TEST REPORT

FCC DTS Test for LCWB-008
Certification

APPLICANT
LG Electronics Inc.

REPORT NO.
HCT-RF-2411-FC024-R1

DATE OF ISSUE
December 16, 2024

Tested by
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Accredited by KOLAS, Republic of KOREA

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Applicant	**LG Electronics Inc.** 170, Seongsan Pachong-ro, Seongsan-gu, Changwon-si, Gyeongsangnam-do 51533, Republic of Korea
Product Name Model Name	RF Module LCWB-008
FCC ID	BEJ-LCWB008
Date of Test	November 04, 2024 ~ November 22, 2024
FCC Classification	Digital Transmission System(DTS)
Test Standard Used	FCC Rule Part(s): Part 15.247
Test Results	PASS
Location of Test	■ Permanent Testing Lab ☐ On Site Testing Lab (Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)
Brand	LG

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	November 22, 2024	Initial Release
1	December 16, 2024	Added Conducted Band Edge result table on page 30.

Notice

Content
Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance. The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated. The test results have only been applied with the test methods required by the standard(s). The laboratory is not accredited for the test results marked *. Information provided by the applicant is marked **. Test results provided by external providers are marked ***. When confirmation of authenticity of this test report is required, please contact www.hct.co.kr This test report provides test result(s) under the scope accredited by the Korea Laboratory Accreditation Scheme (KOLAS), which signed the ILAC-MRA. (KOLAS (KS Q ISO/IEC 17025) Accreditation No. KT197) This test report provides test result(s) under the lab's valid Scope of Accreditation by A2LA (American Association for Laboratory Accreditation), signatory of the ILAC-MRA. (A2LA (ISO/IEC 17025) Certificate No. 4114.01)

CONTENTS

1. EUT DESCRIPTION

Model	LCWB-008		
Additional Model	-		
EUT Type	RF Module		
Power Supply	DC 3.3 V / 5.0 V		
Frequency Range	2 412 MHz – 2 462 MHz		
Max. RF Output Power	Peak Power	802.11b: 802.11g: 802.11n(HT20):	22.14 dBm 23.06 dBm 21.54 dBm
	Average Power	802.11b: 802.11g: 802.11n(HT20):	16.32 dBm 15.40 dBm 14.11 dBm
Modulation Type	DSSS/CCK : 802.11b OFDM : 802.11g, 802.11n(HT20)		
Number of Channels	11 Channels		
Antenna Specification	Antenna type: PCB Pattern Antenna Peak Gain : 1.67 dBi		
EUT Serial number	Conducted : D07602C83426 Radiated : D07602C83440		

2. TEST METHODOLOGY

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

EUT CONFIGURATION

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

EUT EXERCISE

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

GENERAL TEST PROCEDURES

Conducted Emissions

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

Radiated Emissions

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

DESCRIPTION OF TEST MODES

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

3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards.
Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.
Detailed description of test facility was submitted to the Commission and accepted dated March 11, 2024 (Registration Number: KR0032).

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5. ANTENNA REQUIREMENTS

According to FCC 47 CFR § 15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

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

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

6. MEASUREMENT UNCERTAINTY

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

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

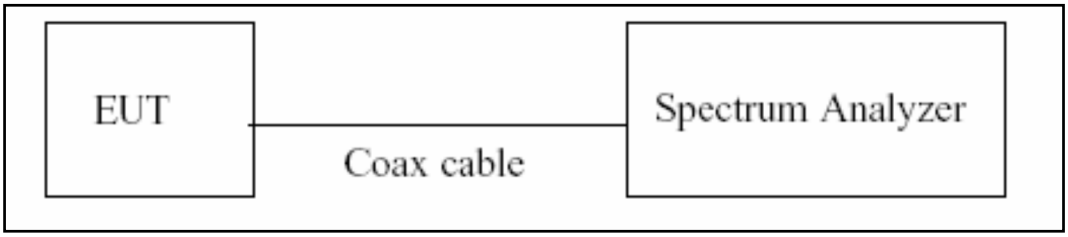
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.98 (Confidence level about 95 %, k=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.36 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.70 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.52 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.66 (Confidence level about 95 %, k=2)
Radiated Disturbance (Above 40 GHz)	5.58 (Confidence level about 95 %, k=2)

7. DESCRIPTION OF TESTS

7.1. Duty Cycle

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to the zero-span measurement method.

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

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

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

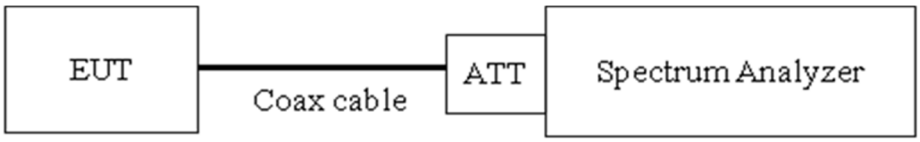
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Average
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on} / T_{total} and Duty Cycle Factor = 10log(1/Duty Cycle)

7.2. 6 dB Bandwidth

Limit

The minimum permissible 6 dB bandwidth is 500 kHz.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

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

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

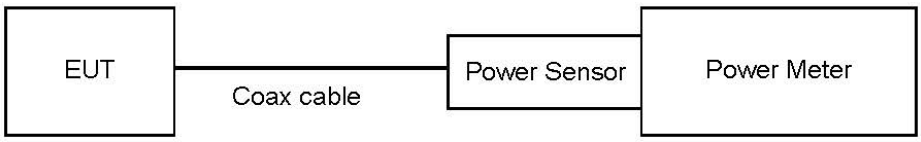
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

7.3. Output Power

Limit

The maximum permissible conducted output power is 1 Watt.

Test Configuration



Test Procedure

The transmitter output is connected to the Power Meter.

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

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

Sample Calculation

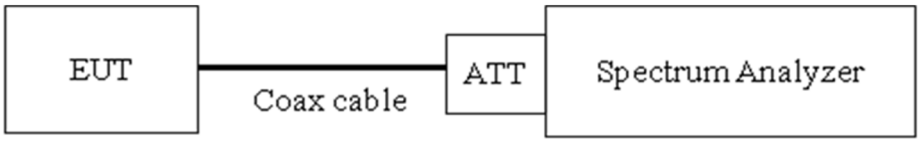
- Conducted Output Power(Peak) = Measured Value + ATT loss + Cable loss
- Conducted Output Power(Average) = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

7.4. Power Spectral Density

Limit

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

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

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

The spectrum analyzer is set to :

1) Set analyzer center frequency to DTS channel center frequency.
2) Set span to at least 1.5 times the DTS bandwidth.
3) RBW = 3 kHz ≤ RBW ≤ 100 kHz.
4) VBW ≥ 3 x 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.
10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Sample Calculation

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

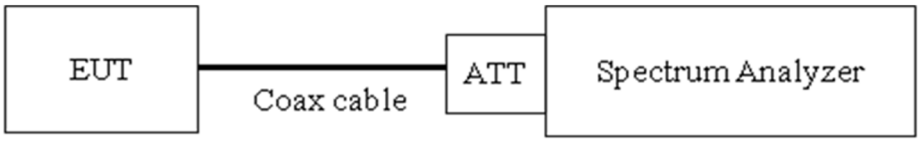
7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

