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HCT

TEST REPORT

FCC/ISED DTS Test for LAIWB4
Certification

APPLICANT
LG Electronics Inc.

REPORT NO.
HCT-RF-2308-FI005

DATE OF ISSUE
August 17, 2023

Tested by
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Technical Manager
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Accredited by KOLAS, Republic of KOREA

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<h1>TEST REPORT</h1> <p>FCC/ISED DTS Test for LAIWB4</p>	REPORT NO. HCT-RF-2308-FI005
	DATE OF ISSUE August 17, 2023
	Additional Model -

Applicant

LG Electronics Inc.

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

Eut Type	RF Module
Model Name	LAIWB4
FCC ID	BEJ-LAIWB4
IC	2703H-LAIWB4
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 3 (August 2023) 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.

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

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	August 17, 2023	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	LAIWB4		
Additional Model	-		
EUT Type	RF Module		
Power Supply	DC 5.0 V / 12.0 V		
Frequency Range	2 412 MHz – 2 462 MHz		
Max. RF Output Power	Peak Power	802.11b:	22.78 dBm
		802.11g:	24.04 dBm
		802.11n(HT20):	23.90 dBm
	Average Power	802.11b:	17.23 dBm
802.11g:		15.95 dBm	
802.11n(HT20):		15.86 dBm	
Modulation Type	DSSS/CCK : 802.11b OFDM : 802.11g, 802.11n		
Number of Channels	11 Channels		
Antenna Specification	WIFI Pattern Antenna Peak Gain : 2.60 dBi		
Date(s) of Tests	July 31, 2023 ~ August 16, 2023		
PMN (Product Marketing Number)	RF Module		
HVIN (Hardware Version Identification Number)	LAIWB4		
FVIN (Firmware Version Identification Number)	Rev 1.0		
HMN (Host Marketing Name)	N/A		
EUT serial numbers	DC 5.0 V	Radiated : D8:4F:B8:06:38:0A Conducted : D8:4F:B8:06:38:08	
	DC 12.0 V	Radiated : D8:4F:B8:06:AE:66 Conducted : D8:4F:B8:06:37:D6	

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 3.

GENERAL TEST PROCEDURES

Conducted Emissions

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

Radiated Emissions

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

DESCRIPTION OF TEST MODES

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

3. INSTRUMENT CALIBRATION

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

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

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil,

Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.

The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated March 31, 2022 (Registration Number: KR0032).

For ISED, test facility was accepted dated March 31, 2022 (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

According to RSS-GEN(Issue 5) Section 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

6. MEASUREMENT UNCERTAINTY

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

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

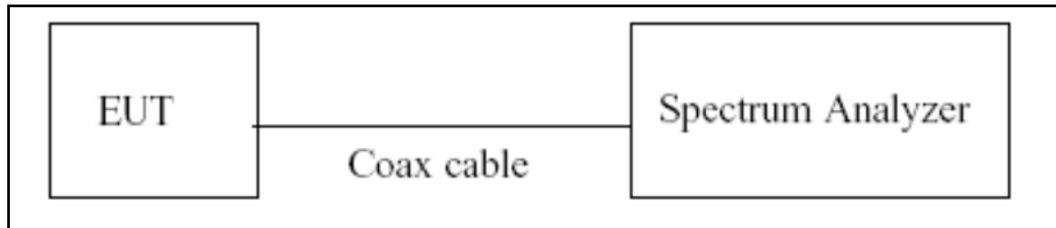
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

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

7. DESCRIPTION OF TESTS

7.1. Duty Cycle

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to the zero-span measurement method.

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

The zero-span method of measuring duty cycle shall not be used if $T \leq 6.25$ 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 $> 50/T$.

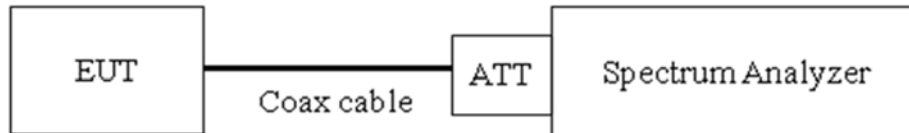
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (\geq RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/T_{total} and Duty Cycle Factor = $10\log(1/\text{Duty Cycle})$

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 (6dB & 99 % Bandwidth for ISED)

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to

- 1) RBW = 1% ~ 5% of the occupied bandwidth
- 2) VBW $\geq 3 \times$ RBW
- 3) Detector = Peak
- 4) Trace mode = max hold
- 5) Sweep = auto couple
- 6) Allow the trace to stabilize
- 7) We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

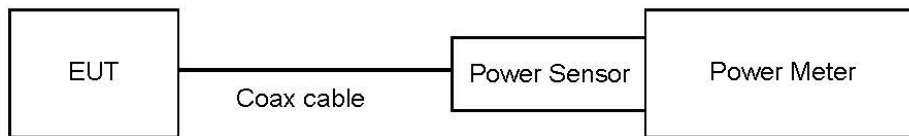
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

7.3. Output Power

Limit

The maximum permissible conducted output power is 1 Watt.

Test Configuration



Test Procedure

The transmitter output is connected to the Power Meter.

- Peak Power (Procedure 11.9.1.3 in ANSI 63.10-2013)
: Measure the peak power of the transmitter.

- Average Power (Procedure 11.9.2.3 in ANSI 63.10-2013)
 - 1) Measure the duty cycle.
 - 2) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
 - 3) Add $10 \log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Sample Calculation

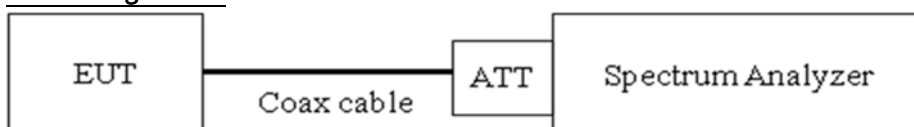
- Conducted Output Power(Peak) = Measured Value + ATT loss + Cable loss
- Conducted Output Power(Average) = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

7.4. Power Spectral Density

Limit

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

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

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

The spectrum analyzer is set to :

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

Sample Calculation

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

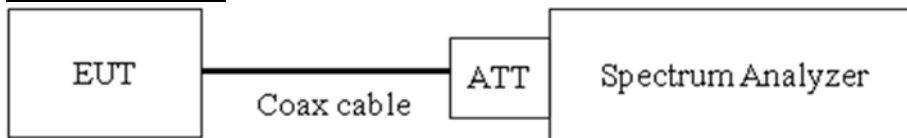
7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

Limit

The maximum conducted (Average) output power was used to demonstrate compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 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	10.05
100	10.1
200	10.14
300	10.19
400	10.25
500	10.25
600	10.26
700	10.27
800	10.28
900	10.3
1 000	10.35
2 000	10.50
2 400	10.60
2 500	10.60
3 000	10.64
4 000	10.72
5 000	10.79
5 700	10.80
5 800	10.87
6 000	10.88
7 000	11.01
8 000	11.01
9 000	11.09
10 000	11.19
11 000	11.28
12 000	11.37
13 000	11.38
14 000	11.41
15 000	11.51
16 000	11.59
17 000	11.80
18 000	11.93
19 000	11.85
20 000	11.52
21 000	11.65
22 000	11.64
23 000	11.65
24 000	11.66
25 000	11.76

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 ($\mu\text{V}/\text{m}$)	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

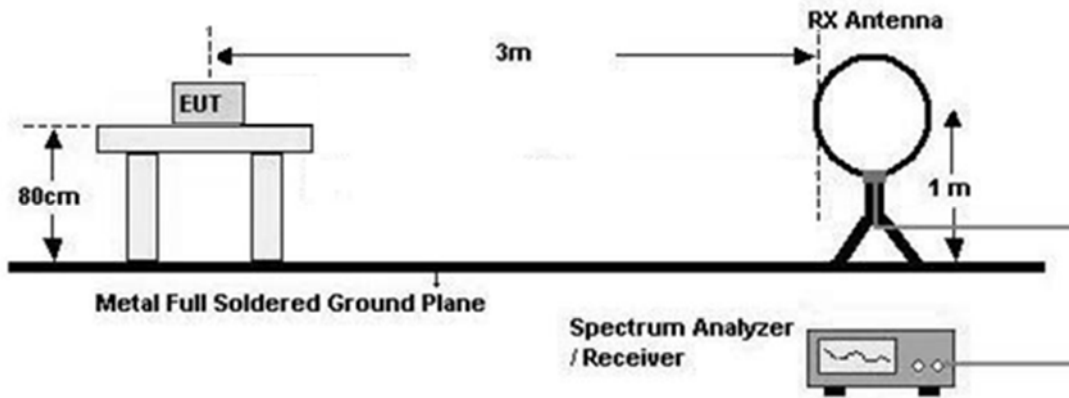
Frequency (MHz)	Field Strength ($\mu\text{A}/\text{m}$)	Measurement Distance (m)
0.009 – 0.490	6.37/F(kHz)	300
0.490 – 1.705	63.7/F(kHz)	30
1.705 – 30	0.08	30

FCC&ISED

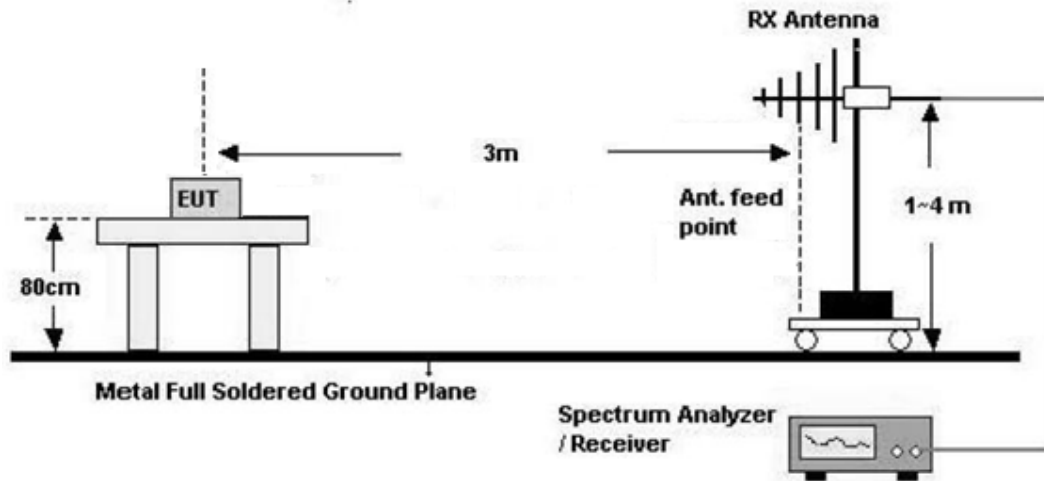
Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

