

On your side



TEST REPORT

FCC DTS Test for JAS-U2-2018 Certification

APPLICANT
Jastec Co., Ltd.

REPORT NO.
HCT-RF-1909-FC010-R1

DATE OF ISSUE
October 02, 2019

HCT Co., Ltd.

74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Tel. +82 31 634 6300 F ax. +82 31 645 6401



HCT Co., Ltd.

74, Seocheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Tel. +82 31 634 6300 Fax. +82 31 645 6401



TEST REPORT

FCC DTS Test for
JAS-U2-2018

REPORT NO.
HCT-RF-1909-FC010-R1

DATE OF ISSUE
October 02, 2019

FCC ID
UK4JAS-U2-2018

Applicant	Jastec Co., Ltd. Jastec B/D, 92-7, Kumgok-Dong, Boondang-Gu Seongnam-Si, Kyunggi-Do N/A South Korea
Eut Type Model Name	uvim-W JAS-U2-2018
Peak Output Power	802.11b: 13.74 dBm / 802.11g: 16.84 dBm / 802.11n(HT20): 16.54 dBm / 802.11n(HT40): 13.77 dBm
Modulation type	CCK/DSSS/OFDM
FCC Classification	Digital Transmission System(DTS)
FCC Rule Part(s)	Part 15.247

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.

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

Tested by
Jeong Ho Kim

Technical Manager
Jong Seok Lee

HCT CO., LTD.
Soo Chan Lee
SooChan Lee / CEO
Accredited by KOLAS, Republic of KOREA

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	September 25, 2019	Initial Release
1	October 02, 2019	Revised Description of test modes

This laboratory is not accredited for the test results marked *.

The above Test Report is the accredited test result by KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA. (HCT Accreditation No.: KT197)

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.

CONTENTS

1. EUT DESCRIPTION	5
2. TEST METHODOLOGY	6
EUT CONFIGURATION	6
EUT EXERCISE	6
GENERAL TEST PROCEDURES	6
DESCRIPTION OF TEST MODES	6
3. INSTRUMENT CALIBRATION	7
4. FACILITIES AND ACCREDITATIONS	7
FACILITIES	7
EQUIPMENT	7
5. ANTENNA REQUIREMENTS	8
6. MEASUREMENT UNCERTAINTY	8
7. DESCRIPTION OF TESTS	9
8. SUMMARY TEST OF RESULTS	25
9. TEST RESULT	26
9.1 DUTY CYCLE	26
9.2 6dB BANDWIDTH	29
9.3 OUTPUT POWER	32
9.4 POWER SPECTRAL DENSITY	40
9.5 BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS	43
9.6 RADIATED SPURIOUS EMISSIONS	55
9.7 RADIATED RESTRICTED BAND EDGES	66
10. LIST OF TEST EQUIPMENT	70
11. ANNEX A_ TEST SETUP PHOTO	72

1. EUT DESCRIPTION

Model	JAS-U2-2018	
Additional Model	-	
EUT Type	uvim-W	
Power Supply	DC 12 [V] & 24 [V]	
Frequency Range	2412 MHz - 2462 MHz	
Max. RF Output Power	<u>Peak Power</u>	802.11b : 13.74 dBm 802.11g : 16.84 dBm 802.11n(HT20) : 16.54 dBm 802.11n(HT40) : 13.77 dBm
	<u>Average Power</u> <u>(For information only)</u>	802.11b: 11.64 dBm 802.11g: 5.00 dBm 802.11n(HT20): 4.32 dBm 802.11n(HT40) : 5.84 dBm
Modulation Type	DSSS/CCK : 802.11b OFDM : 802.11g, 802.11n	
Number of Channels	802.11(b/g/n(20M)) : 11 Channels (1~11) 802.11n(40M) : 7 Channels (3~9)	
Antenna Specification	Antenna type: Internal Antenna Peak Gain: 2.7 dBi	
Date(s) of Tests	August 3, 2019 ~ September 23, 2019	

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 30MHz 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 1GHz. Above 1GHz with 1.5m 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 3.75 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

1. 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.
2. In order to implement the BT & Wifi(2.4G) test mode, the test was performed while controlling the EUT by connecting a jig as shown in the test setup photo.

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.

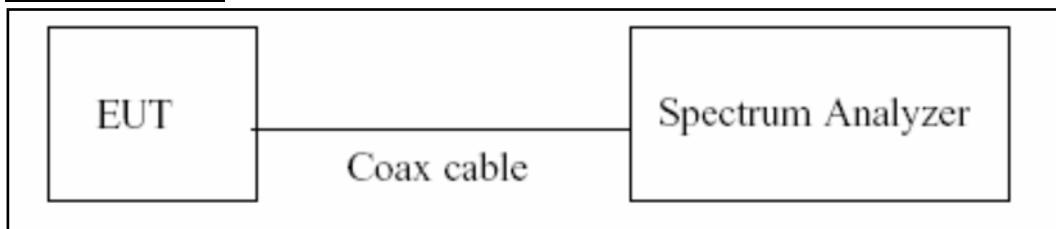
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty ($\pm \text{dB}$)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70
Radiated Disturbance (18 GHz ~ 40 GHz)	5.05

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 $> 50/T$.

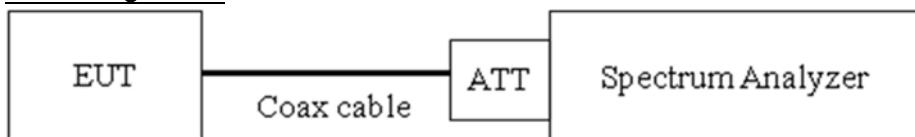
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (\geq RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/T_{total} and Duty Cycle Factor = $10\log(1/\text{Duty Cycle})$

7.2. 6dB 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.

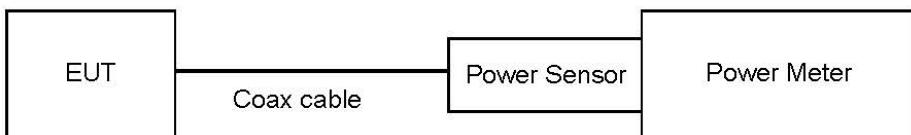
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

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

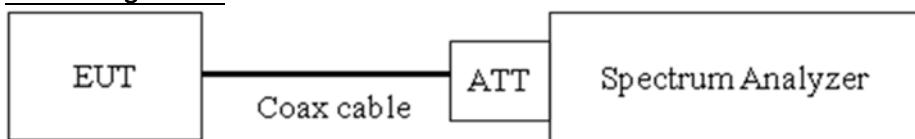
- Conducted Output Power(Peak) = Reading Value + ATT loss + Cable loss
- Conducted Output Power(Average) = Reading Value + ATT loss + Cable loss + Duty Cycle Factor

7.4. Power Spectral Density

Limit

The transmitter power density average over 1-second interval shall not be greater than 8dBm in any 3kHz 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 \leq RBW \leq 100 kHz.
- 4) VBW \geq 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 $\geq [2 \times \text{span} / \text{RBW}]$.
- 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.

Sample Calculation

- Power Spectral Density = Reading Value + ATT loss + Cable loss

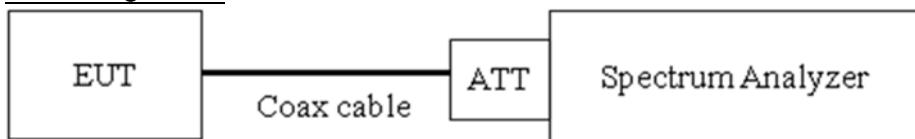
7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

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 30 dB 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)	Factor(dB)
30	21.05
100	21.10
200	21.13
300	21.18
400	21.21
500	21.23
600	21.23
700	21.25
800	21.26
900	21.28
1000	21.29
2000	21.42
2400	21.47
2500	21.47
3000	21.52
4000	21.60
5000	21.68
6000	21.73
7000	21.81
8000	21.88
9000	21.94
10000	22.02
11000	22.05
12000	22.13
13000	22.23
14000	22.20
15000	22.25
16000	22.29
17000	22.33
18000	22.40
19000	22.44
20000	22.48
21000	22.65
22000	22.64
23000	22.67
24000	22.71
25000	22.75
26000	22.84

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

2. Factor = Attenuator loss(20 dB) + Cable loss + EUT connector cable (1 dB)

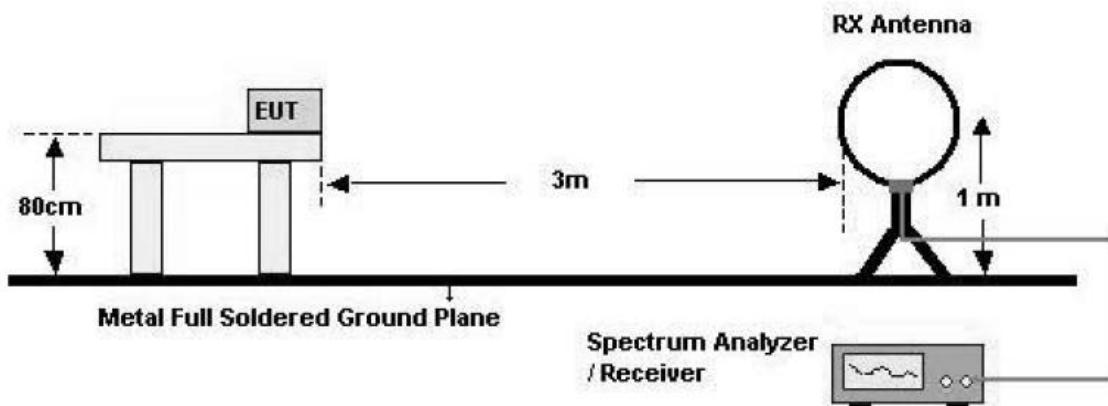
7.6. Radiated Test

Limit

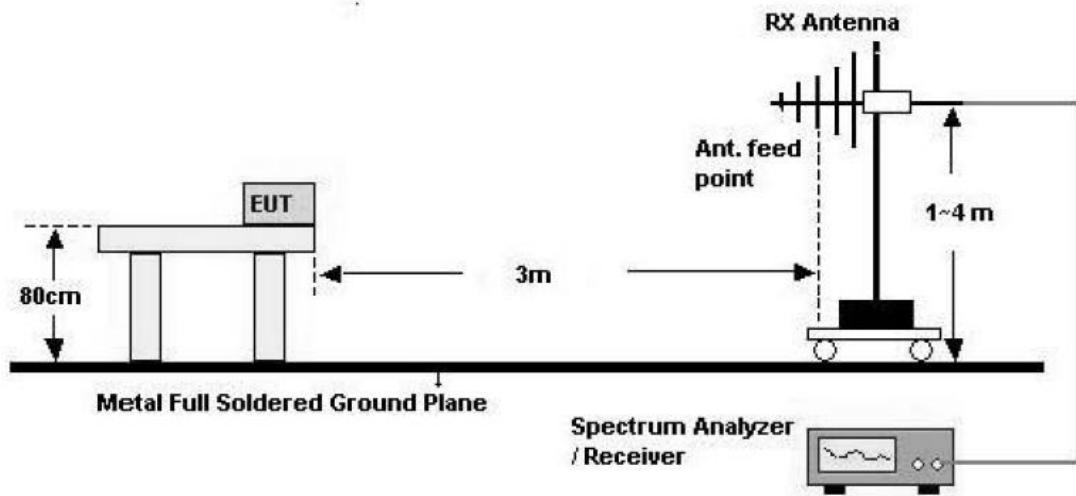
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

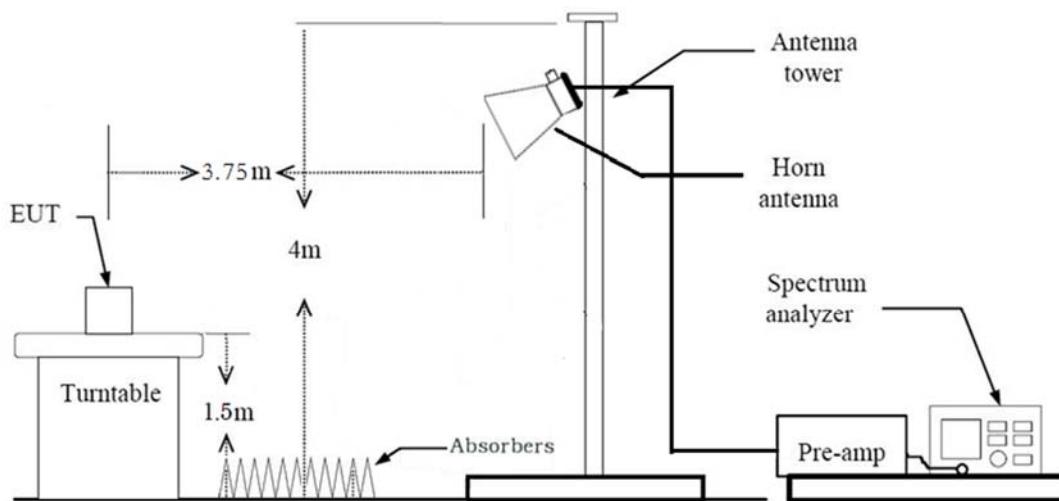
Below 30 MHz



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 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m 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($0.009\text{ MHz} - 0.490\text{ MHz}$) = $40\log(3\text{ m}/300\text{ m}) = -80\text{ dB}$
Measurement Distance : 3 m
7. Distance Correction Factor($0.490\text{ MHz} - 30\text{ MHz}$) = $40\log(3\text{ m}/30\text{ m}) = -40\text{ dB}$
Measurement Distance : 3 m
8. Spectrum Setting
 - Frequency Range = 9 kHz ~ 30 MHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 9 kHz
 - VBW $\geq 3 \times \text{RBW}$
9. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

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 1GHz)

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 0.8m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. 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

6. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)

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 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
 - ◆ Distance extrapolation factor = $20\log(\text{test distance} / \text{specific distance})$ (dB)
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. The unit was tested with its standard battery.
9. 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 percent duty cycle.

- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.

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.

11. Total(Measurement Type : Peak)

= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

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

= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

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

= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(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 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).

◆ Distance extrapolation factor = $20\log(\text{test distance} / \text{specific distance})$ (dB)

6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. The unit was tested with its standard battery.

9. 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 $\geq 3 \times$ 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 $\geq 3 \times$ 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 : 2310 MHz ~ 2390 MHz/ 2483.5 MHz ~ 2500 MHz
- 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.

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.

11. Total(Measurement Type : Peak)

$$\begin{aligned} &= \text{Reading Value} + \text{Antenna Factor(A.F)} + \text{Cable Loss(C.L)} + \text{Distance Factor(D.F)} - \text{AMP Gain (A.G)} \\ &+ \text{Attenuator(ATT)} \end{aligned}$$

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

$$\begin{aligned} &= \text{Reading Value} + \text{Antenna Factor(A.F)} + \text{Cable Loss(C.L)} + \text{Distance Factor(D.F)} - \text{AMP Gain (A.G)} \\ &+ \text{Attenuator(ATT)} \end{aligned}$$

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

$$\begin{aligned} &= \text{Reading Value} + \text{Antenna Factor(A.F)} + \text{Cable Loss(C.L)} + \text{Distance Factor(D.F)} - \text{AMP Gain (A.G)} \\ &+ \text{Attenuator(ATT)} + \text{Duty Cycle Factor} \end{aligned}$$

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 (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) = Reading 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 12[V], Stand alone 24[V]
 - Worstcase : Stand alone 24[V],
2. EUT Axis
 - Radiated Spurious Emissions : Y
 - Radiated Restricted Band Edge : 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 datarate of each mode.
 - 802.11b : 1Mbps
 - 802.11g : 6Mbps
 - 802.11n_HT20 : MCS0
 - 802.11n_HT40 : MCS0
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

AC Power line Conducted Emissions

1. We don't perform powerline conducted emission test. Because this EUT is used with vehicle.

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 > 20 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

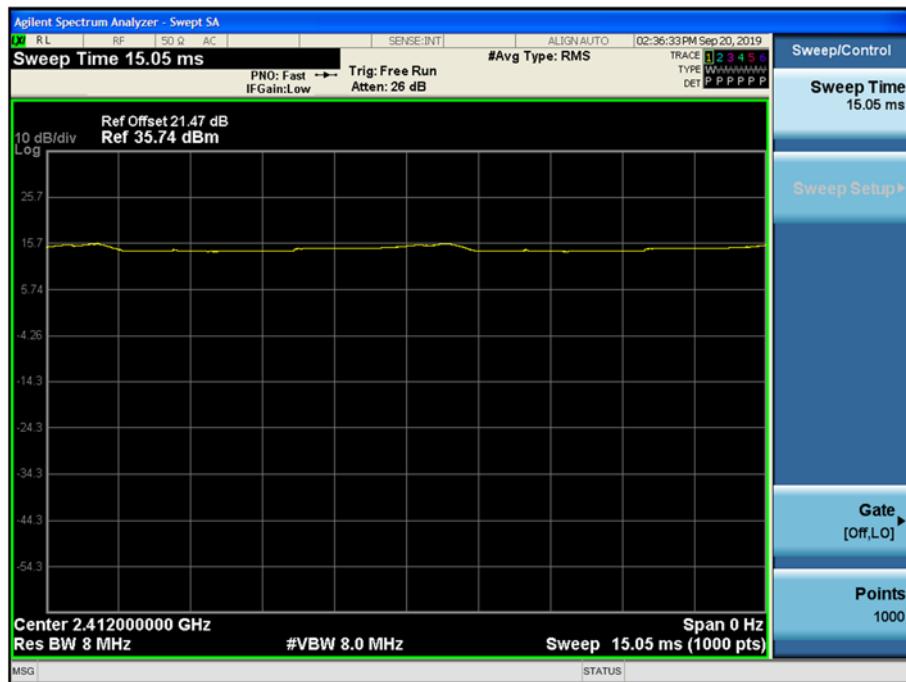
9. TEST RESULT

9.1 DUTY CYCLE

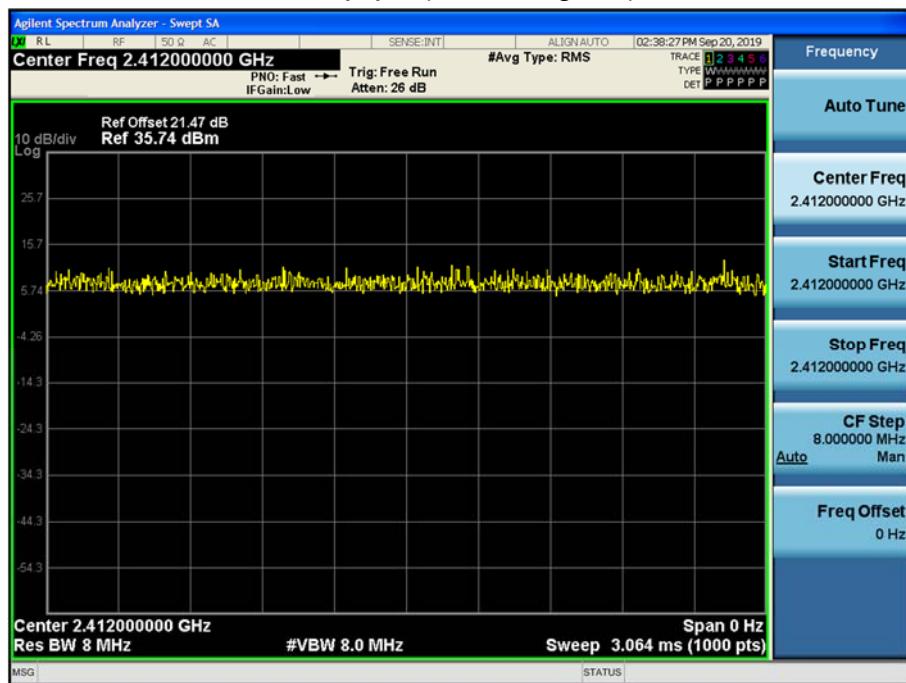
Mode	Data Rate (Mbps)	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11b	1	1.000	1.000	1.000	0.000
	2	1.000	1.000	1.000	0.000
	5.5	1.000	1.000	1.000	0.000
	11	1.000	1.000	1.000	0.000
802.11g	6	1.000	1.000	1.000	0.000
	9	1.000	1.000	1.000	0.000
	12	1.000	1.000	1.000	0.000
	18	1.000	1.000	1.000	0.000
	24	1.000	1.000	1.000	0.000
	36	1.000	1.000	1.000	0.000
	48	1.000	1.000	1.000	0.000
	54	1.000	1.000	1.000	0.000
802.11n (HT20)	6.5 (MCS0)	1.000	1.000	1.000	0.000
	13 (MCS1)	1.000	1.000	1.000	0.000
	19.5 (MCS2)	1.000	1.000	1.000	0.000
	26 (MCS3)	1.000	1.000	1.000	0.000
	39 (MCS4)	1.000	1.000	1.000	0.000
	52 (MCS5)	1.000	1.000	1.000	0.000
	58.5 (MCS6)	1.000	1.000	1.000	0.000
	65 (MCS7)	1.000	1.000	1.000	0.000
802.11n (HT40)	13.5 (MCS0)	1.000	1.000	1.000	0.000
	27 (MCS1)	1.000	1.000	1.000	0.000
	40.5 (MCS2)	1.000	1.000	1.000	0.000
	54 (MCS3)	1.000	1.000	1.000	0.000
	81 (MCS4)	1.000	1.000	1.000	0.000
	108 (MCS5)	1.000	1.000	1.000	0.000
	121.5 (MCS6)	1.000	1.000	1.000	0.000
	135 (MCS7)	1.000	1.000	1.000	0.000

□ Test Plots

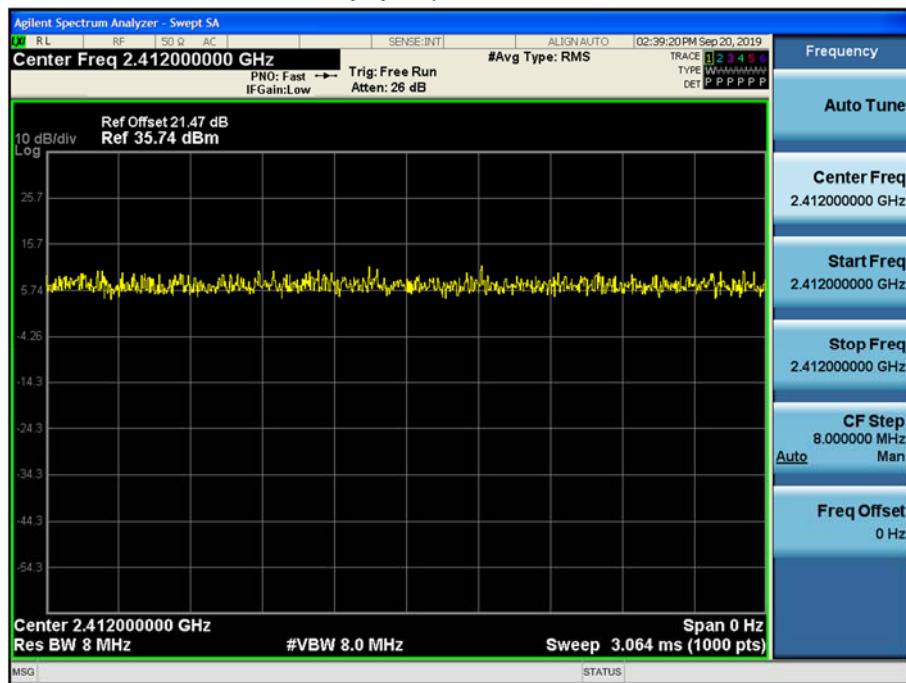
Duty cycle plot (802.11b(1Mbps))



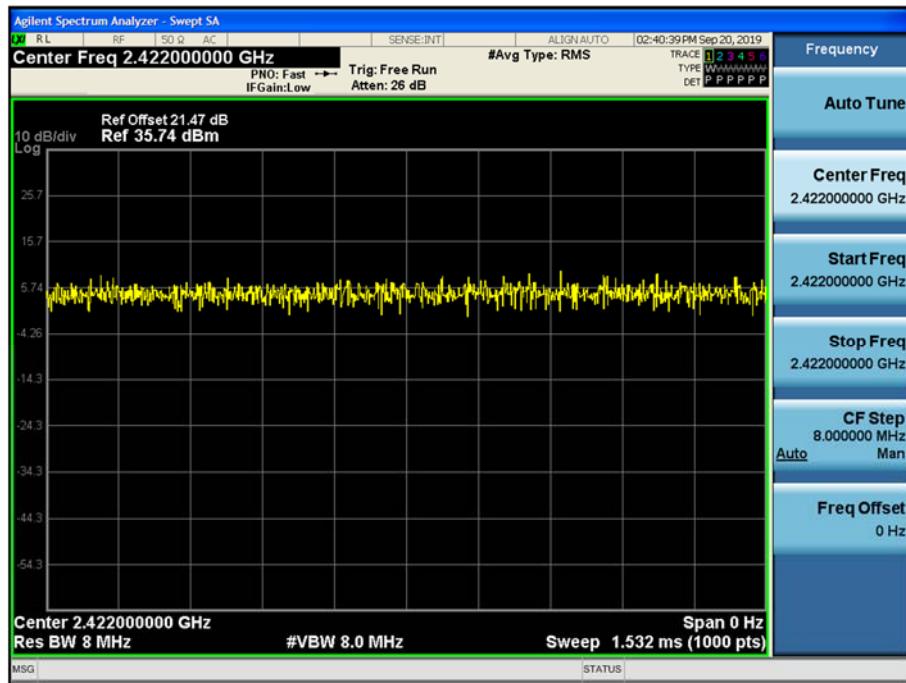
Duty cycle plot (802.11g(6Mbps))



Duty cycle plot (802.11n(MCS0))



Duty cycle plot (802.11n (40M)(MCS0))


Note:

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

9.2 6dB BANDWIDTH

802.11b Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	9.584	0.5
2437	6	9.064	0.5
2462	11	9.121	0.5

802.11g Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	16.334	0.5
2437	6	16.312	0.5
2462	11	16.377	0.5

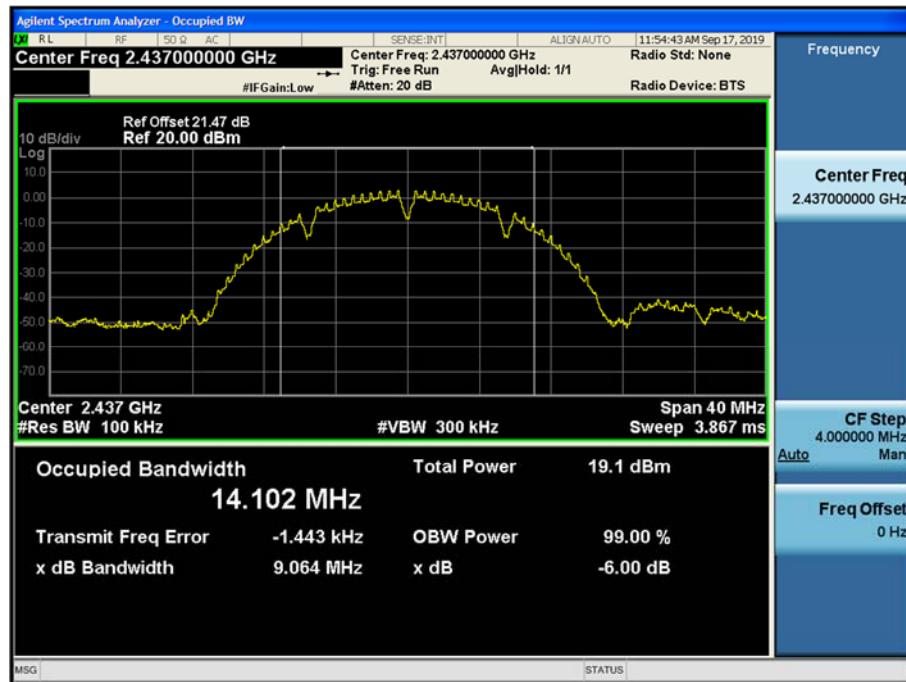
802.11n Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	17.563	0.5
2437	6	17.586	0.5
2462	11	17.346	0.5

802.11n(40M) Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2422	3	35.715	0.5
2437	6	35.989	0.5
2452	9	35.696	0.5

Note : The plot of the 6dB result, expressed as 10 digits, is the result rounded to the third decimal place.