Limit

The maximum conducted (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 ≥ 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) Allow trace to fully stabilize.
8) 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	20.06
100	20.14
200	20.17
300	20.21
400	20.28
500	20.28
600	20.28
700	20.28
800	20.30
900	20.31
1 000	20.35
2 000	20.55
2 400	20.62
2 500	20.62
3 000	20.67
4 000	20.74
5 000	20.86
6 000	20.83
7 000	20.93
8 000	20.97
9 000	21.09
10 000	21.18
11 000	21.27
12 000	21.33
13 000	21.33
14 000	21.40
15 000	21.49
16 000	21.52
17 000	21.55
18 000	21.63
19 000	21.65
20 000	21.66
21 000	21.76
22 000	21.82
23 000	21.86
24 000	21.90
25 000	21.92
26 000	22.04

Note :

1. 2400 ~ 2500 MHz is fundamental frequency range.
2. Factor = Attenuator loss + Cable loss
3. Total Port offset = Attenuator loss + Cable loss + EUT cable loss(0.3 dB) = 20.92 dB

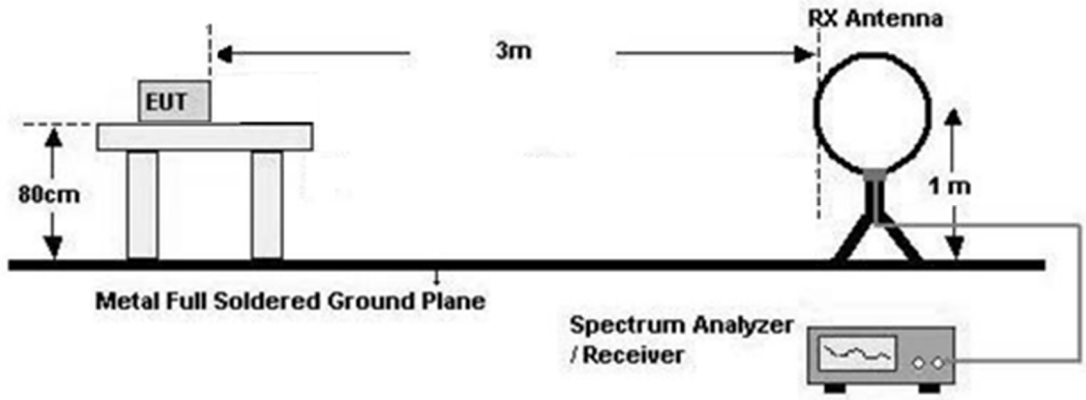
7.6. Radiated Test

Limit

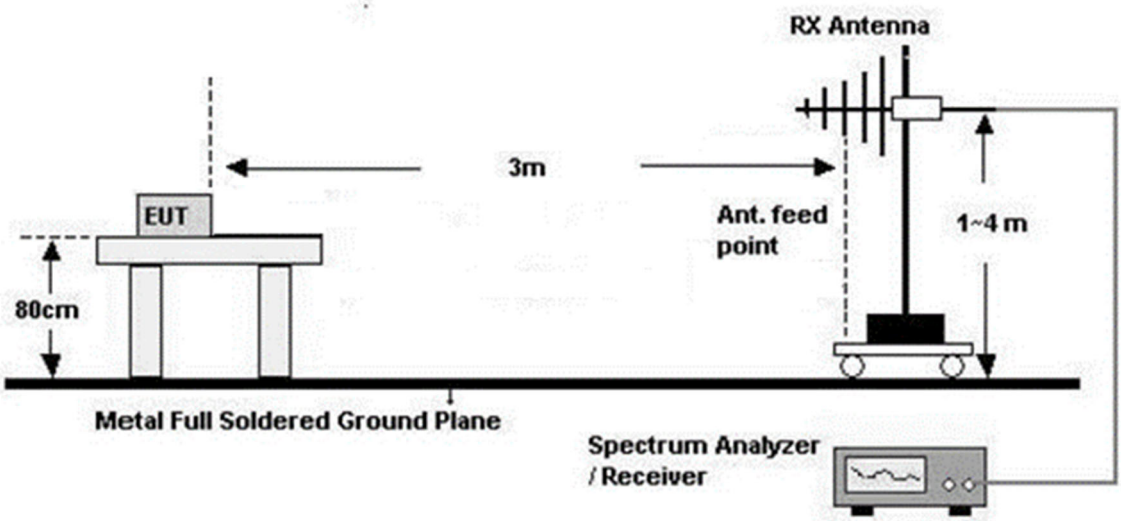
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30

Test Configuration

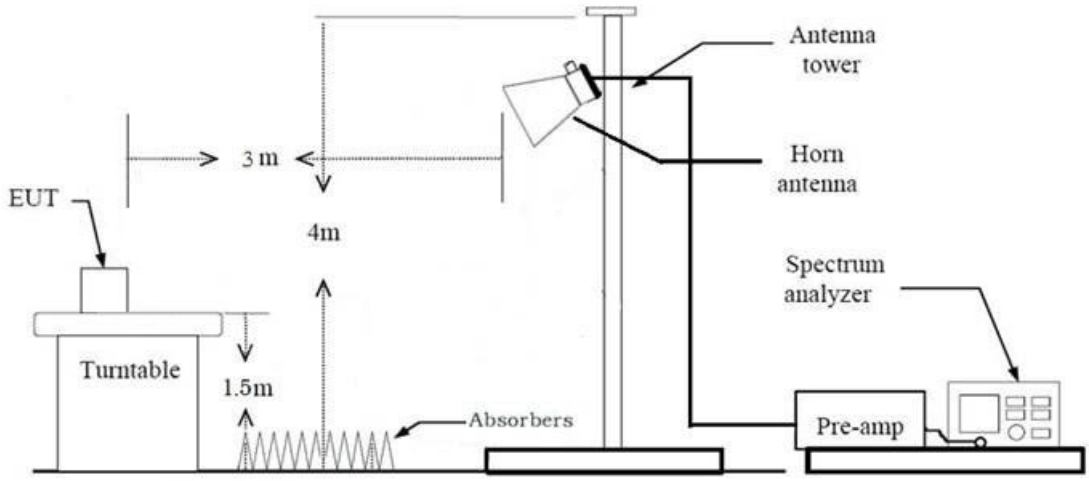
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions (Below 30 MHz)

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

KDB 414788 OFS and Chamber Correlation Justification

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

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

Test Procedure of Radiated spurious emissions (Below 1 GHz)

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

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

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.

5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting (Method 8.6 in KDB 558074 v05r02, Procedure 11.12 in ANSI 63.10-2013)
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Average): Duty cycle ≥ 98 %
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = RMS
      - Averaging type = power (*i.e.*, RMS)
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
      - Sweep time = auto.
      - Trace mode = average (at least 100 traces).

