

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-2018-02468
Page (1) / (54) Pages

1. Client

- Name : KAONMEDIA Co., Ltd.
- Address : KAONMEDIA Building, 884-3 Seongnam-daero, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea
- Date of Receipt : 2018-03-07

2. Manufacturer

- Name : KAONMEDIA Co., Ltd.
- Address : KAONMEDIA Building, 884-3, Seongnam-daero, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea

3. Use of Report : For FCC Certification

4. Test Sample / Model: Entertainment Hub / HDRX4

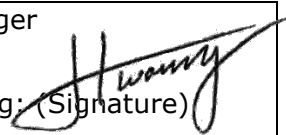
5. Date of Test : 2018-07-24 to 2018-08-08

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

7. Testing Environment: Temp.: (25 ± 5) °C, Humidity: (50 ± 3) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by	Technical Manager
	Ji-Hye, Kim: (Signature) 	Won-Jae, Hwang: (Signature) 

2018-08-09

Republic of KOREA **CTK Co., Ltd.**



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Page (2) / (54)Pages

REPORT REVISION HISTORY

Date	Revision	Page No
2018-08-09	Issued (CTK-2018-02468)	all

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1. General Product Description

1.1 Client Information

Company	KAONMEDIA Co., Ltd.
Contact Point	KAONMEDIA Building, 884-3 Seongnam-daero, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea
Contact Person	Name : Lee Kee-Chul E-mail : kcleee@kaonmedia.com Tel : +82-31-724-8676 Fax : -

1.2 Product Information

FCC ID	WQT-HDRX4
Product Description	Entertainment Hub
Model name	HDRX4
Variant Model name	-
Operating Frequency	2 412 MHz – 2 462 MHz
RF Output Power	802.11b : 12.55 dBm (17.99 mW) 802.11g : 10.64 dBm (11.60 mW) 802.11n_HT20 : 9.86 dBm (9.67 mW) 802.11n_HT40 : 5.76 dBm (3.77 mW)
Antenna Specification	Antenna type : PCB Antenna Peak Gain : 1.9 dBi
Number of channels	11
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: MCS0-7, up to 300 Mbps
Power Source	DC 12 V (Adaptor)
Hardware Rev	1.0
Software Rev	1.1.0

1.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	15-bs563TU	CND7253R6N
AC/DC Adapter	HP	HSTNN-CA40	-

2. Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	
CANADA	ISED	ISED EMI (3/10m test site)	8737A-2	
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	

2.3 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)	Limit	Status (Note 1)	Test Condition
15.247(a)	6 dB Bandwidth	> 500 kHz	C	Conducted
15.247(b)	Maximum Output Power	< 1 Watt	C	
15.247(d)	Conducted Spurious emission	> 30 dBc	C	
15.247(d)	Unwanted Emission(Conducted)	> 30 dBc	C	
15.247(e)	Transmitter Power Spectral Density	< 8 dBm @ 3 kHz	C	
15.209	Radiated Emissions	15.209(a)	C	Radiated
15.207	AC Conducted Emissions	15.207(a)	C	Line Conducted
<u>Note 1:</u> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
<u>Note 2:</u> The data in this test report are traceable to the national or international standards.				
<u>Note 3:</u> The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-2013				
<u>Note 4:</u> The tests were performed according to the method of measurements prescribed in KDB No.558074.				

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.
For WLAN function, the engineering test program was provided and enabled to make EUT continuous transmit.
All modulation modes were tests. The results are only attached worst cases.

Test Frequency

- 802.11b, 802.11g, 802.11n_HT20

Lowest channel	Middle channel	Highest channel
2 412 MHz	2 437 MHz	2 462 MHz

- 802.11n_HT40

Lowest channel	Middle channel	Highest channel
2 422 MHz	2 437 MHz	2 452 MHz

Test mode

Test mode	Modulation	Data rate	Duty Cycle	Duty Cycle Factor
802.11b	DSSS	1 Mbps	97.88%	0.09 dB
802.11g	OFDM	6 Mbps	87.68%	0.57 dB
802.11n_HT20	OFDM	MCS 0	86.92%	0.61 dB
802.11n_HT40	OFDM	MCS 0	76.71%	1.15 dB

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
Power Spectral Density	± 1.5 dB
Occupied Bandwidth	± 0.1 MHz
Unwanted Emission(conducted)	± 3.0 dB
Radiated Emissions ($f \leq 1$ GHz)	± 4.0 dB
Radiated Emissions ($f > 1$ GHz)	± 5.0 dB

3.5 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	TOYO EMI software EP5RE Ver. 5.1.0
Line Conducted Test	ESCI7, ESCI3 : EMC32 Ver. 8.50.0 ESR7 : EMC32 Ver. 8.53.0

4. Technical Characteristic Test

4.1 6dB Bandwidth

Test Procedures

ANSI C63.10-2013 6.9.2

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 6.9.3

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.

Limit

6 dB Bandwidth > 500kHz

Test Data:

ANT0

	6 dB Bandwidth and 99% Bandwidth (MHz)					
Mode	802.11b		802.11g		802.11n_HT20	
Frequency	6dB	99%	6dB	99%	6dB	99%
2 412 MHz	10.10	13.34	16.09	16.55	16.90	17.62
2 437 MHz	10.11	13.06	15.95	16.59	16.19	17.64
2 462 MHz	10.10	13.07	15.95	16.58	17.16	17.66

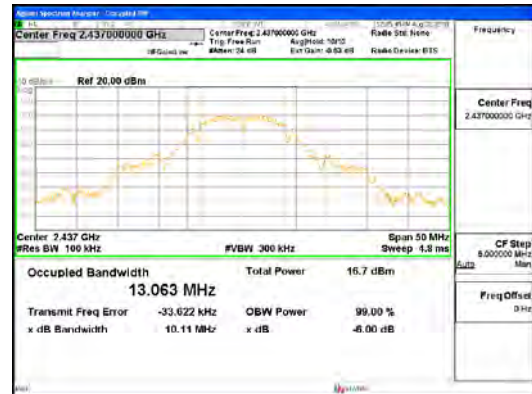
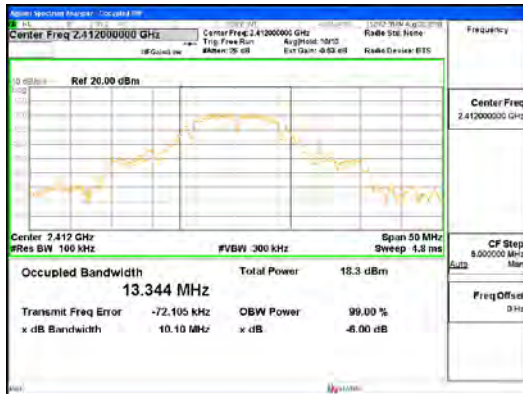
	6 dB Bandwidth and 99% Bandwidth (MHz)	
Mode	802.11n_HT40	
Frequency	6dB	99%
2 422 MHz	35.58	35.94
2 437 MHz	35.60	35.98
2 452 MHz	35.59	35.92

ANT1

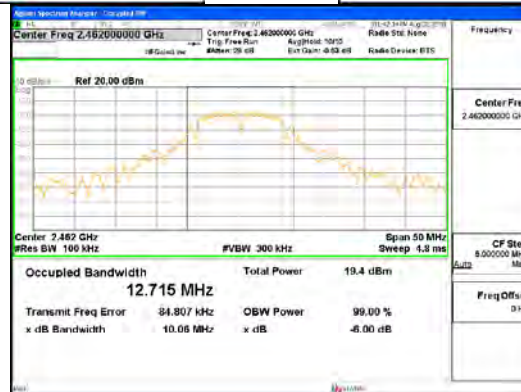
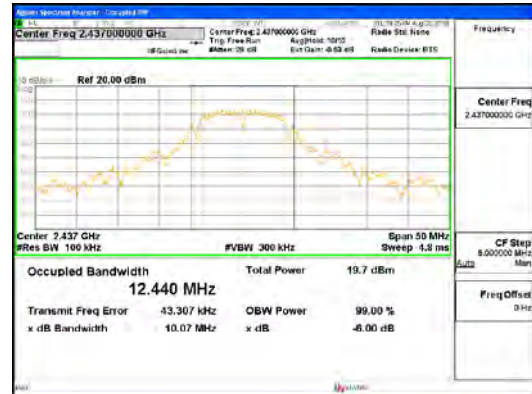
	6 dB Bandwidth and 99% Bandwidth (MHz)			
Mode	802.11g		802.11n_HT20	
Frequency	6dB	99%	6dB	99%
2 422 MHz	16.09	16.56	16.99	17.61
2 437 MHz	16.28	16.90	16.98	17.72
2 452 MHz	16.36	17.46	16.85	17.80

	6 dB Bandwidth and 99% Bandwidth (MHz)	
Mode	802.11n_HT40	
Frequency	6dB	99%
2 422 MHz	35.57	35.90
2 437 MHz	35.41	35.93
2 452 MHz	35.52	35.90

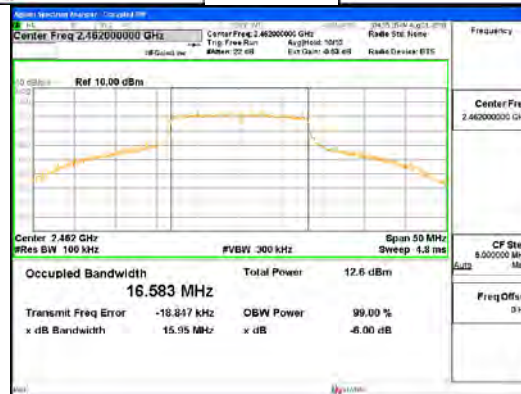
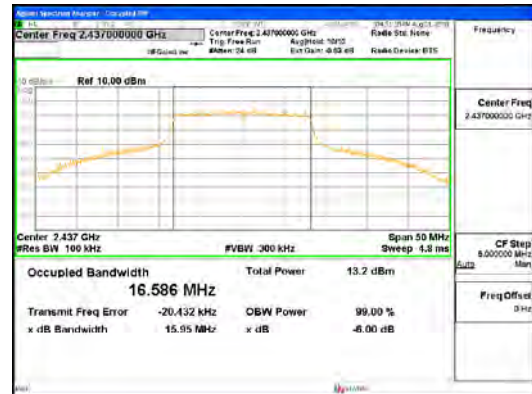
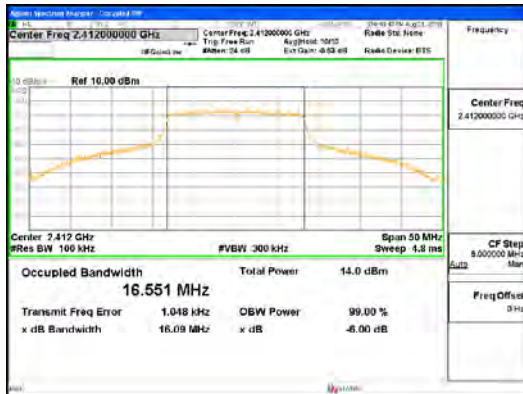
See next pages for actual measured spectrum plots.



