

TEST REPORT



CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.:
CTK-2024-00853
Page (1) / (47) Pages

1. Applicant

- Name : SOLUM CO.,LTD.
- Address : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Yongin-si, Gyeonggi-do,
Republic of Korea (Zip 16914)
- Date of Receipt : 2023-12-26

2. Manufacturer

- Name : SOLUM CO.,LTD.
- Address : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Yongin-si, Gyeonggi-do,
Republic of Korea (Zip 16914)

3. Factory

- Name : DONGGUAN SOLUM ELECTRONICS CO., LTD.
- Address : Building 2/4/6, No.35, Tongzhen Road, Tongsha, Dongcheng District,
Dongguan City, Guangdong Province, 523127 People's Republic of China

4. Use of Report : For FCC Conformance

5. Test Sample / Model : Signage / WC37FAPBDU0/SM

6. Date of Test : 2024-02-27 to 2024-03-27

7. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247

8. Testing Environment: Temp.: (23 ± 1) °C, Humidity: (36 ± 3) % R.H.

9. Test Results : Compliance

- 10. Location of Test :** ☒ Permanent Testing Lab ☐ On Site Testing
(Address : 5, Dongbu-ro 221beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Republic of Korea)

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This report cannot be reproduced or copied without the written consent of CTK

Approval	Tested by Bong-seok Kim: (Signature)	Technical Manager Young-taek Lee: (Signature)
----------	---	--

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2024-03-27

CTK Co., Ltd.

REPORT REVISION HISTORY

Date	Revision	Page No
2024-03-27	Issued (CTK-2024-00853)	all

This report shall not be reproduced except in full, without the written approval of CTK Co., Ltd. This document may be altered or revised by CTK Co., Ltd. personnel only, and shall be noted in the revision section of the document. Any alteration of this document not carried out by CTK Co., Ltd. will constitute fraud and shall nullify the document.

CONTENTS

1. General Product Description	4
1.1 Applicant Information	4
1.2 Product Information.....	4
1.3 Peripheral Devices	4
1.4 Model Differences.....	4
2. Accreditations	5
2.1 Laboratory Accreditations and Listings.....	5
2.2 Calibration Details of Equipment Used for Measurement.....	5
3. Test Specifications	6
3.1 Standards	6
3.2 Mode of operation during the test	6
3.3 Device Modifications	7
3.4 Maximum Measurement Uncertainty	7
3.5 Test Software	7
4. Technical Characteristic Test.....	8
4.1 6dB Bandwidth	8
4.2 OUTPUT POWER.....	12
4.3 Transmitter Power Spectral Density.....	18
4.4 Conducted Spurious emission.....	24
4.5 Radiated Emission	29
4.6 AC Conducted Emissions	45
APPENDIX A – Test Equipment Used For Tests	47

	CTK Co., Ltd. (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2024-00853 Page (4) / (47) Pages	
--	---	--	--

1. General Product Description

1.1 Applicant Information

Company	SOLUM CO.,LTD.
Contact Point	4,5,6th F, 357, Guseong-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Republic of Korea (Zip 16914)
Contact Person	Name : Ki Dong Lee E-mail : kdlee007@solu-m.com Tel : +82-31-8006-7677 Fax : -

1.2 Product Information

FCC ID	2AFWN-WC37FAPBDW0
Product Description	Signage
Model name	WC37FAPBDU0/SM
Variant Model name	-
Operating Frequency	2 412 MHz – 2 462 MHz (20 MHz_BW) 2 422 MHz – 2 452 MHz (40 MHz_BW)
RF Output Power	802.11b : 15.04 dBm (31.915 mW) 802.11g : 13.80 dBm (23.988 mW) 802.11n_HT20 : 13.89 dBm (24.491 mW) 802.11n_HT40 : 12.46 dBm (17.620 mW)
Antenna Specification	Antenna type : PCB Antenna Peak Gain : 3.59 dBi (ANT0), 3.59 dBi (ANT1)
Antenna Configurations	802.11b : MIMO(ANT0+ANT1) 802.11g : MIMO(ANT0+ANT1) 802.11n : MIMO(ANT0+ANT1)
Number of channels	11 (802.11b/g/n_HT20) 9 (802.11n_HT40)
Type of Modulation	802.11b : DSSS 802.11g/n : OFDM
Data Rate	802.11b : 11 / 5.5 / 2 / 1 Mbps 802.11g : 54 / 48 / 36 / 24 / 18 / 12 / 9 / 6 Mbps 802.11n: up to 300 Mbps
Power Source	DC 19 V
Hardware Rev	-
Software Rev	-

1.3 Peripheral Devices

-For Conducted Measurement and Radiated Measurement

Device	Manufacturer	Model No.	Serial No.
Notebook	HP Inc.	HP Probook 455 G7	5CD0234DWM
AC Adapter	HP Inc.	PPP012D-S	677777-003

1.4 Model Differences

Not applicable

2. Accreditations

2.1 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	CN : 8737A CAB ID : KR0025
KOREA	NRRA	KR0025

2.2 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

3. Test Specifications

3.1 Standards

FCC Part Section(s)	Requirement(s)	Status (Note 1)	Test Condition
15.247(a)	6 dB Bandwidth	C	Conducted
15.247(b)	Maximum Output Power	C	
15.247(d)	Conducted Spurious emission	C	
15.247(d)	Unwanted Emission(Conducted)	C	
15.247(e)	Transmitter Power Spectral Density	C	
15.209	Radiated Emissions	C	Radiated
15.207	AC Conducted Emissions	C	Line Conducted
Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable			
Note 2: The data in this test report are traceable to the national or international standards.			
Note 3: The sample was tested according to the following specification: FCC Part 15.247			
Note 4: The tests were performed according to the method of measurements prescribed in KDB No.558074, ANSI C63.10-2013			

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments.
 During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests.
 The results are only attached worst cases.

Test Frequency & Bandwidth

Bandwidth	Lowest channel	Middle channel	Highest channel
20 MHz	2 412 MHz	2 437 MHz	2 462 MHz
40 MHz	2 422 MHz	2 437 MHz	2 452 MHz

Test mode & Worst case

Test mode	Modulation	Data rate (Worst case)	Duty Cycle (%)	Duty Cycle Factor (dB)
802.11b	DSSS	1 Mbps	96.79	0.14
802.11g	OFDM	6 Mbps	91.15	0.40
802.11n_HT20		MCS 0	92.31	0.35
802.11n_HT40		MCS 0	85.19	0.70

3.3 Device Modifications

The following modifications were necessary for compliance:

Not applicable

3.4 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor $k = 2$, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	1.5 dB (C.L.: Approx. 95 %, $k = 2$)
Power Spectral Density	1.5 dB (C.L.: Approx. 95 %, $k = 2$)
Occupied Bandwidth	0.1 MHz (C.L.: Approx. 95 %, $k = 2$)
Unwanted Emission(conducted)	3.0 dB (C.L.: Approx. 95 %, $k = 2$)
Radiated Emissions ($f \leq 1$ GHz)	3.88 dB (C.L.: Approx. 95 %, $k = 2$)
Radiated Emissions ($f > 1$ GHz)	4.50 dB (C.L.: Approx. 95 %, $k = 2$)
Line Conducted Emission	2.08 dB (C.L.: Approx. 95 %, $k = 2$)

3.5 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	EP5RE Ver. 6.0.1.0, ES10 Ver. 10.001
Line Conducted Test	EMC32 Ver. 10.50.00

4. Technical Characteristic Test

4.1 6dB Bandwidth

Test Procedures

KDB 558074 - Section 8.2
ANSI C63.10-2013 - Section 11.8.2

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Procedures

ANSI C63.10-2013 - Section 6.9

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

Test Settings :

Center frequency = the highest, middle and the lowest channels

- | | |
|--|----------------------------|
| a) RBW = 100 kHz | b) VBW $\geq 3 \times$ RBW |
| c) Detector = peak | d) Trace mode = Max hold |
| e) Sweep = auto couple | |
| f) Allow trace to fully stabilize | |
| g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. | |

Minimum Standard :

6 dB Bandwidth > 500kHz

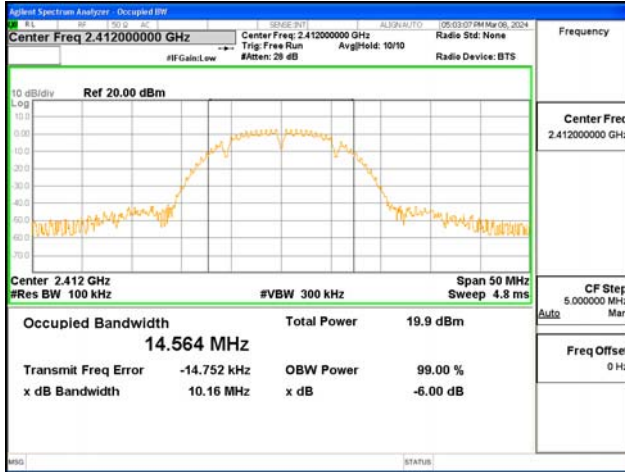
Test Data :

Mode	Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	99 % Bandwidth [MHz]	Result
MIMO, ANT0+ANT1, 802.11b	Lowest	2 412	10.160	14.564	Complies
	Middle	2 437	10.160	14.570	
	Highest	2 462	10.160	14.562	
MIMO, ANT0+ANT1, 802.11g	Lowest	2 412	15.130	16.224	
	Middle	2 437	15.150	16.236	
	Highest	2 462	15.160	16.231	
MIMO, ANT0+ANT1, 802.11n -HT20	Lowest	2 412	15.150	17.394	
	Middle	2 437	15.160	17.399	
	Highest	2 462	15.140	17.400	
MIMO, ANT0+ANT1, 802.11n -HT40	Lowest	2 422	35.130	35.607	
	Middle	2 437	35.140	35.646	
	Highest	2 452	35.130	35.598	

See next pages for actual measured spectrum plots.

ANT0

Test Mode : 802.11b(worst cases)
Lowest channel



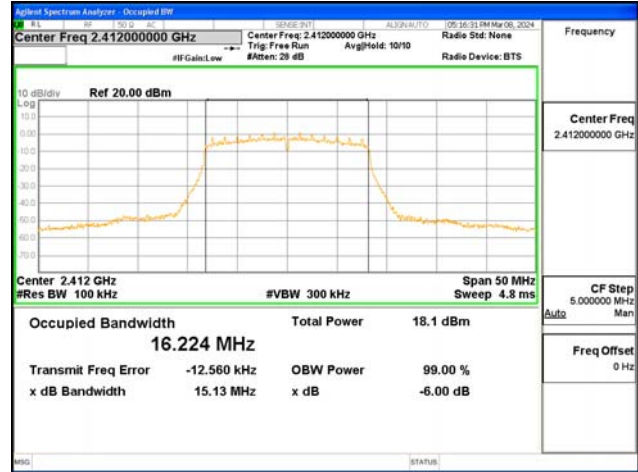
Middle channel



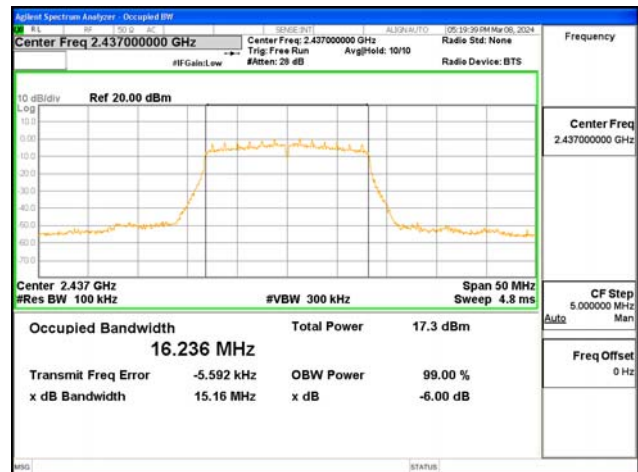
Highest channel



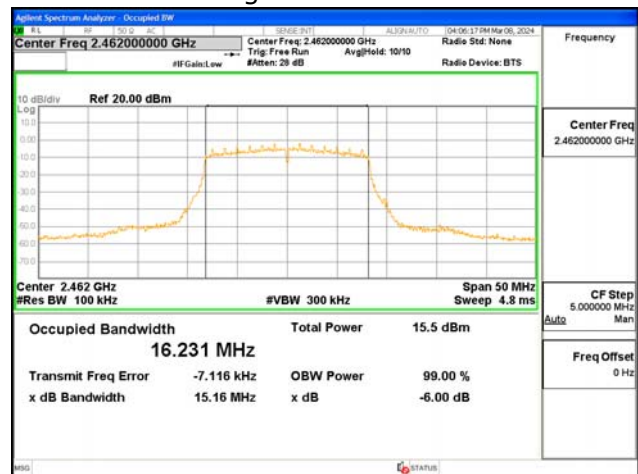
Test Mode : 802.11g(worst cases)
Lowest channel



