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HCT

TEST REPORT

FCC/ISED DTS Test for LAMWBD1
Certification

APPLICANT
LG Electronics Inc.

REPORT NO.
HCT-RF-2212-FI004

DATE OF ISSUE
December 8, 2022

Tested by
Jin Gwan Lee

Technical Manager
Jong Seok Lee

Accredited by KOLAS, Republic of KOREA

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Additional Model

-

Applicant

LG Electronics Inc.

170, Seongsanpaechong-ro, Seongsan-gu, Changwon-si, Gyeongsangnam-do,
51533, Republic of Korea

**Eut Type
Model Name**

RF Module
LAMWBD1

**FCC ID
IC**

BEJ-LAMWBD1
2703N-LAMWBD1

Modulation type

CCK/DSSS/OFDM

FCC Classification

Digital Transmission System(DTS)

FCC Rule Part(s)

Part 15.247

ISED Rule Part(s)

RSS-247 Issue 2 (February 2017)
RSS-Gen Issue 5_Amendment 2 (February 2021)

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.

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	December 08, 2022	Initial Release

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 / ISED Rules under normal use and maintenance.

KOLAS Statement:

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. (KOLAS Accreditation No. KT197)

If this report is required to confirmation of authenticity, please contact to www.hct.co.kr

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1. EUT DESCRIPTION

Model	LAMWBD1		
Additional Model	-		
EUT Type	RF Module		
Power Supply	DC 12.0 V / DC 19.0 V		
Frequency Range	2 412 MHz – 2 462 MHz		
Max. RF Output Power	Peak Power	802.11b:	22.14 dBm
		802.11g:	22.12 dBm
		802.11n(HT20):	21.93 dBm
	Average Power	802.11b:	17.34 dBm
		802.11g:	14.16 dBm
		802.11n(HT20):	14.03 dBm
Modulation Type	DSSS/CCK : 802.11b OFDM : 802.11g, 802.11n		
Number of Channels	11 Channels		
Antenna type	Pattern Antenna		
Antenna Peak Gain	-0.10 dBi		
Date(s) of Tests	November 21, 2022 ~ December 6, 2022		
PMN (Product Marketing Number)	RF Module		
HVIN (Hardware Version Identification Number)	LAMWBD1		
FVIN (Firmware Version Identification Number)	V1.0		
HMN (Host Marketing Name)	N/A		
EUT serial numbers	Radiated : 090000000000 Conducted : 010000000000		
Factory	BEACON I&C Co., Ltd. 82-1 Anyangcheondong-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Republic of Korea		

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. / RSS-Gen issue 5, RSS-247 issue 2.

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 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, 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 A NSI 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).

For ISED, test facility was accepted dated January 26, 2021 (CAB identifier: 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.

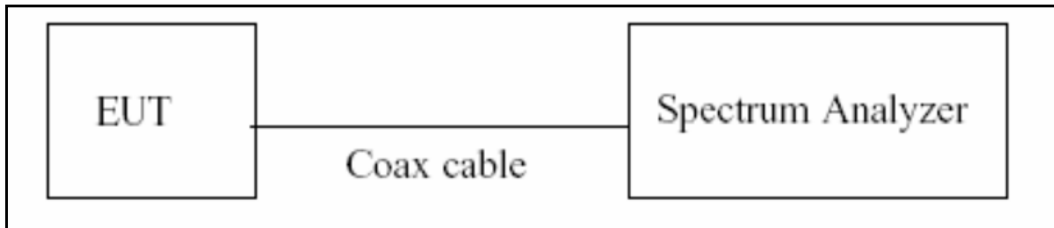
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

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 $> 50/T$.

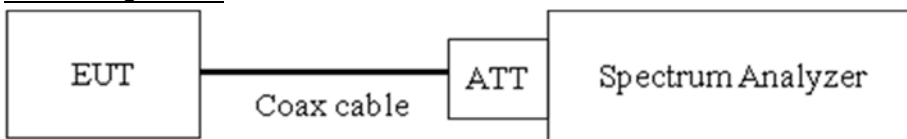
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (\geq RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/T_{total} and Duty Cycle Factor = $10\log(1/\text{Duty Cycle})$

7.2. 6 dB Bandwidth & 99 % 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.

Test Procedure (99 % Bandwidth for ISED)

The transmitter output is connected to the spectrum analyzer.

RBW = 1% ~ 5% of the occupied bandwidth

VBW $\cong 3 \times$ RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow the trace to stabilize

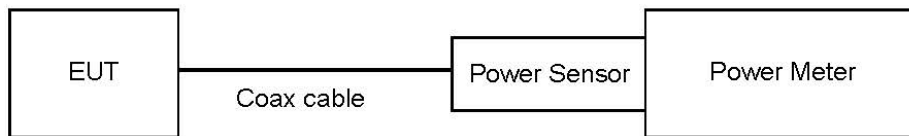
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

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

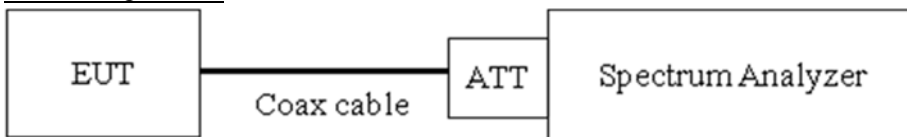
- Conducted Output Power(Peak) = Measured Level + ATT loss + Cable loss
- Conducted Output Power(Average) = Measured Level + ATT loss + Cable loss + Duty Cycle Factor

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 11.10.2 in ANSI 63.10-2013.

The spectrum analyzer is set to :

- 1) Set analyzer center frequency to DTS channel center frequency.
- 2) Span = 1.5 times the DTS channel bandwidth.
- 3) $RBW = 3 \text{ kHz} \leq RBW \leq 100 \text{ kHz}$.
- 4) $VBW \geq 3 \times RBW$.
- 5) Sweep = auto couple
- 6) Detector = peak
- 7) Trace Mode = max hold
- 8) Allow trace to fully stabilize.
- 9) Use the peak marker function to determine the maximum amplitude level within the RBW.
If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Sample Calculation

- Power Spectral Density = Measured Level + ATT loss + Cable loss

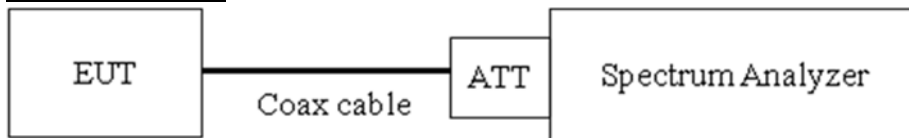
7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

Limit

The maximum conducted (Peak) 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 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

[Conducted > 20 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 x RBW
- 3) Set span to encompass the spectrum to be examined
- 4) Detector = Peak
- 5) Trace Mode = max hold
- 6) Sweep time = auto couple
- 7) Ensure that the number of measurement points \geq 2 x Span/RBW
- 8) Allow trace to fully stabilize.
- 9) Use peak marker function to determine the maximum amplitude level.

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

Factors for frequency

Freq(MHz)	Factor(dB)
30	10.70
100	10.76
200	10.77
300	10.79
400	10.83
500	11.02
600	11.03
700	11.05
800	11.08
900	11.09
1 000	11.10
2 000	11.19
2 400	11.30
2 480	11.30
2 500	11.26
3 000	11.48
4 000	11.54
5 000	11.98
5 150	12.17
5 850	12.17
6 000	12.23
7 000	12.25
8 000	12.28
9 000	12.33
10 000	12.46
11 000	12.52
12 000	12.54
13 000	12.60
14 000	12.63
15 000	12.65
16 000	12.74
17 000	12.93
18 000	13.07
19 000	12.99
20 000	12.66
21 000	12.79
22 000	12.78
23 000	12.75
24 000	12.80
25 000	12.91
26 000	12.94

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

2. Factor = Attenuator loss + Cable loss

7.6. Radiated Test

Limit

FCC

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

ISED

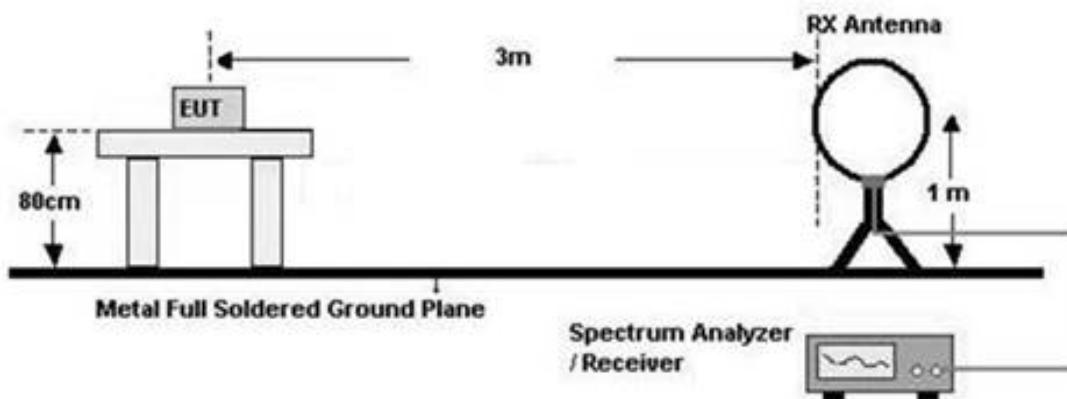
Frequency (MHz)	Field Strength (uA/m)	Measurement Distance (m)
0.009 – 0.490	6.37/F(kHz)	300
0.490 – 1.705	63.7/F(kHz)	30
1.705 – 30	0.08	30

FCC&ISED

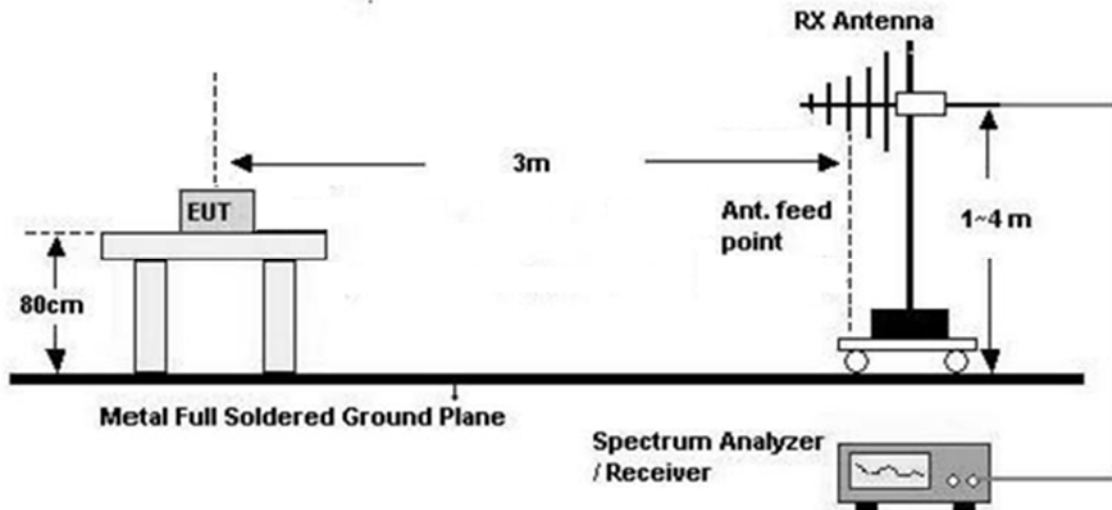
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

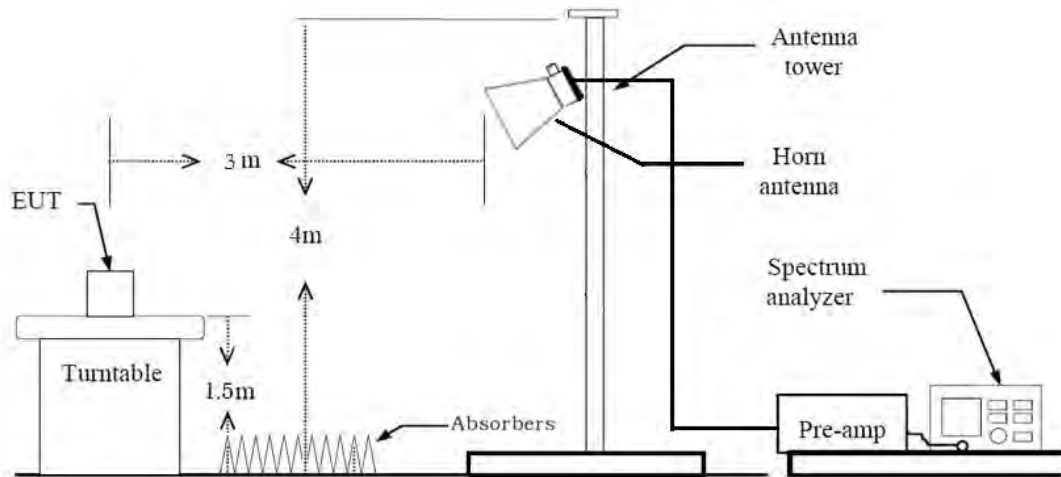
Below 30 MHz



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 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 Level + 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 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. The Hybrid antenna was placed at a location 3m from the EUT, which is varied from 1m to 4m 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 Level + 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 1m to 4m 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 x 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 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 $\pm 2\%$

- Measured Frequency Range : 1 GHz – 25 GHz
- 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 percent 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) - Amp Gain(G) + Distance Factor(D.F)

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

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

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

= Measured 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 m away from the receiving antenna, which is varied from 1m to 4m 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 $\pm 2\%$

- 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 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 percent 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 μH/50 ohms line impedance stabilization network (LISN).