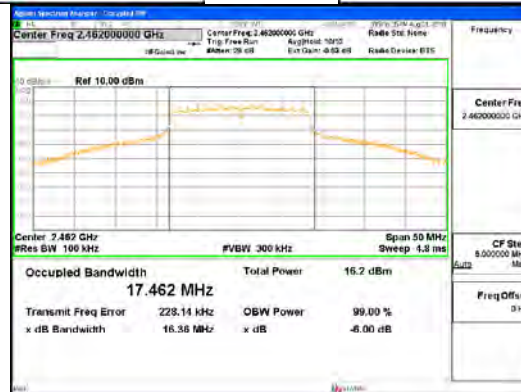
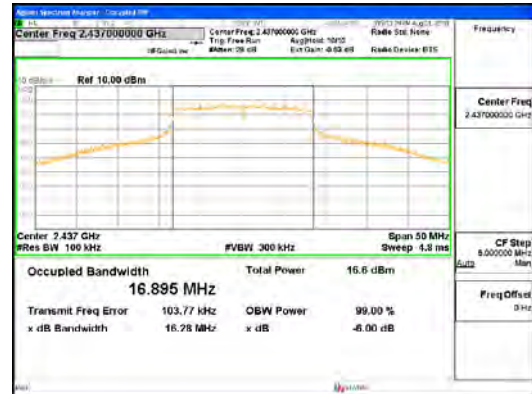
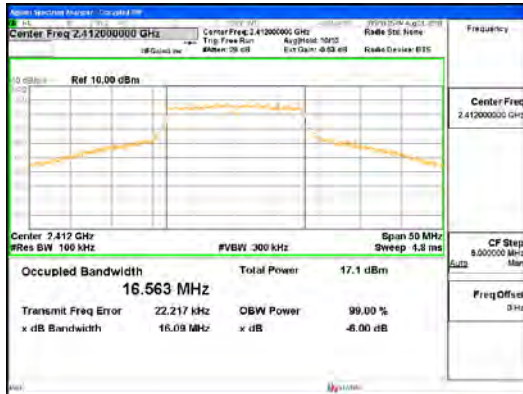
802.11b_ANT0



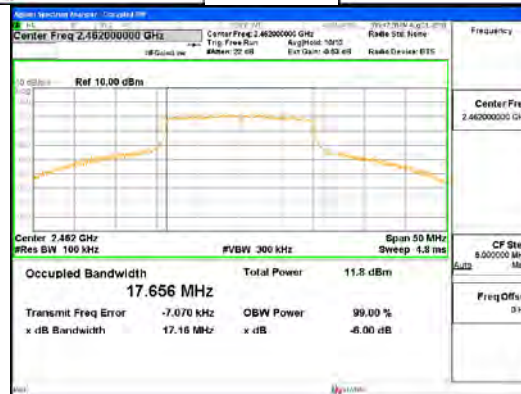
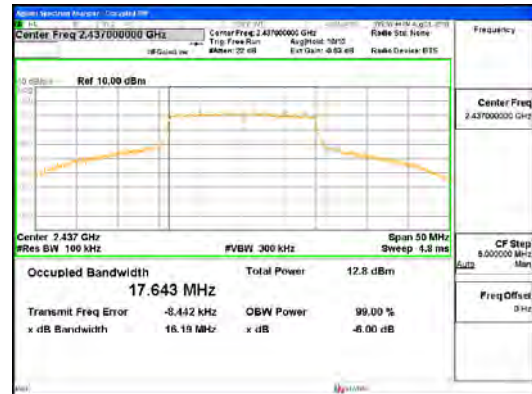
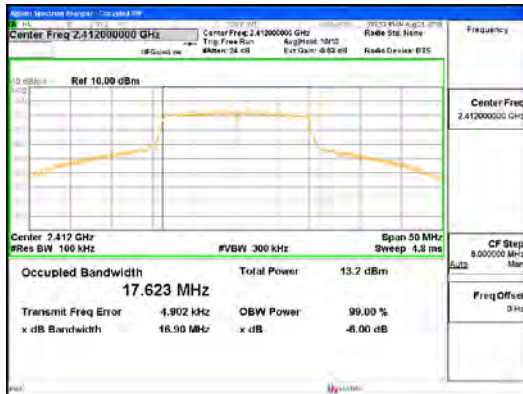
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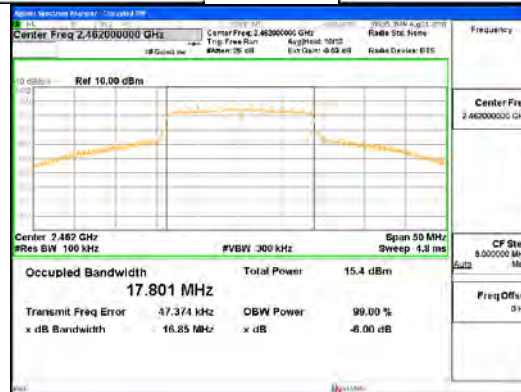
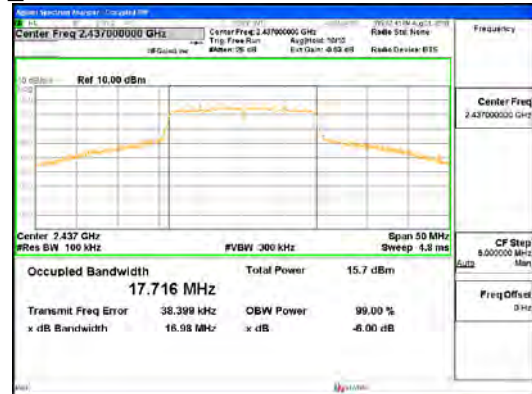
802.11g_ANT0



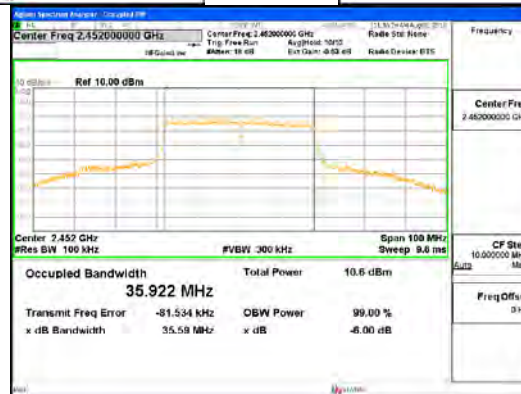
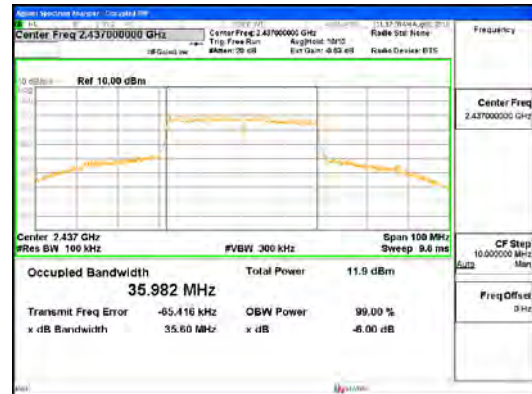
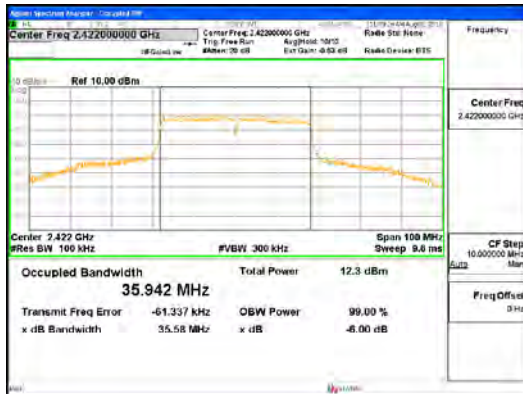
802.11g_ANT1



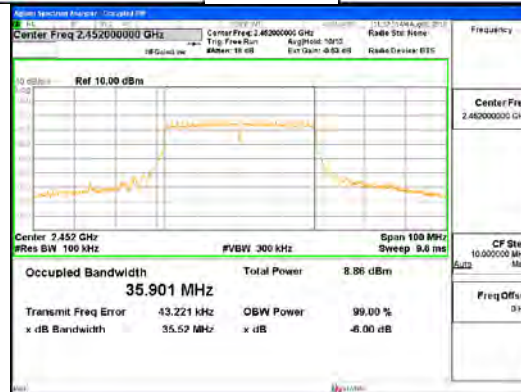
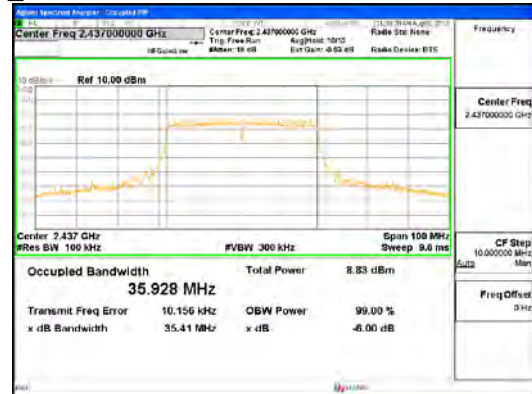
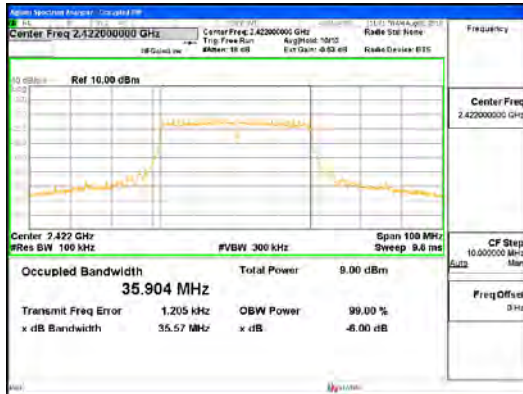
802.11n_HT20_ANT0



802.11n_HT20_ANT1



802.11n_HT40_ANT0



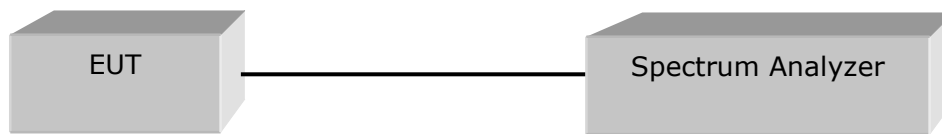
802.11n_HT40_ANT1

4.2 OUTPUT POWER

Test Procedures

Average Power(Procedure 9.2.2.2 in KDB 558074, Method AVGSA-2)
Multiple Transmitter Output (KDB 662911 D01, D02)

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	0.09
802.11g	0.57
802.11n_HT20	0.61
802.11n_HT40	1.15

Limit

Operating Mode	Mode	ANT Configuration	ANT Gain (dBi)	Limit (dBm)
SISO	802.11b/g/n	ANT0, ANT1	1.90	30.00
SISO	802.11b/g/n			
MIMO (2Tx)	802.11b/g/n	ANT0 + ANT1	4.91	30.00

