

FCC DTS REPORT

Certification

Applicant Name: SAMSUNG Electronics Co., Ltd.	Date of Issue: May 13, 2022
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	Report No.: HCT-RF-2205-FC009

FCC ID:	A3LSMG990U2
APPLICANT:	SAMSUNG Electronics Co., Ltd.

Model:	SM-G990U2
Additional Model:	SM-G990U3/DS
EUT Type:	Mobile Phone
Average Output Power:	Ant. 2: 802.11b : 18.36 dBm, 802.11g : 16.22 dBm, 802.11n(HT20) : 15.68 dBm MIMO : 802.11b : 21.70 dBm, 802.11g : 19.55 dBm, 802.11n(HT20) : 19.13 dBm
Frequency Range:	2 412 MHz ~ 2 462 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.

Report No.: HCT-RF-2205-FC009

REVIEWED BY



Report prepared by : Jin Gwan Lee
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)

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-2205-FC009	May 13, 2022	- First Approval Report

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1. EUT DESCRIPTION

Model	SM-G990U2		
Additional Model	SM-G990U3/DS		
EUT Type	Mobile Phone		
Power Supply	DC 3.88 V		
Frequency Range	2 412 MHz ~ 2 462 MHz		
Max. RF Output Power	<u>Peak Power</u> (For information only)	Ant. 1 (For MIMO calculation)	802.11b : 24.05 dBm 802.11g : 24.33 dBm 802.11n(HT20) : 23.62 dBm
		Ant.2	802.11b : 23.84 dBm 802.11g : 23.65 dBm, 802.11n(HT20) : 23.12 dBm
		MIMO (Ant.1&2)	802.11b : 26.92 dBm 802.11g : 26.92 dBm, 802.11n(HT20) : 26.39 dBm
	<u>Average Power</u>	Ant. 1 (For MIMO calculation)	802.11b : 19.04 dBm 802.11g : 16.92 dBm 802.11n(HT20) : 16.52 dBm
		Ant.2	802.11b : 18.36 dBm 802.11g : 16.22 dBm, 802.11n(HT20) : 15.68 dBm
		MIMO (Ant.1&2)	802.11b : 21.70 dBm 802.11g : 19.55 dBm, 802.11n(HT20) : 19.13 dBm
Modulation Type	DSSS/CCK : 802.11b OFDM : 802.11g, 802.11n		
Number of Channels	11 Channels		
Date(s) of Tests	April 06, 2022 ~ May 10, 2022		
Serial number	Radiated: R3CT30Q0R8W Conducted : 0e0b0f75a61f032c		

ANTENNA CONFIGURATIONS

1. The device employs MIMO technology. Below are the possible configurations

Configurations	SISO		SDM	CDD
	Ant1	Ant2	Ant1 + Ant2	Ant1 + Ant2
802.11b	X	O	X	O
802.11g	X	O	X	O
802.11n(HT20)	X	O	O	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.This device supports simultaneous transmission operation, which allows for two channels to operate independent of one another in the 2.4GHz and 5GHz bands simultaneously on each antenna.

RSDB Scenario	Bluetooth Ant.1	2.4 GHz WiFi Ant.1	2.4 GHz WiFi Ant.2	5GHz WiFi Ant.1	5GHz WiFi Ant.2
Bluetooth + 2.4 GHz WiFi + 5GHz WiFi MIMO	On	-	On	On	On
2.4 GHz WiFi MIMO + 5GHz WiFi MIMO	-	On	On	On	On

Non-DBS	5GHz WiFi Ant.1	5GHz WiFi Ant.2	Bluetooth Ant.1
5GHz WiFi MIMO + Bluetooth	On	On	On

3. Directional Gain Calculation

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

Directional gain =

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

Ant Gain (dBi)		N _{ANT} / N _{SS}	Directional Gain (dBi)
Ant.1	-4.6	2 / 2	CDD : -3.32
Ant.2	-8.5		SDM : -4.60

Note

According to Ansi C63.10-2013 section 14.4.3, the directional gain is calculated using the formula, where GN is the gain of the nth antenna and NANT is the total number of antennas used.

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

Sample MIMO Calculation:

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

$$Ant1 + Ant 2 = MIMO$$

$$(11.58 \text{ dBm} + 12.08 \text{ dBm}) = (14.387 \text{ mW} + 16.143 \text{ mW}) = 30.53 \text{ mW} = 14.88 \text{ dBm}$$

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, Republic 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.

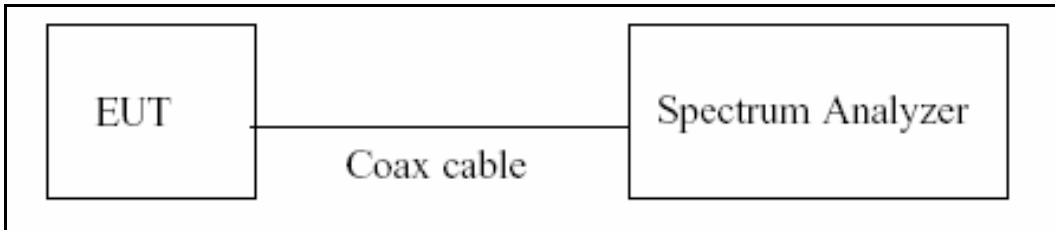
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	2.00 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.40 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.74 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.51 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.92 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (Above 40 GHz)	5.48 (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 $T \leq 6.25$ 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 $> 50/T$.

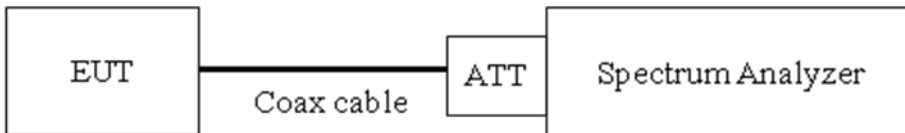
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (\geq RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on} / T_{total} and Duty Cycle Factor = $10\log(1/\text{Duty Cycle})$

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 $\geq 3 \times$ 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.

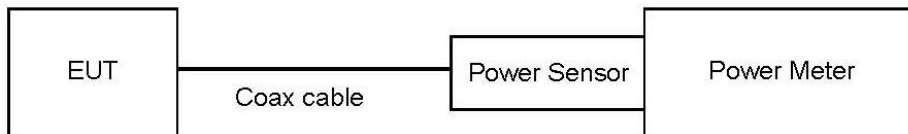
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

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

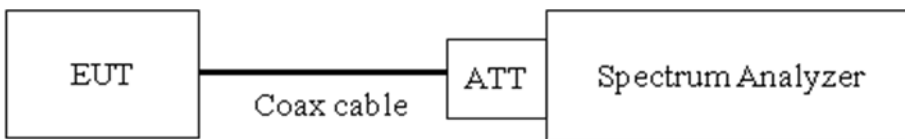
- Conducted Output Power(Peak) = Measured Value + ATT loss + Cable loss
- Conducted Output Power(Average) = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

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) $RBW = 3 \text{ kHz} \leq RBW \leq 100 \text{ kHz}$.
- 4) $VBW \geq 3 \times RBW$.
- 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 $\geq [2 \times \text{span} / RBW]$.
- 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

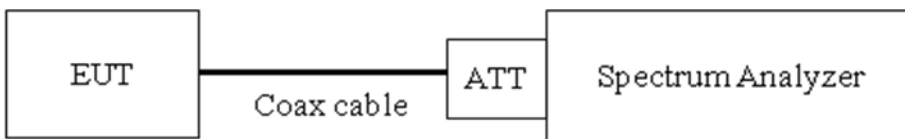
7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

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 $\geq 3 \times$ 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 $\geq 2 \times$ 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)	Ant.1 Factor(dB)
30	10.37
100	10.43
200	10.44
300	10.46
400	10.50
500	10.69
600	10.70
700	10.72
800	10.75
900	10.76
1000	10.77
2000	10.86
2400	10.92
2480	10.92
2500	10.93
3000	11.15
4000	11.21
5000	11.35
5150	11.69
5850	11.69
6000	11.70
7000	11.82
8000	11.81
9000	11.90
10000	12.00
11000	12.09
12000	12.18
13000	12.19
14000	12.23
15000	12.32
16000	12.41
17000	12.60
18000	12.74
19000	12.66
20000	12.33
21000	12.46
22000	12.45
23000	12.42

Note : 1. 2 400 ~ 2 500 MHz is fundamental frequency range.

2. Offset Loss = Attenuator loss(10 dB) + Cable loss + EUT cable Loss

Freq(MHz)	Ant.2 Factor(dB)
30	10.10
100	10.15
200	10.20
300	10.22
400	10.25
500	10.26
600	10.26
700	10.28
800	10.30
900	10.32
1000	10.34
2000	10.49
2400	10.55
2480	10.55
2500	10.55
3000	10.60
4000	10.70
5000	10.79
5150	10.81
5850	10.87
6000	10.87
7000	10.97
8000	11.03
9000	11.10
10000	11.15
11000	11.18
12000	11.23
13000	11.29
14000	11.30
15000	11.33
16000	11.39
17000	11.40
18000	11.45
19000	11.47
20000	11.51
21000	11.64
22000	11.63
23000	11.60

Note : 1. 2 400 ~ 2 500 MHz is fundamental frequency range.

2. Offset Loss = Attenuator loss(10 dB) + Cable loss

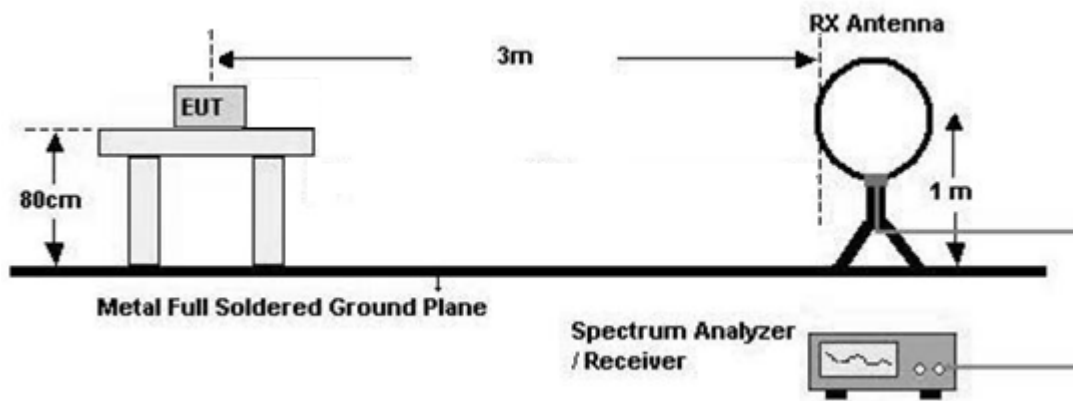
7.6. Radiated Test

Limit

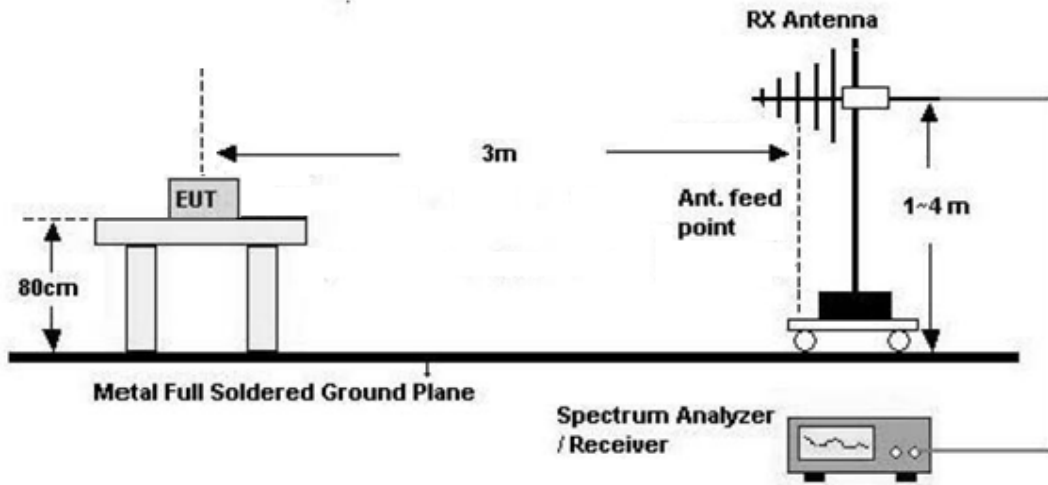
Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

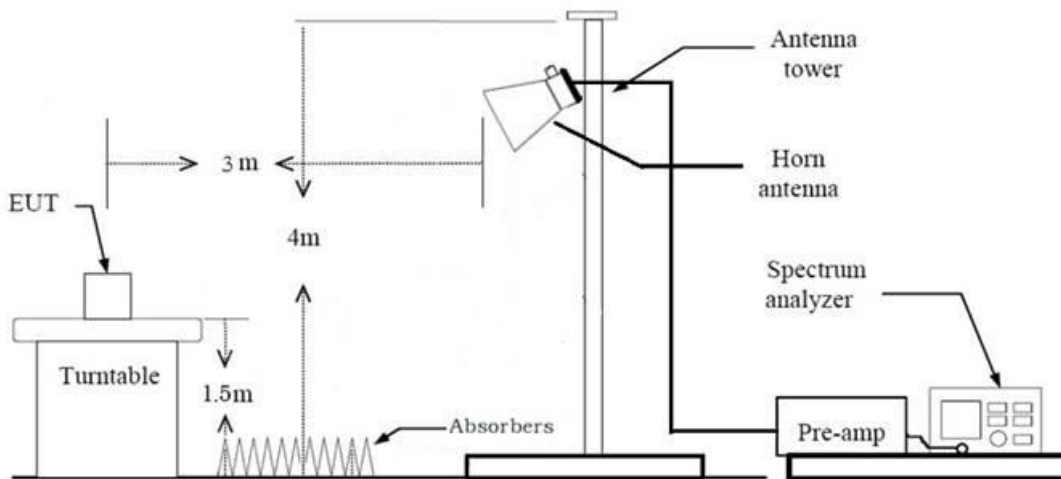
Below 30 MHz



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) = $40\log(3\text{ m}/300\text{ m}) = - 80\text{ dB}$
Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = $40\log(3\text{ m}/30\text{ m}) = - 40\text{ dB}$
Measurement Distance : 3 m
8. Spectrum Setting
 - Frequency Range = 9 kHz ~ 30 MHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 9 kHz
 - VBW $\geq 3 \times$ 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 \geq 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 $\geq 3 \times$ RBW

(2) Measurement Type(Average): Duty cycle $\geq 98 \%$

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

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

- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = RMS
- Averaging type = power (*i.e.*, RMS)
- RBW = 1 MHz
- VBW $\geq 3 \times$ 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 = $20 \log$ (test distance / specific distance) (dB)

11. Total(Measurement Type : Peak)

$$= \text{Measured value} + \text{Antenna Factor(A.F)} + \text{Cable Loss(C.L)} - \text{Amp Gain(A.G)} + \text{Distance Factor(D.F)}$$

Total(Measurement Type : Average, Duty cycle $\geq 98 \%$)

$$= \text{Measured value} + \text{Antenna Factor(A.F)} + \text{Cable Loss(C.L)} - \text{Amp Gain(A.G)} + \text{Distance Factor(D.F)}$$

Total(Measurement Type : Average, Duty cycle $< 98 \%$)

$$= \text{Measured value} + \text{Antenna Factor(A.F)} + \text{Cable Loss(C.L)} - \text{Amp Gain(A.G)} + \text{Distance Factor(D.F)} \\ + \text{Duty Cycle Factor}$$

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 \geq 3 x RBW
 - (2) Measurement Type(Average): Duty cycle \geq 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 \geq 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 \geq 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 = $20\log(\text{test distance} / \text{specific distance})$ (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 $\geq 98\%$)
= 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 μ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dB μ V)	
	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. EUT Axis
 - Radiated Spurious Emissions : Y, Z

- Radiated Restricted Band Edge : Y, Z
- 3. Duty cycle factor applies only 802.11g/n (Duty cycle < 98 %).
- 4. All data rate of operation were investigated and the test results are worst case in lowest Data Rate of each mode.
 - 802.11b : 11 Mbps
 - 802.11g : 54 Mbps
 - 802.11n(HT20): MCS7
- 5. 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
- 6. All Antenna of operation were investigated and the worst case results are reported
 - Worst case : Ant1+Ant2(CDD)
- 7. SM-G990U2, SM-G990U3/DS were tested and the worst case results are reported. (Worst case : SM-G990U2)

Radiated test(DBS)

- 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. EUT Axis
 - Radiated Spurious Emissions : Y, Z
- 3. Test case

RSDB Scenario	Bluetooth Ant.1	2.4 GHz WiFi Ant.1	2.4 GHz WiFi Ant.2	5GHz WiFi Ant.1	5GHz WiFi Ant.2	Test case
Bluetooth + 2.4 GHz WiFi + 5GHz WiFi MIMO	On	-	On	On	On	-
2.4 GHz WiFi MIMO + 5GHz WiFi MIMO	-	On	On	On	On	Case 1

Non-DBS	5GHz WiFi Ant.1	5GHz WiFi Ant.2	Bluetooth Ant.1	Test case
5GHz WiFi MIMO + Bluetooth	On	On	On	Case 2

4. The following tables show the worst case configurations determined during testing.

(Worst case: The lowest margin condition the channels and modes were selected for test.)

(Test case 2 Result : Please refer to the SM-G990U2 [UNII ax, BT] Test Report.)