   (3) Measurement Type(Average): Duty cycle < 98 %, duty cycle variations are less than ±2 %
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = RMS
      - Averaging type = power (*i.e.*, RMS)
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
      - Sweep time = auto.
      - Trace mode = average (at least 100 traces).
      - Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 % duty cycle.
      - Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.
9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total(Measurement Type : Peak)
    = Measured value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

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

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

Test Procedure of Radiated Restricted Band Edge

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 2310 MHz ~ 2390 MHz / 2483.5 MHz ~ 2500 MHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Average): Duty cycle ≥ 98 %,
      - Measured Frequency Range : 2310 MHz ~ 2390 MHz / 2483.5 MHz ~ 2500 MHz
      - Detector = RMS
      - Averaging type = power (*i.e.*, RMS)
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
      - Sweep time = auto.
      - Trace mode = average (at least 100 traces).
   (3) Measurement Type(Average): Duty cycle < 98 %, duty cycle variations are less than ± 2 %
      - Measured Frequency Range : 2310 MHz ~ 2390 MHz / 2483.5 MHz ~ 2500 MHz
      - Detector = RMS
      - Averaging type = power (*i.e.*, RMS)
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW

- Sweep time = auto.
- Trace mode = average (at least 100 traces).
- Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 % duty cycle.
- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.

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

7.7. AC Power line Conducted Emissions

Limit

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

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

[a]Decreases with the logarithm of the frequency.

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

Test Configuration

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

Test Procedure

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

Sample Calculation

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

7.8. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone(DC 3.3V), Stand alone(DC 5V),
   - Worst case : Stand alone(DC 3.3V)
2. EUT Axis
   - Radiated Spurious Emissions : X
   - Radiated Restricted Band Edge : Y
3. Duty cycle factor applies only 802.11g, 802.11n Mode. (Duty cycle < 98 %).
4. All data rate of operation were investigated and the test results are worst case in lowest Data Rate of each mode.
   - 802.11b : 1 Mbps
   - 802.11g : 6 Mbps
   - 802.11n(HT20): 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

6. Radiated Spurious Emission
   - All mode of operation were investigated and the worst case results are reported.
   - Mode: 802.11b, 802.11g, 802.11n(HT20)
   - Worst case: 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 3.3V), Stand alone(DC 5V)

Conducted test

1. The EUT was configured with data rate of highest power.
2. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone(DC 3.3V), Stand alone(DC 5V),
   - Worst case : Stand alone(DC 3.3V)

8. SUMMARY TEST OF RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§ 15.247(a)(2)	> 500 kHz	Conducted	PASS
Conducted Maximum Output Power	§ 15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§ 15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§ 15.247(d)	Conducted > 20 dBc		PASS
AC Power line Conducted Emissions	§ 15.207	cf. Section 7.7		PASS
Radiated Spurious Emissions	§ 15.247(d), 15.205, 15.209	cf. Section 7.6	Radiated	PASS
Radiated Restricted Band Edge	§ 15.247(d), 15.205, 15.209	cf. Section 7.6		PASS

9. TEST RESULT

9.1 DUTY CYCLE

Mode	Data Rate	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11b	1 Mbps	8.395	8.483	0.990	0.045
802.11g	6 Mbps	1.394	1.409	0.989	0.046
802.11n(HT20)	MCS0	0.165	0.169	0.976	0.104

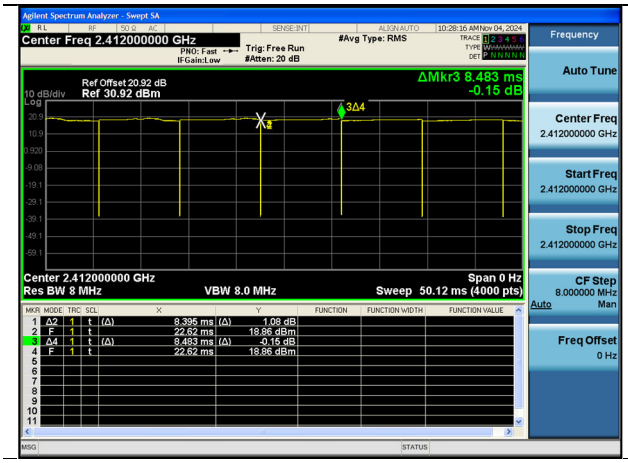
Note:

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

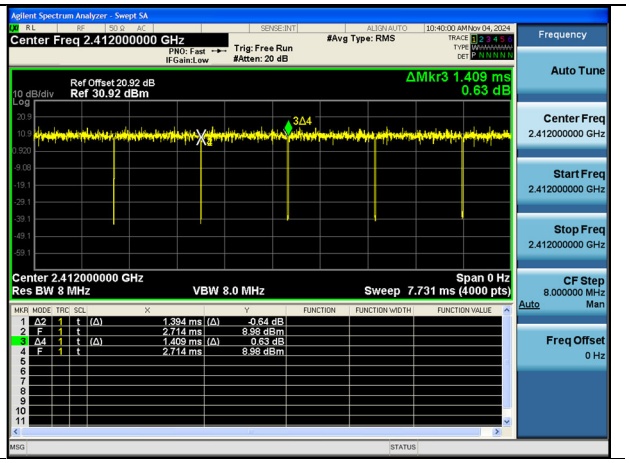
▣ Test Plots

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

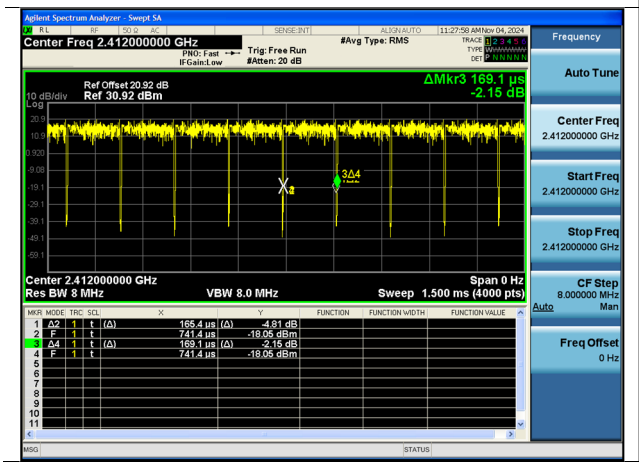
802.11b (1 Mbps)



802.11g (6 Mbps)



802.11n (MCS0)



9.2 6 dB BANDWIDTH

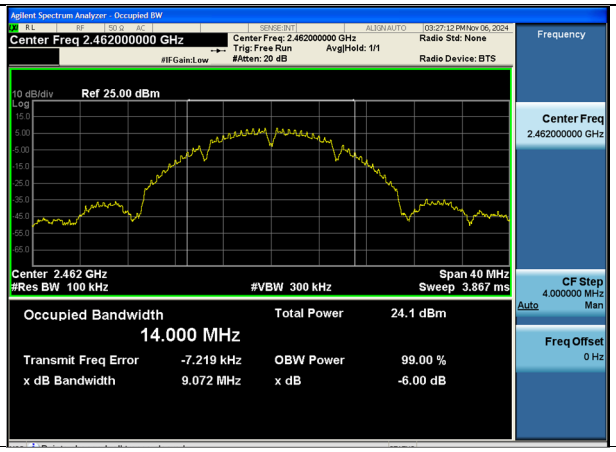
Mode	Frequency [MHz]	Channel No.	6 dB Bandwidth [MHz]	Limit [MHz]
802.11b	2412	1	9.087	0.5
	2437	6	9.087	0.5
	2462	11	9.072	0.5
802.11g	2412	1	15.09	0.5
	2437	6	15.06	0.5
	2462	11	15.04	0.5
802.11n(HT20)	2412	1	15.07	0.5
	2437	6	15.07	0.5
	2462	11	15.07	0.5