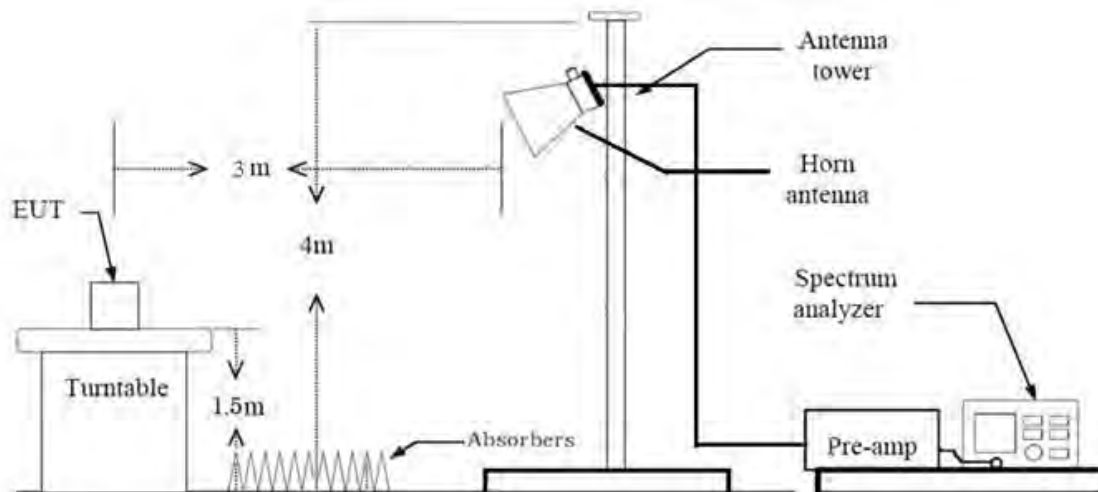
Below 30 MHz



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

that's already beyond the background noise floor.

KDB 414788 OFS and Chamber Correlation Justification

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

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

Test Procedure of Radiated spurious emissions (Below 1 GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8 m above ground plane.
3. The Hybrid antenna was placed at a location 3 m from the EUT, which is varied from 1 m to 4 m to find out the highest emissions.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.

6. Spectrum Setting

(1) Measurement Type(Peak):

- Measured Frequency Range : 30 MHz – 1 GHz
- Detector = Peak
- Trace = Maxhold
- RBW = 100 kHz
- VBW \geq 3 x RBW

(2) Measurement Type(Quasi-peak):

- Measured Frequency Range : 30 MHz – 1 GHz
- Detector = Quasi-Peak
- RBW = 120 kHz

In general, (1) is used mainly

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

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.

2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. 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 % duty cycle.

- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.
- 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.
- 9. Distance extrapolation factor = $20\log(\text{test distance} / \text{specific distance})$ (dB)
- 10. Total(Measurement Type : Peak)
 - = Measured value
 - Total(Measurement Type : Average, Duty cycle $\geq 98\%$)
 - = Measured value
 - Total(Measurement Type : Average, Duty cycle < 98 %)
 - = Measured value + Duty Cycle Factor
 - We apply to the offset in the range 1 GHz - 18 GHz.
 - The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

Test Procedure of Radiated Restricted Band Edge

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. 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.

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.

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

10. Total(Measurement Type : Peak)

= Measured value

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

= Measured value

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

= Measured value + Duty Cycle Factor

- We apply to the offset in the range 1 GHz - 18 GHz.

- The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

7.7. AC Power line Conducted Emissions

Limit

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN).

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

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

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

Test Configuration

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

Test Procedure

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

Sample Calculation

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

7.8. Receiver Spurious Emissions

Limit

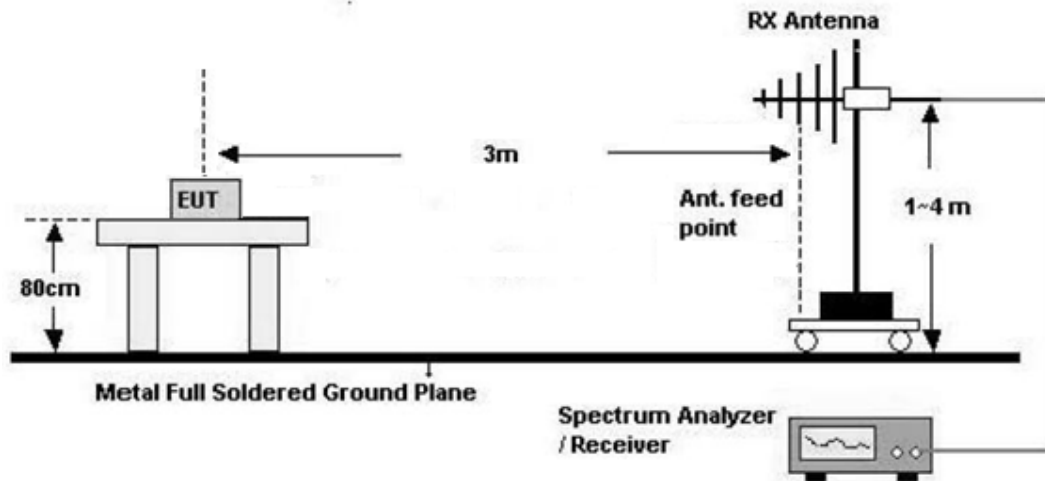
Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

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

Test Configuration

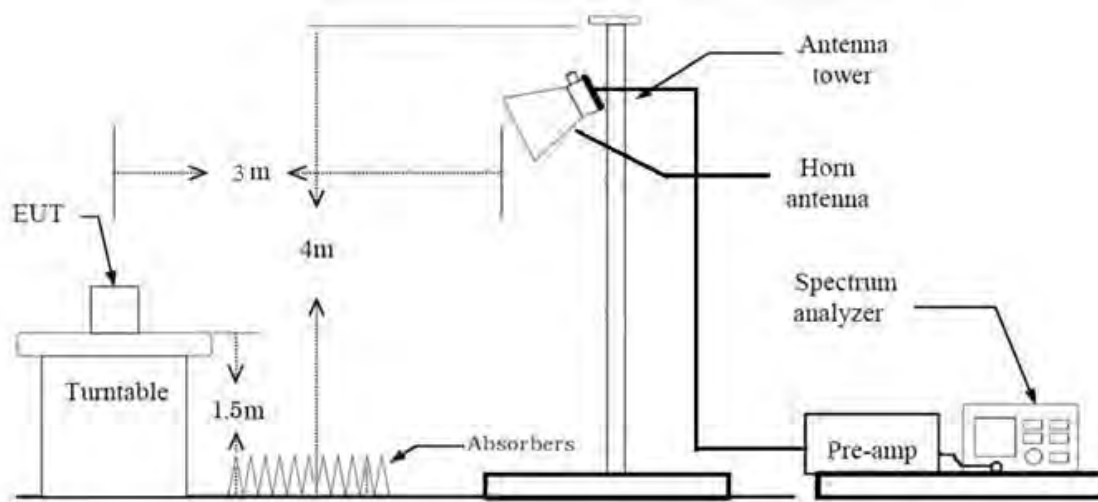
30 MHz - 1 GHz



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 Value + 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. 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 $\geq 1/\tau$ Hz, where τ = pulse width in seconds

The actual setting value of VBW = 1 kHz

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.

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

10. Total = Measured Value

- We apply to the offset in the range 1 GHz - 18 GHz.
- The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

7.9. 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(DC 5V), Stand alone(DC 12V)
2. EUT Axis
 - Radiated Spurious Emissions : Y
 - Radiated Restricted Band Edge : Y
3. All datarate of operation were investigated and the worst case datarate 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

Radiated test(DBS)

1. All modes of operation were investigated and the worst case configuration results are reported.
 - Mode : Stand alone(DC 5V), Stand alone(DC 12V)
2. EUT Axis
 - Radiated Spurious Emissions : Z
3. The following tables show the worst case configurations determined during testing.
 - Mode : Stand alone(DC 5V)

Description	Bluetooth Emission	2.4 GHz Emission
Antenna	WIFI/BT	WIFI/BT
Channel	39	6
Data Rate	1 Mbps	1 Mbps
Mode	GFSK : DH5	802.11b

- Mode : Stand alone(DC 12V)

Description	Bluetooth Emission	2.4 GHz Emission
Antenna	WIFI/BT	WIFI/BT
Channel	39	6
Data Rate	1 Mbps	1 Mbps
Mode	GFSK : 3-DH5	802.11b

AC Power line Conducted Emissions

1. All modes of operation were investigated and the worst case configuration results are reported.
 - Mode : Stand alone(DC 5V)+Notebook, Stand alone(DC 12V)+Notebook

Conducted test

1. The EUT was configured with data rate of highest power.
 - ALL Mode Test
2. All modes of operation were investigated and the worst case configuration results are reported.
 - Mode : Stand alone(DC 5V), Stand alone(DC 12V)
 - Worstcase : Stand alone(DC 12V)

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.(a)	> 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.(d)	< 1 Watt <4 Watt(e.i.r.p.)		PASS
Power Spectral Density	RSS-247, 5.2.(b)	< 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
Receiver Spurious Emissions	RSS-GEN, 5 RSS-GEN, 7.3	cf. Section 7.8	PASS	
Radiated Restricted Band Edge	RSS-GEN, 8.9 RSS-GEN, 8.10	cf. Section 7.6	PASS	