Test case	Description	2.4 GHz Emission	5 GHz Emission	Bluetooth Emission
1	Antenna	Ant All	Ant All	-
	Channel	1	165	-
	Data Rate	11 Mbps	MCS0	-
	Mode	802.11b	802.11ax(HE20) 52T RU38	-

Test case	Description	5 GHz Emission	Bluetooth Emission
2	Antenna	Ant All	Ant 1
	Channel	165	0
	Data Rate	MCS0	1 Mbps
	Mode	802.11ax / HE20 / 52T / RU38	GFSK : DH5

5. SM-G990U2, SM-G990U3/DS were tested and the worst case results are reported. (Worst case : SM-G990U2)

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

2. SM-G990U2, SM-G990U3/DS were tested and the worst case results are reported. (Worst case : SM-G990U2)

Conducted test

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

2. SM-G990U2, SM-G990U3/DS were tested and the worst case results are reported. (Worst case : SM-G990U2)

3. All Antenna of operation were investigated and the worst case results are reported

- Worst case : Ant1+Ant2(CDD)

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

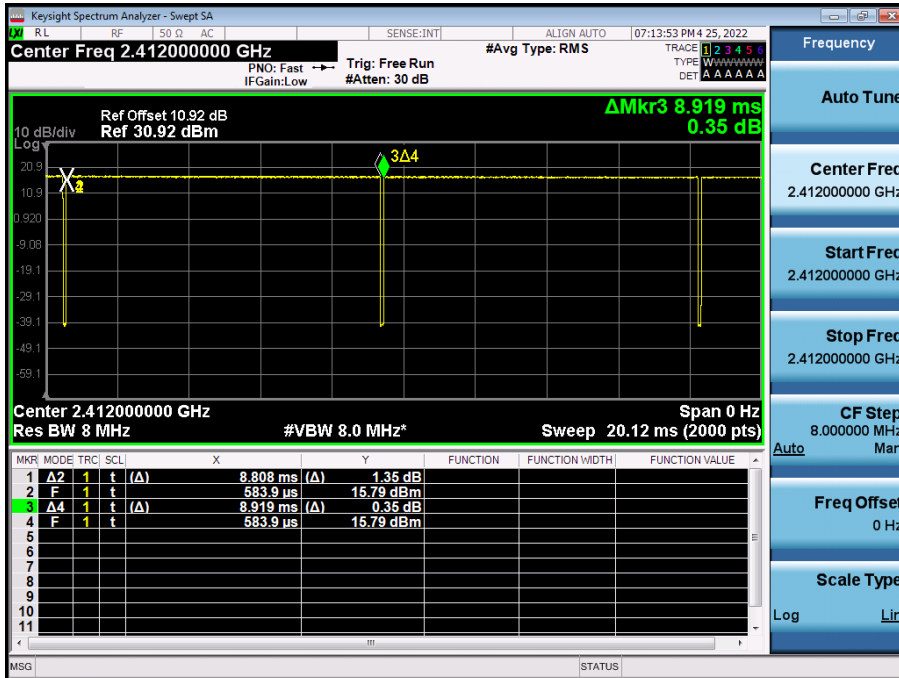
9. TEST RESULT

9.1 DUTY CYCLE

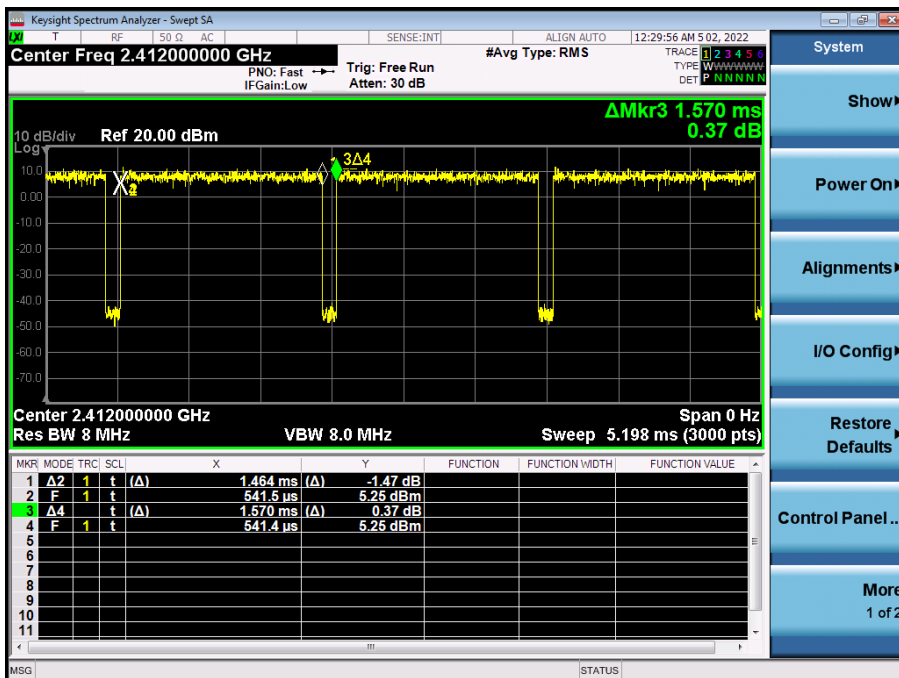
Mode	Data Rate (Mbps)	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11b	1	8.808	8.919	0.988	0.054
	2	4.399	4.512	0.975	0.110
	5.5	1.657	1.768	0.937	0.283
	11	0.877	0.983	0.892	0.498
802.11g	6	1.464	1.570	0.932	0.304
	9	0.983	1.089	0.902	0.446
	12	0.745	0.851	0.875	0.580
	18	0.502	0.613	0.818	0.872
	24	0.385	0.491	0.784	1.060
	36	0.263	0.370	0.712	1.473
	48	0.203	0.309	0.656	1.833
	54	0.182	0.324	0.562	2.499
802.11n (HT20)	6.5 (MCS0)	1.246	1.353	0.921	0.356
	13 (MCS1)	0.643	0.750	0.858	0.665
	19.5 (MCS2)	0.436	0.547	0.796	0.989
	26 (MCS3)	0.339	0.446	0.761	1.184
	39 (MCS4)	0.243	0.355	0.686	1.639
	52 (MCS5)	0.187	0.299	0.627	2.026
	58.5 (MCS6)	0.172	0.324	0.531	2.747
	65 (MCS7)	0.157	0.309	0.508	2.940

Test Plots

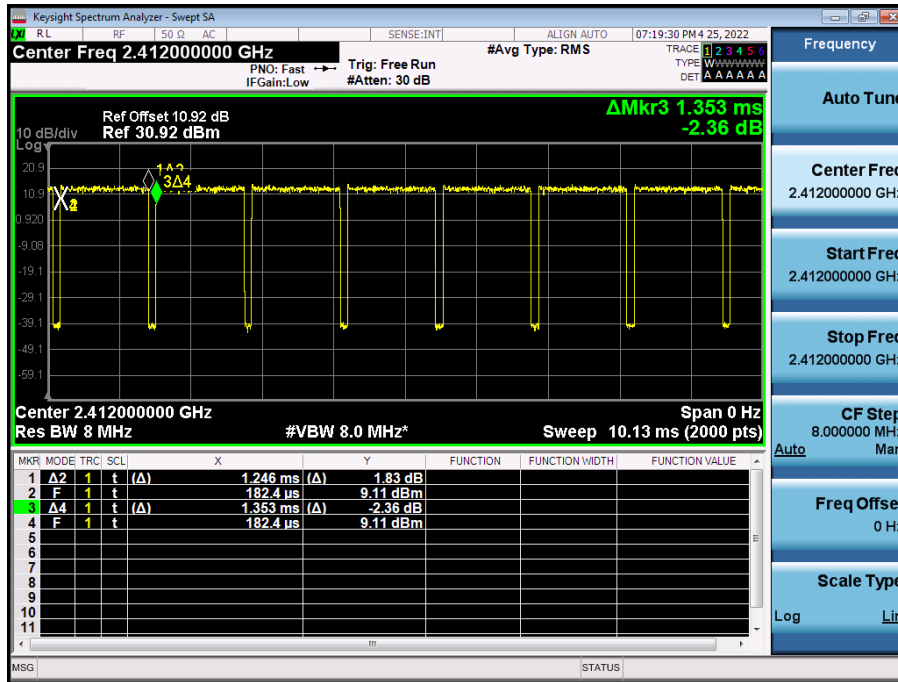
Duty cycle plot (802.11b(1 Mbps))



Duty cycle plot (802.11g(6 Mbps))



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



Note:

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

9.2 6 dB BANDWIDTH

[Ant.1]

802.11b Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	8.145	0.5
2437	6	8.036	0.5
2462	11	8.099	0.5

802.11g Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	14.45	0.5
2437	6	15.17	0.5
2462	11	15.75	0.5

802.11n(HT20) Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	14.75	0.5
2437	6	15.11	0.5
2462	11	16.34	0.5

[Ant.2]

802.11b Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	8.102	0.5
2437	6	8.116	0.5
2462	11	8.113	0.5

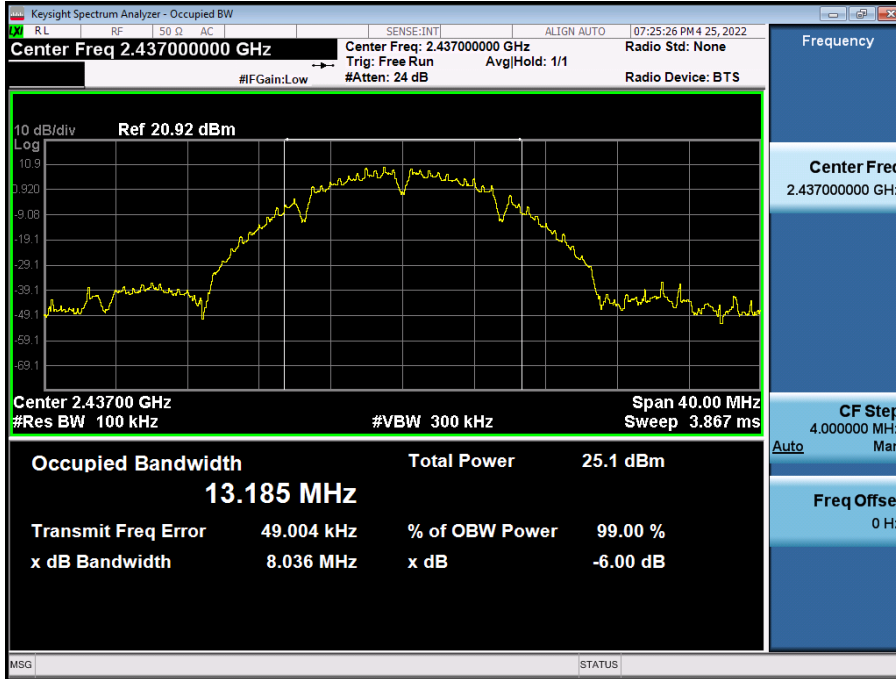
802.11g Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	15.66	0.5
2437	6	15.17	0.5
2462	11	15.78	0.5

802.11n(HT20) Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	15.95	0.5
2437	6	15.20	0.5
2462	11	16.37	0.5

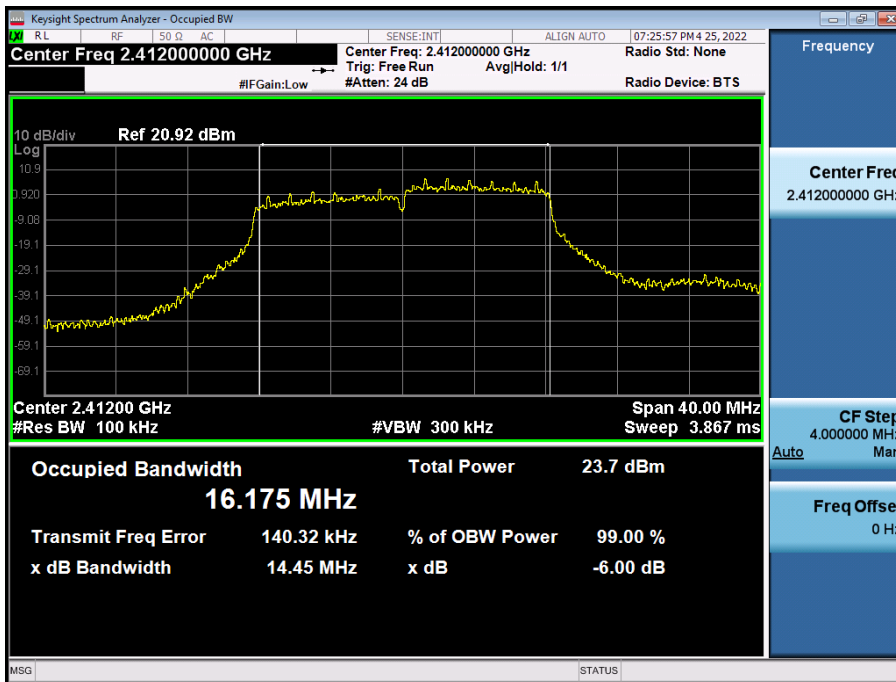
[Ant.1]

▣ Test Plots

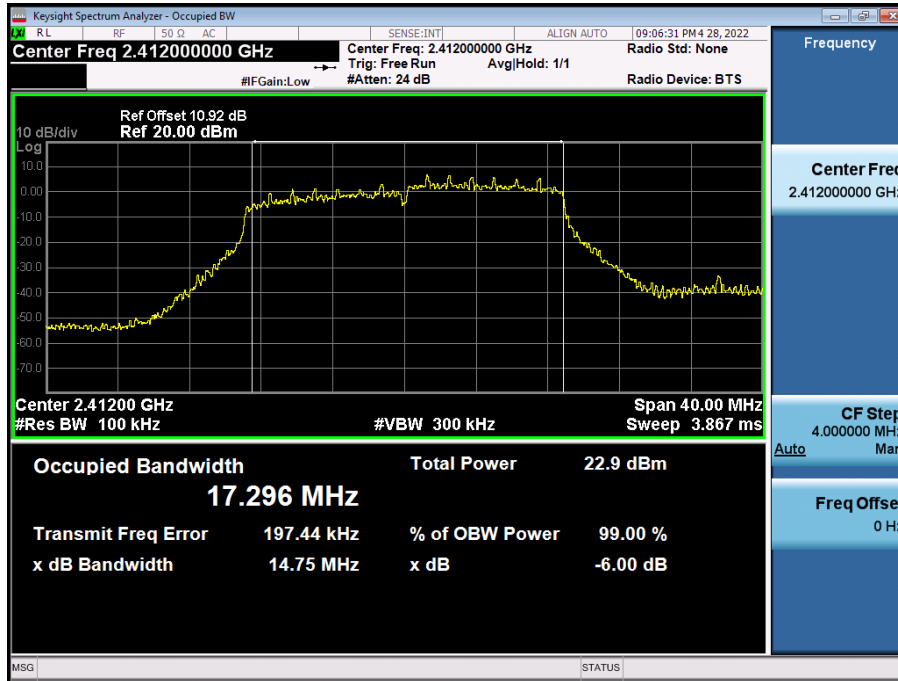
6 dB Bandwidth plot (802.11b-CH 6)



6 dB Bandwidth plot (802.11g-CH 1)



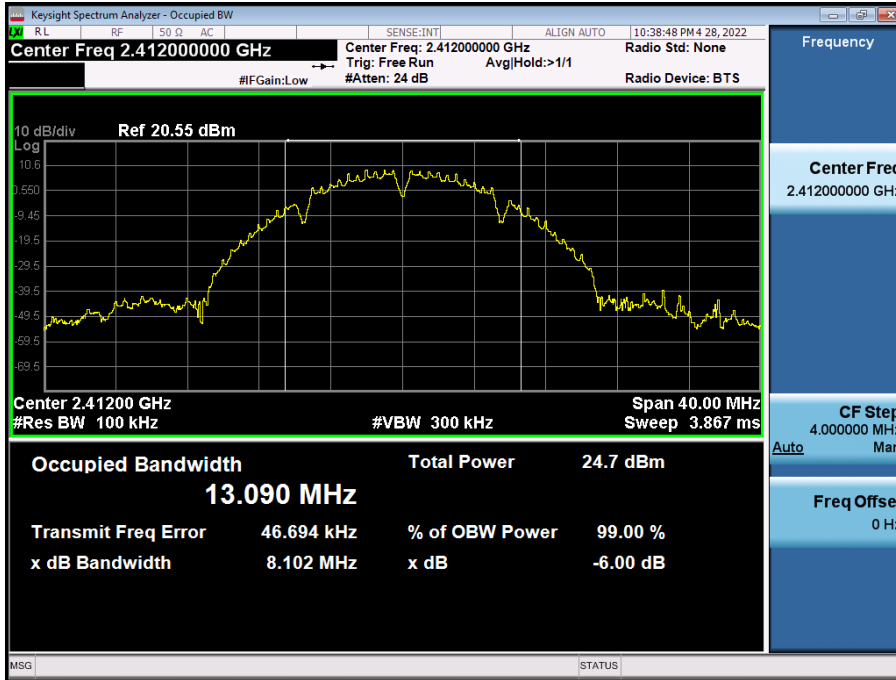
6 dB Bandwidth plot (802.11n_HT20-CH 1)



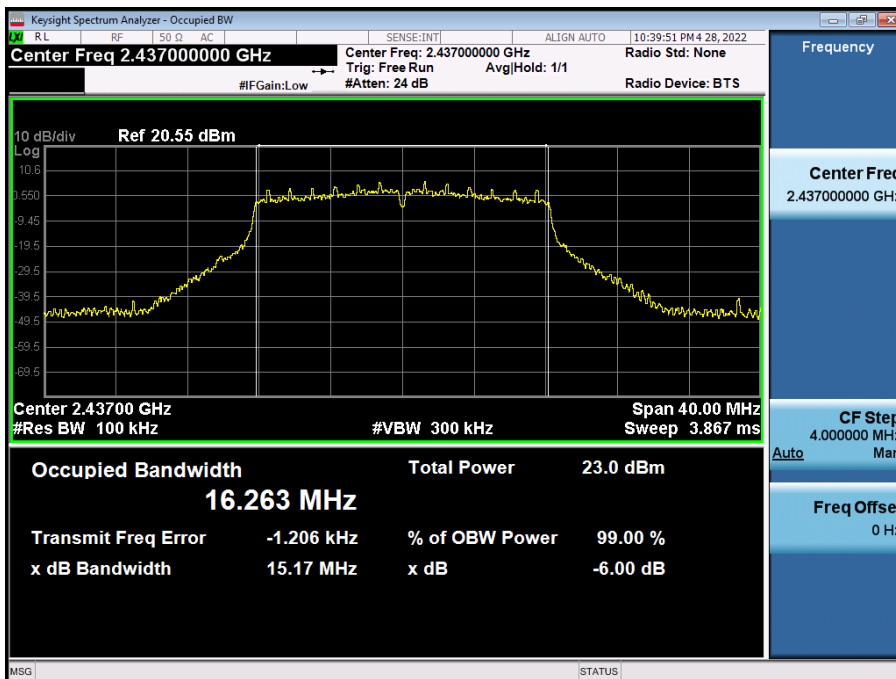
[Ant.2]

