.307	-16.776	
802.11g	2412	1	18M	-11.145	-11.321	-8.222	
	2437	6	18M	**-7.630**	**-8.152**	**-4.873**	
	2462	11	18M	-11.261	-11.770	-8.498	
	2467	12	18M	-20.631	-21.969	-18.239	
	2472	13	18M	-25.708	-26.724	-23.176	
802.11n	2412	1	MCS12	-8.477	-7.619	-5.017	
	2437	6	MCS12	**-6.484**	**-5.469**	**-2.937**	
	2462	11	MCS12	-8.871	-8.823	-5.837	
	2467	12	MCS12	-19.403	-19.713	-16.545	
	2472	13	MCS12	-25.131	-23.414	-21.178	

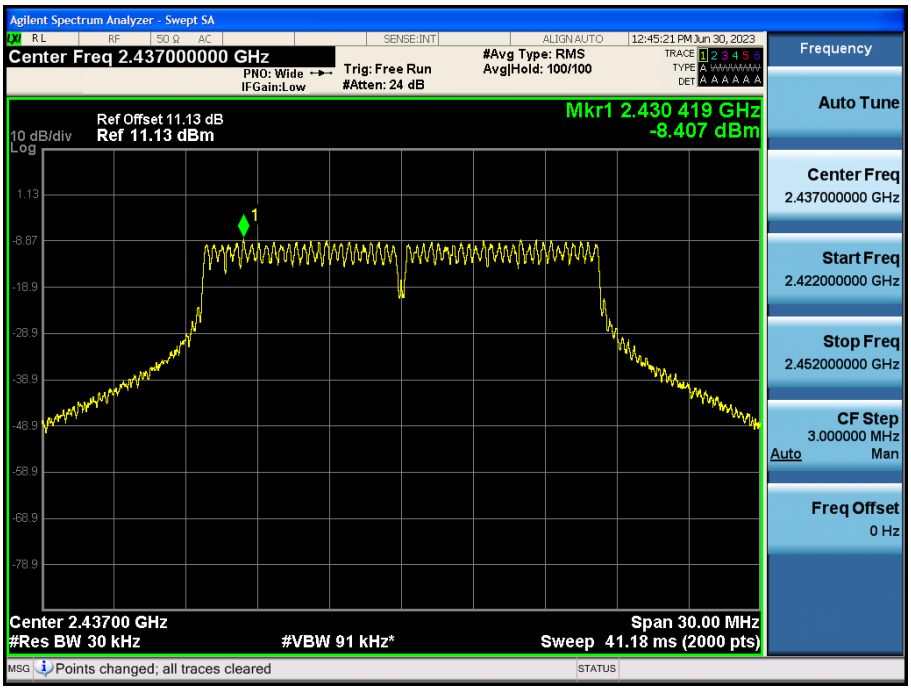
▣ Test Plots

[SISO ANT. 1]

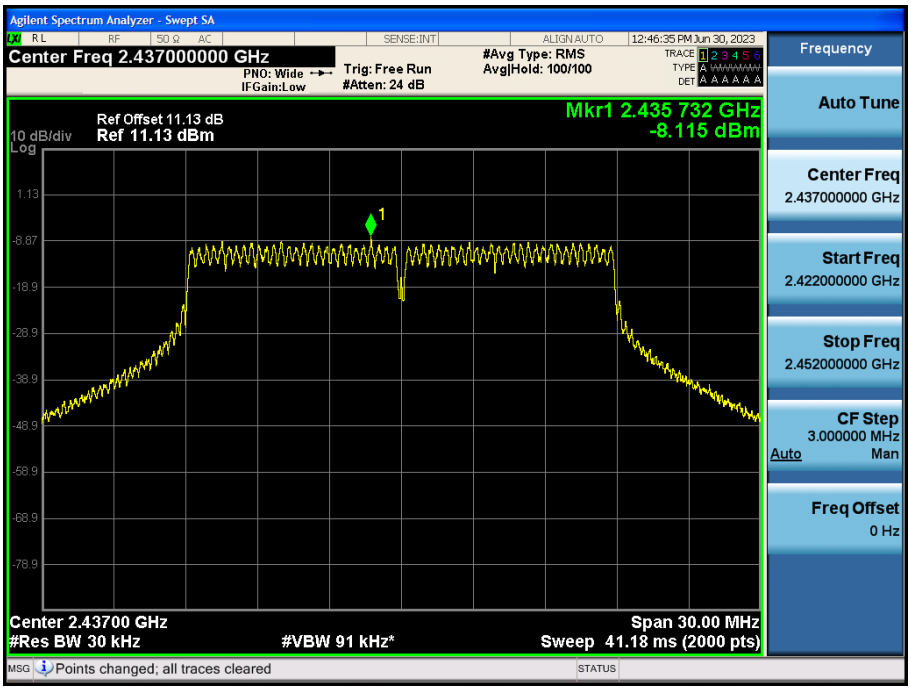
Power Spectral Density (802.11b-CH 6)



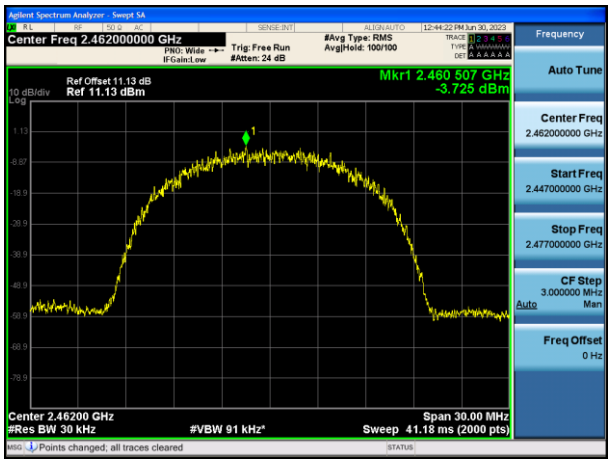
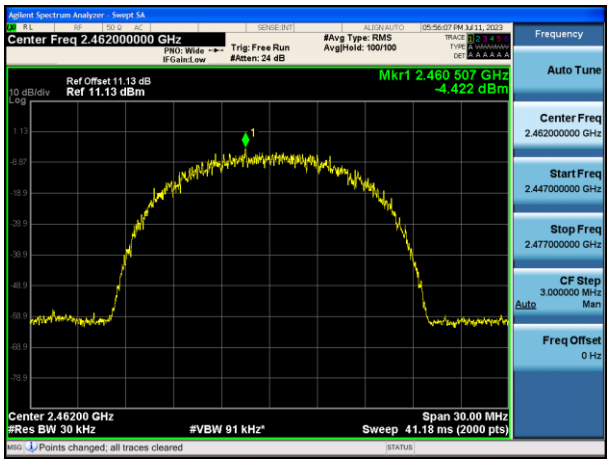
Power Spectral Density (802.11g-CH 6)

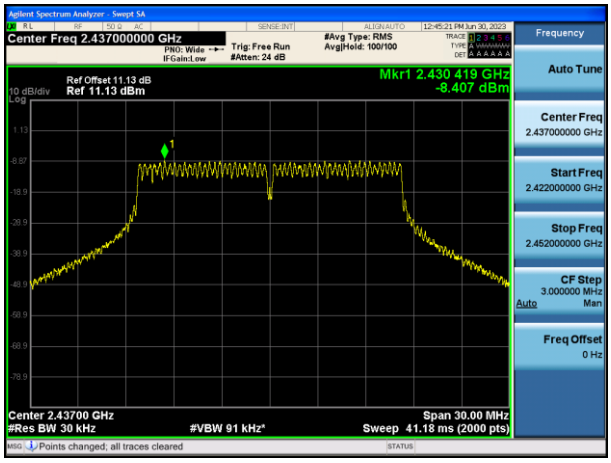
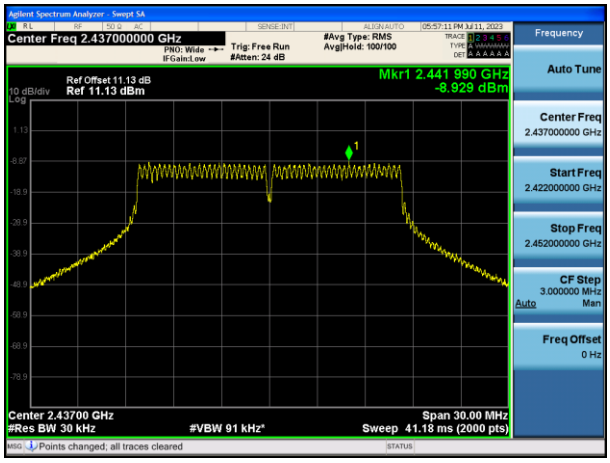


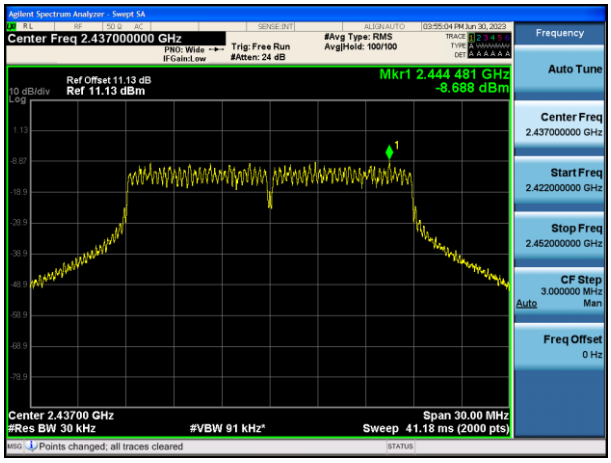
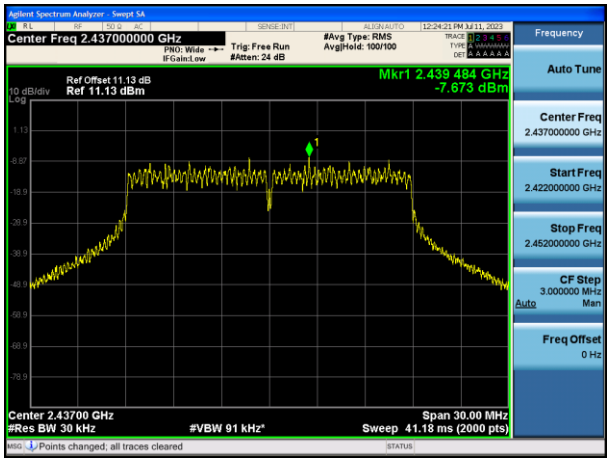
Power Spectral Density (802.11n_HT20-CH 6)



[MIMO]

Power Spectral Density (802.11b-CH 11)	
ANT. 1	**ANT. 2**
	

Power Spectral Density (802.11g-CH 6)	
ANT. 1	**ANT. 2**
	

Power Spectral Density (802.11n-CH 6)	
ANT. 1	**ANT. 2**
	

Note :

In order to simplify the report, attached plots were only the worst case PSD channel.