Test Data

ANT0

Test Mode	Frequency (MHz)	Measured Output Power (dBm)	Duty cycle Factor (dB)	Result Output Power (dBm)	Limit (dBm)	Margin (dB)
802.11b	2 412	10.48	0.09	10.57	30.00	19.43
	2 437	8.97	0.09	9.06	30.00	20.94
	2 462	8.19	0.09	8.28	30.00	21.72
802.11g	2 412	5.25	0.57	5.82	30.00	24.18
	2 437	4.89	0.57	5.46	30.00	24.54
	2 462	4.38	0.57	4.95	30.00	25.05
802.11n _HT20	2 412	4.32	0.61	4.93	30.00	25.07
	2 437	4.28	0.61	4.89	30.00	25.11
	2 462	3.24	0.61	3.85	30.00	26.15
802.11n _HT40	2 422	3.11	1.15	4.26	30.00	25.74
	2 437	2.46	1.15	3.61	30.00	26.39
	2 452	1.17	1.15	2.32	30.00	27.68

ANT1

Test Mode	Frequency (MHz)	Measured Output Power (dBm)	Duty cycle Factor (dB)	Result Output Power (dBm)	Limit (dBm)	Margin (dB)
802.11b	2 412	12.46	0.09	12.55	30.00	17.45
	2 437	12.01	0.09	12.10	30.00	17.90
	2 462	11.61	0.09	11.70	30.00	18.30
802.11g	2 412	8.34	0.57	8.91	30.00	21.09
	2 437	8.07	0.57	8.64	30.00	21.36
	2 462	7.82	0.57	8.39	30.00	21.61
802.11n _HT20	2 412	7.53	0.61	8.14	30.00	21.86
	2 437	7.58	0.61	8.19	30.00	21.81
	2 462	6.87	0.61	7.48	30.00	22.52
802.11n _HT40	2 422	-0.74	1.15	0.41	30.00	29.59
	2 437	-0.4	1.15	0.75	30.00	29.25
	2 452	-0.64	1.15	0.51	30.00	29.49

ANT0 + ANT1

Test Mode	Frequency (MHz)	Measured Output Power (dBm)	Duty cycle Factor (dB)	Result Output Power (dBm)	Limit (dBm)	Margin (dB)
802.11g	2 412	10.07	0.57	10.64	30.00	19.36
	2 437	9.78	0.57	10.35	30.00	19.65
	2 462	9.44	0.57	10.01	30.00	19.99
802.11n _HT20	2 412	9.23	0.61	9.84	30.00	20.16
	2 437	9.25	0.61	9.86	30.00	20.14
	2 462	8.43	0.61	9.04	30.00	20.96
802.11n _HT40	2 422	4.61	1.15	5.76	30.00	24.24
	2 437	4.27	1.15	5.42	30.00	24.58
	2 452	3.37	1.15	4.52	30.00	25.48

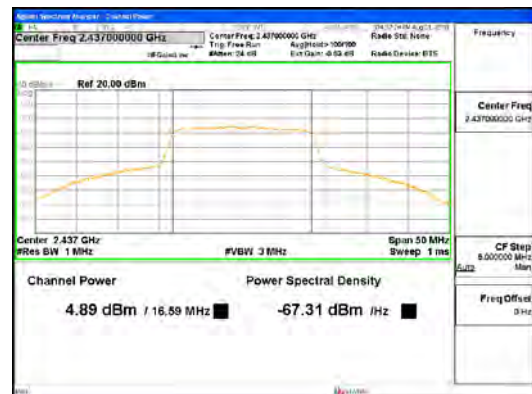
See next pages for actual measured spectrum plots.



802.11b_ANT0



802.11b_ANT1



802.11g_ANT0



802.11g_ANT1



802.11n_HT20_ANT0



802.11n_HT20_ANT1



802.11n_HT40_ANT0



802.11n_HT40_ANT1

4.3 Power Spectral Density

Test Procedures

Procedure 10.2 in KDB 558074, Method Peak PSD
Multiple Transmitter Output (KDB 662911 D01, D02)

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

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)
SISO	802.11b/g/n	ANT0, ANT1	1.90	8.00
SISO	802.11b/g/n			
MIMO (2Tx)	802.11b/g/n	ANT0 + ANT1	4.91	8.00

Test Data

ANT0

Test Mode	Frequency (MHz)	Measured Power Density (dBm)	Limit (dBm)	Margin(dB)
802.11b	2 412	-12.25	8.00	20.25
	2 437	-14.68	8.00	22.68
	2 462	-14.62	8.00	22.62
802.11g	2 412	-18.30	8.00	26.30
	2 437	-19.76	8.00	27.76
	2 462	-19.72	8.00	27.72
802.11n_HT20	2 412	-18.87	8.00	26.87
	2 437	-19.26	8.00	27.26
	2 462	-19.92	8.00	27.92
802.11n_HT40	2 422	-22.82	8.00	30.82
	2 437	-22.80	8.00	30.80
	2 452	-25.15	8.00	33.15

ANT1

Test Mode	Frequency (MHz)	Measured Power Density (dBm)	Limit (dBm)	Margin(dB)
802.11b	2 412	-10.61	8.00	18.61
	2 437	-11.13	8.00	19.13
	2 462	-11.42	8.00	19.42
802.11g	2 412	-15.10	8.00	23.10
	2 437	-15.49	8.00	23.49
	2 462	-15.12	8.00	23.12
802.11n_HT20	2 412	-15.56	8.00	23.56
	2 437	-16.36	8.00	24.36
	2 462	-16.75	8.00	24.75
802.11n_HT40	2 422	-26.79	8.00	34.79
	2 437	-26.67	8.00	34.67
	2 452	-26.98	8.00	34.98

ANT0 +ANT1

Test Mode	Frequency (MHz)	Measured Power Density (dBm)	Limit (dBm)	Margin(dB)
802.11g	2 412	-13.40	8.00	21.40
	2 437	-14.11	8.00	22.11
	2 462	-13.83	8.00	21.83
802.11n_HT20	2 412	-13.90	8.00	21.90
	2 437	-14.56	8.00	22.56
	2 462	-15.04	8.00	23.04
802.11n_HT40	2 422	-21.36	8.00	29.36
	2 437	-21.31	8.00	29.31
	2 452	-22.96	8.00	30.96

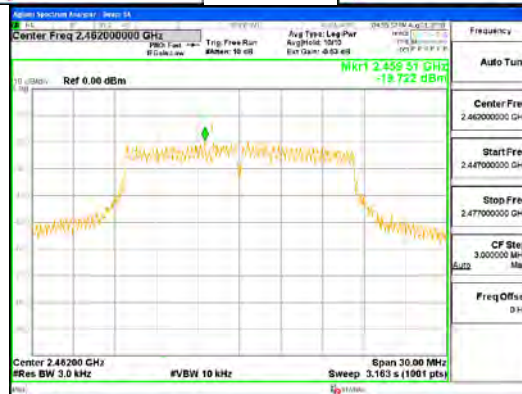
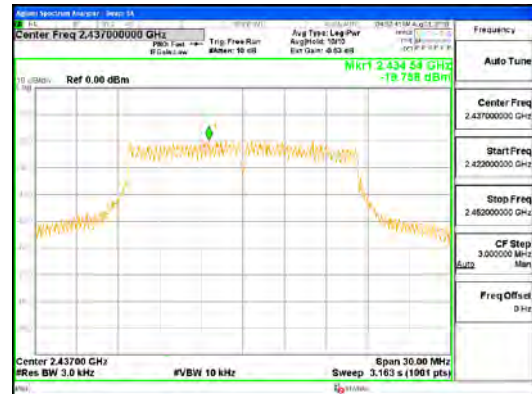
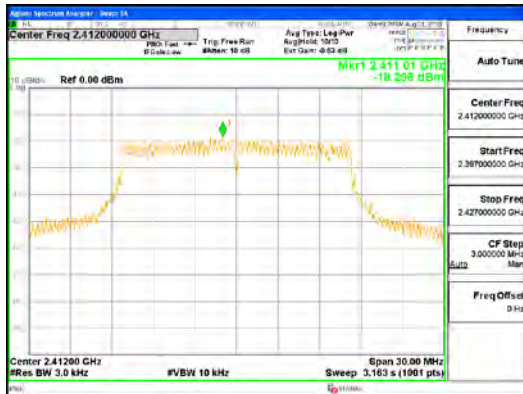
See next pages for actual measured spectrum plots.



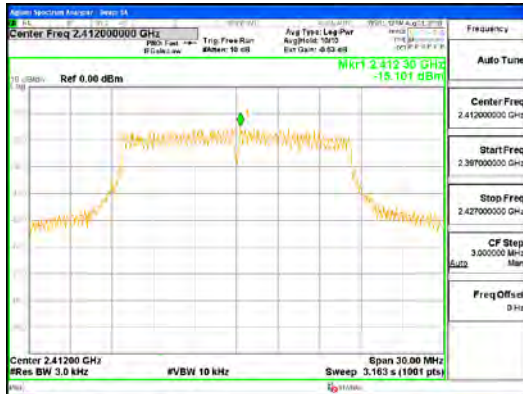
802.11b_ANT0



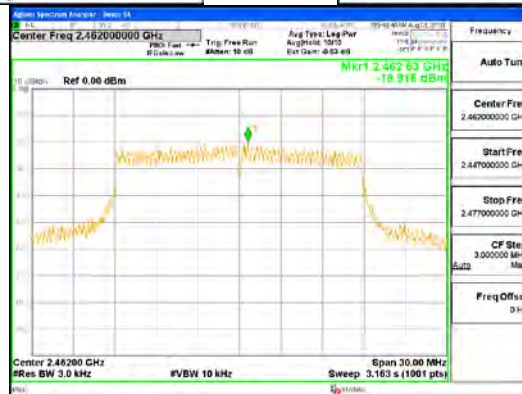
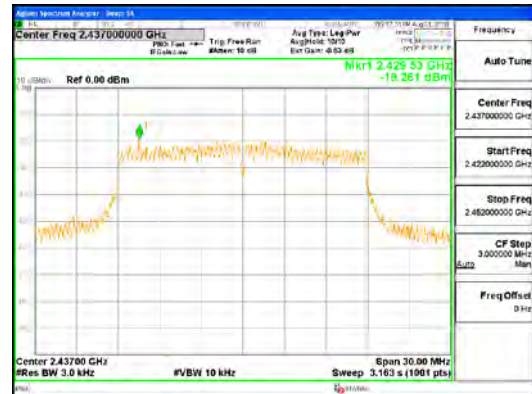
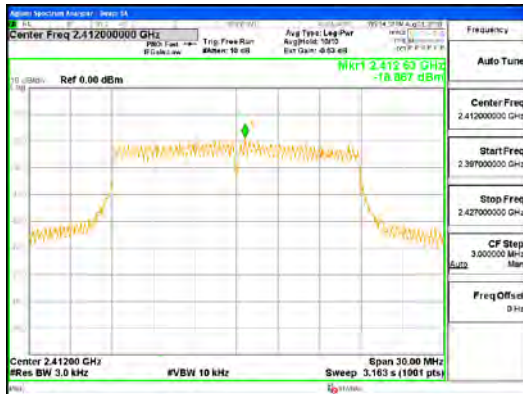
802.11b_ANT1