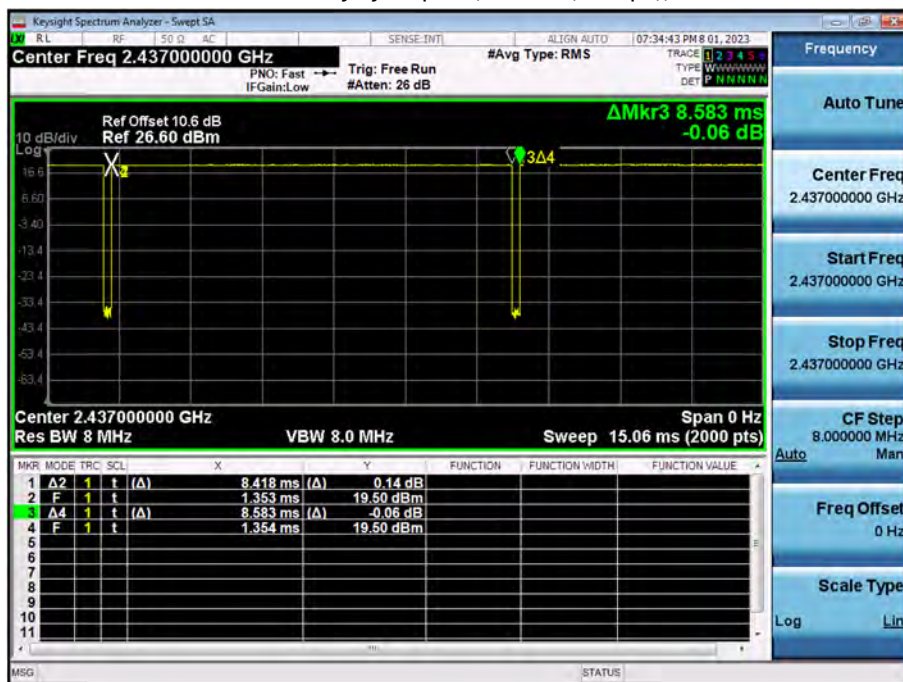
9. TEST RESULT

9.1 DUTY CYCLE

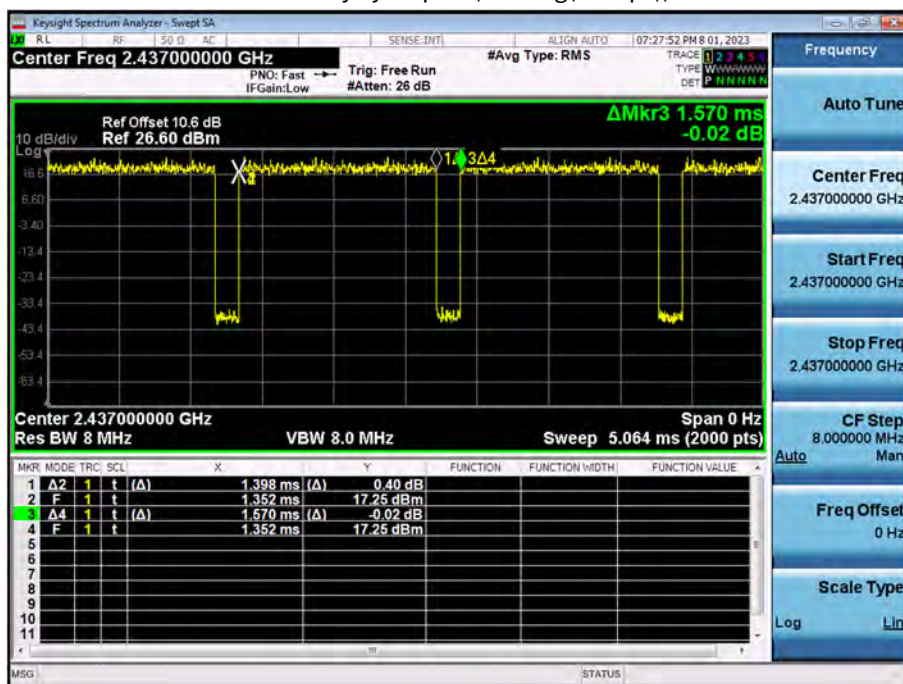
Mode	Data Rate	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11b	1 Mbps	8.418	8.583	0.981	0.084
	2 Mbps	4.303	4.471	0.962	0.167
	5.5 Mbps	1.686	1.919	0.879	0.561
	11 Mbps	0.939	1.169	0.804	0.950
802.11g	6 Mbps	1.398	1.570	0.890	0.504
	9 Mbps	0.940	1.110	0.847	0.723
	12 Mbps	0.707	0.899	0.787	1.042
	18 Mbps	0.480	0.651	0.738	1.321
	24 Mbps	0.364	0.535	0.681	1.670
	36 Mbps	0.252	0.423	0.596	2.247
	48 Mbps	0.192	0.364	0.529	2.769
	54 Mbps	0.176	0.347	0.506	2.956
802.11n (HT20)	MCS0	1.308	1.518	0.862	0.647
	MCS1	0.672	0.842	0.798	0.981
	MCS2	0.460	0.631	0.729	1.374
	MCS3	0.356	0.527	0.675	1.705
	MCS4	0.248	0.419	0.592	2.280
	MCS5	0.196	0.367	0.534	2.726
	MCS6	0.180	0.351	0.512	2.905
	MCS7	0.164	0.335	0.489	3.110

Test Plots

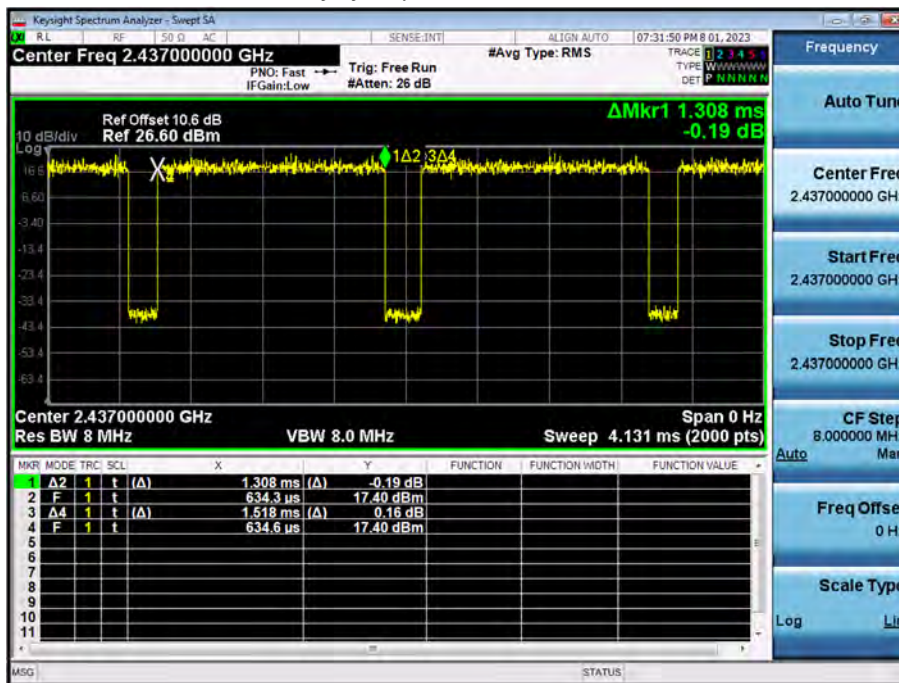
Duty cycle plot (802.11b(1 Mbps))



Duty cycle plot (802.11g(6 Mbps))



Duty cycle plot (802.11n(MCS0))



Note:

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

9.2 6dB BANDWIDTH & 99 % BANDWIDTH

FCC

Mode	Frequency [MHz]	Channel No.	Occupied Bandwidth [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]
802.11b	2412	1	13.493	9.089	> 0.5
	2437	6	13.537	9.092	> 0.5
	2462	11	13.594	9.102	> 0.5
802.11g	2412	1	16.486	16.38	> 0.5
	2437	6	16.493	16.38	> 0.5
	2462	11	16.487	16.38	> 0.5
802.11n(HT20)	2412	1	17.544	17.35	> 0.5
	2437	6	17.549	17.36	> 0.5
	2462	11	17.546	17.19	> 0.5

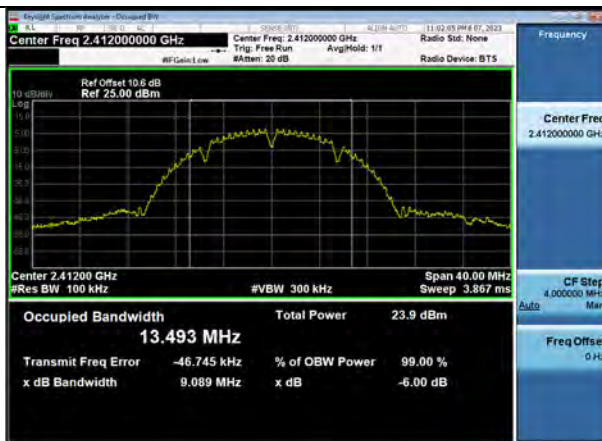
ISED

Mode	Frequency [MHz]	Channel No.	Occupied Bandwidth [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]
802.11b	2412	1	13.568	9.227	> 0.5
	2437	6	13.634	9.226	> 0.5
	2462	11	13.656	9.229	> 0.5
802.11g	2412	1	17.136	16.72	> 0.5
	2437	6	17.138	16.69	> 0.5
	2462	11	17.125	16.71	> 0.5
802.11n(HT20)	2412	1	17.774	17.56	> 0.5
	2437	6	17.786	17.57	> 0.5
	2462	11	17.772	17.58	> 0.5

▣ Test Plots(FCC)

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

6 dB Bandwidth plot (802.11b-CH 1)



6 dB Bandwidth plot (802.11g-CH 1)



6 dB Bandwidth plot (802.11n_HT20-CH 1)



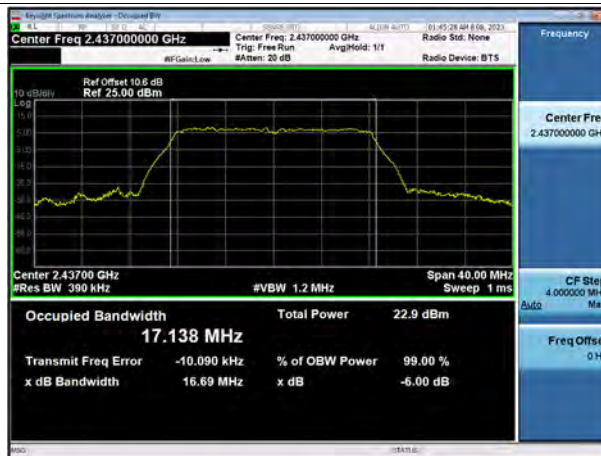
▣ Test Plots(ISED)

Note: In order to simplify the report, attached plots were only the widest channel.