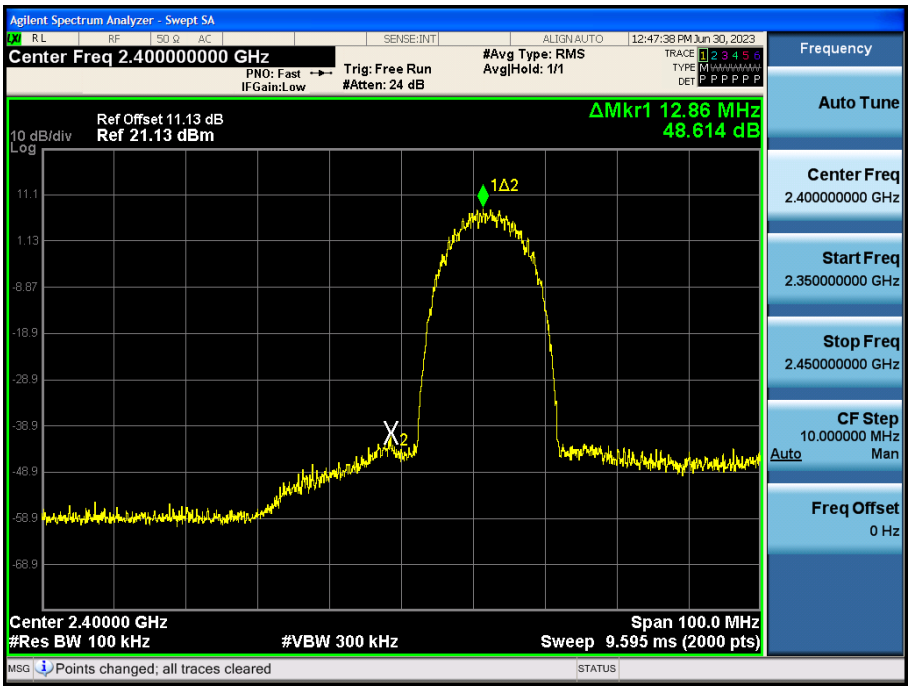
9.5 BAND EDGE / CONDUCTED SPURIOUS EMISSIONS

Test Result : please refer to the plot below.
In order to simplify the report, attached plots were only the worst case channel and data rate.

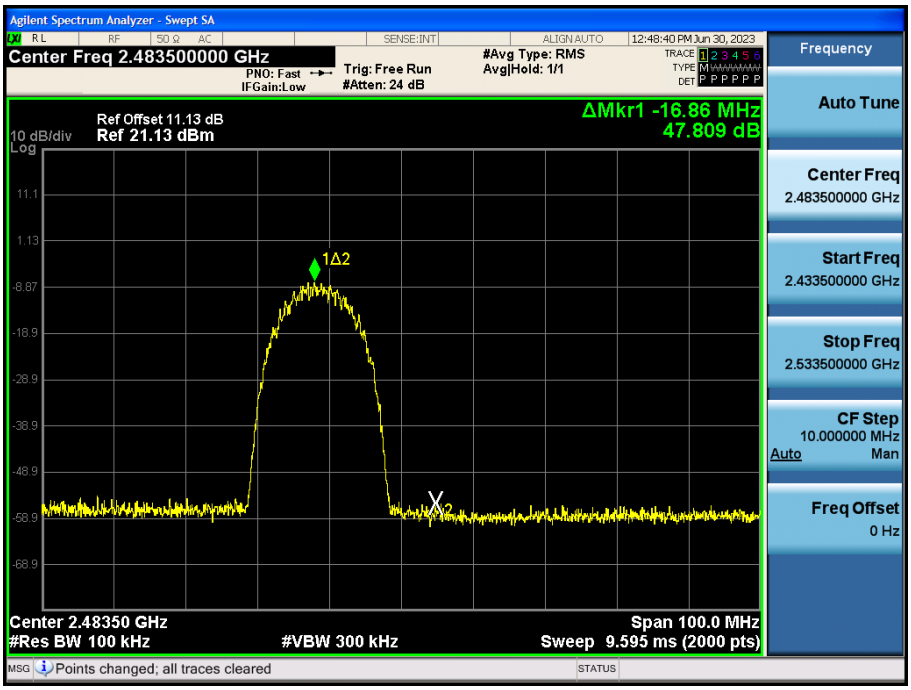
▣ Test Plots(Band Edge)

[SISO ANT. 1]

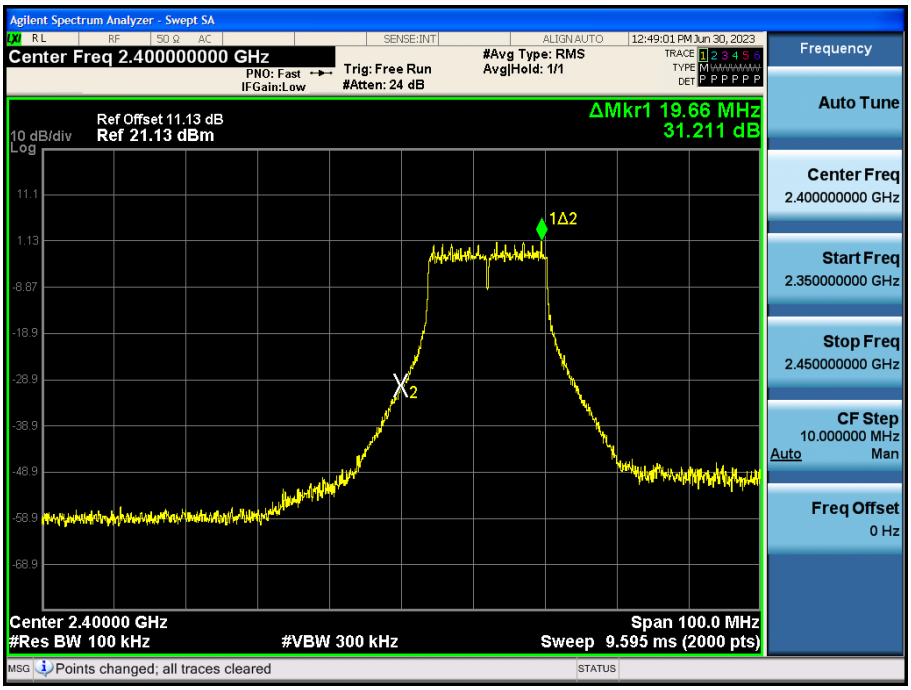
Band Edge (802.11b-CH1)



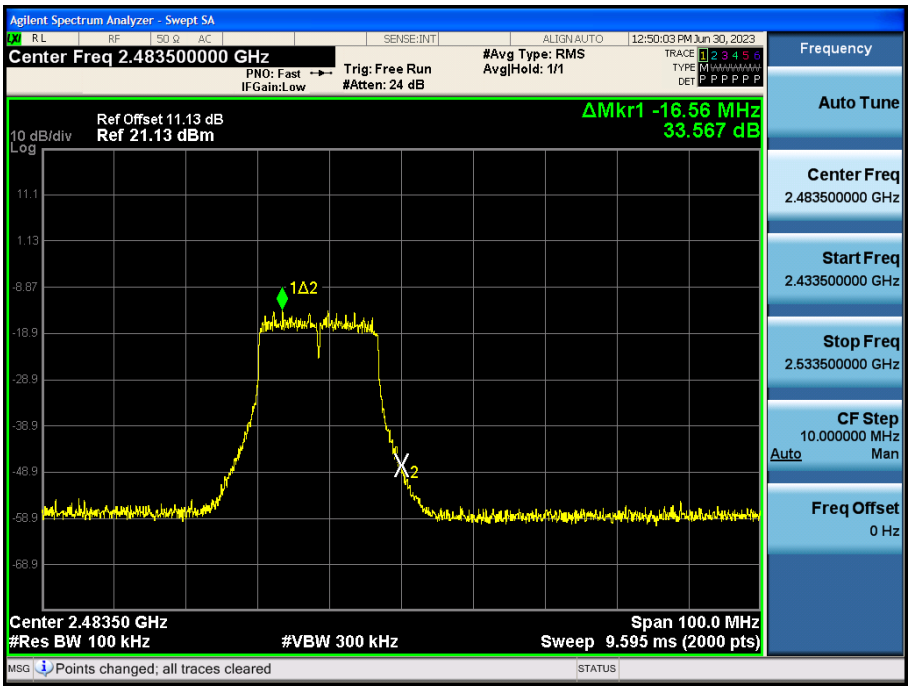
Band Edge (802.11b-CH13)