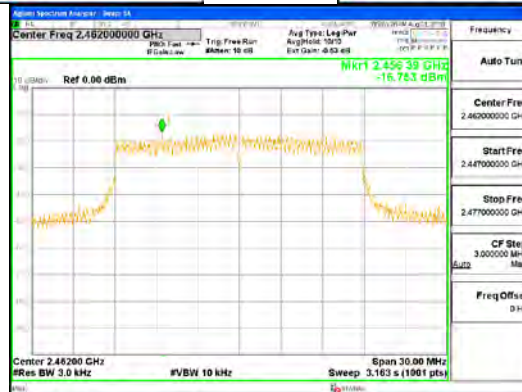
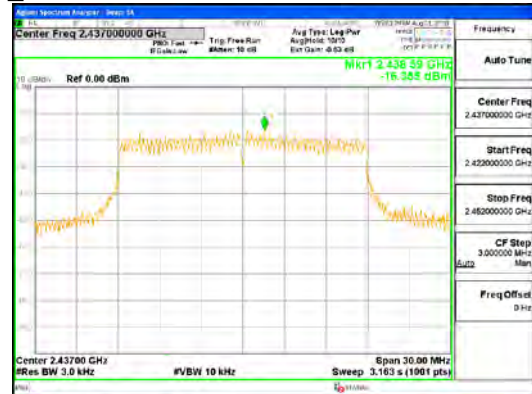
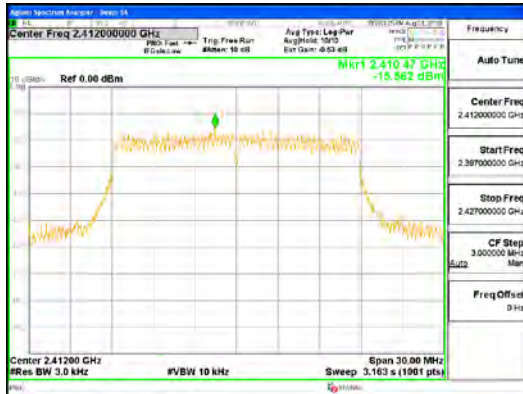
802.11g_ANT0



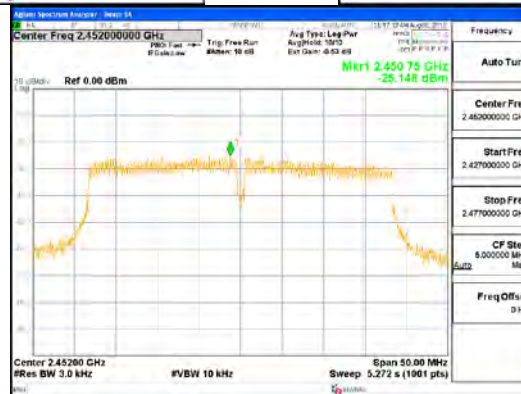
802.11g_ANT1



802.11n_HT20_ANT0



802.11n_HT20_ANT1



802.11n_HT40_ANT0



802.11n_HT40_ANT1

4.4 Band Edge & Conducted Spurious emission

Test Procedures

ANSI C63.10-2013 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

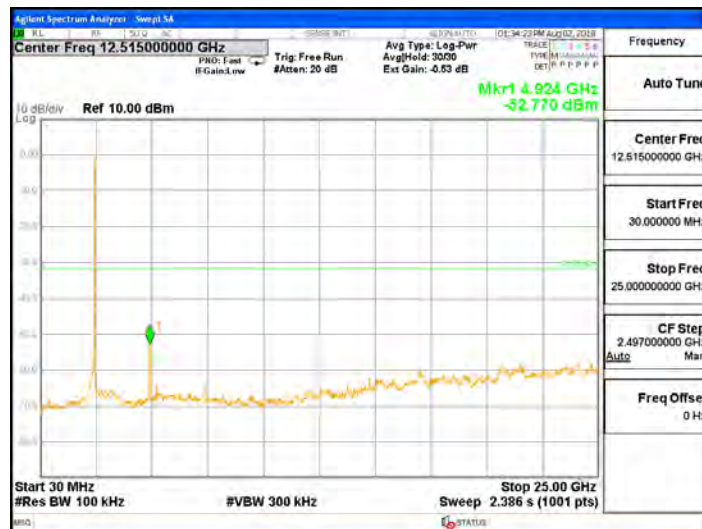
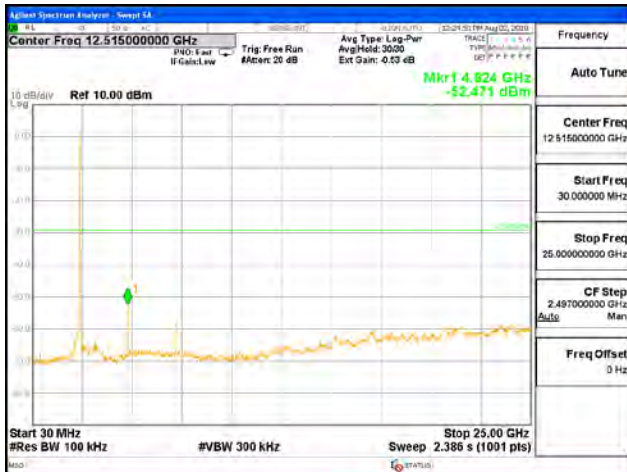
- All conducted emission in any 100 kHz bandwidth outside of the spread spectrum band was at least 30dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.

See next pages for actual measured spectrum plots.

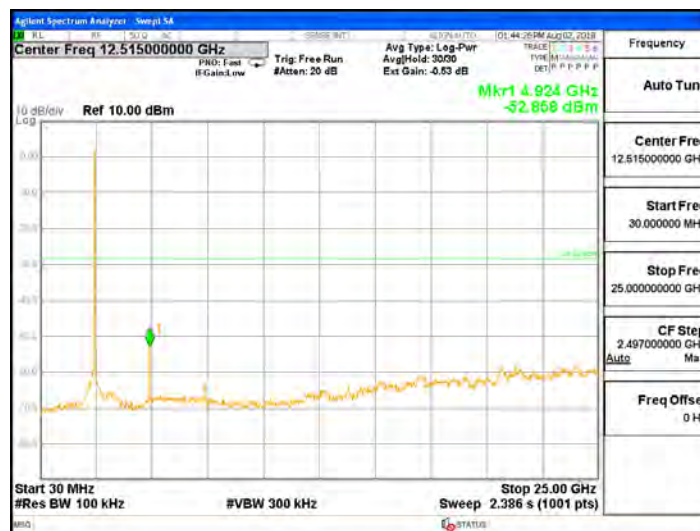
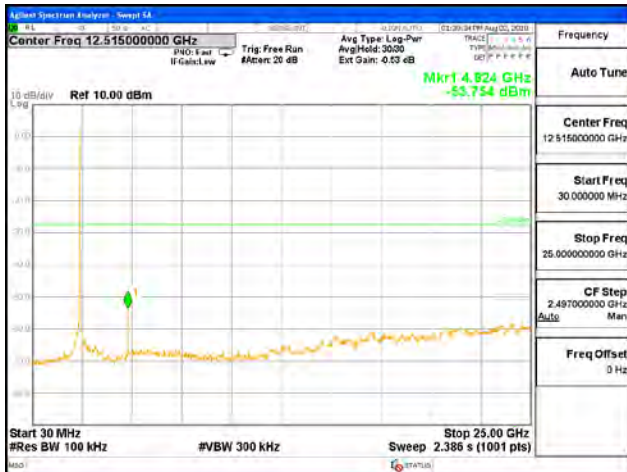


CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

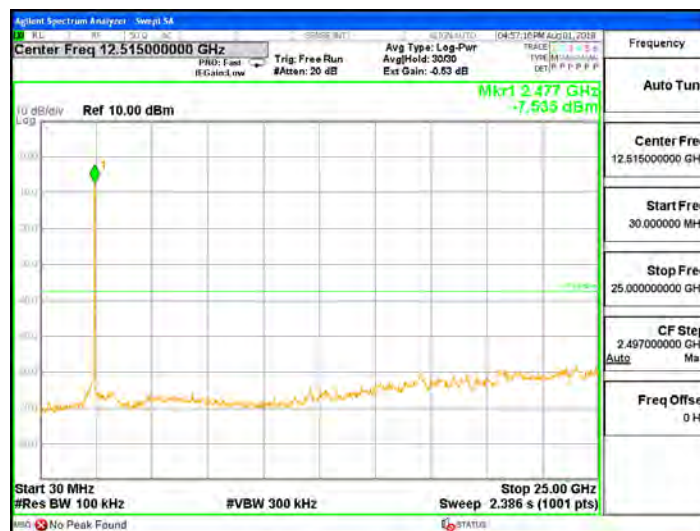
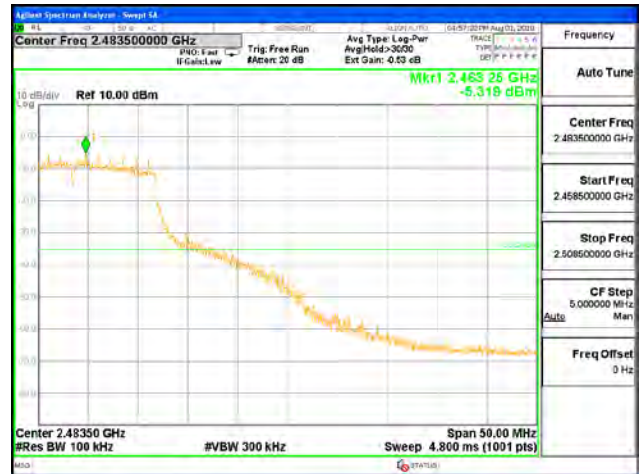
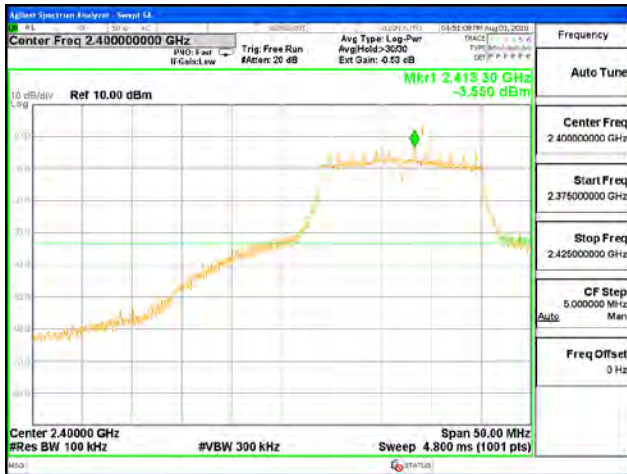
Report No.:
CTK-2018-02468
Page (30) / (54)Pages



