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TEST REPORT

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1. Client

- Name : WONDERFUL PLATFORM CO.,LTD
- Address : F5. F6, 175, Nonhyeon-ro, Seocho-gu, Seoul, Republic of Korea
- Date of Receipt : 2020-09-28

2. Use of Report : Certification

3. Name of Product / Model : AI Terminal / OCTOS

4. Manufacturer / Country of Origin : BANGJOO CO. ,LTD. / Korea

5. FCC ID : 2AST7-OCTOS

6. Date of Test : 2020-12-01 to 2020-12-21

7. Location of Test : ■ Permanent Testing Lab ☐ On Site Testing (Address: Address of testing location)

8. Test method used : FCC Part 15 Subpart E, 15.407

9. Test Results : Refer to the test result in the test report

Affirmation	Tested by Name : Euijung Kim (Signature)	Technical Manager Name : Heesu Ahn (Signature)

2021-01-07

KCTL Inc.

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by KCTL Inc.

REPORT REVISION HISTORY

Date	Revision	Page No
2020-12-28	Originally issued	-
2021-01-07	Updated	4, 8

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Note. The report No. KR20-SRF0321 is superseded by the report No. KR20-SRF0321-A.

General remarks for test reports

Nothing significant to report.

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1. General information

Client	:	WONDERFUL PLATFORM CO.,LTD
Address	:	F5. F6, 175, Nonhyeon-ro, Seocho-gu, Seoul, Republic of Korea
Manufacturer	:	BANGJOO CO. ,LTD.
Address	:	745-34, Samnam-ro, Jinwi-myeon, Pyeongtack-si, Gyeonggi-do.
Factory	:	BANGJOO CO. ,LTD.
Address	:	745-34, Samnam-ro, Jinwi-myeon, Pyeongtack-si, Gyeonggi-do.
Laboratory	:	KCTL Inc.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056 Industry Canada Registration No. : 8035A KOLAS No.: KT231

2. Device information

Equipment under test	:	AI Terminal
Model	:	OCTOS
Frequency range	:	2 402 ㎒ ~ 2 480 ㎒ (Bluetooth_BDR/EDR/BLE) 2 412 ㎒ ~ 2 462 ㎒ (802.11b/g/n_HT20) UNII-1: 5 180 ㎒ ~ 5 240 ㎒ (802.11a/n/ac_HT20/VHT20) UNII-1: 5 190 ㎒ ~ 5 230 ㎒ (802.11n/ac_HT40/VHT40) UNII-1: 5 210 ㎒ (802.11ac_VHT80)
Modulation technique	:	Bluetooth(BDR/EDR)_ GFSK, π/4DQPSK, 8DPSK Bluetooth(BLE)_GFSK WIFI(802.11a/b/g/n/ac)_DSSS, OFDM
Number of channels	:	Bluetooth(BDR/EDR): 79 ch / Bluetooth(BLE): 40 ch 802.11b/g/n_HT20 : 11 ch UNII-1: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒)
Power source	:	DC 12 V
Antenna specification	:	PCB Antenna
Antenna gain	:	Bluetooth(BDR/EDR/BLE): ANT 1: 2.80 ㏈i 802.11b/g/n_HT20 ANT 2: 2.80 ㏈i UNII-1 ANT 1: 1.51 ㏈i, ANT 2: 1.51 ㏈i
Software version	:	OS 00.45.00
Hardware version	:	OCTOS_R0.2
Test device serial No.	:	N/A
Operation temperature	:	0 ℃ ~ 40 ℃

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
AC Adapter	Channel Well Technology CO., LTD.	KPL060F-VI	N/A	Input: 100-240 V, 50/60Hz 1.7 A Output: 12 V /5 A

2.2. Frequency/channel operations

This device contains the following capabilities:
Bluetooth(BDR/EDR/BLE), 2.4 GHz WIFI: WLAN 802.11b/g/n(HT20)
5 GHz WIFI: WLAN 802.11a/g/n(HT20,HT40)/ac(VHT20,VHT40,VHT80)

UNII-1

Ch.	Frequency (MHz)
36	5 180
40	5 200
48	5 240

Table 2.2.1. 802.11a/n/ac_HT20/VHT20 mode

UNII-1

Ch.	Frequency (MHz)
38	5 190
46	5 230

Table 2.2.2. 802.11n/ac_HT40/VHT40 mode

UNII-1

Ch.	Frequency (MHz)
42	5 210

Table 2.2.3 802.11ac_VHT80 mode

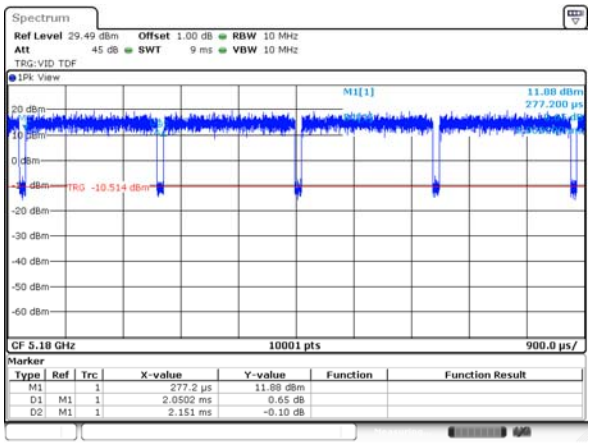
2.3. Duty Cycle Factor

Test mode	T_{on} time (ms)	Period (ms)	Duty cycle		Duty cycle factor (dB)
			(Linear)	(%)	
802.11a	2.151	2.050	0.953 1	95.31	0.21
802.11n_HT20	2.008	1.907	0.949 8	94.98	0.22
802.11n_HT40	1.046	0.944	0.902 9	90.29	0.44
802.11ac_VHT20	2.020	1.919	0.950 1	95.01	0.22
802.11ac_VHT40	1.054	0.952	0.903 7	90.37	0.44
802.11ac_VHT80	0.561	0.460	0. 818 8	81.88	0.87

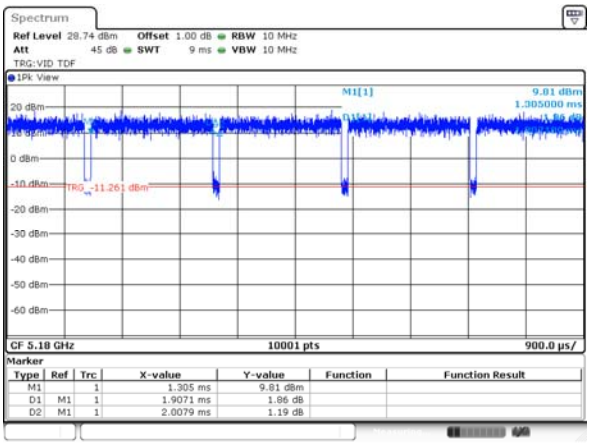
Notes.

1. Duty cycle (Linear) = T_{on} time / Period
2. DCF(Duty cycle factor) = 10log(1/duty cycle)
3. DCF is not applied as a continuous transmitter when the duty cycle is 98% or more.

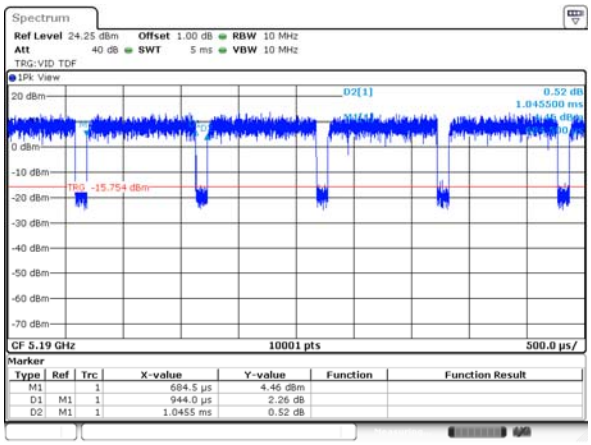
802.11a



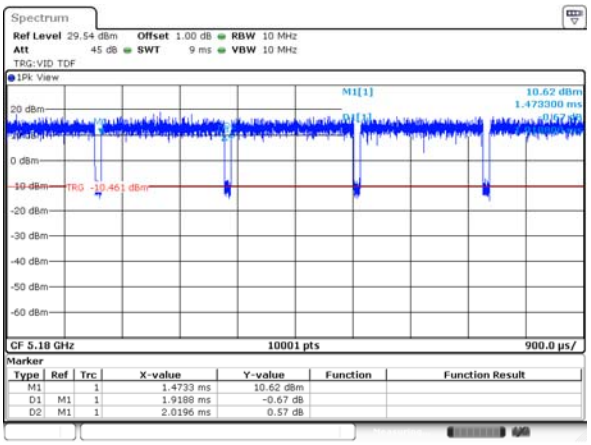
802.11n_HT20

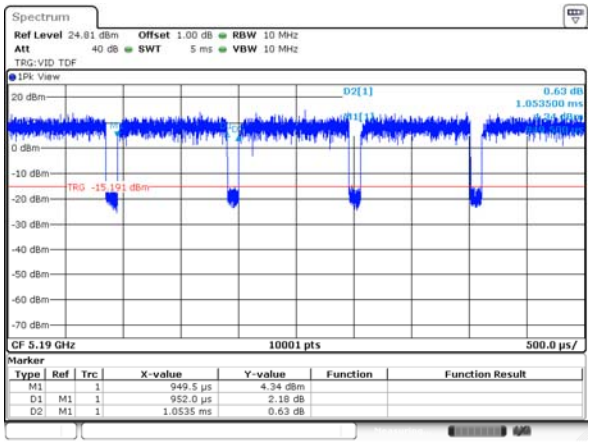
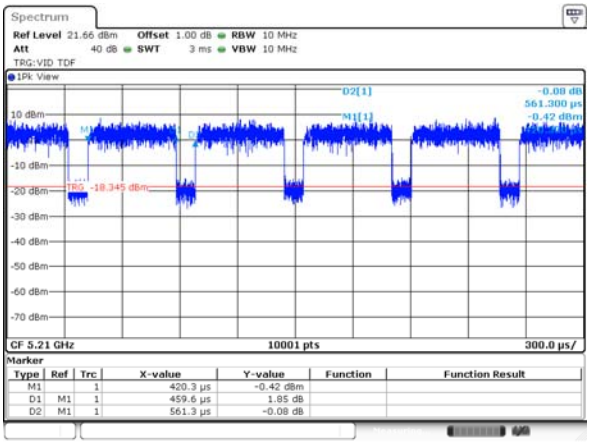


802.11n_HT40



802.11ac_VHT20



802.11ac_VHT40	802.11ac_VHT80
	

2.4. Power level setup in software

Power level setup in software				
Test Mode	Frequency	Software Setup		
		ANT 1	ANT 2	2TX MIMO
802.11a	5 180 ㎒	-	13	-
	5 200 ㎒	-	13	-
	5 240 ㎒	-	13	-
802.11n_HT20	5 180 ㎒	-	12	-
	5 200 ㎒	-	12	-
	5 240 ㎒	-	12	-
802.11n_HT40	5 190 ㎒	-	10	-
	5 230 ㎒	-	10	-
802.11ac_VHT20	5 180 ㎒	-	12	-
	5 200 ㎒	-	12	-
	5 240 ㎒	-	12	-
802.11ac_VHT40	5 190 ㎒	-	10	-
	5 230 ㎒	-	10	-
802.11ac_VHT80	5 210 ㎒	9	9	9

2.5. Simultaneous Tx Condition

Simultaneous Tx condition

Mode	2.4GHz WIFI	5GHz WIFI		BT	BLE	Test Case
	ANT 2	ANT 1	ANT 2	ANT 1	ANT 1	
5GHz WIFI ANT 1 + BT	-	on	-	on	-	V
5GHz WIFI ANT 2 + BT	-	-	on	on	-	V
5GHz WIFI MIMO + BT	-	on	on	on	-	V
5GHz WIFI ANT 1 + BLE	-	on	-	-	on	V
5GHz WIFI ANT 2 + BLE	-	-	on	-	on	V
5GHz WIFI MIMO + BLE	-	on	on	-	on	V

* This device does not support simultaneous operation other than the above table.