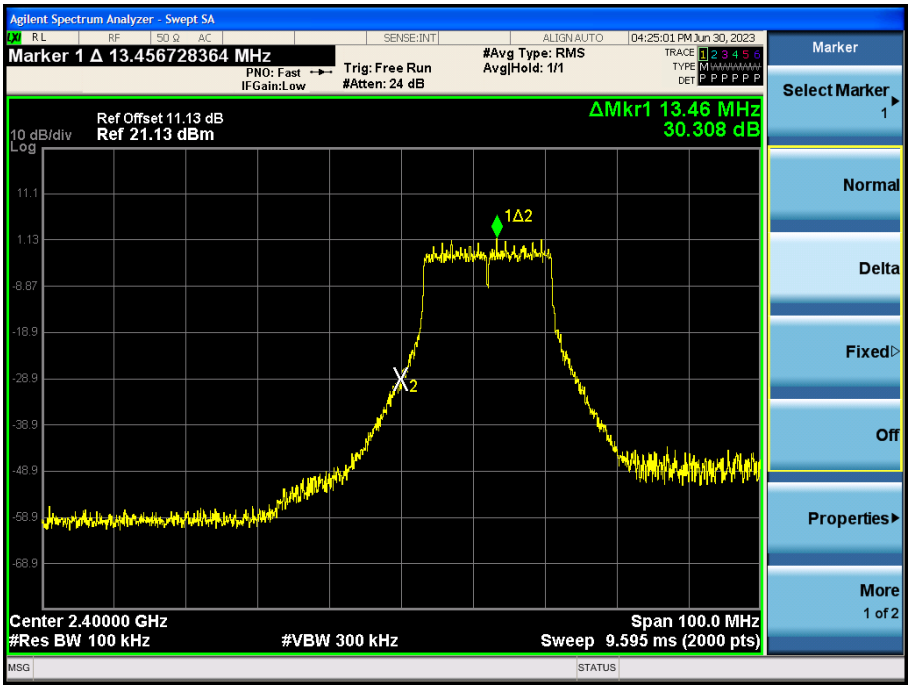
Band Edge (802.11g-CH1)



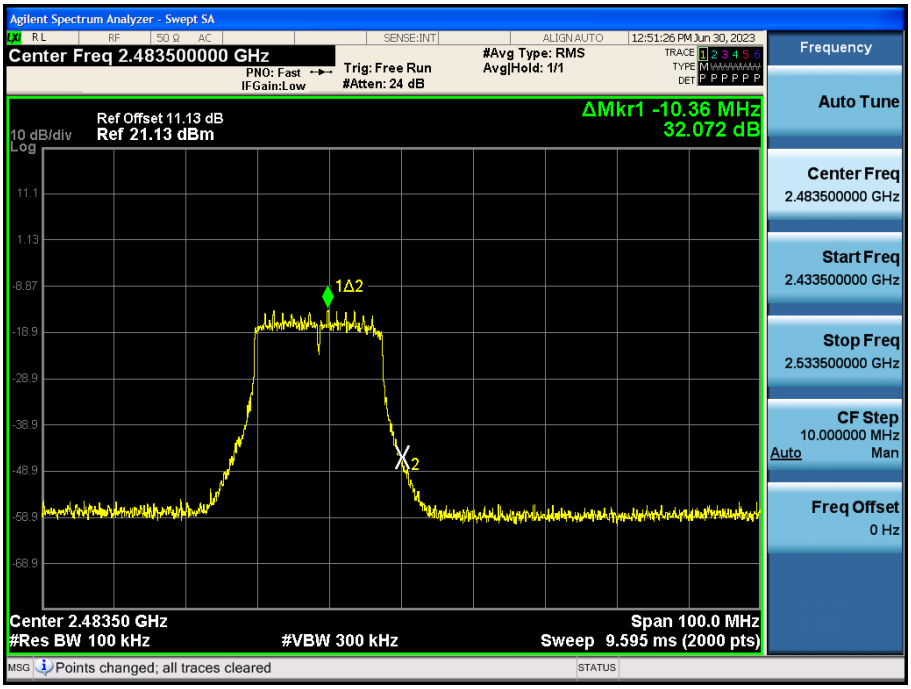
Band Edge (802.11g-CH13)



Band Edge (802.11n_HT20-CH1)

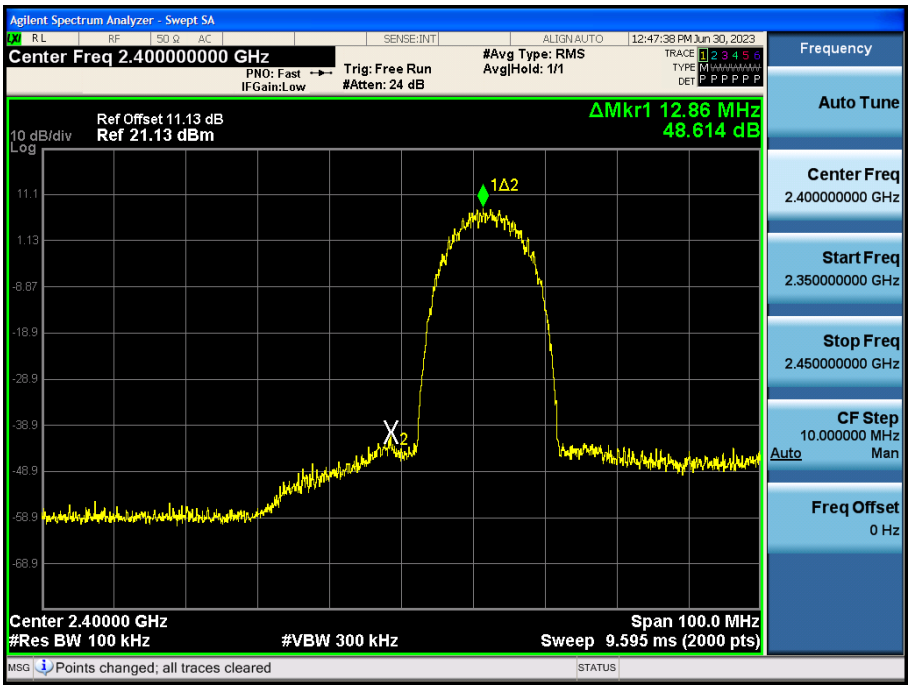


Band Edge (802.11n_HT20-CH13)

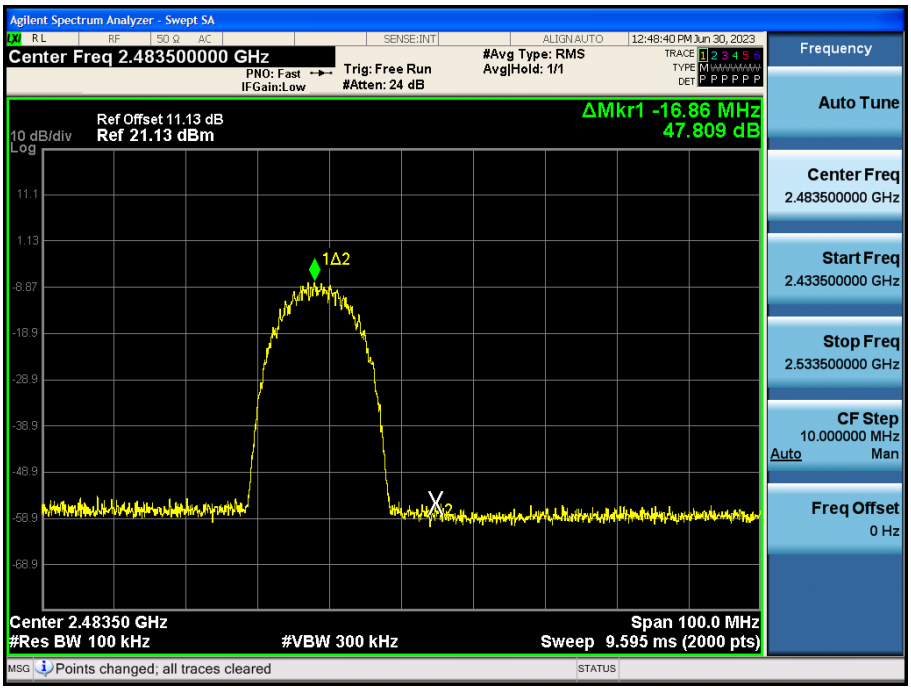


[MIMO ANT. 1]

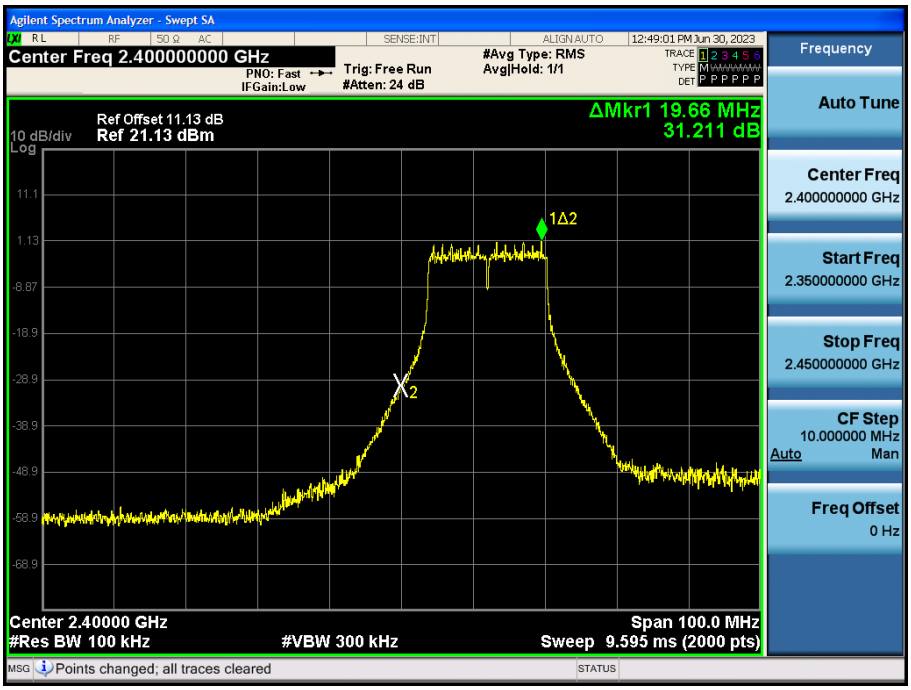
Band Edge (802.11b-CH1)