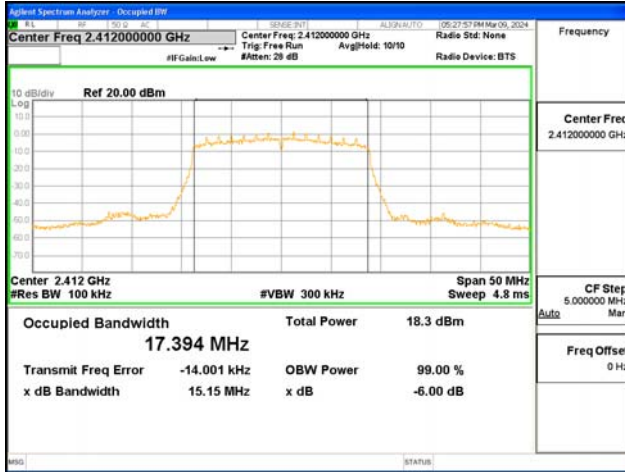
Middle channel



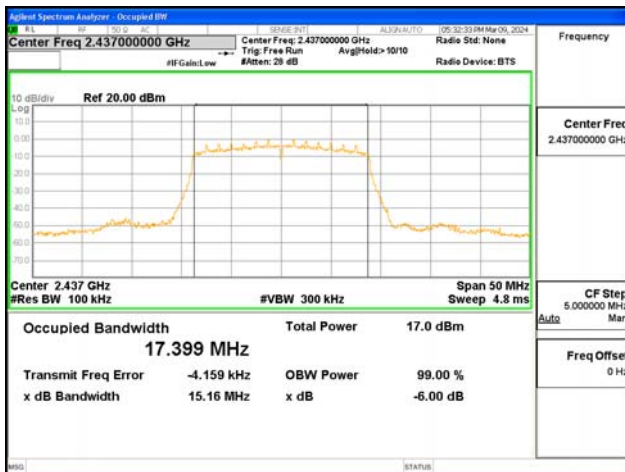
Highest channel



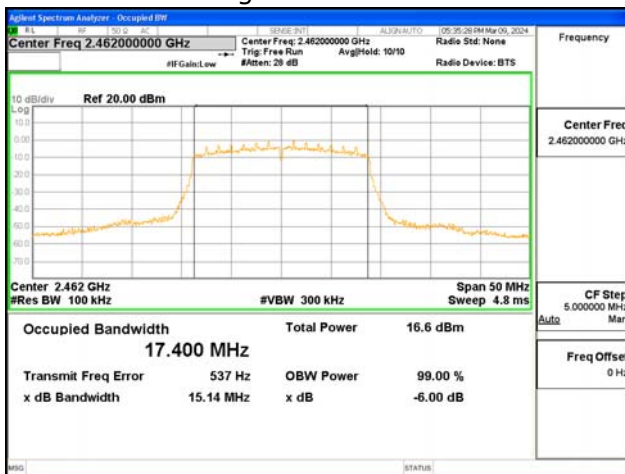
Test Mode : 802.11n20(worst cases)
Lowest channel



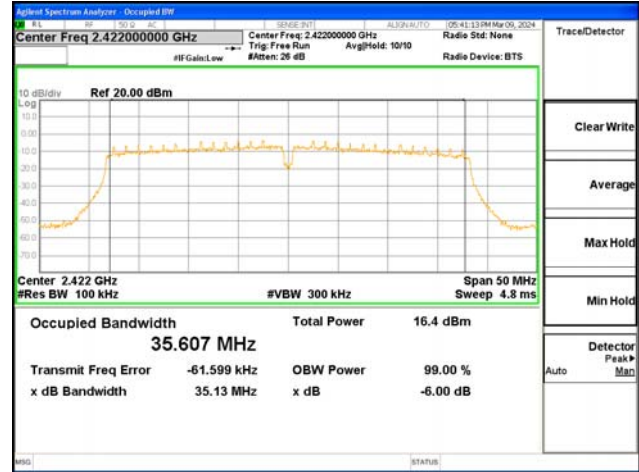
Middle channel



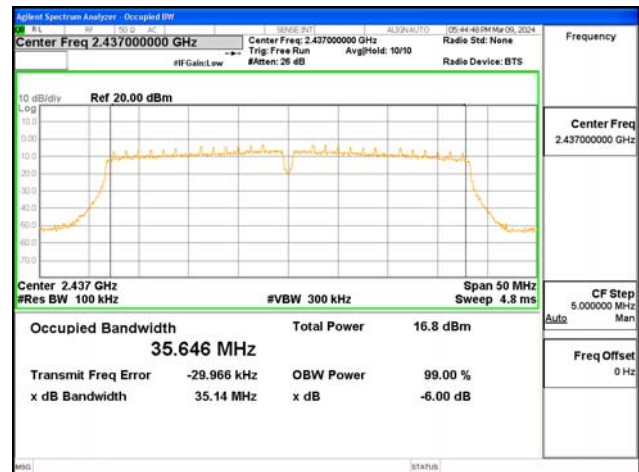
Highest channel



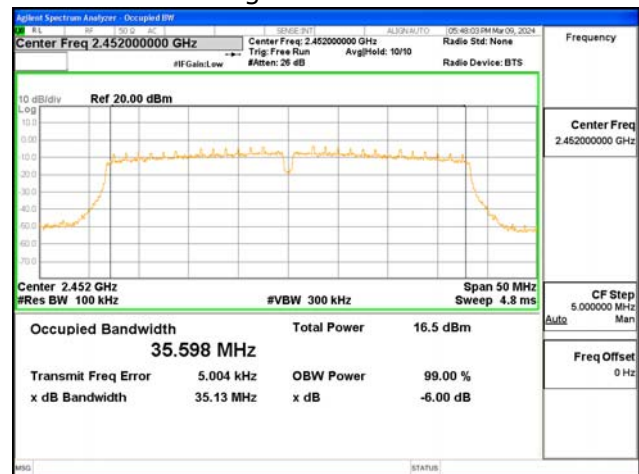
Test Mode : 802.11n40(worst cases)
Lowest channel



Middle channel



Highest channel



4.2 OUTPUT POWER

Test Procedures

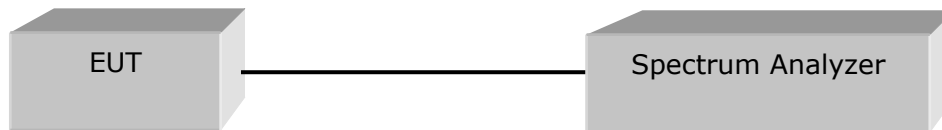
<802.11b/g/n mode>

KDB 558074 - Section 8.3.2.2 (Average Power)

ANSI C63.10-2013 - Section 11.9.2.2

KDB 662911 D01, D02 (Multiple Transmitter Output)

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.



Test Settings:

Center frequency = the highest, middle and the lowest channels

a) span $\geq 1.5 \times \text{OBW}$

b) RBW = 1 MHz

c) VBW $\geq 3 \times \text{RBW}$

d) Sweep time = auto

e) Detector = RMS

f) average at least 100

g) Duty cycle factor = $10\log(1/x)$

Test mode	Duty Cycle Factor (dB)
802.11b	0.14
802.11g	0.40
802.11n_HT20	0.35
802.11n_HT40	0.70

Operating Mode	Mode	ANT Configuration	ANT Gain (dBi)	Limit (dBm)
MIMO (2Tx)	802.11b 802.11g 802.11n_HT20 802.11n_HT40	ANT0 + ANT1	6.60	29.40

Note :

Per KDB 662911, the MIMO directional gain is calculated using the following formula, Where GN is the gain of the nth antenna and N_{ANT}, the total number of antennas used.

Directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{ANT}]$ dBi

Test Data :

Mode	Channel	Frequency [MHz]	Measurement data [dBm]	Duty cycle Factor [dB]	Result Output Power [dBm]	Limit [dBm]	Result
MIMO, ANT0+ANT1, 802.11b	Lowest	2 412	14.90	0.14	15.04	29.40	Complies
	Middle	2 437	14.52	0.14	14.66		
	Highest	2 462	13.44	0.14	13.58		
MIMO, ANT0+ANT1, 802.11g	Lowest	2 412	13.40	0.40	13.80		
	Middle	2 437	12.71	0.40	13.11		
	Highest	2 462	9.76	0.40	10.16		
MIMO, ANT0+ANT1, 802.11n -HT20	Lowest	2 412	13.54	0.35	13.89		
	Middle	2 437	12.47	0.35	12.82		
	Highest	2 462	12.22	0.35	12.57		
MIMO, ANT0+ANT1, 802.11n -HT40	Lowest	2 412	11.76	0.70	12.46		
	Middle	2 437	12.09	0.70	12.79		
	Highest	2 462	11.93	0.70	12.63		

See next pages for actual measured spectrum plots.

Test Mode : 802.11b_ANT0
Lowest channel



Middle channel



Highest channel



Test Mode : 802.11b_ANT1
Lowest channel



Middle channel



Highest channel



Test Mode : 802.11g_ANT0
Lowest channel



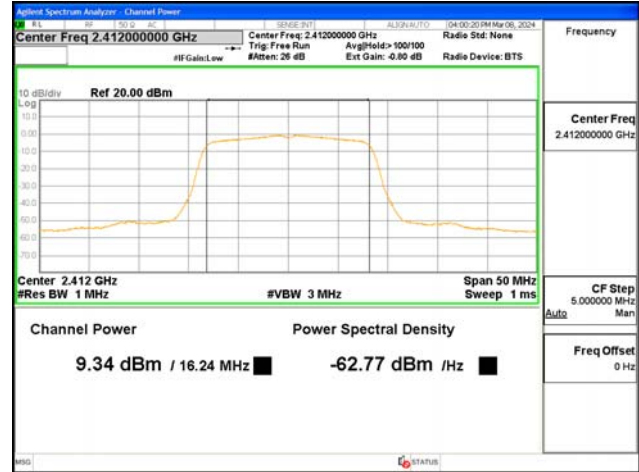
Middle channel



Highest channel



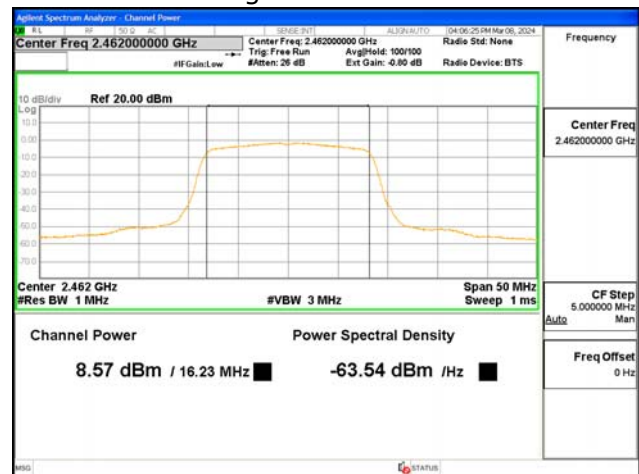
Test Mode : 802.11g_ANT1
Lowest channel



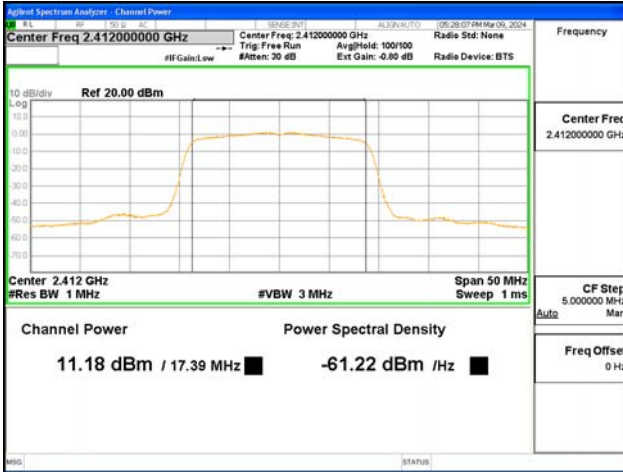
Middle channel



Highest channel



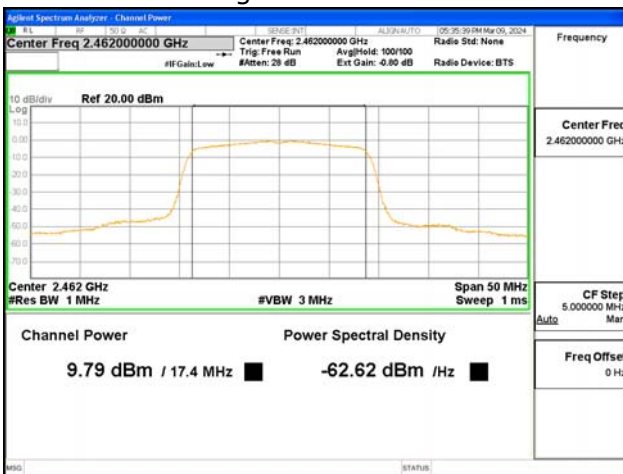
Test Mode : 802.11n-HT20_ANT0
Lowest channel