Test Plots

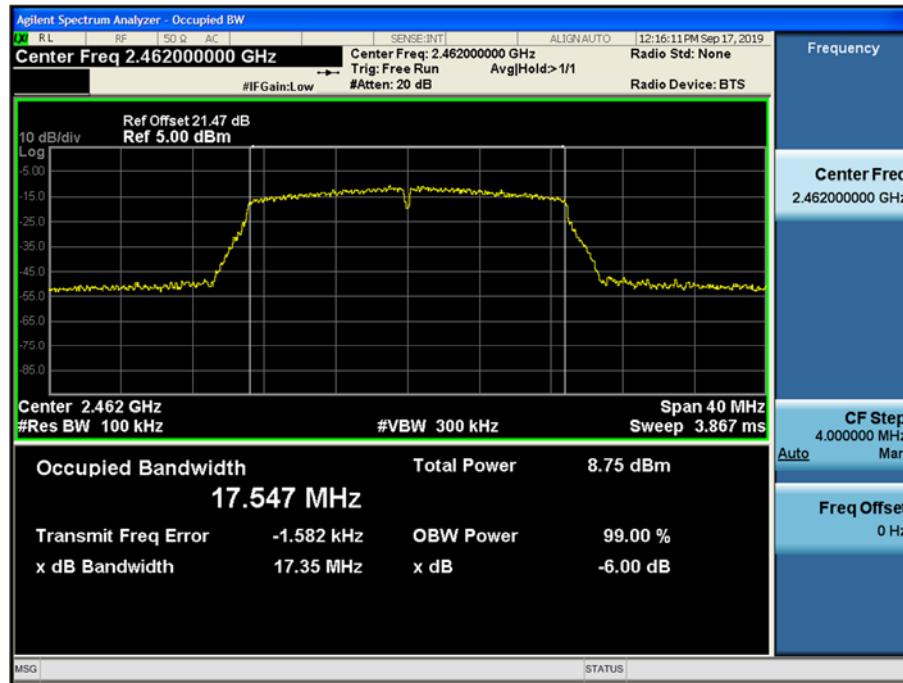
6dB Bandwidth plot (802.11b-CH 6)



6dB Bandwidth plot (802.11g-CH 6)



6dB Bandwidth plot (802.11n_HT20-CH 11)



6dB Bandwidth plot (802.11n_HT40-CH 9)


Note:

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

9.3 OUTPUT POWER

Peak Power

1. Power Meter offset = Attenuator loss(20 dB) + Cable loss
2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB.
So, 21.47 dB is offset for 2.4 GHz Band

802.11b Mode		Rate (Mbps)	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	1	13.26	30
		2	13.39	30
		5.5	13.31	30
		11	13.46	30
2437	6	1	13.70	30
		2	13.74	30
		5.5	13.51	30
		11	13.73	30
2462	11	1	13.64	30
		2	13.65	30
		5.5	13.49	30
		11	13.65	30

802.11g Mode		Rate (Mbps)	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	6	16.53	30
		9	15.28	30
		12	15.42	30
		18	15.29	30
		24	16.66	30
		36	15.94	30
		48	13.72	30
		54	13.80	30
2437	6	6	16.82	30
		9	15.83	30
		12	15.71	30
		18	15.55	30
		24	16.71	30
		36	16.07	30
		48	14.00	30
		54	14.03	30
2462	11	6	16.84	30
		9	15.87	30
		12	15.83	30
		18	15.56	30
		24	16.80	30
		36	16.05	30
		48	14.21	30
		54	13.84	30

802.11n Mode		MCS Index	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	0	15.58	30
		1	15.30	30
		2	14.91	30
		3	15.09	30
		4	15.25	30
		5	15.02	30
		6	13.00	30
		7	13.49	30
2437	6	0	16.29	30
		1	15.42	30
		2	15.96	30
		3	16.54	30
		4	15.56	30
		5	15.11	30
		6	13.23	30
		7	13.73	30
2462	11	0	16.21	30
		1	15.66	30
		2	15.73	30
		3	15.59	30
		4	16.03	30
		5	15.60	30
		6	14.06	30
		7	14.29	30

802.11n 40M BW Mode		MCS Index	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2422	3	0	12.84	30
		1	12.85	30
		2	13.27	30
		3	13.52	30
		4	13.23	30
		5	13.31	30
		6	11.31	30
		7	11.32	30
2437	6	0	13.51	30
		1	13.08	30
		2	13.24	30
		3	13.74	30
		4	13.67	30
		5	13.77	30
		6	11.64	30
		7	11.64	30
2452	9	0	13.01	30
		1	13.00	30
		2	12.99	30
		3	13.24	30
		4	13.49	30
		5	13.48	30
		6	11.17	30
		7	11.17	30

Average Power

1. Power Meter offset = Attenuator loss(20 dB) + Cable loss
2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB.
So, 20.38 dB is offset for 2.4 GHz Band.

802.11b Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	1	11.16	0.000	11.16	30
		2	11.29	0.000	11.29	30
		5.5	11.42	0.000	11.42	30
		11	11.37	0.000	11.37	30
2437	6	1	11.61	0.000	11.61	30
		2	11.60	0.000	11.60	30
		5.5	11.46	0.000	11.46	30
		11	11.64	0.000	11.64	30
2462	11	1	11.53	0.000	11.53	30
		2	11.52	0.000	11.52	30
		5.5	11.52	0.000	11.52	30
		11	11.54	0.000	11.54	30

802.11g Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	6	4.13	0.000	4.13	30
		9	4.14	0.000	4.14	30
		12	4.15	0.000	4.15	30
		18	4.17	0.000	4.17	30
		24	4.71	0.000	4.71	30
		36	4.72	0.000	4.72	30
		48	2.48	0.000	2.48	30
		54	2.49	0.000	2.49	30
2437	6	6	4.48	0.000	4.48	30
		9	4.44	0.000	4.44	30
		12	4.44	0.000	4.44	30
		18	4.45	0.000	4.45	30
		24	4.70	0.000	4.70	30
		36	4.71	0.000	4.71	30
		48	2.68	0.000	2.68	30
		54	2.70	0.000	2.70	30
2462	11	6	4.72	0.000	4.72	30
		9	4.74	0.000	4.74	30
		12	4.72	0.000	4.72	30
		18	4.72	0.000	4.72	30
		24	4.98	0.000	4.98	30
		36	5.00	0.000	5.00	30
		48	2.83	0.000	2.83	30
		54	2.83	0.000	2.83	30

802.11n Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	0	3.55	0.000	3.55	30
		1	3.74	0.000	3.74	30
		2	3.44	0.000	3.44	30
		3	3.91	0.000	3.91	30
		4	3.88	0.000	3.88	30
		5	3.89	0.000	3.89	30
		6	1.89	0.000	1.89	30
		7	1.73	0.000	1.73	30
2437	6	0	3.78	0.000	3.78	30
		1	3.80	0.000	3.80	30
		2	3.79	0.000	3.79	30
		3	4.26	0.000	4.26	30
		4	4.27	0.000	4.27	30
		5	4.03	0.000	4.03	30
		6	2.11	0.000	2.11	30
		7	2.09	0.000	2.09	30
2462	11	0	3.82	0.000	3.82	30
		1	4.06	0.000	4.06	30
		2	3.78	0.000	3.78	30
		3	4.29	0.000	4.29	30
		4	4.29	0.000	4.29	30
		5	4.32	0.000	4.32	30
		6	2.14	0.000	2.14	30
		7	2.15	0.000	2.15	30

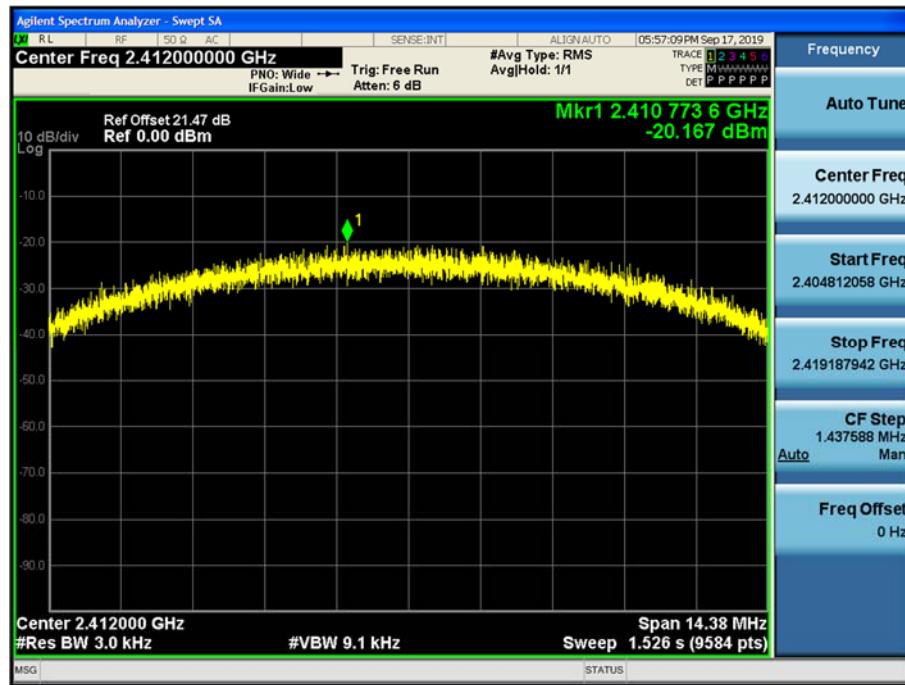
802.11n 40M BW Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2422	3	0	4.87	0.000	4.87	30
		1	4.85	0.000	4.85	30
		2	5.27	0.000	5.27	30
		3	5.52	0.000	5.52	30
		4	5.52	0.000	5.52	30
		5	5.30	0.000	5.30	30
		6	3.34	0.000	3.34	30
		7	3.34	0.000	3.34	30
2437	6	0	5.53	0.000	5.53	30
		1	5.07	0.000	5.07	30
		2	5.15	0.000	5.15	30
		3	5.72	0.000	5.72	30
		4	5.66	0.000	5.66	30
		5	5.84	0.000	5.84	30
		6	3.65	0.000	3.65	30
		7	3.62	0.000	3.62	30
2452	9	0	5.02	0.000	5.02	30
		1	4.99	0.000	4.99	30
		2	4.99	0.000	4.99	30
		3	5.24	0.000	5.24	30
		4	5.48	0.000	5.48	30
		5	5.47	0.000	5.47	30
		6	3.14	0.000	3.14	30
		7	3.16	0.000	3.16	30

9.4 POWER SPECTRAL DENSITY

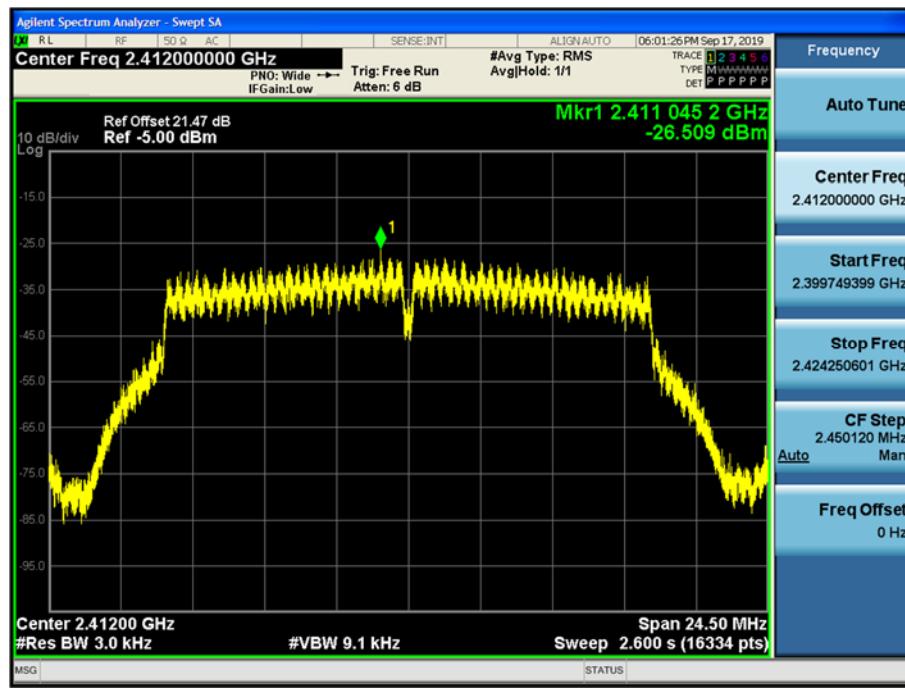
Mode	Frequency (MHz)	Channel No.	Test Result	
			Measured PSD (dBm)	Limit (dBm)
802.11b	2412	1	-20.167	8
	2437	6	-20.368	
	2462	11	-20.624	
802.11g	2412	1	-26.509	8
	2437	6	-27.322	
	2462	11	-29.265	
802.11n	2412	1	-26.475	8
	2437	6	-27.049	
	2462	11	-29.648	
802.11n(40M)	2422	3	-22.074	8
	2437	6	-21.127	
	2452	9	-21.544	