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

^(a)Decreases with the logarithm of the frequency.

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

Test Configuration

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

Test Procedure

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

Sample Calculation

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

7.8. Receiver Spurious Emissions

Limit

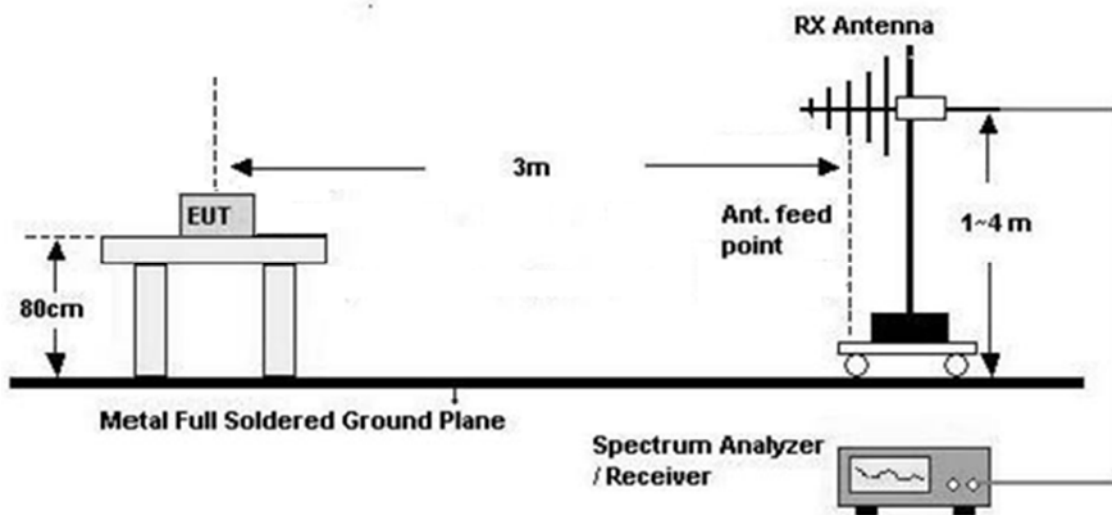
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

Measurements for compliance with the limits in table may be performed at distances other than 3 metres.

Test Configuration

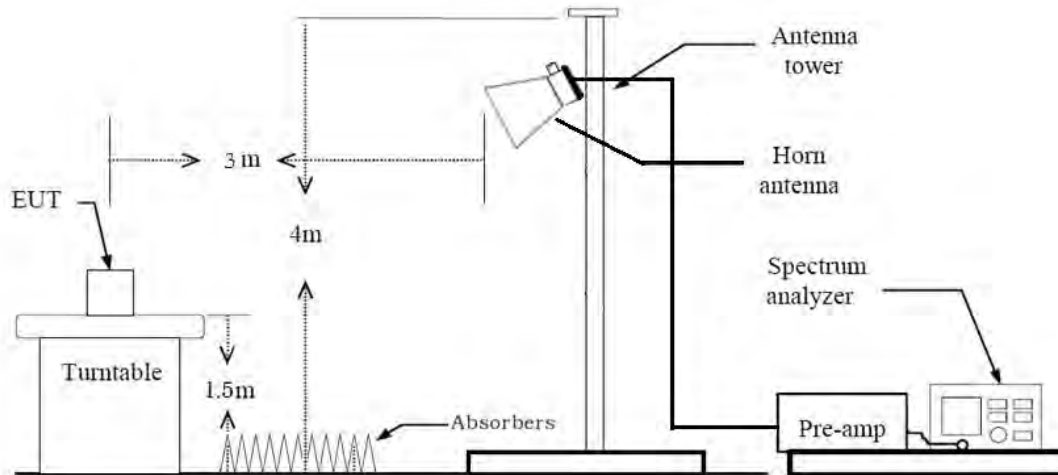
30 MHz - 1 GHz



Test Procedure of Receiver 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. The Hybrid antenna was placed at a location 3m from the EUT, which is varied from 1m to 4m 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
7. Total = Measured Level + Antenna Factor(A.F) + Cable Loss(C.L)

Above 1 GHz



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 1m to 4m 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 : 1 GHz – 25 GHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 1 MHz
 - VBW \geq 3 x RBW

(2) Measurement Type(Average):

- We performed using a reduced video BW method was done with the analyzer in linear mode
- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = Peak
- Trace = Maxhold
- RBW = 1 MHz
- VBW \geq 3 x RBW

10. Measurement Level 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 = Measured Level + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G)

7.9. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
2. All configurations of antenna were investigated and the worst case configuration results are reported.
 - Mode : Stand alone ,
3. EUT Axis
 - Radiated Spurious Emissions : Z
 - Radiated Restricted Band Edge : Y
4. All data rate of operation were investigated and the worst case data rate results are reported
 - 802.11b : 1 Mbps
 - 802.11g : 6 Mbps
 - 802.11n : 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. All modes of operation were investigated and the worst case configuration results are reported.
 - Mode : Stand alone

Conducted test

1. The EUT was configured with data rate of highest power.
2. All data rate of operation were investigated and the worst case data rate results are reported.
 - 802.11b : 11 Mbps
 - 802.11g : 6 Mbps
 - 802.11n : MCS0

8. SUMMARY TEST OF RESULTS

FCC Part

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

ISED Part

Test Description	ISED Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	RSS-247, 5.2	> 500 kHz	Conducted	PASS
99% Bandwidth	RSS-GEN, 6.7	N/A		PASS
Conducted Maximum Peak Output Power And e.i.r.p.	RSS-247, 5.4.	< 1 Watt <4 Watt(e.i.r.p.)		PASS
Power Spectral Density	RSS-247, 5.2	< 8 dBm / 3 kHz Band		PASS
Band Edge(Out of Band Emissions)	RSS-247, 5.5	Conducted > 20 dBc		PASS
AC Power line Conducted Emissions	RSS-GEN, 8.8	cf. Section 7.7		PASS
Radiated Spurious Emissions	RSS-GEN, 8.9	cf. Section 7.6	Radiated	PASS
Receiver Spurious Emissions	RSS-GEN, 7	cf. Section 7.8		PASS
Radiated Restricted Band Edge	RSS-GEN, 8.10	cf. Section 7.6		PASS

9. TEST RESULT

9.1 DUTY CYCLE

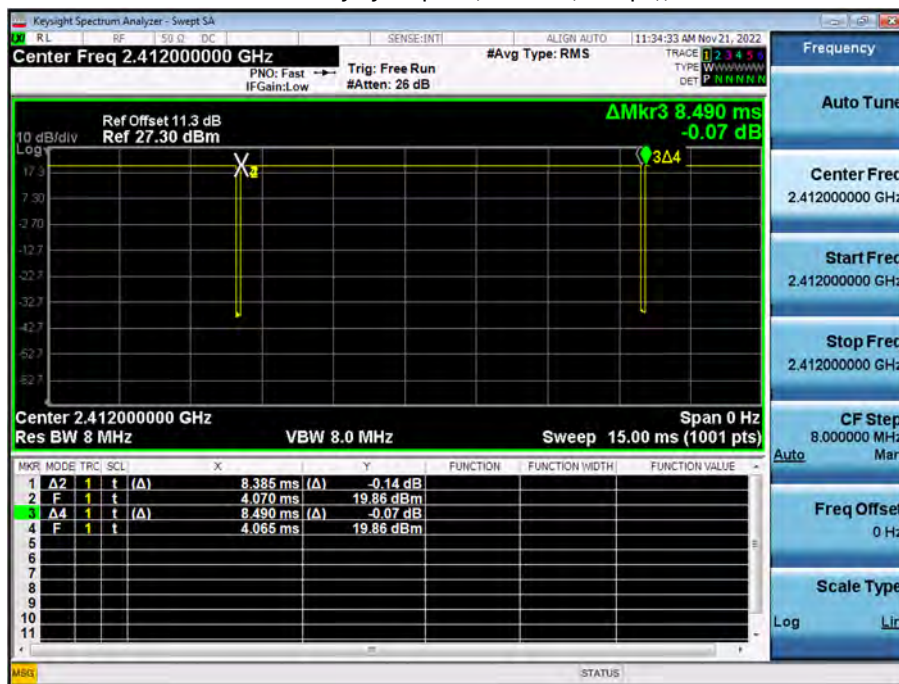
Mode	Data Rate (Mbps)	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11b	1	8.385	8.490	0.988	0.054
	2	4.291	4.393	0.977	0.101
	5.5	1.681	1.784	0.943	0.256
	11	0.938	1.040	0.902	0.450
802.11g	6	1.390	1.500	0.926	0.332
	9	0.937	1.044	0.897	0.473
	12	0.708	0.816	0.868	0.615
	18	0.480	0.588	0.816	0.881
	24	0.364	0.473	0.770	1.136
	36	0.252	0.360	0.699	1.552
	48	0.192	0.300	0.640	1.941
	54	0.176	0.284	0.619	2.081
802.11n (HT20)	6.5 (MCS0)	1.300	1.410	0.922	0.353
	13 (MCS1)	0.668	0.777	0.860	0.656
	19.5 (MCS2)	0.460	0.568	0.809	0.920
	26 (MCS3)	0.352	0.460	0.765	1.163
	39 (MCS4)	0.248	0.356	0.696	1.571
	52 (MCS5)	0.196	0.305	0.645	1.905
	58.5 (MCS6)	0.180	0.289	0.624	2.047
	65 (MCS7)	0.164	0.272	0.604	2.193

Note :

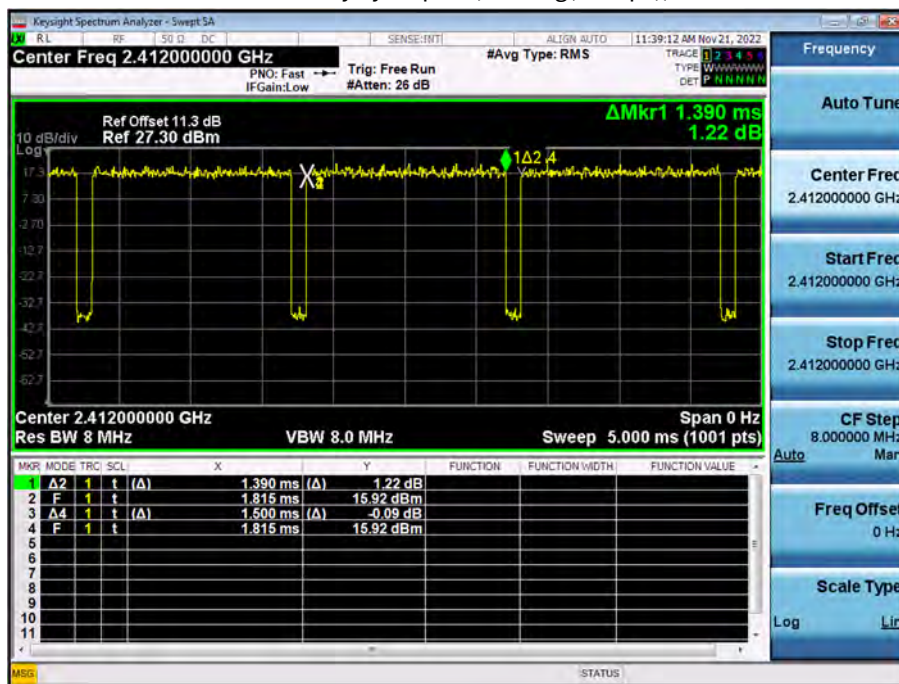
Duty Cycle Factor = 10log(1/Duty Cycle). where, Duty Cycle = T_{on} / T_{total}

▣ Test Plots

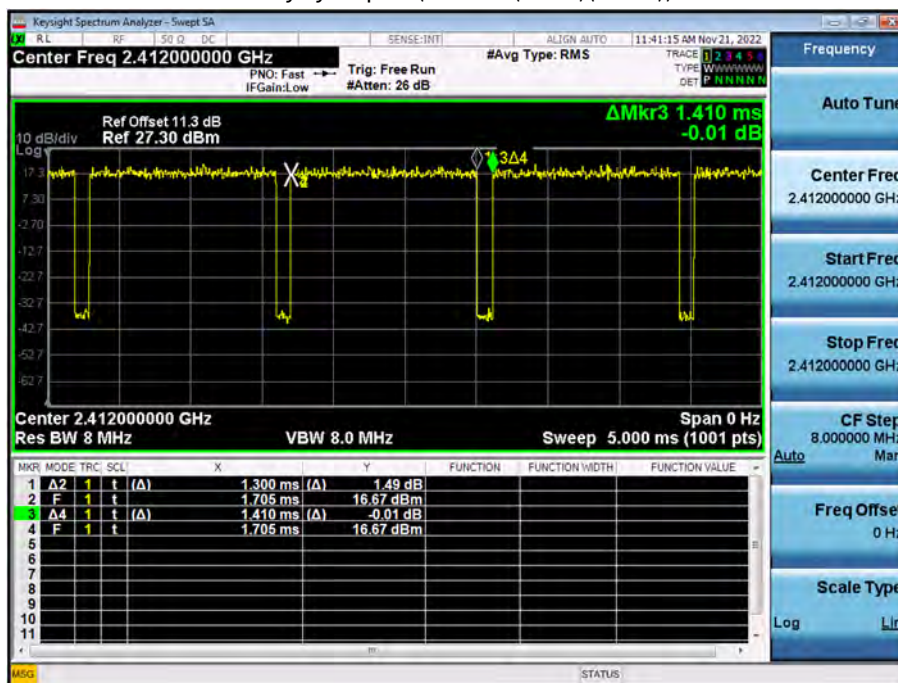
Duty cycle plot (802.11b(1 Mbps))