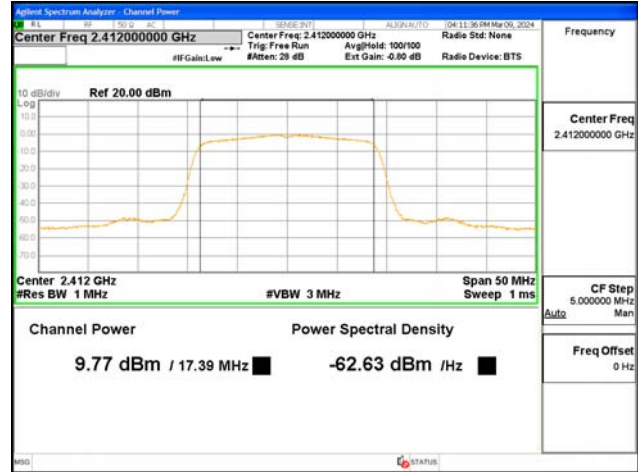
Middle channel



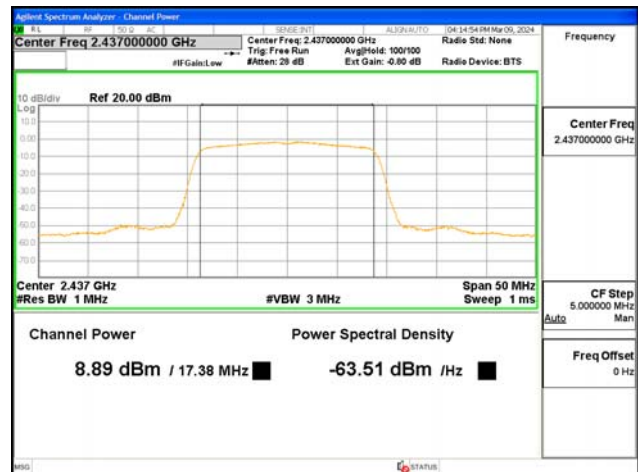
Highest channel



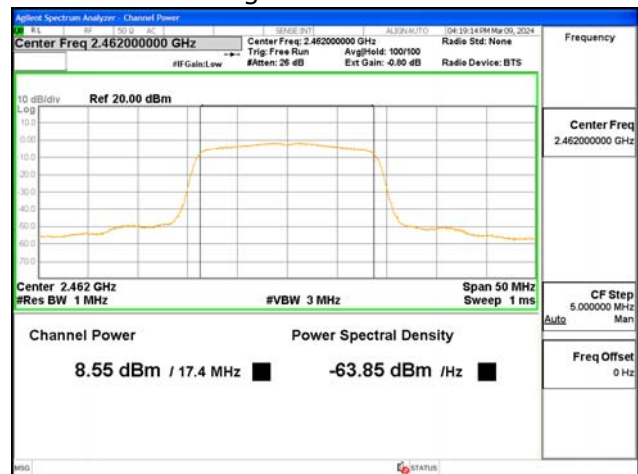
Test Mode : 802.11n-HT20_ANT1
Lowest channel



Middle channel



Highest channel



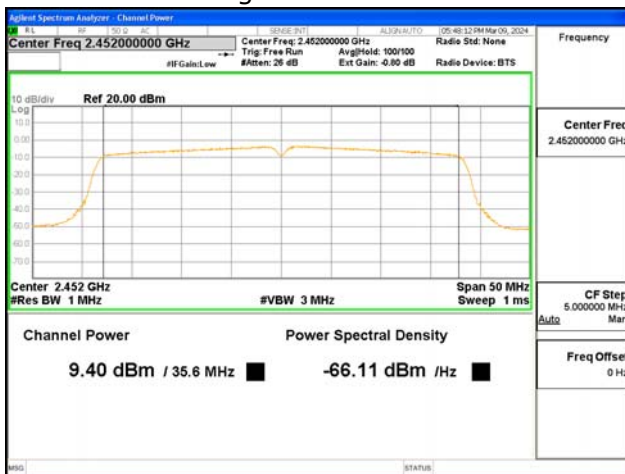
Test Mode : 802.11n-HT40_ANT0
Lowest channel



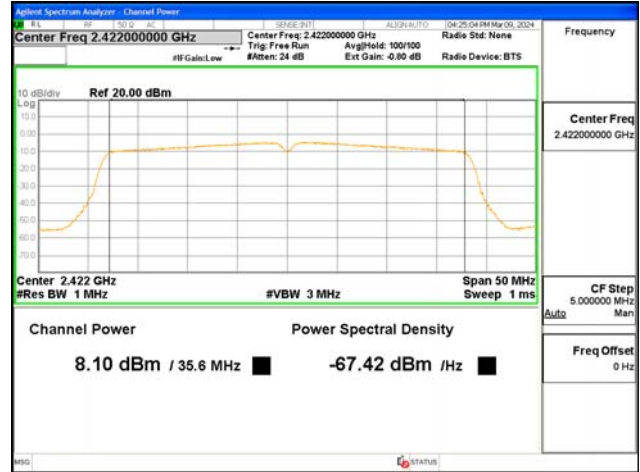
Middle channel



Highest channel



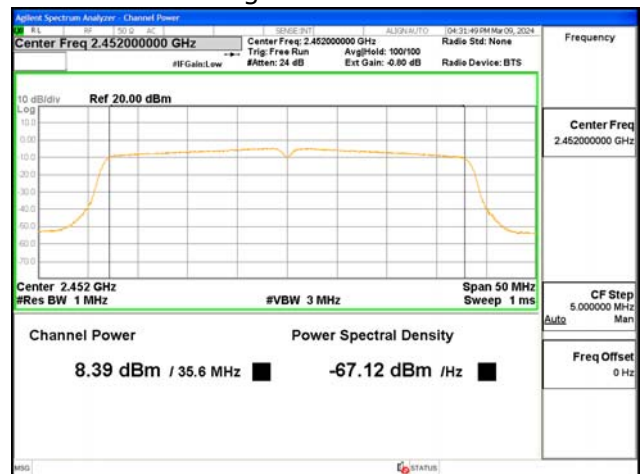
Test Mode : 802.11n-HT40_ANT1
Lowest channel



Middle channel



Highest channel



4.3 Transmitter Power Spectral Density

Test Procedures

KDB 558074 - Section 8.4
 ANSI C63.10-2013 - Section 11.10.2
 KDB 662911 D01, D02 (Multiple Transmitter Output)

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance.

Test Settings:

Center frequency = the highest, middle and the lowest channels

- a) RBW : $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- b) VBW $\geq 3 \times \text{RBW}$
- c) span $\geq 1.5 \times \text{DTS bandwidth}$
- d) Sweep time = auto couple
- e) Detector = peak
- f) Trace mode= max hold
- g) Allow trace to fully stabilize
- h) Use the peak marker function to determine the maximum amplitude level within the RBW.

Limit

Operating Mode	Mode	ANT Configuration	ANT Gain (dBi)	Limit (dBm)
MIMO (2Tx)	802.11b 802.11g 802.11n_HT20 802.11n_HT40	ANT0 + ANT1	6.60	7.40

Note :

Per KDB 662911, the MIMO directional gain is calculated using the following formula, Where G_N is the gain of the nth antenna and N_{ANT} , the total number of antennas used.

$$\text{Directional gain} = 10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{\text{ANT}}] \text{ dBi}$$

Test Data

Mode	Channel	Frequency [MHz]	Measurement data [dBm]	Limit [dBm]	Result
MIMO, ANT0+ANT1, 802.11b	Lowest	2 412	-8.36	7.4	Complies
	Middle	2 437	-8.46		
	Highest	2 462	-9.55		
MIMO, ANT0+ANT1, 802.11g	Lowest	2 412	-10.78		
	Middle	2 437	-12.00		
	Highest	2 462	-13.71		
MIMO, ANT0+ANT1, 802.11n -HT20	Lowest	2 412	-11.27		
	Middle	2 437	-11.23		
	Highest	2 462	-11.61		
MIMO, ANT0+ANT1, 802.11n -HT40	Lowest	2 412	-15.03		
	Middle	2 437	-14.94		
	Highest	2 462	-13.78		

See next pages for actual measured spectrum plots.



CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.:
CTK-2024-00853
Page (20) / (47) Pages

Power Spectral Density

Test Mode : 802.11b_ANT0
Lowest channel



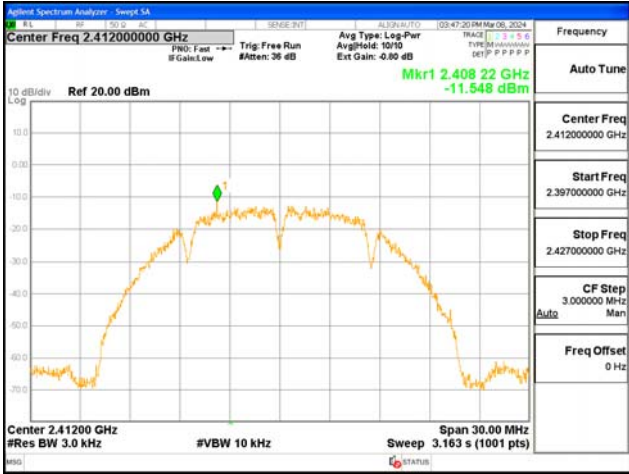
Middle channel



Highest channel



Test Mode : 802.11b_ANT1
Lowest channel



Middle channel



Highest channel

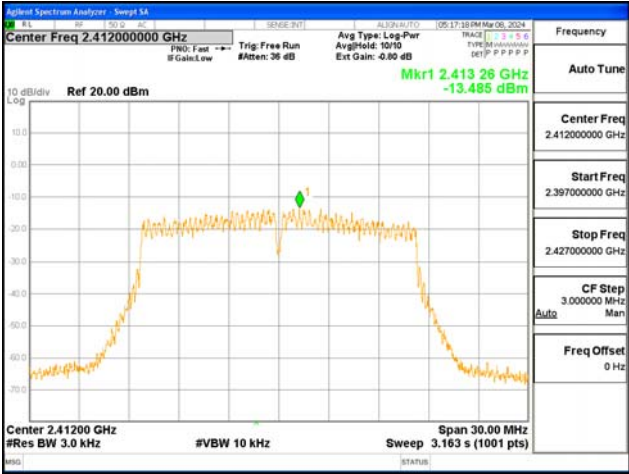




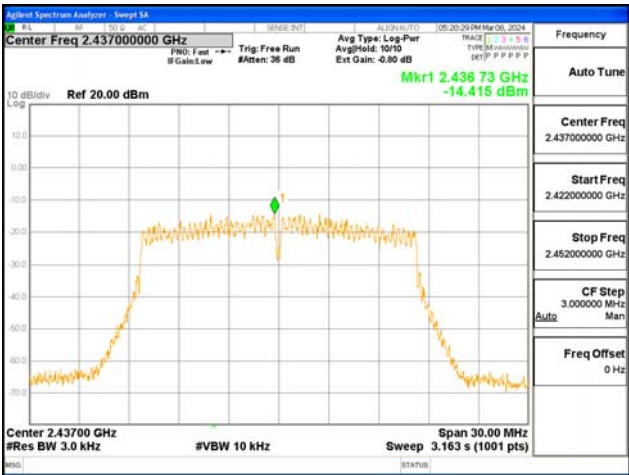
CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.:
CTK-2024-00853
Page (21) / (47) Pages

Test Mode : 802.11g _ANT0
Lowest channel



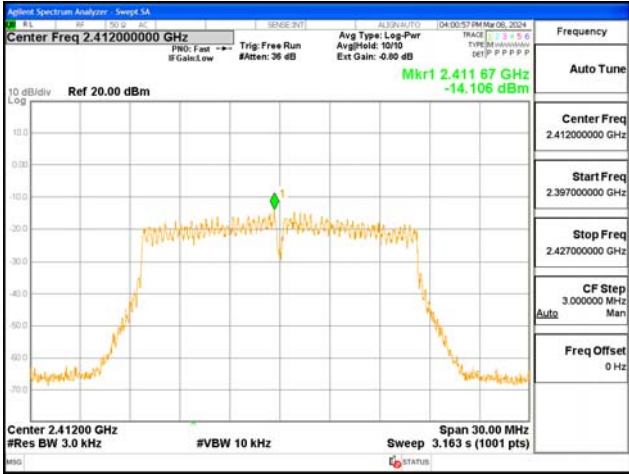
Middle channel



Highest channel



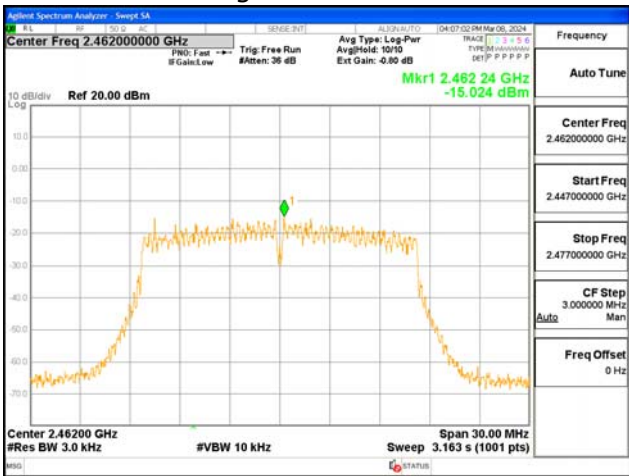
Test Mode : 802.11g _ANT2
Lowest channel



Middle channel



Highest channel

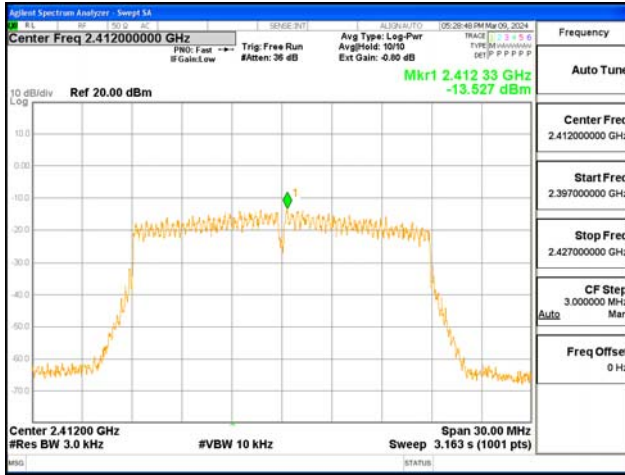




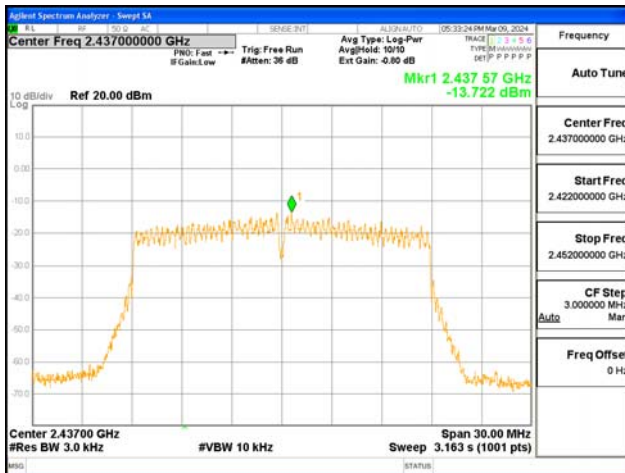
CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.:
CTK-2024-00853
Page (22) / (47) Pages