3. Antenna requirement

According to §15.203, §15.407

"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."

- The transmitter has permanently attached PCB Antenna(internal antenna) on board.
- The E.U.T Complies with the requirement of §15.203, §15.407

3.1 Antenna information

Mode	SISO		MIMO
	ANT 1	ANT 2	ANT 1 + 2
802.11a	×	√	×
802.11n HT20	×	√	×
802.11n HT40	×	√	×
802.11ac VHT20	×	√	×
802.11ac VHT40	×	√	×
802.11ac VHT80	√	√	√

√ = Support, ×= Not support

Note.

1. This device employs SISO, MIMO technology output power as ANT 1 and ANT 2.

3.2 Directional Gain Calculations

According to clause F), 2), f), (iii) of KDB 662911 D01 Multiple Transmitter Output, Directional gain may be calculated by using the formulas as below.

3.2.1. Directional Antenna Gain with equal gain

Band	ANT 1 Gain (dBi)	ANT 2 Gain (dBi)	PSD Directional Gain (dBi)	Power Directional Gain (dBi)
UNII 1	1.51	1.51	4.52	1.51

Note.

1. If all transmit signals are completely correlated, then

Directional gain = $G_{ANT\,MAX}$ + Array Gain.

- For PSD measurements on all devices Array gain = 10 log (N_{ANT} / N_{ss}) dB
- For Power measurements on IEEE 802.11 devices Array gain = 0 dB For $N_{ANT} \leq 4$.

4. Summary of tests

FCC Part section(s)	Parameter	Test condition	Test results
15.407(a)	Maximum conducted output power	Conducted	Pass
15.407(a)	Maximum power spectral density		Pass
15.407(a)	26 dB bandwidth		Pass
15.207(a)	Conducted emissions		Pass
15.407(d), 15.205(a), 15.209(a)	Spurious emission	Radiated	Pass
	Band-edge, restricted band		Pass

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
3. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that **X** orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in **X** orientation.
4. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.10-2013
   - KDB 662911 D01 v02r01
   - KDB 789033 D02 v02r01
5. The EUT supports SISO and MIMO modes.
6. The worst-case data rates were:
   802.11a mode : 6Mbps
   802.11n/ac_HT20 mode : MCS0 / MCS0NSS1
   802.11n/ac_HT40 mode : MCS0 / MCS0NSS1
   802.11ac_VHT80 mode : MCS0NSS1

5. 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 indicated a 95% level of confidence. The measurement data shown herein meets of 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 (±)	
Conducted RF power	1.3 dB	
Conducted spurious emissions	1.3 dB	
Radiated spurious emissions	9 kHz ~ 30 MHz:	2.3 dB
	30 MHz ~ 300 MHz	5.4 dB
	300 MHz ~ 1 000 MHz	5.5 dB
	1 GHz ~ 6 GHz	6.7 dB
	Above 6 GHz	6.7 dB
Conducted emissions	9 kHz ~ 150 kHz	3.7 dB
	150 kHz ~ 30 MHz	3.3 dB

6. Measurement results explanation example

The offset level is set in the spectrum analyzer to compensate the RF cable loss factor between EUT conducted output port and spectrum analyzer.
With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Frequency (㎒)	Factor(㏈)	Frequency (㎒)	Factor(㏈)
30	9.80	9 000	12.62
50	9.89	10 000	12.65
100	10.05	11 000	12.66
200	10.04	12 000	12.43
300	10.19	13 000	13.15
400	10.41	14 000	12.90
500	10.48	15 000	13.27
600	10.54	16 000	13.58
700	10.60	17 000	13.59
800	10.65	18 000	13.65
900	10.68	19 000	13.26
1 000	10.64	20 000	14.03
2 000	11.11	21 000	14.10
3 000	11.40	22 000	14.31
4 000	11.64	23 000	14.47
5 000	11.83	24 000	14.41
6 000	12.13	25 000	14.51
7 000	12.21	26 000	15.11
8 000	12.01	26 500	14.70

Note.
Offset(㏈) = RF cable loss(㏈) + Attenuator(㏈)

7. Test results

7.1. Maximum conducted output power

Test setup

EUT — Attenuator — Spectrum analyzer

Limit

According to §15.407(a)

Band	EUT category		Limit
UNII-1		Outdoor access point	1 W (30 dBm)
		Indoor access point	
		Fixed point-to-point access point	
	√	Client device	250 mW (23.98 dBm)
UNII-2A			250 mW or 11 dBm + 10logB*
UNII-2C			250 mW or 11 dBm + 10logB*
UNII-3			1 W (30 dBm)

Note.:

*FCC Limit B is the 26 dB emission bandwidth.

Test procedure

ANSI C63.10-2013-Section 12.3.3.2 and 14.2
KDB 789033 D02 v02r01 - Section E.2.d) or e)
KDB 662911 D01 v02r01 – Section E).1)

Test settings
Used test method is Section E.2.d)

◆ KDB 789033 D02 v02r01

Section E.2.d)
Method SA-2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction):

(i) Measure the duty cycle, x, of the transmitter output signal as described in II.B..
(ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
(iii) Set RBW = 1 ㎒
(iv) Set RBW ≥ 3 ㎒
(v) Number of points in sweep ≥ 2×span/RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(vi) Sweep time = auto.
(vii) Detector = power averaging (rms), if available. Otherwise use sample detector mode.
(viii) Do not use sweep triggering. Allow the sweep to "free run."
(ix) Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.
(x) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 ㎒ intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
(xi) 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 (because the measurement represents an average over both the on and off times of the transmission). For example, add 10 log(1/0,25) = 6 ㏈ if the duty cycle is 25%.

Section E.2.e)
Method SA-2 Alternative (power averaging(rms) detection with slow sweep with each spectrum bin averaging across on and off times of the EUT transmissions, followed by duty cycle correction):

(i) Measure the duty cycle, x, of the transmitter output signal as described in II.B..
(ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
(iii) Set RBW = 1 ㎒
(iv) Set RBW ≥ 3 ㎒
(v) Number of points in sweep ≥ 2×span/RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(vi) Manually set sweep time ≥ 10 × (number of points in sweep) × (total on/off period of the transmitted signal).
(vii) Set detector = power averaging (rms)
(viii) Perform a single sweep.
(ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement

function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 ㎒ intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

(x) 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 (because the measurement represents an average over both the on and off times of the transmission). For example, add 10 log(1/0,25) = 6 ㏈ if the duty cycle is 25%.

Section E.3.a)
Method PM (Measurement using an RF average power meter):

(xi) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.

- The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
- At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
- The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five

(xii) If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in Ⅱ

(xiii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

(xiv) Adjust the measurement in ㏈m by adding 10 log (1/x) where x is the duty cycle (e.g., 10 log (1/0.25) if the duty cycle is 25%).

Section E.3.b)
Method PM-G (Measurement using a gated RF average power meter):
Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

Test results

SISO

Test mode	Band	Frequency (MHz)	Measured output power					
			Reading ANT 1 (dBm)	Reading ANT 2 (dBm)	DCF (dB)	Result ANT 1 (dBm)[1)]	Result ANT 2 (dBm)[1)]	Limit (dBm)
802.11a	UNII 1	5 180	-	11.04	0.21	-	11.25	23.98
		5 200	-	10.67		-	10.88	
		5 240	-	10.61		-	10.82	
802.11n HT20	UNII 1	5 180	-	9.86	0.22	-	10.08	23.98
		5 200	-	9.87		-	10.09	
		5 240	-	9.69		-	9.91	
802.11n HT40	UNII 1	5 190	-	7.67	0.44	-	8.11	23.98
		5 230	-	7.25		-	7.69	
802.11ac VHT20	UNII 1	5 180	-	9.78	0.22	-	10.00	23.98
		5 200	-	9.79		-	10.01	
		5 240	-	9.66		-	9.88	
802.11ac VHT40	UNII 1	5 190	-	7.85	0.44	-	8.29	23.98
		5 230	-	7.48		-	7.92	
802.11ac VHT80	UNII 1	5 210	6.35	5.78	0.87	7.22	6.65	23.98

Note.

1. Result(dBm) = Reading (dBm) + Duty Cycle Factor (dB)

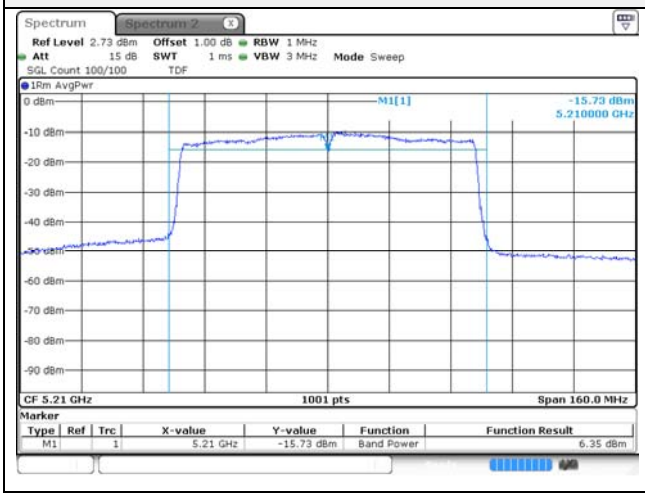
MIMO

Test mode	Band	Frequency (MHz)	Measured output power						
			Reading ANT 1 (dBm)	Reading ANT 2 (dBm)	DCF (dB)	Result ANT 1 (dBm)[1)]	Result ANT 2 (dBm)[1)]	Result MIMO (dBm)[1)]	Limit (dBm)
802.11ac_ VHT80	UNII 1	5 210	6.60	5.49	0.87	7.47	6.36	9.96	23.98

Note.

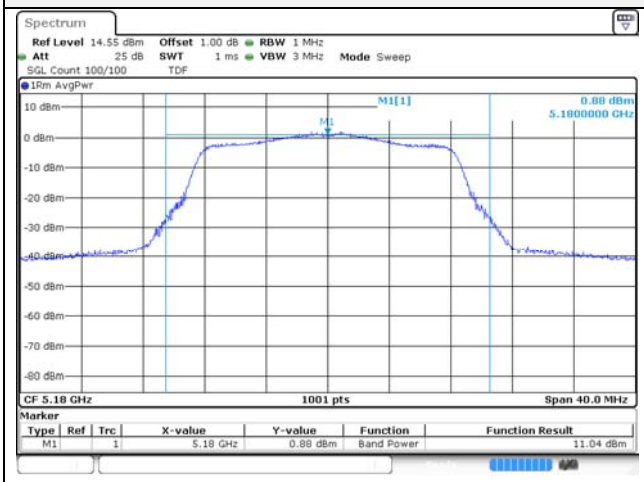
1. Result(dBm) = $10\log(10^{(ANT\ 1/10)} + 10^{(ANT\ 2/10)})$ + Duty Cycle Factor (dB)

SISO ANT 1

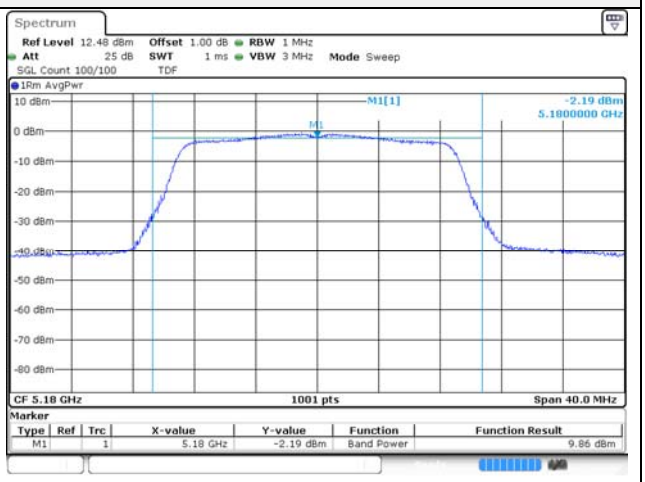
UNII-1 / 802.11ac VHT80 / 5 210 ㎒	
	Blank