Duty cycle plot (802.11g(6 Mbps))



Duty cycle plot (802.11n(HT20)(MCS0))



Note:

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

9.2 6 dB BANDWIDTH & 99 % BANDWIDTH

FCC

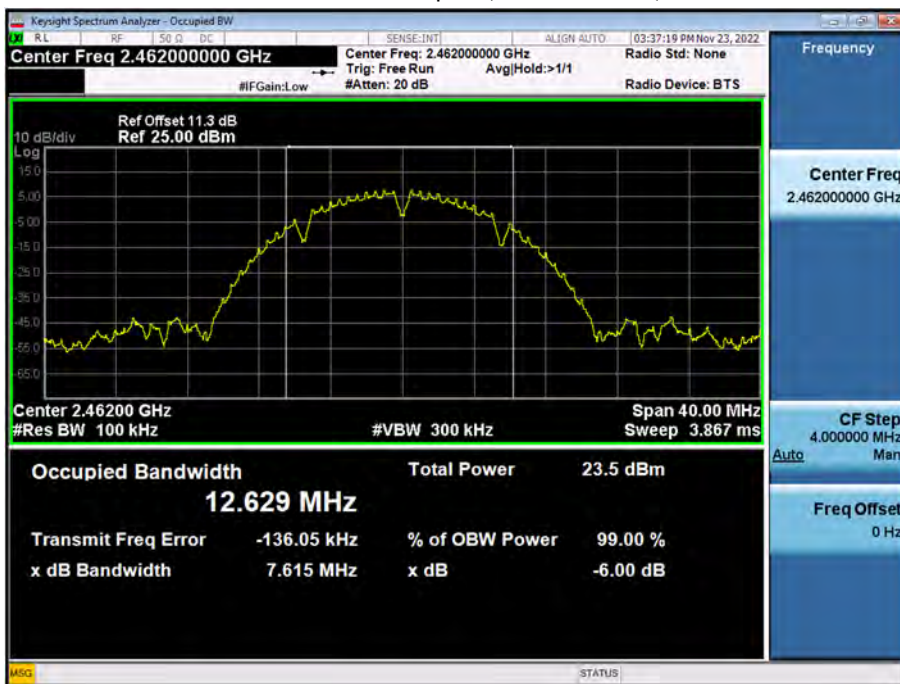
802.11b Mode		6 dB Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	8.573	> 0.5
2437	6	8.587	> 0.5
2462	11	7.615	> 0.5

802.11g Mode		6 dB Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	15.71	> 0.5
2437	6	15.74	> 0.5
2462	11	15.10	> 0.5

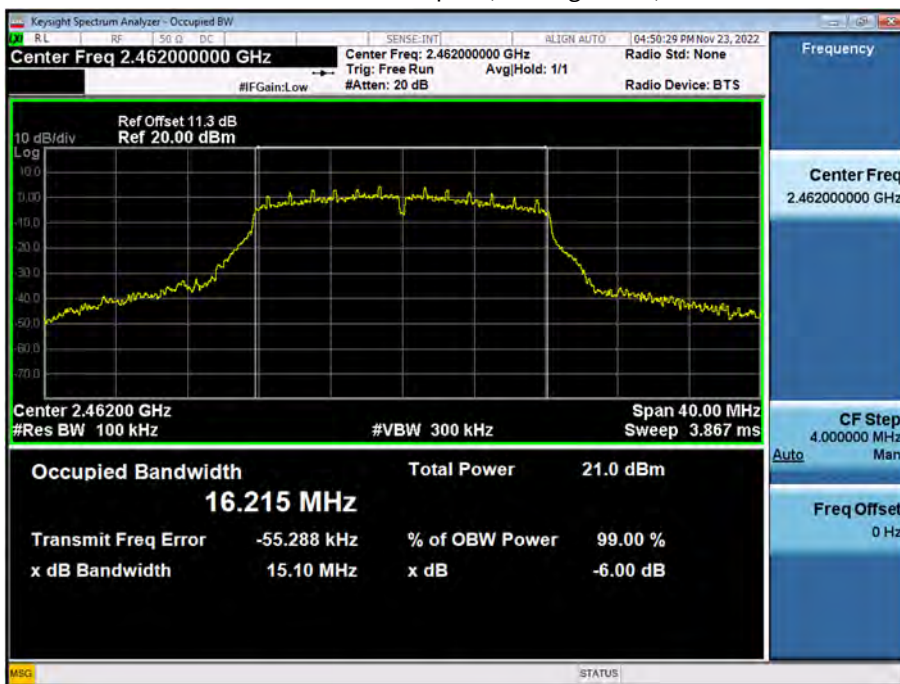
802.11n(HT20) Mode		6 dB Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	15.98	> 0.5
2437	6	15.98	> 0.5
2462	11	15.11	> 0.5

Test Plots

6 dB Bandwidth plot (802.11b-CH 11)



6 dB Bandwidth plot (802.11g-CH 11)



6 dB Bandwidth plot (802.11n_HT20-CH 11)



Note:

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

99% Bandwidth Measurements(ISED)

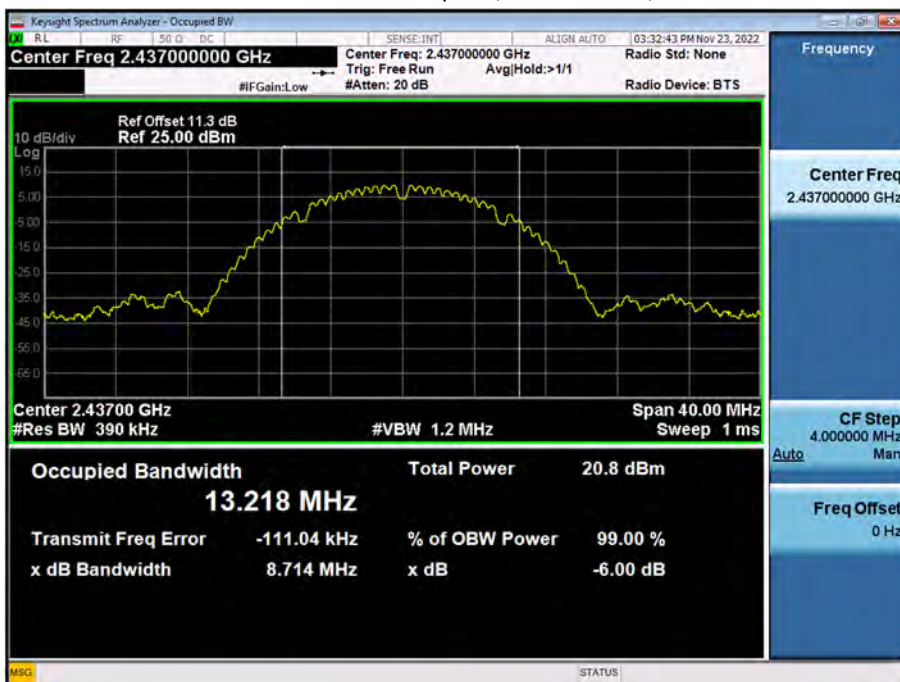
802.11b Mode		OBW Bandwidth [MHz]	Limit [MHz]
Frequency [MHz]	Channel No.		
2412	1	12.943	N/A
2437	6	13.218	N/A
2462	11	12.627	N/A

802.11g Mode		OBW Bandwidth [MHz]	Limit [MHz]
Frequency [MHz]	Channel No.		
2412	1	17.141	N/A
2437	6	17.258	N/A
2462	11	16.750	N/A

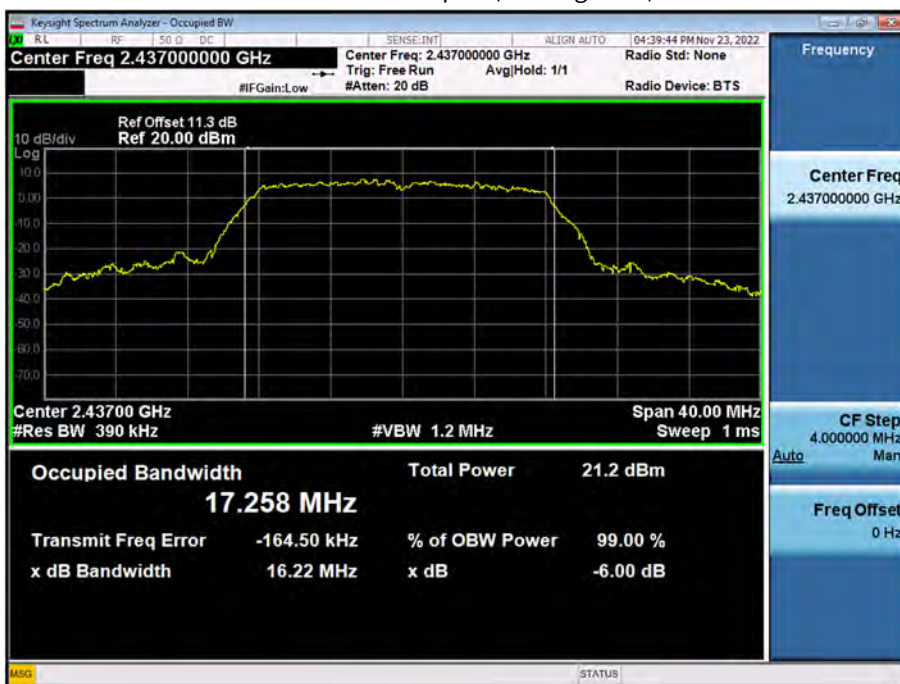
802.11n(HT20) Mode		OBW Bandwidth [MHz]	Limit [MHz]
Frequency [MHz]	Channel No.		
2412	1	17.819	N/A
2437	6	17.879	N/A
2462	11	17.544	N/A

▣ Test Plots

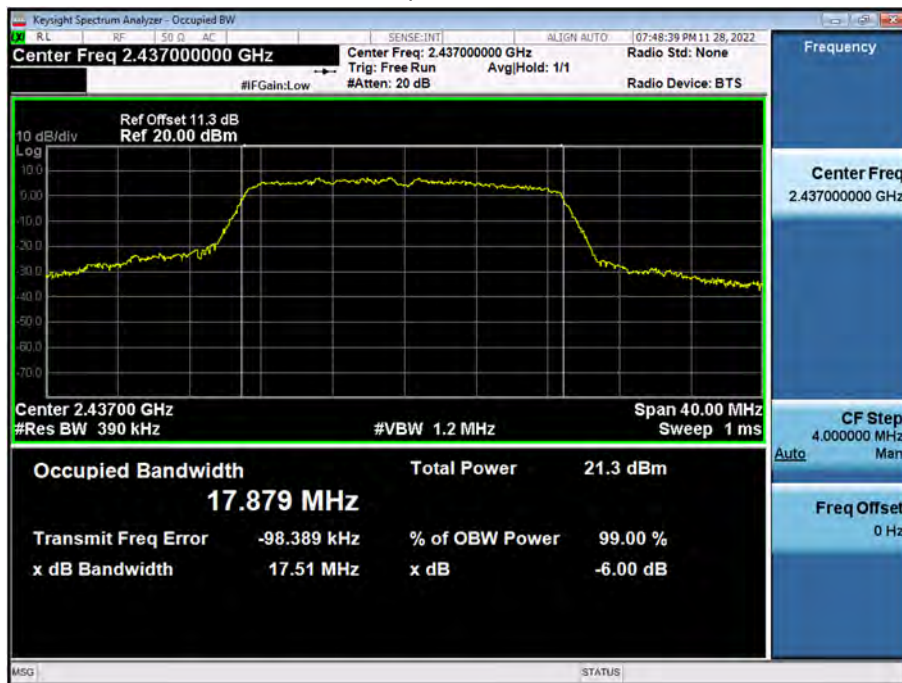
99% Bandwidth plot (802.11b-CH 6)



99% Bandwidth plot (802.11g-CH 6)



99% Bandwidth plot (802.11n_HT20-CH 6)



Note:

In order to simplify the report, attached plots were only the most wide 99% Bandwidth channel.