□ Test Plots

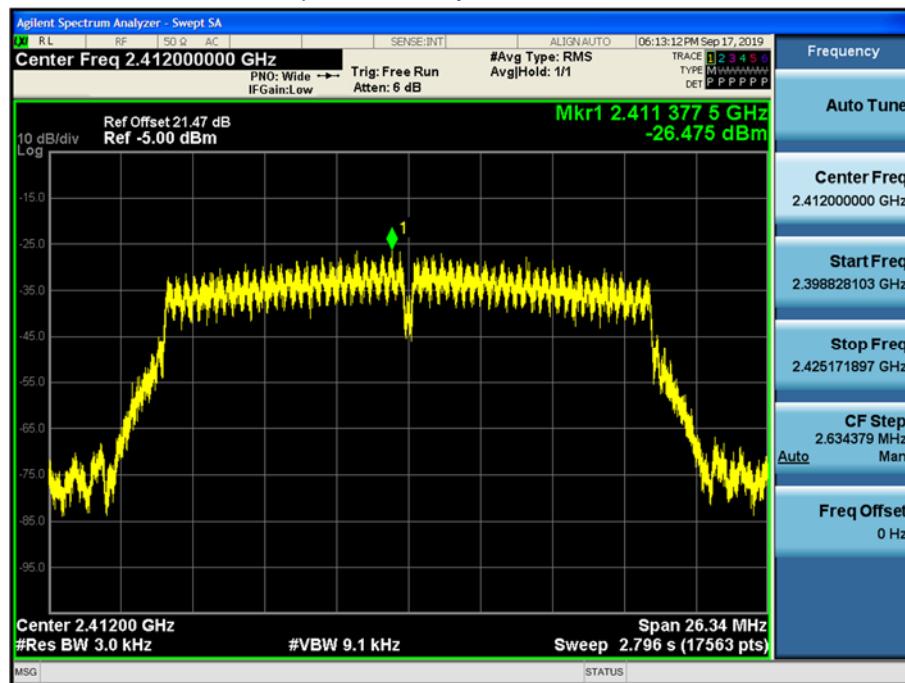
Power Spectral Density (802.11b-CH 1)



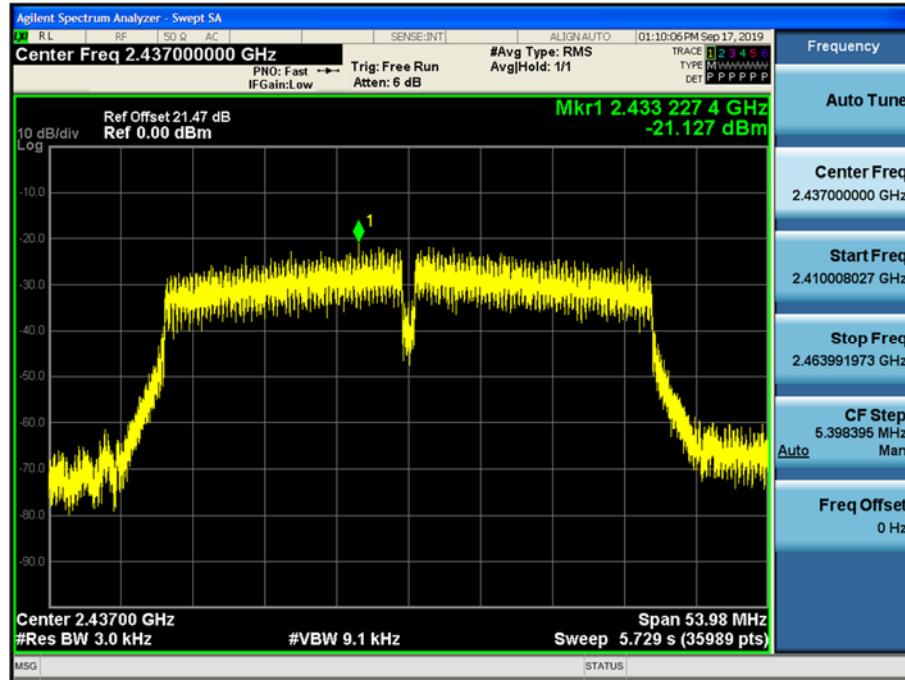
Power Spectral Density (802.11g-CH 1)



Power Spectral Density (802.11n_HT20 -CH 1)



Power Spectral Density (802.11n_HT40 -CH 6)



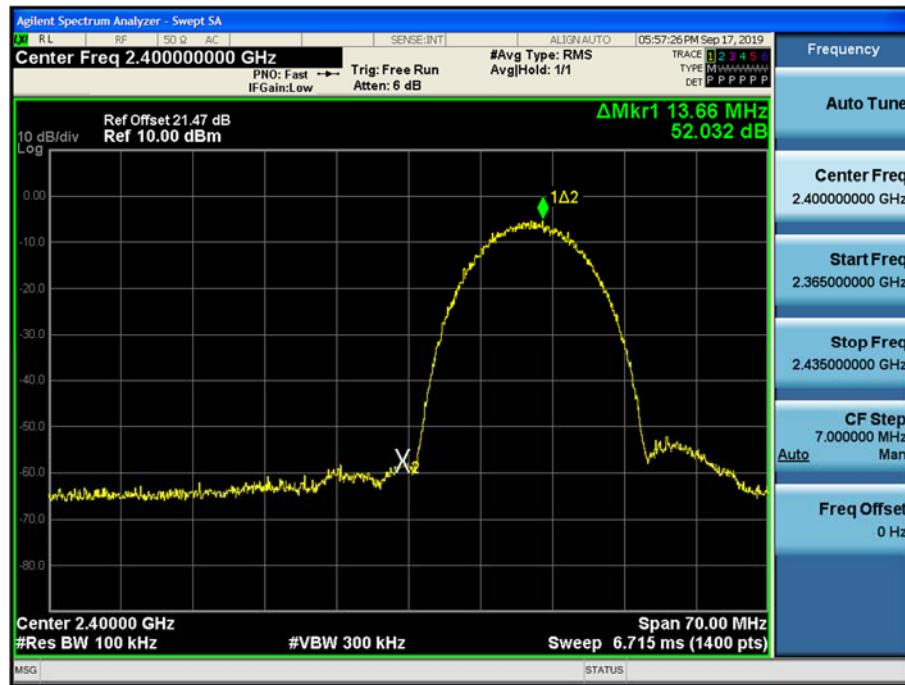
9.5 BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

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(BandEdge)

Band Edge (802.11b-CH1)



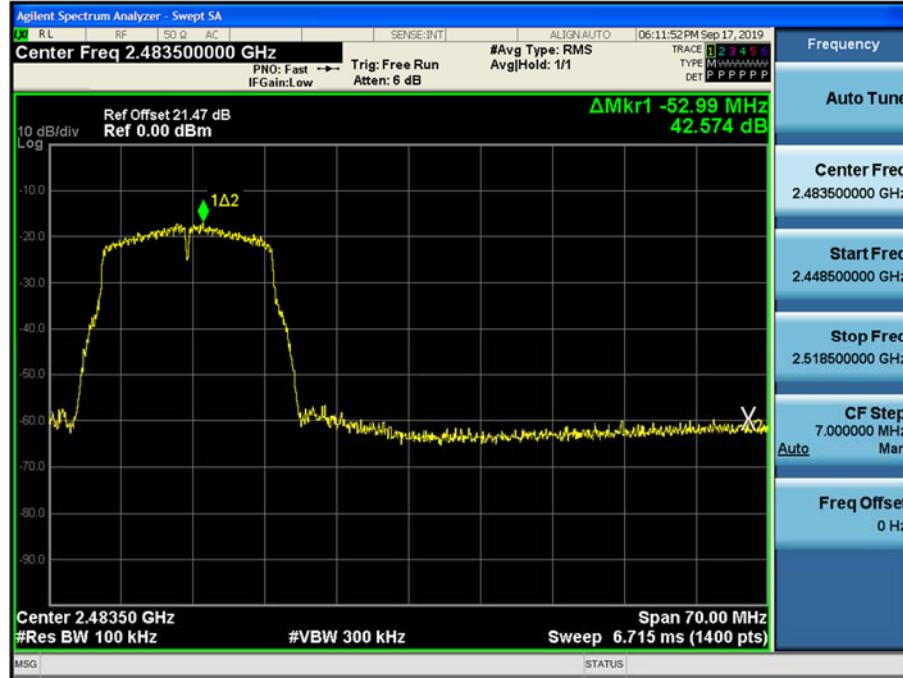
Band Edge (802.11b-CH11)



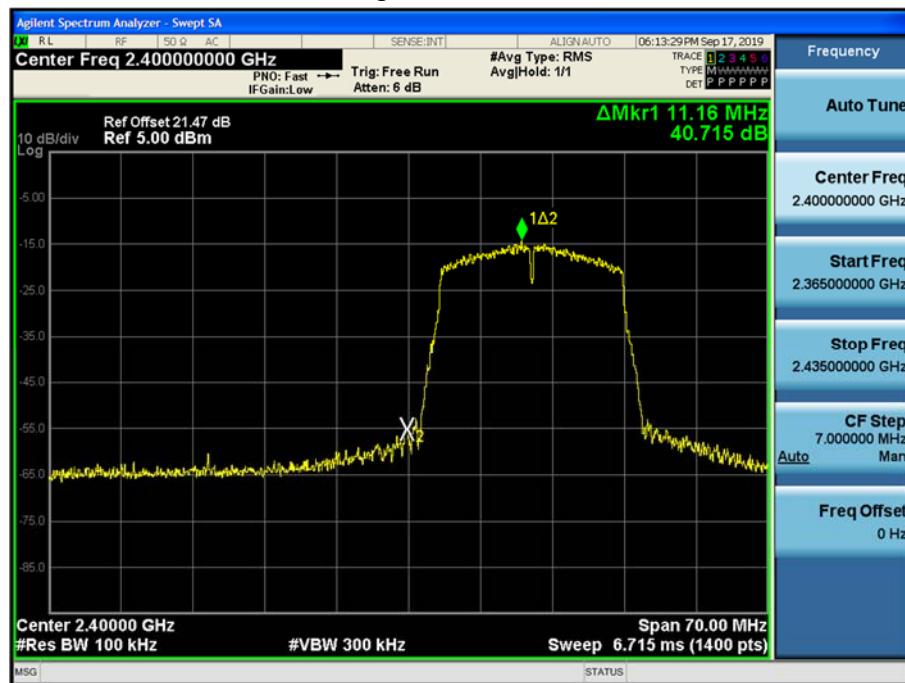
Band Edge (802.11g-CH1)



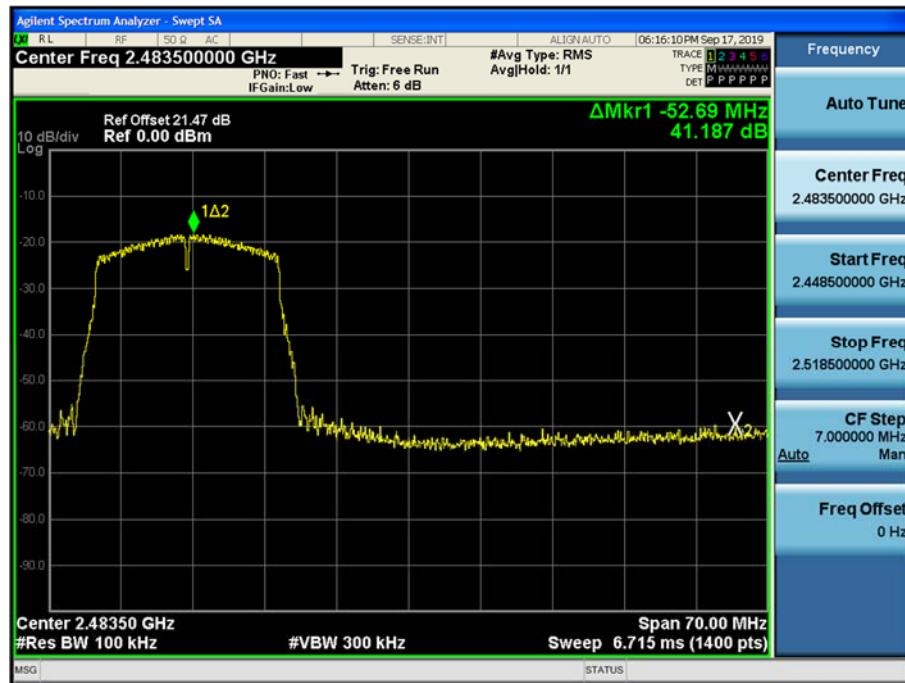
Band Edge (802.11g-CH11)



Band Edge (802.11n_HT20 -CH1)



Band Edge (802.11n_HT20 -CH11)



Band Edge (802.11n_HT40 -CH3)