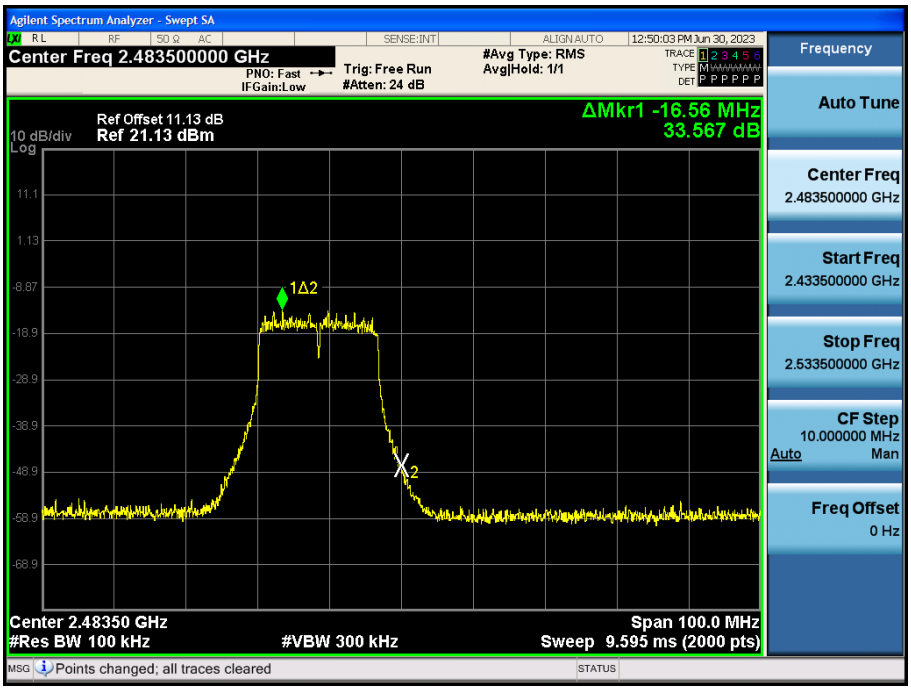
Band Edge (802.11b-CH13)



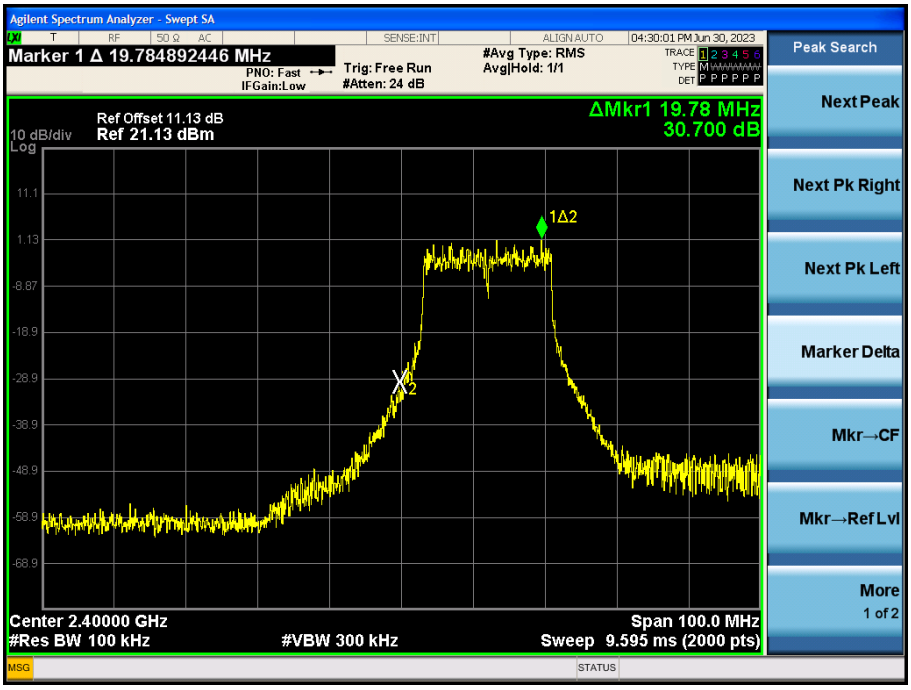
Band Edge (802.11g-CH1)



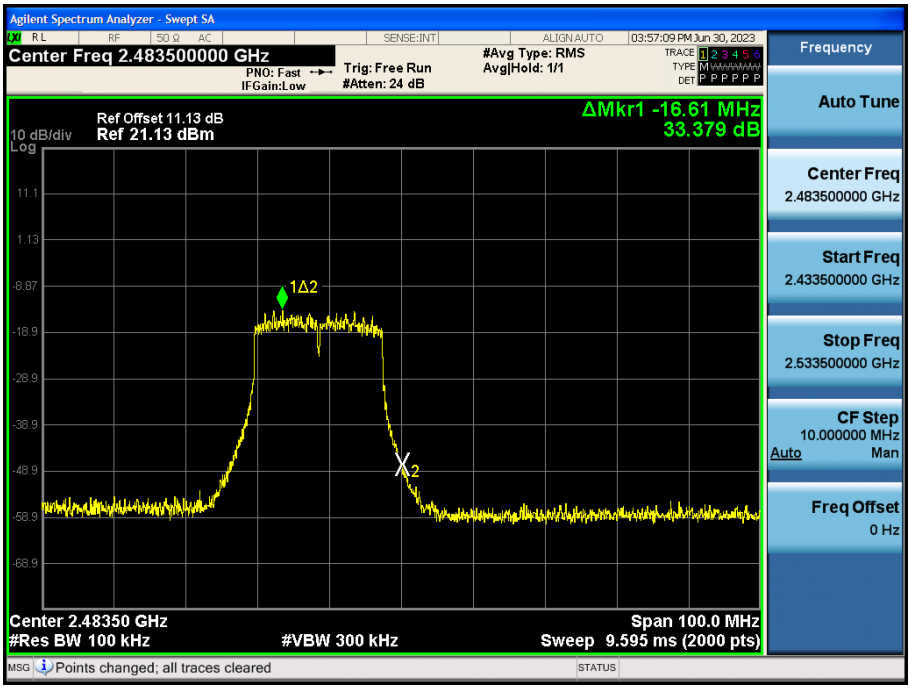
Band Edge (802.11g-CH13)



Band Edge (802.11n_HT20-CH1)

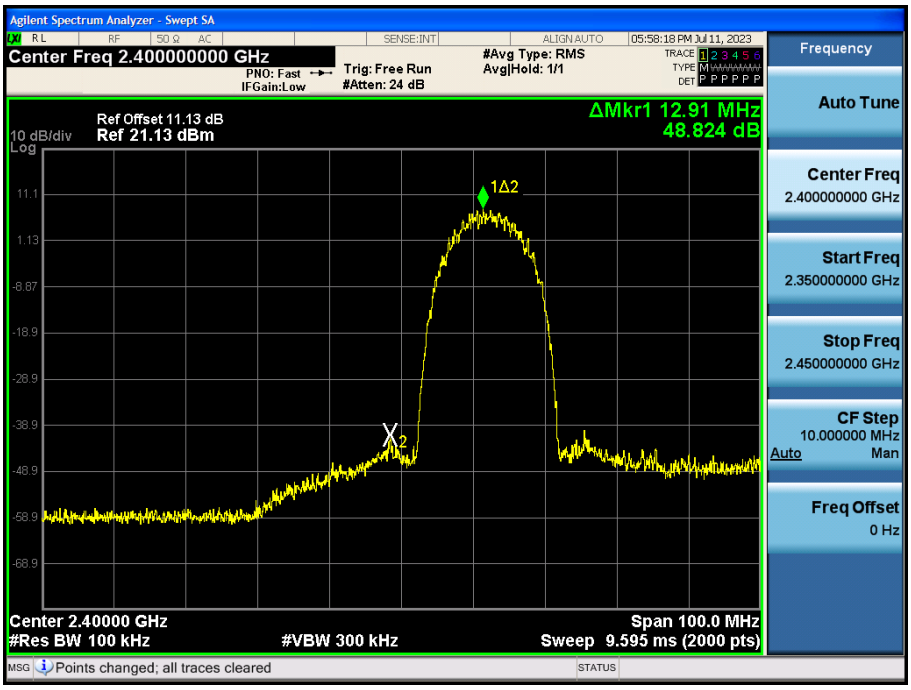


Band Edge (802.11n_HT20-CH13)