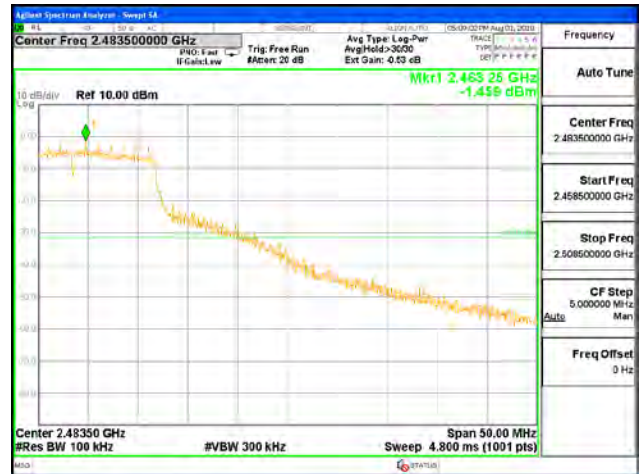
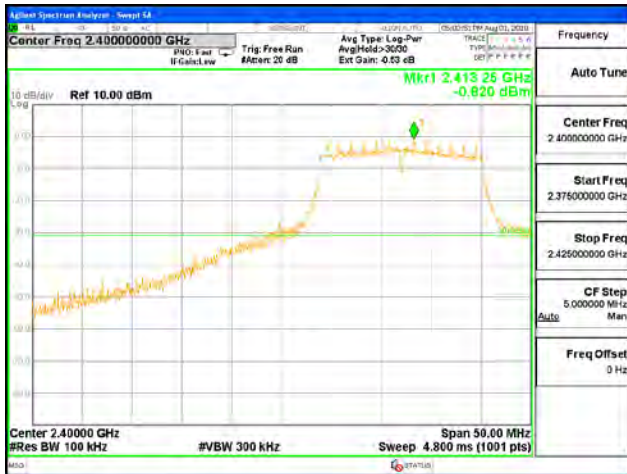
802.11b_ANT0



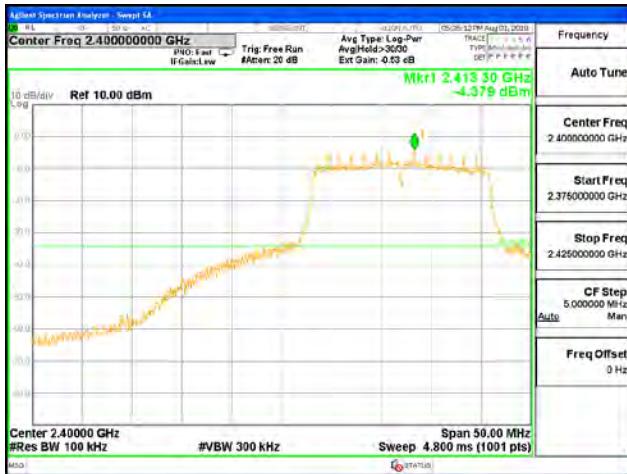
802.11b_ANT1



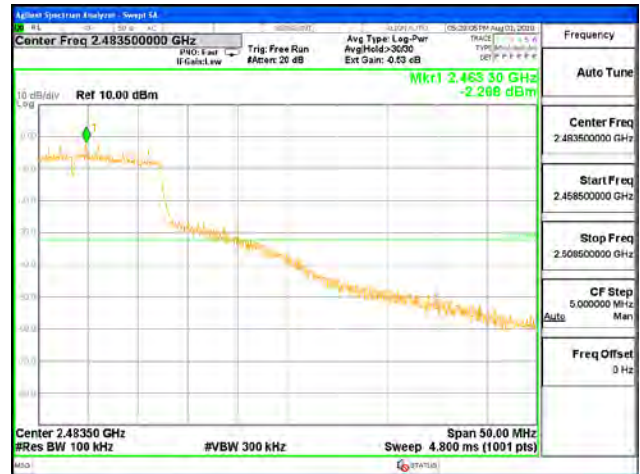
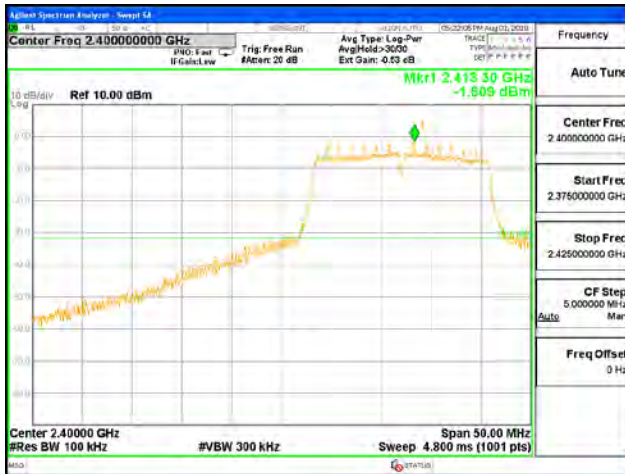
802.11g_ANT0



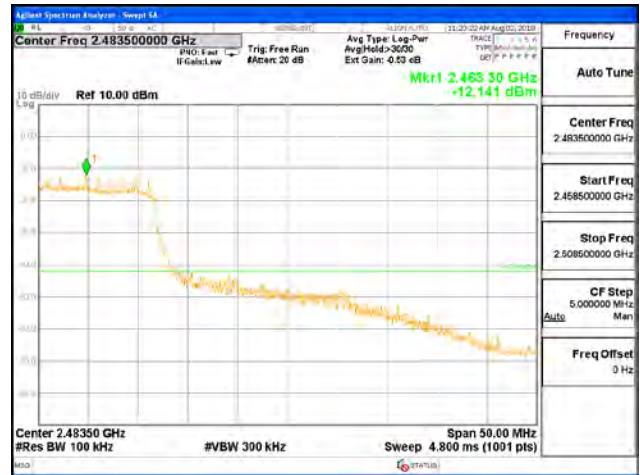
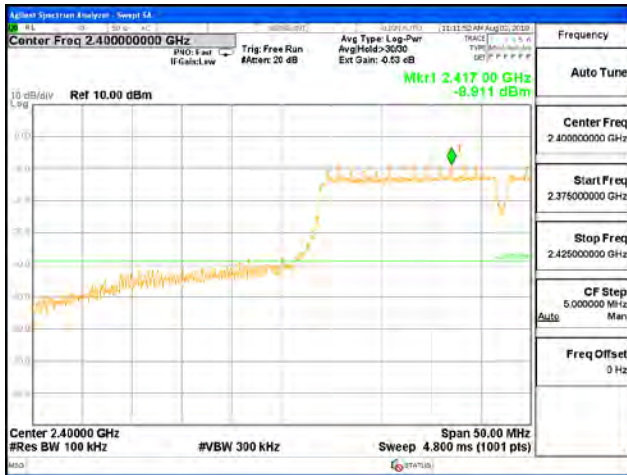
802.11g_ANT1



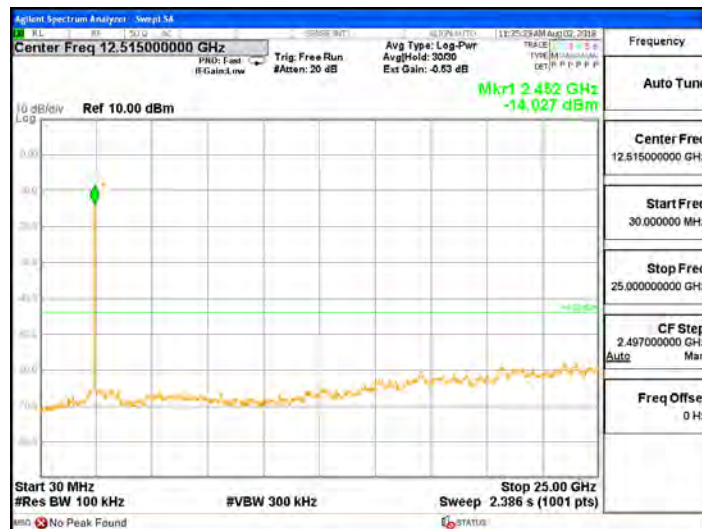
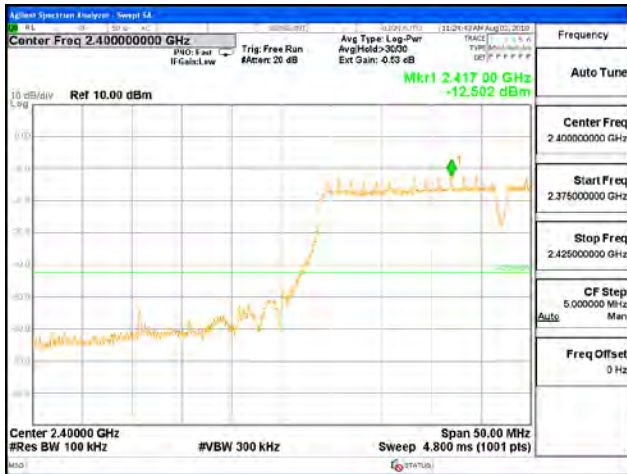
802.11n_HT20_ANT0



802.11n_HT20_ANT1



802.11n_HT40_ANT0



802.11n_HT40_ANT1

4.5 Radiated Emission

Test Location

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

Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. 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 (dB)
802.11b	0.09
802.11g	0.57
802.11n_HT20	0.61
802.11n_HT40	1.15

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)

We have done all test mode.

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

802.11b mode : ANT1 (SISO)

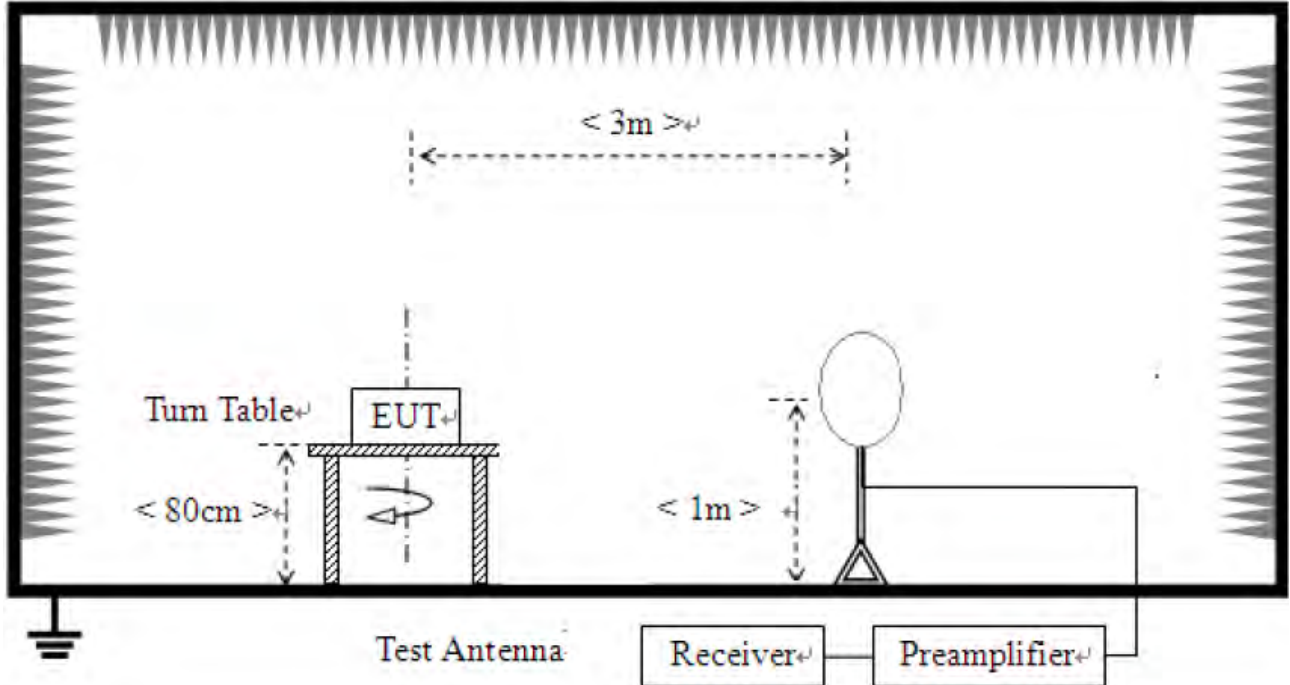
802.11g mode : ANT0 + ANT1 (MIMO)