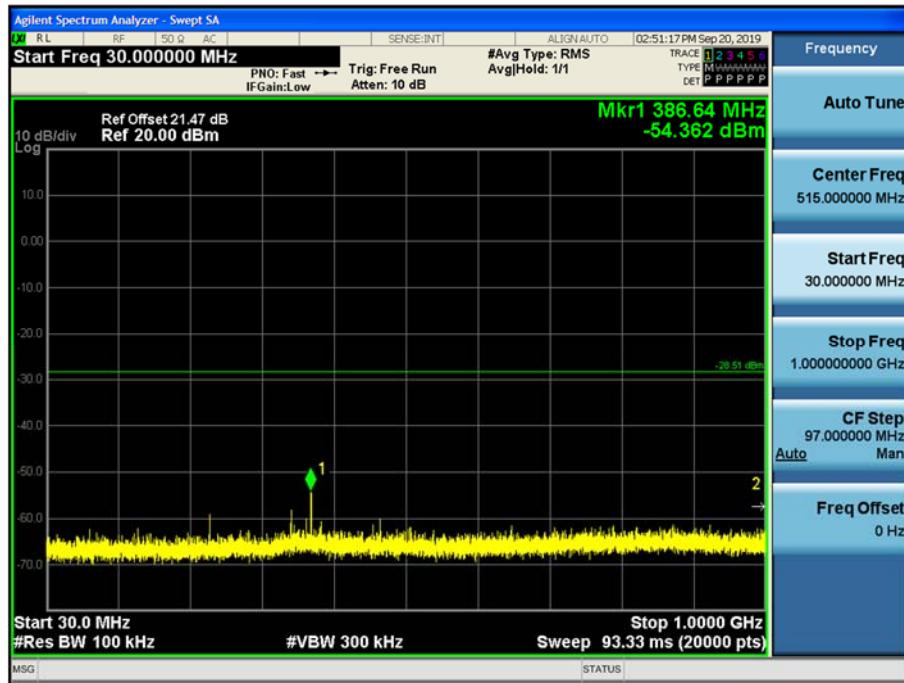
Band Edge (802.11n_HT40 -CH9)



□ Test Plots(Conducted Spurious Emission)

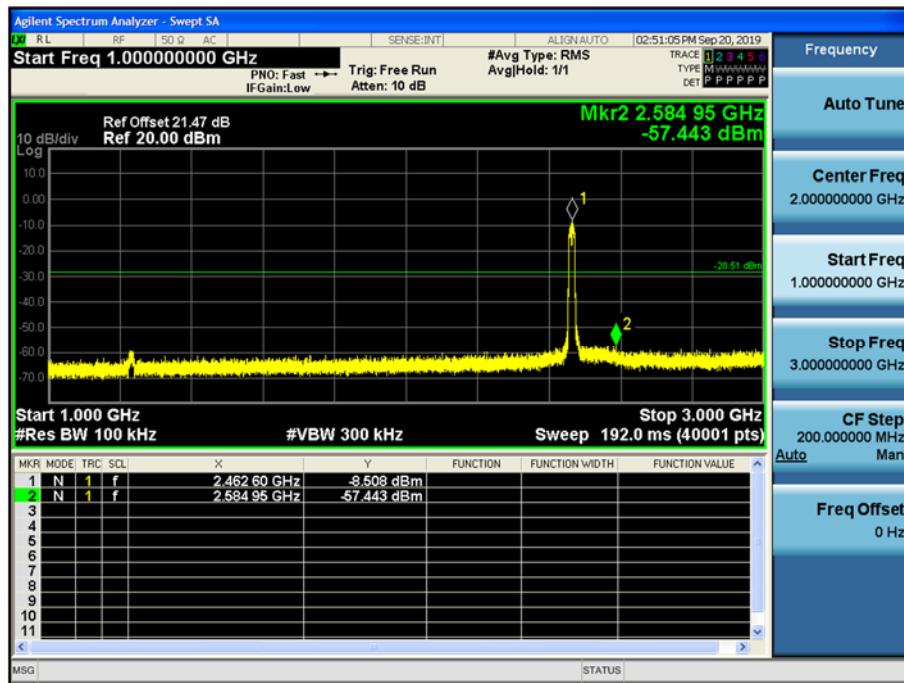
30 MHz ~ 1 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



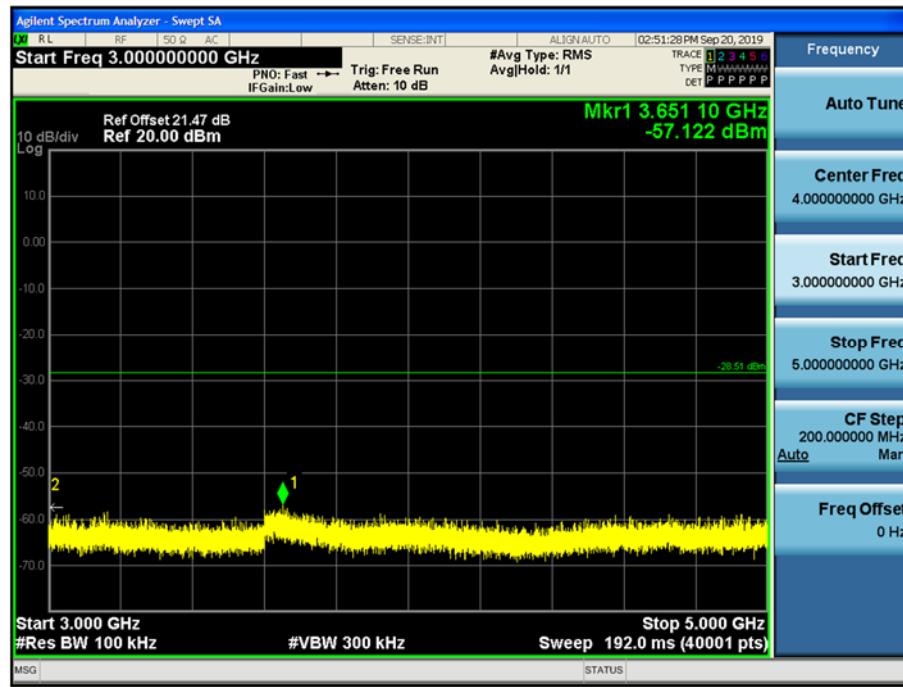
1 GHz ~ 3 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



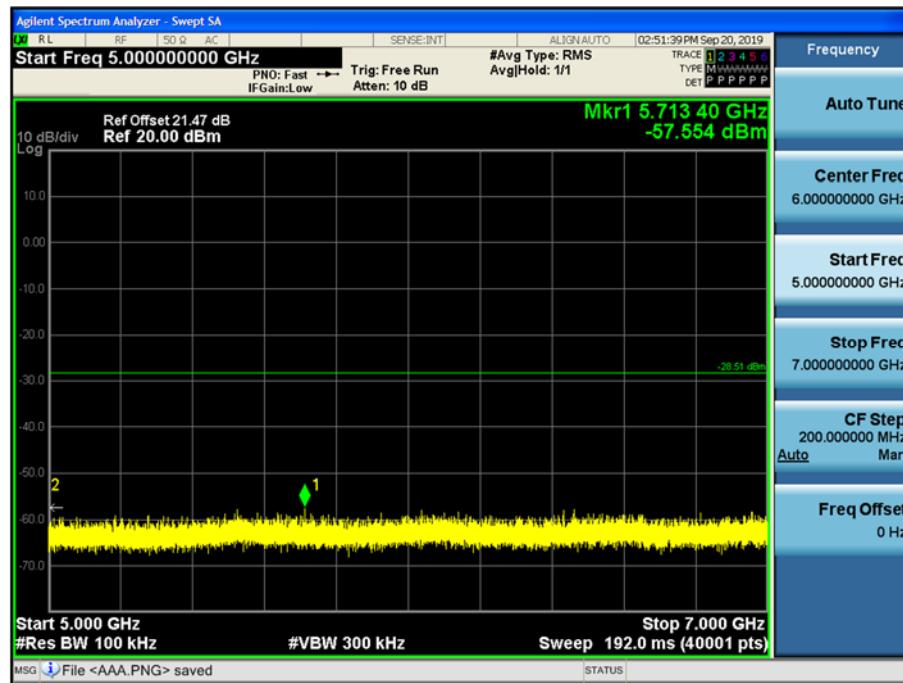
3 GHz ~ 5 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



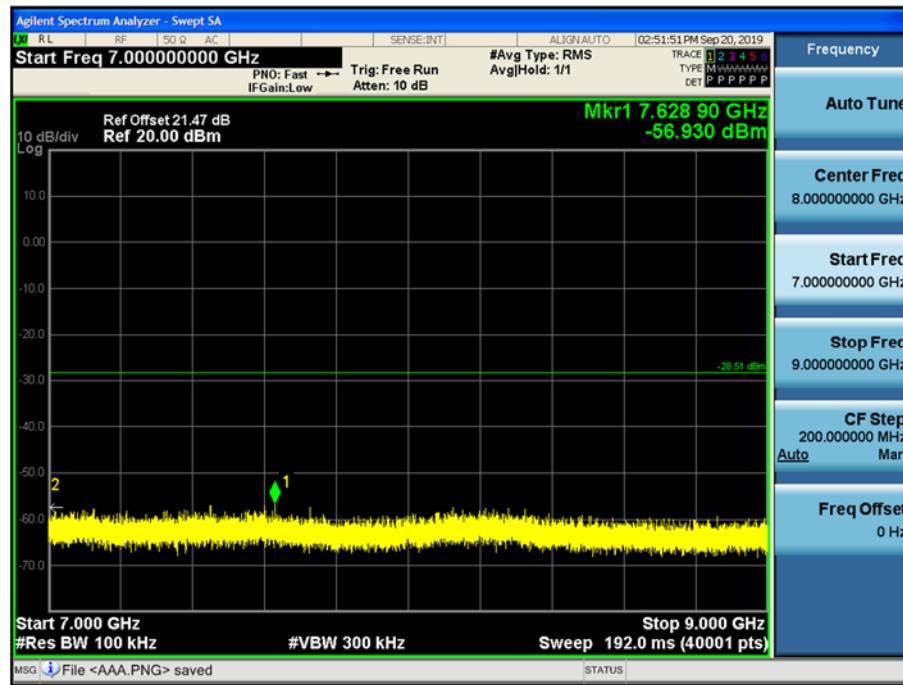
5 GHz ~ 7 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



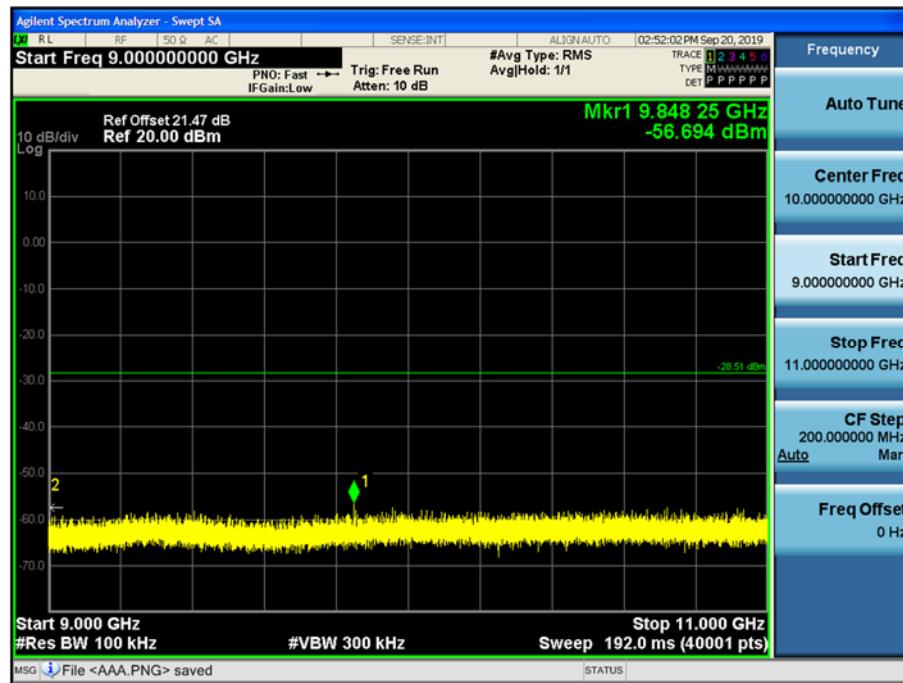
7 GHz ~ 9 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



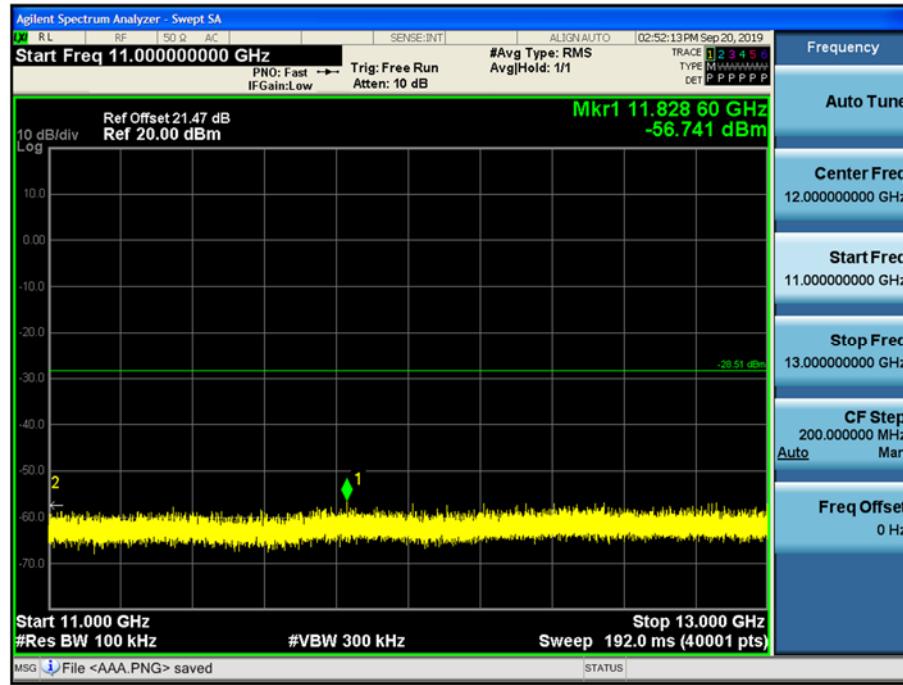
9 GHz ~ 11 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