▣ Test Plots

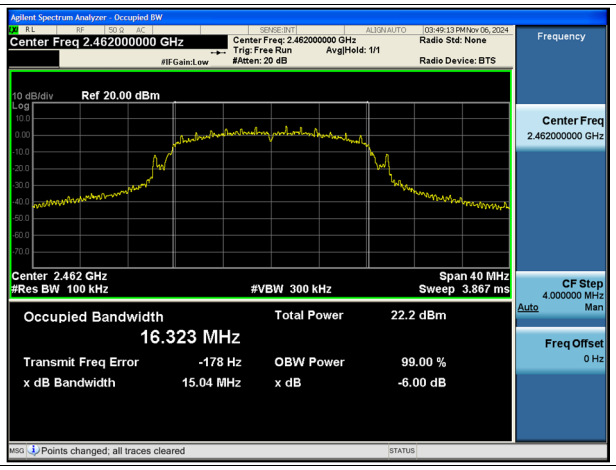
Note:

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

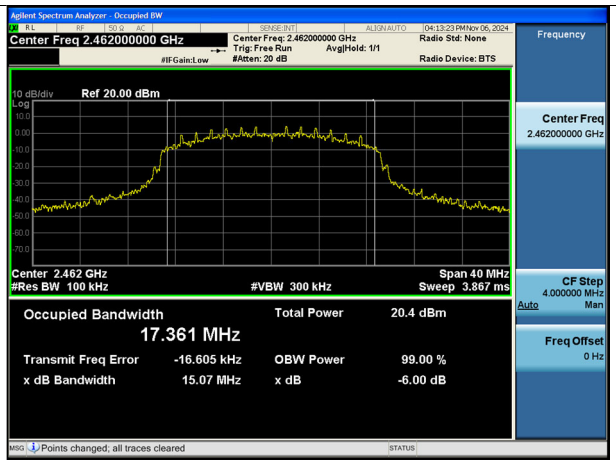
6 dB Bandwidth plot (802.11b-CH 11)



6 dB Bandwidth plot (802.11g-CH 11)



6 dB Bandwidth plot (802.11n_HT20-CH 11)



9.3 OUTPUT POWER

Peak Output Power

Mode	Frequency [MHz]	Channel No.	Data Rate	Conducted Peak Power [dBm]	Limit [dBm]
802.11b	2412	1	11M	22.08	30
	2437	6	11M	22.14	30
	2462	11	11M	22.07	30
802.11g	2412	1	54M	22.18	30
	2437	6	54M	23.06	30
	2462	11	54M	22.15	30
802.11n	2412	1	MCS3	20.11	30
	2437	6	MCS3	21.54	30
	2462	11	MCS3	21.45	30

Average Output Power

Mode	Frequency [MHz]	Channel No.	Data Rate	Conducted Average Power [dBm]			Limit [dBm]
				Measured Value	D.C.F	Summed	
802.11b	2412	1	1M	16.23	0.05	16.28	30
	2437	6	1M	16.28	0.05	16.32	30
	2462	11	1M	16.20	0.05	16.24	30
802.11g	2412	1	54M	14.37	0.13	14.50	30
	2437	6	54M	15.27	0.13	15.40	30
	2462	11	54M	14.33	0.13	14.47	30
802.11n	2412	1	MCS0	12.57	0.10	12.67	30
	2437	6	MCS0	14.00	0.10	14.11	30
	2462	11	MCS0	13.92	0.10	14.02	30

9.4 POWER SPECTRAL DENSITY

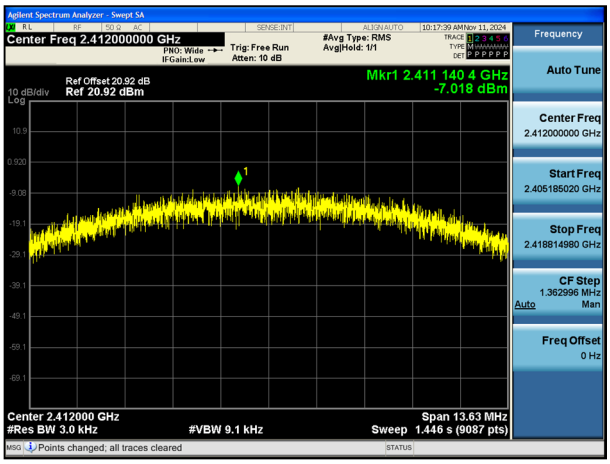
Mode	Frequency (MHz)	Channel No.	Data Rate	Test Result	
				Power Spectral Density [dBm]	Limit [dBm]
802.11b	2412	1	11M	-7.018	8 dBm /3 kHz
	2437	6	11M	-7.101	
	2462	11	11M	-7.065	
802.11g	2412	1	54M	-9.621	
	2437	6	54M	-8.681	
	2462	11	54M	-9.644	
802.11n(HT20)	2412	1	MCS3	-11.485	
	2437	6	MCS3	-10.011	
	2462	11	MCS3	-10.091	

▣ Test Plots

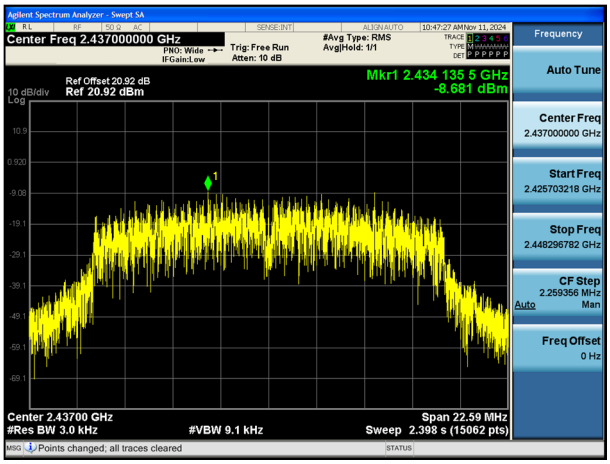
Note :

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

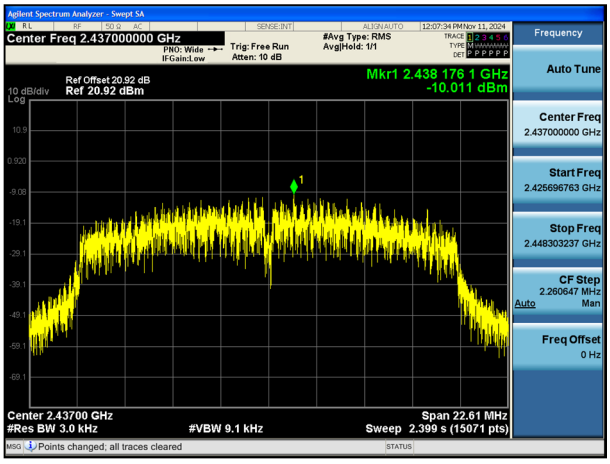
Power Spectral Density (802.11b-CH 1)



Power Spectral Density (802.11g-CH 6)