▣ Test Plots

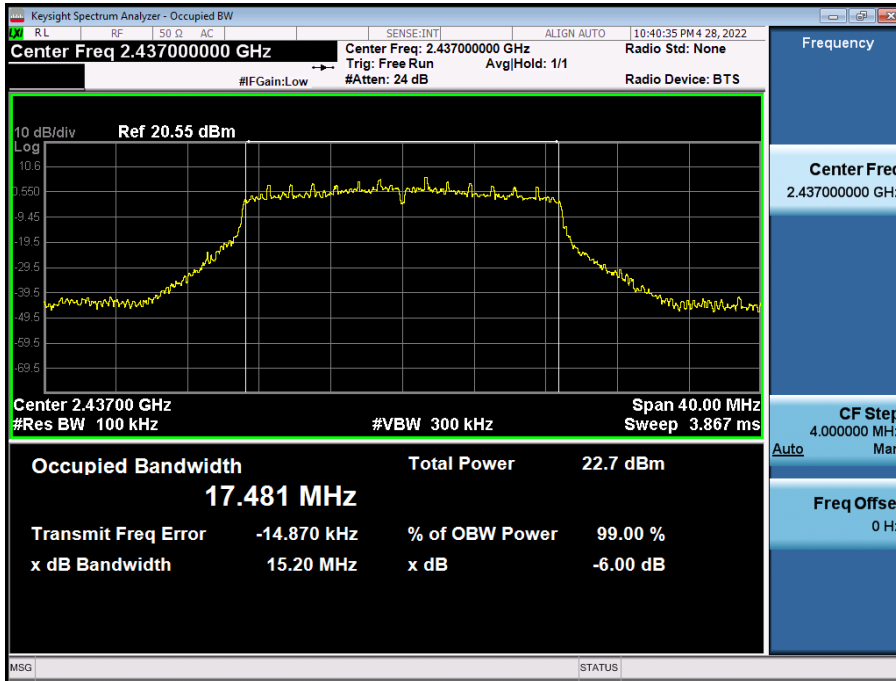
6 dB Bandwidth plot (802.11b-CH 1)



6 dB Bandwidth plot (802.11g-CH 6)



6 dB Bandwidth plot (802.11n_HT20-CH 6)



Note:

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

9.3 OUTPUT POWER

Note:

1. 802.11b Mode Trnasmits Continuously(Duty Cycle \geq 98%, cf. 9.1)

Peak Power

Power Meter offset

Ant.1 Loss : Attenuator loss(10 dB) + Cable loss + EUT cable Loss

Ant.2 Loss : Attenuator loss(10 dB) + Cable loss

[Ant.1]

Note:

1. Reporting for MIMO calculation

802.11b Mode		Rate (Mbps)	Measured Power (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.			
2412	1	1	20.85	30
		2	21.13	
		5.5	22.69	
		11	24.05	
2437	6	1	20.66	
		2	21.03	
		5.5	22.56	
		11	23.98	
2462	11	1	20.67	
		2	21.13	
		5.5	22.64	
		11	24.01	

802.11g Mode		Rate (Mbps)	Measured Power (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.			
2412	1	6	23.98	30
		9	24.16	
		12	23.48	
		18	24.09	
		24	24.29	
		36	23.85	
		48	23.95	
		54	24.10	
2437	6	6	23.91	
		9	24.17	
		12	23.27	
		18	23.68	
		24	24.15	
		36	23.81	
		48	23.88	
		54	23.98	
2462	11	6	23.88	
		9	24.03	
		12	23.20	
		18	23.48	
		24	24.33	
		36	24.01	
		48	24.03	
		54	24.16	

802.11n(HT20) Mode		MCS Index	Measured Power (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.			
2412	1	0	23.07	30
		1	22.74	
		2	22.69	
		3	22.70	
		4	22.66	
		5	22.74	
		6	22.67	
		7	22.65	
2437	6	0	23.62	
		1	23.56	
		2	23.42	
		3	23.49	
		4	23.35	
		5	23.48	
		6	23.42	
		7	23.28	
2462	11	0	22.94	
		1	22.56	
		2	22.57	
		3	22.79	
		4	22.93	
		5	23.04	
		6	23.07	
		7	22.94	

[Ant.2]

802.11b Mode		Rate (Mbps)	Measured Power (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.			
2412	1	1	20.33	30
		2	20.72	
		5.5	22.21	
		11	23.58	
2437	6	1	20.52	
		2	20.90	
		5.5	22.34	
		11	23.84	
2462	11	1	20.01	
		2	20.44	
		5.5	21.95	
		11	23.34	

802.11g Mode		Rate (Mbps)	Measured Power (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.			
2412	1	6	23.20	30
		9	23.40	
		12	22.41	
		18	22.96	
		24	23.44	
		36	23.10	
		48	23.24	
		54	23.35	
2437	6	6	23.45	
		9	23.59	
		12	22.77	
		18	23.09	
		24	23.65	
		36	23.30	
		48	23.39	
		54	23.55	
2462	11	6	23.01	
		9	23.14	
		12	22.19	
		18	22.49	
		24	23.06	
		36	22.66	
		48	22.74	
		54	22.88	

802.11n(HT20) Mode		MCS Index	Measured Power (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.			
2412	1	0	21.94	30
		1	21.60	
		2	21.67	
		3	21.70	
		4	21.82	
		5	21.90	
		6	21.90	
		7	21.81	
2437	6	0	23.12	
		1	23.00	
		2	22.87	
		3	23.01	
		4	22.90	
		5	23.03	
		6	22.38	
		7	22.77	
2462	11	0	21.75	
		1	21.58	
		2	21.43	
		3	21.51	
		4	21.44	
		5	21.56	
		6	21.55	
		7	21.41	

[MIMO]

802.11b Mode		Rate (Mbps)	Ant.1 Measured Power(dBm)	Ant.2 Measured Power(dBm)	MIMO Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.					
2412	1	1	20.85	20.33	23.61	30
		2	21.13	20.72	23.94	
		5.5	22.69	22.21	25.46	
		11	24.05	23.58	26.83	
2437	6	1	20.66	20.52	23.60	
		2	21.03	20.90	23.98	
		5.5	22.56	22.34	25.46	
		11	23.98	23.84	26.92	
2462	11	1	20.67	20.01	23.36	
		2	21.13	20.44	23.81	
		5.5	22.64	21.95	25.32	
		11	24.01	23.34	26.70	

802.11g Mode		Rate (Mbps)	Ant.1 Measured Power(dBm)	Ant.2 Measured Power(dBm)	MIMO Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.					
2412	1	6	23.98	23.20	26.62	30
		9	24.16	23.40	26.81	
		12	23.48	22.41	25.99	
		18	24.09	22.96	26.57	
		24	24.29	23.44	26.90	
		36	23.85	23.10	26.50	
		48	23.95	23.24	26.62	
		54	24.10	23.35	26.75	
2437	6	6	23.91	23.45	26.70	
		9	24.17	23.59	26.90	
		12	23.27	22.77	26.03	
		18	23.68	23.09	26.40	
		24	24.15	23.65	26.92	
		36	23.81	23.30	26.57	
		48	23.88	23.39	26.65	
		54	23.98	23.55	26.78	
2462	11	6	23.88	23.01	26.48	
		9	24.03	23.14	26.62	
		12	23.20	22.19	25.73	
		18	23.48	22.49	26.02	
		24	24.33	23.06	26.75	
		36	24.01	22.66	26.40	
		48	24.03	22.74	26.44	
		54	24.16	22.88	26.57	

802.11n(HT20) Mode		MCS Index	Ant.1 Measured Power(dBm)	Ant.2 Measured Power(dBm)	MIMO Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.					
2412	1	0	23.07	21.94	25.55	30
		1	22.74	21.60	25.21	
		2	22.69	21.67	25.22	
		3	22.70	21.70	25.24	
		4	22.66	21.82	25.27	
		5	22.74	21.90	25.35	
		6	22.67	21.90	25.31	
		7	22.65	21.81	25.26	
2437	6	0	23.62	23.12	26.39	
		1	23.56	23.00	26.30	
		2	23.42	22.87	26.16	
		3	23.49	23.01	26.27	
		4	23.35	22.90	26.14	
		5	23.48	23.03	26.27	
		6	23.42	22.38	25.94	
		7	23.28	22.77	26.04	
2462	11	0	22.94	21.75	25.40	
		1	22.56	21.58	25.11	
		2	22.57	21.44	25.05	
		3	22.79	21.51	25.21	
		4	22.93	21.44	25.26	
		5	23.04	21.56	25.37	
		6	23.07	21.55	25.39	
		7	22.94	21.41	25.25	

Average Power

Power Meter offset

Ant.1 Loss : Attenuator loss(10 dB) + Cable loss + EUT cable Loss

Ant.2 Loss : Attenuator loss(10 dB) + Cable loss

[Ant.1]

Note:

1. Reporting for MIMO calculation

802.11b Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	1	19.04	0.000	19.04	30
		2	18.91	0.110	19.02	
		5.5	18.66	0.283	18.95	
		11	18.47	0.498	18.96	
2437	6	1	18.91	0.000	18.91	
		2	18.73	0.110	18.84	
		5.5	18.60	0.283	18.88	
		11	18.35	0.498	18.85	
2462	11	1	18.76	0.000	18.76	
		2	18.45	0.110	18.56	
		5.5	18.44	0.283	18.72	
		11	18.21	0.498	18.71	

802.11g Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	6	16.62	0.304	16.92	30
		9	16.41	0.446	16.86	
		12	15.41	0.580	15.99	
		18	15.85	0.872	16.72	
		24	15.45	1.060	16.51	
		36	14.91	1.473	16.39	
		48	14.43	1.833	16.26	
		54	13.99	2.499	16.49	
2437	6	6	16.53	0.304	16.83	
		9	16.24	0.446	16.69	
		12	15.03	0.580	15.61	
		18	15.44	0.872	16.31	
		24	15.09	1.060	16.15	
		36	14.66	1.473	16.14	
		48	14.19	1.833	16.02	
		54	13.67	2.499	16.17	
2462	11	6	16.37	0.304	16.67	
		9	16.02	0.446	16.46	
		12	14.91	0.580	15.49	
		18	15.28	0.872	16.15	
		24	15.13	1.060	16.19	
		36	14.66	1.473	16.14	
		48	14.20	1.833	16.03	
		54	13.81	2.499	16.31	

802.11n(HT20) Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	0	15.53	0.356	15.89	30
		1	14.79	0.665	15.46	
		2	14.48	0.989	15.47	
		3	14.30	1.184	15.48	
		4	14.00	1.639	15.64	
		5	13.82	2.026	15.84	
		6	12.85	2.747	15.60	
		7	12.83	2.940	15.77	
2437	6	0	16.16	0.356	16.52	
		1	15.55	0.665	16.22	
		2	15.13	0.989	16.12	
		3	14.89	1.184	16.07	
		4	14.54	1.639	16.18	
		5	13.75	2.026	15.78	
		6	13.45	2.747	16.20	
		7	12.99	2.940	15.93	
2462	11	0	14.70	0.356	15.06	
		1	14.11	0.665	14.77	
		2	13.88	0.989	14.87	
		3	13.69	1.184	14.87	
		4	13.29	1.639	14.93	
		5	13.02	2.026	15.05	
		6	12.05	2.747	14.80	
		7	12.00	2.940	14.94	

[Ant.2]

802.11b Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	1	18.31	0.000	18.31	30
		2	18.07	0.110	18.18	
		5.5	17.71	0.283	17.99	
		11	17.51	0.498	18.00	
2437	6	1	18.36	0.000	18.36	
		2	18.10	0.110	18.21	
		5.5	17.95	0.283	18.24	
		11	17.76	0.498	18.25	
2462	11	1	18.27	0.000	18.27	
		2	17.99	0.110	18.10	
		5.5	17.50	0.283	17.78	
		11	17.24	0.498	17.74	

802.11g Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	6	15.52	0.304	15.82	30
		9	14.89	0.446	15.34	
		12	13.64	0.580	14.22	
		18	14.06	0.872	14.93	
		24	13.84	1.060	14.90	
		36	13.35	1.473	14.82	
		48	12.94	1.833	14.78	
		54	12.45	2.499	14.95	
2437	6	6	15.92	0.304	16.22	
		9	15.66	0.446	16.10	
		12	14.52	0.580	15.10	
		18	14.95	0.872	15.82	
		24	14.62	1.060	15.68	
		36	14.16	1.473	15.63	
		48	13.74	1.833	15.57	
		54	13.26	2.499	15.76	
2462	11	6	15.21	0.304	15.51	
		9	14.89	0.446	15.34	
		12	13.64	0.580	14.22	
		18	13.98	0.872	14.85	
		24	13.64	1.060	14.70	
		36	13.14	1.473	14.61	
		48	12.75	1.833	14.58	
		54	12.21	2.499	14.71	

802.11n(HT20) Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	0	14.56	0.356	14.92	30
		1	13.83	0.665	14.49	
		2	13.50	0.989	14.49	
		3	13.24	1.184	14.43	
		4	12.99	1.639	14.63	
		5	12.24	2.026	14.26	
		6	11.91	2.747	14.65	
		7	11.49	2.940	14.43	
2437	6	0	15.32	0.356	15.68	
		1	14.91	0.665	15.57	
		2	14.52	0.989	15.51	
		3	14.29	1.184	15.47	
		4	13.98	1.639	15.62	
		5	13.23	2.026	15.26	
		6	12.90	2.747	15.64	
		7	12.50	2.940	15.44	
2462	11	0	13.73	0.356	14.09	
		1	13.30	0.665	13.96	
		2	12.87	0.989	13.86	
		3	12.63	1.184	13.81	
		4	12.23	1.639	13.87	
		5	11.50	2.026	13.53	
		6	11.18	2.747	13.92	
		7	10.74	2.940	13.68	

[MIMO]

802.11b Mode		Rate (Mbps)	Ant.1 Power(dBm)	Ant.2 Power(dBm)	MIMO Power(dBm)	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	1	19.04	18.31	21.70	30
		2	19.02	18.18	21.63	
		5.5	18.95	17.99	21.51	
		11	18.96	18.00	21.52	
2437	6	1	18.91	18.36	21.65	
		2	18.84	18.21	21.55	
		5.5	18.88	18.24	21.58	
		11	18.85	18.25	21.57	
2462	11	1	18.76	18.27	21.53	
		2	18.56	18.10	21.35	
		5.5	18.72	17.78	21.29	
		11	18.71	17.74	21.26	

802.11g Mode		Rate (Mbps)	Ant.1 Power(dBm)	Ant.2 Power(dBm)	MIMO Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.					
2412	1	6	16.92	15.82	19.42	30
		9	16.86	15.34	19.17	
		12	15.99	14.22	18.21	
		18	16.72	14.93	18.93	
		24	16.51	14.90	18.79	
		36	16.39	14.82	18.68	
		48	16.26	14.78	18.59	
		54	16.49	14.95	18.80	
2437	6	6	16.83	16.22	19.55	
		9	16.69	16.10	19.41	
		12	15.61	15.10	18.38	
		18	16.31	15.82	19.08	
		24	16.15	15.68	18.93	
		36	16.14	15.63	18.90	
		48	16.02	15.57	18.81	
		54	16.17	15.76	18.98	
2462	11	6	16.67	15.51	19.14	
		9	16.46	15.34	18.95	
		12	15.49	14.22	17.91	
		18	16.15	14.85	18.56	
		24	16.19	14.70	18.52	
		36	16.14	14.61	18.45	
		48	16.03	14.58	18.37	
		54	16.31	14.71	18.59	

802.11n(HT20) Mode		MCS Index	Ant.1 Measured Power(dBm)	Ant.2 Measured Power(dBm)	MIMO Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.					
2412	1	0	15.89	14.92	18.44	30
		1	15.46	14.49	18.01	
		2	15.47	14.49	18.02	
		3	15.48	14.43	18.00	
		4	15.64	14.63	18.17	
		5	15.84	14.26	18.14	
		6	15.60	14.65	18.16	
		7	15.77	14.43	18.16	
2437	6	0	16.52	15.68	19.13	
		1	16.22	15.57	18.92	
		2	16.12	15.51	18.84	
		3	16.07	15.47	18.79	
		4	16.18	15.62	18.92	
		5	15.78	15.26	18.54	
		6	16.20	15.64	18.94	
		7	15.93	15.44	18.70	
2462	11	0	15.06	14.09	17.61	
		1	14.77	13.96	17.40	
		2	14.87	13.86	17.40	
		3	14.87	13.81	17.38	
		4	14.93	13.87	17.44	
		5	15.05	13.53	17.36	
		6	14.80	13.92	17.39	
		7	14.94	13.68	17.36	

9.4 POWER SPECTRAL DENSITY

Note :

1. Spectrum Measured Levels are not plot data.

The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.