9.3 OUTPUT POWER

Peak Power

802.11b Mode		Rate (Mbps)	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	1	19.57	30.00
		2	19.83	30.00
		5.5	21.32	30.00
		11	21.65	30.00
2437	6	1	20.14	30.00
		2	20.22	30.00
		5.5	21.77	30.00
		11	22.14	30.00
2462	11	1	19.59	30.00
		2	19.83	30.00
		5.5	21.48	30.00
		11	21.96	30.00

802.11g Mode		Rate (Mbps)	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	6	21.45	30.00
		9	21.40	30.00
		12	21.39	30.00
		18	21.32	30.00
		24	21.38	30.00
		36	21.32	30.00
		48	21.30	30.00
		54	21.37	30.00
2437	6	6	22.12	30.00
		9	21.95	30.00
		12	22.09	30.00
		18	21.76	30.00
		24	22.01	30.00
		36	21.96	30.00
		48	22.10	30.00
		54	22.08	30.00
2462	11	6	21.85	30.00
		9	21.56	30.00
		12	21.62	30.00
		18	21.66	30.00
		24	21.81	30.00
		36	21.69	30.00
		48	21.71	30.00
		54	21.58	30.00



802.11n(HT20) Mode		MCS Index	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	0	21.61	30.00
		1	21.35	30.00
		2	21.34	30.00
		3	21.53	30.00
		4	21.44	30.00
		5	21.50	30.00
		6	21.45	30.00
		7	21.29	30.00
2437	6	0	21.93	30.00
		1	21.74	30.00
		2	21.78	30.00
		3	21.89	30.00
		4	21.73	30.00
		5	21.91	30.00
		6	21.85	30.00
		7	21.87	30.00
2462	11	0	21.72	30.00
		1	21.48	30.00
		2	21.63	30.00
		3	21.57	30.00
		4	21.68	30.00
		5	21.59	30.00
		6	21.68	30.00
		7	21.66	30.00

Average Power

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	16.90	0.000	16.90	30.00
		2	16.49	0.101	16.59	30.00
		5.5	16.49	0.256	16.75	30.00
		11	15.31	0.450	15.76	30.00
2437	6	1	17.34	0.000	17.34	30.00
		2	17.12	0.101	17.22	30.00
		5.5	17.01	0.256	17.27	30.00
		11	16.27	0.450	16.72	30.00
2462	11	1	17.11	0.000	17.11	30.00
		2	16.90	0.101	17.00	30.00
		5.5	16.84	0.256	17.10	30.00
		11	15.91	0.450	16.36	30.00

802.11g Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor (dB)	Total Power (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	6	13.33	0.332	13.66	30.00
		9	13.12	0.473	13.59	30.00
		12	12.86	0.615	13.48	30.00
		18	12.60	0.881	13.48	30.00
		24	12.41	1.136	13.54	30.00
		36	11.99	1.552	13.54	30.00
		48	11.62	1.941	13.56	30.00
		54	11.48	2.081	13.56	30.00
2437	6	6	13.83	0.332	14.16	30.00
		9	13.61	0.473	14.08	30.00
		12	13.46	0.615	14.07	30.00
		18	13.22	0.881	14.10	30.00
		24	12.81	1.136	13.95	30.00
		36	12.58	1.552	14.14	30.00
		48	12.14	1.941	14.08	30.00
		54	11.86	2.081	13.94	30.00
2462	11	6	13.66	0.332	13.99	30.00
		9	13.27	0.473	13.74	30.00
		12	12.93	0.615	13.55	30.00
		18	12.80	0.881	13.68	30.00
		24	12.57	1.136	13.71	30.00
		36	12.17	1.552	13.72	30.00
		48	12.00	1.941	13.94	30.00
		54	11.81	2.081	13.89	30.00

802.11n(HT20) Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor (dB)	Total Power (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	0	13.31	0.353	13.66	30.00
		1	12.78	0.656	13.44	30.00
		2	12.53	0.920	13.45	30.00
		3	12.41	1.163	13.57	30.00
		4	11.91	1.571	13.48	30.00
		5	11.62	1.905	13.52	30.00
		6	11.40	2.047	13.45	30.00
		7	11.31	2.193	13.50	30.00
2437	6	0	13.68	0.353	14.03	30.00
		1	13.12	0.656	13.78	30.00
		2	12.81	0.920	13.73	30.00
		3	12.52	1.163	13.68	30.00
		4	12.05	1.571	13.62	30.00
		5	12.11	1.905	14.01	30.00
		6	11.82	2.047	13.87	30.00
		7	11.50	2.193	13.70	30.00
2462	11	0	13.50	0.353	13.85	30.00
		1	13.12	0.656	13.78	30.00
		2	12.81	0.920	13.73	30.00
		3	12.47	1.163	13.63	30.00
		4	12.04	1.571	13.61	30.00
		5	11.90	1.905	13.80	30.00
		6	11.75	2.047	13.79	30.00
		7	11.42	2.193	13.61	30.00

9.4 POWER SPECTRAL DENSITY

Mode	Frequency (MHz)	Channel No.	Test Result	
			Max. PSD	Limit (dBm/3 kHz)
802.11b	2412	1	-6.257	8
	2437	6	-6.143	
	2462	11	-6.494	
802.11g	2412	1	-12.473	
	2437	6	-11.275	
	2462	11	-11.293	
802.11n(HT20)	2412	1	-11.880	
	2437	6	-12.437	
	2462	11	-11.165	

Note :

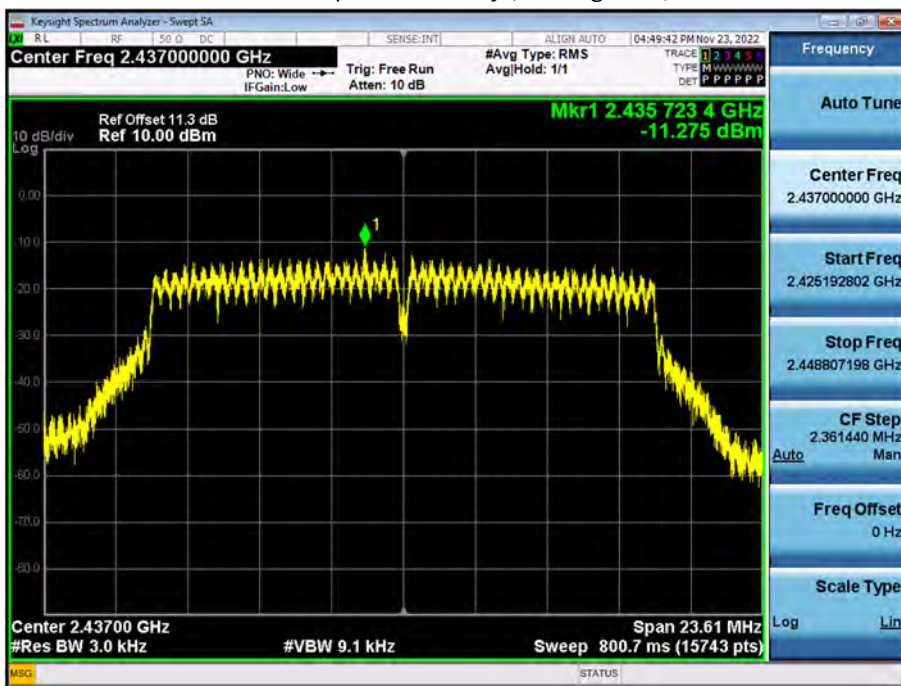
1. The measured PSD results in plot is already including the actual values of loss for the attenuator and cable combination.

Test Plots

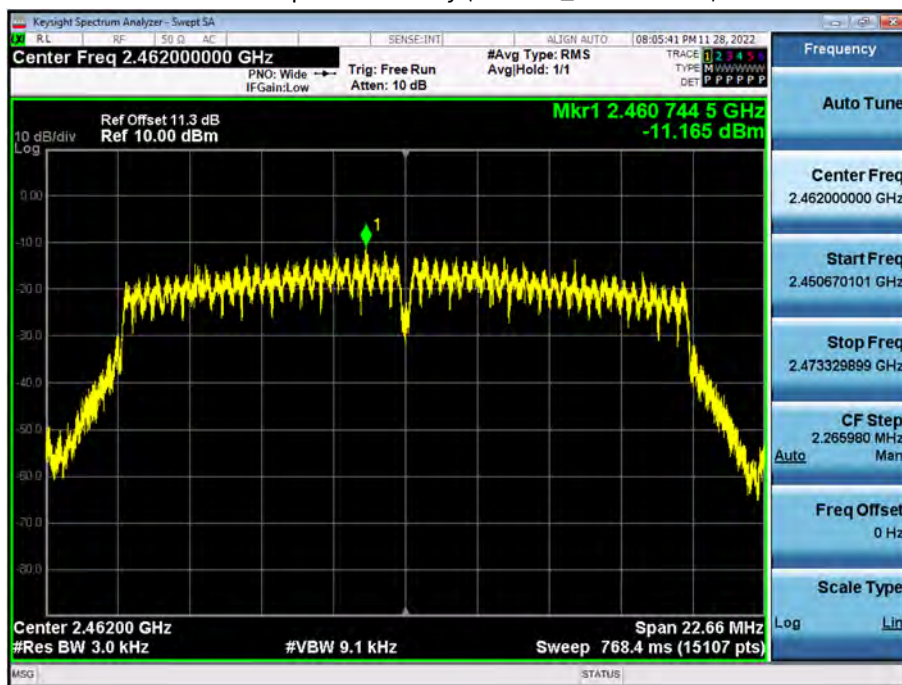
Power Spectral Density (802.11b-CH 6)



Power Spectral Density (802.11g-CH 6)



Power Spectral Density (802.11n_HT20 -CH 11)



Note :

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

9.5 BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

Note :

In order to simplify the report, attached plots were only the worst case channel and data rate.

☐ Test Plots(BandEdge)

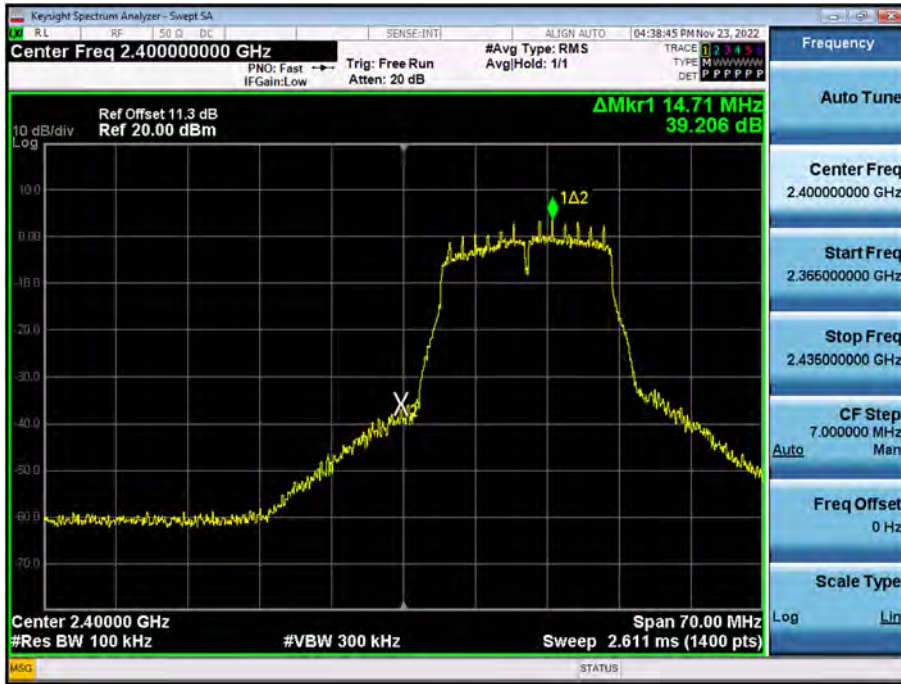
Band Edge (802.11b-CH1)



Band Edge (802.11b-CH11)



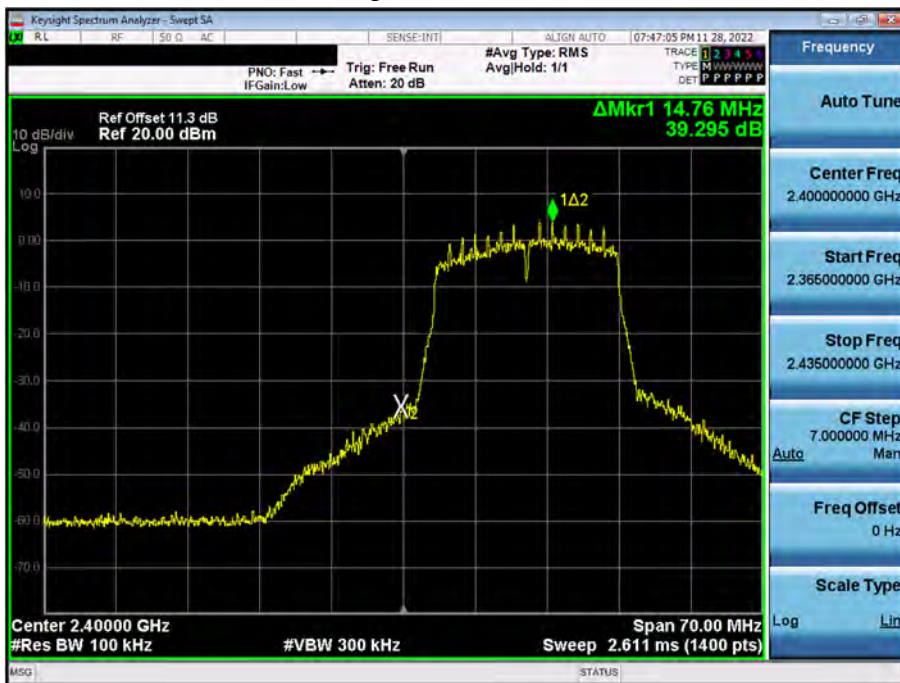
Band Edge (802.11g_Ch.1)