Power Spectral Density (802.11n_HT20-CH 6)



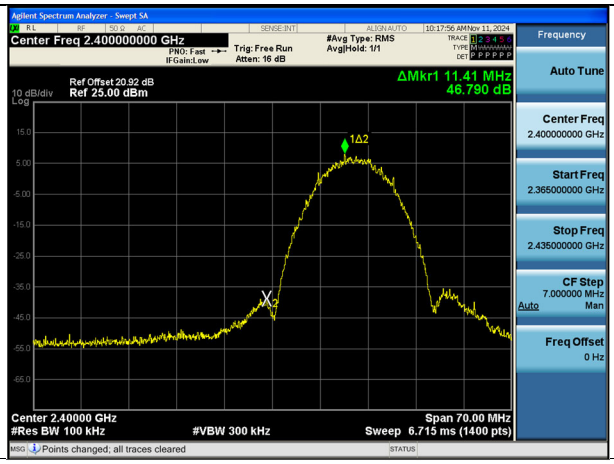
9.5 BAND EDGE / CONDUCTED SPURIOUS EMISSIONS

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

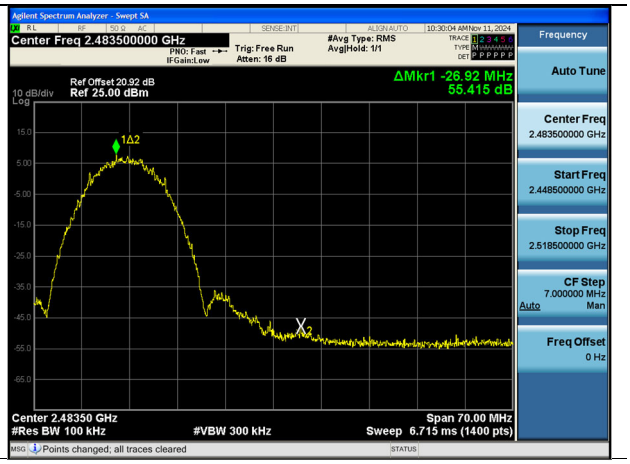
Mode	Frequency [MHz]	Channel No.	TEST Position	Band-Edge [dB]	Limit [dBc]
802.11b	2412	1	Low	46.790	20
	2462	11	High	55.415	20
802.11g	2412	1	Low	38.180	20
	2462	11	High	51.765	20
802.11n	2412	1	Low	38.203	20
	2462	11	High	51.572	20

▣ Test Plots(Band Edge)

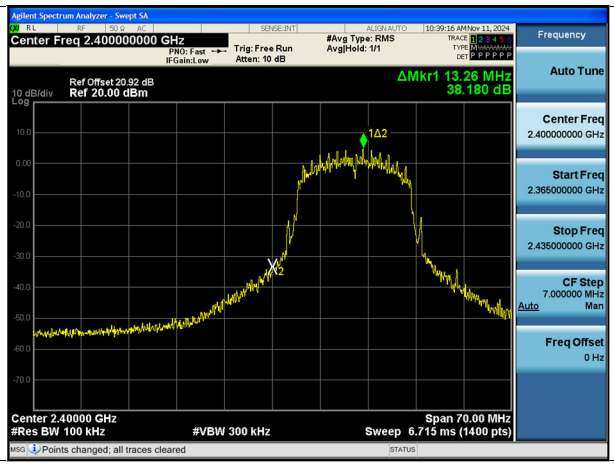
Band Edge (802.11b-CH1)



Band Edge (802.11b-CH11)

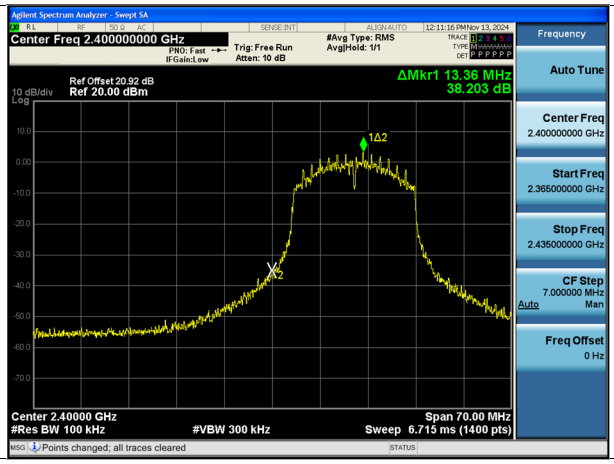


Band Edge (802.11g-CH1)

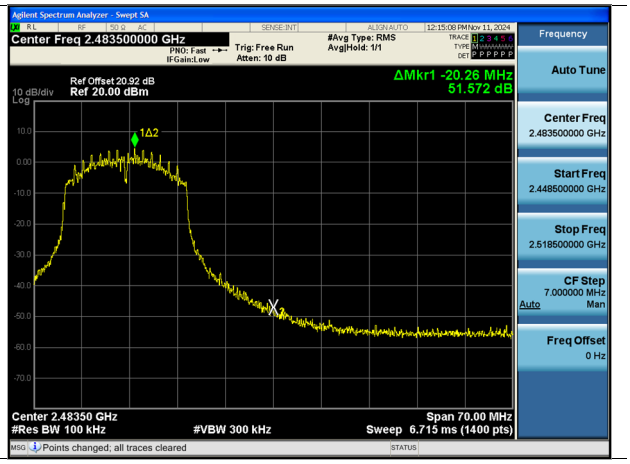


Band Edge (802.11g-CH11)

Band Edge (802.11n_HT20-CH1)



Band Edge (802.11n_HT20-CH11)



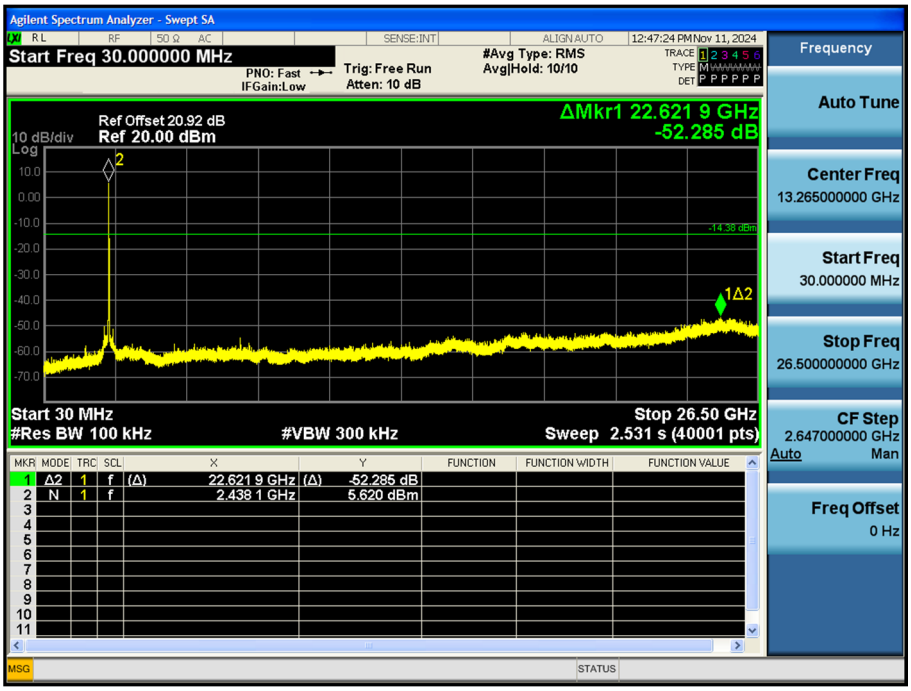
▣ Test Plots(Conducted Spurious Emission)