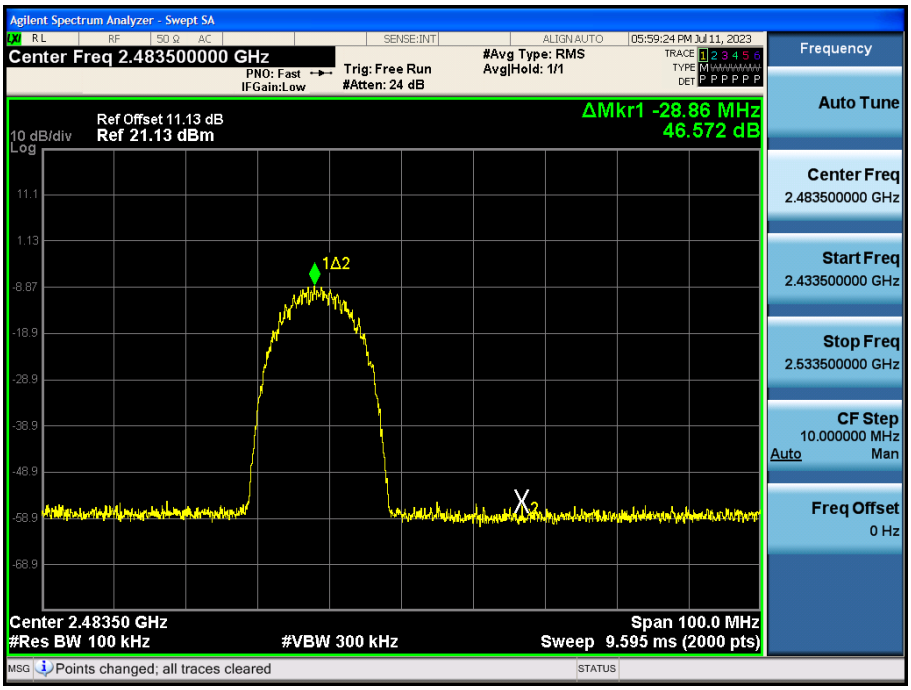


[MIMO ANT. 2]

Band Edge (802.11b-CH1)

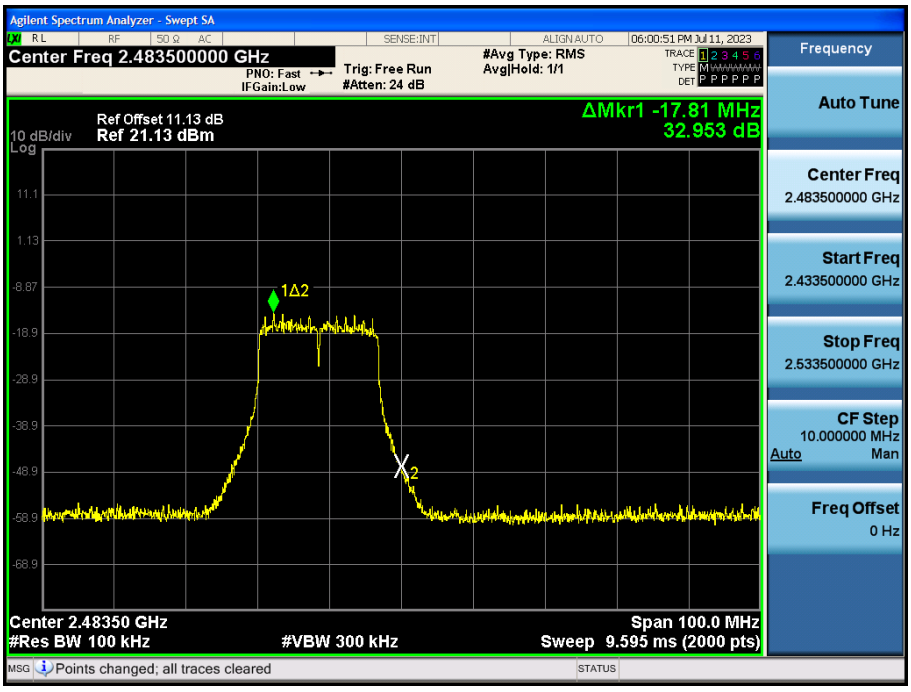


Band Edge (802.11b-CH13)

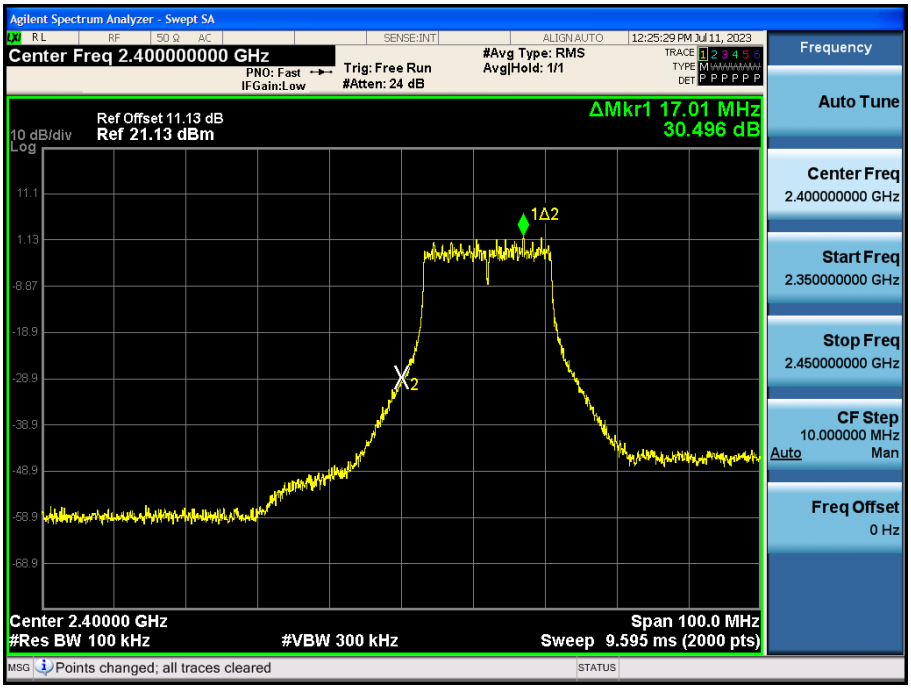


Band Edge (802.11g-CH1)

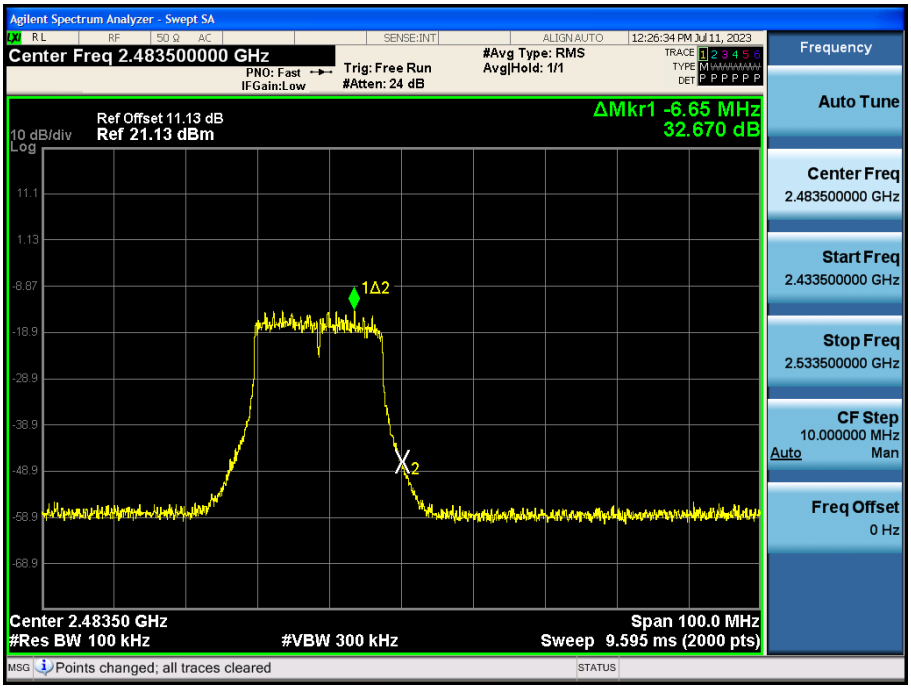
Band Edge (802.11g-CH13)



Band Edge (802.11n_HT20-CH1)



Band Edge (802.11n_HT20-CH13)

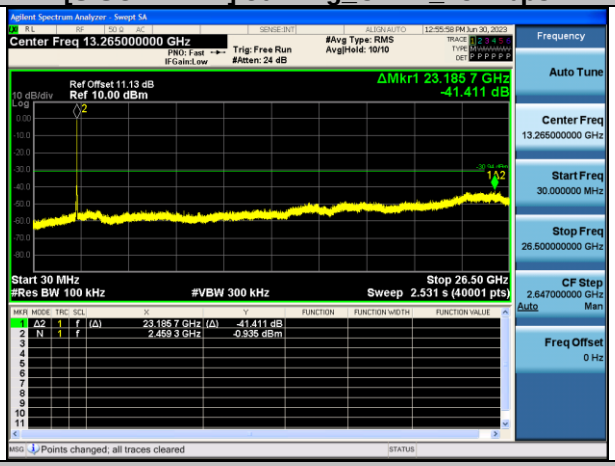


▣ Test Plots(Conducted Spurious Emission)

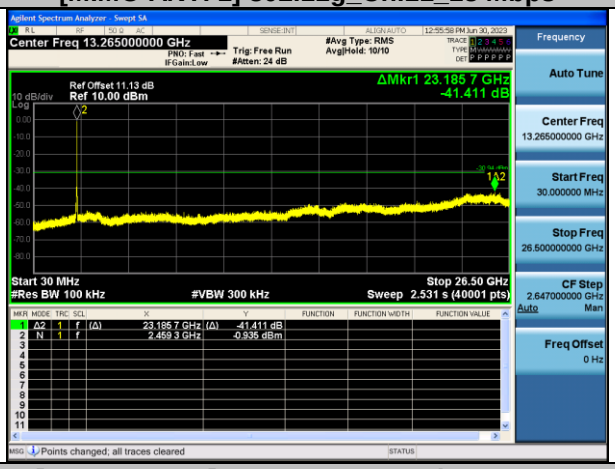
Note:

In order to simplify the report, attached plots were only the worst case.