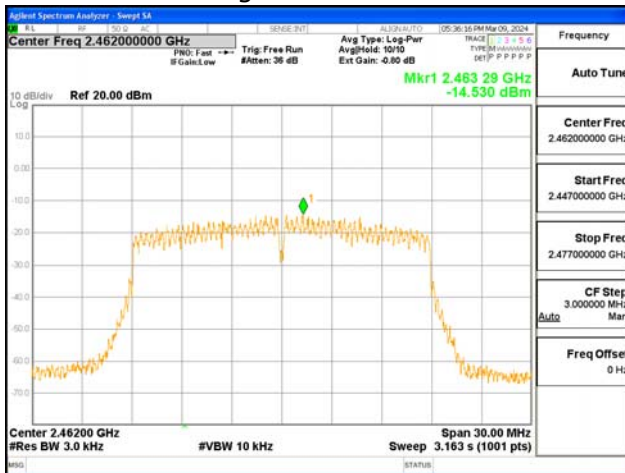
Test Mode : 802.11n-HT20_ANT0
Lowest channel



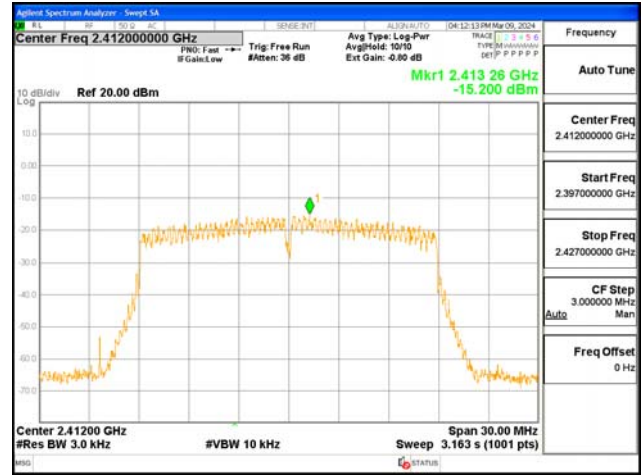
Middle channel



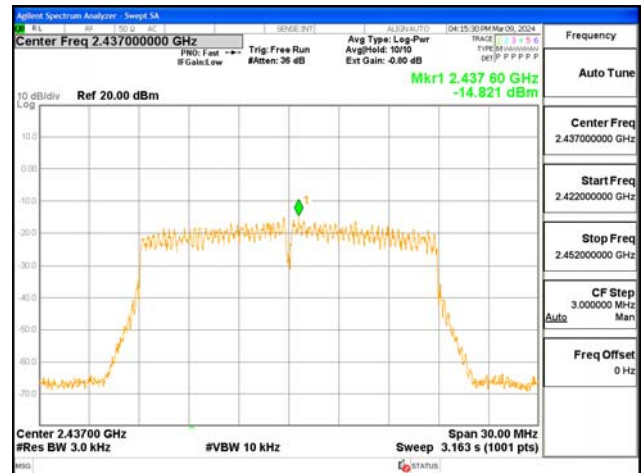
Highest channel



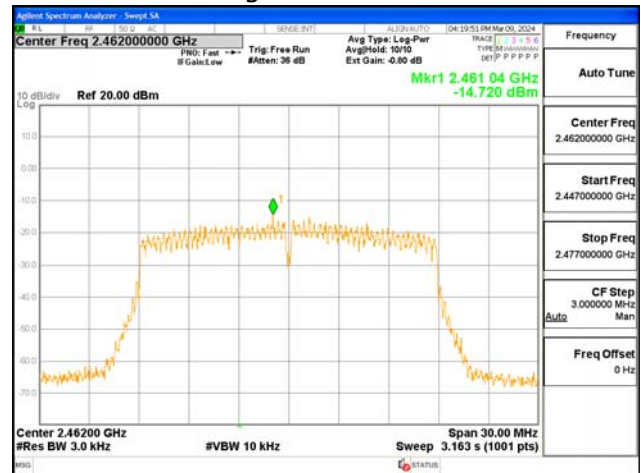
Test Mode : 802.11n-HT20_ANT1
Lowest channel



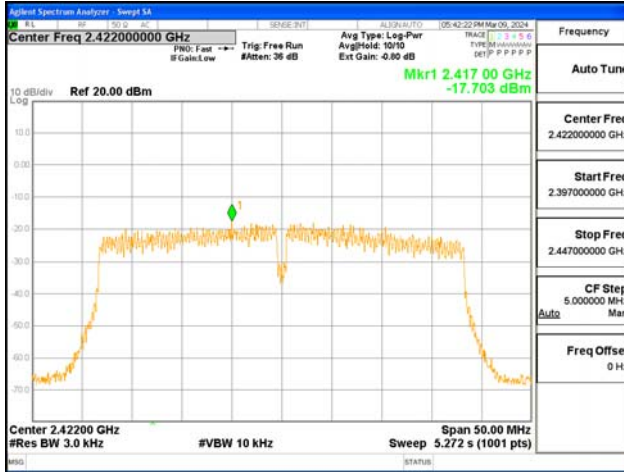
Middle channel



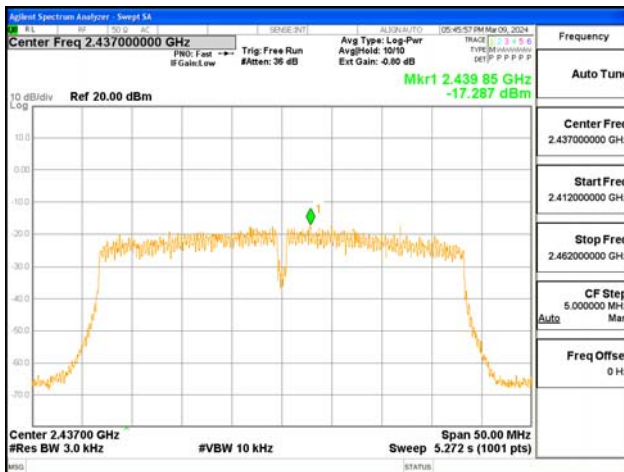
Highest channel



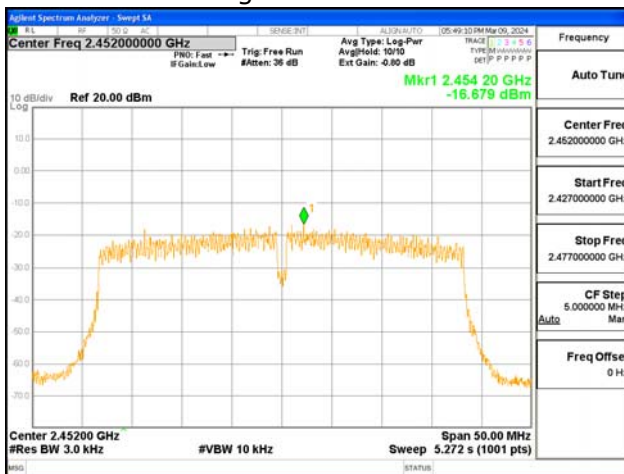
Test Mode : 802.11n-HT40_ANT0
Lowest channel



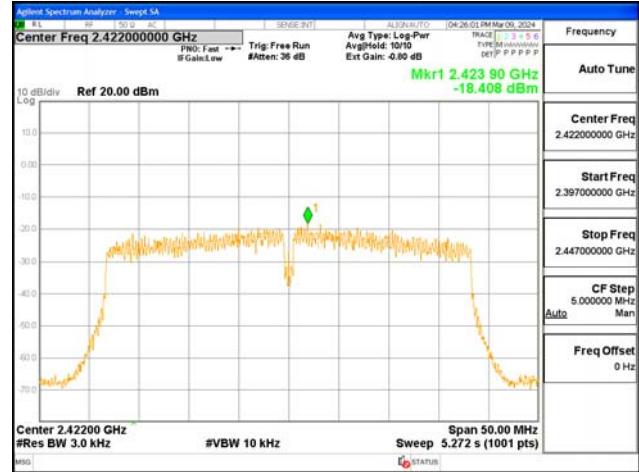
Middle channel



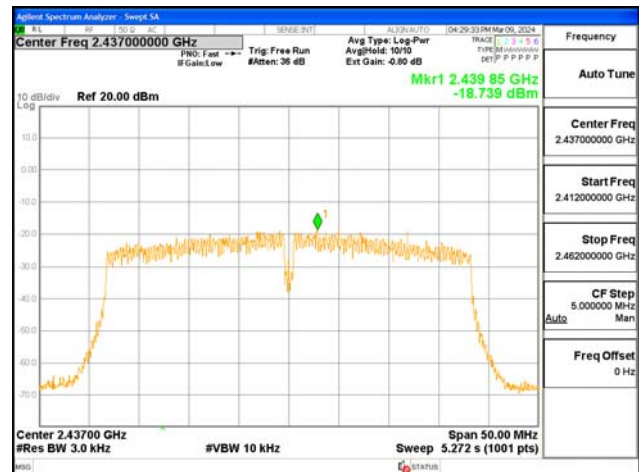
Highest channel



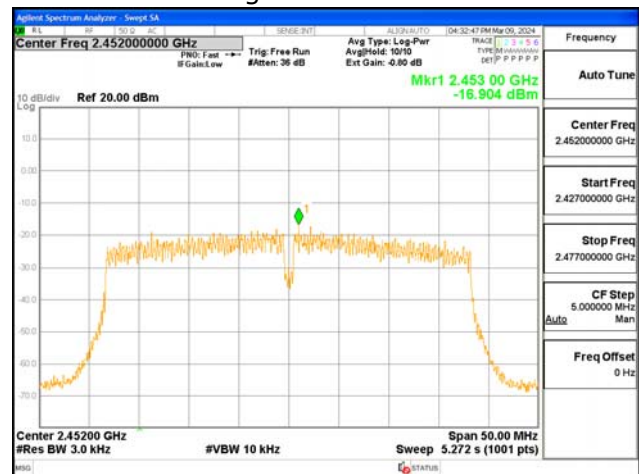
Test Mode : 802.11n-HT40_ANT1
Lowest channel



Middle channel



Highest channel



4.4 Conducted Spurious emission

Test Procedures

KDB 558074 - Section 8.5

ANSI C63.10-2013 - Section 11.11.3

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

Test Settings:

Center frequency = the highest, middle and the lowest channels

a) RBW = 100 kHz

b) VBW $\geq 3 \times$ RBW

c) Detector = peak

d) Sweep time = auto couple

e) Trace mode= max hold

f) Allow trace to fully stabilize

g) Use the peak marker function to determine the maximum amplitude level.

Limit :

Emission level < 30 dBc

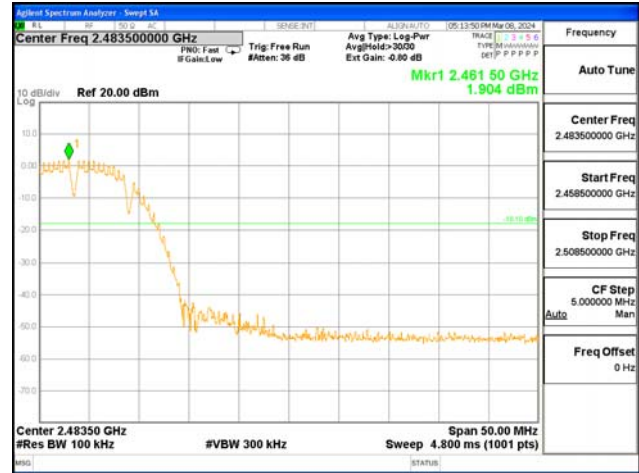
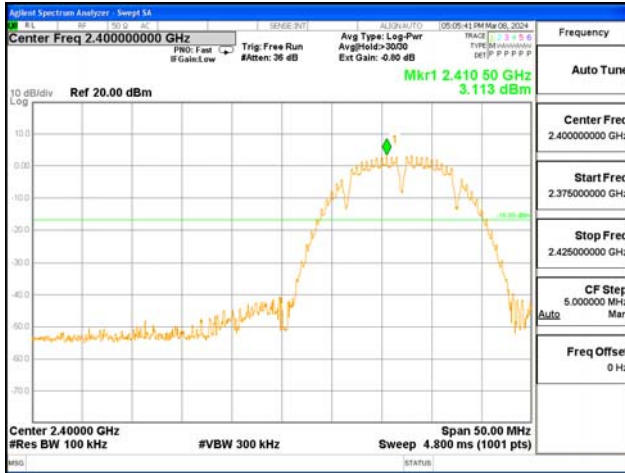
Test Data: Complies

- All conducted emission in any 100 kHz bandwidth outside of the spread spectrum band was at least 30dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.