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

▣ TEST PLOTS

Worst case : 802.11g_Ch.6(2 437 MHz)_54 Mbps

Spurious Emission (30 MHz – 26.50 GHz)



Note:

Limit : -14.38 dBm

9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

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

Note:

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

Frequency Range : Below 1 GHz

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

Note:

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

Frequency Range : Above 1 GHz

Band :	DTS	Operation Mode :		802.11b			
CH.1	2412	Transfer Rate :		1 Mbps			
Frequency	Measured value	CL+AF+DF-AG	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	Type
4824	45.88	4.99	V	50.87	73.98	23.11	PK
4824	41.01	4.99	V	46.00	53.98	7.98	AV
7236	43.61	12.93	V	56.54	73.98	17.44	PK
7236	35.55	12.93	V	48.48	53.98	5.50	AV
4824	46.36	4.99	H	51.35	73.98	22.63	PK
4824	41.67	4.99	H	46.66	53.98	7.32	AV
7236	44.05	12.93	H	56.98	73.98	17.00	PK
7236	36.57	12.93	H	49.50	53.98	4.48	AV

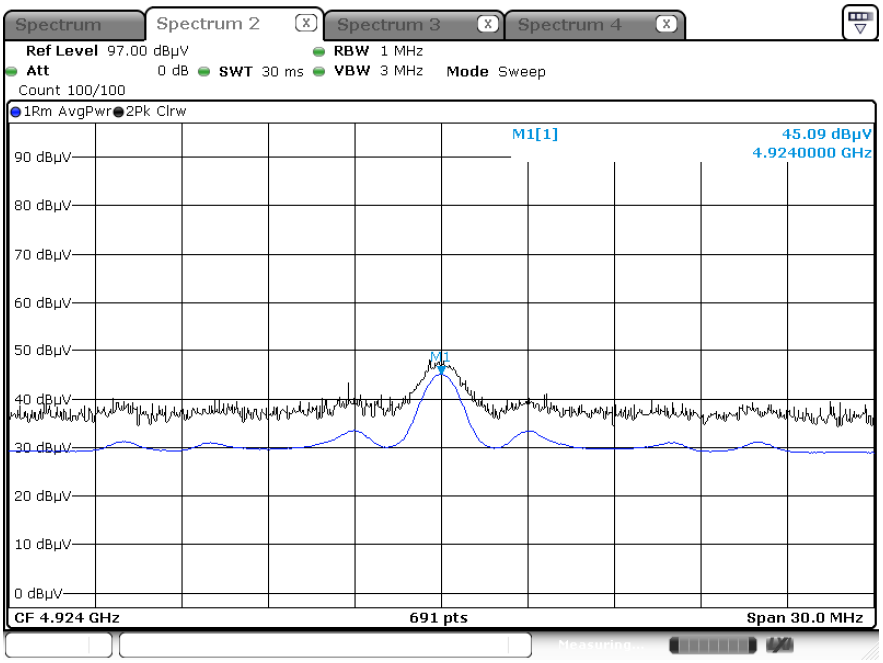
Band :	DTS	Operation Mode :		802.11b			
CH.6	2437	Transfer Rate :		1 Mbps			
Frequency	Measured value	CL+AF+DF-AG	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	Type
4874	46.15	5.25	V	51.40	73.98	22.58	PK
4874	41.12	5.25	V	46.37	53.98	7.61	AV
7311	44.51	12.82	V	57.33	73.98	16.65	PK
7311	36.77	12.82	V	49.59	53.98	4.39	AV
4874	47.52	5.25	H	52.77	73.98	21.21	PK
4874	42.59	5.25	H	47.84	53.98	6.14	AV
7311	45.05	12.82	H	57.87	73.98	16.11	PK
7311	37.34	12.82	H	50.16	53.98	3.82	AV

Band :	DTS	Operation Mode :		802.11b			
CH.11	2462	Transfer Rate :		1 Mbps			
Frequency	Measured value	CL+AF+DF-AG	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	Type
4924	47.25	5.45	V	52.70	73.98	21.28	PK
4924	43.95	5.45	V	49.40	53.98	4.58	AV
7386	43.22	12.63	V	55.85	73.98	18.13	PK
7386	34.88	12.63	V	47.51	53.98	6.47	AV
4924	48.61	5.45	H	54.06	73.98	19.92	PK
4924	45.09	5.45	H	50.54	53.98	3.44	AV
7386	44.39	12.63	H	57.02	73.98	16.96	PK
7386	36.22	12.63	H	48.85	53.98	5.13	AV

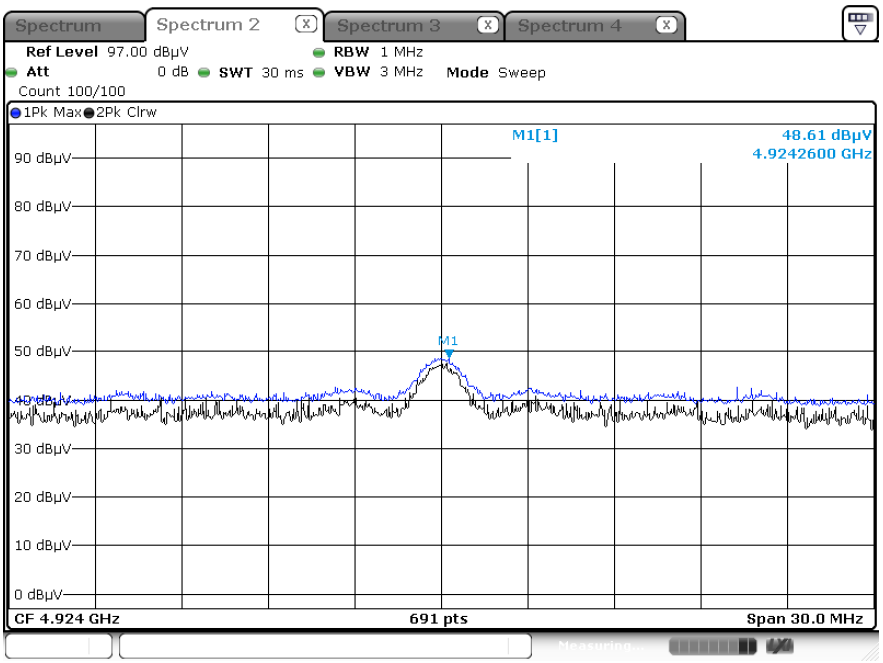
▣ **Test Plots (Worst case : X-H)**

Note: Plots of worst case are only reported.