2. Spectrum offset

Ant.1 Loss : Attenuator loss(10 dB) + Cable loss + EUT cable Loss

Ant.2 Loss : Attenuator loss(10 dB) + Cable loss

3. 802.11b Mode Trnasmits Continuously(Duty Cycle \geq 98%, cf. 9.1)

[Ant.1]

Note:

1. Reporting for MIMO calculation

Mode	Frequency (MHz)	Channel No.	Test Result			Limit (dBm)
			Measured PSD (dBm)	Duty Cycle Factor	Measured PSD(dBm) + Duty Cycle Factor	
802.11b	2412	1	-2.963	0.000	-2.963	8 dBm / 3 kHz
	2437	6	-2.778	0.000	-2.778	
	2462	11	-3.348	0.000	-3.348	
802.11g	2412	1	-7.015	0.304	-6.711	
	2437	6	-7.292	0.304	-6.988	
	2462	11	-7.039	0.304	-6.735	
802.11n(HT20)	2412	1	-8.099	0.356	-7.743	
	2437	6	-7.624	0.356	-7.268	
	2462	11	-8.264	0.356	-7.908	

[Ant.2]

Mode	Frequency (MHz)	Channel No.	Test Result			Limit (dBm)
			Measured PSD (dBm)	Duty Cycle Factor	Measured PSD(dBm) + Duty Cycle Factor	
802.11b	2412	1	-3.735	0.000	-3.735	8 dBm / 3 kHz
	2437	6	-3.623	0.000	-3.623	
	2462	11	-3.978	0.000	-3.978	
802.11g	2412	1	-7.619	0.304	-7.315	
	2437	6	-7.659	0.304	-7.355	
	2462	11	-8.003	0.304	-7.699	
802.11n(HT20)	2412	1	-9.365	0.356	-9.009	
	2437	6	-8.161	0.356	-7.805	
	2462	11	-9.980	0.356	-9.624	

[MIMO]

Mode	Frequency (MHz)	Channel No.	Test Result			Limit (dBm)
			ANT 1 Measured PSD(dBm) + Duty Cycle Factor	ANT 2 Measured PSD(dBm) + Duty Cycle Factor	MIMO Result (dBm)	
802.11b	2412	1	-2.963	-3.735	-0.322	8 dBm / 3 kHz
	2437	6	-2.778	-3.623	-0.170	
	2462	11	-3.348	-3.978	-0.641	
802.11g	2412	1	-6.711	-7.315	-3.993	
	2437	6	-6.988	-7.355	-4.158	
	2462	11	-6.735	-7.699	-4.180	
802.11n(HT20)	2412	1	-7.743	-9.009	-5.320	
	2437	6	-7.268	-7.805	-4.518	
	2462	11	-7.908	-9.624	-5.672	

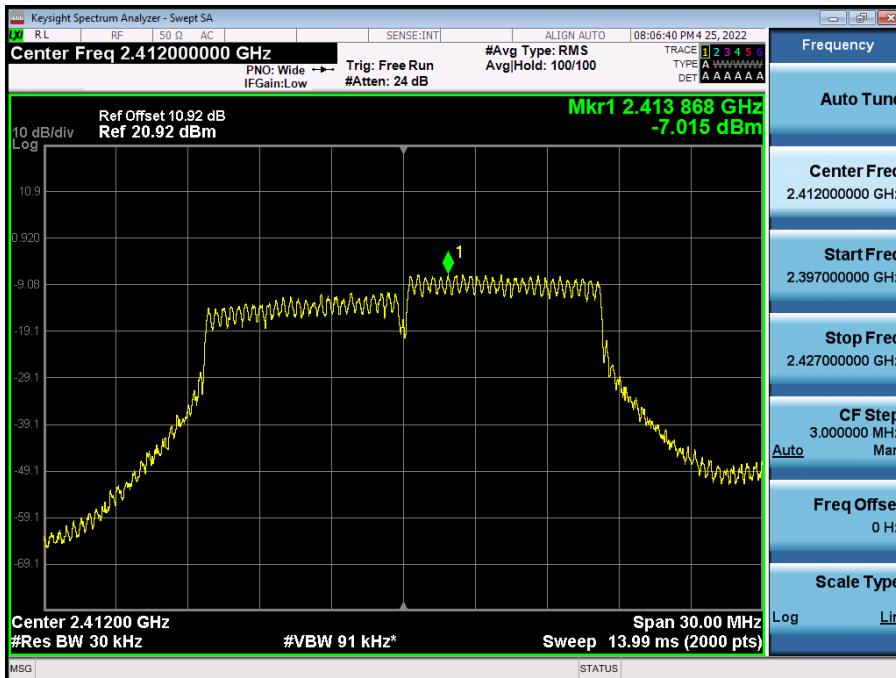
[Ant.1]

Test Plots

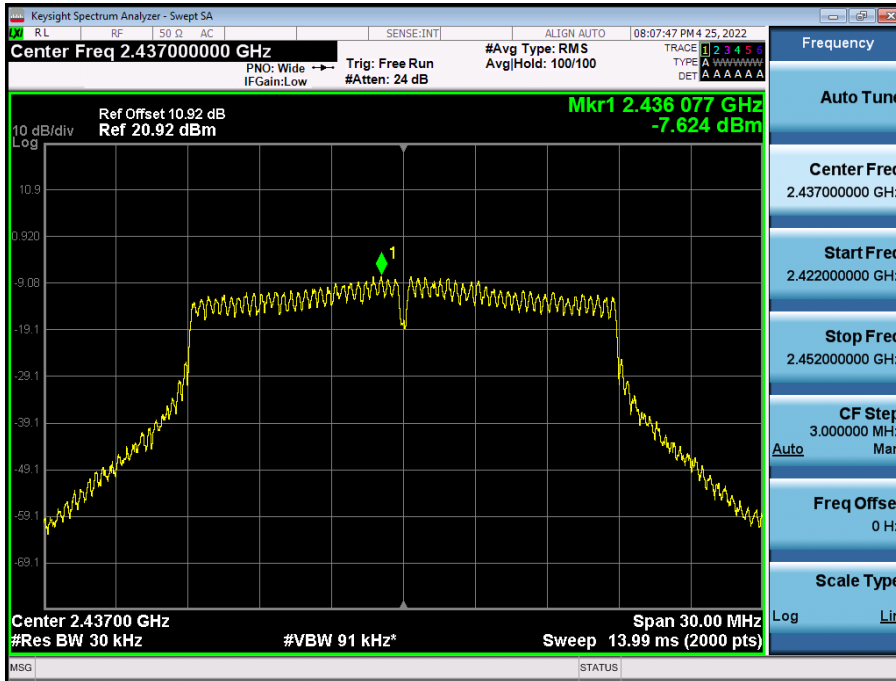
Power Spectral Density (802.11b-CH 6)



Power Spectral Density (802.11g-CH 1)



Power Spectral Density (802.11n_HT20-CH 6)



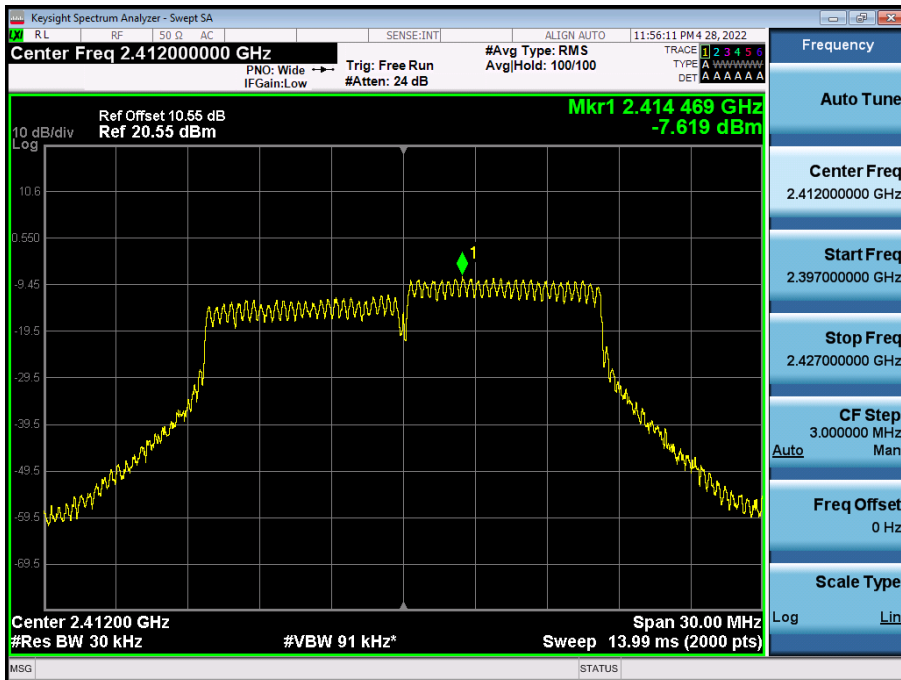
[Ant.2]

☑ Test Plots

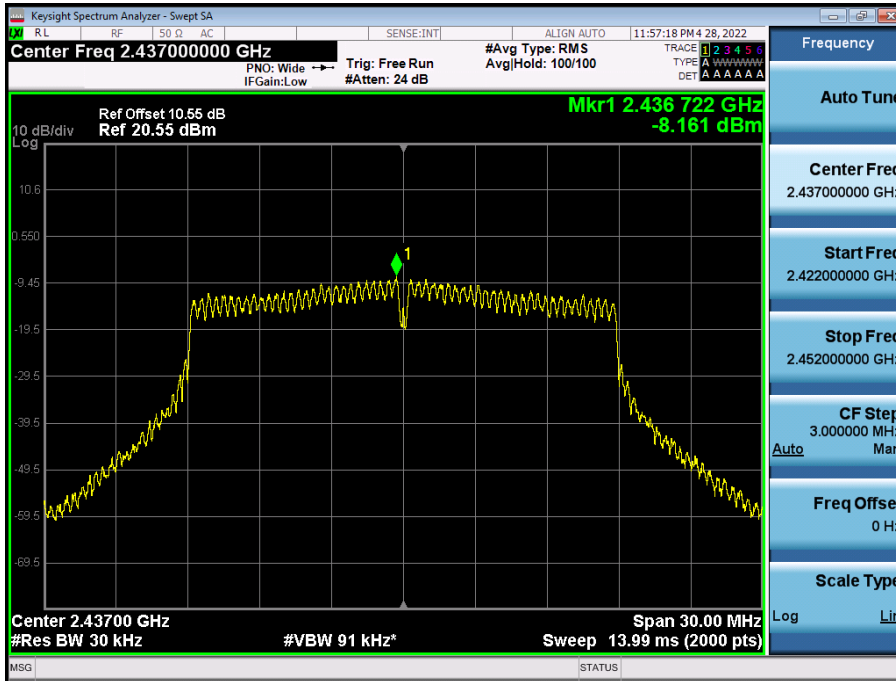
Power Spectral Density (802.11b-CH 6)



Power Spectral Density (802.11g-CH 1)



Power Spectral Density (802.11n_HT20-CH 6)



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.

[Ant.1]

Frequency [MHz]	Channel No.	Mode	Band Edge Position	Test Result	
				Measured Level (dB)	Limit (dB)
2412	1	802.11b	Lower	57.635	30
2462	11		Upper	59.689	30
2412	1	802.11g	Lower	46.545	30
2462	11		Upper	47.884	30
2412	1	802.11n (HT20)	Lower	45.284	30
2462	11		Upper	53.961	30

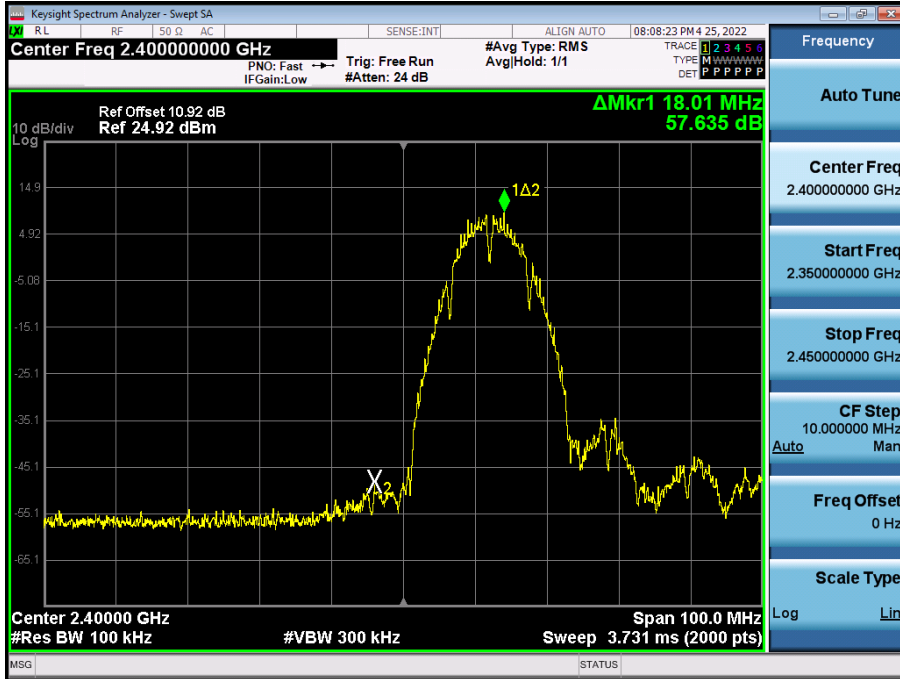
[Ant.2]

Frequency [MHz]	Channel No.	Mode	Band Edge Position	Test Result	
				Measured Level (dB)	Limit (dB)
2412	1	802.11b	Lower	54.589	30
2462	11		Upper	61.333	30
2412	1	802.11g	Lower	41.836	30
2462	11		Upper	48.600	30
2412	1	802.11n (HT20)	Lower	40.854	30
2462	11		Upper	52.487	30

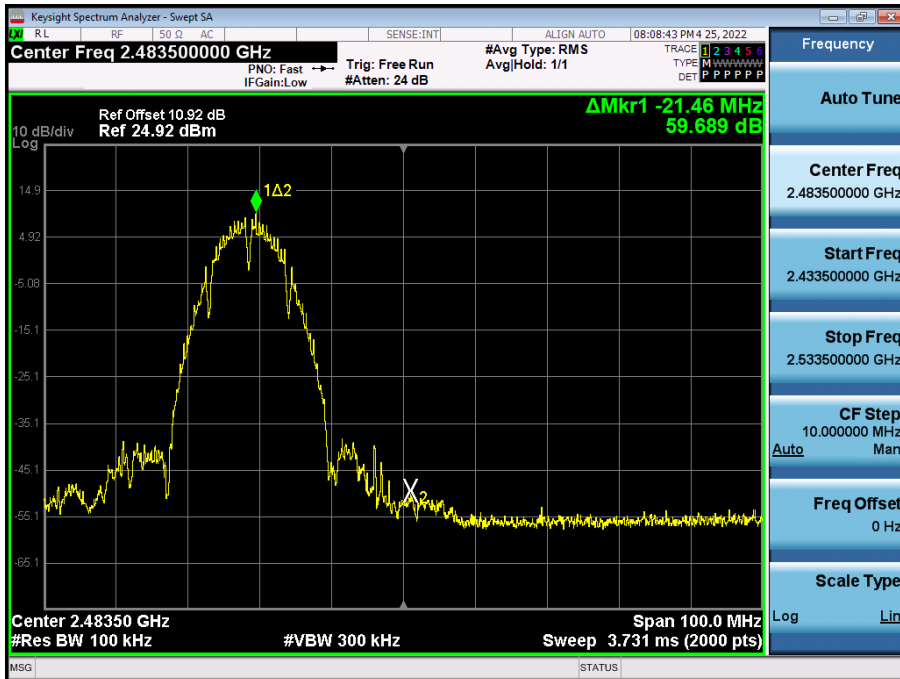
Test Plots(BandEdge)

[Ant.1]

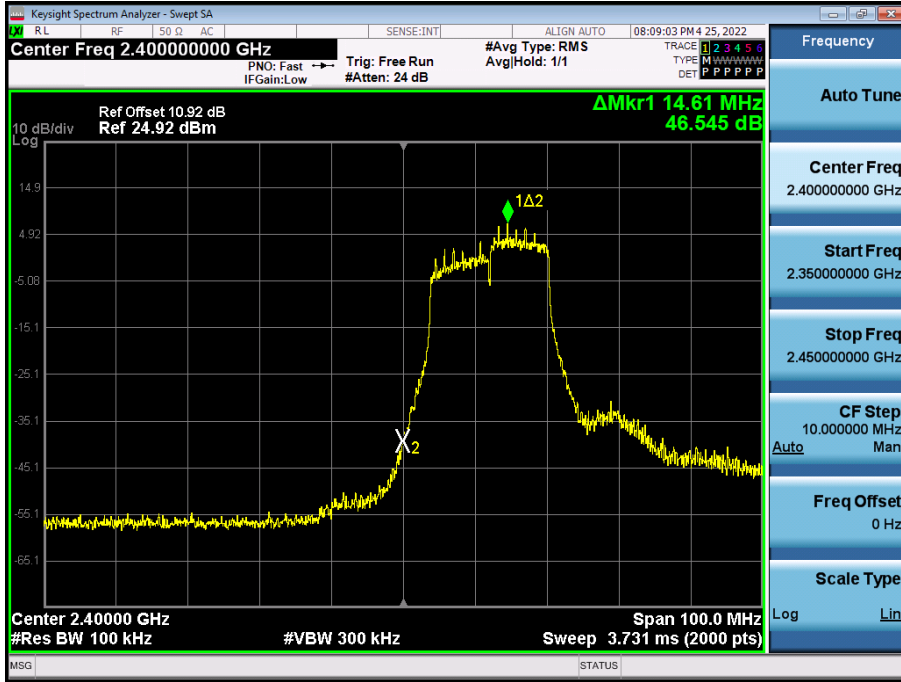
Band Edge (802.11b-CH1)



Band Edge (802.11b-CH11)



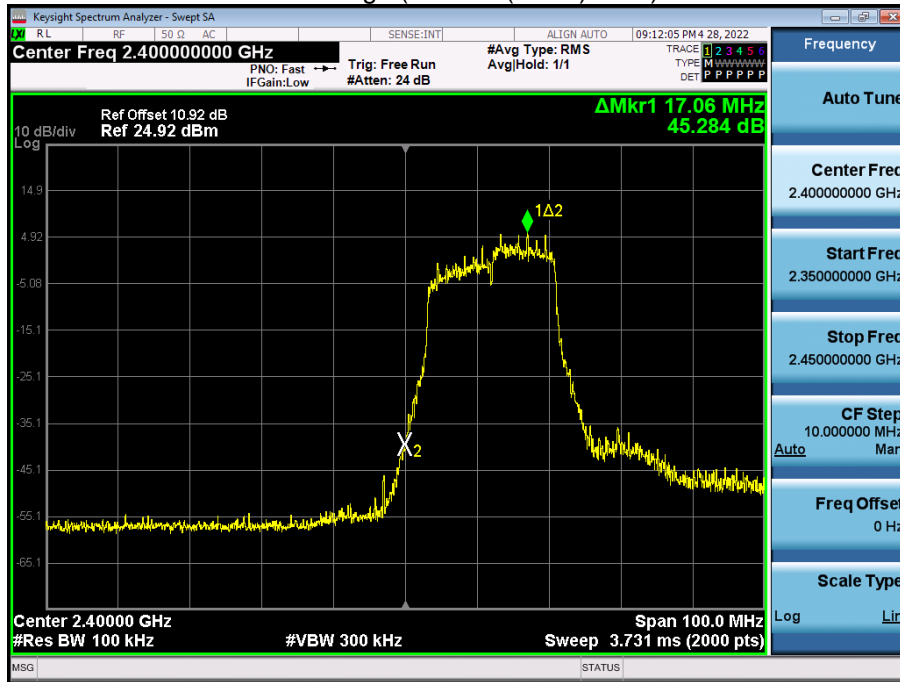
Band Edge (802.11g-CH1)