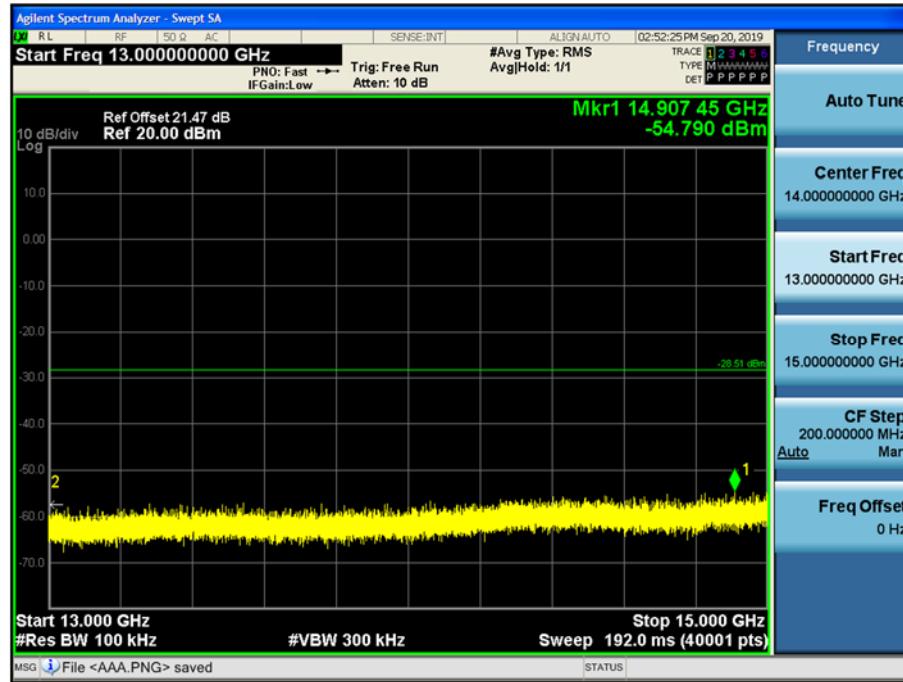
11 GHz ~ 13 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



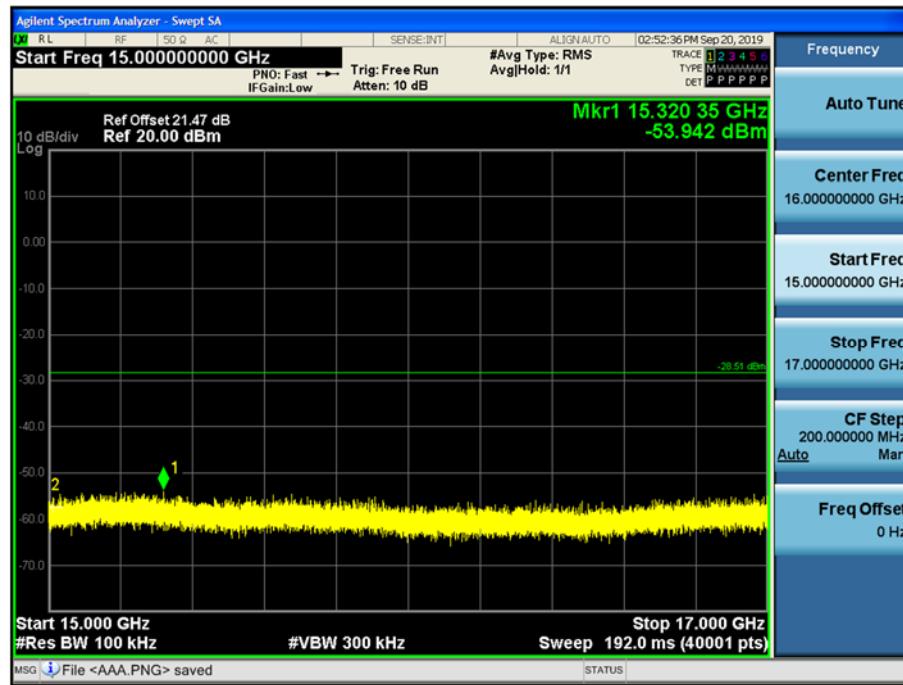
13 GHz ~ 15 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



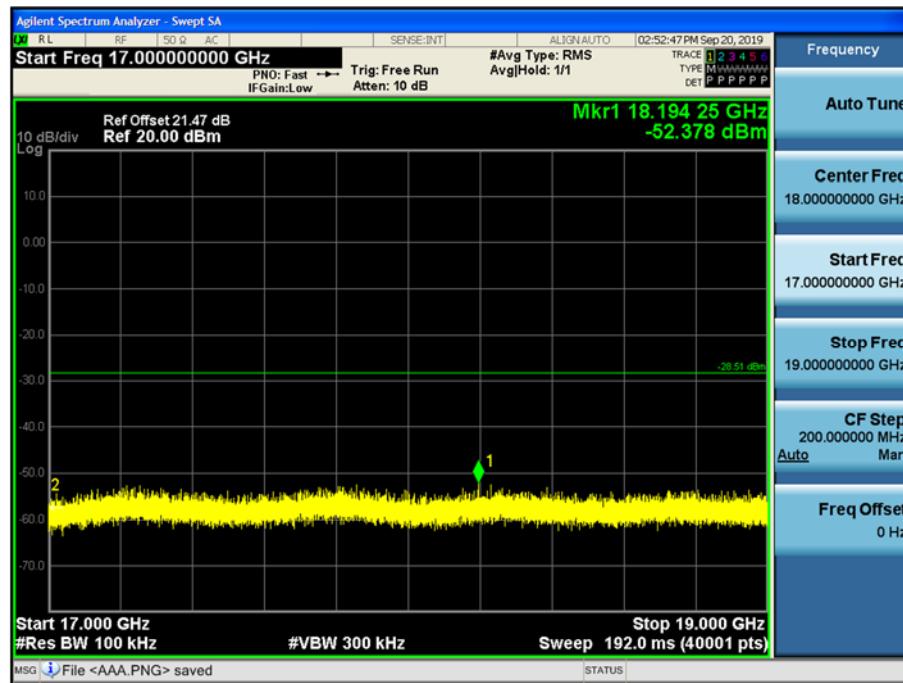
15 GHz ~ 17 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



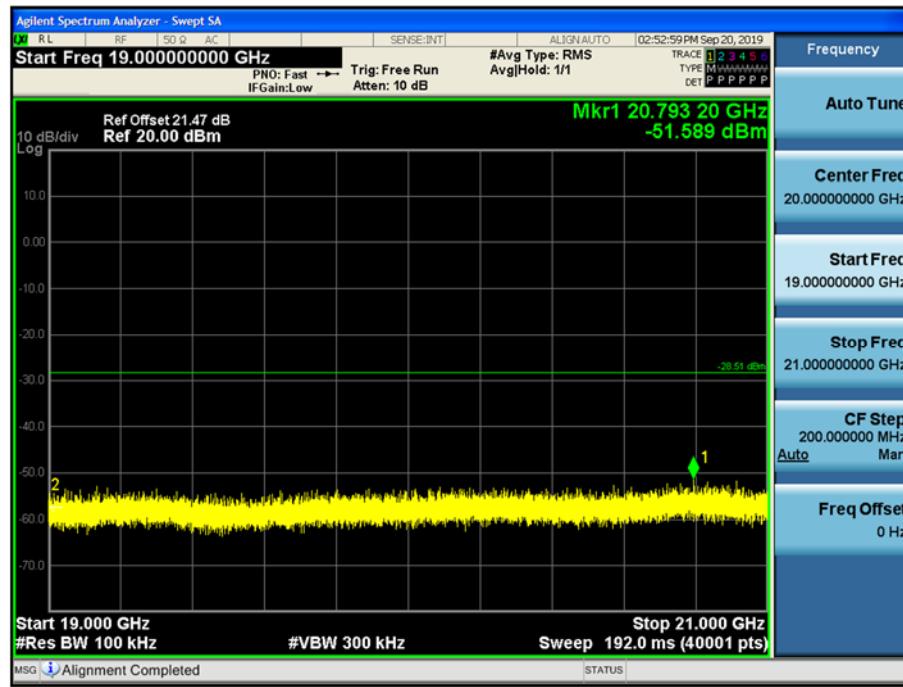
17 GHz ~ 19 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



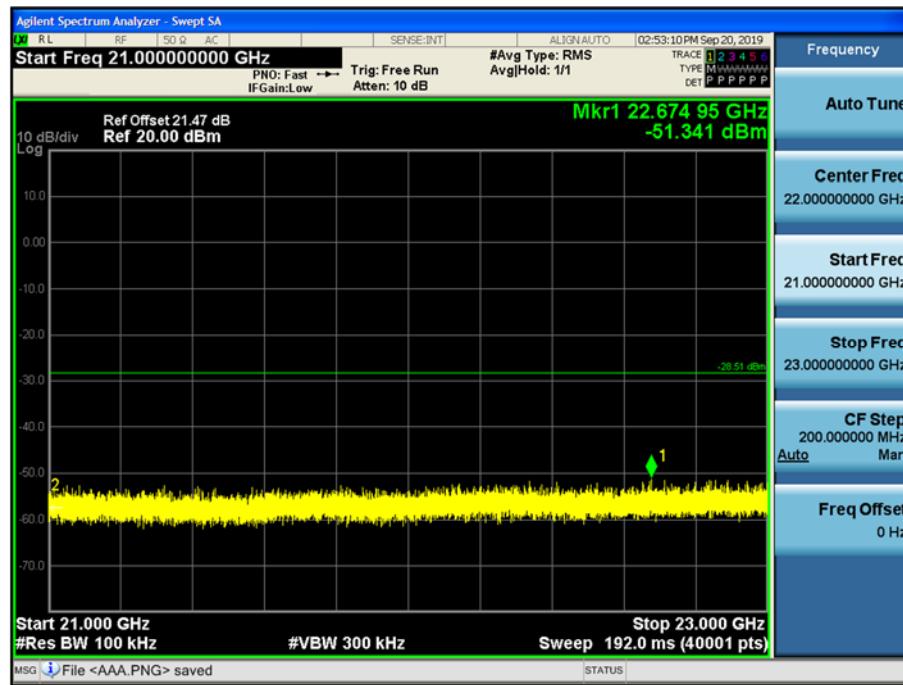
19 GHz ~ 21 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



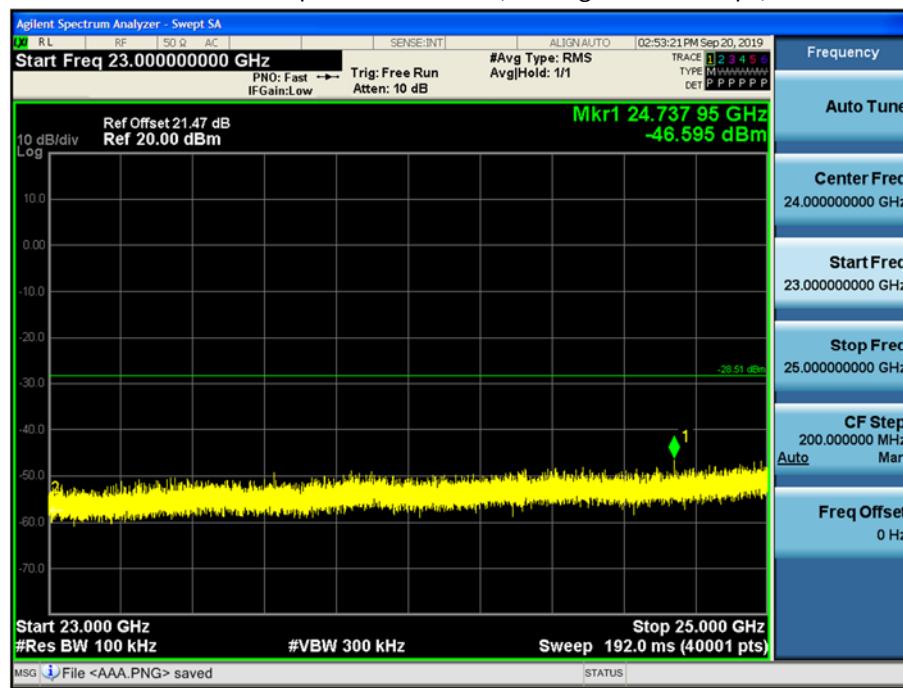
21 GHz ~ 23 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



23 GHz ~ 25 GHz

Conducted Spurious Emission (802.11g_Ch.11_6 Mbps)



9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30MHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Note:

1. The reading 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 (dBuV) + Distance extrapolation factor
4. Radiated test is performed with hopping off.