99 % Bandwidth plot (802.11b-CH 11)



99 % Bandwidth plot (802.11g-CH 6)



99 % Bandwidth plot (802.11n_HT20-CH 6)



9.3 OUTPUT POWER

Peak Power

802.11b Mode		Rate (Mbps)	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	1	19.07	30
		2	19.31	30
		5.5	20.59	30
		11	22.06	30
2437	6	1	19.70	30
		2	19.92	30
		5.5	21.27	30
		11	22.78	30
2462	11	1	19.44	30
		2	19.68	30
		5.5	21.01	30
		11	22.49	30



802.11g Mode		Rate (Mbps)	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	6	22.21	30
		9	22.02	30
		12	21.67	30
		18	21.65	30
		24	22.00	30
		36	22.17	30
		48	21.78	30
		54	22.04	30
2437	6	6	24.04	30
		9	23.86	30
		12	23.55	30
		18	23.51	30
		24	23.84	30
		36	24.02	30
		48	23.67	30
		54	23.88	30
2462	11	6	21.72	30
		9	21.54	30
		12	21.27	30
		18	21.22	30
		24	21.57	30
		36	21.67	30
		48	21.43	30
		54	21.65	30

802.11n(HT20) Mode		MCS Index	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	0	21.01	30
		1	20.56	30
		2	20.60	30
		3	20.97	30
		4	20.94	30
		5	21.00	30
		6	20.97	30
		7	20.88	30
2437	6	0	23.90	30
		1	23.41	30
		2	23.46	30
		3	23.79	30
		4	23.84	30
		5	23.81	30
		6	23.78	30
		7	23.67	30
2462	11	0	21.71	30
		1	21.23	30
		2	21.26	30
		3	21.53	30
		4	21.57	30
		5	21.57	30
		6	21.51	30
		7	21.42	30



Average Power

802.11b Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	1	16.28	0.000	16.28	30
		2	16.10	0.167	16.26	30
		5.5	15.87	0.561	16.43	30
		11	15.50	0.950	16.45	30
2437	6	1	16.93	0.000	16.93	30
		2	16.77	0.167	16.94	30
		5.5	16.44	0.561	17.00	30
		11	16.28	0.950	17.23	30
2462	11	1	16.76	0.000	16.76	30
		2	16.50	0.167	16.66	30
		5.5	16.27	0.561	16.83	30
		11	15.96	0.950	16.91	30

802.11g Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	6	13.91	0.504	14.41	30
		9	13.43	0.723	14.15	30
		12	13.27	1.042	14.31	30
		18	12.96	1.321	14.28	30
		24	12.53	1.670	14.20	30
		36	11.90	2.247	14.15	30
		48	11.59	2.769	14.36	30
		54	11.38	2.956	14.34	30
2437	6	6	15.45	0.504	15.95	30
		9	15.12	0.723	15.85	30
		12	14.88	1.042	15.92	30
		18	14.56	1.321	15.88	30
		24	14.24	1.670	15.91	30
		36	13.50	2.247	15.75	30
		48	13.09	2.769	15.86	30
		54	12.95	2.956	15.91	30
2462	11	6	13.71	0.504	14.21	30
		9	13.37	0.723	14.09	30
		12	13.16	1.042	14.20	30
		18	12.75	1.321	14.07	30
		24	12.39	1.670	14.06	30
		36	11.81	2.247	14.06	30
		48	11.23	2.769	14.00	30
		54	11.08	2.956	14.04	30

802.11n(HT20) Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor (dB)	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	0	12.65	0.647	13.30	30
		1	12.06	0.981	13.04	30
		2	11.72	1.374	13.10	30
		3	11.55	1.705	13.25	30
		4	10.96	2.280	13.24	30
		5	10.56	2.726	13.28	30
		6	10.35	2.905	13.25	30
		7	10.16	3.110	13.27	30
2437	6	0	15.21	0.647	15.86	30
		1	14.68	0.981	15.66	30
		2	14.32	1.374	15.69	30
		3	14.08	1.705	15.79	30
		4	13.51	2.280	15.79	30
		5	13.11	2.726	15.84	30
		6	12.95	2.905	15.85	30
		7	12.68	3.110	15.79	30
2462	11	0	13.52	0.647	14.17	30
		1	12.99	0.981	13.97	30
		2	12.36	1.374	13.73	30
		3	12.16	1.705	13.87	30
		4	11.65	2.280	13.93	30
		5	11.17	2.726	13.90	30
		6	11.08	2.905	13.98	30
		7	11.01	3.110	14.12	30

9.4 POWER SPECTRAL DENSITY

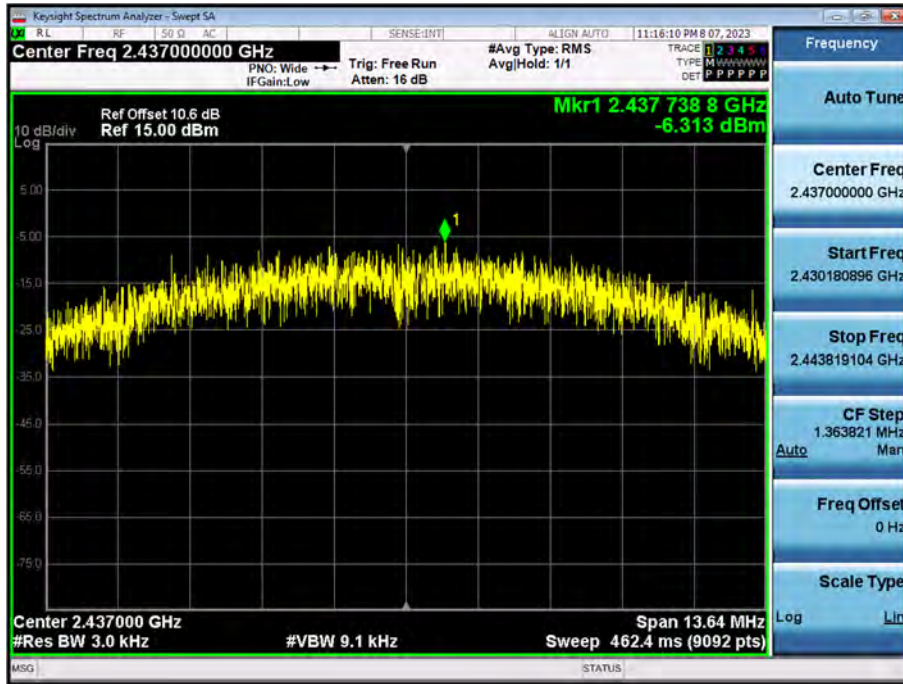
Mode	Frequency (MHz)	Channel No.	Test Result	
			Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)
802.11b	2412	1	-6.914	8
	2437	6	-6.313	
	2462	11	-6.586	
802.11g	2412	1	-13.659	
	2437	6	-11.726	
	2462	11	-13.985	
802.11n(HT20)	2412	1	-14.151	
	2437	6	-11.285	
	2462	11	-13.414	

Note :

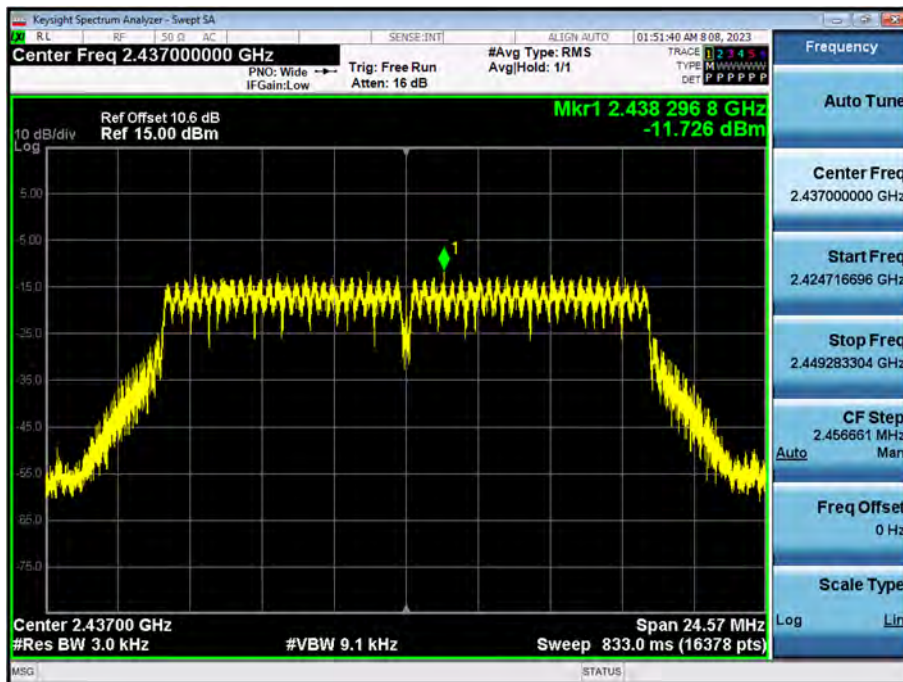
1. The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.

▣ Test Plots

Power Spectral Density (802.11b - Ch. 6)



Power Spectral Density (802.11g - Ch. 6)



Power Spectral Density (802.11n_HT20 – Ch. 6)



Note :

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



9.5 BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

Test Result : please refer to the plot below.

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

▣ Test Plots(BandEdge)

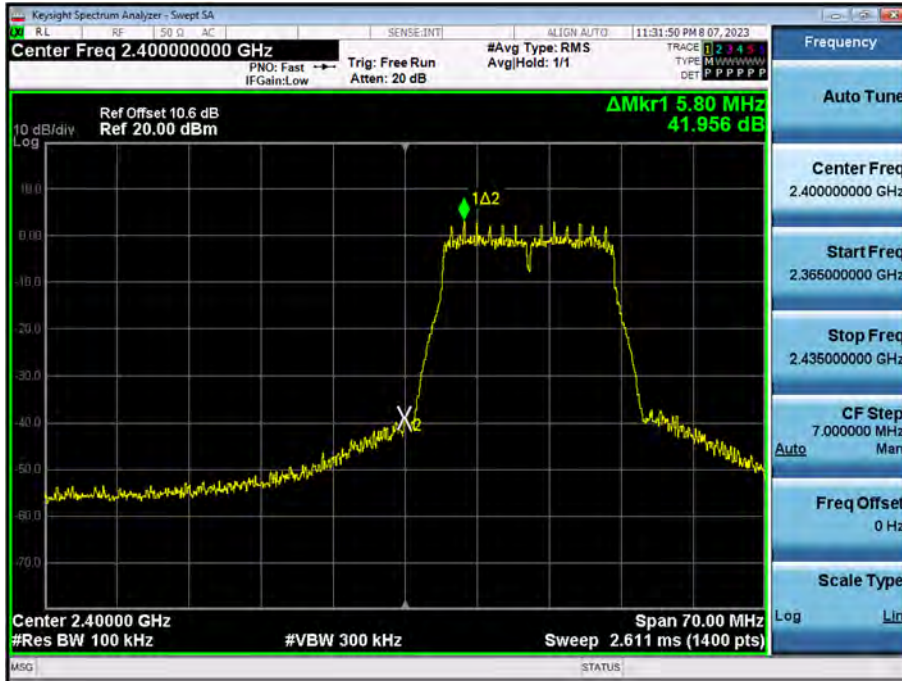
Band Edge (802.11b - Ch. 1)