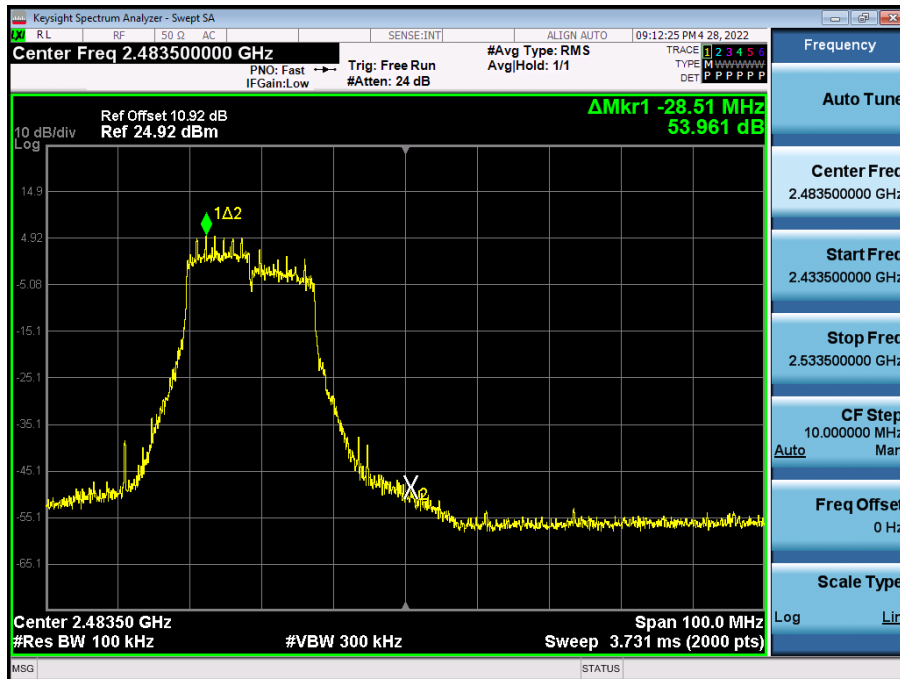
Band Edge (802.11g-CH11)



Band Edge (802.11n(HT20)-CH1)

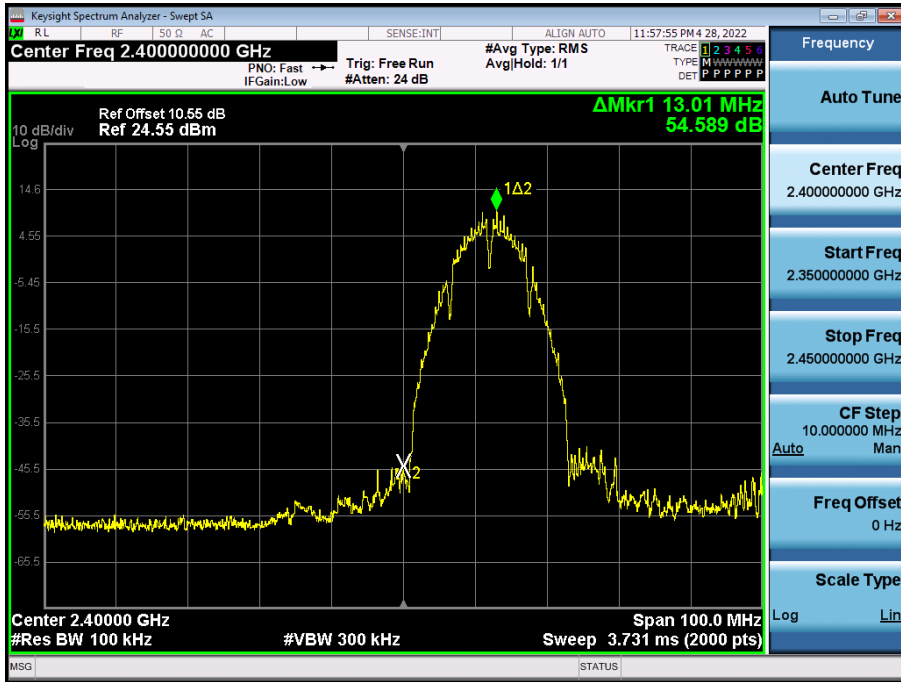


Band Edge (802.11n(HT20)-CH1)



[Ant.2]

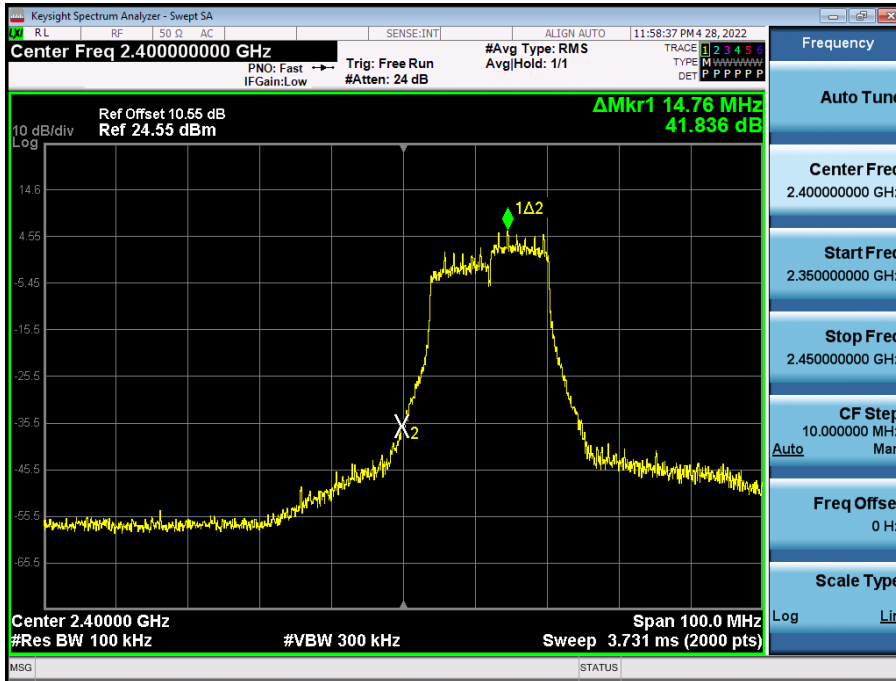
Band Edge (802.11b-CH1)



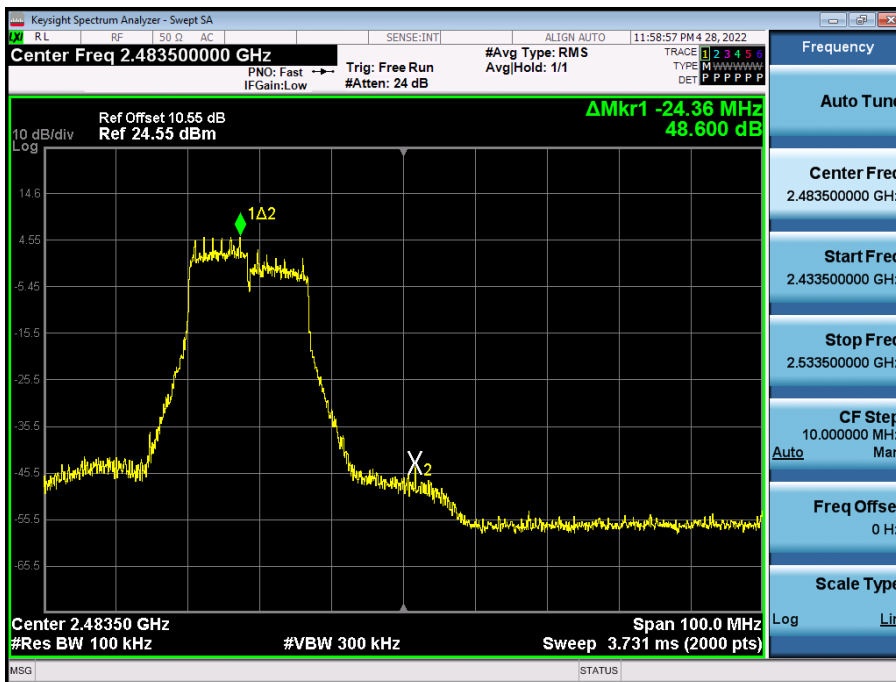
Band Edge (802.11b-CH11)



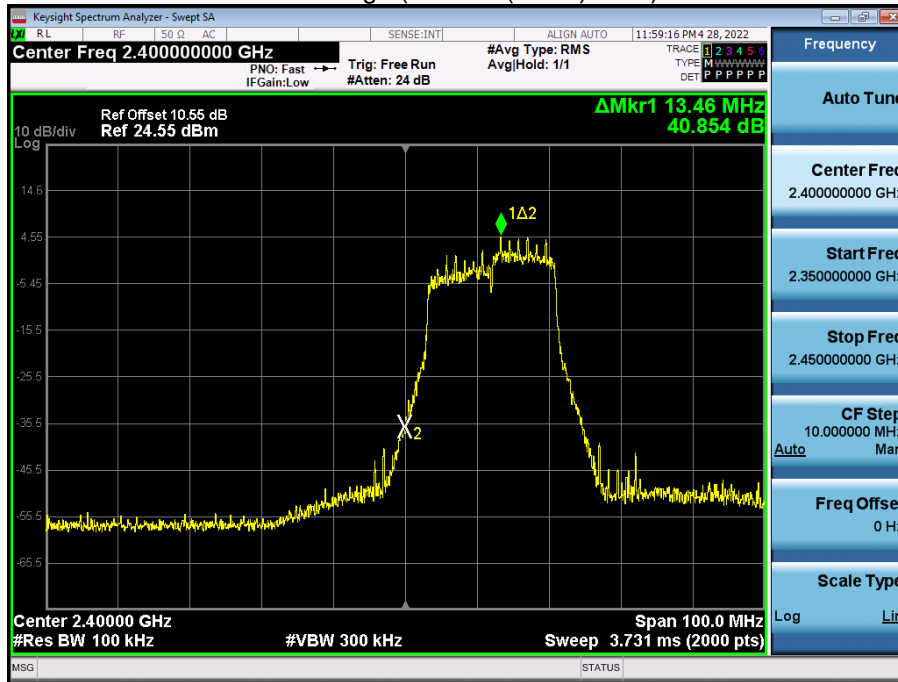
Band Edge (802.11g-CH1)



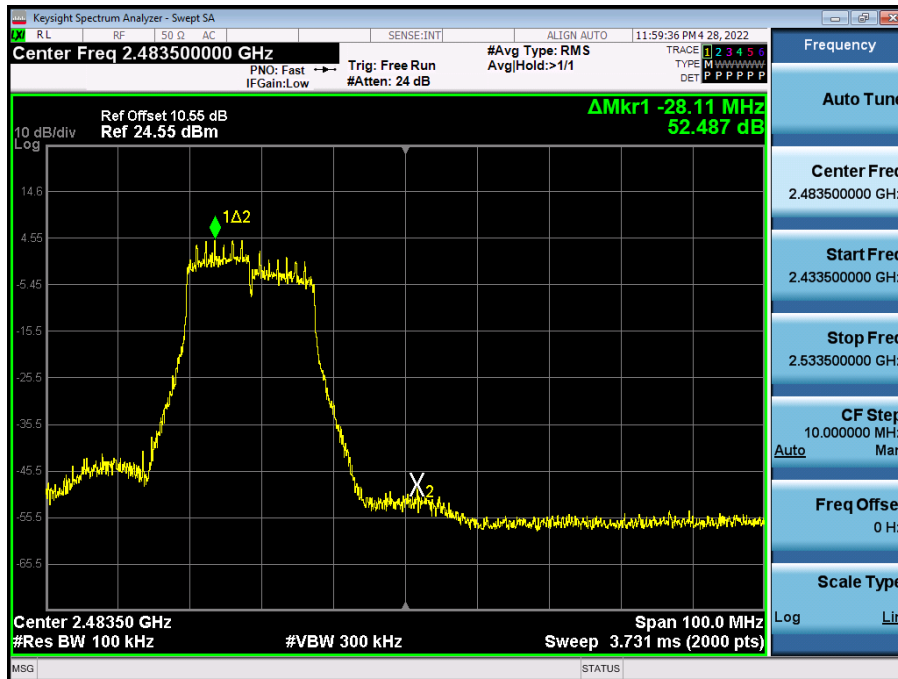
Band Edge (802.11g-CH11)



Band Edge (802.11n(HT20)-CH1)



Band Edge (802.11n(HT20)-CH1)

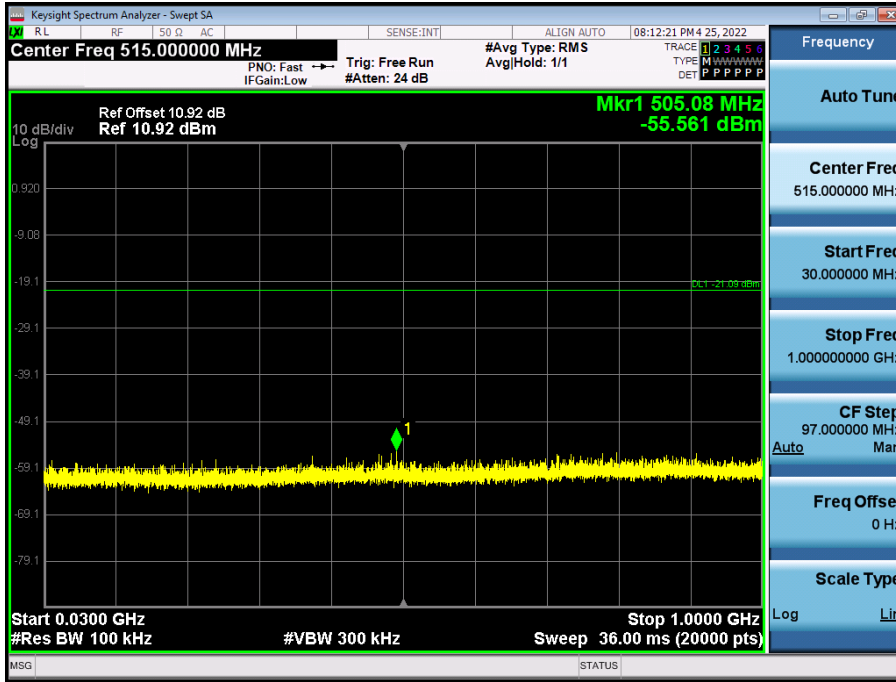


Test Plots(Conducted Spurious Emission)

In order to simplify the report, attached plots were only Ant.1 (Worst Case: Ant.1).

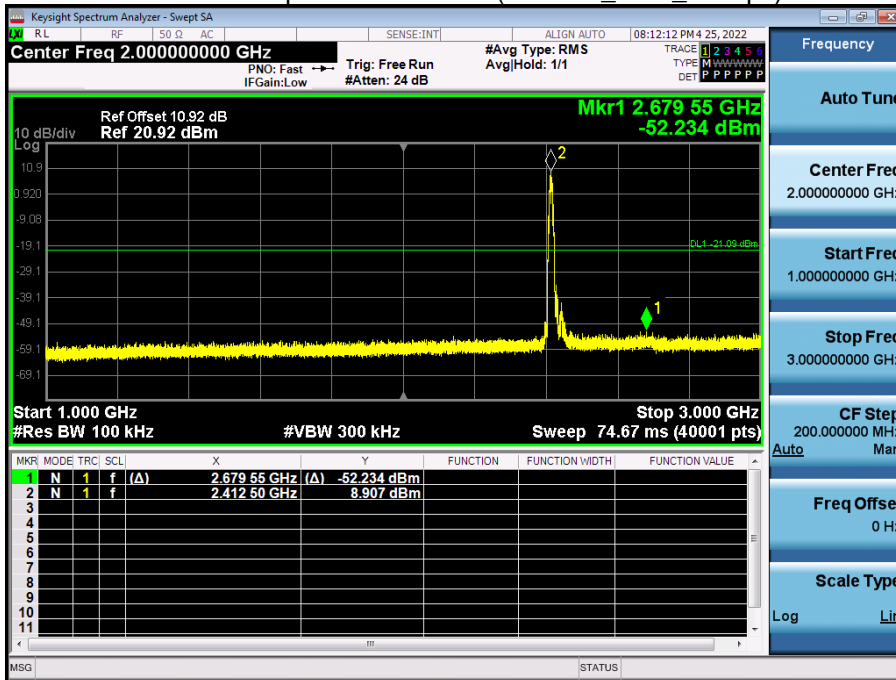
30 MHz ~ 1 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



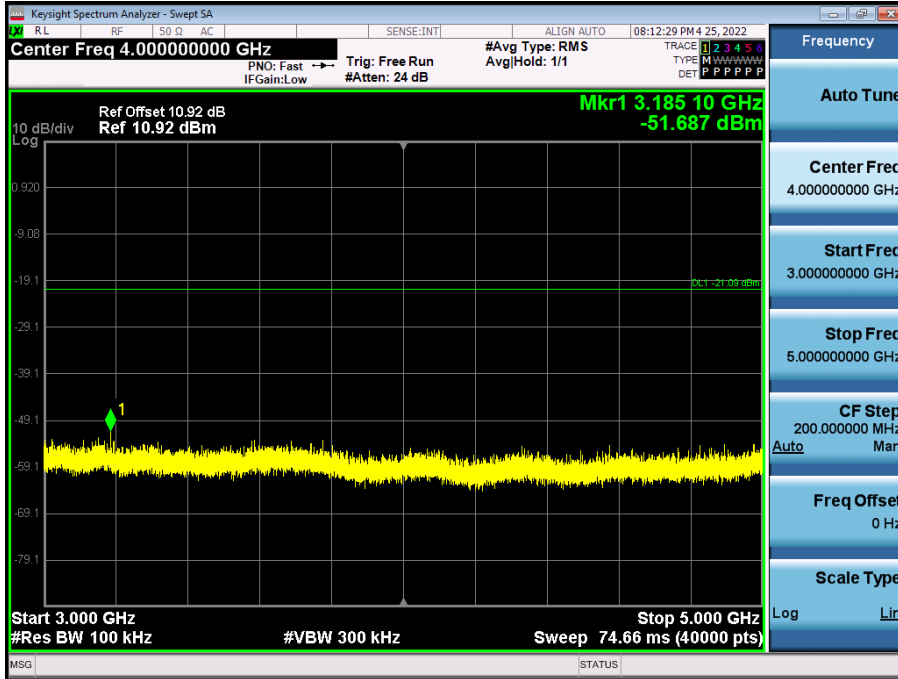
1 GHz ~ 3 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