Radiated Spurious Emissions plot – Average Result (802.11b_1 Mbps, Ch.11 2nd Harmonic)



Radiated Spurious Emissions plot – Peak Result (802.11b_1 Mbps, Ch.11 2nd Harmonic)



9.7 RADIATED RESTRICTED BAND EDGES

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

802.11b	Channel	01 Ch	Freq	2412 MHz		Transfer Rate	1 Mbps
Frequency	Measured Value	A.F.+C.L+D.F	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
2390.0	22.63	36.66	H	59.29	73.98	14.69	PK
2390.0	12.96	36.66	H	49.62	53.98	4.36	AV

802.11b	Channel	11 Ch	Freq	2462 MHz		Transfer Rate	1 Mbps
Frequency	Measured Value	A.F.+C.L+D.F	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
2483.5	22.68	37.22	V	59.90	73.98	14.08	PK
2483.5	12.57	37.22	V	49.79	53.98	4.19	AV

802.11g		Channel	01 Ch	Freq	2412 MHz		Transfer Rate	6 Mbps
Frequency	Measured Value	Duty Cycle Factor	A.F.+C.L+D.F	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
2390.0	31.23	0.00	36.66	H	67.89	73.98	6.09	PK
# 2390.0	13.91	0.05	36.66	H	50.62	53.98	3.36	AV

802.11g		Channel	11 Ch	Freq	2462 MHz		Transfer Rate	6 Mbps
Frequency	Measured Value	Duty Cycle Factor	A.F.+C.L+D.F	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
2483.5	29.58	0.00	37.22	V	66.80	73.98	7.18	PK
# 2483.5	13.50	0.05	37.22	V	50.77	53.98	3.21	AV

802.11n (HT20)		Channel	01 Ch	Freq	2412 MHz		Transfer MCS Index	MCS0
Frequency	Measured Value	Duty Cycle Factor	A.F.+C.L+D.F	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
2390.0	29.58	0.00	36.66	H	66.24	73.98	7.74	PK
# 2390.0	13.54	0.10	36.66	H	50.30	53.98	3.68	AV

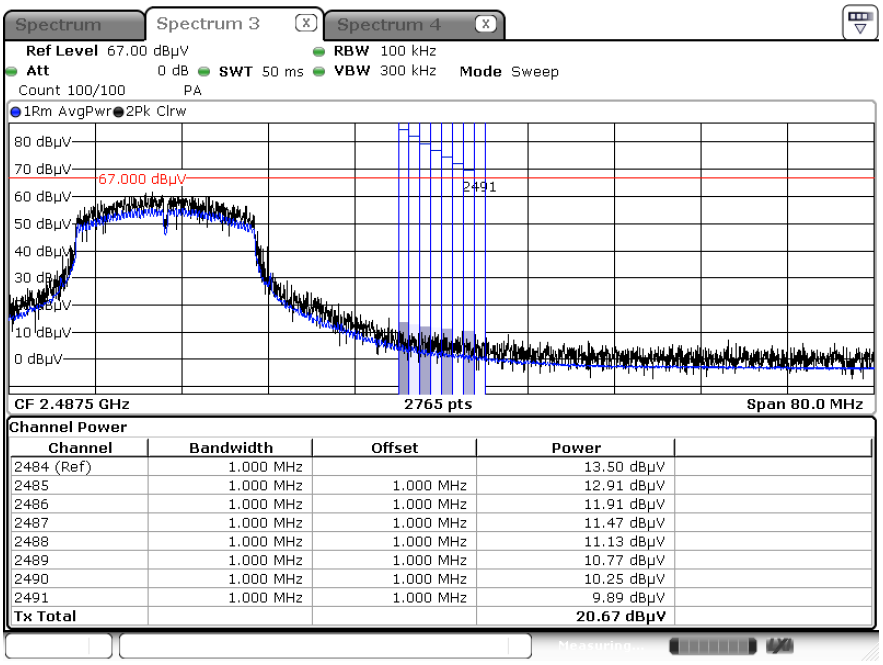
802.11n (HT20)		Channel	11 Ch	Freq	2462 MHz		Transfer MCS Index	MCS0
Frequency	Measured Value	Duty Cycle Factor	A.F.+C.L+D.F	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
2483.5	26.41	0.00	37.22	V	63.63	73.98	10.35	PK
# 2483.5	12.77	0.10	37.22	V	50.09	53.98	3.89	AV

▣ Test Plots

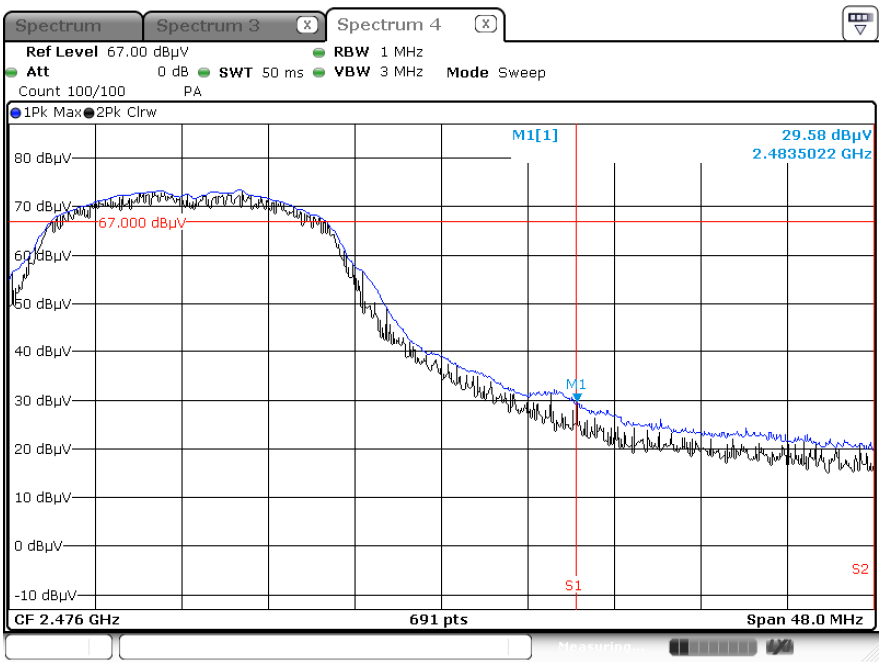
Note: Plots of worst case are only reported.

Radiated Restricted Band Edges plot – Average Result (802.11g , 6 Mbps, Ch.11, Y-V)

(Integration method Used)



Radiated Restricted Band Edges plot – Peak Result (802.11g, 6 Mbps, Ch.11, Y-V)



9.8 POWERLINE CONDUCTED EMISSIONS

[3.3V]

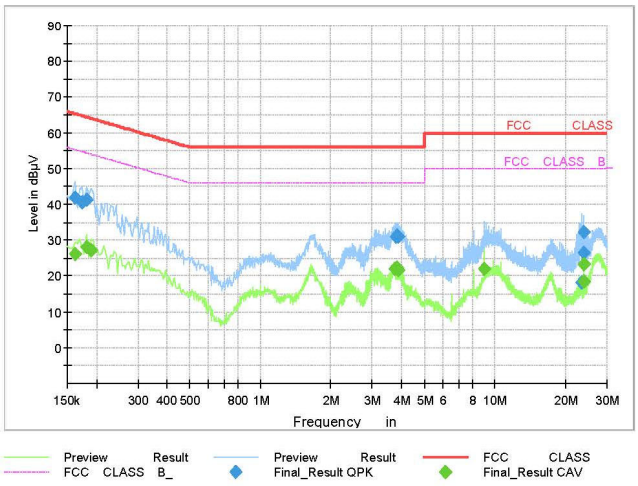
WLAN_2.4G_3.3V 1 / 1

Test Report

Common Information

EUT : LCWB-008
Operating Conditions : WLAN 2.4GHz_3.3V
Comment :