802.11n mode : ANT0 + ANT1 (MIMO)

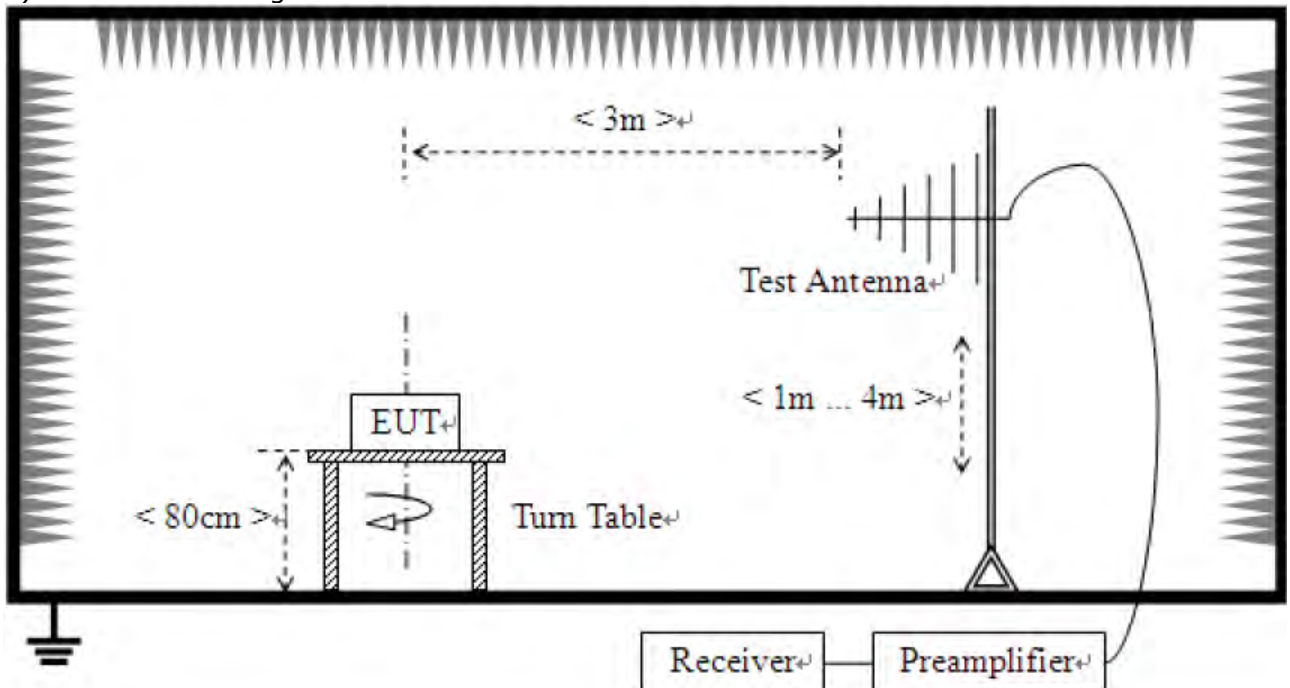
So the results are only attached worst cases.

Test Setup:

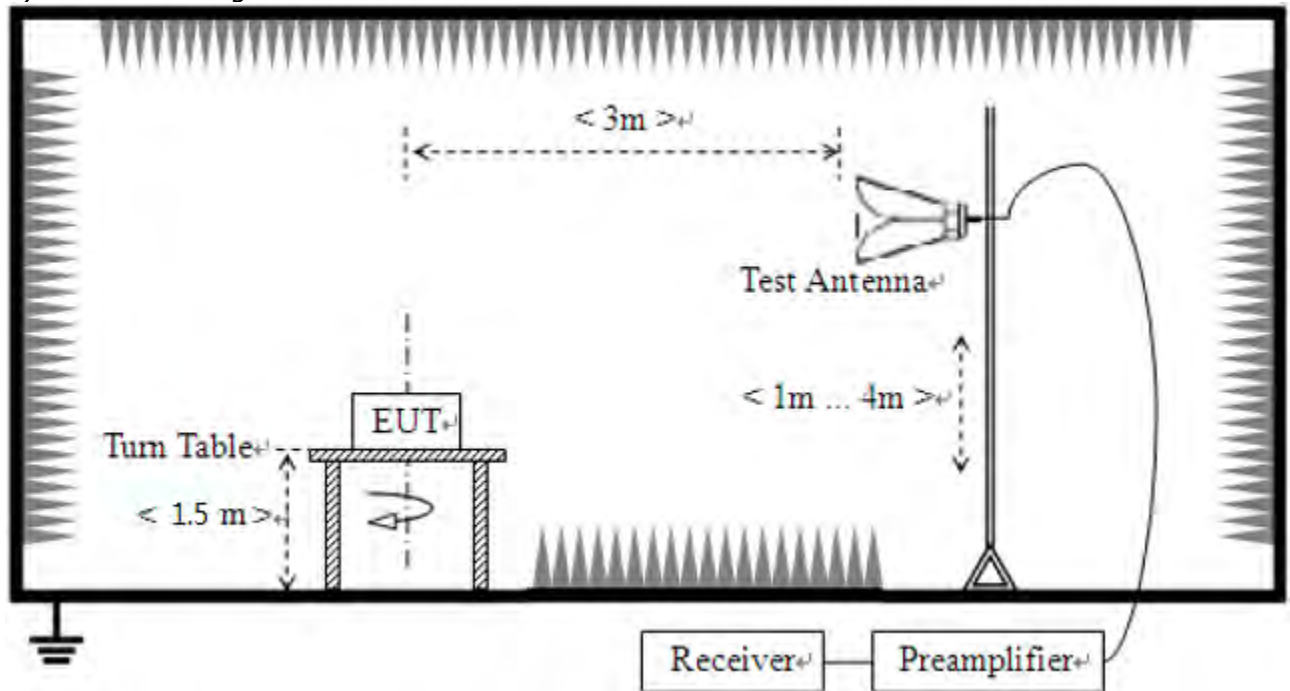
- 1) For field strength of emissions from 9 kHz to 30 MHz



- 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 : Transmitter, Receiver, 802.11b, 802.11g, 802.11n (Worst case)

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
-	-	-	See note

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)

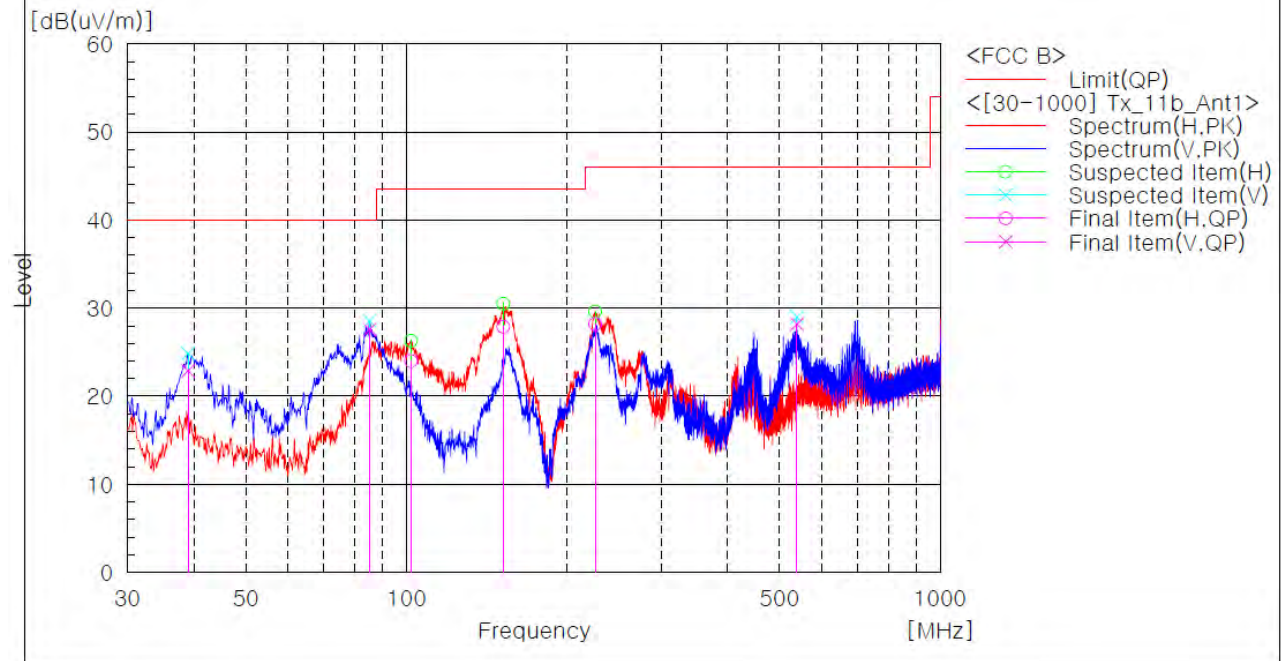
2) 30 MHz to 1 GHz

Test mode : Transmitter, 802.11b(Worst Case)

The requirements are:

☒ Complies

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	38.927	V	36.7	-13.8	22.9	40.0	17.1	99.8	20.5	
2	85.196	V	45.0	-17.4	27.6	40.0	12.4	99.8	146.9	
3	101.962	H	38.1	-14.1	24.0	43.5	19.5	99.8	54.5	
4	151.823	H	45.3	-17.4	27.9	43.5	15.6	99.8	54.5	
5	225.526	H	41.8	-13.6	28.2	46.0	17.8	99.8	9.9	
6	538.630	V	37.1	-8.9	28.2	46.0	17.8	99.8	0.9	

Remark :