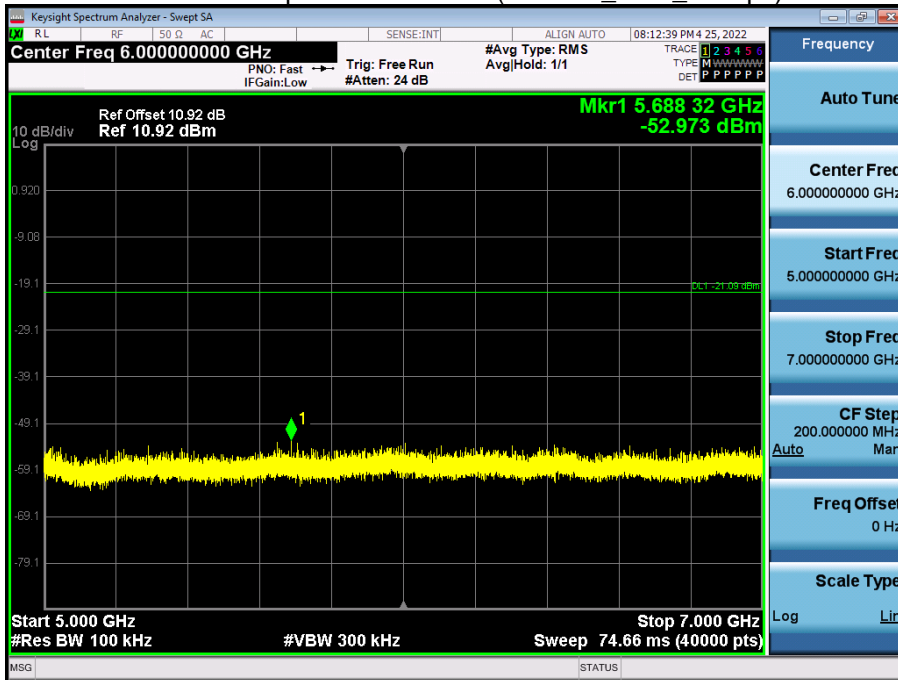
3 GHz ~ 5 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



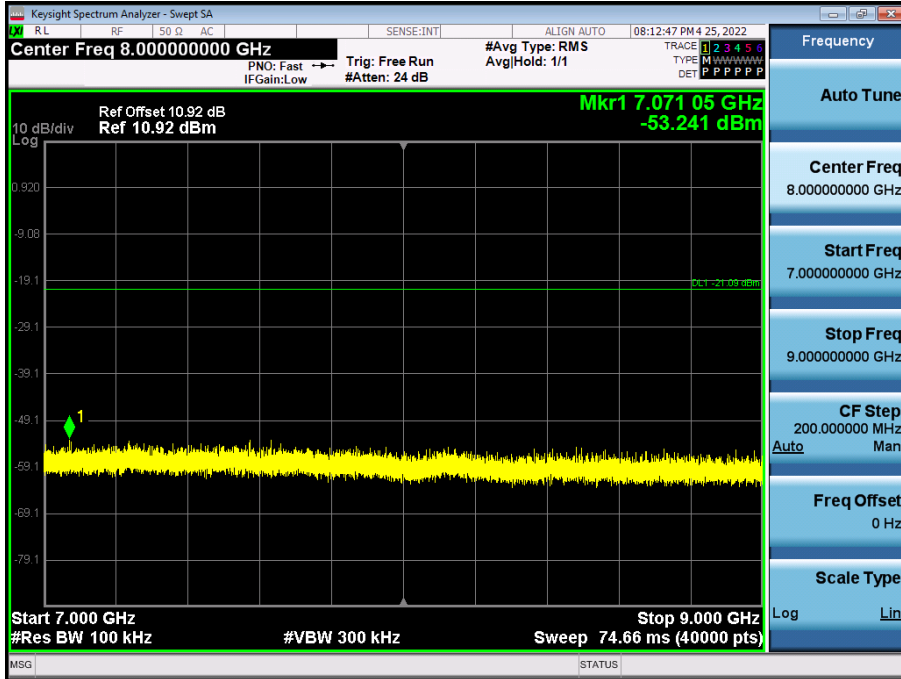
5 GHz ~ 7 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



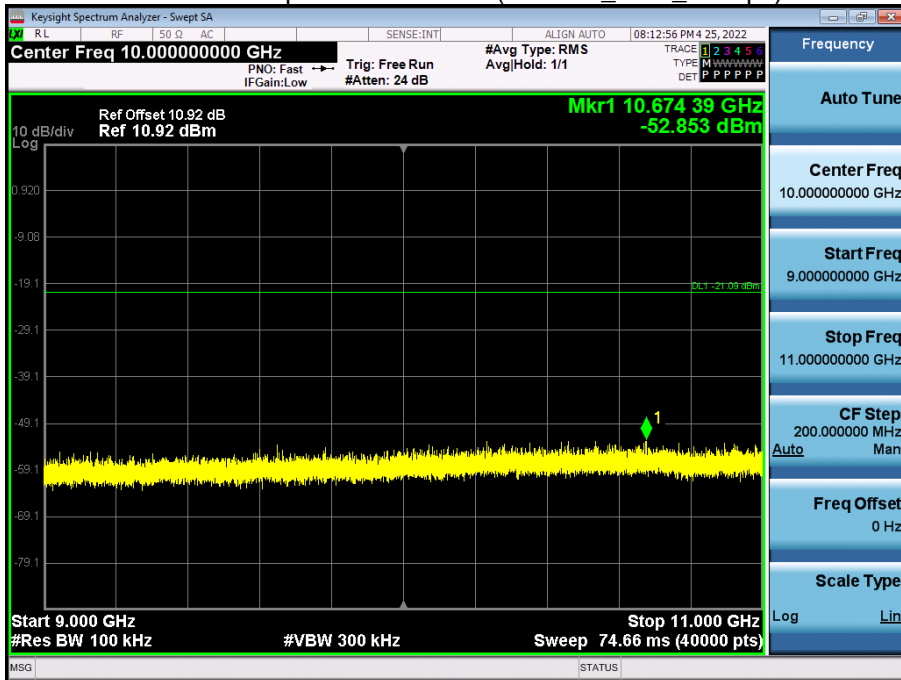
7 GHz ~ 9 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



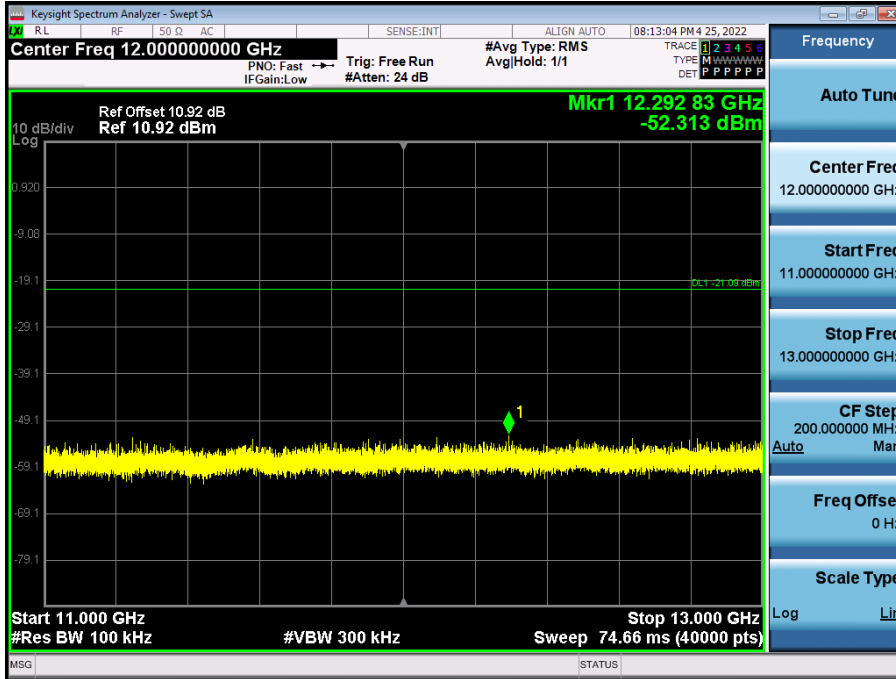
9 GHz ~ 11 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



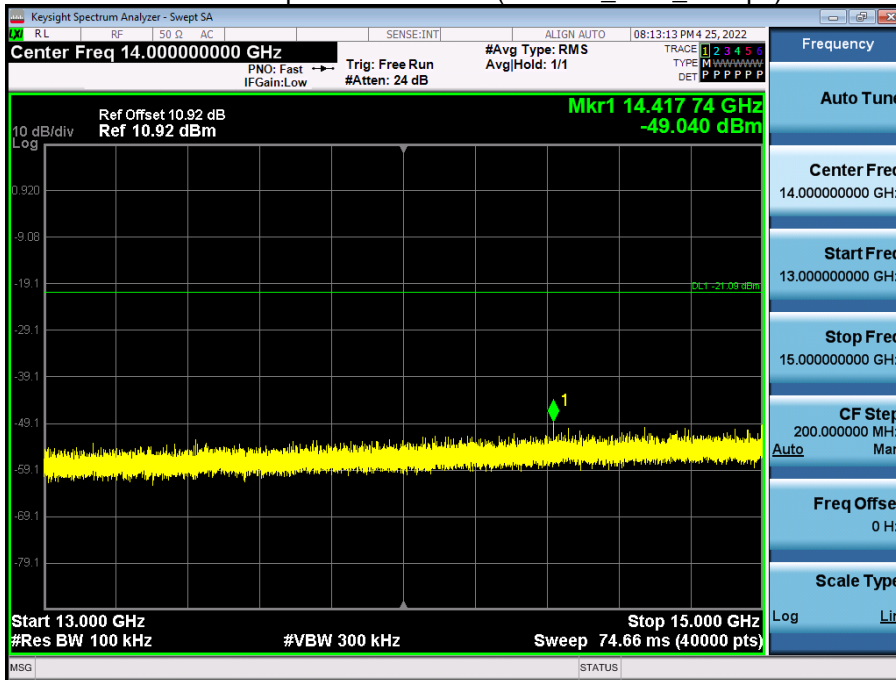
11 GHz ~ 13 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



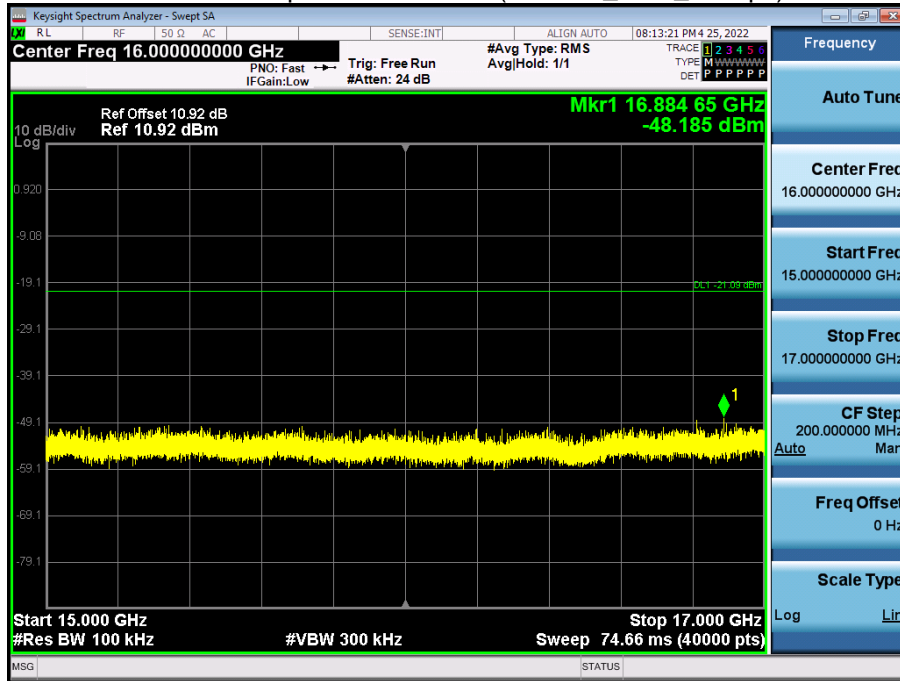
13 GHz ~ 15 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



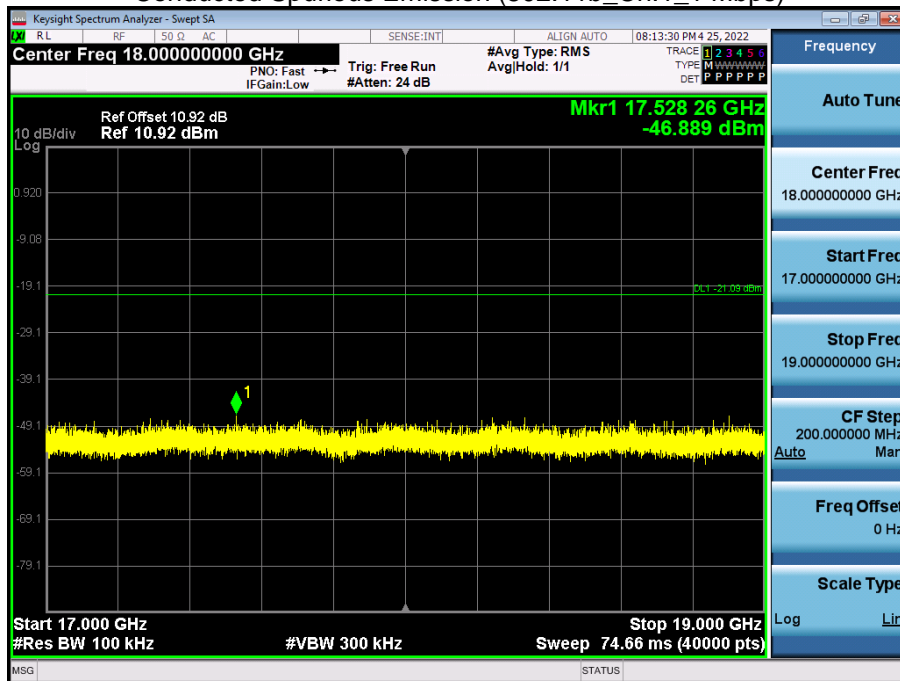
15 GHz ~ 17 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



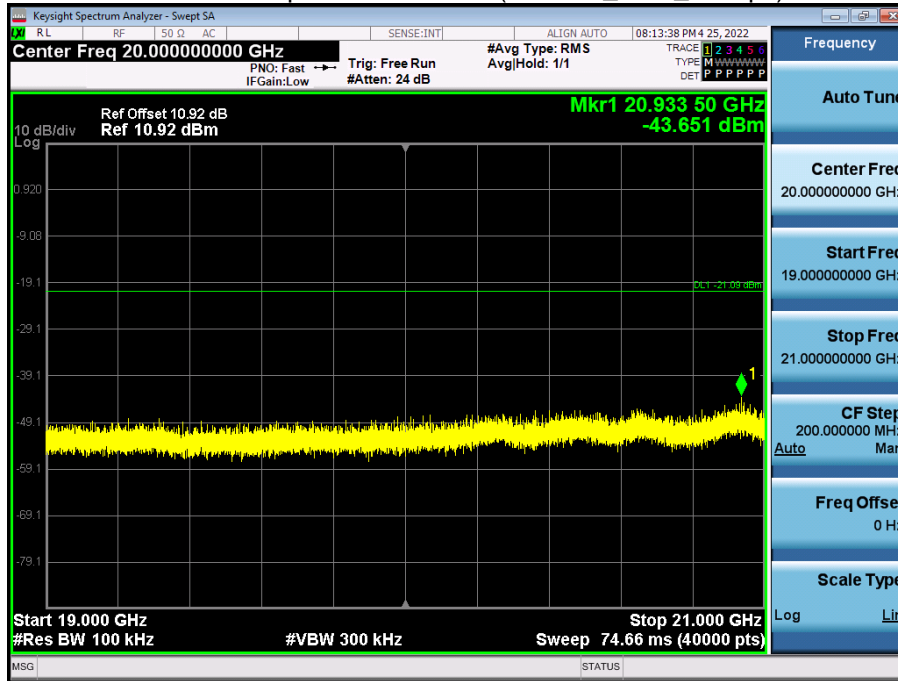
17 GHz ~ 19 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



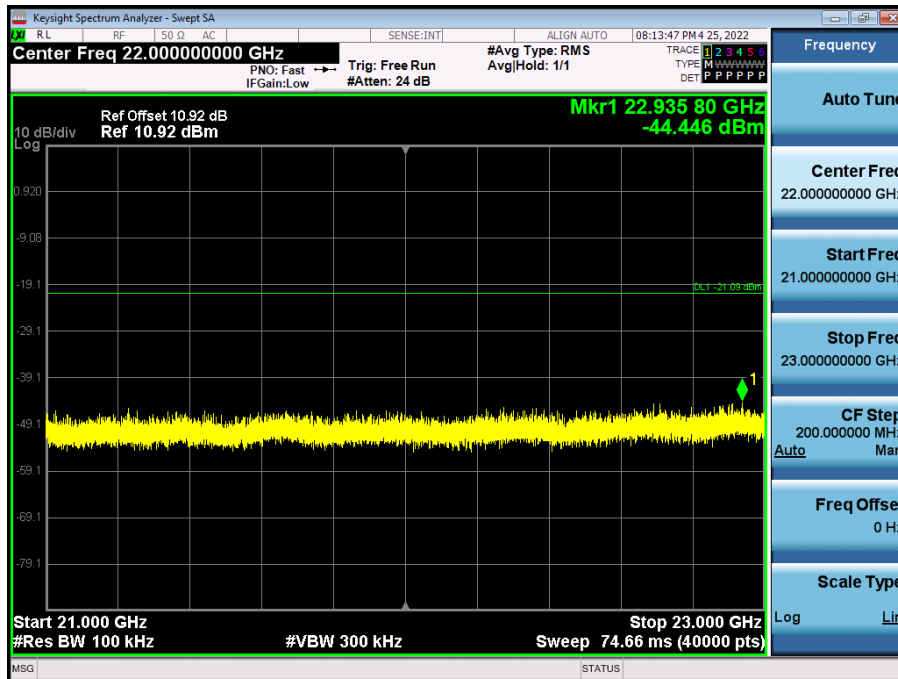
19 GHz ~ 21 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



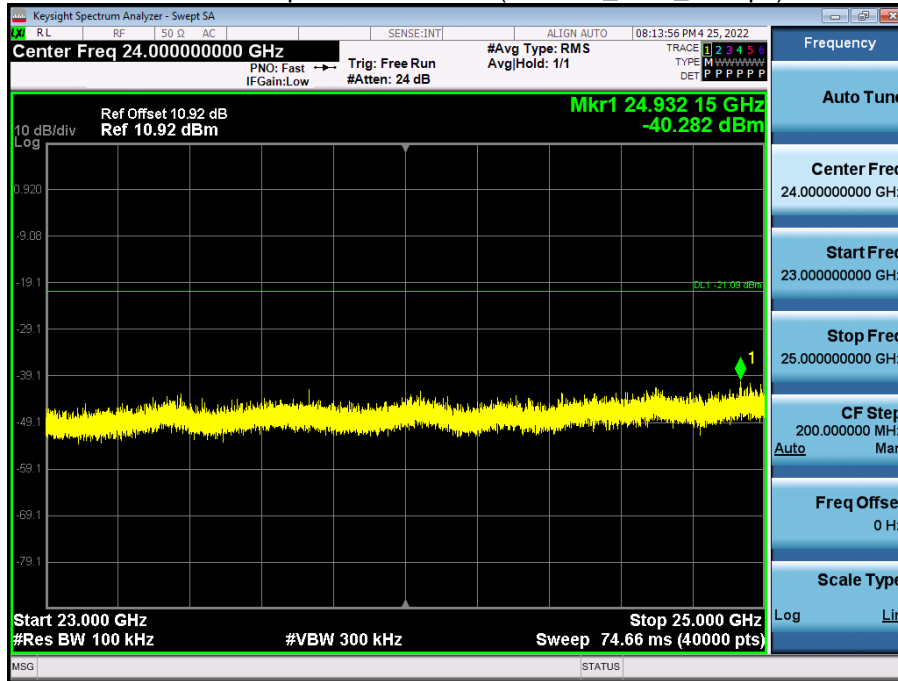
21 GHz ~ 23 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



23 GHz ~ 25 GHz

Conducted Spurious Emission (802.11b_Ch.1_1 Mbps)



Note :

In order to simplify the report, attached plots were only the worstcase channel.