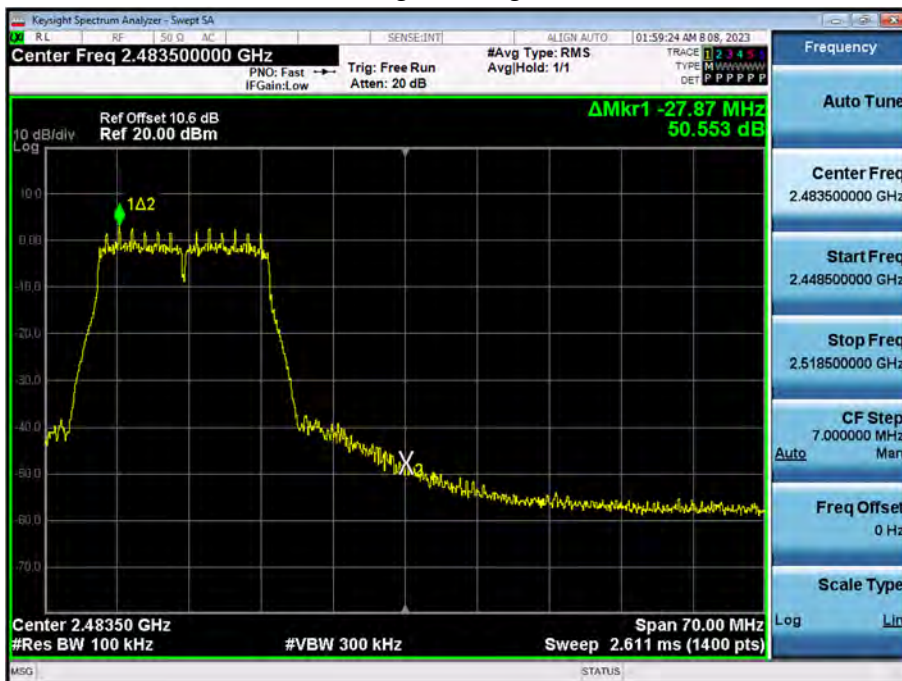
Band Edge (802.11b - Ch. 11)



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 Mode : 802.11g_Ch_6_6 Mbps

Limit : -17.38 dBm

Spurious Emission (30 MHz – 26 GHz)



9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

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

Note:

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

Frequency Range : Below 1 GHz

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

Note:

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

9.6.1 5V

Frequency Range : Above 1 GHz

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

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4824	48.94	V	48.94	73.98	25.04	PK
4824	41.22	V	41.22	53.98	12.76	AV
7236	51.09	V	51.09	73.98	22.89	PK
7236	39.21	V	39.21	53.98	14.77	AV
4824	49.32	H	49.32	73.98	24.66	PK
4824	41.27	H	41.27	53.98	12.71	AV
7236	51.51	H	51.51	73.98	22.47	PK
7236	39.34	H	39.34	53.98	14.64	AV

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

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4874	48.63	V	48.63	73.98	25.35	PK
4874	41.39	V	41.39	53.98	12.59	AV
7311	51.90	V	51.90	73.98	22.08	PK
7311	39.58	V	39.58	53.98	14.40	AV
4874	48.91	H	48.91	73.98	25.07	PK
4874	41.82	H	41.82	53.98	12.16	AV
7311	52.23	H	52.23	73.98	21.75	PK
7311	39.96	H	39.96	53.98	14.02	AV

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

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4924	49.21	V	49.21	73.98	24.77	PK
4924	42.16	V	42.16	53.98	11.82	AV
7386	51.34	V	51.34	73.98	22.64	PK
7386	40.21	V	40.21	53.98	13.77	AV
4924	49.26	H	49.26	73.98	24.72	PK
4924	42.70	H	42.70	53.98	11.28	AV
7386	51.99	H	51.99	73.98	21.99	PK
7386	40.32	H	40.32	53.98	13.66	AV

Note:

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

[Worst case]

- Worstcase : 802.11b

2. The offset was included in the Sigant Analyzer.

- The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

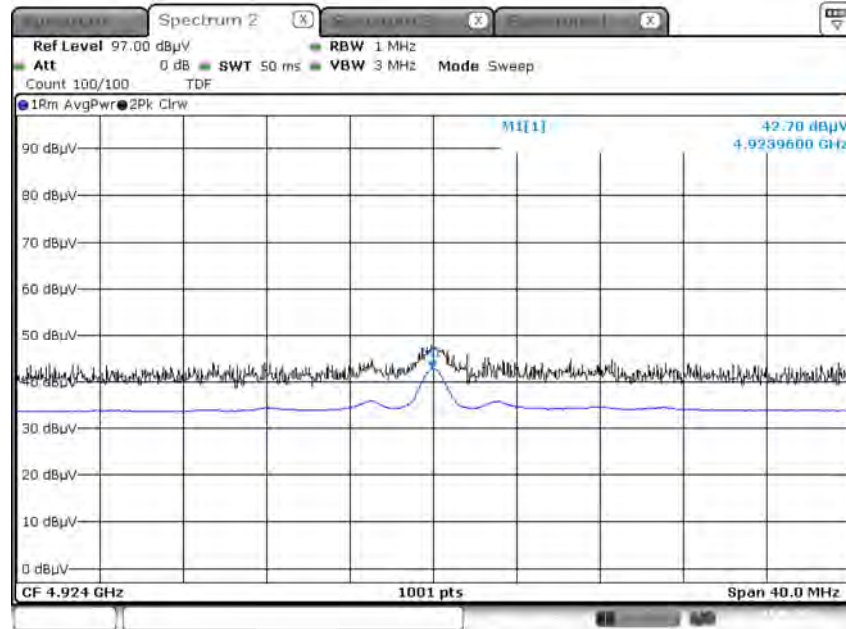
[DBS Mode]

BT GFSK Ch.39 & WLAN 2.4 GHz 802.11b 1 Mbps Ch.11

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4924	46.93	V	46.93	73.98	27.05	PK
4924	36.94	V	36.94	53.98	17.04	AV
7386	51.39	V	51.39	73.98	22.59	PK
7386	40.48	V	40.48	53.98	13.50	AV
4924	47.04	H	47.04	73.98	26.94	PK
4924	36.99	H	36.99	53.98	16.99	AV
7386	51.74	H	51.74	73.98	22.24	PK
7386	40.57	H	40.57	53.98	13.41	AV

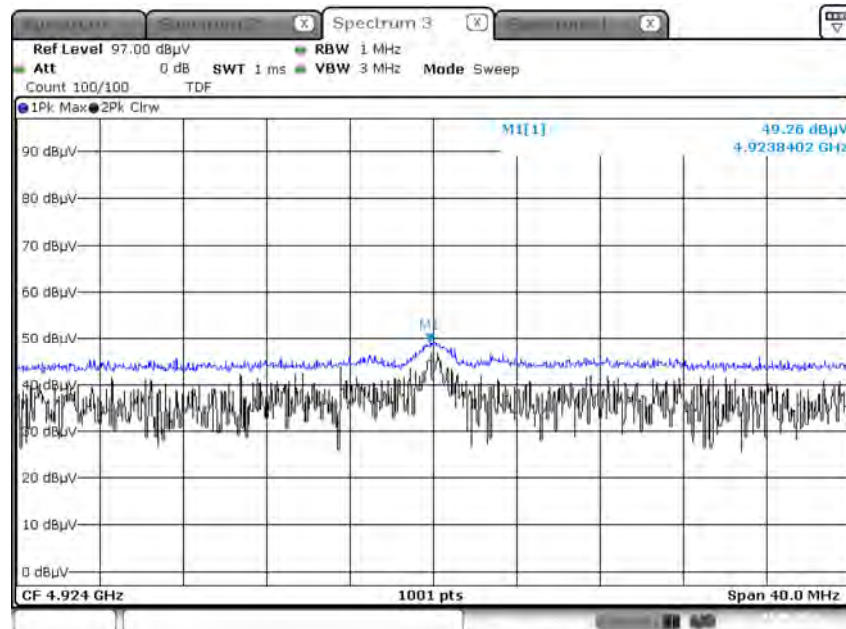
▣ Test Plots (Worst case : H)

Radiated Spurious Emissions plot – Average Result (802.11b, 1 Mbps, Ch.11 2nd Harmonic)



Date: 7 AUG 2023 16:42:59

Radiated Spurious Emissions plot – Peak Result (802.11b, 1 Mbps, Ch.11 2nd Harmonic)



Date: 7 AUG 2023 16:43:48

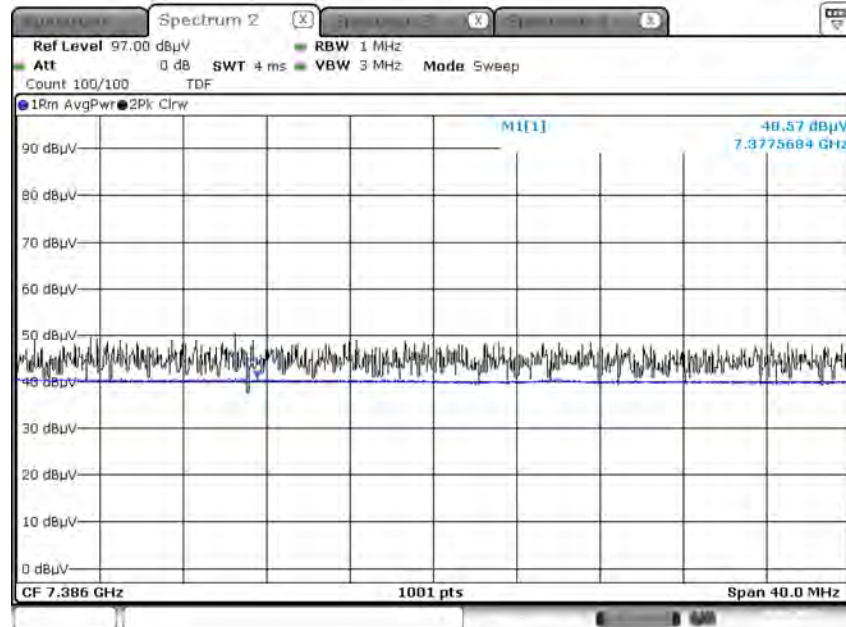
Note:

Plots of worst case were only reported.