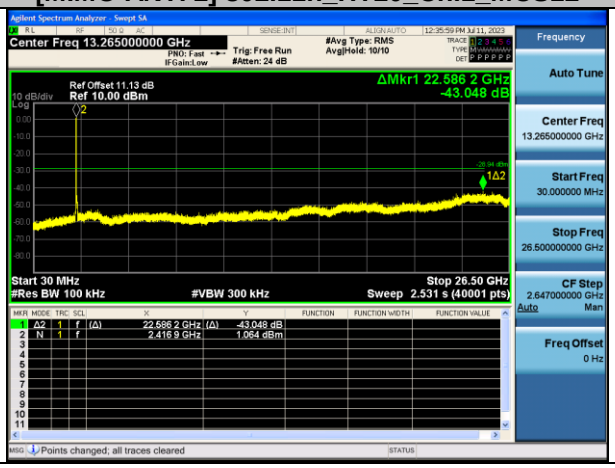
[SISO ANT. 1] 802.11g_Ch.11_18 Mbps



[MIMO ANT. 1] 802.11g_Ch.11_18 Mbps



[MIMO ANT. 2] 802.11n_HT20_Ch.1_MCS12



9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

Frequency	Measured Value	A.F+C.L+D.F	Ant. POL	Total	Limit	Margin
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]
No Critical peaks found						

Note:

1. The Measured value of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Distance extrapolation factor = 40log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBµV) + Distance extrapolation factor

Frequency Range : Below 1 GHz

Frequency	Measured Value	A.F+C.L	Ant. POL	Total	Limit	Margin
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]
No Critical peaks found						

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.

Frequency Range : Above 1 GHz

[MIMO]

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2412 MHz
Channel No.	01 Ch

Frequency [MHz]	Measured Value [dBµV]	AF+CL+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4824	43.05	3.58	V	46.63	73.98	27.35	PK
4824	30.98	3.58	V	34.56	53.98	19.42	AV
7236	37.42	12.72	V	50.14	73.98	23.84	PK
7236	25.05	12.72	V	37.77	53.98	16.21	AV
4824	43.36	3.58	H	46.94	73.98	27.04	PK
4824	31.25	3.58	H	34.83	53.98	19.15	AV
7236	37.90	12.72	H	50.62	73.98	23.36	PK
7236	25.48	12.72	H	38.20	53.98	15.78	AV

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2437 MHz
Channel No.	06 Ch

Frequency [MHz]	Measured Value [dBµV]	AF+CL+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4874	42.88	3.64	V	46.52	73.98	27.46	PK
4874	30.79	3.64	V	34.43	53.98	19.55	AV
7311	37.55	11.97	V	49.52	73.98	24.46	PK
7311	25.49	11.97	V	37.46	53.98	16.52	AV
4874	43.73	3.64	H	47.37	73.98	26.61	PK
4874	31.52	3.64	H	35.16	53.98	18.82	AV
7311	38.16	11.97	H	50.13	73.98	23.85	PK
7311	26.15	11.97	H	38.12	53.98	15.86	AV

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2462 MHz
Channel No.	11 Ch

Frequency [MHz]	Measured Value [dBµV]	AF+CL+DF-AG [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4924	41.91	4.84	V	46.75	73.98	27.23	PK
4924	30.83	4.84	V	35.67	53.98	18.31	AV
7386	38.11	12.44	V	50.55	73.98	23.43	PK
7386	26.02	12.44	V	38.46	53.98	15.52	AV
4924	42.89	4.84	H	47.73	73.98	26.25	PK
4924	31.04	4.84	H	35.88	53.98	18.10	AV
7386	**38.57**	**12.44**	**H**	**51.01**	**73.98**	**22.97**	**PK**
7386	**26.31**	**12.44**	**H**	**38.75**	**53.98**	**15.23**	**AV**

Note:

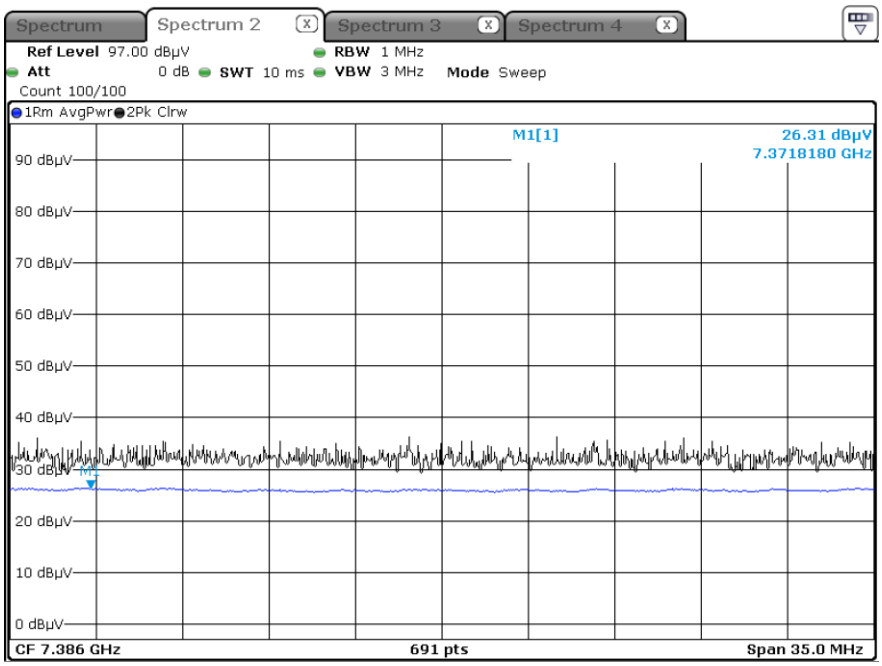
Channel 12 and 13 are less powerful than channel 11. So, The test for high channel was performed at channel 11.

▣ Test Plots

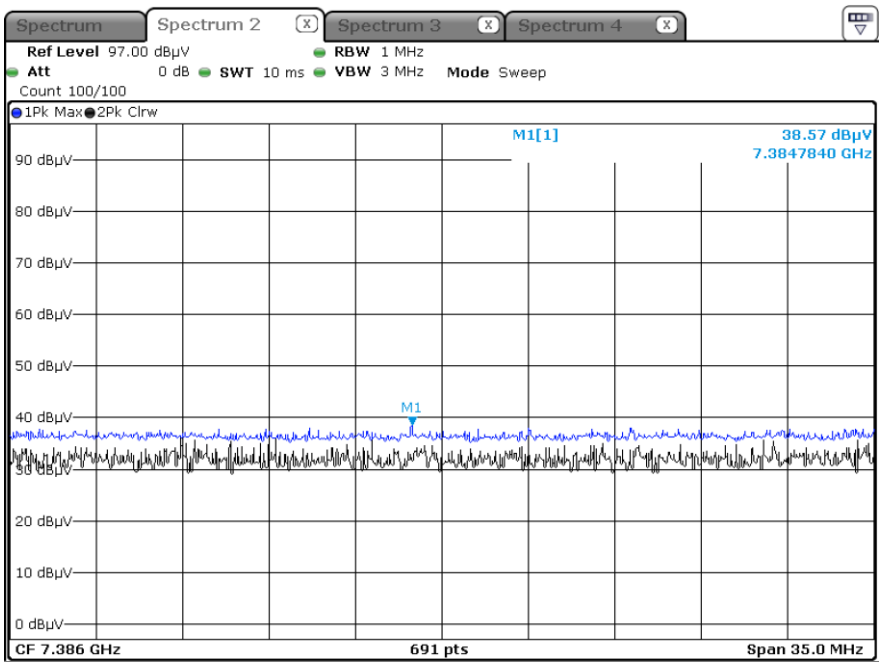
Note: In order to simplify the report, Plot of worst case are only reported.

[MIMO]

Radiated Spurious Emissions plot – Average Result (802.11b_1 Mbps, Ch.11 3rd Harmonic, Z-H)



Radiated Spurious Emissions plot – Peak Result (802.11b_1 Mbps, Ch.11 3rd Harmonic, Z-H)



9.7 RADIATED RESTRICTED BAND EDGES

[MIMO]

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2412 MHz
Channel No.	01 Ch

Frequency [MHz]	Measured Value [dBμV]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
#2383~2390	28.67	34.35	H	63.02	73.98	10.96	PK
#2383~2390	14.02	34.35	H	48.37	53.98	5.61	AV
2390~2383	32.55	34.35	H	66.90	73.98	7.08	PK
2390~2383	12.08	34.35	H	46.43	53.98	7.55	AV
#2383~2390	27.93	34.35	V	62.28	73.98	11.70	PK
#2383~2390	13.67	34.35	V	48.02	53.98	5.96	AV
2390~2383	31.88	34.35	V	66.23	73.98	7.75	PK
2390~2383	11.67	34.35	V	46.02	53.98	7.96	AV

Note : Integration method Used (ANSI C63.10 Section11.13.3)

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2462 MHz
Channel No.	11 Ch

Frequency [MHz]	Measured Value [dBμV]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
2483.5~2500	34.65	34.83	H	69.48	73.98	4.50	PK
2483.5~2500	13.36	34.83	H	48.19	53.98	5.79	AV
2483.5~2500	33.62	34.83	V	68.45	73.98	5.53	PK
2483.5~2500	12.91	34.83	V	47.74	53.98	6.24	AV