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]	[dB μ V]	[dB/m]	[H/V]	[dB μ V/m]	[dB μ V/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 = $40\log(\text{specific distance} / \text{test distance})$ (dB)
3. Limit line = specific Limits (dB μ V) + Distance extrapolation factor

Frequency Range : Below 1 GHz

Frequency	Measured Value	A.F+C.L	Ant. POL	Total	Limit	Margin
[MHz]	[dB μ V]	[dB/m]	[H/V]	[dB μ V/m]	[dB μ V/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**[Ant.1&Ant.2_MIMO(CDD)]**

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

Frequency [MHz]	Reading [dBuV]	AF+CL+DF-AG [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4824	46.22	3.48	V	49.70	73.98	24.28	PK
4824	38.21	3.48	V	41.69	53.98	12.29	AV
7236	44.22	8.67	V	52.89	73.98	21.09	PK
7236	35.57	8.67	V	44.24	53.98	9.74	AV
4824	46.38	3.48	H	49.86	73.98	24.12	PK
4824	39.15	3.48	H	42.63	53.98	11.35	AV
7236	45.59	8.67	H	54.26	73.98	19.72	PK
7236	37.65	8.67	H	46.32	53.98	7.66	AV

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

Frequency [MHz]	Reading [dBuV]	AF+CL+DF-AG [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4874	47.24	3.19	V	50.43	73.98	23.55	PK
4874	40.91	3.19	V	44.10	53.98	9.88	AV
7311	44.93	9.41	V	54.34	73.98	19.64	PK
7311	35.17	9.41	V	44.58	53.98	9.40	AV
4874	46.51	3.19	H	49.70	73.98	24.28	PK
4874	39.14	3.19	H	42.33	53.98	11.65	AV
7311	45.32	9.41	H	54.73	73.98	19.25	PK
7311	36.62	9.41	H	46.03	53.98	7.95	AV

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

Frequency [MHz]	Reading [dBuV]	AF+CL+DF-AG [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4924	46.16	2.54	V	48.70	73.98	25.28	PK
4924	39.61	2.54	V	42.15	53.98	11.83	AV
7386	43.84	10.04	V	53.88	73.98	20.10	PK
7386	33.52	10.04	V	43.56	53.98	10.42	AV
4924	45.33	2.54	H	47.87	73.98	26.11	PK
4924	38.24	2.54	H	40.78	53.98	13.20	AV
7386	44.76	10.04	H	54.80	73.98	19.18	PK
7386	35.26	10.04	H	45.30	53.98	8.68	AV

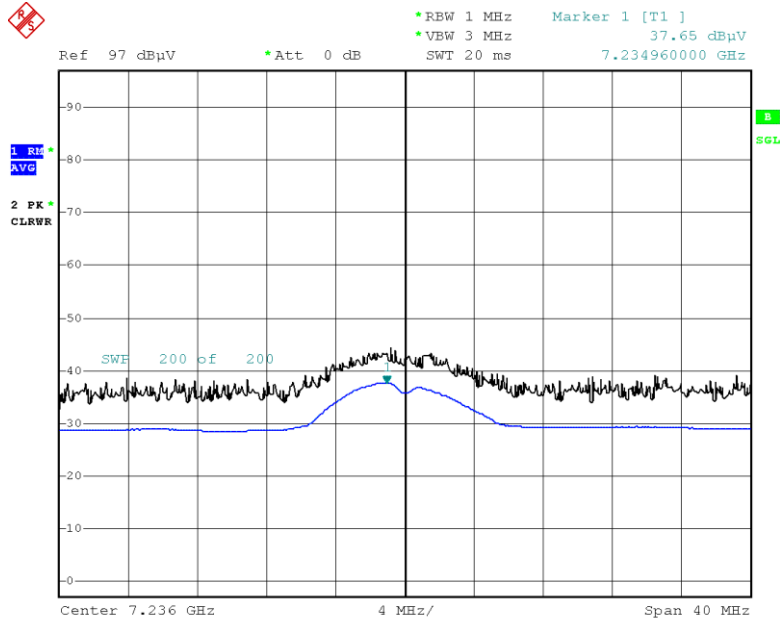
[DBS Mode]**802.11b Ch.1 2 412 GHz Ant ALL & 802.11ax(HE20) Ch.165 5 825 GHz UNII-3 Ant ALL**

Frequency [MHz]	Reading [dBuV]	A.F.+C.L.-A.G + D.F [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
7236	46.98	8.67	V	55.65	73.98	18.33	PK
7236	35.26	8.67	V	43.93	53.98	10.05	AV

Test Plots

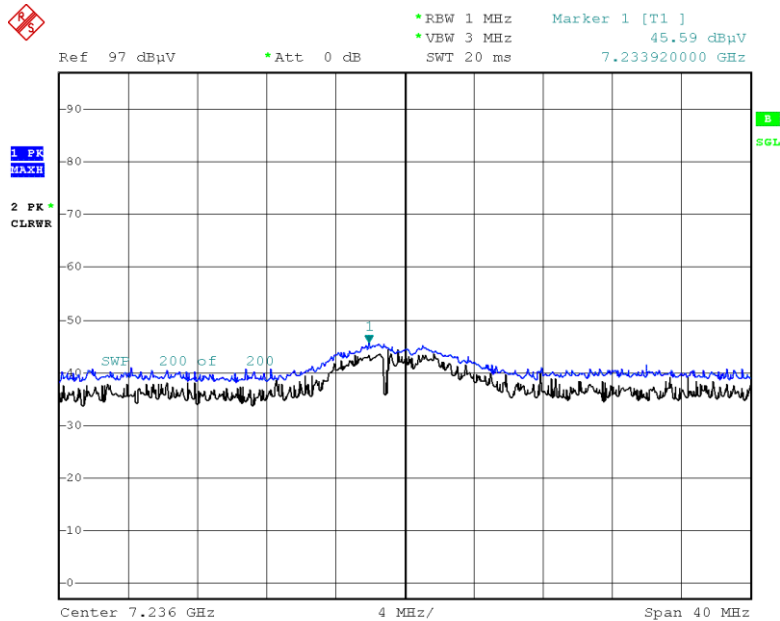
[Ant.1&Ant.2_MIMO(CDD)] _ Worst case : Y-H

Radiated Spurious Emissions plot – Average Reading (802.11b_1 Mbps, Ch.1 3rd Harmonic)



Date: 22.APR.2022 15:51:53

Radiated Spurious Emissions plot – Peak Reading (802.11b_1 Mbps, Ch.1 3rd Harmonic)

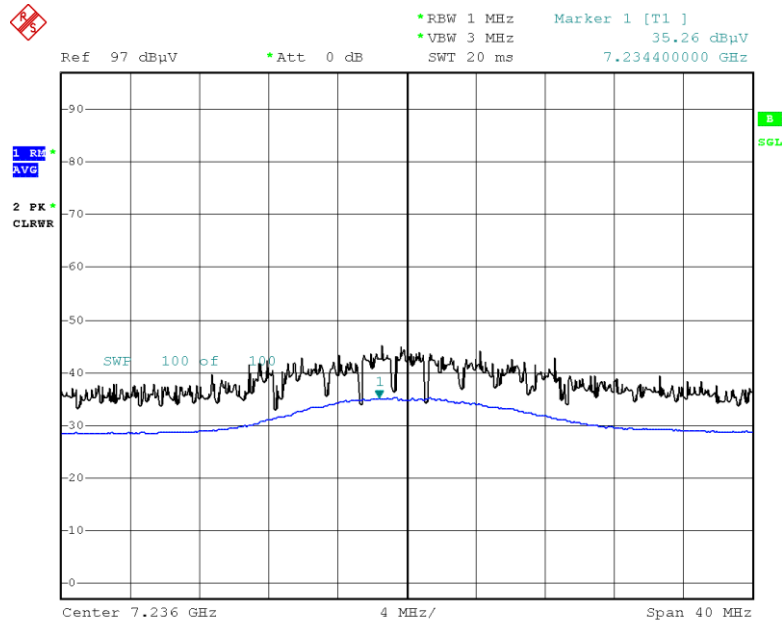


Date: 22.APR.2022 15:52:05

[DBS]

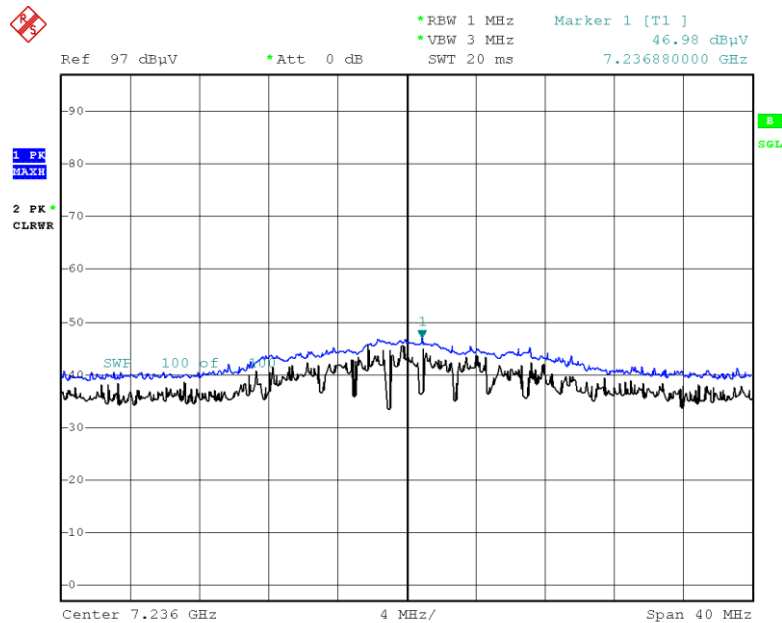
802.11b Ch.1 2 412 GHz Ant ALL & 802.11ax(HE20) Ch.165 5 825 GHz UNII-3 Ant ALL

Radiated Spurious Emissions plot – Average Reading (Z-V_3rd Harmonic)



Date: 9.MAY.2022 16:41:25

Radiated Spurious Emissions plot – Peak Reading (Z-V_3rd Harmonic)



Date: 9.MAY.2022 16:42:18

Note: Plot of worst case are only reported.

9.7 RADIATED RESTRICTED BAND EDGES**[Ant.1&Ant.2_MIMO(CDD)]**

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2412 MHz, 2462 MHz
Channel No.	01 Ch, 11 Ch

Frequency [MHz]	Reading [dBuV]	AF+CL+DF [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2310-2390	22.34	33.78	H	56.12	73.98	17.86	PK
2310-2390	11.15	33.78	H	44.93	53.98	9.05	AV
2310-2390	22.13	33.78	V	55.90	73.98	18.08	PK
2310-2390	11.08	33.78	V	44.86	53.98	9.12	AV
2483.5-2500	23.22	34.10	H	57.32	73.98	16.66	PK
2483.5-2500	12.45	34.10	H	46.55	53.98	7.43	AV
2483.5-2500	23.09	34.10	V	57.19	73.98	16.79	PK
2483.5-2500	12.11	34.10	V	46.21	53.98	7.77	AV

Operation Mode: 802.11g
 Transfer Rate: 6 Mbps
 Operating Frequency: 2412 MHz, 2462 MHz
 Channel No. 01 Ch, 11 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	AF+CL+DF [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2310-2390	32.00	0.00	33.78	H	65.78	73.98	8.20	PK
2310-2390	14.06	2.50	33.78	H	50.34	53.98	3.64	AV
2310-2390	30.67	0.00	33.78	V	64.45	73.98	9.53	PK
2310-2390	13.85	2.50	33.78	V	50.13	53.98	3.85	AV
#2483.5-2484.5	28.50	0.00	34.10	H	62.59	73.98	11.39	PK
#2483.5-2484.5	14.61	2.50	34.10	H	51.21	53.98	2.77	AV
#2484.5-2485.5	26.86	0.00	34.10	H	60.95	73.98	13.03	PK
#2484.5-2485.5	12.42	2.50	34.10	H	49.01	53.98	4.97	AV
2485.5-2500	32.76	0.00	34.10	H	66.86	73.98	7.12	PK
2485.5-2500	13.72	2.50	34.10	H	50.32	53.98	3.66	AV
#2483.5-2484.5	28.42	0.00	34.10	V	62.52	73.98	11.46	PK
#2483.5-2484.5	14.22	2.50	34.10	V	50.81	53.98	3.17	AV
#2484.5-2485.5	26.39	0.00	34.10	V	60.49	73.98	13.49	PK
#2484.5-2485.5	12.35	2.50	34.10	V	48.95	53.98	5.03	AV
2485.5-2500	31.57	0.00	34.10	V	65.67	73.98	8.31	PK
2485.5-2500	13.34	2.50	34.10	V	49.93	53.98	4.05	AV

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

Operation Mode: 802.11n (HT20)
 Transfer Rate: 0
 Operating Frequency: 2412 MHz, 2462 MHz
 Channel No.: 01 Ch, 11 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	AF+CL+DF [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2310-2388	25.27	0.00	33.78	H	59.04	73.98	14.94	PK
2310-2388	12.08	2.94	33.78	H	48.80	53.98	5.18	AV
#2388-2389	26.20	0.00	33.78	H	59.98	73.98	14.00	PK
#2388-2389	12.90	2.94	33.78	H	49.62	53.98	4.36	AV
#2389-2390	29.24	0.00	33.78	H	63.02	73.98	10.96	PK
#2389-2390	14.58	2.94	33.78	H	51.30	53.98	2.68	AV
2310-2388	24.64	0.00	33.78	V	58.42	73.98	15.56	PK
2310-2388	11.93	2.94	33.78	V	48.65	53.98	5.33	AV
#2388-2389	25.06	0.00	33.78	V	58.84	73.98	15.14	PK
#2388-2389	12.53	2.94	33.78	V	49.25	53.98	4.73	AV
#2389-2390	28.64	0.00	33.78	V	62.42	73.98	11.56	PK
#2389-2390	14.31	2.94	33.78	V	51.03	53.98	2.95	AV
#2483.5-2484.5	26.70	0.00	34.10	H	60.80	73.98	13.18	PK
#2483.5-2484.5	14.54	2.94	34.10	H	51.58	53.98	2.40	AV
#2484.5-2485.5	25.66	0.00	34.10	H	59.76	73.98	14.22	PK
#2484.5-2485.5	13.51	2.94	34.10	H	50.55	53.98	3.43	AV
2485.5-2500	30.32	0.00	34.10	H	64.42	73.98	9.56	PK
2485.5-2500	14.33	2.94	34.10	H	51.37	53.98	2.61	AV
#2483.5-2484.5	26.42	0.00	34.10	V	60.52	73.98	13.46	PK
#2483.5-2484.5	14.03	2.94	34.10	V	51.07	53.98	2.91	AV
#2484.5-2485.5	25.34	0.00	34.10	V	59.44	73.98	14.54	PK
#2484.5-2485.5	13.19	2.94	34.10	V	50.22	53.98	3.76	AV
2485.5-2500	29.15	0.00	34.10	V	63.25	73.98	10.73	PK
2485.5-2500	12.93	2.94	34.10	V	49.97	53.98	4.01	AV

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

■ Test Plots

[Ant.1&Ant.2_MIMO(CDD)] (Worst case : X-H)

Radiated Restricted Band Edges plot – Average Reading (802.11n (HT20)_ MCS7, Ch.11)

Integration method Used_2 483.5 MHz – 2 484.5 MHz



Radiated Restricted Band Edges plot – Average Reading (802.11n (HT20)_ MCS7, Ch.11)



Radiated Restricted Band Edges plot – Peak Reading (802.11n (HT20)_ MCS7, Ch.11)

Integration method Used_ 2 483.5 MHz – 2 484.5 MHz



Radiated Restricted Band Edges plot – Peak Reading (802.11n (HT20)_ MCS7, Ch.11)



Note:

Plot of worst case are only reported.