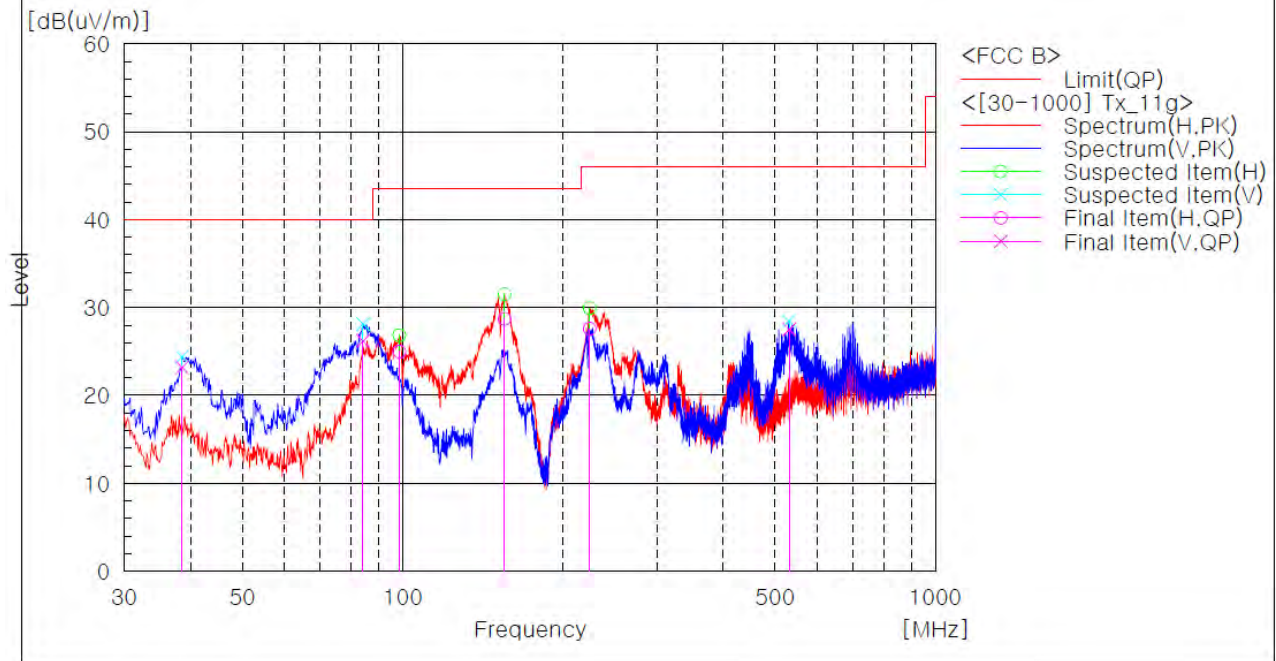
1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

Test mode : Transmitter, 802.11g(Worst Case)

The requirements are:

☒ Complies

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	38.492	V	37.2	-14.0	23.2	40.0	16.8	99.8	271.7	
2	84.216	V	43.8	-17.6	26.2	40.0	13.8	99.8	119.4	
3	98.478	H	39.2	-14.2	25.0	43.5	18.5	99.8	74.3	
4	155.307	H	45.9	-17.2	28.7	43.5	14.8	99.8	63.3	
5	224.329	H	41.2	-13.6	27.6	46.0	18.4	99.8	157.1	
6	531.009	V	36.5	-9.0	27.5	46.0	18.5	99.8	350.4	

Remark :

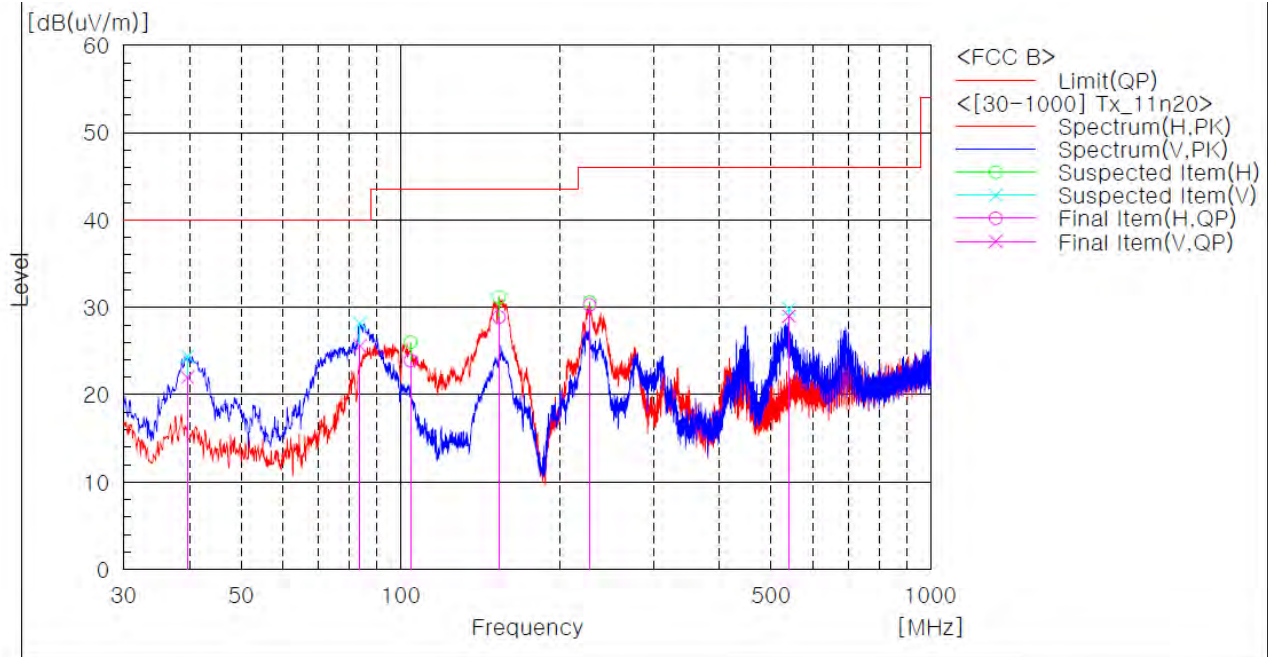
1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

Test mode : Transmitter, 802.11n_HT20(Worst Case)

The requirements are:

☒ Complies

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	39.580	V	35.5	-13.5	22.0	40.0	18.0	99.8	1.4	
2	83.781	V	43.3	-17.7	25.6	40.0	14.4	99.8	119.0	
3	104.466	H	38.1	-14.2	23.9	43.5	19.6	99.8	42.7	
4	153.347	H	46.2	-17.3	28.9	43.5	14.6	99.8	54.6	
5	227.268	H	43.8	-13.5	30.3	46.0	15.7	99.8	161.3	
6	540.045	V	37.8	-8.8	29.0	46.0	17.0	99.8	75.2	

Remark :

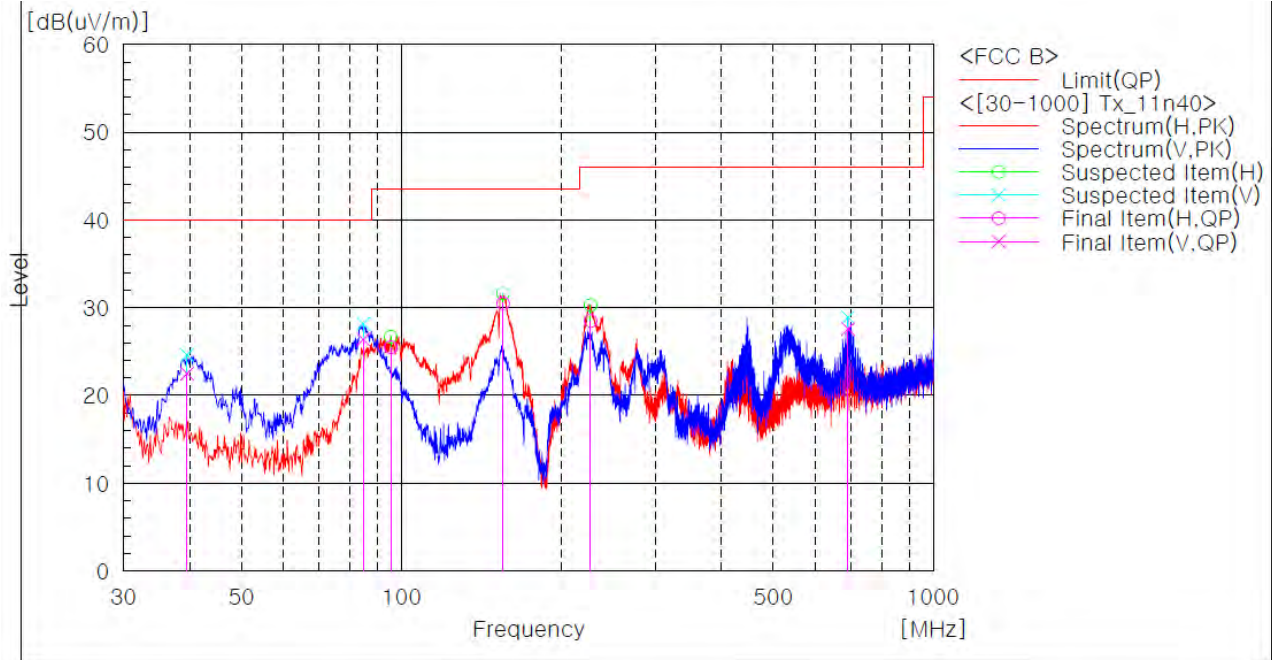
1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

Test mode : Transmitter, 802.11n_HT40(Worst Case)

The requirements are:

☒ Complies

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	39.471	V	36.1	-13.6	22.5	40.0	17.5	99.8	2.1	
2	84.652	V	43.9	-17.5	26.4	40.0	13.6	99.8	101.3	
3	95.429	H	40.0	-14.5	25.5	43.5	18.0	99.8	76.4	
4	155.198	H	47.8	-17.3	30.5	43.5	13.0	99.8	53.1	
5	226.724	H	42.1	-13.6	28.5	46.0	17.5	99.8	174.8	
6	691.262	V	34.5	-6.9	27.6	46.0	18.4	99.8	350.3	

Remark :

1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

3) above 1 GHz

Test mode : Transmitter, 802.11b_ANT1

The requirements are:

☒ Complies

Test Data

Low(2 412 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 920.18	H	54.00	74.00	34.29	45.90	19.71	28.10
1 920.20	V	54.00	74.00	37.09	50.60	16.91	23.40
4 824.97	H	54.00	74.00	45.09	50.70	8.91	23.30
4 824.01	V	54.00	74.00	42.99	49.00	11.01	25.00
2 389.30	H	54.00	74.00	44.69	52.60	9.31	21.40
2 389.20	V	54.00	74.00	35.59	45.10	18.41	28.90

Mid(2 437 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 919.13	H	54.00	74.00	34.29	45.10	19.71	28.90
1 919.39	V	54.00	74.00	36.79	48.80	17.21	25.20
4 884.18	H	54.00	74.00	43.79	50.40	10.21	23.60
4 884.01	V	54.00	74.00	43.19	49.10	10.81	24.90

High(2 462 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 920.43	H	54.00	74.00	34.29	45.40	19.71	28.60
4 920.29	V	54.00	74.00	35.39	46.70	18.61	27.30
4 924.03	H	54.00	74.00	41.39	48.30	12.61	25.70
4 923.93	V	54.00	74.00	40.59	47.30	13.41	26.70
2 483.50	H	54.00	74.00	49.39	57.40	4.61	16.60
2 483.50	V	54.00	74.00	41.29	49.40	12.71	24.60

Remarks

1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.