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2467 MHz
Channel No.	12 Ch

Frequency [MHz]	Measured Value [dBµV]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2483.5	22.18	34.83	H	57.01	73.98	16.98	PK
2483.5	8.85	34.83	H	43.68	53.98	10.31	AV
2483.5	21.64	34.83	V	56.47	73.98	17.52	PK
2483.5	8.03	34.83	V	42.86	53.98	11.13	AV

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2472 MHz
Channel No.	13 Ch

Frequency [MHz]	Measured Value [dBµV]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2483.5	24.39	34.83	H	59.22	73.98	14.77	PK
2483.5	8.75	34.83	H	43.58	53.98	10.41	AV
2483.5	23.85	34.83	V	58.68	73.98	15.31	PK
2483.5	8.12	34.83	V	42.95	53.98	11.04	AV

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2412 MHz
Channel No.	01 Ch

Frequency [MHz]	Measured Value [dBµV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2310~2390	35.04	0.00	34.35	H	69.39	73.98	4.59	PK
2310~2390	14.34	0.29	34.35	H	48.98	53.98	5.00	AV
2310~2390	34.52	0.00	34.35	V	68.87	73.98	5.11	PK
2310~2390	13.92	0.29	34.35	V	48.56	53.98	5.42	AV

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2462 MHz
Channel No.	11 Ch

Frequency [MHz]	Measured Value [dBµV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
#2483.5~2490.5	26.86	0.00	34.83	H	61.69	73.98	12.30	PK
#2483.5~2490.5	14.83	0.29	34.83	H	49.95	53.98	4.04	AV
2490.5~2500	26.65	0.00	34.83	H	61.48	73.98	12.51	PK
2490.5~2500	9.61	0.29	34.83	H	44.73	53.98	9.26	AV
#2483.5~2490.5	25.51	0.00	34.83	V	60.34	73.98	13.65	PK
#2483.5~2490.5	13.67	0.29	34.83	V	48.79	53.98	5.20	AV
2490.5~2500	25.91	0.00	34.83	V	60.74	73.98	13.25	PK
2490.5~2500	8.49	0.29	34.83	V	43.61	53.98	10.38	AV

Note : Integration method Used (ANSI C63.10 Section11.13.3)

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2417 MHz
Channel No.	2 Ch

Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
#2383~2390	28.43	0.00	34.35	H	62.78	73.98	11.20	PK
#2383~2390	15.05	0.29	34.35	H	49.69	53.98	4.29	AV
2390~2383	34.47	0.00	34.35	H	68.82	73.98	5.16	PK
2390~2383	12.30	0.29	34.35	H	46.94	53.98	7.04	AV
#2383~2390	27.61	0.00	34.35	V	61.96	73.98	12.02	PK
#2383~2390	14.81	0.29	34.35	V	49.45	53.98	4.53	AV
2390~2383	33.24	0.00	34.35	V	67.59	73.98	6.39	PK
2390~2383	11.91	0.29	34.35	V	46.55	53.98	7.43	AV

Note : Integration method Used (ANSI C63.10 Section11.13.3)

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2457 MHz
Channel No.	10 Ch

Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
#2483.5~2490.5	29.24	0.00	34.83	H	64.07	73.98	9.91	PK
#2483.5~2490.5	15.60	0.29	34.83	H	50.72	53.98	3.26	AV
2490.5~2500	29.84	0.00	34.83	H	64.67	73.98	9.31	PK
2490.5~2500	10.14	0.29	34.83	H	45.26	53.98	8.72	AV
#2483.5~2490.5	28.46	0.00	34.83	V	63.29	73.98	10.69	PK
#2483.5~2490.5	14.92	0.29	34.83	V	50.04	53.98	3.94	AV
2490.5~2500	28.99	0.00	34.83	V	63.82	73.98	10.16	PK
2490.5~2500	9.88	0.29	34.83	V	45.00	53.98	8.98	AV

Note : Integration method Used (ANSI C63.10 Section11.13.3)

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2467 MHz
Channel No.	12 Ch

Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
2483.5	30.27	0.00	34.83	H	65.10	73.98	8.89	PK
2483.5	13.57	0.29	34.83	H	48.69	53.98	5.30	AV
2483.5	29.78	0.00	34.83	V	64.61	73.98	9.38	PK
2483.5	12.98	0.29	34.83	V	48.10	53.98	5.89	AV

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2472 MHz
Channel No.	13 Ch

Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
2483.5	36.04	0.00	34.83	H	70.87	73.98	3.12	PK
#2483.5~2484.5	15.86	0.29	34.83	H	50.98	53.98	3.01	AV
2484.5	14.86	0.29	34.83	H	49.98	53.98	4.01	AV
2483.5	35.44	0.00	34.83	V	70.27	73.98	3.72	PK
#2483.5~2484.5	14.87	0.29	34.83	V	49.99	53.98	4.00	AV
2484.5	14.02	0.29	34.83	V	49.14	53.98	4.85	AV

Note : Integration method Used (ANSI C63.10 Section11.13.3)

Operation Mode:	802.11n (HT20)
Transfer MCS Index:	8
Operating Frequency	2412 MHz
Channel No.	01 Ch

Frequency [MHz]	Measured Value [dBµV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2310~2390	35.87	0.00	34.35	H	70.22	73.98	3.76	PK
2310~2390	14.89	0.57	34.35	H	49.81	53.98	4.17	AV
2310~2390	34.88	0.00	34.35	H	69.23	73.98	4.75	PK
2310~2390	13.75	0.57	34.35	H	48.67	53.98	5.31	AV

Operation Mode:	802.11n (HT20)
Transfer MCS Index:	8
Operating Frequency	2462 MHz
Channel No.	11 Ch

Frequency [MHz]	Measured Value [dBµV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
#2483.5~2490.5	28.18	0.00	34.83	H	63.01	73.98	10.98	PK
#2483.5~2490.5	13.89	0.57	34.83	H	49.29	53.98	4.70	AV
2490.5~2500	28.19	0.00	34.83	H	63.02	73.98	10.97	PK
2490.5~2500	9.71	0.57	34.83	H	45.11	53.98	8.88	AV
#2483.5~2490.5	27.66	0.00	34.83	V	62.49	73.98	11.50	PK
#2483.5~2490.5	12.92	0.57	34.83	V	48.32	53.98	5.67	AV
2490.5~2500	27.62	0.00	34.83	V	62.45	73.98	11.54	PK
2490.5~2500	9.55	0.57	34.83	V	44.95	53.98	9.04	AV

Note : Integration method Used (ANSI C63.10 Section11.13.3)

Operation Mode:	802.11n (HT20)
Transfer MCS Index:	8
Operating Frequency	2417 MHz
Channel No.	2 Ch

Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
#2383~2390	28.78	0.00	34.35	H	63.13	73.98	10.85	PK
#2383~2390	14.85	0.57	34.35	H	49.77	53.98	4.21	AV
2390~2383	34.12	0.00	34.35	H	68.47	73.98	5.51	PK
2390~2383	12.37	0.57	34.35	H	47.29	53.98	6.69	AV
#2383~2390	27.74	0.00	34.35	V	62.09	73.98	11.89	PK
#2383~2390	13.61	0.57	34.35	V	48.53	53.98	5.45	AV
2390~2383	33.79	0.00	34.35	V	68.14	73.98	5.84	PK
2390~2383	11.92	0.57	34.35	V	46.84	53.98	7.14	AV

Note : Integration method Used (ANSI C63.10 Section11.13.3)

Operation Mode:	802.11n (HT20)
Transfer MCS Index:	8
Operating Frequency	2457 MHz
Channel No.	10 Ch

Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
#2483.5~2490.5	29.58	0.00	34.83	H	64.41	73.98	9.58	PK
#2483.5~2490.5	15.14	0.57	34.83	H	50.54	53.98	3.45	AV
2490.5~2500	29.56	0.00	34.83	H	64.39	73.98	9.60	PK
2490.5~2500	10.52	0.57	34.83	H	45.92	53.98	8.07	AV
#2483.5~2490.5	28.79	0.00	34.83	V	63.62	73.98	10.37	PK
#2483.5~2490.5	14.82	0.57	34.83	V	50.22	53.98	3.77	AV
2490.5~2500	28.32	0.00	34.83	V	63.15	73.98	10.84	PK
2490.5~2500	9.92	0.57	34.83	V	45.32	53.98	8.67	AV

Note : Integration method Used (ANSI C63.10 Section11.13.3)

Operation Mode: 802.11n (HT20)
Transfer MCS Index: 8
Operating Frequency 2467 MHz
Channel No. 12 Ch

Frequency [MHz]	Measured Value [dBµV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2483.5	30.92	0.00	34.83	H	65.75	73.98	8.24	PK
2483.5	13.29	0.57	34.83	H	48.69	53.98	5.30	AV
2483.5	30.02	0.00	34.83	V	64.85	73.98	9.14	PK
2483.5	12.88	0.57	34.83	V	48.28	53.98	5.71	AV

Operation Mode: 802.11n (HT20)
Transfer MCS Index: 8
Operating Frequency 2472 MHz
Channel No. 13 Ch

Frequency [MHz]	Measured Value [dBµV]	Duty Cycle Factor [dB]	AF+CL+DF [dB/m]	ANT. POL [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2483.5	**36.80**	**0.00**	**34.83**	**H**	**71.63**	**73.98**	**2.36**	**PK**
#2483.5~2484.5	**15.96**	**0.57**	**34.83**	**H**	**51.36**	**53.98**	**2.63**	**AV**
2484.5	14.66	0.57	34.83	H	50.06	53.98	3.93	AV
2483.5	36.04	0.00	34.83	V	70.87	73.98	3.12	PK
#2483.5~2484.5	15.25	0.57	34.83	V	50.65	53.98	3.34	AV
2484.5	14.02	0.57	34.83	V	49.42	53.98	4.57	AV