9.8 POWERLINE CONDUCTED EMISSIONS

Conducted Emissions (Line 1)

Test

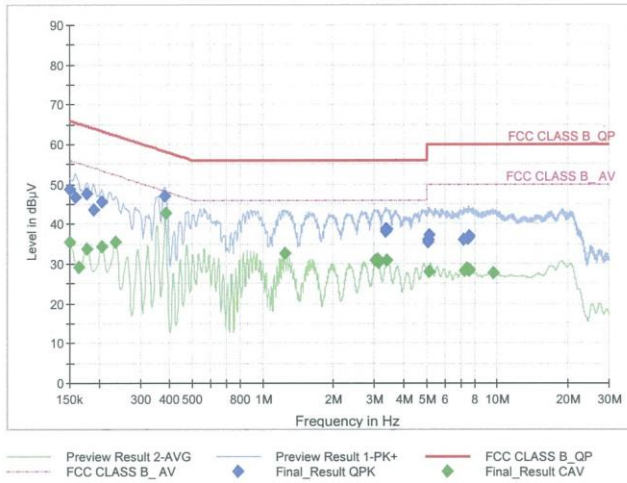
1 / 2

Test Report

Common Information

EUT : SM-G990U2
 Manufacturer : SAMSUNG Electronics Co., Ltd.
 Test Site: SHIELD ROOM
 Operating Conditions : 2.4G WLAN_L1
 Operator Name:
 Comment:

Full Spectrum



Final Result QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	48.84	66.00	17.16	9.000	L1	OFF	9.6
0.1590	46.61	65.52	18.90	9.000	L1	OFF	9.6
0.1770	47.65	64.63	16.97	9.000	L1	OFF	9.6
0.1905	43.42	64.02	20.59	9.000	L1	OFF	9.6
0.2063	45.55	63.36	17.80	9.000	L1	OFF	9.6
0.3818	47.05	58.24	11.19	9.000	L1	OFF	9.6
3.3418	37.96	56.00	18.04	9.000	L1	OFF	9.8
3.3530	38.58	56.00	17.42	9.000	L1	OFF	9.8
3.3845	38.80	56.00	17.20	9.000	L1	OFF	9.8
5.0563	35.57	60.00	24.43	9.000	L1	OFF	9.9
5.0878	36.16	60.00	23.84	9.000	L1	OFF	9.9
5.1103	37.12	60.00	22.88	9.000	L1	OFF	9.9
7.1555	35.91	60.00	24.09	9.000	L1	OFF	9.9
7.1870	36.05	60.00	23.95	9.000	L1	OFF	9.9
7.5065	36.49	60.00	23.51	9.000	L1	OFF	10.0
7.5380	36.45	60.00	23.55	9.000	L1	OFF	10.0
7.5448	36.59	60.00	23.41	9.000	L1	OFF	10.0
7.6010	36.82	60.00	23.18	9.000	L1	OFF	10.0

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Test

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Final Result CAV

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	35.40	56.00	20.60	9.000	L1	OFF	9.6
0.1635	29.20	55.28	26.09	9.000	L1	OFF	9.6
0.1770	33.87	54.63	20.75	9.000	L1	OFF	9.6
0.2063	34.30	53.36	19.06	9.000	L1	OFF	9.6
0.2355	35.34	52.25	16.92	9.000	L1	OFF	9.6
0.3840	42.67	48.19	5.53	9.000	L1	OFF	9.6
1.2403	32.51	46.00	13.49	9.000	L1	OFF	9.7
3.0335	30.83	46.00	15.17	9.000	L1	OFF	9.8
3.0943	31.02	46.00	14.98	9.000	L1	OFF	9.8
3.1235	30.42	46.00	15.58	9.000	L1	OFF	9.8
3.3868	30.75	46.00	15.25	9.000	L1	OFF	9.8
5.1013	28.10	50.00	21.90	9.000	L1	OFF	9.9
7.2500	28.15	50.00	21.85	9.000	L1	OFF	9.9
7.4705	28.91	50.00	21.09	9.000	L1	OFF	9.9
7.5110	28.59	50.00	21.41	9.000	L1	OFF	10.0
7.5695	28.40	50.00	21.60	9.000	L1	OFF	10.0
7.6033	28.44	50.00	21.56	9.000	L1	OFF	10.0
9.6035	27.79	50.00	22.21	9.000	L1	OFF	10.0

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Conducted Emissions (Line 2)

Test

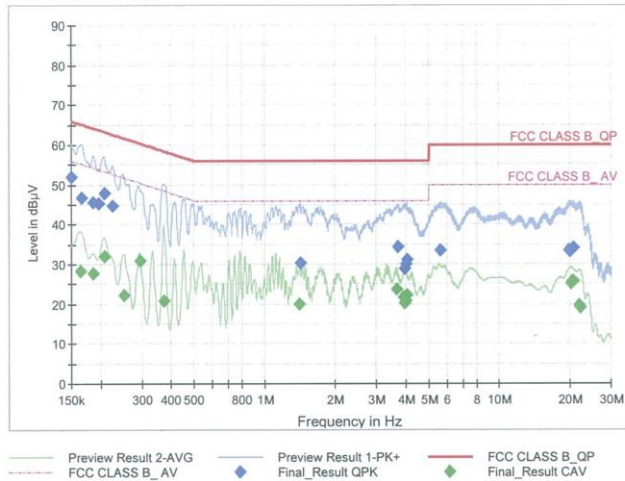
1 / 2

Test Report

Common Information

EUT : SM-G990U2
 Manufacturer : SAMSUNG Electronics Co., Ltd.
 Test Site: SHIELD ROOM
 Operating Conditions : 2.4G WLAN_N
 Operator Name:
 Comment:

Full Spectrum



Final Result QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	51.99	66.00	14.01	9.000	N	OFF	9.6
0.1658	46.69	65.17	18.48	9.000	N	OFF	9.6
0.1860	45.45	64.21	18.76	9.000	N	OFF	9.6
0.1973	45.32	63.73	18.41	9.000	N	OFF	9.6
0.2085	47.81	63.27	15.46	9.000	N	OFF	9.6
0.2243	44.70	62.66	17.96	9.000	N	OFF	9.6
1.4158	30.19	56.00	25.81	9.000	N	OFF	9.7
3.7063	34.32	56.00	21.68	9.000	N	OFF	9.8
3.9470	28.85	56.00	27.15	9.000	N	OFF	9.8
3.9988	30.00	56.00	26.00	9.000	N	OFF	9.8
4.0370	31.30	56.00	24.70	9.000	N	OFF	9.8
4.0415	31.22	56.00	24.78	9.000	N	OFF	9.8
5.6278	33.44	60.00	26.56	9.000	N	OFF	9.9
19.8545	33.41	60.00	26.59	9.000	N	OFF	10.5
20.0210	33.21	60.00	26.79	9.000	N	OFF	10.5
20.1515	33.59	60.00	26.41	9.000	N	OFF	10.5
20.1875	33.53	60.00	26.47	9.000	N	OFF	10.5
20.6015	33.93	60.00	26.07	9.000	N	OFF	10.5

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Test

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Final Result CAV

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1635	28.33	55.28	26.96	9.000	N	OFF	9.6
0.1860	27.66	54.21	26.55	9.000	N	OFF	9.6
0.2085	31.94	53.27	21.33	9.000	N	OFF	9.6
0.2513	22.14	51.72	29.57	9.000	N	OFF	9.6
0.2940	30.82	50.41	19.59	9.000	N	OFF	9.6
0.3728	20.64	48.44	27.80	9.000	N	OFF	9.6
1.4135	19.92	46.00	26.08	9.000	N	OFF	9.7
3.6568	23.79	46.00	22.21	9.000	N	OFF	9.8
3.9110	21.64	46.00	24.36	9.000	N	OFF	9.8
3.9515	20.32	46.00	25.68	9.000	N	OFF	9.8
3.9920	20.87	46.00	25.13	9.000	N	OFF	9.8
4.0303	22.10	46.00	23.90	9.000	N	OFF	9.8
20.1448	25.20	50.00	24.80	9.000	N	OFF	10.5
20.2033	25.10	50.00	24.90	9.000	N	OFF	10.5
20.4800	25.53	50.00	24.47	9.000	N	OFF	10.5
20.7703	25.57	50.00	24.43	9.000	N	OFF	10.5
21.9583	19.50	50.00	30.50	9.000	N	OFF	10.5
22.2485	19.14	50.00	30.86	9.000	N	OFF	10.5

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9.9 CONFIRMATION OF GEO-LOCATION MECHANISM

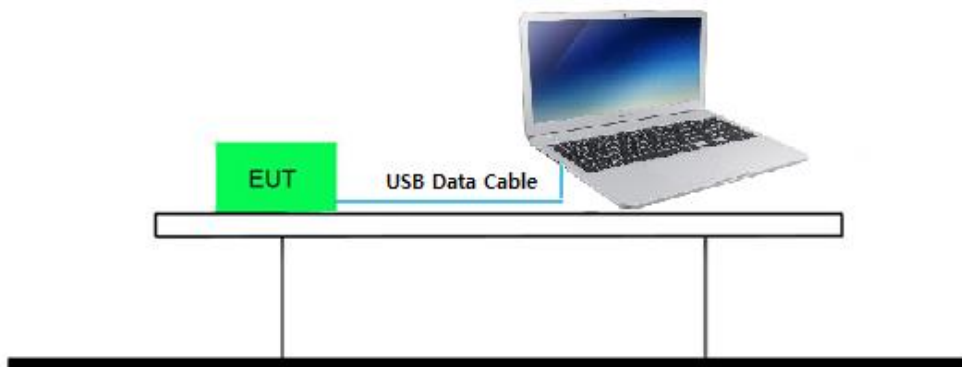
The device uses MCC information obtained from the public cellular carrier to determine that it is operating outside the U.S. and then enable channels 12 and 13 only if a non-US MCC that supports channel 12 and 13 is confirmed.

The device uses a geo-location mechanism based on the Country in order to only enable certain WLAN DTS bands when the device is not in the USA.

WLAN	Country code = US	Country code = KR(Korea)
CH 12	Did not connect	Connected
CH 13	Did not connect	Connected

The verification tests confirmed the operational of the geo-location mechanism.

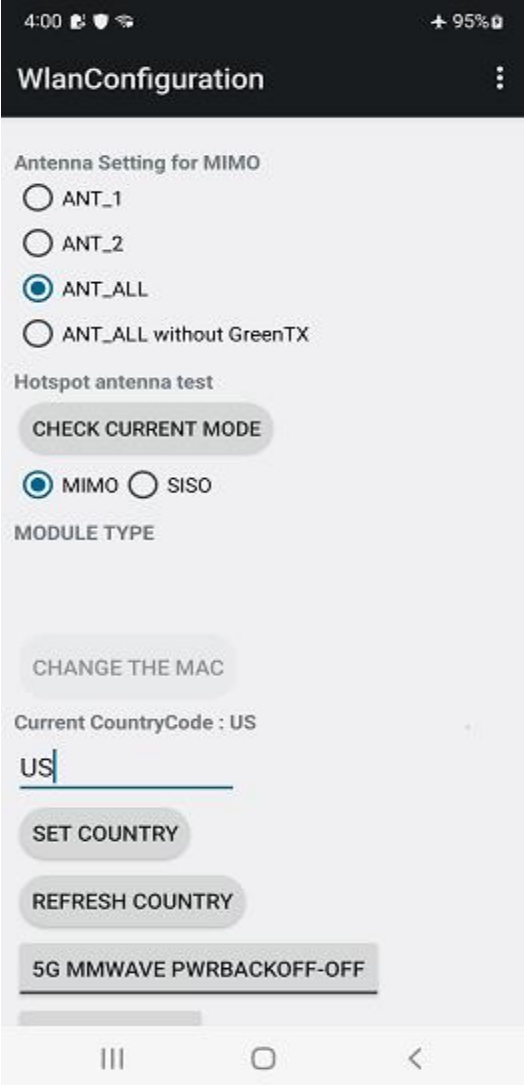
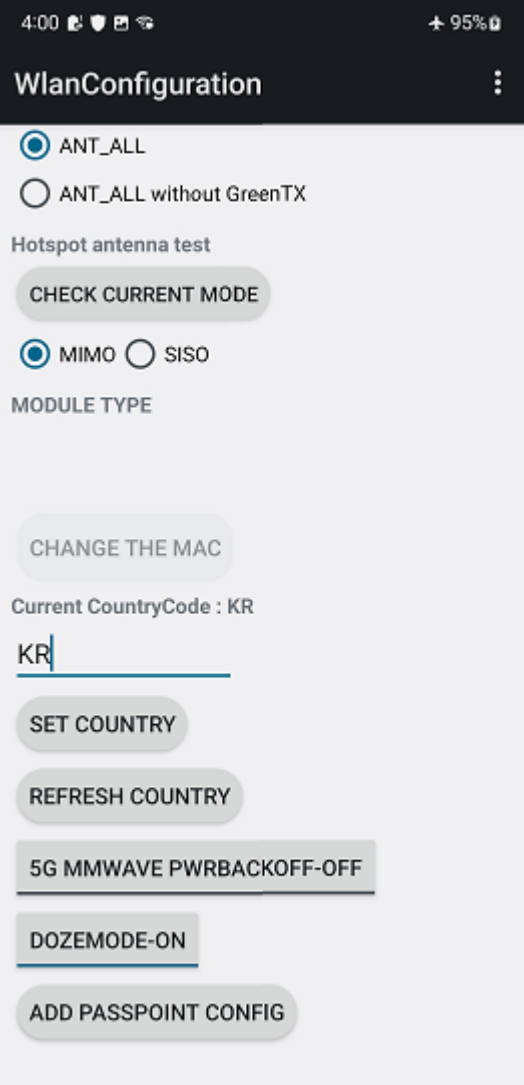
Test Setup



Test Procedure

In case of Country code	In case of airplane mode
1. Open Command Prompt. 2. At the Command Prompt, enter the command. - C:\adb>adb remount - C:\adb>adb shell - gts4lv:/ # wpa_cli driver country US // Setting the country. - gts4lv:/ # iw list // Channel list is obtain.	1. airplane mode on 2. Wifi on 3. Open Command Prompt. 4. At the Command Prompt, enter the command. - C:\adb>adb remount - C:\adb>adb shell - gts4lv:/ # iw list // support band in case of airplane mode

Setting the country for product

Country code = US	Country code = KR(Korea)
 <p>4:00 95% WlanConfiguration</p> <p>Antenna Setting for MIMO</p> <ul style="list-style-type: none"><input type="radio"/> ANT_1<input type="radio"/> ANT_2<input checked="" type="radio"/> ANT_ALL<input type="radio"/> ANT_ALL without GreenTX <p>Hotspot antenna test</p> <p>CHECK CURRENT MODE</p> <p><input checked="" type="radio"/> MIMO <input type="radio"/> SISO</p> <p>MODULE TYPE</p> <p>CHANGE THE MAC</p> <p>Current CountryCode : US</p> <p>US</p> <p>SET COUNTRY</p> <p>REFRESH COUNTRY</p> <p>5G MMWAVE PWRBACKOFF-OFF</p>	 <p>4:00 95% WlanConfiguration</p> <ul style="list-style-type: none"><input checked="" type="radio"/> ANT_ALL<input type="radio"/> ANT_ALL without GreenTX <p>Hotspot antenna test</p> <p>CHECK CURRENT MODE</p> <p><input checked="" type="radio"/> MIMO <input type="radio"/> SISO</p> <p>MODULE TYPE</p> <p>CHANGE THE MAC</p> <p>Current CountryCode : KR</p> <p>KR</p> <p>SET COUNTRY</p> <p>REFRESH COUNTRY</p> <p>5G MMWAVE PWRBACKOFF-OFF</p> <p>DOZEMODE-ON</p> <p>ADD PASSPOINT CONFIG</p>

Country code = US

```
Frequencies:  
* 2412 MHz [1] (30.0 dBm)  
* 2417 MHz [2] (30.0 dBm)  
* 2422 MHz [3] (30.0 dBm)  
* 2427 MHz [4] (30.0 dBm)  
* 2432 MHz [5] (30.0 dBm)  
* 2437 MHz [6] (30.0 dBm)  
* 2442 MHz [7] (30.0 dBm)  
* 2447 MHz [8] (30.0 dBm)  
* 2452 MHz [9] (30.0 dBm)  
* 2457 MHz [10] (30.0 dBm)  
* 2462 MHz [11] (30.0 dBm)  
* 2467 MHz [12] (disabled)  
* 2472 MHz [13] (disabled)
```

Country code = KR (Korea)

```
Frequencies:  
* 2412 MHz [1] (23.0 dBm)  
* 2417 MHz [2] (23.0 dBm)  
* 2422 MHz [3] (23.0 dBm)  
* 2427 MHz [4] (23.0 dBm)  
* 2432 MHz [5] (23.0 dBm)  
* 2437 MHz [6] (23.0 dBm)  
* 2442 MHz [7] (23.0 dBm)  
* 2447 MHz [8] (23.0 dBm)  
* 2452 MHz [9] (23.0 dBm)  
* 2457 MHz [10] (23.0 dBm)  
* 2462 MHz [11] (23.0 dBm)  
* 2467 MHz [12] (23.0 dBm)  
* 2472 MHz [13] (23.0 dBm)
```

10. LIST OF TEST EQUIPMENT

Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	08/23/2022	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	06/17/2022	Annual
Temperature Chamber	SU-642	ESPEC	0093008124	03/04/2023	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	09/07/2022	Annual
Power Meter	N1911A	Agilent	MY45100523	03/24/2023	Annual
Power Sensor	N1921A	Agilent	MY57820067	03/24/2023	Annual
Directional Coupler	87300B	Agilent	3116A03621	11/02/2022	Annual
Power Splitter	11667B	Hewlett Packard	10545	02/03/2023	Annual
DC Power Supply	E3646A	Agilent	MY40002937	12/14/2022	Annual
Attenuator(10 dB)(DC-26.5 GHz)	5910-N-50-010	H+S	00801	10/29/2022	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	03/07/2023	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	02/22/2023	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	EM2090	Emco	060520	N/A	N/A
Turn Table	N/A	Ets	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/17/2024	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	09/04/2022	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1191	11/18/2023	Biennial
Horn Antenna(15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170124	04/12/2023	Biennial
Amp & Filter Bank Switch Controller	FBSM-01A	TNM system	0	N/A	N/A
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	01/06/2023	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	06/24/2022	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/24/2022	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	02/07/2023	Annual
ATT(3 dB) + LNA2(6~18 GHz)	18B-03, CBL06185030	WEINSCHEL CERNEK	N/A	12/22/2022	Annual
ATT(10 dB) + LNA1(0.1~18 GHz)	56-10, CBLU1183540B-01	Api tech, CERNEK	N/A	12/22/2022	Annual
High Pass Filter	WHKX10-2700-3000-18000-40SS	Wainwright Instruments	N/A	12/22/2022	Annual
High Pass Filter	WHKX8-6090-7000-18000-40SS	Wainwright Instruments	N/A	12/22/2022	Annual
Thru	COAXIAL ATTENUATOR	T&M SYSTEM	N/A	12/22/2022	Annual
Power Amplifier	CBL18265035	CERNEK	22966	12/02/2022	Annual
Power Amplifier	CBL26405040	CERNEK	25956	03/11/2023	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	04/05/2023	Annual
Spectrum Analyzer	FSP(9 kHz ~ 30 GHz)	Rohde & Schwarz	836650/016	09/13/2022	Annual
Spectrum Analyzer	FSV40-N(9 kHz ~ 30 GHz)	Rohde & Schwarz	101068-SZ	09/15/2022	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-2205-FC009-P