SISO ANT 2

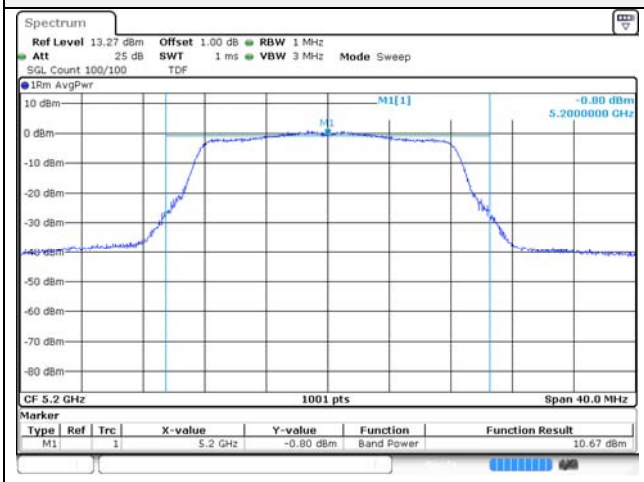
UNII-1 / 802.11a / 5 180 ㎒



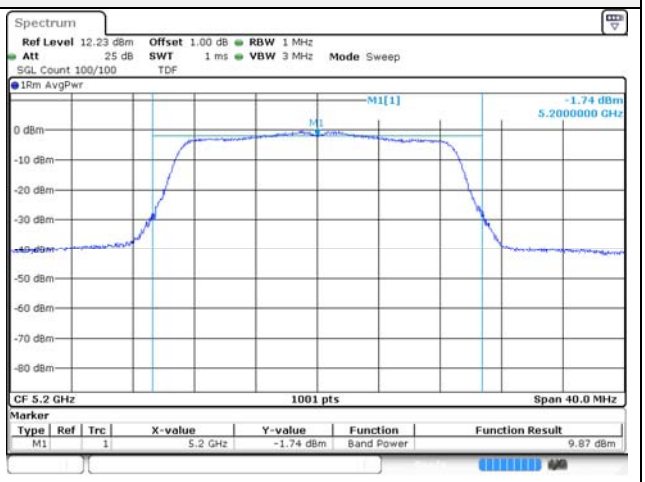
UNII-1 / 802.11n HT20 / 5 180 ㎒



UNII-1 / 802.11a / 5 200 ㎒



UNII-1 / 802.11n HT20 / 5 200 ㎒



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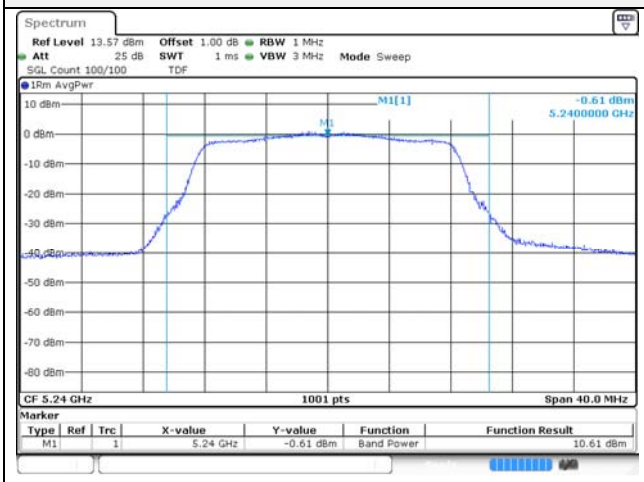

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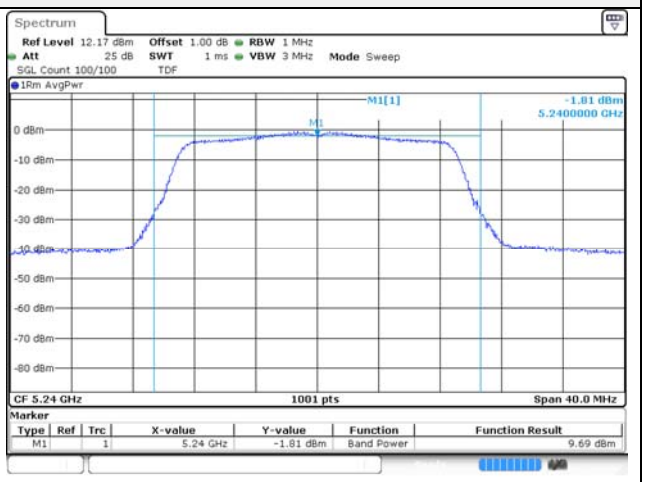
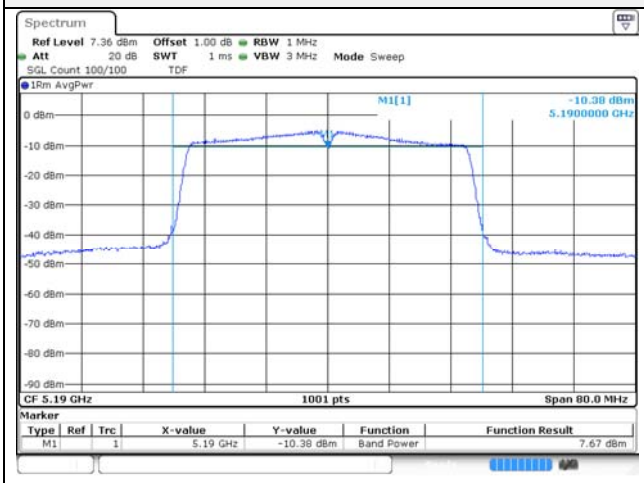


UNII-1 / 802.11n HT40 / 5 190 ㎒



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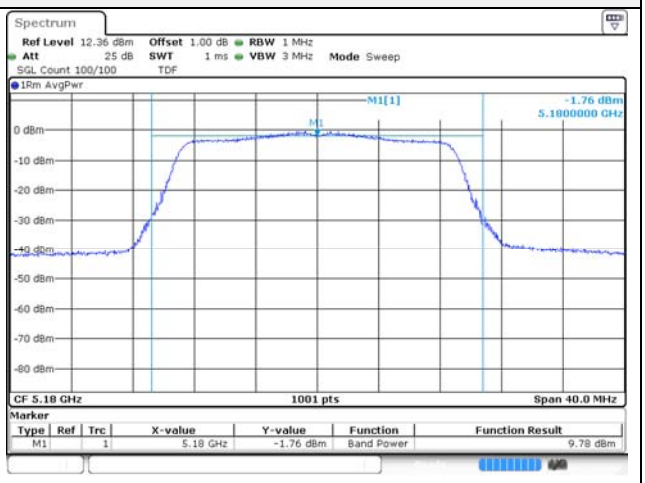

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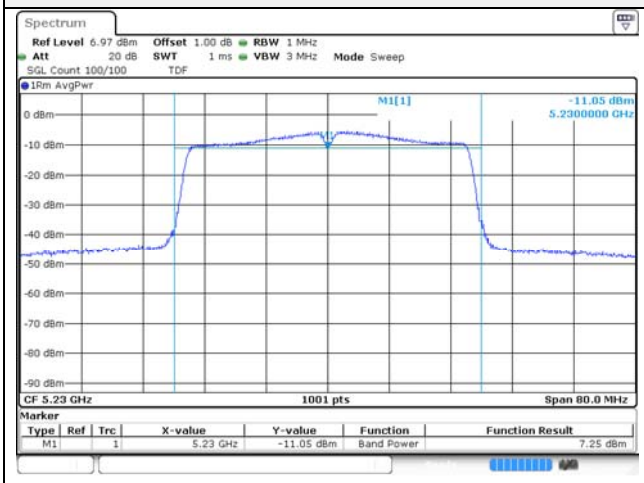

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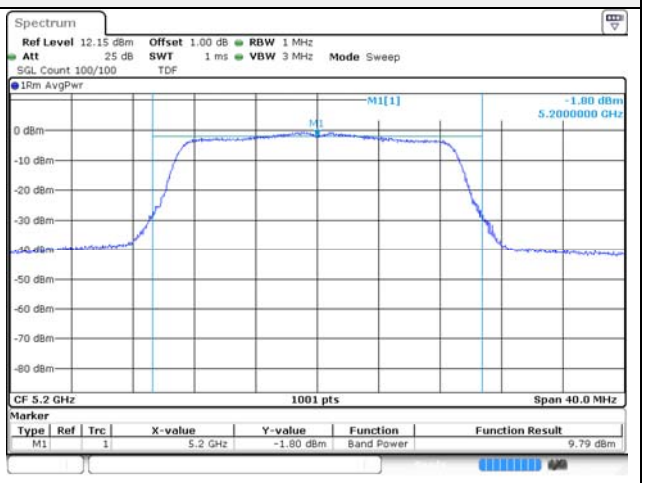

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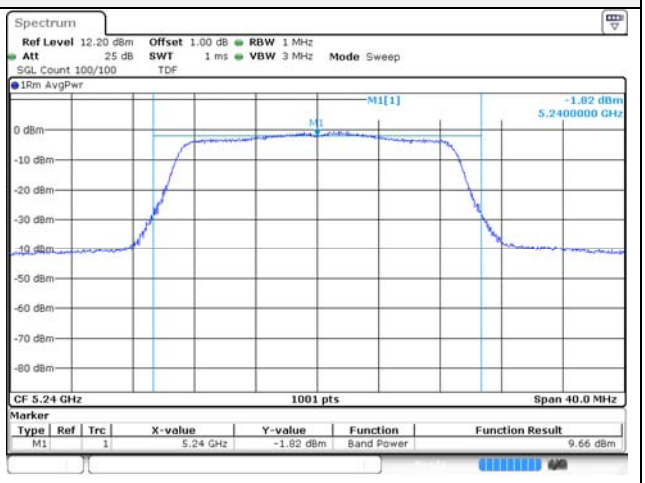

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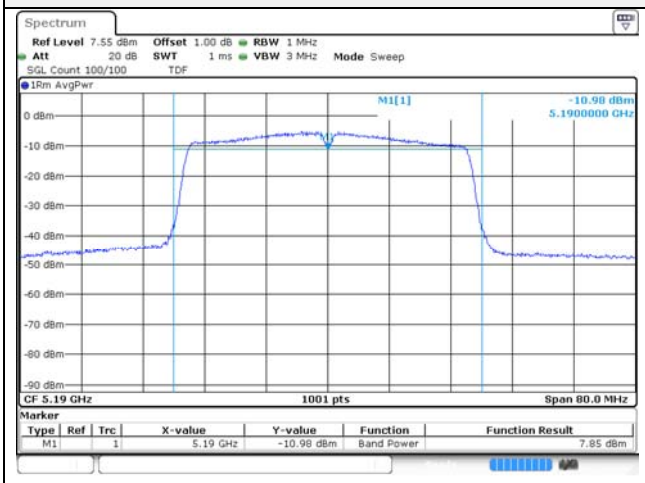
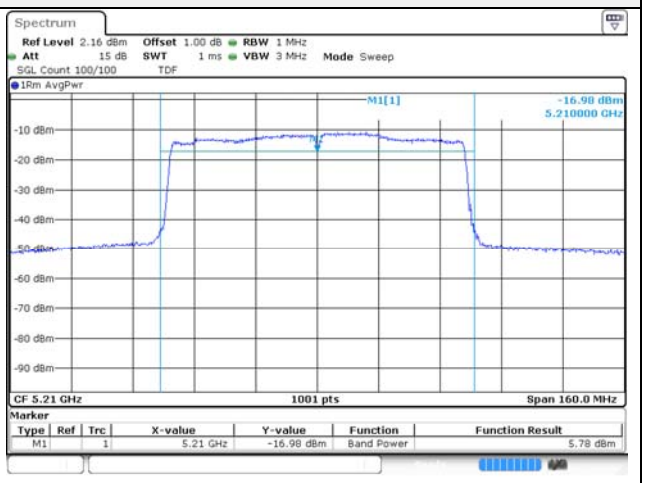