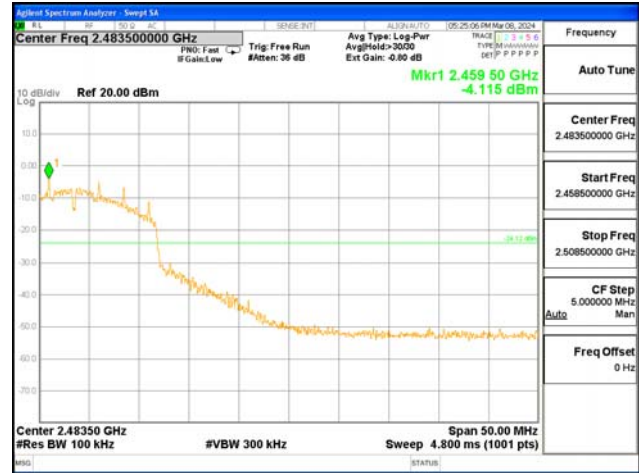
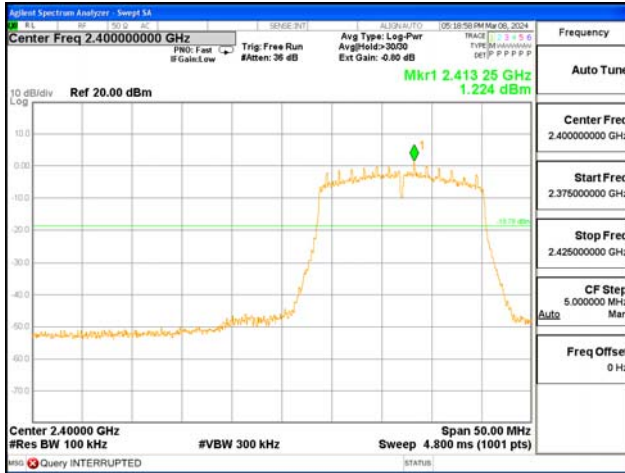
See next pages for actual measured spectrum plots.

Band-edge

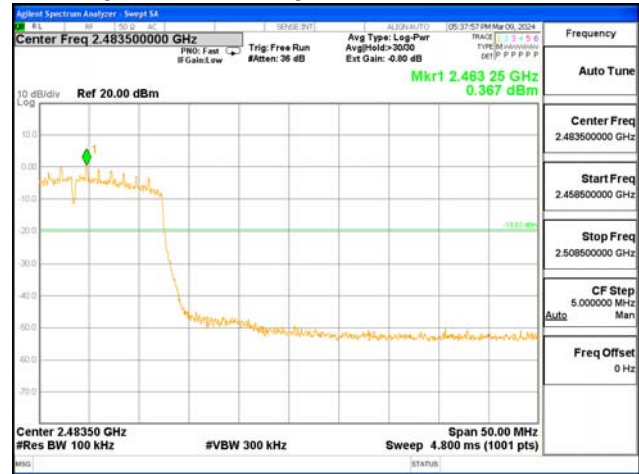
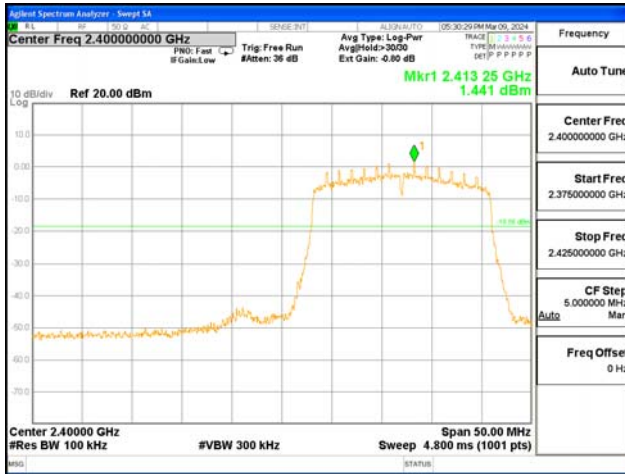
Test Mode : 802.11b(worst cases)



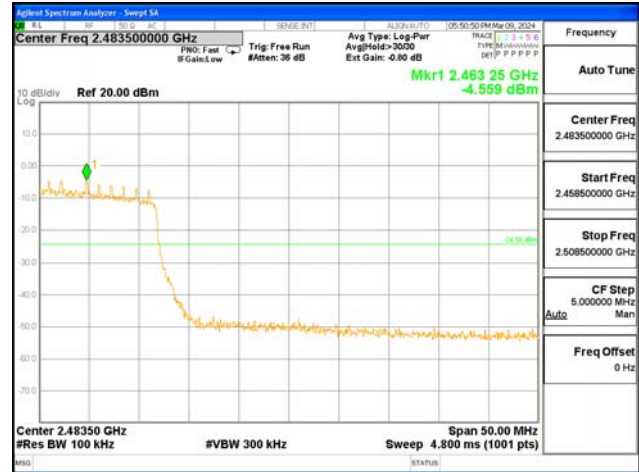
Test Mode : 802.11g(worst cases)



Test Mode : 802.11n-HT20(worst cases)



Test Mode : 802.11n-HT40(worst cases)





CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.:
CTK-2024-00853
Page (27) / (47) Pages

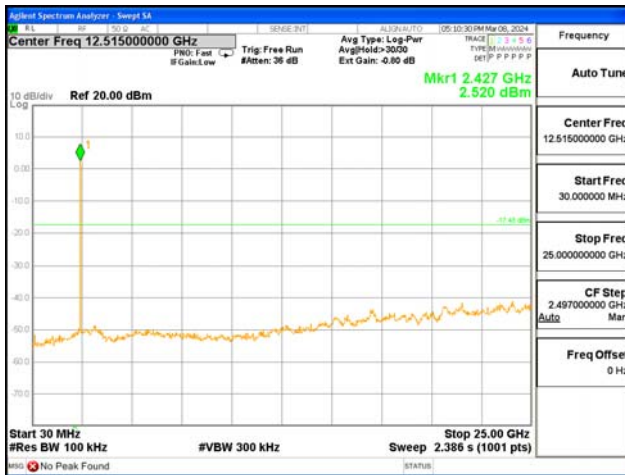
Spurious

Test Mode : 802.11b(worst cases)

Lowest channel



Middle channel

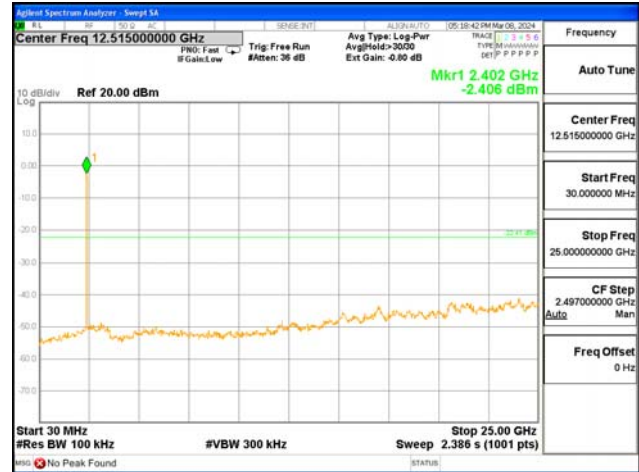


Highest channel



Test Mode : 802.11g(worst cases)

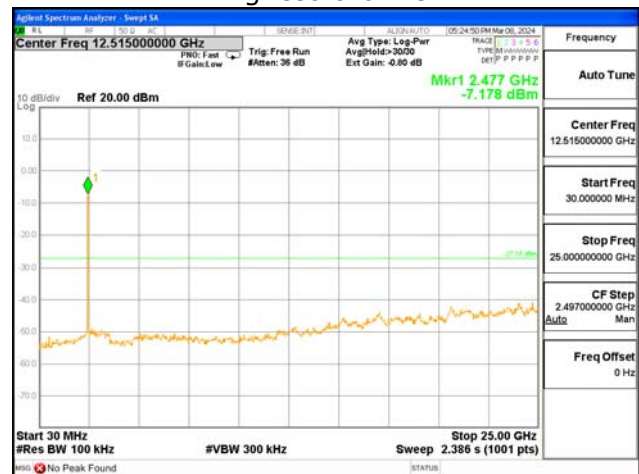
Lowest channel



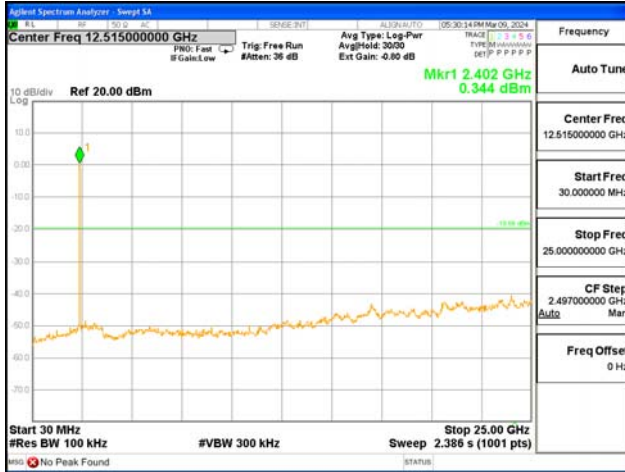
Middle channel



Highest channel



Test Mode : 802.11n-HT20(worst cases)
Lowest channel



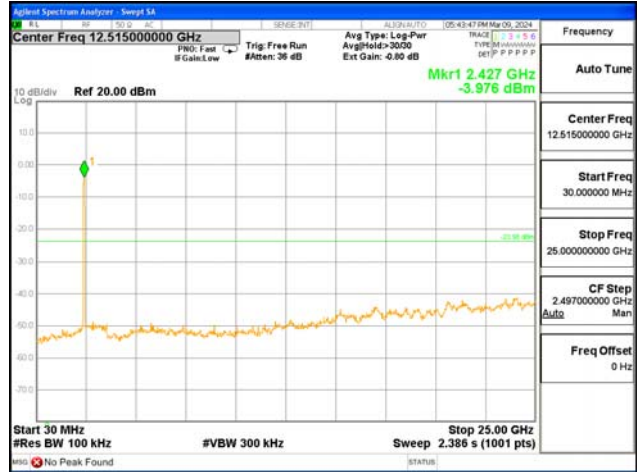
Middle channel



Highest channel



Test Mode : 802.11n-HT40(worst cases)
Lowest channel



Middle channel



Highest channel



4.5 Radiated Emission

Test Location

- ☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)
☒ 3 m SAC (test distance : 3 m)

Test Procedures

KDB 558074 - Section 8.5, 8.6
ANSI C63.10-2013 - Section 11.11, 11.12

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

Test Settings:

Frequency Range = 9 kHz ~ 1 GHz

- a) RBW = 100 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz
b) VBW $\geq$ RBW
c) Detector = CISPR Quasi-peak
d) Sweep time = auto couple

- Peak

Frequency Range = 1 GHz ~ 25 GHz (2.4 GHz 10th harmonic)

- a) RBW = 1 MHz
b) VBW $\geq 3 \times$ RBW
c) Detector = Peak
d) Sweep time = auto
e) Trace mode = max hold

- Average (duty cycle $\geq 98\%$)

Frequency Range = 1 GHz ~ 25 GHz (2.4 GHz 10th harmonic)

- a) RBW = 1 MHz
b) VBW $\geq 3 \times$ RBW
c) Detector = RMS
d) Sweep time = auto
e) Averaging type = power (i.e., RMS)
f) Trace mode = average (at least 100 traces)

- Average (duty cycle < 98%, duty cycle variations are less than $\pm 2\%$)

Frequency Range = 1 GHz ~ 25 GHz (2.4 GHz 10th harmonic)

a) RBW = 1 MHz

b) VBW $\geq 3 \times$ RBW

c) Detector = RMS

d) Sweep time = auto

e) Averaging type = power (i.e., RMS)

f) Trace mode = average (at least 100 traces)

A 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.

If power averaging (RMS) mode, then the applicable correction factor is $10 \log(1/x)$, where x is the duty cycle.

Test mode	Duty Cycle Factor
802.11g_ANT0	0.14
802.11g_ANT1	0.40
802.11n_HT20	0.35
802.11n_HT40	0.70

Limit :

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	MHz	GHz
0.09-0.11	8.37626-8.38675	73-74.6	399.9-410	2690-2900	10.6-12.7
¹ 0.495-0.505	8.41425-8.41475	74.8-75.2	608-614	3260-3267	13.25-13.4
2.1735-2.1905	12.29-12.293	108-121.94	960-1240	3332-3339	14.47-14.5
4.125-4.128	12.51975-12.52025	123-138	1300-1427	3345.8-3358	15.35-16.2
4.17725-4.17775	12.57675-12.57725	149.9-150.05	1435-1626.5	3600-4400	17.7-21.4
4.20725-4.20775	13.36-13.41	156.52475-156.52525	1645.5-1646.5	4500-5150	22.01-23.12
6.215-6.218	16.42-16.423	156.7-156.9	1660-1710	5350-5460	23.6-24
6.26775-6.26825	16.69475-16.69525	162.0125-167.17	1718.8-1722.2	7250-7750	31.2-31.8
6.31175-6.31225	16.80425-16.80475	167.72-173.2	2200-2300	8025-8500	36.43-36.5
8.291-8.294	25.5-25.67	240-285	2310-2390	9000-9200	² Above 38.6
8.362-8.366	37.5-38.25	322-335.4	2483.5-2500	9300-9500	

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Deasurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)

Test Mode

We have done all test mode.