Frequency Range : Below 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/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

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

Frequency [MHz]	Reading [dBuV]	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4824	53.62	1.95	V	55.57	73.98	18.41	PK
4824	46.92	1.95	V	48.87	53.98	5.11	AV
7236	50.72	9.86	V	60.58	73.98	13.40	PK
7236	40.11	9.86	V	49.97	53.98	4.01	AV
4824	54.38	1.95	H	56.33	73.98	17.65	PK
4824	47.67	1.95	H	49.62	53.98	4.36	AV
7236	51.56	9.86	V	61.42	73.98	12.56	PK
7236	40.41	9.86	V	50.27	53.98	3.71	AV

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

Frequency [MHz]	Reading [dBuV]	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4874	53.96	2.33	V	56.29	73.98	17.69	PK
4874	45.38	2.33	V	47.71	53.98	6.27	AV
7311	49.98	10.14	V	60.12	73.98	13.86	PK
7311	38.26	10.14	V	48.40	53.98	5.58	AV
4874	54.22	2.33	H	56.55	73.98	17.43	PK
4874	46.48	2.33	H	48.81	53.98	5.17	AV
7311	49.98	10.14	V	60.12	73.98	13.86	PK
7311	38.26	10.14	V	48.40	53.98	5.58	AV



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

Frequency [MHz]	Reading [dBuV]	AN.+CL-AMP G [dB]	ANT. POL	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4924	52.65	2.28	V	54.93	73.98	19.05	PK
4924	43.96	2.28	V	46.24	53.98	7.74	AV
	49.64	9.81		59.45	73.98	14.53	PK
7386	37.88	9.81	V	47.69	53.98	6.29	AV
	52.82	2.28		55.10	73.98	18.88	PK
4924	44.55	2.28	H	46.83	53.98	7.15	AV
	49.64	9.81		59.45	73.98	14.53	PK
7386	37.88	9.81	V	47.69	53.98	6.29	AV

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

Frequency [MHz]	Reading dBuV	Duty Cycle Factor	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detec
4824	52.98	0.00	1.95	V	54.93	73.98	19.05	PK
4824	40.44	0.00	1.95	V	42.39	53.98	11.59	AV
7236	49.97	0.00	9.86	V	59.83	73.98	14.15	PK
7236	37.31	0.00	9.86	V	47.17	53.98	6.81	AV
4824	53.92	0.00	1.95	H	55.87	73.98	18.11	PK
4824	40.50	0.00	1.95	H	42.45	53.98	11.53	AV
7236	50.59	0.00	9.86	H	60.45	73.98	13.53	PK
7236	38.25	0.00	9.86	H	48.11	53.98	5.87	AV

Operation Mode: 802.11g
 Transfer Rate: 6 Mbps
 Operating Frequency 2437
 Channel No. 06 Ch

Frequency [MHz]	Reading dBuV	Duty Cycle Factor	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detec
4874	51.86	0.00	2.33	V	54.19	73.98	19.79	PK
4874	39.56	0.00	2.33	V	41.89	53.98	12.09	AV
7311	49.28	0.00	10.14	V	59.42	73.98	14.56	PK
7311	37.98	0.00	10.14	V	48.12	53.98	5.86	AV
4874	52.36	0.00	2.33	H	54.69	73.98	19.29	PK
4874	39.87	0.00	2.33	H	42.20	53.98	11.78	AV
7311	50.21	0.00	10.14	H	60.35	73.98	13.63	PK
7311	38.03	0.00	10.14	H	48.17	53.98	5.81	AV

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

Frequency [MHz]	Reading dBuV	Duty Cycle Factor	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	
4924	49.83	0.00	2.28	V	52.11	73.98	21.87	PK
4924	38.33	0.00	2.28	V	40.61	53.98	13.37	AV
7386	49.21	0.00	9.81	V	59.02	73.98	14.96	PK
7386	36.80	0.00	9.81	V	46.61	53.98	7.37	AV
4924	50.32	0.00	2.28	H	52.60	73.98	21.38	PK
4924	38.45	0.00	2.28	H	40.73	53.98	13.25	AV
7386	49.80	0.00	9.81	H	59.61	73.98	14.37	PK
7386	37.32	0.00	9.81	H	47.13	53.98	6.85	AV



Operation Mode: 802.11n (HT20)
Transfer MCS Index: 0(6.5 Mbps)
Operating Frequency 2412
Channel No. 01 Ch

Frequency [MHz]	Reading dBuV	Duty Cycle Factor	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	
4824	51.90	0.00	1.95	V	53.85	73.98	20.13	PK
4824	40.12	0.00	1.95	V	42.07	53.98	11.91	AV
7236	50.28	0.00	9.86	V	60.14	73.98	13.84	PK
7236	37.81	0.00	9.86	V	47.67	53.98	6.31	AV
4824	52.44	0.00	1.95	H	54.39	73.98	19.59	PK
4824	40.37	0.00	1.95	H	42.32	53.98	11.66	AV
7236	50.43	0.00	9.86	H	60.29	73.98	13.69	PK
7236	38.25	0.00	9.86	H	48.11	53.98	5.87	AV

Operation Mode: 802.11n (HT20)
Transfer MCS Index: 0(6.5 Mbps)
Operating Frequency 2437
Channel No. 06 Ch

Frequency [MHz]	Reading dBuV	Duty Cycle Factor	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	
4874	52.08	0.00	2.33	V	54.41	73.98	19.57	PK
4874	39.51	0.00	2.33	V	41.84	53.98	12.14	AV
7311	49.73	0.00	10.14	V	59.87	73.98	14.11	PK
7311	37.91	0.00	10.14	V	48.05	53.98	5.93	AV
4874	52.60	0.00	2.33	H	54.93	73.98	19.05	PK
4874	39.76	0.00	2.33	H	42.09	53.98	11.89	AV
7311	50.04	0.00	10.14	H	60.18	73.98	13.80	PK
7311	38.03	0.00	10.14	H	48.17	53.98	5.81	AV

Operation Mode: 802.11n (HT20)
Transfer MCS Index: 0(6.5 Mbps)
Operating Frequency 2462
Channel No. 11 Ch

Frequency [MHz]	Reading dBuV	Duty Cycle Factor	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detec
4924	50.10	0.00	2.28	V	52.38	73.98	21.60	PK
4924	38.02	0.00	2.28	V	40.30	53.98	13.68	AV
7386	49.37	0.00	9.81	V	59.18	73.98	14.80	PK
7386	36.88	0.00	9.81	V	46.69	53.98	7.29	AV
4924	51.14	0.00	2.28	H	53.42	73.98	20.56	PK
4924	38.45	0.00	2.28	H	40.73	53.98	13.25	AV
7386	49.42	0.00		H	59.23	73.98	14.75	PK
7386	37.31	0.00		H	47.12	53.98	6.86	AV

Operation Mode: 802.11n (HT40)
 Transfer MCS Index: 0(13.5 Mbps)
 Operating Frequency 2422
 Channel No. 03 Ch

Frequency [MHz]	Reading dBuV	Duty Cycle Factor	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	
4844	50.10	0.00	1.91	V	52.01	73.98	21.97	PK
4844	37.60	0.00	1.91	V	39.51	53.98	14.47	AV
7266	49.01	0.00	10.15	V	59.16	73.98	14.82	PK
7266	36.80	0.00	10.15	V	46.95	53.98	7.03	AV
4844	51.57	0.00	1.91	H	53.48	73.98	20.50	PK
4844	38.85	0.00	1.91	H	40.76	53.98	13.22	AV
	49.43	0.00		H	59.58	73.98	14.40	PK
	37.62	0.00		H	47.77	53.98	6.21	AV

Operation Mode: 802.11n (HT40)
 Transfer MCS Index: 0(13.5 Mbps)
 Operating Frequency 2437
 Channel No. 06 Ch

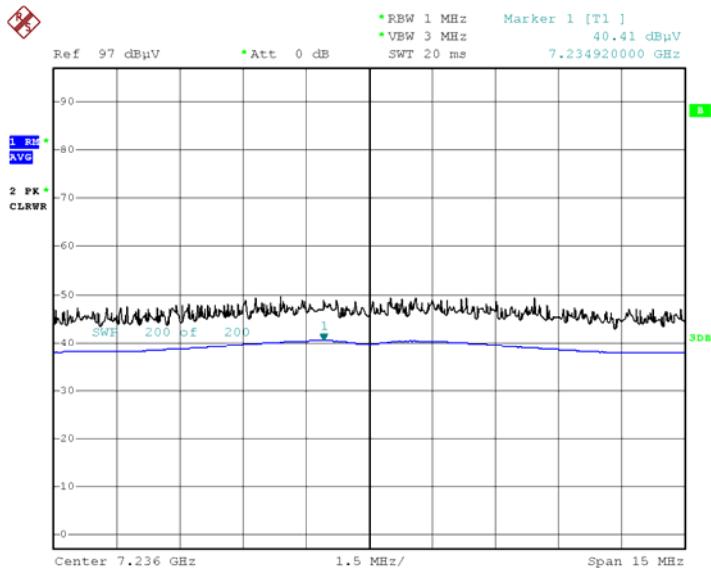
Frequency [MHz]	Reading dBuV	Duty Cycle Factor	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	
4874	49.50	0.00	2.33	V	51.83	73.98	22.15	PK
4874	38.52	0.00	2.33	V	40.85	53.98	13.13	AV
7311	49.40	0.00	10.14	V	59.54	73.98	14.44	PK
7311	37.25	0.00	10.14	V	47.39	53.98	6.59	AV
4874	51.26	0.00	2.33	H	53.59	73.98	20.39	PK
	38.73	0.00		H	41.06	53.98	12.92	AV
	50.43	0.00		H	60.57	73.98	13.41	PK
7311	37.78	0.00	10.14	H	47.92	53.98	6.06	AV

Operation Mode: 802.11n (HT40)
Transfer MCS Index: 0(13.5 Mbps)
Operating Frequency 2452
Channel No. 9 Ch

Frequency [MHz]	Reading dBuV	Duty Cycle Factor	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detec
4904	49.76	0.00	2.19	V	51.95	73.98	22.03	PK
4904	38.02	0.00	2.19	V	40.21	53.98	13.77	AV
7356	48.74	0.00	9.91	V	58.65	73.98	15.33	PK
7356	37.33	0.00	9.91	V	47.24	53.98	6.74	AV
4904	50.69	0.00	2.19	H	52.88	73.98	21.10	PK
4904	38.27	0.00	2.19	H	40.46	53.98	13.52	AV
	50.31	0.00		H	60.22	73.98	13.76	PK
	37.69	0.00		H	47.60	53.98	6.38	AV

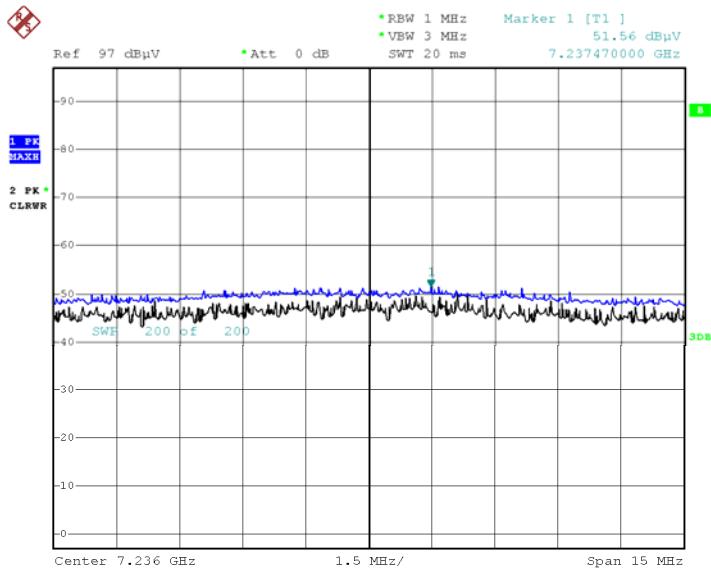
□ Test Plots (Worst case : Z-H)

Radiated Spurious Emissions plot – Average Reading (802.11b_1Mbps, Ch.1 3rd Harmonic)



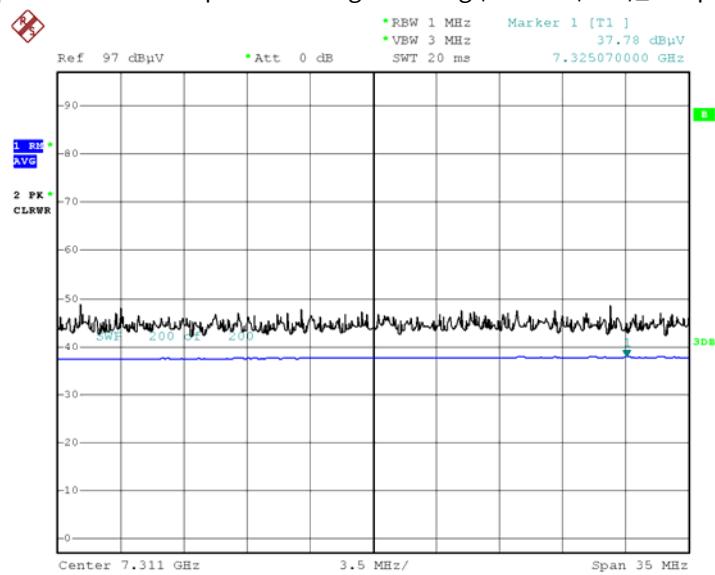
Date: 12.SEP.2019 17:06:48

Radiated Spurious Emissions plot – Peak Reading (802.11b_1Mbps, Ch.1 3rd Harmonic)



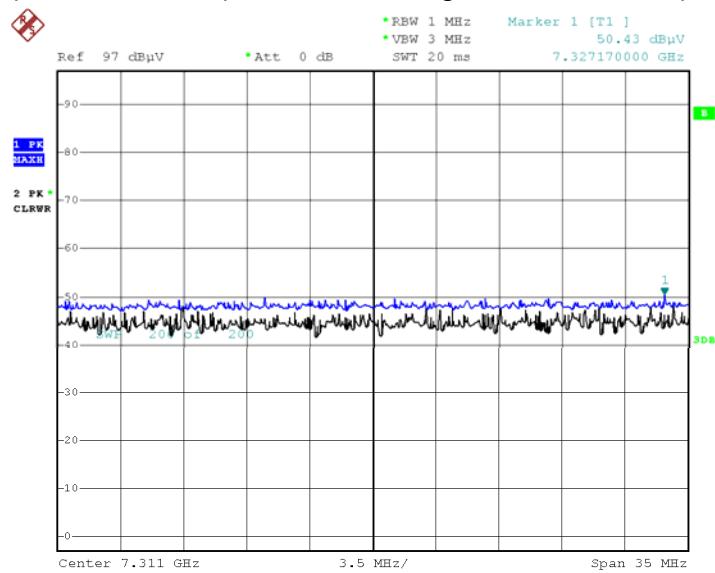
Date: 12.SEP.2019 17:07:15

Radiated Spurious Emissions plot – Average Reading (802.11n(40M)_0Mbps, Ch.6 3rd Harmonic)



Date: 12.SEP.2019 19:21:40

Radiated Spurious Emissions plot – Peak Reading (802.11n(40M)_0Mbps, Ch.6 3rd Harmonic)



Date: 12.SEP.2019 19:22:39

Note:

Plot of worst case are only reported.