Band Edge (802.11g_Ch.11)



Band Edge (802.11n_HT20_Ch.1)



Band Edge (802.11n_HT20_Ch.11)

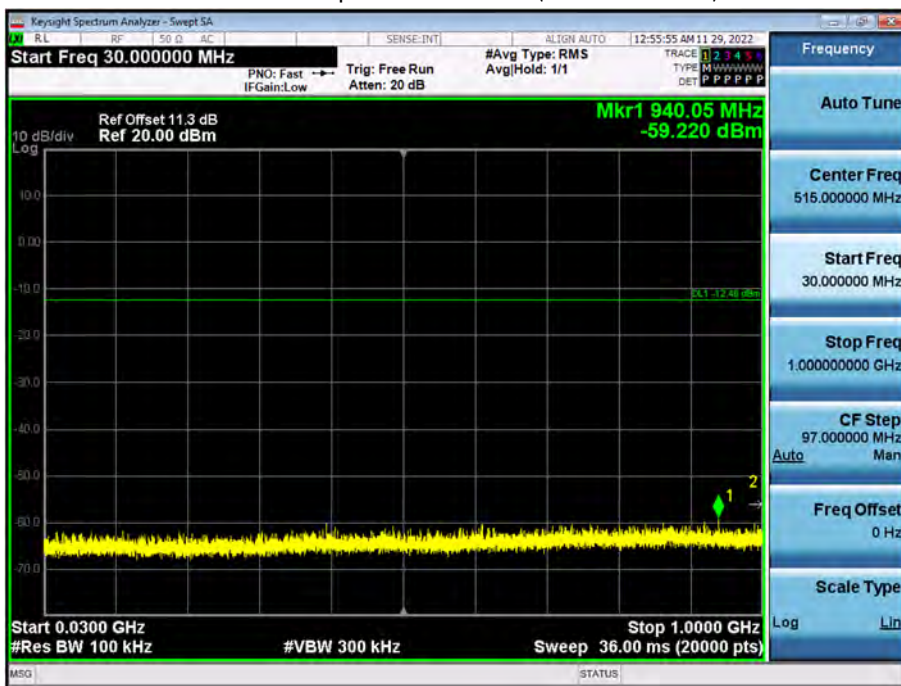


☐ Test Plots(Conducted Spurious Emission)

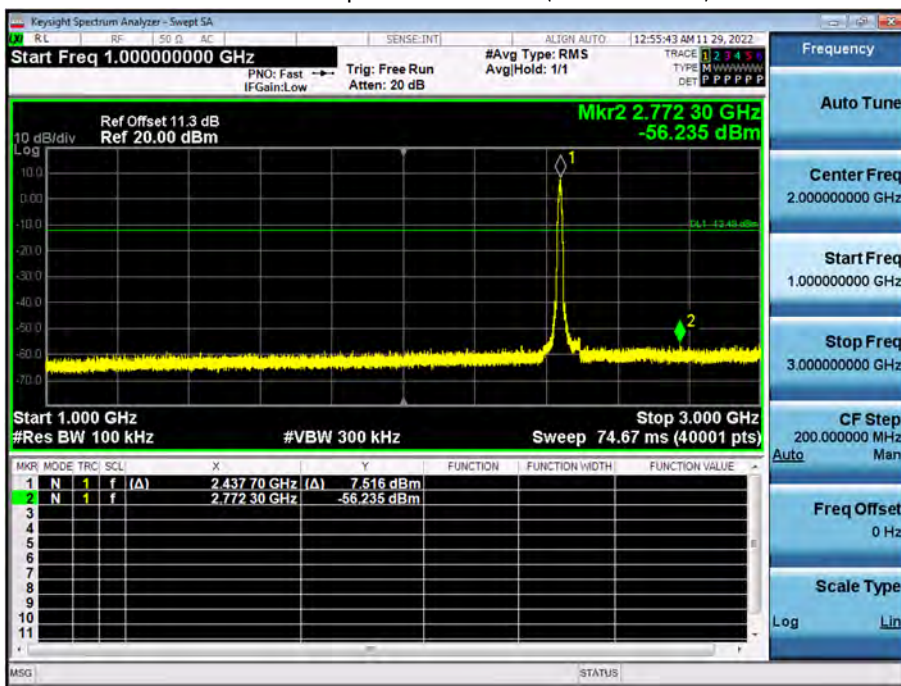
Worst case : 802.11b_Ch6_11 Mbps

Limit : -12.48 dBm

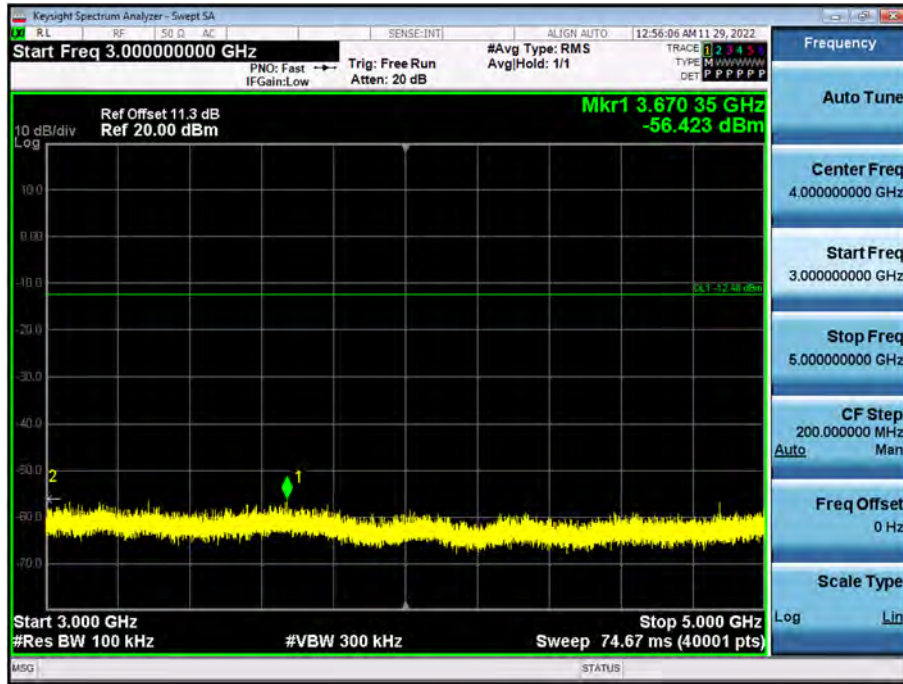
Conducted Spurious Emission (30 MHz ~ 1 GHz)



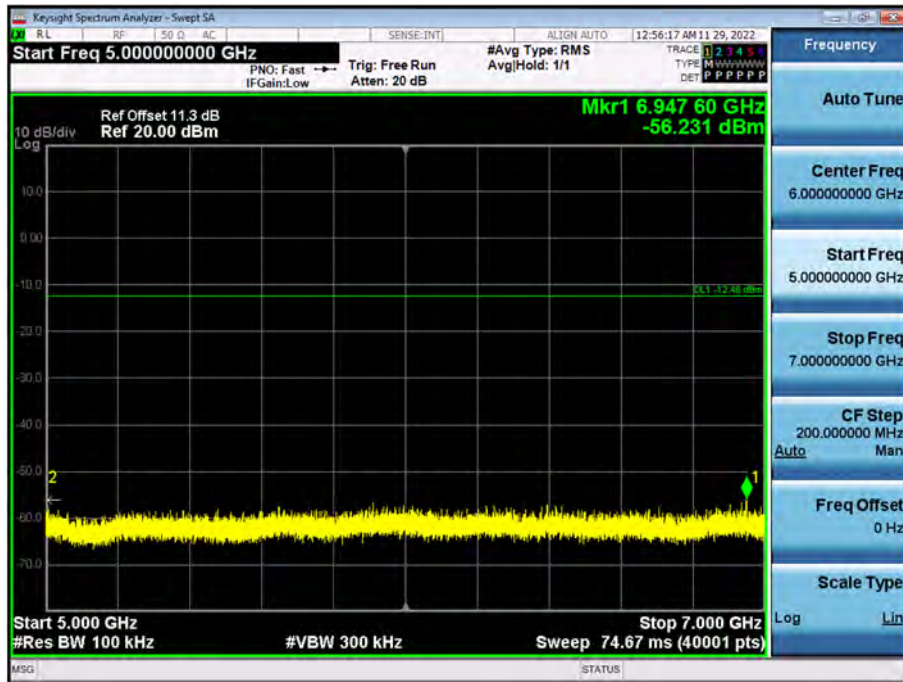
Conducted Spurious Emission (1 GHz ~ 3 GHz)



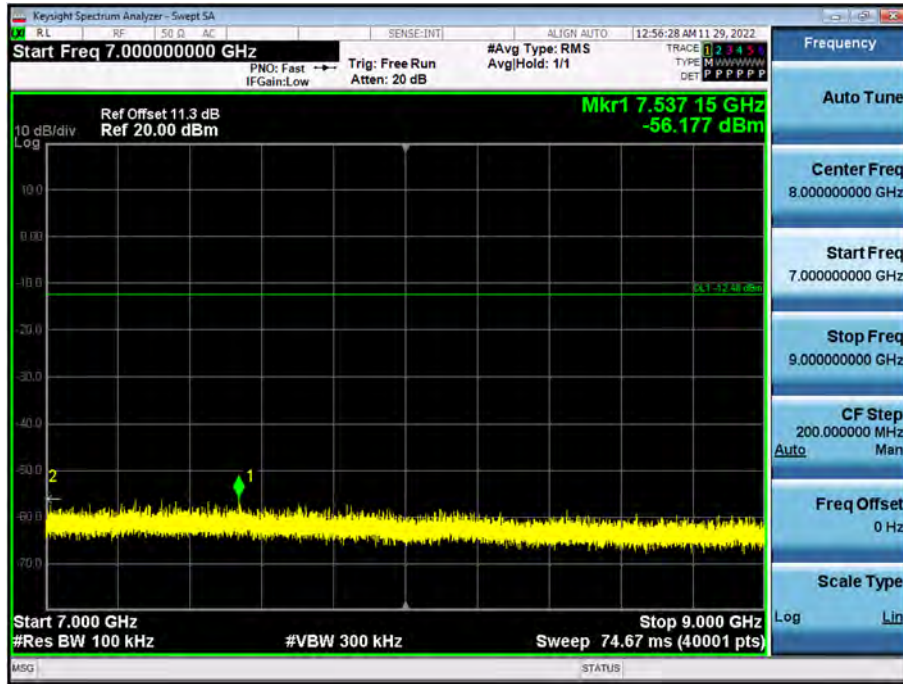
Conducted Spurious Emission (3 GHz ~ 5 GHz)



Conducted Spurious Emission (5 GHz ~ 7 GHz)



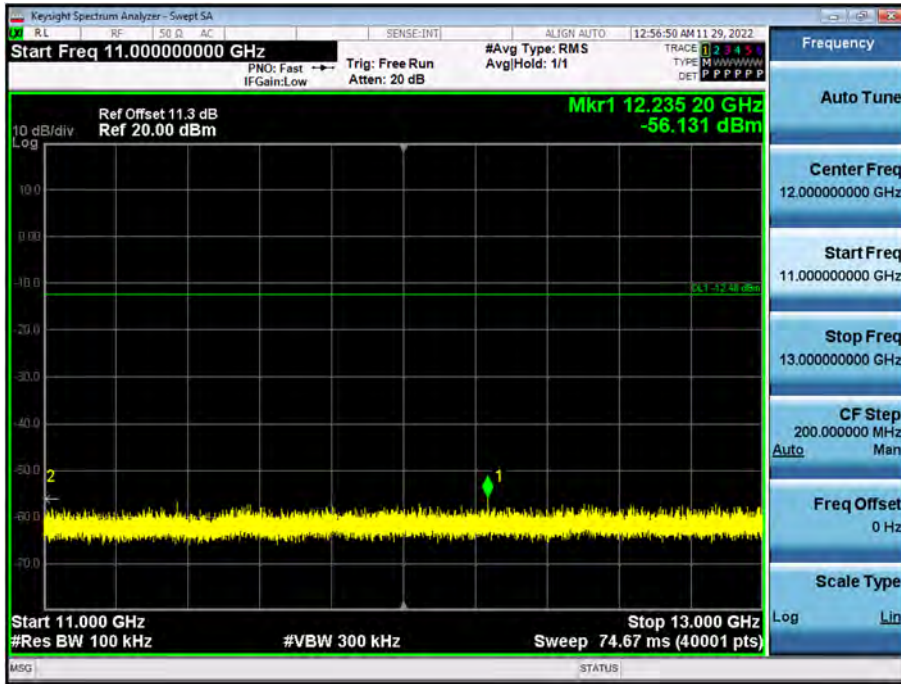
Conducted Spurious Emission (7 GHz ~ 9 GHz)