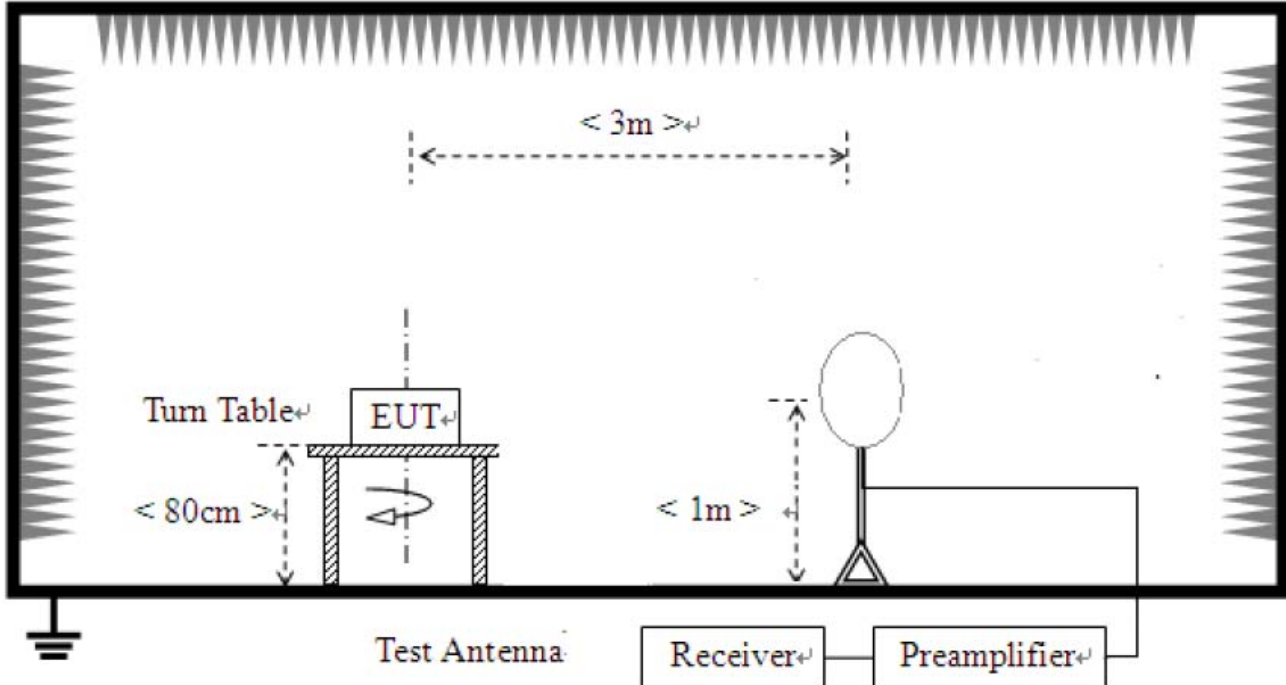
The worst-case antenna configuration and Test mode are determined to be as follows.

802.11b, g, n-HT20, n-HT40 mode : ANT0 + ANT1 (MIMO)

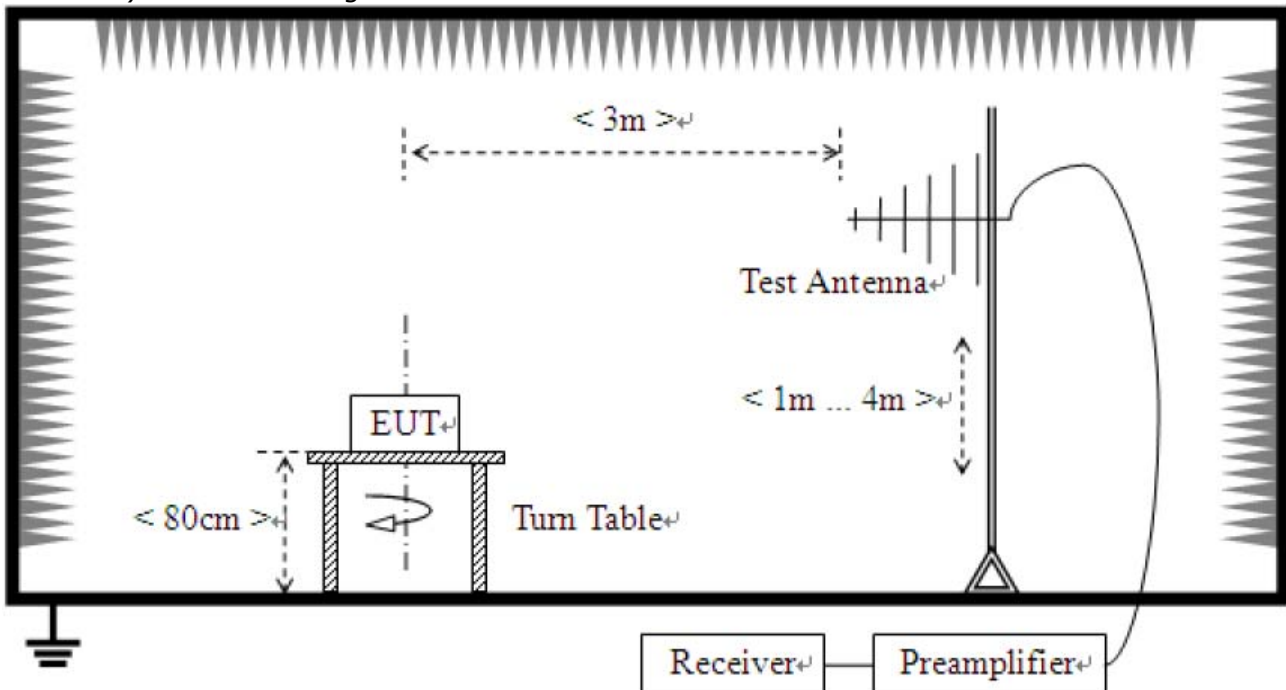
So the results are only attached worst cases.

Test Setup:

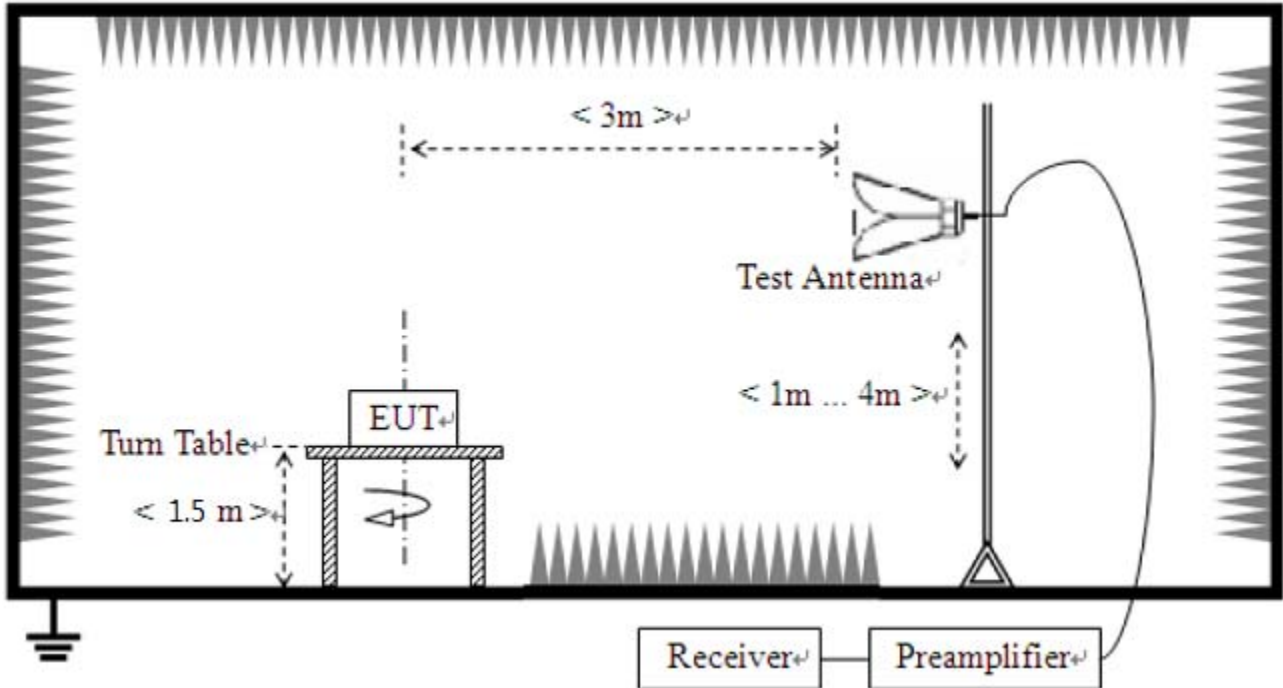
- 1) For field strength of emissions from 9 kHz to 30 MHz



- 2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



Test results

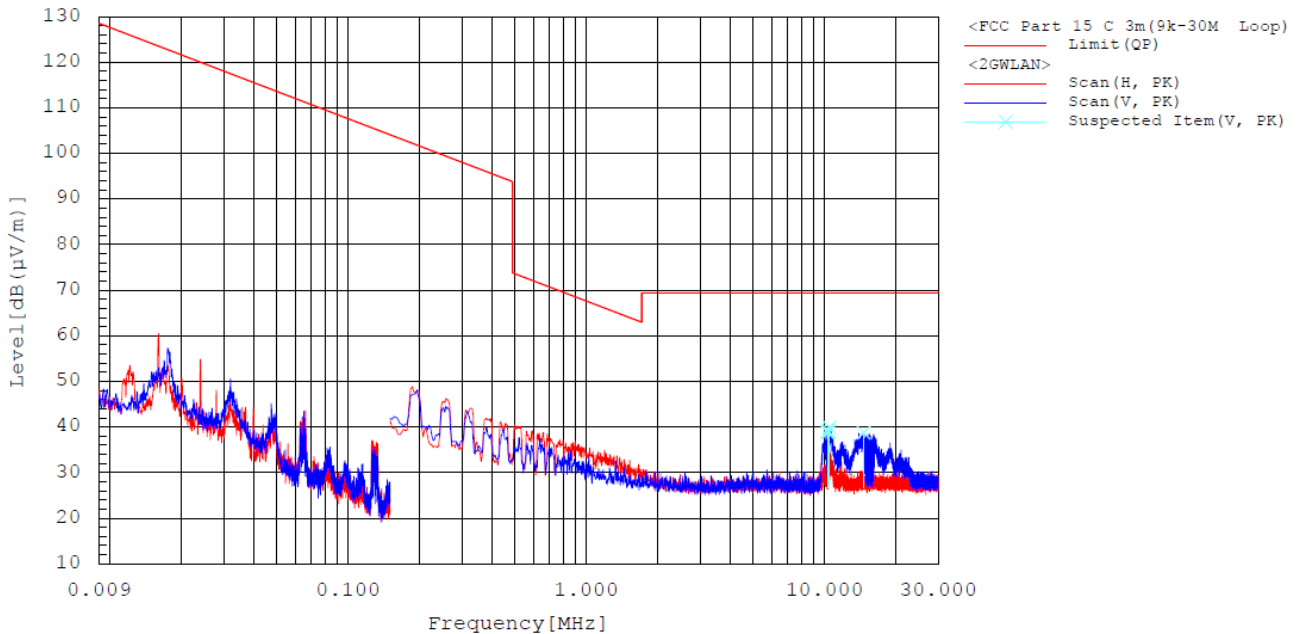
1) 9 kHz to 30 MHz

Test mode : 802.11b_MIMO(Worst Case)

The requirements are:

☒ Complies

Test Data



Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]
-----------------	-----	----------------	---------------	------------------	------------------	-------------

The emissions 9 kHz to 30 MHz were 20 dB lower than the limit.

Remark :

1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
4. This data is the Peak(PK) value.