Test mode : Transmitter, 802.11g

The requirements are:

☒ Complies

Test Data

Low(2 412 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 440.18	H	54.00	74.00	27.97	50.60	26.03	23.40
1 440.10	V	54.00	74.00	31.77	52.10	22.23	21.90
1 920.26	H	54.00	74.00	35.97	53.50	18.03	20.50
1 920.22	V	54.00	74.00	38.37	53.60	15.63	20.40
2 389.82	H	54.00	74.00	45.87	65.10	8.13	8.90
2 390.00	V	54.00	74.00	42.57	62.70	11.43	11.30

Mid(2 437 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 440.11	H	54.00	74.00	27.97	49.50	26.03	24.50
1 440.08	V	54.00	74.00	33.17	51.60	20.83	22.40
1 920.42	H	54.00	74.00	34.77	53.40	19.23	20.60
1 920.37	V	54.00	74.00	35.57	51.30	18.43	22.70

High(2 462 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 920.38	H	54.00	74.00	34.47	52.90	19.53	21.10
1 920.44	V	54.00	74.00	38.47	52.50	15.53	21.50
4 924.76	H	54.00	74.00	34.37	48.30	19.63	25.70
4 924.19	V	54.00	74.00	35.37	50.20	18.63	23.80
2 483.57	H	54.00	74.00	49.67	71.00	4.33	3.00
2 483.50	V	54.00	74.00	44.97	64.00	9.03	10.00

Remarks

1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.

Test mode : Transmitter, 802.11n_HT20

The requirements are:

☒ Complies

Test Data

Low(2 412 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 080.08	V	54.00	74.00	32.61	38.70	21.39	35.30
1 440.20	V	54.00	74.00	31.21	53.70	22.79	20.30
1 920.17	H	54.00	74.00	36.01	52.50	17.99	21.50
1 920.29	V	54.00	74.00	38.51	51.80	15.49	22.20
2 389.47	H	54.00	74.00	41.41	61.60	12.59	12.40
2 390.00	V	54.00	74.00	42.91	61.40	11.09	12.60

Mid(2 437 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 440.22	H	54.00	74.00	27.91	48.20	26.09	25.80
1 440.16	V	54.00	74.00	30.91	54.80	23.09	19.20
1 920.29	H	54.00	74.00	36.11	51.00	17.89	23.00
1 920.38	V	54.00	74.00	37.41	52.10	16.59	21.90

High(2 462 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 440.10	V	54.00	74.00	31.61	50.80	22.39	23.20
1 680.40	V	54.00	74.00	34.21	51.50	19.79	22.50
1 920.38	H	54.00	74.00	33.71	52.50	20.29	21.50
1 920.43	V	54.00	74.00	37.41	59.50	16.59	14.50
2 483.50	H	54.00	74.00	49.61	69.40	4.39	4.60
2 483.50	V	54.00	74.00	44.71	62.10	9.29	11.90

Remarks

1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.

Test mode : Transmitter, 802.11n_HT40

The requirements are:

☒ Complies

Test Data

Low(2 422 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 920.37	H	54.00	74.00	36.05	53.40	17.95	20.60
1 920.36	V	54.00	74.00	37.85	51.90	16.15	22.10
2 880.83	H	54.00	74.00	32.95	47.90	21.05	26.10
2 880.54	V	54.00	74.00	29.35	51.90	24.65	22.10
2 389.96	H	54.00	74.00	41.85	59.70	12.15	14.30
2 387.96	V	54.00	74.00	49.95	65.60	4.05	8.40

Mid(2 437 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 440.34	H	54.00	74.00	28.75	51.00	25.25	23.00
1 440.20	V	54.00	74.00	31.45	51.90	22.55	22.10
1 920.49	H	54.00	74.00	35.75	53.40	18.25	20.60
1 920.60	V	54.00	74.00	37.75	51.50	16.25	22.50

High(2 452 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
1 440.09	V	54.00	74.00	32.65	51.90	21.35	22.10
1 920.32	H	54.00	74.00	34.15	51.60	19.85	22.40
1 920.27	V	54.00	74.00	36.05	53.70	17.95	20.30
2 880.11	H	54.00	74.00	33.45	49.20	20.55	24.80
2 487.64	H	54.00	74.00	50.15	67.70	3.85	6.30
2 487.78	V	54.00	74.00	46.55	63.60	7.45	10.40

Remarks

1. The EUT was tested in three orientations in order to determine that "X axis" was the worst case.

4.6 AC Power Line Conducted Emissions

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits.

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

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

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

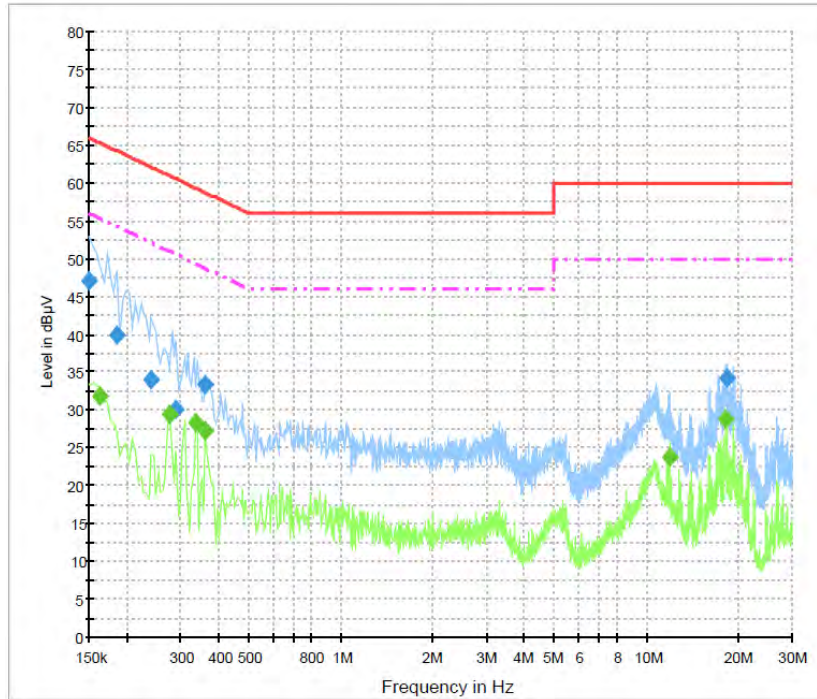
The requirements are:

☒ Complies

Test Data

[LINE]

Class B_L1



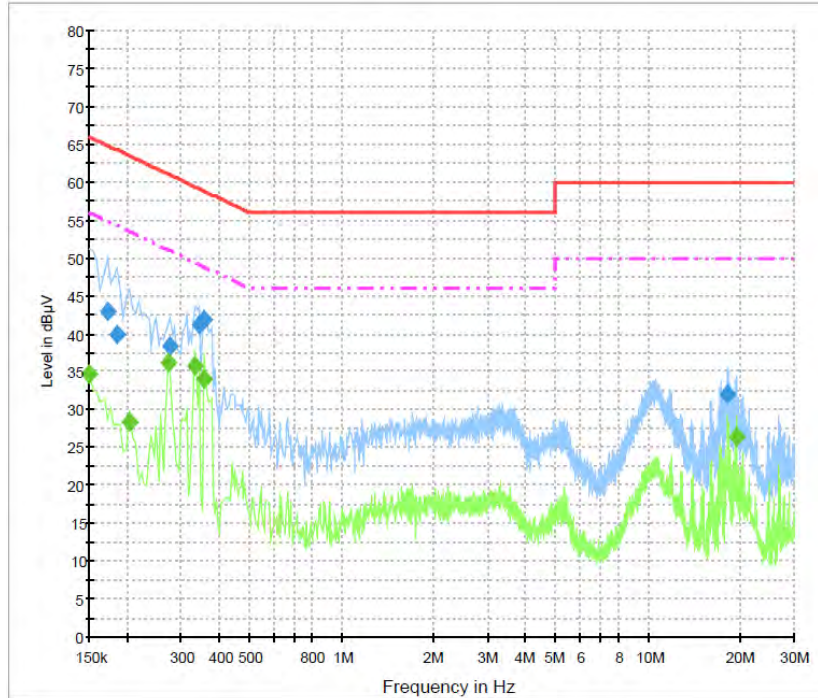
Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	47.1	1000.0	9.000	On	L1	9.8	18.9	66.0
0.186000	39.9	1000.0	9.000	On	L1	9.9	24.3	64.2
0.240000	34.1	1000.0	9.000	On	L1	9.8	28.0	62.1
0.289500	30.1	1000.0	9.000	On	L1	9.8	30.4	60.5
0.361500	33.4	1000.0	9.000	On	L1	9.9	25.3	58.7
18.303000	34.3	1000.0	9.000	On	L1	10.0	25.7	60.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.163500	31.8	1000.0	9.000	On	L1	9.8	23.5	55.3
0.276000	29.5	1000.0	9.000	On	L1	9.8	21.5	50.9
0.334500	28.3	1000.0	9.000	On	L1	9.9	21.0	49.3
0.361500	27.2	1000.0	9.000	On	L1	9.9	21.4	48.7
11.913000	23.8	1000.0	9.000	On	L1	9.9	26.2	50.0
18.177000	28.8	1000.0	9.000	On	L1	10.0	21.2	50.0

[NEUTRAL]
Class B_N



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.172500	42.9	1000.0	9.000	On	N	9.8	22.0	64.8
0.186000	40.0	1000.0	9.000	On	N	9.9	24.3	64.2
0.276000	38.3	1000.0	9.000	On	N	9.7	22.7	60.9
0.343500	41.1	1000.0	9.000	On	N	9.9	18.0	59.1
0.357000	41.8	1000.0	9.000	On	N	9.9	17.0	58.8
18.262500	32.0	1000.0	9.000	On	N	10.0	28.0	60.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	34.7	1000.0	9.000	On	N	9.8	21.3	56.0
0.204000	28.2	1000.0	9.000	On	N	9.9	25.2	53.4
0.271500	36.3	1000.0	9.000	On	N	9.7	14.8	51.1
0.330000	35.8	1000.0	9.000	On	N	9.8	13.6	49.5
0.357000	34.0	1000.0	9.000	On	N	9.9	14.8	48.8
19.432500	26.4	1000.0	9.000	On	N	10.0	23.6	50.0

APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Signal Analyzer	Agilent	N9020A	MY48011598	2017-11-01	2018-11-01
2	Signal Generator	Rohde & Schwarz	SMB100A	175528	2017-11-01	2018-11-01
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2017-10-25	2018-10-25
4	Bilog Antenna	Schaffner	CBL6111C	2551	2018-05-10	2020-05-10
5	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2018-05-02	2020-05-02
6	6dB Attenuator	R&S	DNF	272.4110.50-2	2017-10-25	2018-10-25
7	AMPLIFIER	SONOMA	310	291721	2018-02-02	2019-02-02
8	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2018-02-01	2019-02-01
9	Preamplifier	Agilent	8449B	3008A02011	2017-11-30	2018-11-30
10	Horn Antenna	ETS-Lindgren	3116	00062504	2017-12-04	2019-12-04
11	Horn Antenna	ETS-Lindgren	3117	00154525	2017-02-17	2019-02-17
12	Band Reject Filter	Micro Tronics	BRM50702	G233	2018-01-26	2019-01-26
13	LISN	Rohde & Schwarz	ENV216	101760	2018-01-31	2019-01-31
14	Singnal Canditioning Unit	R&S	SCU-40	10023	2017-11-01	2018-11-01