UNII-1 / 802.11ac VHT80 / 5 210 ㎒



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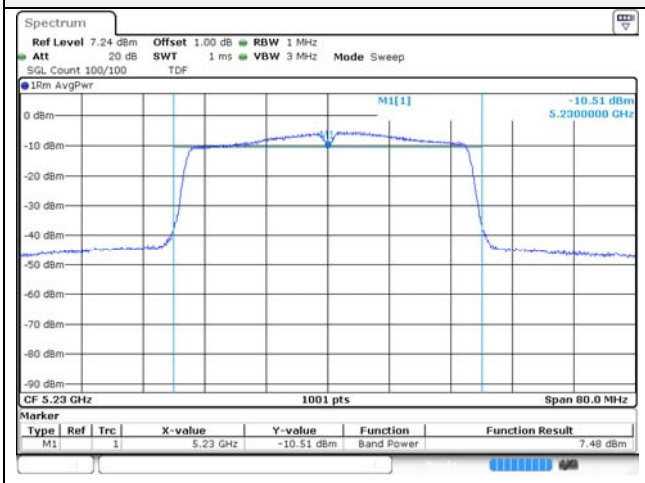

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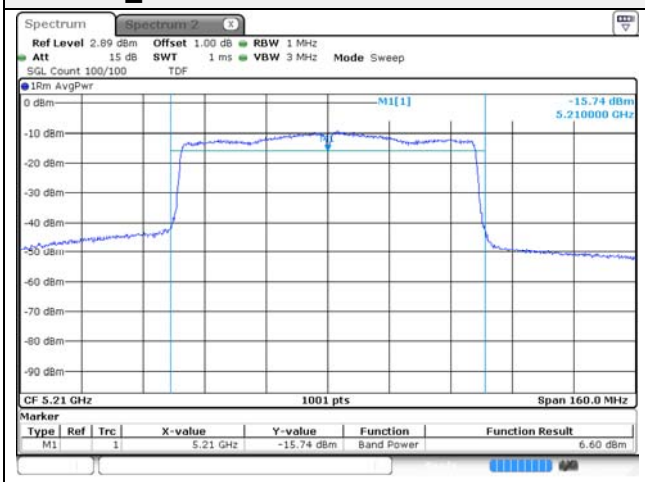
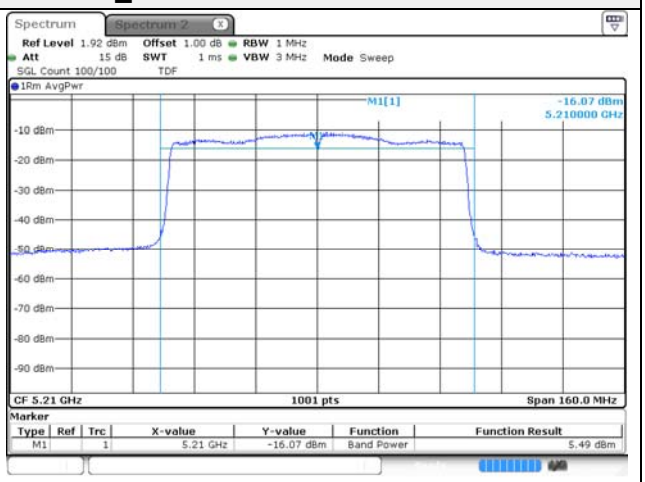
MIMO

ANT 1_UNII-1 / 802.11ac VHT80 / 5 210 ㎒



ANT 2_UNII-1 / 802.11ac VHT80 / 5 210 ㎒



7.2. Maximum Power Spectral Density

Test setup

EUT	—	Attenuator	—	Spectrum analyzer

Limit

According to §15.407(a)

Band	EUT category		Limit
UNII-1		Outdoor access point	17 dBm/MHz
		Indoor access point	
		Fixed point-to-point access point	
	√	Client device	11 dBm/MHz
UNII-2A			11 dBm/MHz
UNII-2C			11 dBm/MHz
UNII-3			30 dBm/500 kHz

Notes:

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain if the antenna exceed 6 dBi

Test procedure

KDB 789033 D02 v02r01 - Section F
KDB 662911 D01 v02r01 - Section E). 2)
ANSI C63.10-2013

Test settings

Section F

The rules requires "maximum power spectral density" measurements where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission. Refer to III.A for additional guidance for devices that use channel aggregation.

1. Create an average power spectrum for the EUT operating mode being tested by following the instructions in II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled,
   "Compute power…." (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
2. Search function on the instrument to find the peak of the spectrum and record its value.
3. Adjustments to the peak value of the spectrum, if applicable:

   a) If Method SA-2 or SA-2 Alternative was used, add 10 log (1/x), where x is the duty cycle, to the peak of the spectrum.
   b) If Method SA-3 Alternative was used and the linear mode was used in II.E.2.g) (viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
4. The result is the Maximum PSD over 1 MHz reference bandwidth
5. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the

preceding procedures make use of 1 ㎒ RBW to satisfy directly the 1 ㎒ reference bandwidth specified in Section 15.407(a)(5). For devices operating in the band 5.725-5.85 ㎓, the rules specify a measurement bandwidth of 500 ㎑. Many spectrum analyzers do not have 500 ㎑ RBW, thus a narrower RBW may need to be used. The rules permit the use of RBWs less than 1 ㎒, or 500 ㎑, "provided that the measured power is integrated over the full reference bandwidth" to show the total power over the specified measurement bandwidth (i.e., 1 ㎒, or 500 ㎑). If measurements are performed using a reduced resolution bandwidth (< 1 ㎒, or < 500 ㎑) and integrated over 1 ㎒, or 500 ㎑ bandwidth, the following adjustments to the procedures apply:

a) Set RBW ≥ 1/T, where T is defined in II.B.I.a).
b) Set VBW ≥ 3 RBW.
c) If measurement bandwidth of Maximum PSD is specified in 500 ㎑, add 10 log (500 ㎑ /RBW) to the measured result, whereas RBW (< 500 ㎑) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
d) If measurement bandwidth of Maximum PSD is specified in 1 ㎒, add 10 log (1 ㎒/RBW) to the measured result, whereas RBW (< 1 ㎒) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Notes:

1. As a practical matter, it is recommended to use reduced RBW of 100 ㎑ for the II.F.5.c) and II.F.5.d), since RBW = 100 ㎑ is available on nearly all spectrum analyzers.

Test results

SISO

Test mode	Band	Frequency (MHz)	Maximum Power Spectral Density					
			Reading ANT 1 (dBm/MHz)	Reading ANT 2 (dBm/MHz)	DCF (dB)	Result ANT 1 (dBm/MHz)[1)]	Result ANT 2 (dBm/MHz)[1)]	Limit (dBm/MHz)
802.11a	UNII 1	5 180	-	1.72	0.21	-	1.93	11.00
		5 200	-	0.73		-	0.94	
		5 240	-	0.60		-	0.81	
802.11n HT20	UNII 1	5 180	-	-0.38	0.22	-	-0.16	11.00
		5 200	-	-0.44		-	-0.22	
		5 240	-	-0.70		-	-0.48	
802.11n HT40	UNII 1	5 190	-	-5.52	0.44	-	-5.08	11.00
		5 230	-	-5.76		-	-5.32	
802.11ac VHT20	UNII 1	5 180	-	-0.36	0.22	-	-0.14	11.00
		5 200	-	-0.64		-	-0.42	
		5 240	-	-0.63		-	-0.41	
802.11ac VHT40	UNII 1	5 190	-	-4.83	0.13	-	-4.93	11.00
		5 230	-	-5.89		-	-5.45	
802.11ac VHT80	UNII 1	5 210	-10.00	-10.57	0.27	-10.00	-9.70	11.00

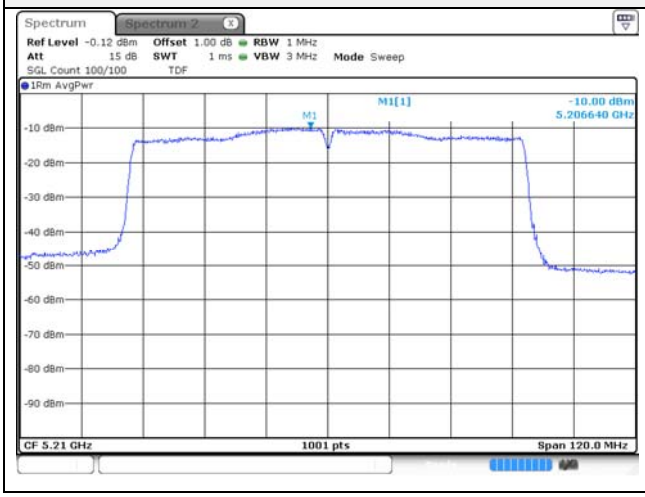
Note.
1. Result(dBm) = Reading (dBm) + Duty Cycle Factor (dB)

MIMO

Test mode	Band	Frequency (MHz)	Maximum Power Spectral Density					
			Reading ANT 1 (dBm/MHz)	Reading ANT 2 (dBm/MHz)	DCF (dB)	Result 4TX MIMO	(dBm/MHz)[1)]	Limit (dBm/MHz)
802.11ac VHT80	UNII 1	5 210	-10.00	-11.15	0.87	-10.00	-11.15	11.00

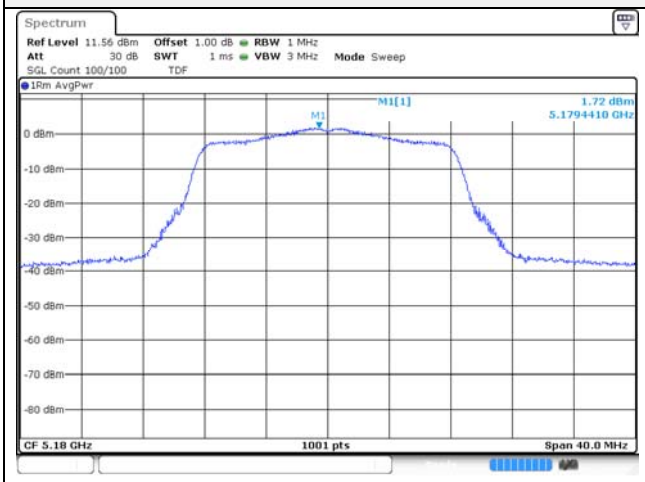
Note.
1. Result(dBm) = $10\log(10^{(ANT\ 1/10)} + 10^{(ANT\ 2/10)})$ + Duty Cycle Factor (dB)

SISO ANT 1

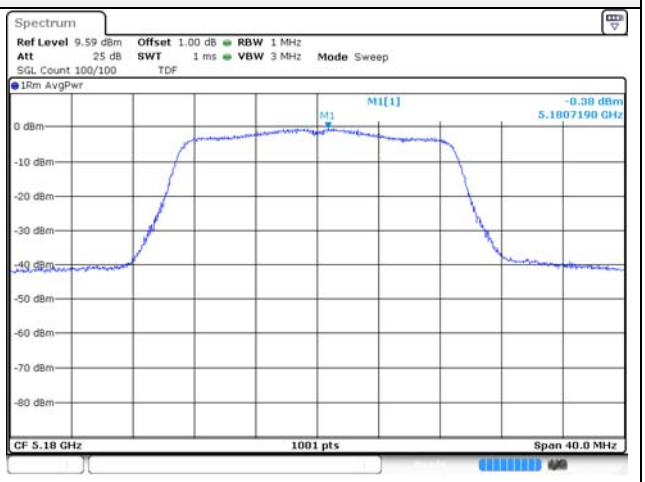
UNII-1 / 802.11ac VHT80 / 5 210 MHz	
	Blank