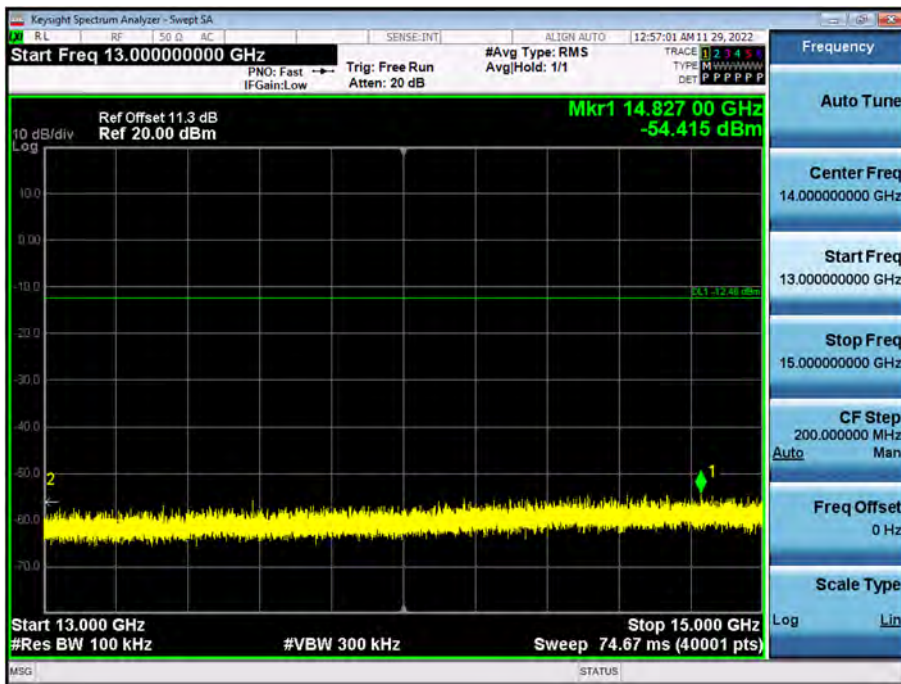
Conducted Spurious Emission (9 GHz ~ 11 GHz)



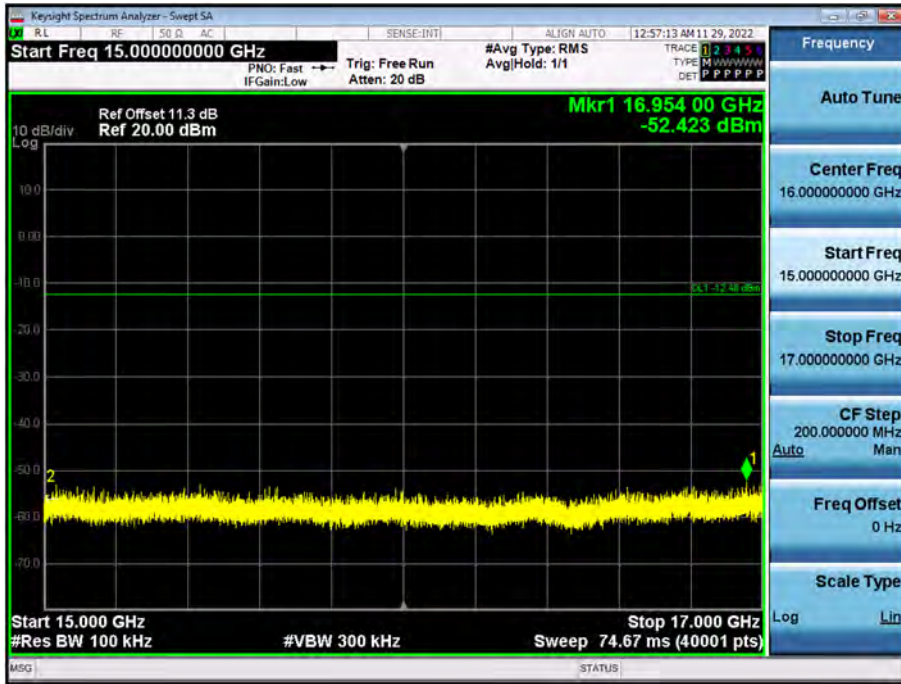
Conducted Spurious Emission (11 GHz ~ 13 GHz)



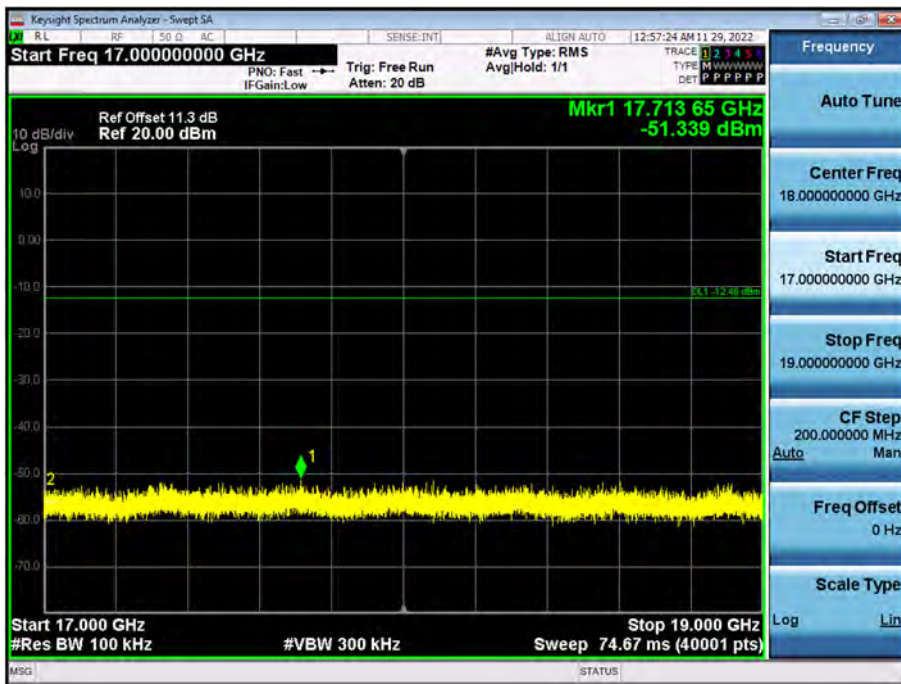
Conducted Spurious Emission (13 GHz ~ 15 GHz)



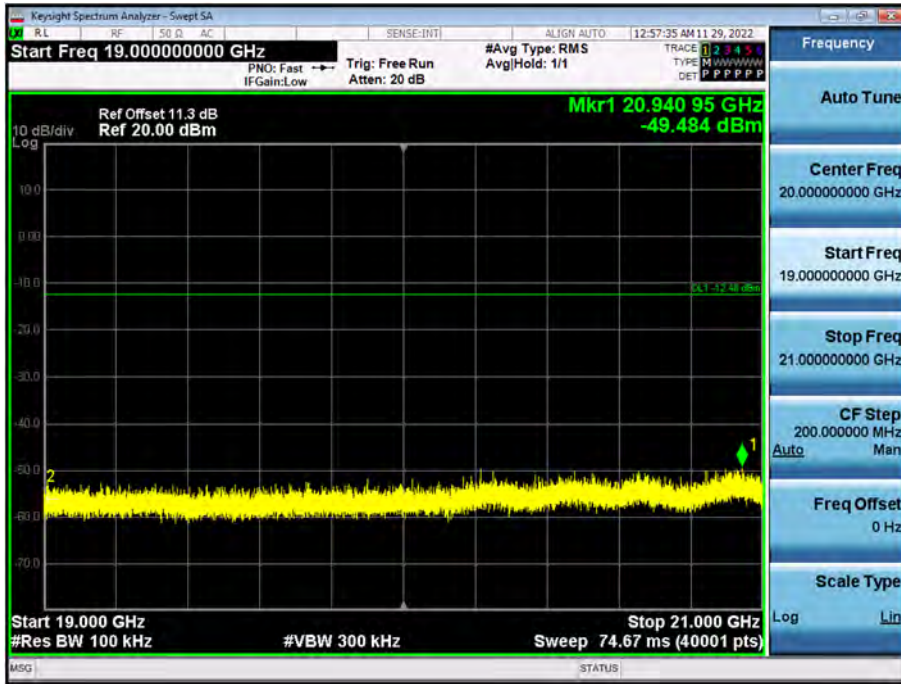
Conducted Spurious Emission (15 GHz ~ 17 GHz)



Conducted Spurious Emission (17 GHz ~ 19 GHz)



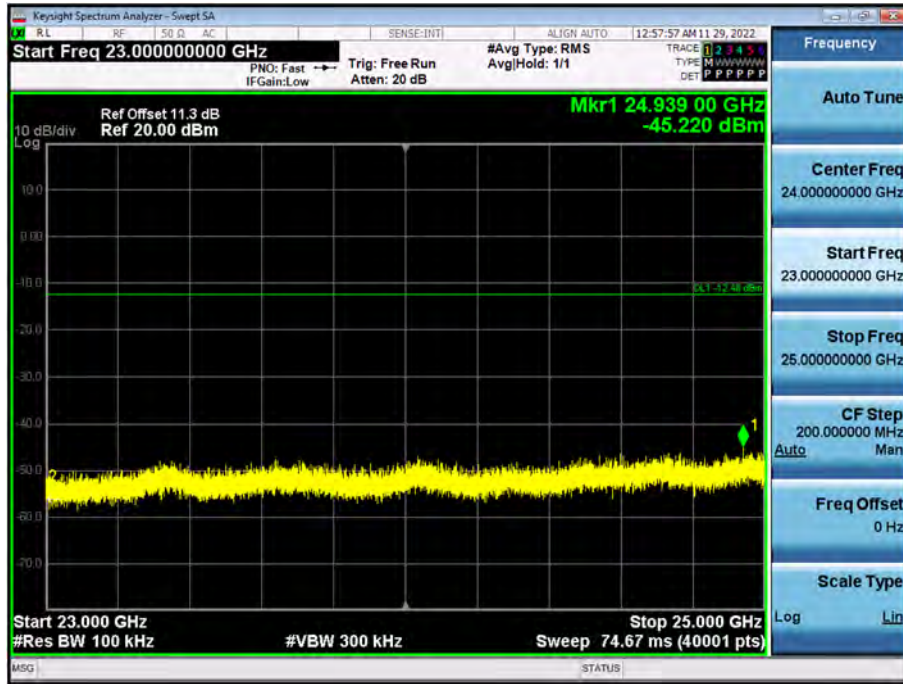
Conducted Spurious Emission (19 GHz ~ 21 GHz)



Conducted Spurious Emission (21 GHz ~ 23 GHz)



Conducted Spurious Emission (23 GHz ~ 25 GHz)



9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

Frequency	Measured Level	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 Level	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

Operation Mode: 802.11b
 Transfer Rate: 1 Mbps
 Operating Frequency: 2 412 MHz
 Channel No.: 01 Ch

Frequency	Measured Level	AF+CL+DF-AG	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V/m]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4824	44.52	3.42	V	47.94	73.98	26.04	PK
4824	34.34	3.42	V	37.76	53.98	16.22	AV
7236	42.23	8.48	V	50.71	73.98	23.27	PK
7236	30.46	8.48	V	38.94	53.98	15.04	AV
4824	44.25	3.42	H	47.67	73.98	26.31	PK
4824	33.65	3.42	H	37.07	53.98	16.91	AV
7236	42.40	8.48	H	50.88	73.98	23.10	PK
7236	30.57	8.48	H	39.05	53.98	14.93	AV

Operation Mode: 802.11b
 Transfer Rate: 1 Mbps
 Operating Frequency: 2 437 MHz
 Channel No.: 06 Ch

Frequency	Measured Level	AF+CL+DF-AG	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V/m]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4874	46.74	2.97	V	49.71	73.98	24.27	PK
4874	40.30	2.97	V	43.27	53.98	10.71	AV
7311	43.89	9.43	V	53.32	73.98	20.66	PK
7311	33.84	9.43	V	43.27	53.98	10.71	AV
4874	47.01	2.97	H	49.98	73.98	24.00	PK
4874	40.27	2.97	H	43.24	53.98	10.74	AV
7311	43.75	9.43	H	53.18	73.98	20.80	PK
7311	32.98	9.43	H	42.41	53.98	11.57	AV



Operation Mode:	802.11b
Transfer MCS Index:	1 Mbps
Operating Frequency	2 462 MHz
Channel No.	11 Ch

Frequency	Measured Level	AF+CL+DF-AG	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V/m]	[dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4924	45.43	2.47	V	47.90	73.98	26.08	PK
4924	38.66	2.47	V	41.13	53.98	12.85	AV
7386	42.01	10.24	V	52.25	73.98	21.73	PK
7386	30.74	10.24	V	40.98	53.98	13.00	AV
4924	46.52	2.47	H	48.99	73.98	24.99	PK
4924	39.64	2.47	H	42.11	53.98	11.87	AV
7386	42.45	10.24	H	52.69	73.98	21.29	PK
7386	31.04	10.24	H	41.28	53.98	12.70	AV

Note:

All Modes of operation were investigated and the worst case configuration results are reported.