Note : Integration method Used (ANSI C63.10 Section11.13.3)

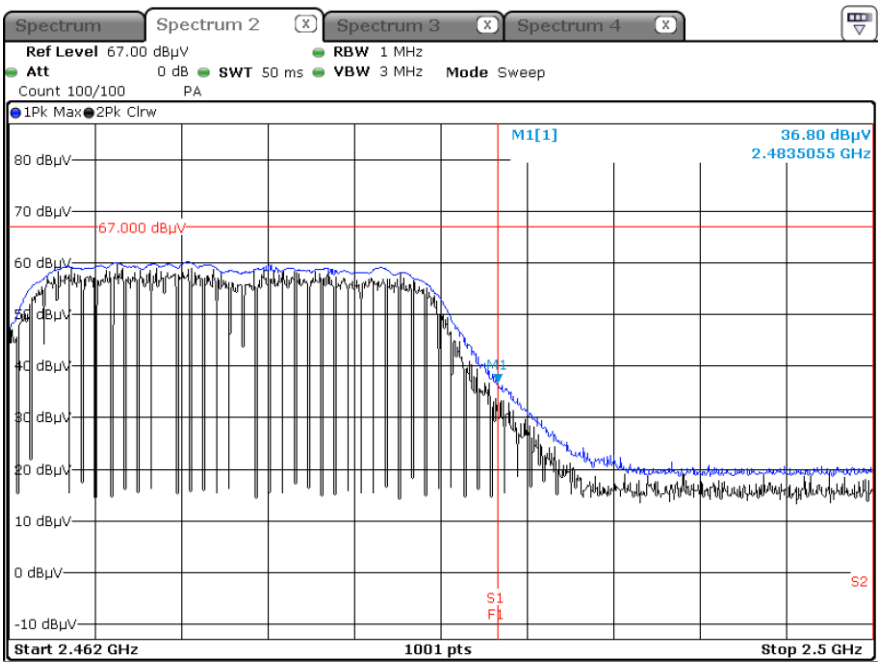
▣ Test Plots

Note:

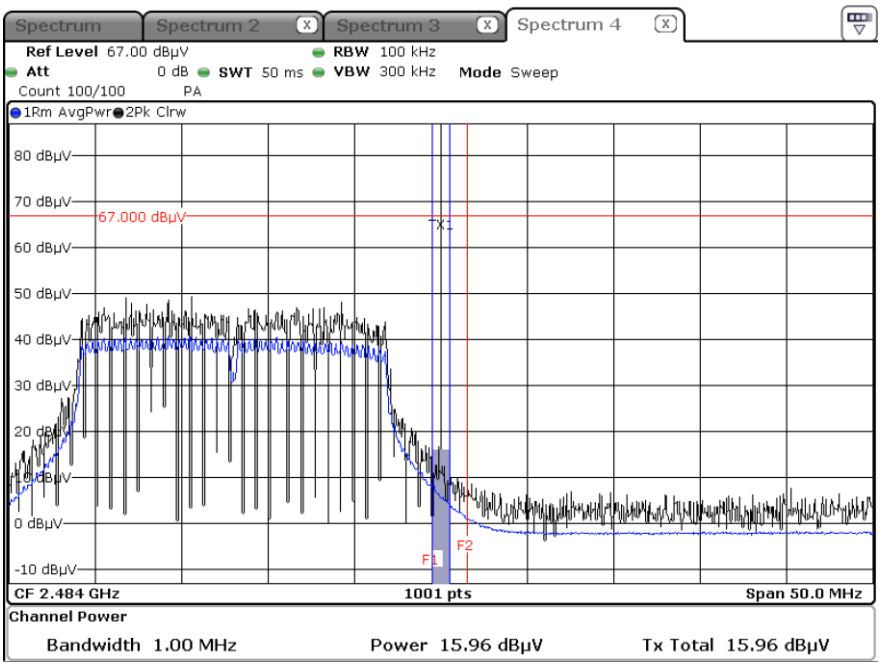
In order to simplify the report, Plots of worst case are only reported.

[MIMO]

Radiated Restricted Band Edges plot – Peak Result (802.11n (HT20)_ MCS8, Ch.13, Z-H)



Radiated Restricted Band Edges plot – Average Result (802.11n (HT20)_ MCS8, Ch.13, Z-H)



9.8 POWERLINE CONDUCTED EMISSIONS

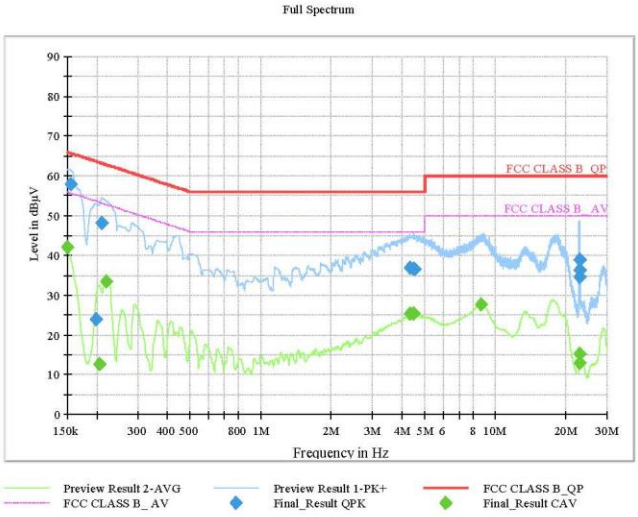
Conducted Emissions

Test 1 / 1

Test Report

Common Information

EUT : SM-X616B
Operating Conditions : 2.4G WLAN
Comment :



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	57.95	65.75	7.81	1000.0	9.000	L1	OFF	9.7
0.1995	23.88	63.63	39.76	1000.0	9.000	N	OFF	9.6
0.2108	48.17	63.18	15.01	1000.0	9.000	L1	OFF	9.7
4.3475	37.04	56.00	18.96	1000.0	9.000	L1	OFF	9.8
4.4915	36.67	56.00	19.33	1000.0	9.000	L1	OFF	9.8
4.5343	36.72	56.00	19.28	1000.0	9.000	L1	OFF	9.8
22.7750	36.42	60.00	23.58	1000.0	9.000	L1	OFF	10.4
22.7840	38.98	60.00	21.02	1000.0	9.000	L1	OFF	10.4
22.8335	34.48	60.00	25.52	1000.0	9.000	L1	OFF	10.4

Final_Result_CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	42.13	56.00	13.87	1000.0	9.000	L1	OFF	9.7
0.2063	12.68	53.36	40.68	1000.0	9.000	N	OFF	9.6
0.2198	33.32	52.83	19.51	1000.0	9.000	L1	OFF	9.7
4.3453	25.44	46.00	20.56	1000.0	9.000	L1	OFF	9.8
4.3543	25.39	46.00	20.61	1000.0	9.000	L1	OFF	9.8
4.4938	25.24	46.00	20.76	1000.0	9.000	L1	OFF	9.8
8.6585	27.63	50.00	22.37	1000.0	9.000	L1	OFF	10.0
22.7840	15.39	50.00	34.61	1000.0	9.000	L1	OFF	10.4
22.8335	13.02	50.00	36.98	1000.0	9.000	L1	OFF	10.4

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10. LIST OF TEST EQUIPMENT

Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	08/22/2023	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	05/26/2024	Annual
Temperature Chamber	SU-642	ESPEC	0093008124	02/22/2024	Annual
Signal Analyzer	N9030A	Keysight	MY49431210	12/29/2023	Annual
Power Meter	N1911A	Agilent	MY45100523	03/06/2024	Annual
Power Sensor	N1921A	Agilent	MY57820067	03/06/2024	Annual
Directional Coupler	87300B	Agilent	3116A03621	11/02/2023	Annual
Power Splitter	11667B	Hewlett Packard	10545	02/06/2024	Annual
DC Power Supply	E3632A	Agilent	KR75305528	01/03/2024	Annual
Attenuator(10 dB)	8493C	Hewlett Packard	07560	06/12/2024	Annual
Software	EMC32	Rohde & Schwarz	N/A	N/A	N/A
FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	HCT CO., LTD.	N/A	N/A	N/A
Bluetooth Tester	CBT	Rohde & Schwarz	100808	02/16/2024	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

Radiated Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Controller(Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Controller	EM1000	Audix	060520	N/A	N/A
Turn Table	N/A	Audix	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/17/2024	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	760	02/24/2025	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	02299	03/24/2024	Biennial
Horn Antenna (15GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170342	09/29/2024	Biennial
Spectrum Analyzer	FSV40	Rohde & Schwarz	100901	03/27/2024	Annual
Signal Analyzer	N9030A	Agilent	MY52350879	01/02/2024	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	06/12/2024	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/12/2024	Annual
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	01/05/2024	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	02/09/2024	Annual
RF Switching System	FMSR-04B (3G HPF+LNA)	T&M SYSTEM	S2L1	16/01/2024	Annual
RF Switching System	FMSR-04B (10dB ATT+LNA)	T&M SYSTEM	S2L2	16/01/2024	Annual
RF Switching System	FMSR-04B (3dB ATT+LNA)	T&M SYSTEM	S2L3	16/01/2024	Annual
RF Switching System	FMSR-04B (LNA)	T&M SYSTEM	S2L4	16/01/2024	Annual
RF Switching System	FMSR-04B (7G HPF+LNA)	T&M SYSTEM	S2L5	16/01/2024	Annual
Power Amplifier	CBL18265035	CERNEX	22966	12/01/2023	Annual
Power Amplifier	CBL26405040	CERNEX	25956	03/02/2024	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
3. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5(Version : 2017).

11. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2307-FC021-P