SISO ANT 2

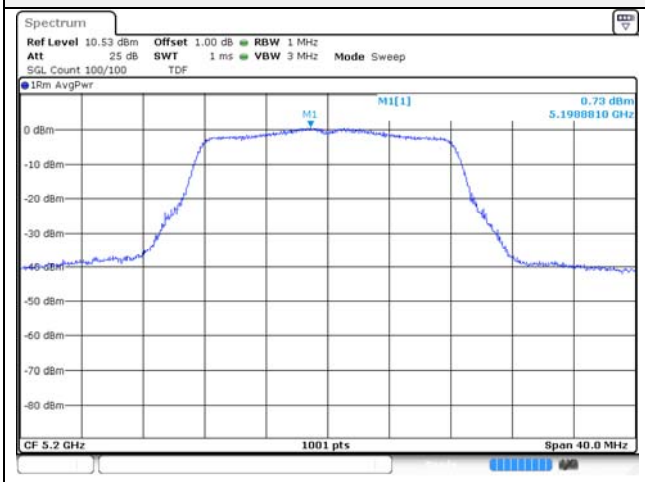
UNII-1 / 802.11a / 5 180 ㎒



UNII-1 / 802.11n HT20 / 5 180 ㎒



UNII-1 / 802.11a / 5 200 ㎒



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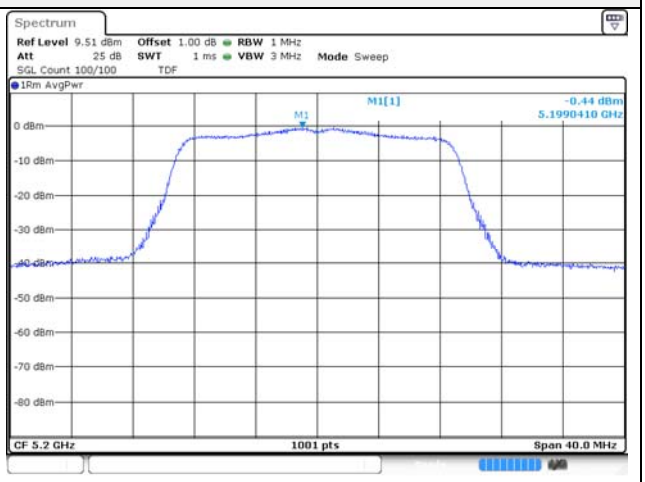
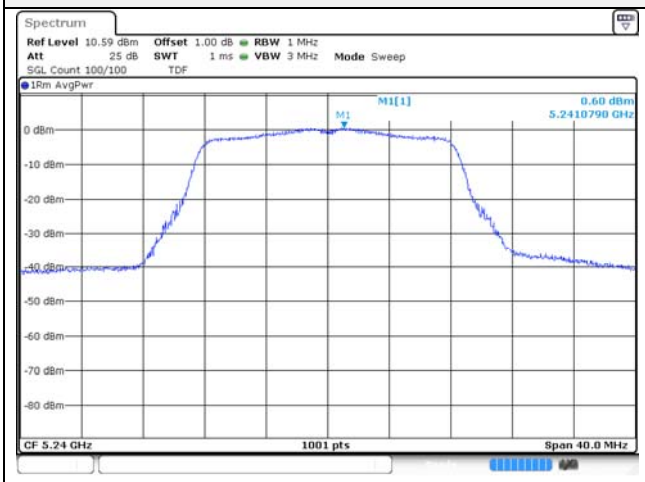
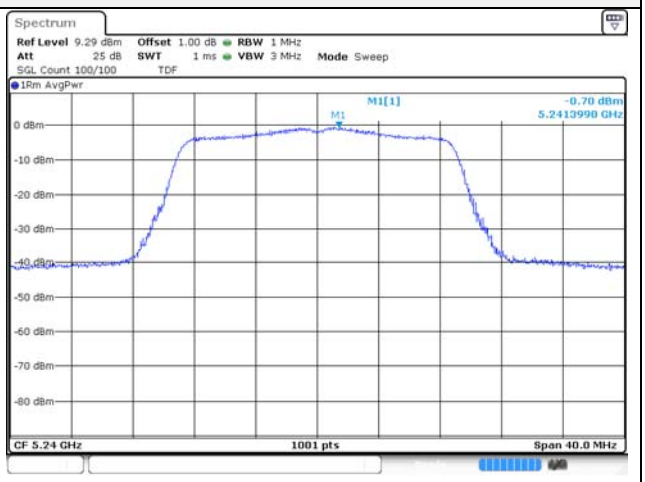


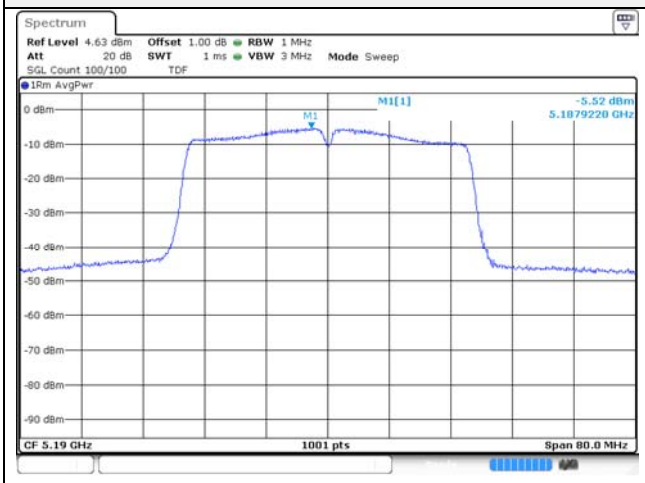
UNII-1 / 802.11a / 5 240 ㎒



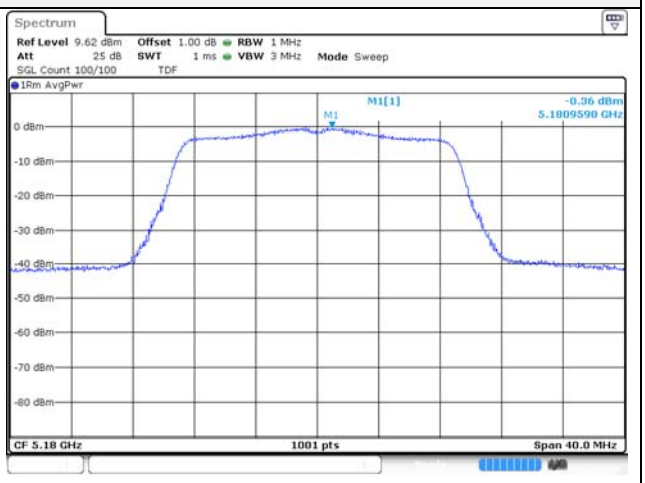
UNII-1 / 802.11n HT20 / 5 240 ㎒



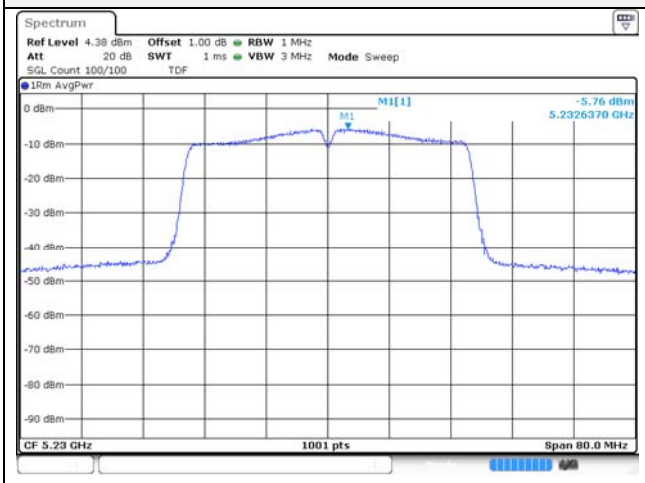
UNII-1 / 802.11n HT40 / 5 190 ㎒



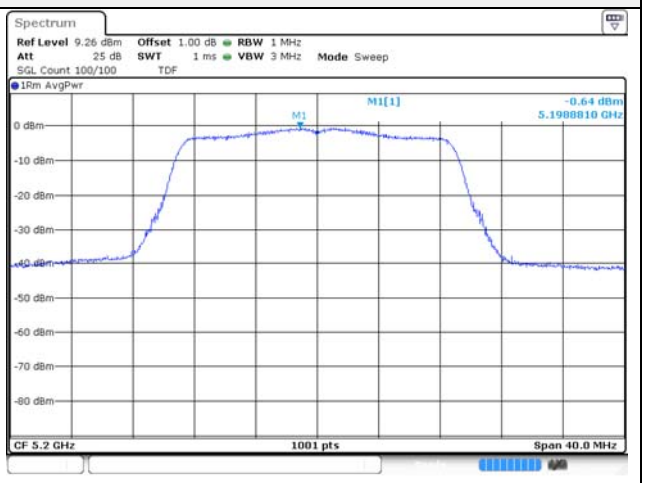
UNII-1 / 802.11ac VHT20 / 5 180 ㎒



UNII-1 / 802.11n HT40 / 5 230 ㎒



UNII-1 / 802. 11ac VHT20 / 5 200 ㎒



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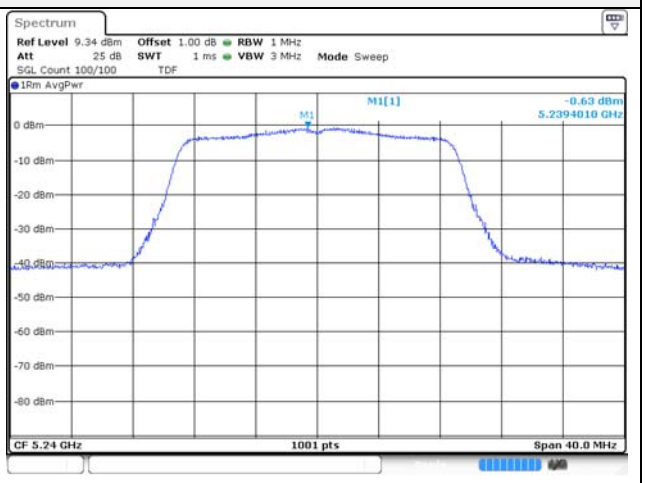
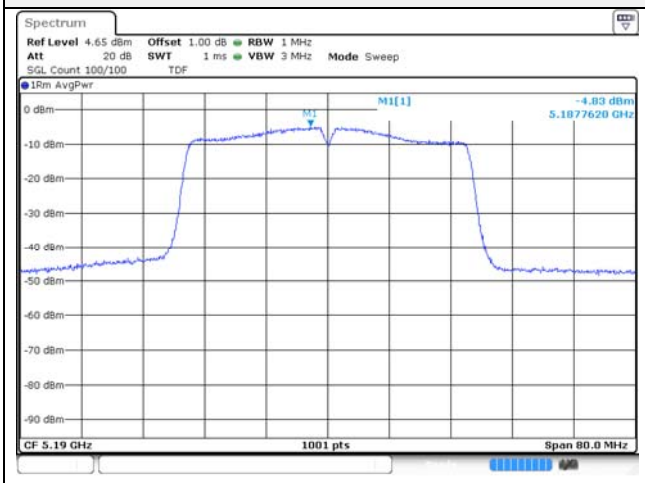
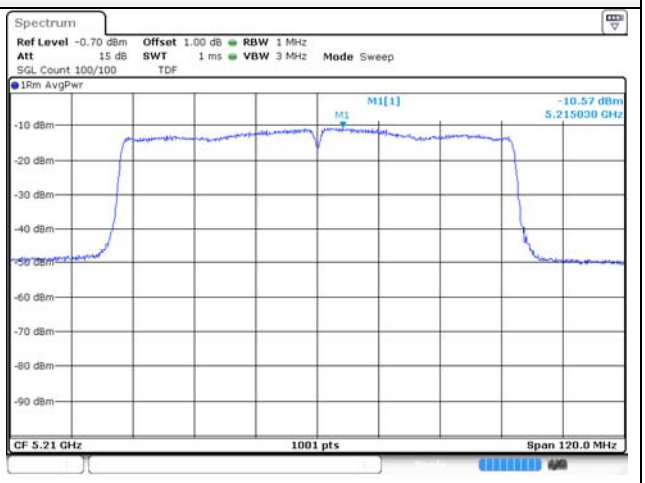