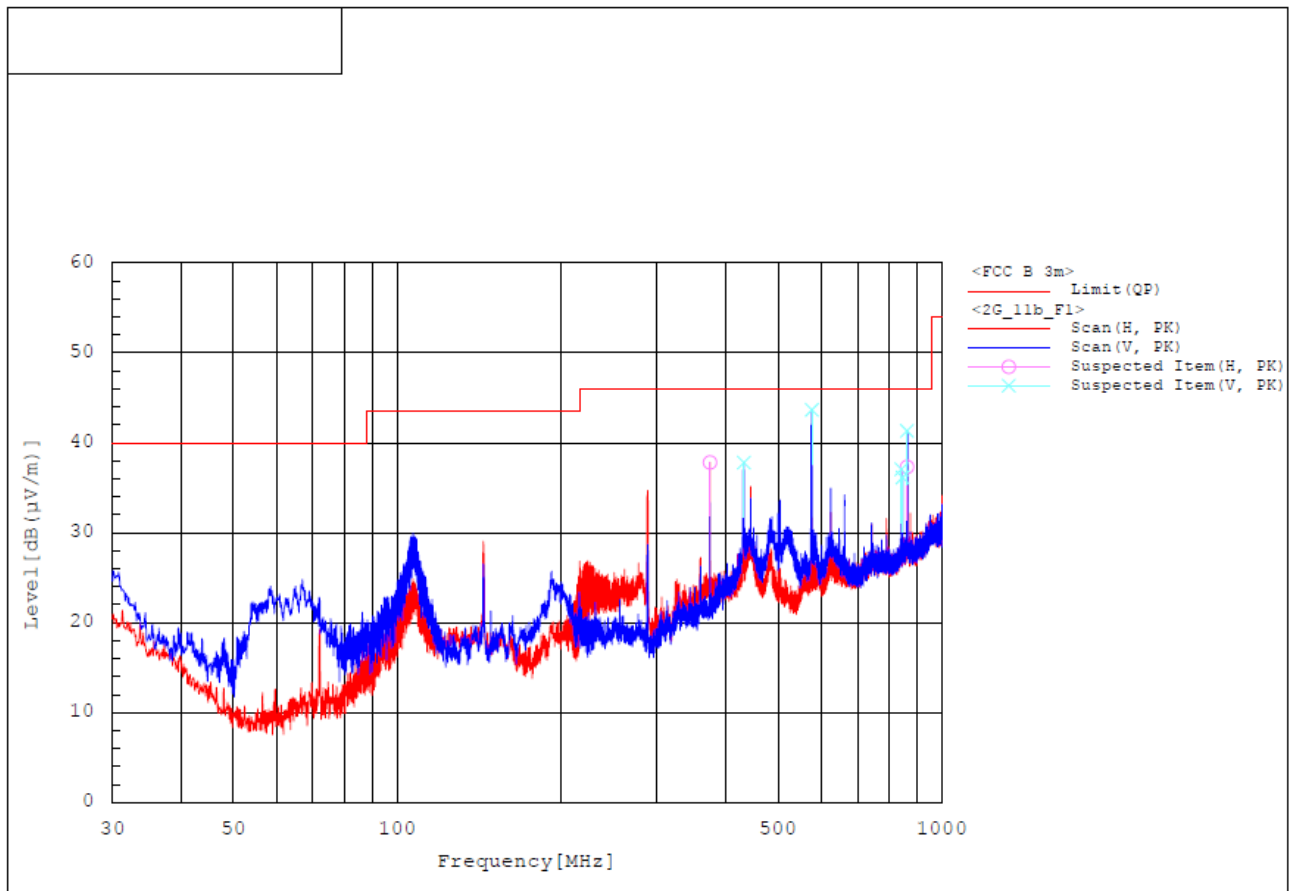
2) 30 MHz to 1 GHz

Test mode : 802.11b_MIMO(Worst Case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency [MHz]	Pol	Reading PK [dB(μV)]	c.f [dB(1/m)]	Result PK [dB(μV/m)]	Limit QP [dB(μV/m)]	Margin QP-PK [dB]	Height [cm]	Angle [deg]	Remark
1	375.029	H	45.8	-8.0	37.8	46.0	8.2	99.9	123.9	
2	432.928	V	43.7	-5.9	37.8	46.0	8.2	99.9	0.4	
3	576.886	V	45.9	-2.2	43.7	46.0	2.3	99.9	41.6	
4	842.278	V	34.8	2.3	37.1	46.0	8.9	99.9	116.1	
5	846.827	V	33.6	2.6	36.2	46.0	9.8	99.9	221.1	
6	862.648	V	38.3	3.0	41.3	46.0	4.7	99.9	0.4	
7	862.929	H	34.3	3.0	37.3	46.0	8.7	400.0	255.3	

Remark :

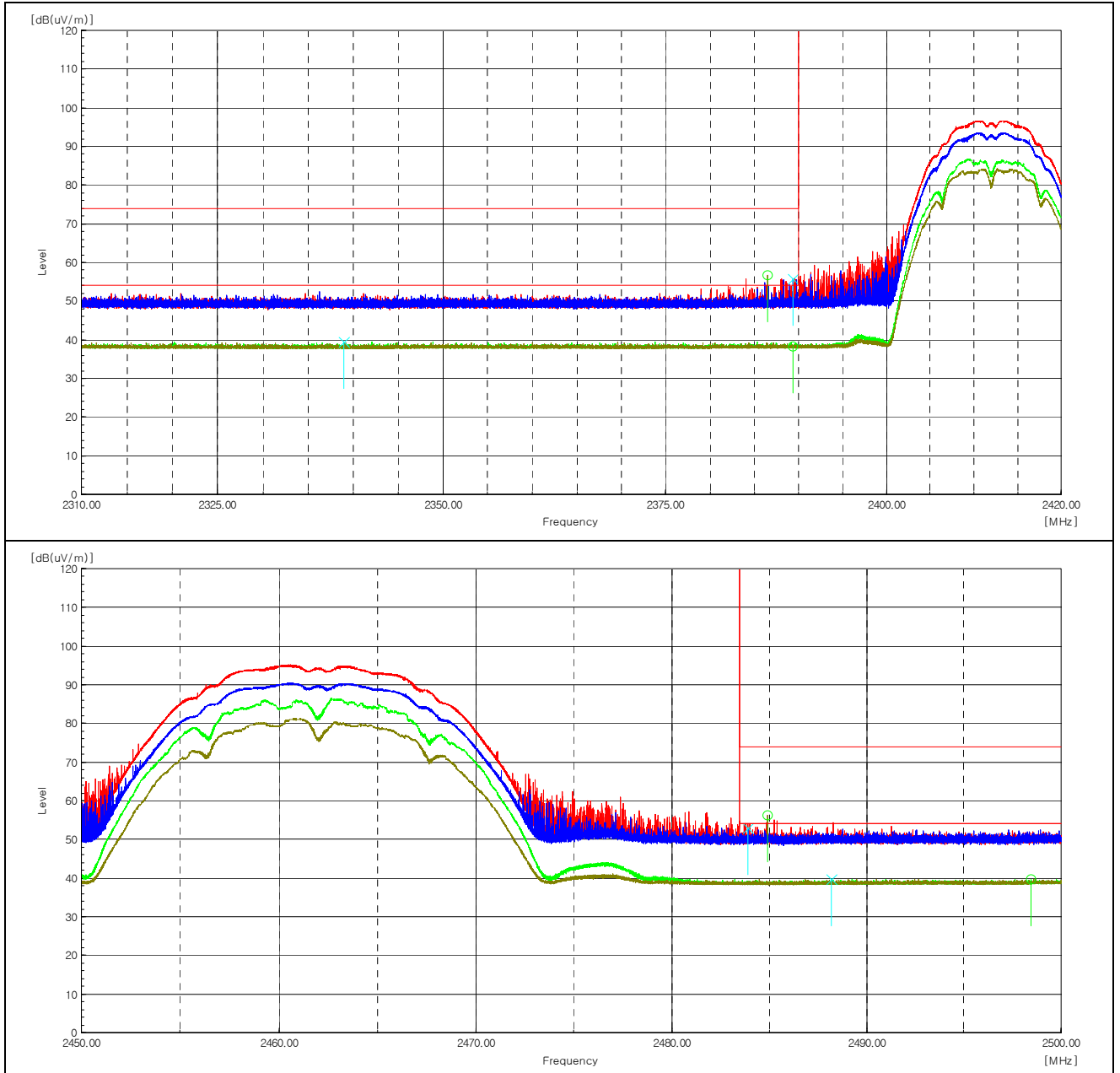
- The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
- Result = Reading + c.f(Correction factor)
- Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

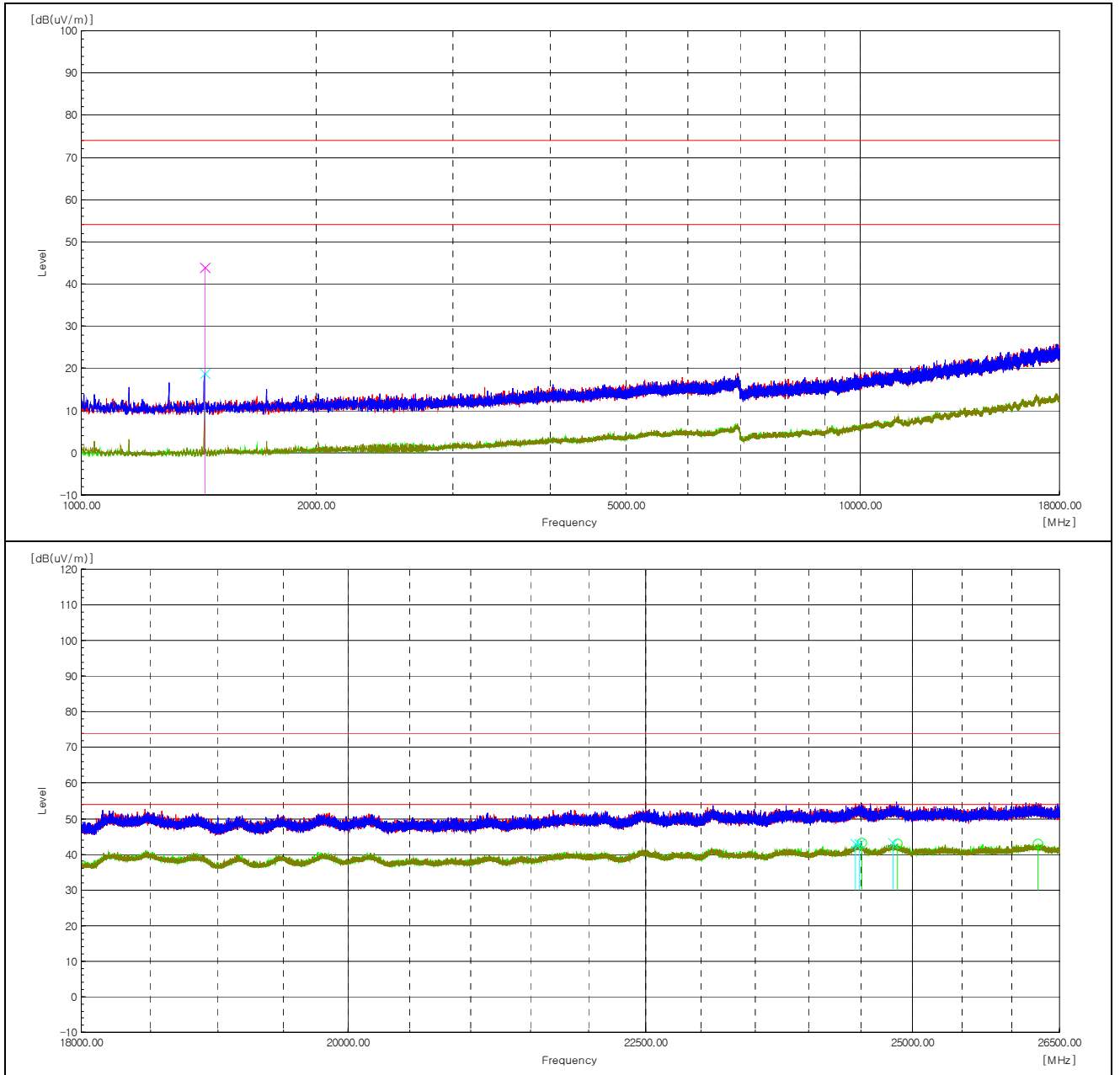
3) above 1 GHz

The requirements are:

☒ Complies

Test Data





Test mode : 802.11b_MIMO

Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
2 338.9	V	45.4	-6.0	-----	-----	39.4	-----	54.0	-----	14.6	Average
2 389.4	V	61.5	-5.8	0.1	55.8	-----	74.0	-----	18.2	-----	Peak
2 389.4	H	44.0	-5.8	0.1	-----	38.3	-----	54.0	-----	15.7	Average
2 386.5	H	62.5	-5.8	0.1	56.8	-----	74.0	-----	17.2	-----	Peak
1 440.0	V	53.9	-9.9	-----	44.0	-----	74.0	-----	30.0	-----	Peak

Middle channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
The emissions 30 MHz to 1 GHz were 20 dB lower than the limit.											

Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
2 484.9	H	61.6	-5.3	0.1	56.3	-----	74.0	-----	17.7	-----	Average
2 498.5	H	45.0	-5.1	0.1	-----	39.9	-----	54.0	-----	14.1	Peak
2 483.9	V	58.3	-5.3	0.1	53.0	-----	74.0	-----	21.0	-----	Average
2 488.2	V	45.1	-5.2	0.1	-----	39.9	-----	54.0	-----	14.1	Peak
1 440.7	V	54.8	-9.9	-----	44.9	-----	74.0	-----	29.1	-----	Peak

Remarks

1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
2. Peak Result = Reading + c.f(Correction factor)
Average Result = Reading + c.f(Correction factor) + Duty Cycle Factor
3. Correction factor = Antenna factor + Cable loss - Amp Gain

Test mode : 802.11g_MIMO

Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
2 322.9	H	58.2	-6.0	-----	52.2	-----	74.0	-----	21.8	-----	Peak
2 316.0	H	45.4	-6.0	-----	-----	39.4	-----	54.0	-----	14.6	Average
2 316.0	V	55.7	-6.0	-----	49.7	-----	74.0	-----	24.3	-----	Peak
2 381.1	V	44.2	-5.8	-----	-----	38.4	-----	54.0	-----	15.6	Average

Middle channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
The emissions 30 MHz to 1 GHz were 20 dB lower than the limit.											

Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
2 486.9	H	57.8	-5.2	-----	52.6	-----	74.0	-----	21.4	-----	Peak
2 494.9	H	45.2	-5.2	-----	-----	40.0	-----	54.0	-----	14.0	Average
2 499.3	V	57.5	-5.1	-----	52.4	-----	74.0	-----	21.6	-----	Peak
2 490.2	V	44.9	-5.2	-----	-----	39.7	-----	54.0	-----	14.3	Average

Remarks

1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
2. Peak Result = Reading + c.f(Correction factor)
Average Result = Reading + c.f(Correction factor) + Duty Cycle Factor
3. Correction factor = Antenna factor + Cable loss - Amp Gain

Test mode : 802.11n_HT20_MIMO

Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
2 376.8	H	58.2	-5.9	-----	52.3	-----	74.0	-----	21.7	-----	Peak
2 353.8	H	45.5	-5.9	-----	-----	39.6	-----	54.0	-----	14.4	Average
2 357.0	V	58.2	-5.9	-----	52.3	-----	74.0	-----	21.7	-----	Peak
2 357.0	V	44.0	-5.9	-----	-----	38.1	-----	54.0	-----	15.9	Average

Middle channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
The emissions 30 MHz to 1 GHz were 20 dB lower than the limit.											

Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
2 491.6	H	58.4	-5.2	-----	53.2	-----	74.0	-----	20.8	-----	Peak
2 491.8	H	45.2	-5.2	-----	-----	40.0	-----	54.0	-----	14.0	Average
2 497.0	V	58.3	-5.2	-----	53.1	-----	74.0	-----	20.9	-----	Peak
2 499.1	V	45.0	-5.1	-----	-----	39.9	-----	54.0	-----	14.1	Average

Remarks

1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
2. Peak Result = Reading + c.f(Correction factor)
Average Result = Reading + c.f(Correction factor) + Duty Cycle Factor
3. Correction factor = Antenna factor + Cable loss - Amp Gain

Test mode : 802.11n_HT40_MIMO

Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
2 318.9	H	58.8	-6.0	-----	52.8	-----	74.0	-----	21.2	-----	Peak
2 353.5	H	45.6	-5.9	0.7	-----	39.7	-----	54.0	-----	14.3	Average
2 385.0	V	58.2	-5.8	0.7	52.4	-----	74.0	-----	21.6	-----	Peak
2 355.7	V	45.3	-5.9	0.7	-----	39.4	-----	54.0	-----	14.6	Average

Middle channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
The emissions 30 MHz to 1 GHz were 20 dB lower than the limit.											

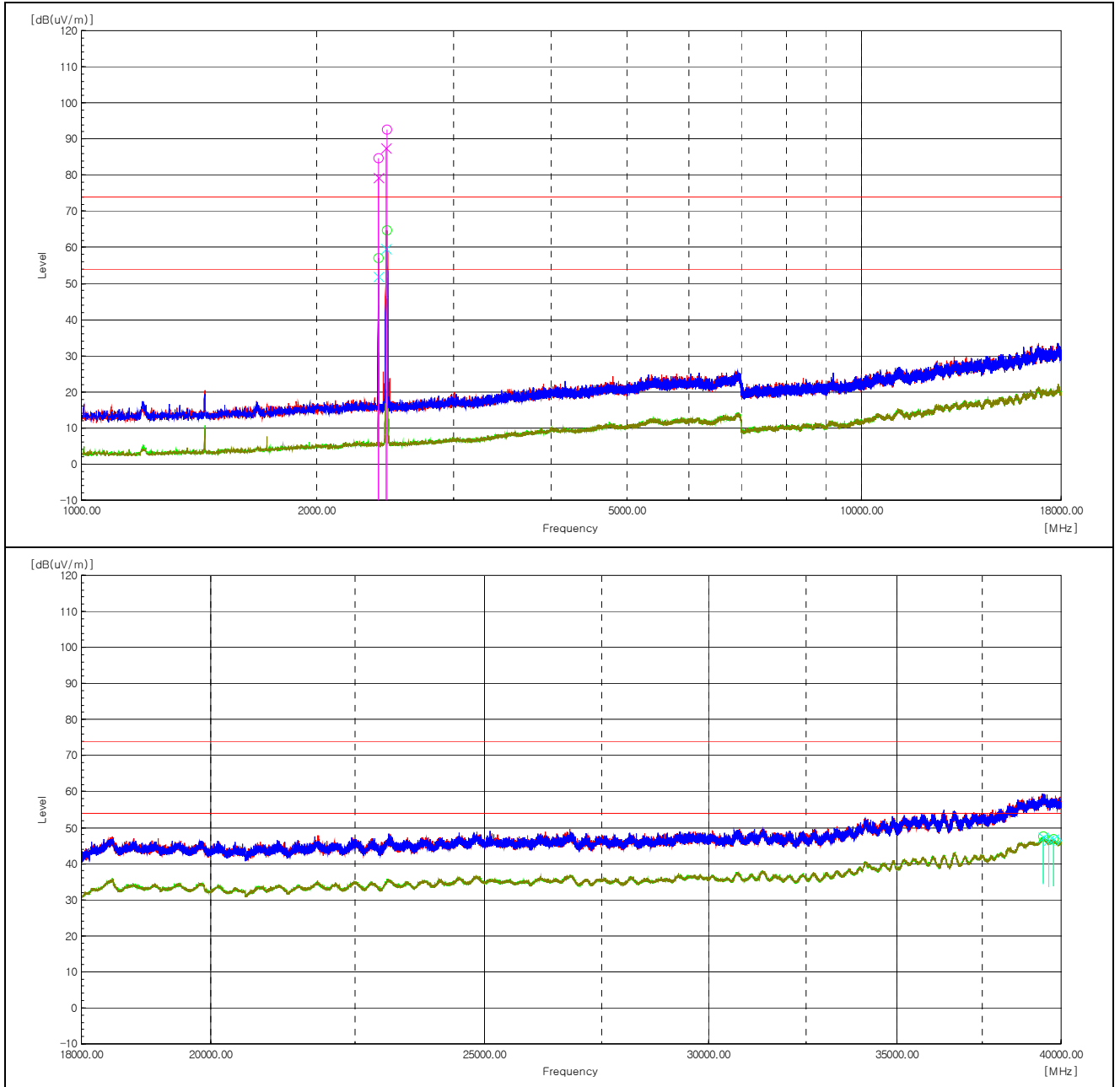
Highest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
2 487.0	H	59.0	-5.2	-----	53.8	-----	74.0	-----	20.2	-----	Peak
2 499.7	H	45.4	-5.1	-----	-----	40.3	-----	54.0	-----	13.7	Average
2 497.1	V	58.6	-5.2	-----	53.4	-----	74.0	-----	20.6	-----	Peak
2 487.2	V	45.0	-5.2	-----	-----	39.8	-----	54.0	-----	14.2	Average

Remarks

1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
2. Peak Result = Reading + c.f(Correction factor)
Average Result = Reading + c.f(Correction factor) + Duty Cycle Factor
3. Correction factor = Antenna factor + Cable loss - Amp Gain

Test mode : BT(ANT0) + WLAN(ANT0+ANT1)



GFSK Lowest channel & 802.11b Lowest channel

Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Duty Cycle Factor [dB]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Note
The emissions 30 MHz to 1 GHz were 20 dB lower than the limit.											

 CTK Co., Ltd. The Prime Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2024-00853 Page (44) / (47) Pages	
---	---	---	--

Remarks

1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
2. Peak Result = Reading + c.f(Correction factor)
Average Result = Reading + c.f(Correction factor) + Duty Cycle Factor
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. The measured frequency is the operating frequency.

4.6 AC Conducted Emissions

Frequency Range of Measurement

150 kHz to 30 MHz

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

ANSI C63.10-2013 - Section 6.2

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

- 15.207(a)

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average**
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* The level decreases linearly with the logarithm of the frequency.

** A linear average detector is required.

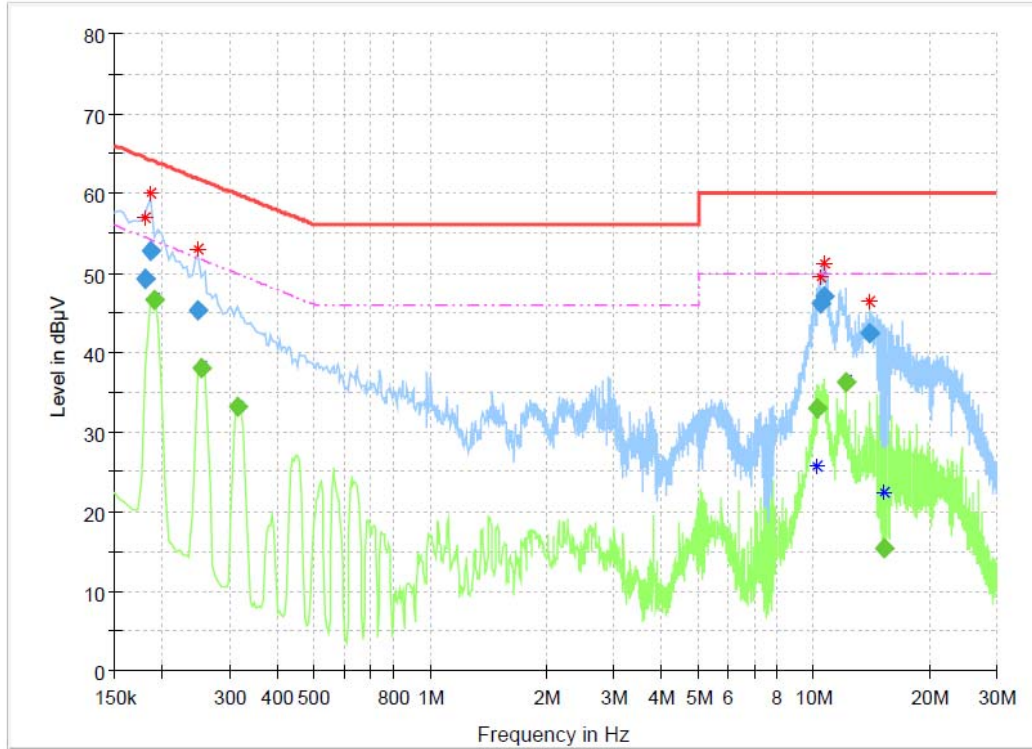
Test Results

The requirements are:

☒ Complies

Test Data

802.11g_MIMO(Worst Case)



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.181500	49.13	---	64.42	15.29	15000.0	9.000	L1	ON	9.9
0.186000	52.74	---	64.21	11.48	15000.0	9.000	N	ON	9.9
0.190500	---	46.64	54.02	7.38	15000.0	9.000	N	ON	9.9
0.249000	45.28	---	61.79	16.51	15000.0	9.000	N	ON	9.6
0.253500	---	38.04	51.64	13.60	15000.0	9.000	N	ON	9.6
0.316500	---	33.11	49.80	16.69	15000.0	9.000	N	ON	9.8
10.180500	---	33.07	50.00	16.93	15000.0	9.000	N	ON	9.9
10.392000	46.12	---	60.00	13.88	15000.0	9.000	L1	ON	9.8
10.603500	47.06	---	60.00	12.94	15000.0	9.000	N	ON	9.9
12.129000	---	36.32	50.00	13.68	15000.0	9.000	L1	ON	9.8
14.041500	42.46	---	60.00	17.54	15000.0	9.000	L1	ON	9.8
15.243000	---	15.39	50.00	34.61	15000.0	9.000	N	ON	10.0

APPENDIX A – Test Equipment Used For Tests

No.	Name of Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Signal Analyzer	Agilent	N9020A	MY50510324	2023-12-05	2024-12-05
2	Signal Analyzer	Agilent	N9020A	MY48011598	2023-09-25	2024-09-25
3	Signal Generator	Rohde & Schwarz	SMB100A	175528	2023-03-22 2024-03-21	2024-03-22 2025-03-21
4	EMI TEST RECEIVER	Rohde & Schwarz	ESW44	102039	2023-05-03	2024-05-03
5	BILOG ANTENNA	TESEQ	CBL6111D	60654	2023-08-21	2025-08-21
6	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2023-04-15	2025-04-15
7	6dB Attenuator	NONE	6dB	190557	2023-09-25	2024-09-25
8	6dB Attenuator	PASTERNAK	PE7AP006-06	L20210504000023	2023-08-04	2024-08-04
9	AMPLIFIER	SONOMA INSTRUMENT	310N	411011	2023-08-04	2024-08-04
10	Spectrum Analyzer	R&S	FSV40	101574	2024-01-15	2025-01-15
11	PRE AMPLIFIER	HP	8449B	3008A00620	2023-04-21	2024-04-21
12	Double Ridged Guide Antenna	ETS-Lindgren	3115	00078895	2023-04-13	2024-04-13
13	HORN ANTENNA	SCHWARZBECK	BBHA9170	1153	2023-10-19	2024-10-19
14	LOW NOISE AMPLIFIER	TESTEK	TK-PA1840H	210124-L	2023-10-23	2024-10-23
15	Band Reject Filter	Micro Tronics	BRM50702	G233	2023-12-04	2024-12-04
16	EMI Test Receiver	R&S	ESR3	102826	2023-05-03	2024-05-03
17	LISN	R&S	ENV216	102698	2023-05-03	2024-05-03

No.	Cable	Manufacturer	Model No.	Serial No.	Check Date
1	RF Cable (Conducted)	Junkosha Inc.	MWX221	1512S151	2023-08-21
2	RF Cable (Conducted)	Junkosha Inc.	MWX221	1512S148	2023-08-21
3	RF Cable (Line Conducted)	Canare Corporation	L-5D2W	N/A	2024-03-06
4	RF Cable (9kHz-30MHz Radiated)	Canare Corporation	L-5D2W	N/A	2024-03-06
5	RF Cable (9kHz-1GHz Radiated)	Canare Corporation	L-5D2W	N/A	2023-08-23
6	RF Cable (9kHz-1GHz Radiated)	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	2023-08-23
7	RF Cable (1GHz-18GHz Radiated)	Junkosha Inc.	MWX221	2008S246	2023-06-28
8	RF Cable (1GHz-18GHz Radiated)	Rosenberger	NONE	1520.9927.00	2023-06-28
9	RF Cable (1GHz-18GHz Radiated)	Sensorview Co., LTD	9S18	TPC2204060007	2023-06-28
10	RF Cable (18 GHz - 40 GHz Radiated)	Sensorview Co., LTD	9S40	TPC2204060009	2023-06-28
11	RF Cable (18 GHz - 40 GHz Radiated)	Sensorview Co., LTD	9A40	TP210713-001	2023-06-28

-END-