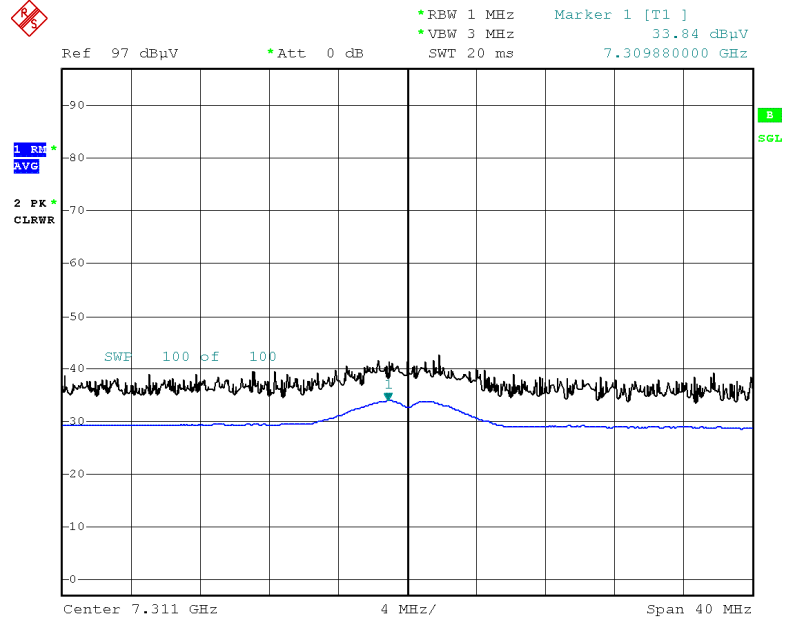
[Worst case]

- Worstcase : 802.11b



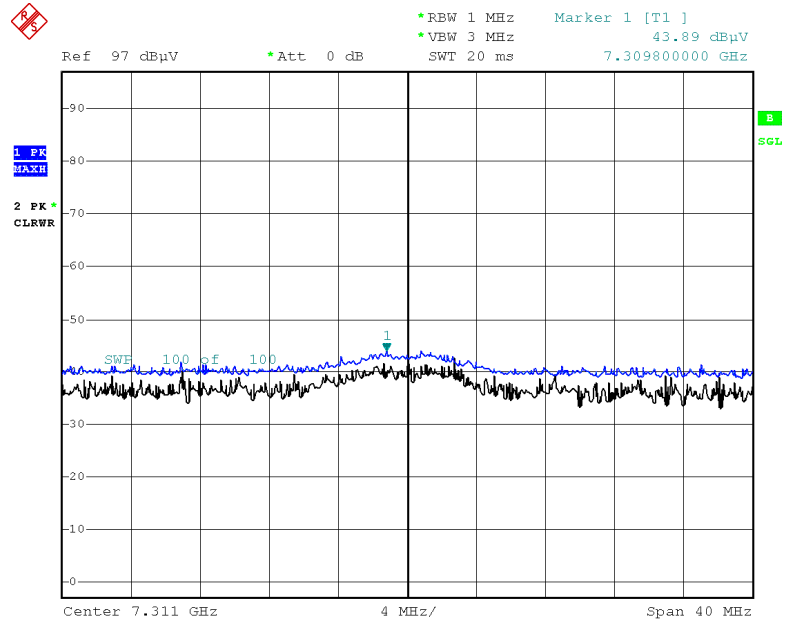
Test Plots (Worst case : Y-V)

Radiated Spurious Emissions plot – Average Measured Level (802.11b, Ch.06 3rd Harmonic)



Date: 23.NOV.2022 11:46:42

Radiated Spurious Emissions plot – Peak Measured Level (802.11b, Ch.06 3rd Harmonic)



Date: 23.NOV.2022 11:47:05

Note:

Plot of worst case are only reported.

9.7 RADIATED RESTRICTED BAND EDGES

Operation Mode: 802.11b
 Transfer Rate: 1 Mbps
 Operating Frequency: 2 412 MHz, 2 462 MHz
 Channel No. 01 Ch, 11 Ch

Frequency	Measured Level	AF+CL+DF	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV/m]	[dB]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
2310.0~2390.0	19.03	34.90	H	53.92	73.98	20.06	PK
2310.0~2390.0	1.71	34.90	H	36.61	53.98	17.37	AV
2310.0~2390.0	19.15	34.90	V	54.05	73.98	19.93	PK
2310.0~2390.0	1.77	34.90	V	36.67	53.98	17.31	AV
2483.5~2500.0	20.63	35.10	H	55.73	73.98	18.25	PK
2483.5~2500.0	8.35	35.10	H	43.45	53.98	10.53	AV
2483.5~2500.0	21.70	35.10	V	56.80	73.98	17.18	PK
2483.5~2500.0	8.36	35.10	V	43.46	53.98	10.52	AV

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

Frequency	Measured Level	Duty Cycle	AF+CL+DF	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV/m]	Factor [dB]	[dB]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
2310.0~2390.0	24.19	0.00	34.90	H	59.09	73.98	14.89	PK
2310.0~2390.0	5.69	0.33	34.90	H	40.92	53.98	13.06	AV
2310.0~2390.0	24.22	0.00	34.90	V	59.12	73.98	14.86	PK
2310.0~2390.0	5.78	0.33	34.90	V	41.00	53.98	12.98	AV
2483.5~2500.0	24.32	0.00	35.10	H	59.42	73.98	14.56	PK
2483.5~2500.0	12.69	0.33	35.10	H	48.12	53.98	5.86	AV
2483.5~2500.0	24.52	0.00	35.10	V	59.62	73.98	14.36	PK
2483.5~2500.0	12.74	0.33	35.10	V	48.17	53.98	5.81	AV



Operation Mode:	802.11n (HT20)
Transfer Rate:	MCS0
Operating Frequency	2 412 MHz, 2 462 MHz
Channel No.	01 Ch, 11 Ch

Frequency	Measured Level	Duty Cycle	AF+CL+DF	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV/m]	Factor [dB]	[dB]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
2310.0~2390.0	31.58	0.00	34.90	H	66.47	73.98	7.51	PK
2310.0~2390.0	5.39	0.35	34.90	H	40.64	53.98	13.34	AV
2310.0~2390.0	31.86	0.00	34.90	V	66.76	73.98	7.22	PK
2310.0~2390.0	5.44	0.35	34.90	V	40.69	53.98	13.29	AV
2483.5~2500.0	29.11	0.00	35.10	H	64.21	73.98	9.77	PK
2483.5~2500.0	13.42	0.35	35.10	H	48.87	53.98	5.11	AV
2483.5~2500.0	29.21	0.00	35.10	V	64.30	73.98	9.68	PK
2483.5~2500.0	13.52	0.35	35.10	V	48.97	53.98	5.01	AV

▣ Test Plots

Radiated Restricted Band Edges plot – Average Measured Level (802.11n (HT20), Ch.11, Y-V)



Radiated Restricted Band Edges plot – Peak Measured Level (802.11n (HT20), Ch.11, Y-V)



Note:

Plot of worst case are only reported.

9.8 RECEIVER SPURIOUS EMISSIONS

Frequency Range : Below 1 GHz

Frequency	Measured Level	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:

- 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

Frequency	Measured Level	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

9.9 POWERLINE CONDUCTED EMISSIONS

[12V]

Conducted Emissions (Line 1)

Test

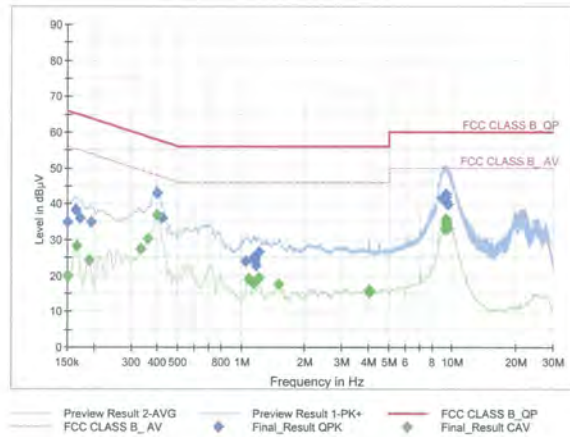
1 / 2

Test Report

Common Information

EUT : LAMWBD1
 Operating Conditions : 2.4G WLAN Mode_L1
 Comment :

Full Spectrum



Final Result QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	35.00	66.00	31.00	1000.0	9.000	L1	OFF	9.7
0.1635	38.46	65.28	26.82	1000.0	9.000	L1	OFF	9.7
0.1725	35.91	64.84	28.93	1000.0	9.000	L1	OFF	9.7
0.1950	35.02	63.82	28.80	1000.0	9.000	L1	OFF	9.7
0.3975	43.12	57.91	14.78	1000.0	9.000	L1	OFF	9.7
0.4223	35.99	57.40	21.42	1000.0	9.000	L1	OFF	9.7
1.0445	23.95	56.00	32.05	1000.0	9.000	L1	OFF	9.7
1.1480	25.15	56.00	30.85	1000.0	9.000	L1	OFF	9.7
1.1593	24.89	56.00	31.11	1000.0	9.000	L1	OFF	9.7
1.1683	23.85	56.00	32.15	1000.0	9.000	L1	OFF	9.7
1.1773	22.82	56.00	33.18	1000.0	9.000	L1	OFF	9.7
1.2178	26.44	56.00	29.56	1000.0	9.000	L1	OFF	9.7
9.0478	41.63	60.00	18.37	1000.0	9.000	L1	OFF	10.0
9.2300	41.82	60.00	18.18	1000.0	9.000	L1	OFF	10.0
9.2773	40.69	60.00	19.31	1000.0	9.000	L1	OFF	10.0
9.2953	41.79	60.00	18.21	1000.0	9.000	L1	OFF	10.0
9.3268	42.61	60.00	17.39	1000.0	9.000	L1	OFF	10.0
9.5518	39.78	60.00	20.22	1000.0	9.000	L1	OFF	10.0

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오후 4:07:01



Test

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Final Result CAV

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	19.91	56.00	36.09	1000.0	9.000	L1	OFF	9.7
0.1658	28.35	55.17	26.82	1000.0	9.000	L1	OFF	9.7
0.1905	24.27	54.02	29.74	1000.0	9.000	L1	OFF	9.7
0.3323	27.28	49.40	22.11	1000.0	9.000	L1	OFF	9.7
0.3593	30.38	48.75	18.37	1000.0	9.000	L1	OFF	9.7
0.3998	36.85	47.86	11.01	1000.0	9.000	L1	OFF	9.7
1.0805	19.18	46.00	26.82	1000.0	9.000	L1	OFF	9.7
1.1525	17.98	46.00	28.02	1000.0	9.000	L1	OFF	9.7
1.2133	19.38	46.00	26.62	1000.0	9.000	L1	OFF	9.7
1.5125	17.52	46.00	28.48	1000.0	9.000	L1	OFF	9.7
4.0303	15.77	46.00	30.23	1000.0	9.000	L1	OFF	9.8
4.0370	15.30	46.00	30.70	1000.0	9.000	L1	OFF	9.8
9.2300	32.78	50.00	17.22	1000.0	9.000	L1	OFF	10.0
9.2773	35.81	50.00	14.19	1000.0	9.000	L1	OFF	10.0
9.2930	34.58	50.00	15.42	1000.0	9.000	L1	OFF	10.0
9.3268	34.17	50.00	15.83	1000.0	9.000	L1	OFF	10.0
9.3538	35.29	50.00	14.71	1000.0	9.000	L1	OFF	10.0
9.5540	33.30	50.00	16.70	1000.0	9.000	L1	OFF	10.0

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오후 4:07:01

Conducted Emissions (Line 2)

Test

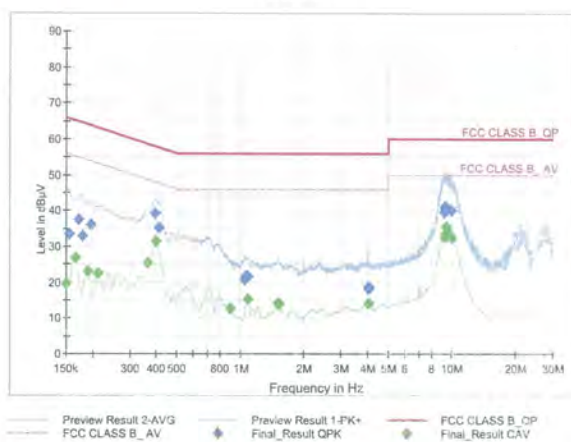
1 / 2

Test Report

Common Information

EUT : LAMWBD1
 Operating Conditions : 2.4G WLAN Mode_N
 Comment :