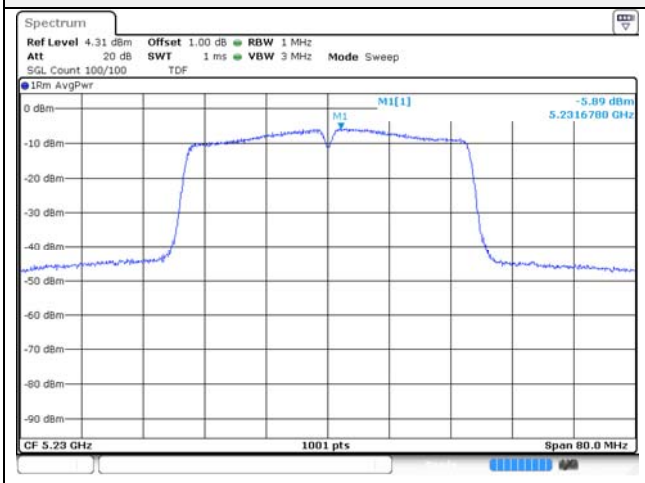
UNII-1 / 802.11ac VHT40 / 5 190 ㎒



UNII-1 / 802.11ac VHT80 / 5 210 ㎒



UNII-1 / 802.11ac VHT40 / 5 230 ㎒



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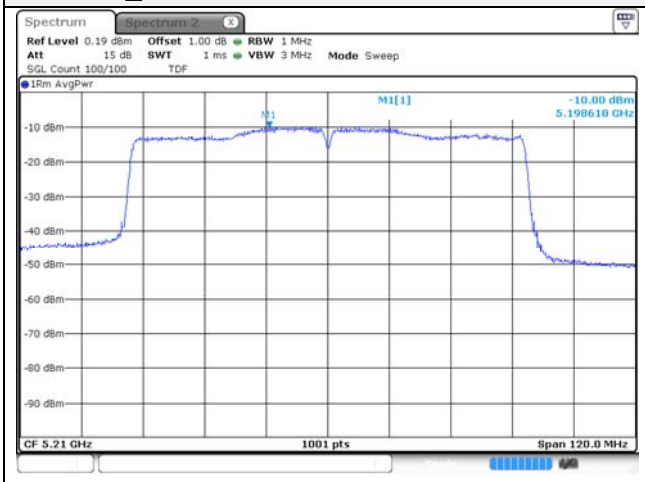
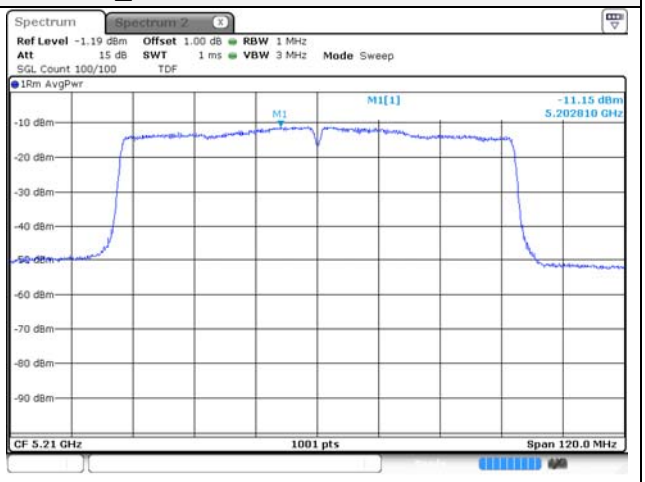
MIMO

ANT 1_UNII-1 / 802.11ac VHT80 / 5 210 ㎒

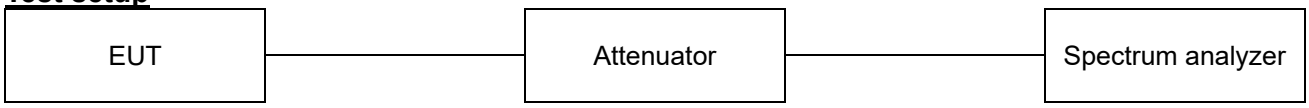


ANT 2_UNII-1 / 802.11ac VHT80 / 5 210 ㎒



7.3. 26 dB Bandwidth & 99% Bandwidth

Test setup



Limit

N/A

Test procedure

ANSI C63.10-2013 Section 12.4
KDB 789033 D02 v02r01 - Section C.1 (26dBbandwidth)
KDB 789033 D02 v02r01 - Section D (99% bandwidth)

Test settings

1. 26 dB Bandwidth

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

2. 99% Occupied Bandwidth

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1% to 5% of the OBW
4. Set VBW ≥ 3 x RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99% power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

Test results

26dB Bandwidth

Test mode	Band	Frequency(MHz)	Measured Bandwidth ANT 1 (MHz)	Measured Bandwidth ANT 2 (MHz)
802.11a	UNII-1	5 180	-	21.08
		5 200	-	21.03
		5 240	-	20.93
802.11n HT20	UNII-1	5 180	-	21.43
		5 200	-	21.43
		5 240	-	21.28
802.11n HT40	UNII-1	5 190	-	40.26
		5 230	-	39.86
802.11ac VHT20	UNII-1	5 180	-	21.58
		5 200	-	21.48
		5 240	-	21.38
802.11ac VHT40	UNII-1	5 190	-	40.16
		5 230	-	40.06
802.11ac VHT80	UNII-1	5 210	82.60	81.88

MIMO

Test mode	Band	Frequency(MHz)	Measured Bandwidth ANT 1 (MHz)	Measured Bandwidth ANT 2 (MHz)
802.11ac VHT80	UNII-1	5 210	81.88	81.88

99% Bandwidth

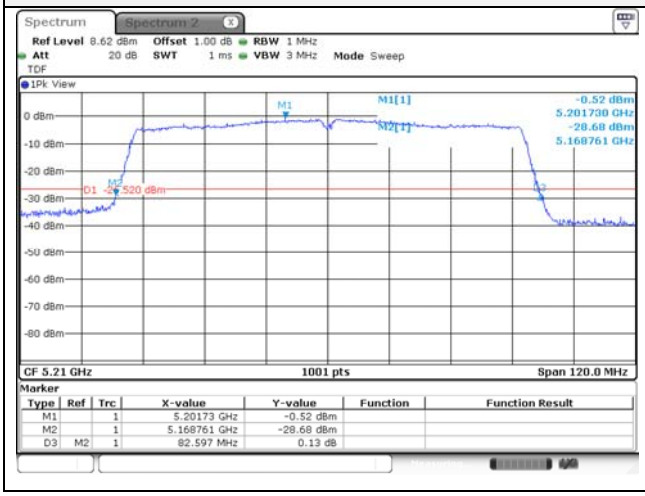
Test mode	Band	Frequency(㎒)	Measured Bandwidth ANT 1 (㎒)	Measured Bandwidth ANT 2 (㎒)
802.11a	UNII-1	5 180	-	16.53
		5 200	-	16.63
		5 240	-	16.68
802.11n HT20	UNII-1	5 180	-	17.73
		5 200	-	17.83
		5 240	-	17.78
802.11n HT40	UNII-1	5 190	-	36.26
		5 230	-	36.26
802.11ac VHT20	UNII-1	5 180	-	17.78
		5 200	-	17.83
		5 240	-	17.78
802.11ac VHT40	UNII-1	5 190	-	36.36
		5 230	-	36.26
802.11ac VHT80	UNII-1	5 210	75.52	75.76

MIMO

Test mode	Band	Frequency(㎒)	Measured Bandwidth ANT 1 (㎒)	Measured Bandwidth ANT 2 (㎒)
802.11ac VHT80	UNII-1	5 210	75.52	75.52

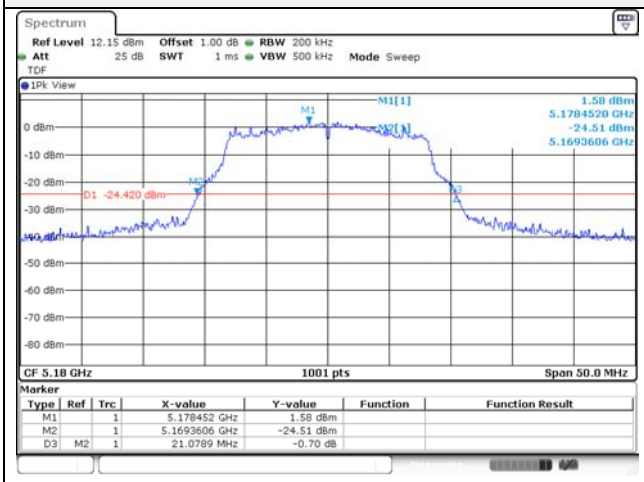
26 dB bandwidth

ANT 1

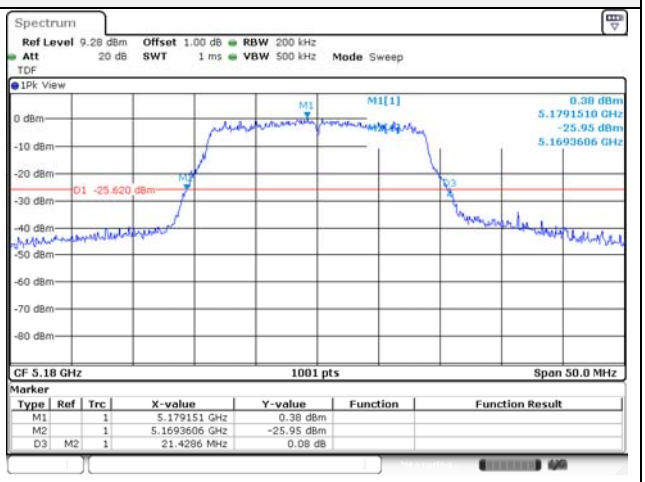
UNII-1 / 802.11ac VHT80 / 5 210 MHz	
	Blank

ANT 2

UNII-1 / 802.11a / 5 180 ㎒



UNII-1 / 802.11n HT20 / 5 180 ㎒



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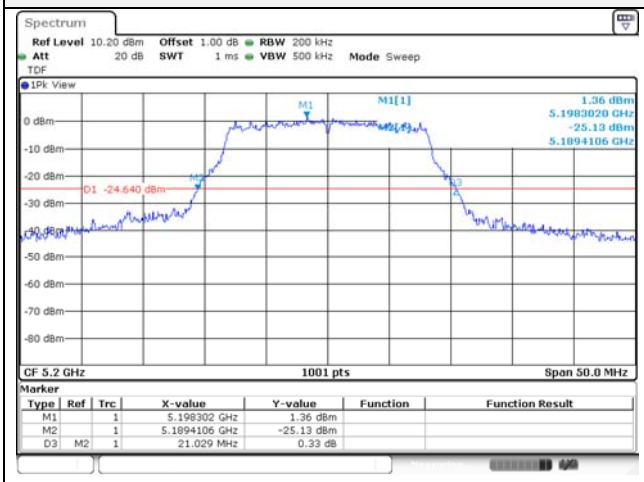

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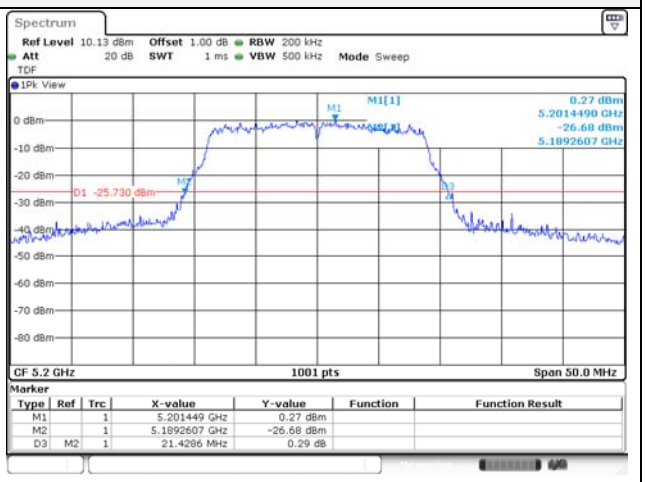