[DBS Mode]

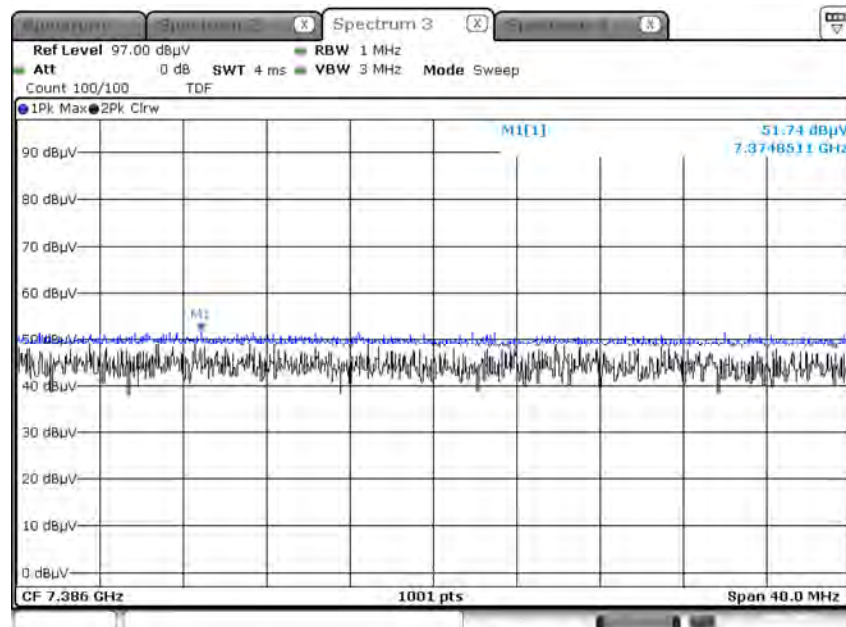
BT GFSK Ch.39 & WLAN 2.4 GHz 802.11b 1 Mbps Ch.11 (Worst case : H)

Radiated Spurious Emissions plot – Average Result (802.11b, 1 Mbps, Ch.11 3rd Harmonic)



Date: 16 AUG,2023 13:54:27

Radiated Spurious Emissions plot – Peak Result (802.11b, 1 Mbps, Ch.11 3rd Harmonic)



Date: 16 AUG,2023 13:54:45

Note:

Plot of worst case are only reported.

9.6.2 12V

Frequency Range : Above 1 GHz

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

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4824	49.28	V	49.28	73.98	24.70	PK
4824	43.91	V	43.91	53.98	10.07	AV
7236	50.76	V	50.76	73.98	23.22	PK
7236	39.13	V	39.13	53.98	14.85	AV
4824	49.88	H	49.88	73.98	24.10	PK
4824	44.08	H	44.08	53.98	9.90	AV
7236	51.47	H	51.47	73.98	22.51	PK
7236	39.26	H	39.26	53.98	14.72	AV

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

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4874	49.97	V	49.97	73.98	24.01	PK
4874	45.15	V	45.15	53.98	8.83	AV
7311	52.11	V	52.11	73.98	21.87	PK
7311	39.65	V	39.65	53.98	14.33	AV
4874	50.50	H	50.50	73.98	23.48	PK
4874	45.37	H	45.37	53.98	8.61	AV
7311	52.17	H	52.17	73.98	21.81	PK
7311	39.90	H	39.90	53.98	14.08	AV

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

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4924	40.45	V	40.45	73.98	33.53	PK
4924	45.39	V	45.39	53.98	8.59	AV
7386	51.82	V	51.82	73.98	22.16	PK
7386	40.08	V	40.08	53.98	13.90	AV
4924	50.76	H	50.76	73.98	23.22	PK
4924	45.42	H	45.42	53.98	8.56	AV
7386	52.18	H	52.18	73.98	21.80	PK
7386	40.14	H	40.14	53.98	13.84	AV

Note:

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

[Worst case]

- Worstcase : 802.11b

2. The offset was included in the Sigant Analyzer.

- The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

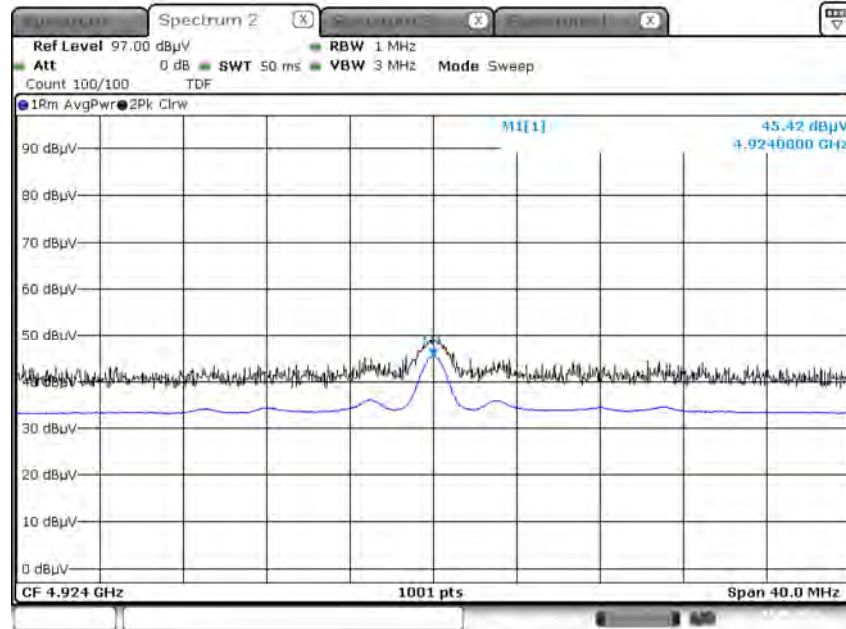
[DBS Mode]

BT 8DPSK Ch.39 & WLAN 2.4 GHz 802.11b 1 Mbps Ch.11

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
4924	46.89	V	46.89	73.98	27.09	PK
4924	36.11	V	36.11	53.98	17.87	AV
7386	52.49	V	52.49	73.98	21.49	PK
7386	40.69	V	40.69	53.98	13.29	AV
4924	47.41	H	47.41	73.98	26.57	PK
4924	36.24	H	36.24	53.98	17.74	AV
7386	52.56	H	52.56	73.98	21.42	PK
7386	40.81	H	40.81	53.98	13.17	AV

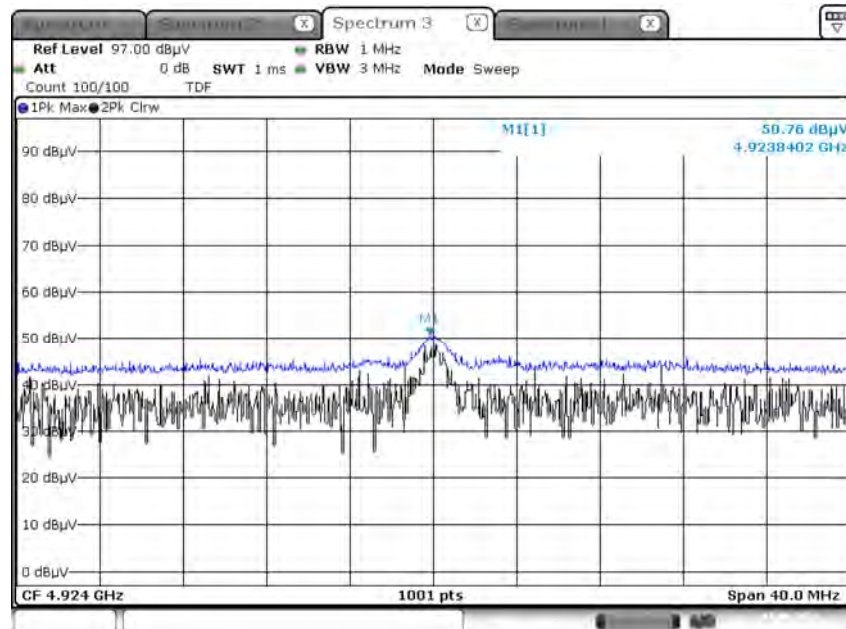
▣ Test Plots (Worst case : H)

Radiated Spurious Emissions plot – Average Result (802.11b, 1 Mbps, Ch.11 2nd Harmonic)



Date: 7 AUG 2023 13:57:20

Radiated Spurious Emissions plot – Peak Result (802.11b, 1 Mbps, Ch.11 2nd Harmonic)



Date: 7 AUG 2023 13:57:32

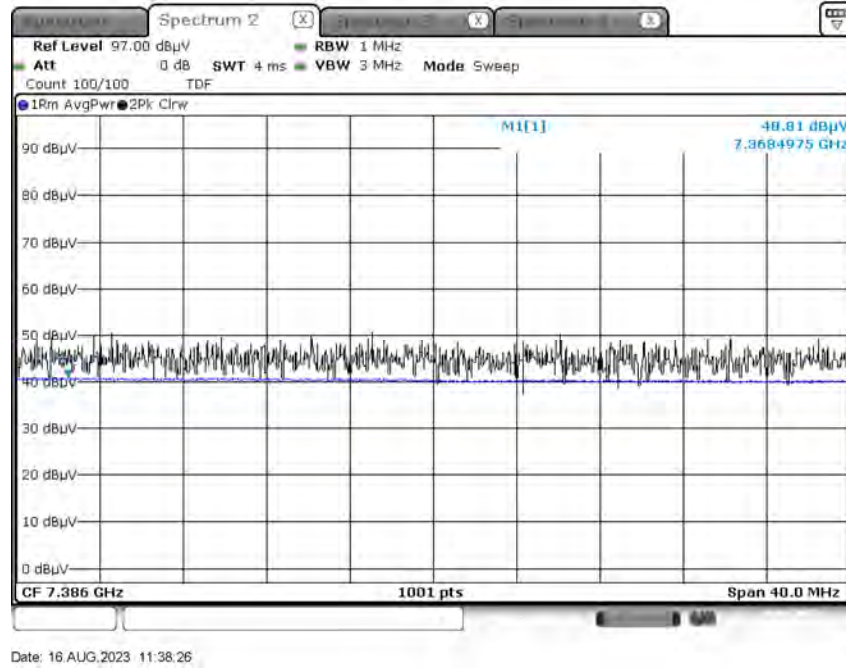
Note:

Plots of worst case were only reported.