9.7 RADIATED RESTRICTED BAND EDGES

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

Frequency [MHz]	Reading [dBuV]	A.F.+C.L.+D.F. -A.G+ATT [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	54.33	0.85	H	55.18	73.98	18.80	PK
2390.0	41.99	0.85		42.84	53.98	11.14	AV
2390.0	53.98	0.85	V	54.83	73.98	19.15	PK
2390.0	41.25	0.85		42.10	53.98	11.88	AV
2483.5	54.08	1.13	H	55.21	73.98	18.77	PK
2483.5	42.37	1.13		43.50		10.48	AV
2483.5	53.70	1.13	V	54.83		19.15	PK
2483.5	40.86	1.13	V	41.99	53.98	11.99	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	※ A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
2390.0	55.41	0.00	0.85	H	56.26	73.98	17.72	PK
2390.0	42.25	0.00	0.85	H	43.10	53.98	10.88	AV
2390.0	54.62	0.00	0.85	V	55.47	73.98	18.51	PK
2390.0	42.11	0.00	0.85	V	42.96	53.98	11.02	AV
2483.5	54.32	0.00	1.13	H	55.45	73.98	18.53	PK
2483.5	42.31	0.00	1.13	H	43.44	53.98	10.54	AV
2483.5	53.18	0.00	1.13	V	54.31	73.98	19.67	PK
2483.5	42.05	0.00	1.13	V	43.18	53.98	10.80	AV

Operation Mode: 802.11n (HT20)
Transfer MCS Index: 0(6.5 Mbps)
Operating Frequency 2412 MHz, 2462 MHz
Channel No. 01 Ch, 11 Ch

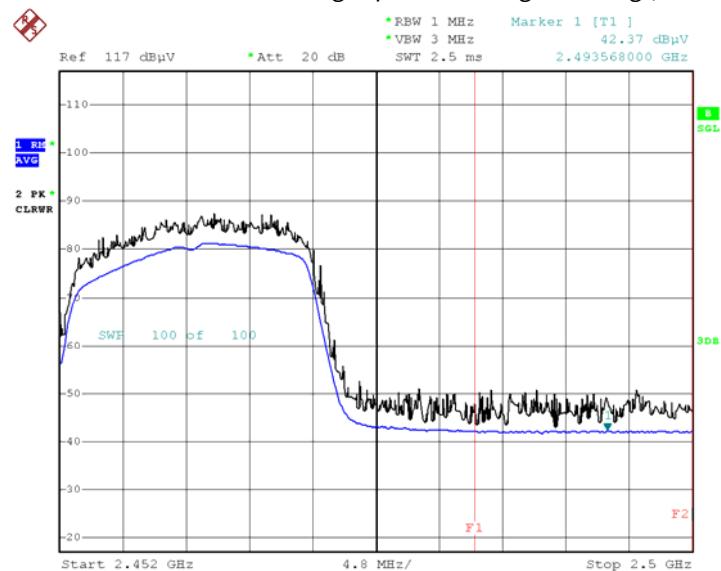
Frequency [MHz]	Reading dBuV	Duty Cycle Factor	※ A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
2390.0	54.47	0.00	0.85	H	55.32	73.98	18.66	PK
2390.0	42.36	0.00	0.85	H	43.21	53.98	10.77	AV
2390.0	53.78	0.00	0.85	V	54.63	73.98	19.35	PK
2390.0	42.15	0.00	0.85	V	43.00	53.98	10.98	AV
2483.5	54.08	0.00	1.13	H	55.21	73.98	18.77	PK
2483.5	42.35	0.00	1.13	H	43.48	53.98	10.50	AV
2483.5	53.79	0.00	1.13	V	54.92	73.98	19.06	PK
2483.5	42.02	0.00	1.13	V	43.15	53.98	10.83	AV

Operation Mode: 802.11n (HT40)
Transfer MCS Index: 0(13.5 Mbps)
Operating Frequency 2422 MHz, 2452 MHz
Channel No. 03 Ch, 09 Ch

Frequency [MHz]	Reading dBuV	Duty Cycle Factor	※ A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
2390.0	52.76	0.00	1.12	H	53.88	73.98	20.10	PK
2390.0	41.81	0.00	1.12	H	42.93	53.98	11.05	AV
2390.0	53.88	0.00	1.12	V	55.00	73.98	18.98	PK
2390.0	42.07	0.00	1.12	V	43.19	53.98	10.79	AV
2483.5	54.16	0.00	1.38	H	55.54	73.98	18.44	PK
2483.5	43.98	0.00	1.38	H	45.36	53.98	8.62	AV
2483.5	55.63	0.00	1.38	V	57.01	73.98	16.97	PK
2483.5	44.10	0.00	1.38	V	45.48	53.98	8.50	AV

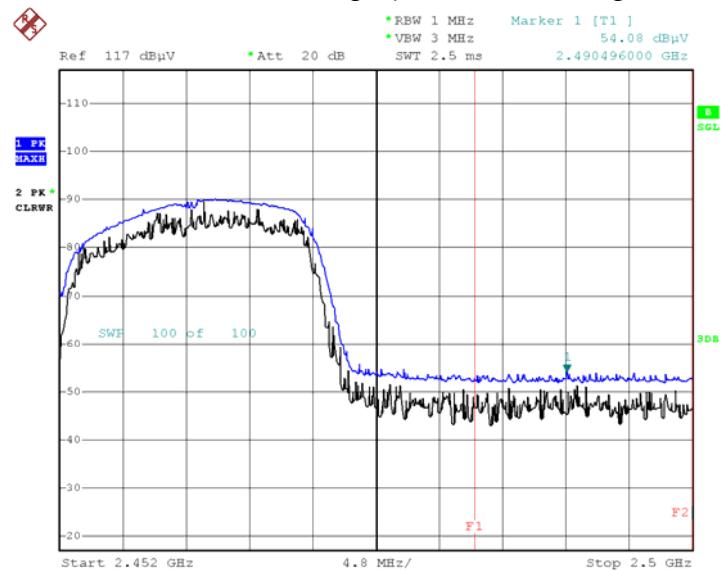
□ Test Plots (Worst case : X-H)

Radiated Restricted Band Edges plot – Average Reading (802.11b Ch.11)



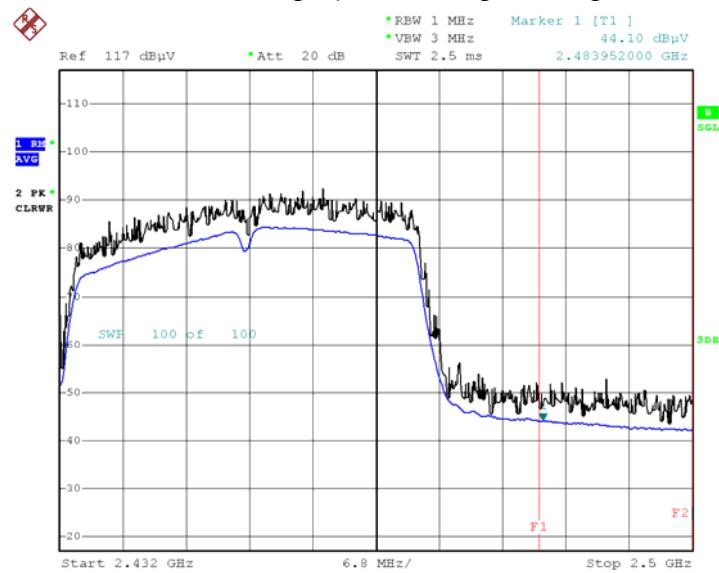
Date: 31.AUG.2019 19:14:33

Radiated Restricted Band Edges plot – Peak Reading (802.11b Ch.11)



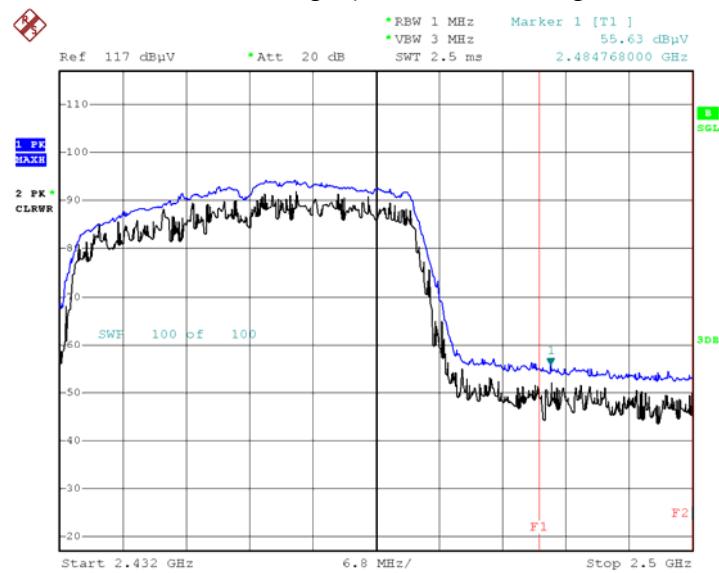
Date: 31.AUG.2019 19:10:52

Radiated Restricted Band Edges plot – Average Reading (802.11n_40 MHz Ch.9)



Date: 30.AUG.2019 17:20:28

Radiated Restricted Band Edges plot – Peak Reading (802.11n_40 MHz Ch.9)



Date: 30.AUG.2019 17:21:12

Note:

Plot of worst case are only reported.

10. LIST OF TEST EQUIPMENT

Conducted Test

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216 / LISN	12/12/2018	Annual	102245
Rohde & Schwarz	ESCI / Test Receiver	06/18/2019	Annual	100584
ESPAC	SU-642 /Temperature Chamber	03/12/2019	Annual	0093008124
Agilent	N9020A / Signal Analyzer	05/23/2019	Annual	MY51110085
Agilent	N9030A / Signal Analyzer	11/20/2018	Annual	MY49431210
Agilent	N1911A / Power Meter	04/10/2019	Annual	MY45100523
Agilent	N1921A / Power Sensor	04/10/2019	Annual	MY52260025
Agilent	87300B / Directional Coupler	11/20/2018	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	05/24/2019	Annual	05001
Hewlett Packard	E3632A / DC Power Supply	06/18/2019	Annual	KR75303960
WEINSCHEL	2-20 / Attenuator(20 dB)	10/26/2018	Annual	BR0592
Rohde & Schwarz	EMC32 / Software	N/A	N/A	N/A
HCT CO., LTD.	FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	N/A	N/A
Rohde & Schwarz	CBT / Bluetooth Tester	05/16/2019	Annual	100422

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

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Audix	EM1000 / Controller	N/A	N/A	060520
Audix	Turn Table	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	08/23/2018	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	03/22/2019	Biennial	760
Schwarzbeck	VULB 9160 / TRILOG Antenna	08/09/2018	Biennial	9160-3368
Schwarzbeck	BBHA 9120D / Horn Antenna	08/01/2019	Biennial	1151
Schwarzbeck	BBHA 9120D / Horn Antenna	04/29/2019	Biennial	937
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	12/04/2017	Biennial	BBHA9170541
Rohde & Schwarz	FSP(9 kHz ~ 30 GHz) / Spectrum Analyzer	09/03/2018	Annual	100688
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/28/2018	Annual	101068-SZ
Agilent	N9020A / Signal Analyzer	05/23/2019	Annual	MY51110085
Wainwright Instruments	WHK3.0/18G-10EF / High Pass Filter	05/23/2019	Annual	8
Wainwright Instruments	WHKX7.0/18G-8SS / High Pass Filter	05/03/2019	Annual	29
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	06/19/2019	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	01/03/2019	Annual	2
Api tech.	18B-03 / Attenuator (3 dB)	06/04/2019	Annual	1
H+S	5910-N-50-010 / Attenuator(10 dB)	11/08/2018	Annual	NONE
CERNEX	CBLU1183540 / Power Amplifier	07/01/2019	Annual	22964
CERNEX	CBL06185030 / Power Amplifier	07/01/2019	Annual	22965
CERNEX	CBL18265035 / Power Amplifier	01/03/2019	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	06/18/2019	Annual	25956
TESCOM	TC-3000C / Bluetooth Tester	03/26/2019	Annual	3000C000276

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.

11. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-1909-FC010-P