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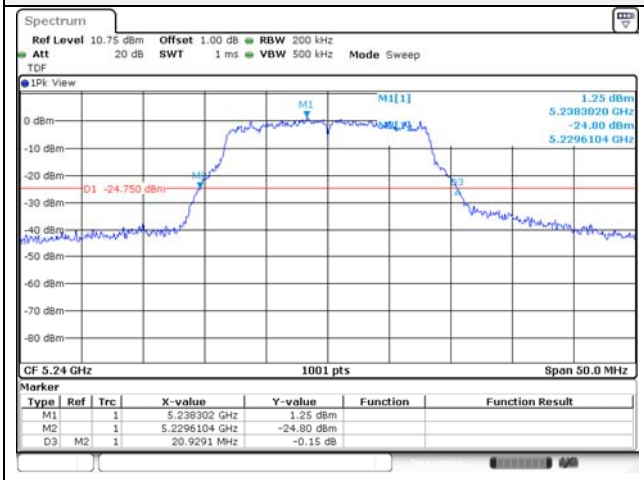
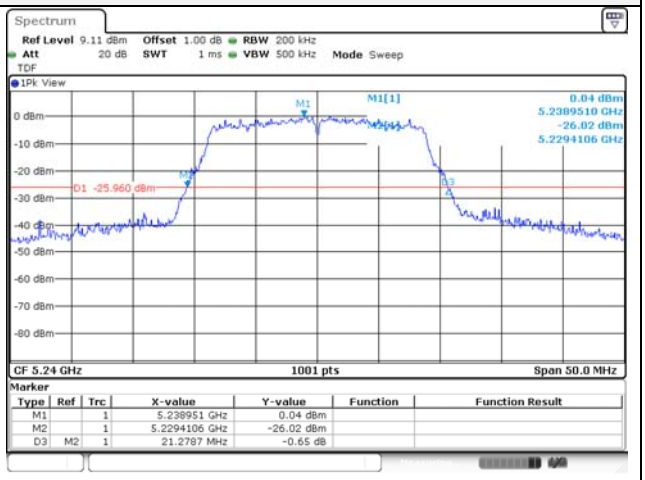


UNII-1 / 802.11n HT20 / 5 240 ㎒



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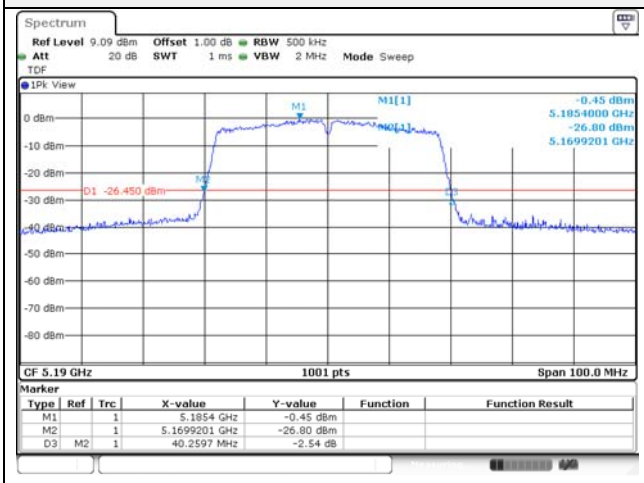
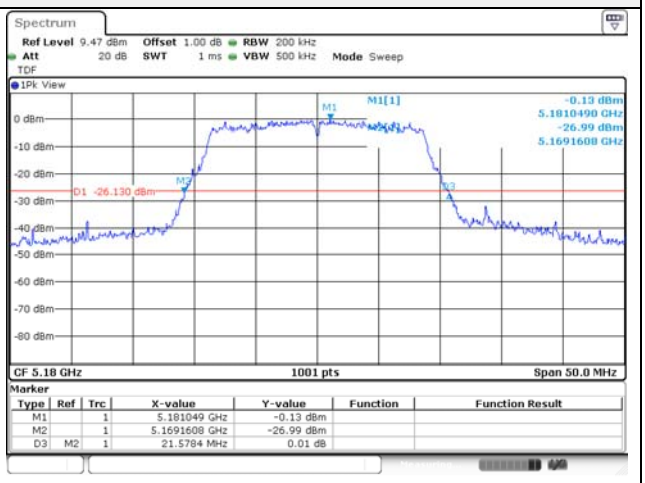
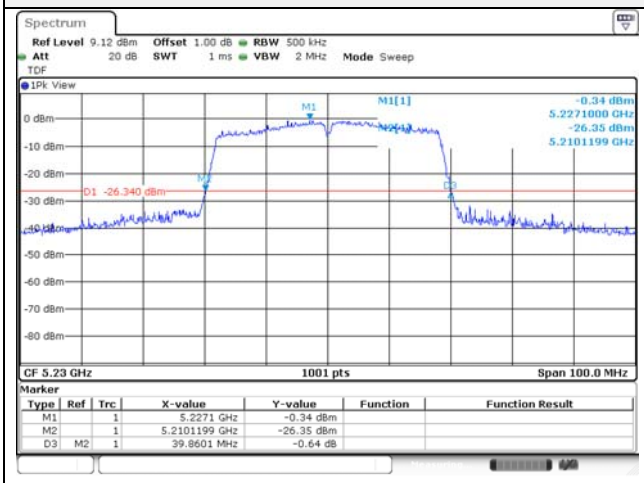


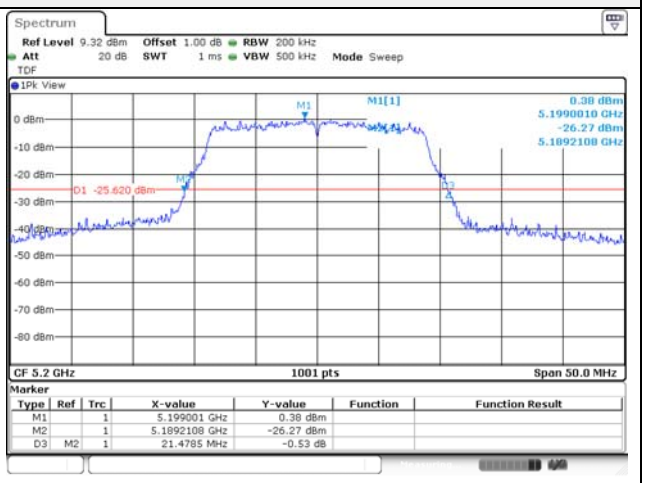
UNII-1 / 802.11ac VHT20 / 5 180 ㎒



UNII-1 / 802.11n HT40 / 5 230 ㎒



UNII-1 / 802. 11ac VHT20 / 5 200 ㎒



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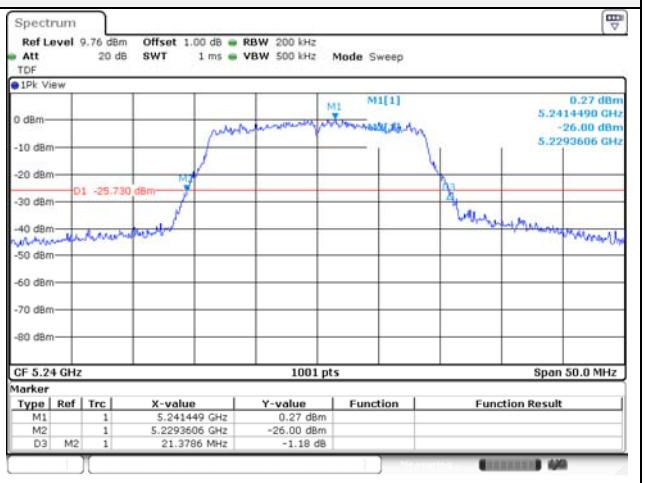
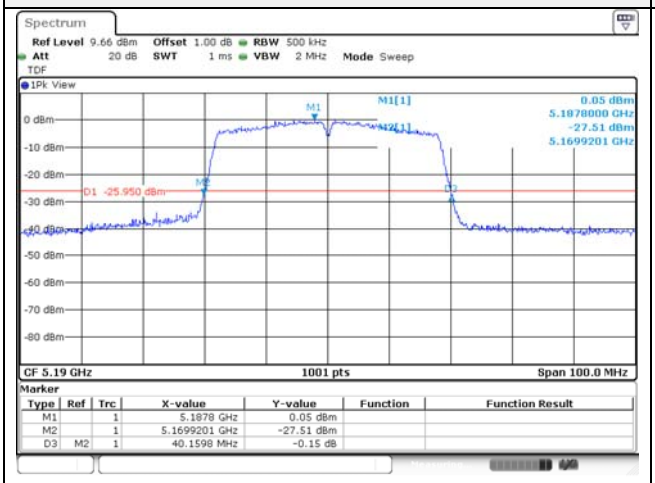
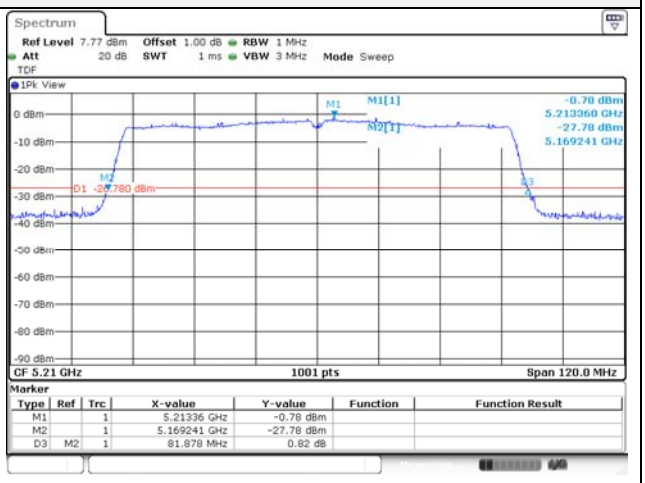
UNII-1 / 802. 11ac VHT20 / 5 240 ㎒



UNII-1 / 802.11ac VHT40 / 5 190 ㎒



UNII-1 / 802.11ac VHT80 / 5 210 ㎒



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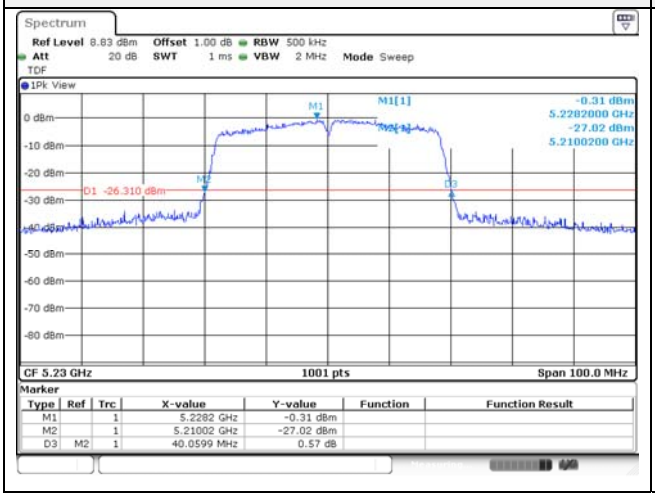

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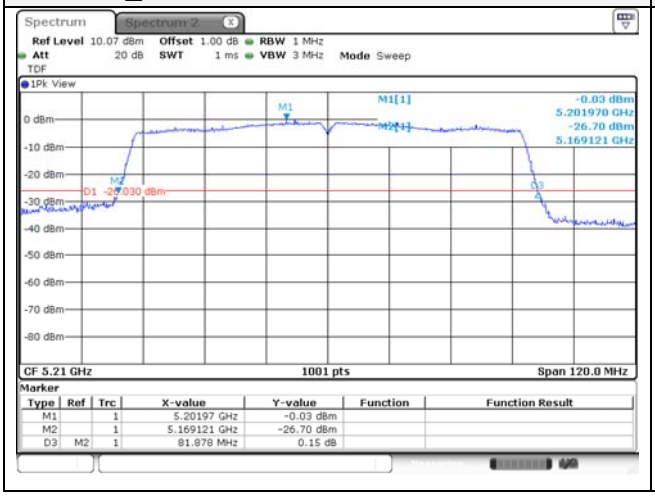
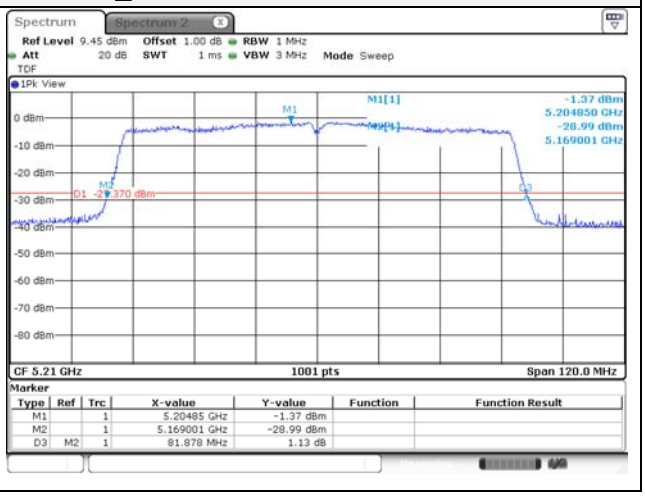
MIMO