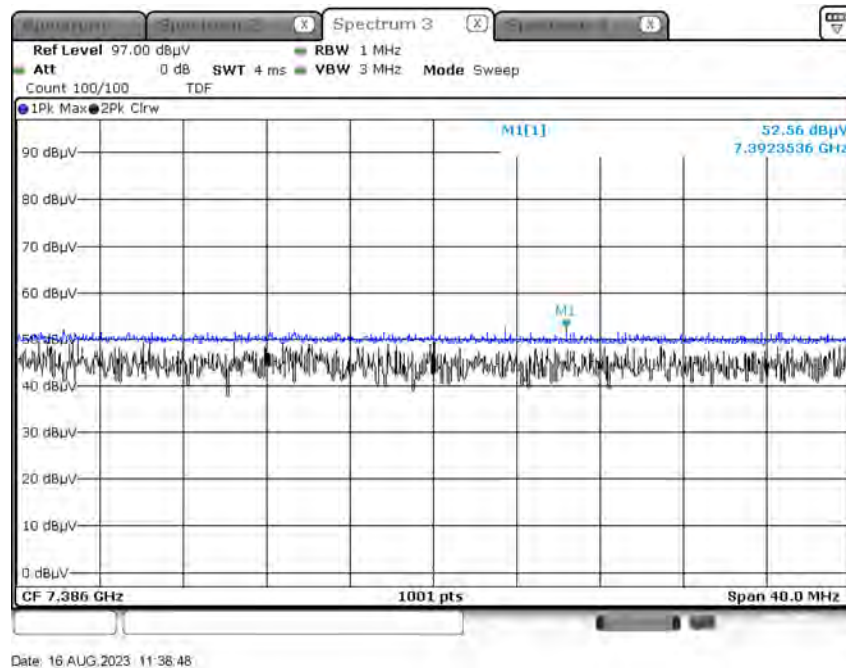
[DBS Mode]

BT 8DPSK Ch.39 & WLAN 2.4 GHz 802.11b 1 Mbps Ch.11 (Worst case : H)

Radiated Spurious Emissions plot – Average Result (802.11b, 1 Mbps, Ch.11 3rd Harmonic)



Radiated Spurious Emissions plot – Peak Result (802.11b, 1 Mbps, Ch.11 3rd Harmonic)



Note:

Plot of worst case are only reported.

9.7 RADIATED RESTRICTED BAND EDGES

9.7.1 5V

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

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
2310.0~2390.0	54.96	H	54.96	73.98	19.02	PK
2310.0~2390.0	44.54	H	44.54	53.98	9.44	AV
2310.0~2390.0	54.33	V	54.33	73.98	19.65	PK
2310.0~2390.0	44.09	V	44.09	53.98	9.89	AV
2483.5~2500.0	55.28	H	55.28	73.98	18.70	PK
2483.5~2500.0	43.83	H	43.83	53.98	10.15	AV
2483.5~2500.0	54.93	V	54.93	73.98	19.05	PK
2483.5~2500.0	48.59	V	48.59	53.98	5.39	AV

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

Frequency	Measured Value	Duty Cycle	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	Factor [dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
2310.0~2390.0	64.53	0.00	H	64.53	73.98	9.45	PK
#2310.0~2390.0	48.61	0.50	H	49.11	53.98	4.87	AV
2310.0~2390.0	64.28	0.00	V	64.28	73.98	9.70	PK
#2310.0~2390.0	48.58	0.50	V	49.08	53.98	4.90	AV
2483.5~2500.0	66.02	0.00	H	66.02	73.98	7.96	PK
#2483.5~2500.0	49.66	0.50	H	50.16	53.98	3.82	AV
2483.5~2500.0	65.84	0.00	V	65.84	73.98	8.14	PK
#2483.5~2500.0	46.58	0.50	V	47.08	53.98	6.90	AV

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

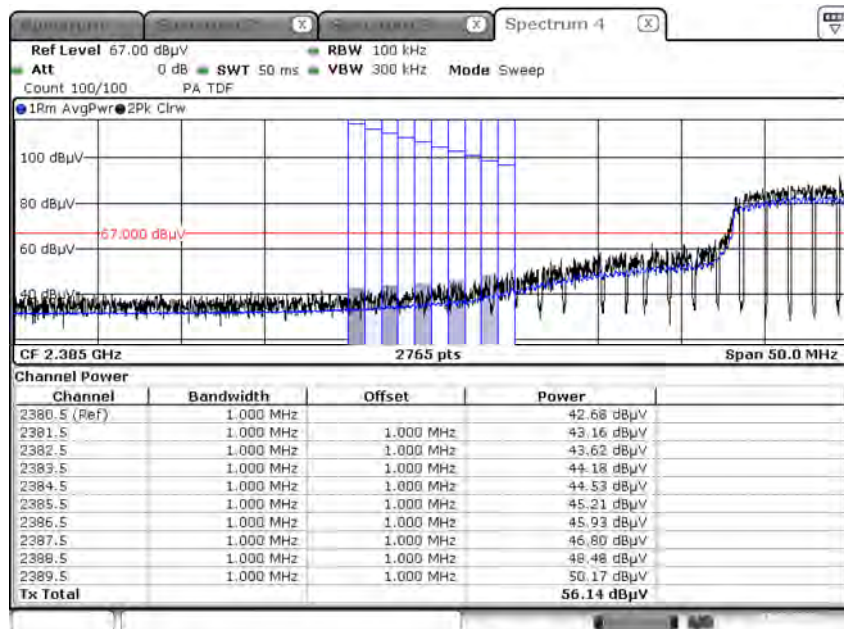
Frequency	Measured Value	Duty Cycle	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	Factor [dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
2310.0~2390.0	68.55	0.00	H	68.55	73.98	5.43	PK
#2310.0~2390.0	50.17	0.65	H	50.82	53.98	3.16	AV
2310.0~2390.0	67.91	0.00	V	67.91	73.98	6.07	PK
#2310.0~2390.0	49.67	0.65	V	50.32	53.98	3.66	AV
2483.5~2500.0	66.57	0.00	H	66.57	73.98	7.41	PK
#2483.5~2500.0	49.18	0.65	H	49.83	53.98	4.15	AV
2483.5~2500.0	66.50	0.00	V	66.50	73.98	7.48	PK
#2483.5~2500.0	49.03	0.65	V	49.68	53.98	4.30	AV

Note:

1. # indicates that the Integration method was used.(ANSI C63.10 Section 11.13.3)
2. The offset was included in the Sigant Analyzer.
 - The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

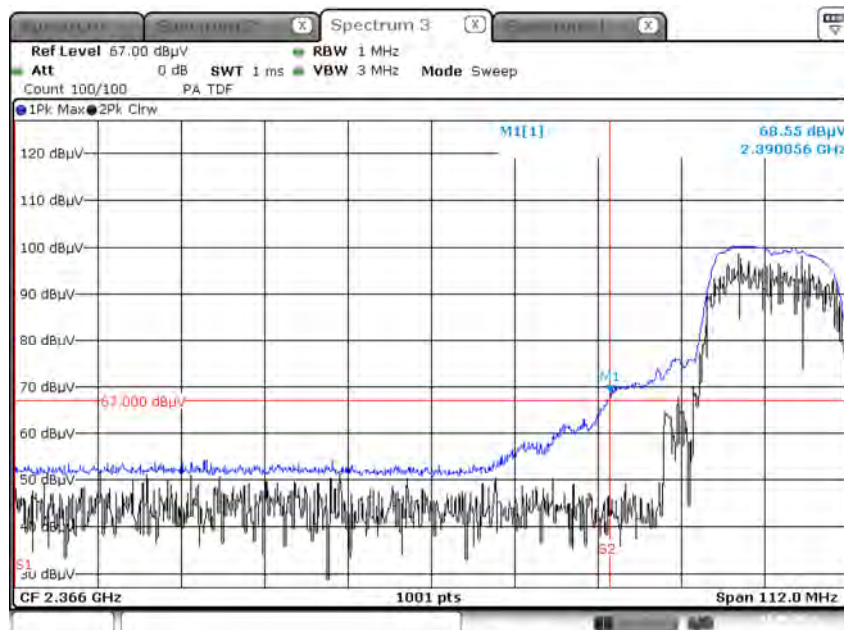
▣ Test Plots (Worst case : X-H)

Radiated Restricted Band Edges plot – Average Result (802.11n_HT20, 6.5 Mbps, Ch.1)



Date: 7 AUG 2023 15:19:14

Radiated Restricted Band Edges plot – Peak Result (802.11n_HT20, 6.5 Mbps, Ch.1)



Date: 7 AUG 2023 15:19:53

Note:

Plots of worst case were only reported.

9.7.2 12V

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

Frequency	Measured Value	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
2310.0~2390.0	56.25	H	56.25	73.98	17.73	PK
2310.0~2390.0	46.77	H	46.77	53.98	7.21	AV
2310.0~2390.0	56.15	V	56.15	73.98	17.83	PK
2310.0~2390.0	46.31	V	46.31	53.98	7.67	AV
2483.5~2500.0	55.84	H	55.84	73.98	18.14	PK
2483.5~2500.0	46.16	H	46.16	53.98	7.82	AV
2483.5~2500.0	55.39	V	55.39	73.98	18.59	PK
2483.5~2500.0	46.02	V	46.02	53.98	7.96	AV

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

Frequency	Measured Value	Duty Cycle	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	Factor [dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
2310.0~2390.0	66.10	0.00	H	66.10	73.98	7.88	PK
#2310.0~2390.0	50.40	0.50	H	50.90	53.98	3.08	AV
2310.0~2390.0	65.94	0.00	V	65.94	73.98	8.04	PK
#2310.0~2390.0	49.62	0.50	V	50.12	53.98	3.86	AV
2483.5~2500.0	65.02	0.00	H	65.02	73.98	8.96	PK
#2310.0~2390.0	48.83	0.50	H	49.33	53.98	4.65	AV
2483.5~2500.0	64.39	0.00	V	64.39	73.98	9.59	PK
#2310.0~2390.0	48.67	0.50	V	49.17	53.98	4.81	AV

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

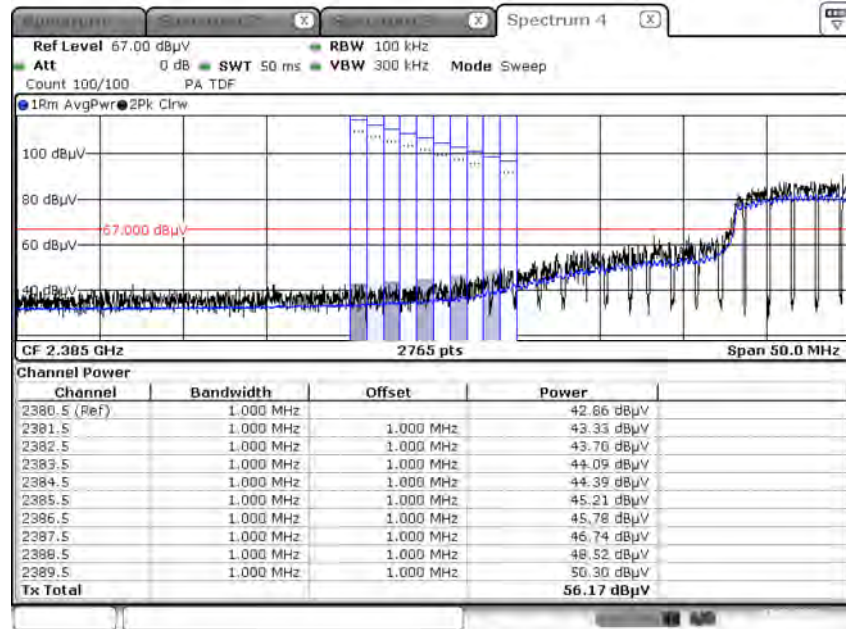
Frequency	Measured Value	Duty Cycle	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dB μ V]	Factor [dB]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]	
2310.0~2390.0	69.58	0.00	H	69.58	73.98	4.40	PK
#2310.0~2390.0	50.30	0.65	H	50.95	53.98	3.03	AV
2310.0~2390.0	68.72	0.00	V	68.72	73.98	5.26	PK
#2310.0~2390.0	49.58	0.65	V	50.23	53.98	3.75	AV
2483.5~2500.0	66.67	0.00	H	66.67	73.98	7.31	PK
#2310.0~2390.0	49.77	0.65	H	50.42	53.98	3.56	AV
2483.5~2500.0	66.58	0.00	V	66.58	73.98	7.40	PK
#2310.0~2390.0	49.34	0.65	V	49.99	53.98	3.99	AV