Full Spectrum



Final Result QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	33.53	65.75	32.22	1000.0	9.000	N	OFF	9.6
0.1725	37.61	64.84	27.23	1000.0	9.000	N	OFF	9.6
0.1793	33.01	64.52	31.51	1000.0	9.000	N	OFF	9.6
0.1973	35.94	63.73	27.78	1000.0	9.000	N	OFF	9.6
0.3930	39.14	58.00	18.86	1000.0	9.000	N	OFF	9.6
0.4133	35.25	57.58	22.33	1000.0	9.000	N	OFF	9.6
1.0535	20.68	56.00	35.32	1000.0	9.000	N	OFF	9.7
1.0580	21.73	56.00	34.27	1000.0	9.000	N	OFF	9.7
1.0648	21.48	56.00	34.52	1000.0	9.000	N	OFF	9.7
1.0873	21.68	56.00	34.32	1000.0	9.000	N	OFF	9.7
4.0280	18.17	56.00	37.83	1000.0	9.000	N	OFF	9.8
4.0370	18.80	56.00	37.20	1000.0	9.000	N	OFF	9.8
9.2480	39.66	60.00	20.34	1000.0	9.000	N	OFF	10.0
9.2615	41.32	60.00	18.68	1000.0	9.000	N	OFF	10.0
9.2908	40.41	60.00	19.59	1000.0	9.000	N	OFF	10.0
9.3155	40.90	60.00	19.10	1000.0	9.000	N	OFF	10.0
9.3245	39.80	60.00	20.20	1000.0	9.000	N	OFF	10.0
9.9433	40.04	60.00	19.96	1000.0	9.000	N	OFF	10.1

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오후 4:00:23



Test

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Final Result CAV

Frequency (MHz)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	19.53	56.00	36.47	1000.0	9.000	N	OFF	9.6
0.1658	26.88	55.17	28.29	1000.0	9.000	N	OFF	9.6
0.1905	23.08	54.02	30.94	1000.0	9.000	N	OFF	9.6
0.2130	22.39	53.09	30.69	1000.0	9.000	N	OFF	9.6
0.3638	25.47	48.64	23.17	1000.0	9.000	N	OFF	9.6
0.3998	31.57	47.86	16.29	1000.0	9.000	N	OFF	9.6
0.8960	12.77	46.00	33.23	1000.0	9.000	N	OFF	9.7
1.0805	15.17	46.00	30.83	1000.0	9.000	N	OFF	9.7
1.5103	14.21	46.00	31.79	1000.0	9.000	N	OFF	9.7
1.5193	14.01	46.00	31.99	1000.0	9.000	N	OFF	9.7
1.5283	13.85	46.00	32.15	1000.0	9.000	N	OFF	9.7
4.0370	14.02	46.00	31.98	1000.0	9.000	N	OFF	9.8
9.3110	32.71	50.00	17.29	1000.0	9.000	N	OFF	10.0
9.3290	33.55	50.00	16.45	1000.0	9.000	N	OFF	10.0
9.4280	35.51	50.00	14.49	1000.0	9.000	N	OFF	10.1
9.6238	33.16	50.00	16.84	1000.0	9.000	N	OFF	10.1
9.6890	33.50	50.00	16.50	1000.0	9.000	N	OFF	10.1
10.0063	32.30	50.00	17.70	1000.0	9.000	N	OFF	10.1

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오후 4:00:23

[19V]

Conducted Emissions (Line 1)

Test

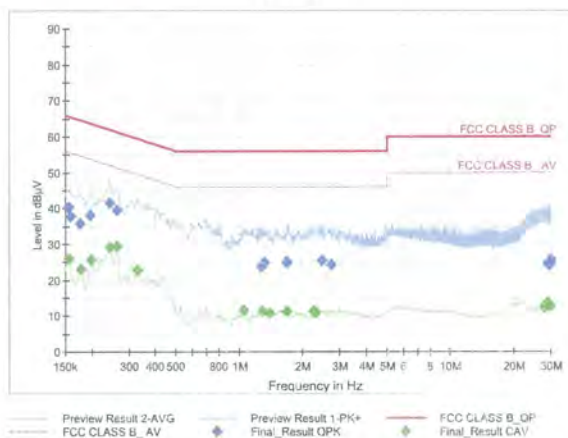
1 / 2

Test Report

Common Information

EUT : LAMWBD1
 Operating Conditions : 2.4G WLAN Mode_L1
 Comment :

Full Spectrum



Final Result QPK

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	40.29	65.75	25.47	1000.0	9.000	L1	OFF	9.6
0.1590	37.92	65.52	27.59	1000.0	9.000	L1	OFF	9.6
0.1748	35.73	64.73	29.00	1000.0	9.000	L1	OFF	9.6
0.1973	38.06	63.73	25.67	1000.0	9.000	L1	OFF	9.6
0.2423	41.48	62.02	20.54	1000.0	9.000	L1	OFF	9.6
0.2625	39.63	61.35	21.72	1000.0	9.000	L1	OFF	9.6
1.2650	23.71	56.00	32.29	1000.0	9.000	L1	OFF	9.6
1.3123	24.86	56.00	31.14	1000.0	9.000	L1	OFF	9.6
1.6858	24.91	56.00	31.09	1000.0	9.000	L1	OFF	9.7
1.6925	24.99	56.00	31.01	1000.0	9.000	L1	OFF	9.7
2.4598	25.31	56.00	30.69	1000.0	9.000	L1	OFF	9.7
2.7365	24.24	56.00	31.76	1000.0	9.000	L1	OFF	9.7
28.9310	24.44	60.00	35.56	1000.0	9.000	L1	OFF	9.9
29.1943	25.07	60.00	34.93	1000.0	9.000	L1	OFF	9.9
29.4575	24.69	60.00	35.31	1000.0	9.000	L1	OFF	9.9
29.5880	24.49	60.00	35.51	1000.0	9.000	L1	OFF	9.9
29.7208	24.24	60.00	35.76	1000.0	9.000	L1	OFF	9.9
29.8513	25.59	60.00	34.41	1000.0	9.000	L1	OFF	9.9

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오전 8:53:40



Test

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Final Result CAV

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	26.09	55.75	29.66	1000.0	9.000	L1	OFF	9.6
0.1770	23.09	54.63	31.54	1000.0	9.000	L1	OFF	9.6
0.1995	25.60	53.63	28.04	1000.0	9.000	L1	OFF	9.6
0.2423	29.07	52.02	22.95	1000.0	9.000	L1	OFF	9.6
0.2625	29.28	51.35	22.07	1000.0	9.000	L1	OFF	9.6
0.3300	22.90	49.45	26.56	1000.0	9.000	L1	OFF	9.6
1.0513	11.68	46.00	34.32	1000.0	9.000	L1	OFF	9.6
1.2853	11.22	46.00	34.78	1000.0	9.000	L1	OFF	9.6
1.3865	10.77	46.00	35.23	1000.0	9.000	L1	OFF	9.7
1.6835	11.28	46.00	34.72	1000.0	9.000	L1	OFF	9.7
2.2685	11.24	46.00	34.76	1000.0	9.000	L1	OFF	9.7
2.2955	10.88	46.00	35.12	1000.0	9.000	L1	OFF	9.7
27.8668	12.53	50.00	37.47	1000.0	9.000	L1	OFF	9.9
28.2740	12.76	50.00	37.24	1000.0	9.000	L1	OFF	9.9
28.9040	12.98	50.00	37.02	1000.0	9.000	L1	OFF	9.9
28.9310	13.06	50.00	36.94	1000.0	9.000	L1	OFF	9.9
29.0638	13.49	50.00	36.51	1000.0	9.000	L1	OFF	9.9
29.5880	12.62	50.00	37.38	1000.0	9.000	L1	OFF	9.9

2022-12-07

오전 8:53:40

Conducted Emissions (Line 2)

Test

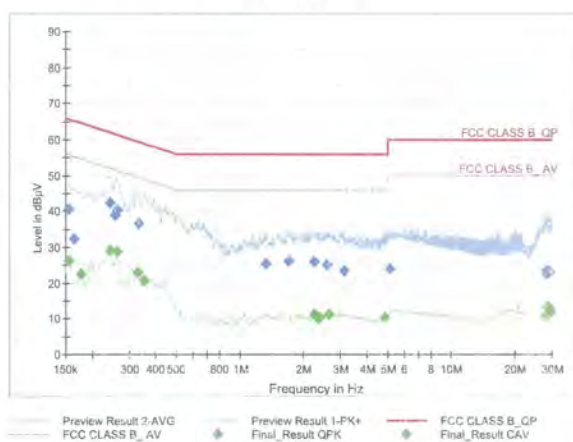
1 / 2

Test Report

Common Information

EUT : LAMWBD1
 Operating Conditions : 2.4G WLAN Mode_N
 Comment :

Full Spectrum



Final Result QPK

Frequency (MHz)	QuasiPeak (µV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	40.75	65.75	25.00	1000.0	9.000	N	OFF	9.5
0.1635	32.44	65.28	32.85	1000.0	9.000	N	OFF	9.5
0.2423	42.50	62.02	19.51	1000.0	9.000	N	OFF	9.6
0.2580	38.90	61.50	22.59	1000.0	9.000	N	OFF	9.6
0.2625	40.34	61.35	21.01	1000.0	9.000	N	OFF	9.6
0.3323	36.76	59.40	22.64	1000.0	9.000	N	OFF	9.6
1.3325	25.36	56.00	30.64	1000.0	9.000	N	OFF	9.6
1.6970	26.23	56.00	29.77	1000.0	9.000	N	OFF	9.6
2.2663	26.07	56.00	29.93	1000.0	9.000	N	OFF	9.7
2.5925	24.99	56.00	31.01	1000.0	9.000	N	OFF	9.7
3.1325	23.38	56.00	32.62	1000.0	9.000	N	OFF	9.7
5.1013	23.98	60.00	36.02	1000.0	9.000	N	OFF	9.7
27.9118	22.57	60.00	37.43	1000.0	9.000	N	OFF	9.9
28.1750	23.26	60.00	36.74	1000.0	9.000	N	OFF	9.9
28.4405	22.99	60.00	37.01	1000.0	9.000	N	OFF	9.9
28.5733	23.03	60.00	36.97	1000.0	9.000	N	OFF	9.9
28.9693	23.08	60.00	36.92	1000.0	9.000	N	OFF	9.9
29.1020	23.42	60.00	36.58	1000.0	9.000	N	OFF	9.9

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Final Result CAV

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	26.28	55.75	29.47	1000.0	9.000	N	OFF	9.5
0.1770	22.56	54.63	32.07	1000.0	9.000	N	OFF	9.6
0.2423	29.09	52.02	22.93	1000.0	9.000	N	OFF	9.6
0.2625	28.71	51.35	22.64	1000.0	9.000	N	OFF	9.6
0.3300	23.10	49.45	26.35	1000.0	9.000	N	OFF	9.6
0.3525	20.84	48.90	28.06	1000.0	9.000	N	OFF	9.6
2.2640	11.33	46.00	34.67	1000.0	9.000	N	OFF	9.7
2.2933	11.04	46.00	34.96	1000.0	9.000	N	OFF	9.7
2.3608	10.01	46.00	35.99	1000.0	9.000	N	OFF	9.7
2.3765	10.45	46.00	35.55	1000.0	9.000	N	OFF	9.7
2.6375	11.23	46.00	34.77	1000.0	9.000	N	OFF	9.7
4.8538	10.47	46.00	35.53	1000.0	9.000	N	OFF	9.7
28.0445	10.88	50.00	39.12	1000.0	9.000	N	OFF	9.9
28.7038	11.44	50.00	38.56	1000.0	9.000	N	OFF	9.9
28.7308	13.39	50.00	36.61	1000.0	9.000	N	OFF	9.9
28.8388	13.17	50.00	36.83	1000.0	9.000	N	OFF	9.9
28.9715	11.85	50.00	38.15	1000.0	9.000	N	OFF	9.9
29.6308	12.20	50.00	37.80	1000.0	9.000	N	OFF	9.9

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10. LIST OF TEST EQUIPMENT

Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	08/22/2023	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	06/07/2023	Annual
Temperature Chamber	SU-642	ESPEC	0093008124	03/04/2023	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	09/06/2023	Annual
Power Meter	N1911A	Agilent	MY45100523	03/24/2023	Annual
Power Sensor	N1921A	Agilent	MY57820067	03/24/2023	Annual
Directional Coupler	87300B	Agilent	3116A03621	11/02/2023	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)	8493C-010	Agilent	08285	06/21/2023	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	08/16/2024	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	06/13/2023	Annual
Band Reject Filter	WRCJV12-4900-5100- 5900-6100-50SS	Wainwright Instruments	6	06/13/2023	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 CERNEX	N/A	12/05/2023	Annual
ATT(10 dB) + LNA1(0.1~18 GHz)	56-10, CBLU1183540B-01	Api tech, CERNEX	N/A	12/05/2023	Annual
High Pass Filter	WHKX10-2700-3000- 18000-40SS	Wainwright Instruments	N/A	12/05/2023	Annual
High Pass Filter	WHKX8-6090-7000- 18000-40SS	Wainwright Instruments	N/A	12/05/2023	Annual
Thru	COAXIAL ATTENUATOR	T&M SYSTEM	N/A	12/05/2023	Annual
Power Amplifier	CBL18265035	CERNEX	22966	12/01/2023	Annual
Power Amplifier	CBL26405040	CERNEX	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	09/06/2023	Annual
Spectrum Analyzer	FSV40-N(9 kHz ~ 30 GHz)	Rohde & Schwarz	101068-SZ	09/07/2023	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.
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-2212-FI004-P