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.1620	41.95	65.36	23.41	9.000	L1	9.6
0.1740	40.49	64.77	24.28	9.000	L1	9.6
0.1820	41.14	64.39	23.25	9.000	N	9.6
3.8040	31.18	56.00	24.82	9.000	N	9.8
3.8120	31.43	56.00	24.57	9.000	N	9.8
3.8720	31.16	56.00	24.84	9.000	N	9.8
23.4600	18.34	60.00	41.66	9.000	L1	10.5
24.0760	32.23	60.00	27.77	9.000	L1	10.5
24.0840	26.48	60.00	33.52	9.000	N	10.7

Final_Result_CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.1620	26.10	55.36	29.26	9.000	L1	9.6
0.1820	28.00	54.39	26.39	9.000	N	9.6
0.1900	27.07	54.04	26.97	9.000	N	9.6
3.7560	21.96	46.00	24.04	9.000	N	9.8
3.8120	22.28	46.00	23.72	9.000	N	9.8
3.8720	21.81	46.00	24.19	9.000	N	9.8
8.9880	22.01	50.00	27.99	9.000	L1	10.0
24.0760	23.32	50.00	26.68	9.000	L1	10.5
24.0840	18.63	50.00	31.37	9.000	N	10.7

2024-11-15 오후 1:53:55

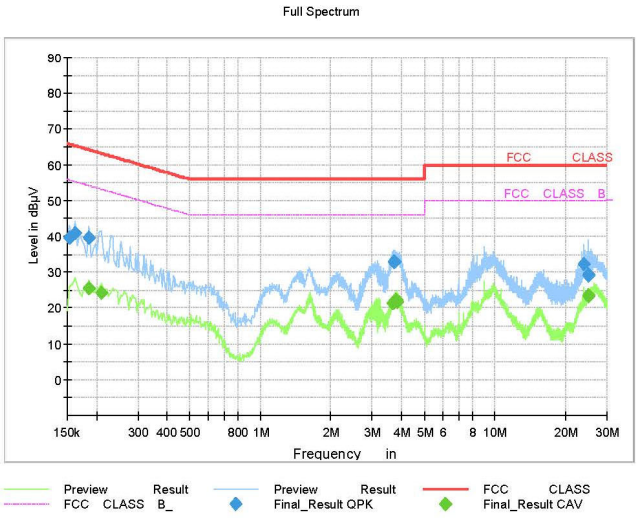
[5V]

WLAN_2.4G_5V 1 / 1

Test Report

Common Information

EUT : LCWB-008
Operating Conditions : WLAN 2.4GHz_5V
Comment :



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.1540	39.57	65.78	26.21	9.000	N	9.6
0.1620	40.88	65.36	24.48	9.000	N	9.6
0.1860	39.79	64.21	24.42	9.000	N	9.6
3.7160	32.91	56.00	23.09	9.000	N	9.8
3.7400	32.97	56.00	23.03	9.000	N	9.8
3.7640	32.98	56.00	23.02	9.000	N	9.8
24.0440	32.15	60.00	27.85	9.000	L1	10.5
24.9720	29.08	60.00	30.92	9.000	L1	10.6
25.1360	29.33	60.00	30.67	9.000	L1	10.6

Final_Result_CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.1860	25.42	54.21	28.79	9.000	N	9.6
0.2100	24.19	53.21	29.01	9.000	N	9.6
3.6800	21.47	46.00	24.53	9.000	N	9.8
3.7400	21.83	46.00	24.17	9.000	N	9.8
3.8000	22.46	46.00	23.54	9.000	N	9.8
3.8480	21.77	46.00	24.23	9.000	N	9.8
24.9720	23.43	50.00	26.57	9.000	L1	10.6
25.0080	23.75	50.00	26.25	9.000	L1	10.6
25.1360	23.66	50.00	26.34	9.000	L1	10.6

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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	07/17/2025	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	07/02/2025	Annual
Temperature Chamber	SU-642	ESPEC	0093008124	02/19/2025	Annual
Signal Analyzer	N9030A	Agilent	MY49432108	02/20/2025	Annual
Power Measurement Set	OSP 120	Rohde & Schwarz	100935	08/01/2025	Annual
Power Meter	N1911A	Agilent	MY45100523	02/28/2025	Annual
Power Sensor	N1921A	Agilent	MY57820067	02/22/2025	Annual
Directional Coupler	87300B	Agilent	3116A03621	10/21/2025	Annual
Power Splitter	11667B	Hewlett Packard	10545	02/06/2025	Annual
DC Power Supply	E3632A	Agilent	KR75303243	04/19/2025	Annual
Attenuator(10 dB)(DC-26.5 GHz)	8493C	HP	07560	06/05/2025	Annual
Attenuator(10 dB)(DC-26.5 GHz)	8493C	HP	08285	05/28/2025	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	02/20/2025	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	100752	01/03/2025	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	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	S1AM	07/30/2025	Annual
Turn Table	DS2000-S-1t	Innco system	DS2000/572/54610422/P	N/A	N/A
Amp & Filter Bank Switch Controller	FBSM-01B	T&M system	TM19050002	N/A	N/A
Loop Antenna	1513	Schwarzbeck	1513-333	03/07/2026	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	08/28/2026	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1300	01/03/2026	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-2296	05/16/2026	Biennial
Horn Antenna(15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170342	09/20/2026	Biennial
Spectrum Analyzer	FSV(10 Hz ~ 40 GHz)	Rohde & Schwarz	101055	05/09/2025	Annual
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	01/02/2025	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	06/04/2025	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/04/2025	Annual
High Pass Filter(7 GHz ~ 18 GHz)	WHKX10-7150-8000-18000-50SS	Wainwright Instruments	1	02/28/2025	Annual
Power Amplifier	CBL18265035	CERNEX	22966	11/07/2025	Annual
Power Amplifier	CBL26405040	CERNEX	25956	02/26/2025	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	03/19/2025	Annual
RF Switching System	FMSR-05B (HPF(3~18GHz) + LNA1(1~18GHz))	T&M system	S1L1	01/02/2025	Annual
RF Switching System	FMSR -05B (ATT(10dB) + LNA1(1~18GHz))	T&M system	S1L2	01/02/2025	Annual
RF Switching System	FMSR -05B (ATT(3dB) + LNA1(1~18GHz))	T&M system	S1L3	01/02/2025	Annual
RF Switching System	FMSR -05B (LNA1(1~18GHz))	T&M system	S1L4	01/02/2025	Annual
RF Switching System	FMSR -05B (HPF(7~18GHz) + LNA2(6~18GHz))	T&M system	S1L5	01/02/2025	Annual
RF Switching System	FMSR -05B (Thru(30MHz ~ 18GHz))	T&M system	S1L6	01/02/2025	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-2411-FC024-P