Note:

1. # indicates that the Integration method was used.(ANSI C63.10 Section 11.13.3)
2. The offset was included in the Sigant Analyzer.
 - The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

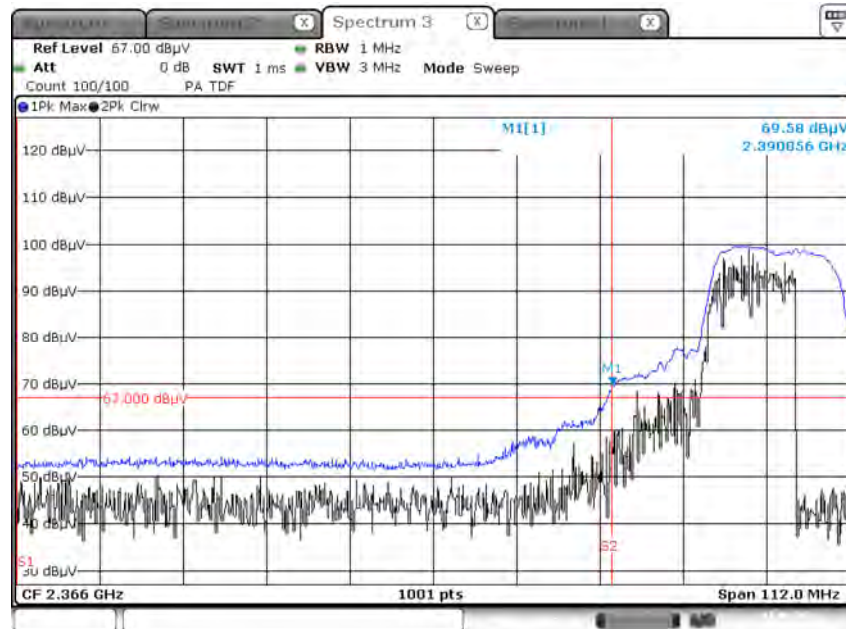
▣ Test Plots (Worst case : X-H)

Radiated Restricted Band Edges plot – Average Result (802.11n_HT20, 6.5 Mbps, Ch.1)



Date: 7 AUG 2023 10:45:08

Radiated Restricted Band Edges plot – Peak Result (802.11n_HT20, 6.5 Mbps, Ch.1)



Date: 7 AUG 2023 10:44:33

Note:

Plots of worst case Pwr were only reported.

9.8 RECEIVER SPURIOUS EMISSIONS

Frequency Range : Below 1 GHz

Frequency	Measured Value	A.F + C.L	Ant. POL	Total	Limit	Margin
[MHz]	[dB μ V]	[dB/m]	[H/V]	[dB μ V/m]	[dB μ V/m]	[dB]

No Critical peaks found

Note:

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

Frequency Range : Above 1 GHz

Frequency	Measured Value	A.F + C.L – A.G + 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

9.9 POWERLINE CONDUCTED EMISSIONS

Test

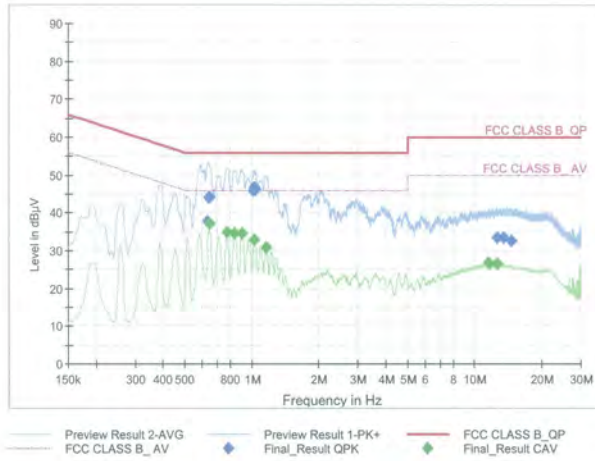
1 / 1

Test Report

Common Information

EUT : LAIWB4
 Operating Conditions : 2.4G WLAN Mode_5V
 Comment :

Full Spectrum



Final Result QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.6305	37.93	56.00	18.07	9.000	N	9.7
0.6373	44.09	56.00	11.91	9.000	N	9.7
0.6463	44.19	56.00	11.81	9.000	N	9.7
1.0175	45.83	56.00	10.17	9.000	L1	9.7
1.0220	46.68	56.00	9.32	9.000	L1	9.7
1.0400	46.14	56.00	9.86	9.000	L1	9.7
12.5780	33.34	60.00	26.66	9.000	L1	9.9
13.4848	33.49	60.00	26.51	9.000	L1	9.9
14.5333	32.49	60.00	27.51	9.000	N	10.0

Final Result CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.6440	37.11	46.00	8.89	9.000	L1	9.7
0.7745	34.77	46.00	11.23	9.000	L1	9.7
0.8420	34.48	46.00	11.52	9.000	L1	9.7
0.9028	34.56	46.00	11.44	9.000	L1	9.7
1.0310	33.02	46.00	12.98	9.000	L1	9.7
1.1615	30.97	46.00	15.03	9.000	L1	9.7
11.5295	26.90	50.00	23.10	9.000	L1	9.9
11.5970	26.50	50.00	23.50	9.000	L1	9.9
12.5690	26.40	50.00	23.60	9.000	L1	9.9

2023-08-10

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Test

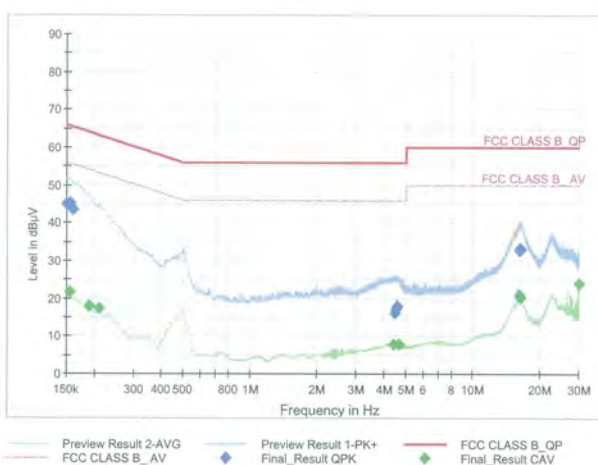
1 / 1

Test Report

Common Information

EUT : LAIWB4
 Operating Conditions : 2.4G WLAN Mode_12V
 Comment :

Full Spectrum



Final Result QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.1500	44.95	66.00	21.05	9.000	N	9.7
0.1545	45.18	65.75	20.58	9.000	N	9.7
0.1613	43.55	65.40	21.85	9.000	N	9.7
4.5050	16.24	56.00	39.76	9.000	N	9.8
4.5545	17.23	56.00	38.77	9.000	N	9.8
4.5590	17.75	56.00	38.25	9.000	N	9.8
16.2478	32.82	60.00	27.18	9.000	L1	9.9
16.2680	32.81	60.00	27.19	9.000	L1	9.9
16.3265	33.27	60.00	26.73	9.000	L1	9.9

Final Result CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.1545	21.49	55.75	34.26	9.000	L1	9.7
0.1905	18.00	54.02	36.02	9.000	L1	9.7
0.2108	17.21	53.18	35.96	9.000	N	9.7
4.4353	7.93	46.00	38.07	9.000	N	9.8
4.6693	7.79	46.00	38.21	9.000	N	9.8
16.2253	20.91	50.00	29.09	9.000	L1	9.9
16.2478	20.92	50.00	29.08	9.000	L1	9.9
16.3423	20.13	50.00	29.87	9.000	L1	9.9
29.8378	23.95	50.00	26.05	9.000	N	10.0

2023-08-10

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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	08/02/2024	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	05/26/2024	Annual
Temperature Chamber	SU-642	ESPEC	93008124	02/22/2024	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	09/06/2023	Annual
Power Meter	N1911A	Agilent	MY45100523	03/06/2024	Annual
Power Sensor	N1921A	Agilent	MY57820067	03/06/2024	Annual
Directional Coupler	87300B	Agilent	3116A03621	11/02/2023	Annual
Power Splitter	11667B	Hewlett Packard	10545	02/06/2024	Annual
DC Power Supply	E3632A	Agilent	KR75305528	01/03/2024	Annual
Attenuator(10 dB)(DC-26.5 GHz)	8493C-010	Agilent	08285	06/02/2024	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	03/08/2024	Annual
Software	EMC32	Rohde & Schwarz	N/A	N/A	N/A
FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	HCT CO., LTD.	N/A	N/A	N/A
Bluetooth Tester	CBT	Rohde & Schwarz	100808	02/16/2024	Annual

Note:

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

Radiated Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Controller(Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	S3AM	08/03/2025	Biennial
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	03/28/2025	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	01/05/2024	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	06/12/2024	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/12/2024	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	02/09/2024	Annual
RF Switching System	FBSR-03A (3G HPF+LNA)	T&M SYSTEM	S3L1	12/05/2023	Annual
RF Switching System	FBSR-03A (10dB ATT+LNA)	T&M SYSTEM	S3L2	12/05/2023	Annual
RF Switching System	FBSR-03A (7G HPF+LNA)	T&M SYSTEM	S3L3	12/05/2023	Annual
RF Switching System	FBSR-03A (3dB ATT+LNA)	T&M SYSTEM	S3L4	12/05/2023	Annual
Power Amplifier	CBL18265035	CERNEX	22966	12/01/2023	Annual
Power Amplifier	CBL26405040	CERNEX	25956	03/02/2024	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	03/28/2024	Annual
Spectrum Analyzer	FSVA40 (10 Hz ~ 40 GHz)	Rohde & Schwarz	101502	03/17/2024	Annual

Note:

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

11. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2308-FI005-P