ANT 1_UNII-1 / 802.11ac VHT80 / 5 210 ㎒

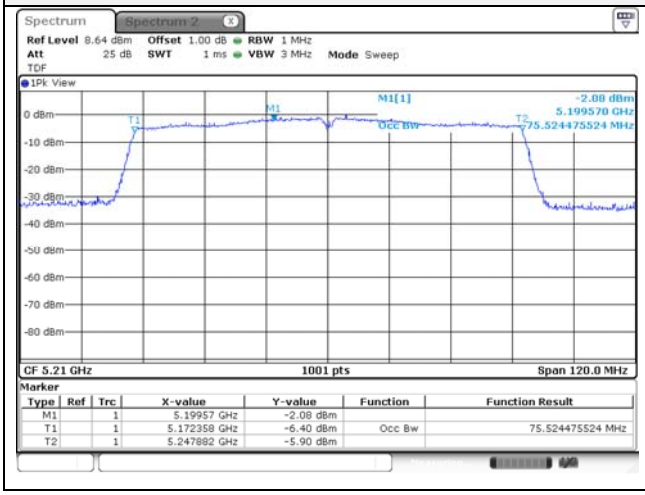


ANT 2_UNII-1 / 802.11ac VHT80 / 5 210 ㎒



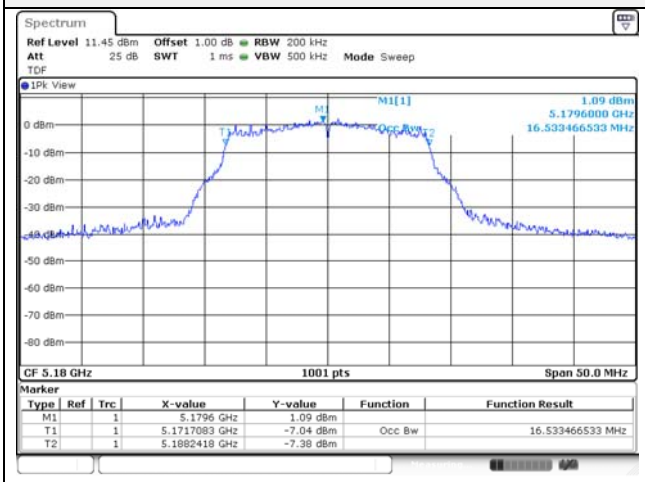
99 % bandwidth

ANT 1

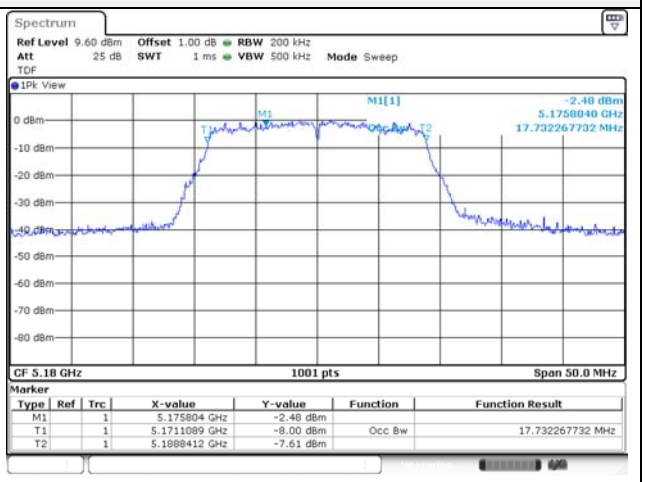
UNII-1 / 802.11ac VHT80 / 5 210 MHz	
	Blank

ANT 2

UNII-1 / 802.11a / 5 180 ㎒



UNII-1 / 802.11n HT20 / 5 180 ㎒



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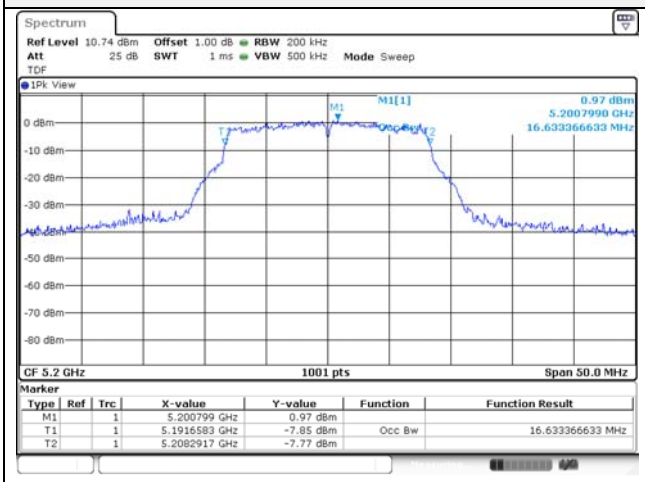

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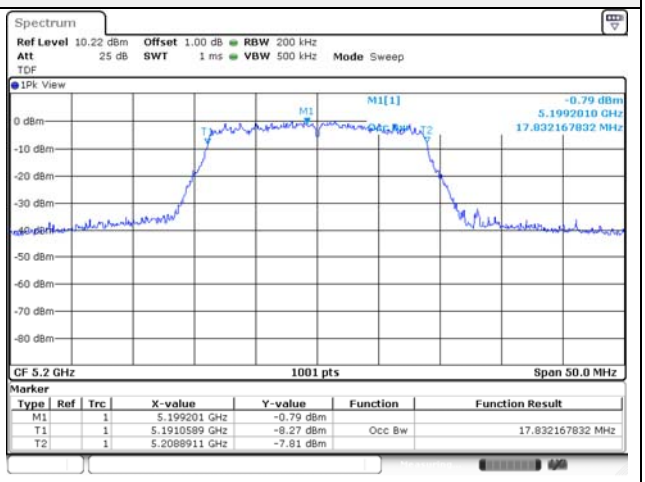
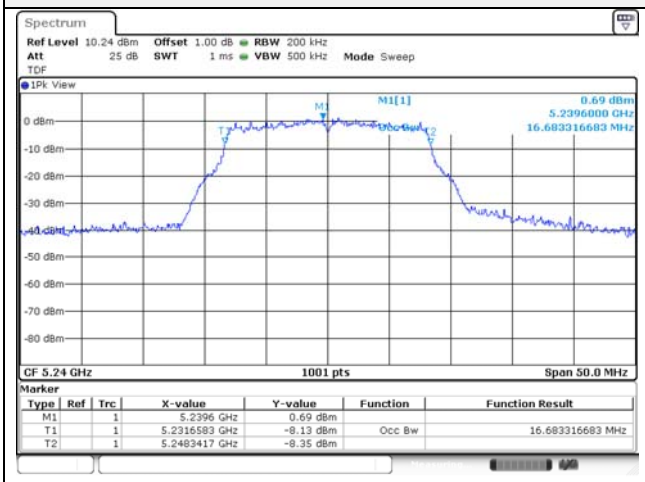
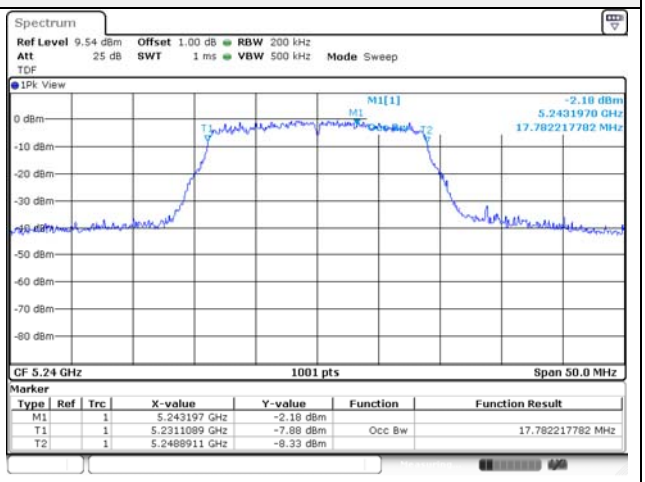


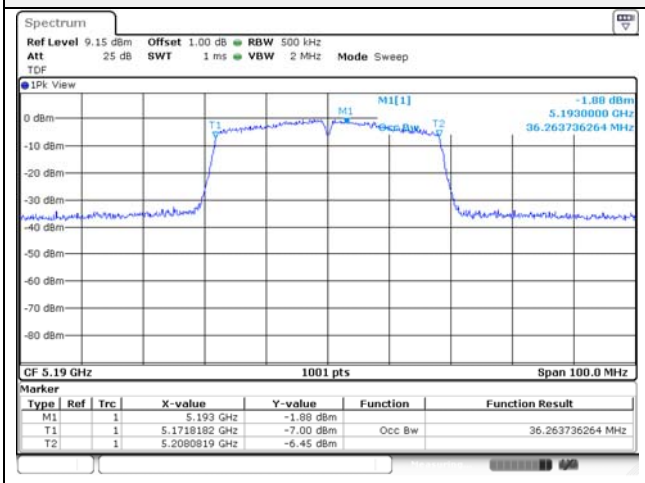
UNII-1 / 802.11a / 5 240 ㎒



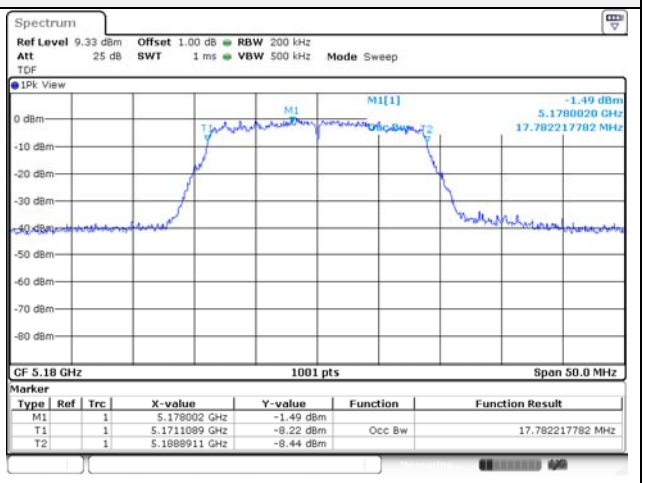
UNII-1 / 802.11n HT20 / 5 240 ㎒



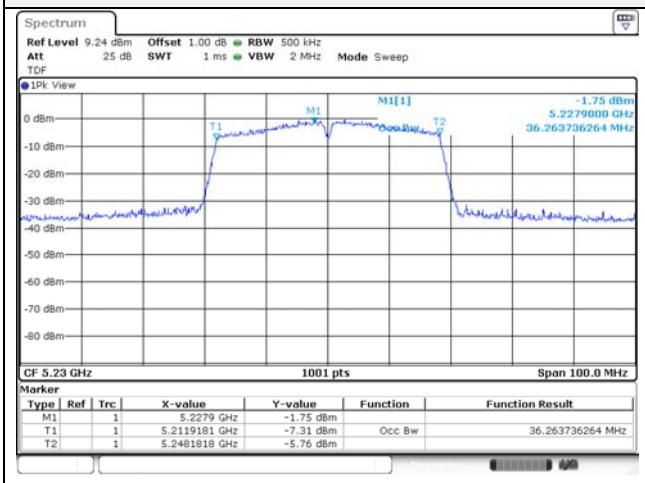
UNII-1 / 802.11n HT40 / 5 190 ㎒



UNII-1 / 802.11ac VHT20 / 5 180 ㎒



UNII-1 / 802.11n HT40 / 5 230 ㎒



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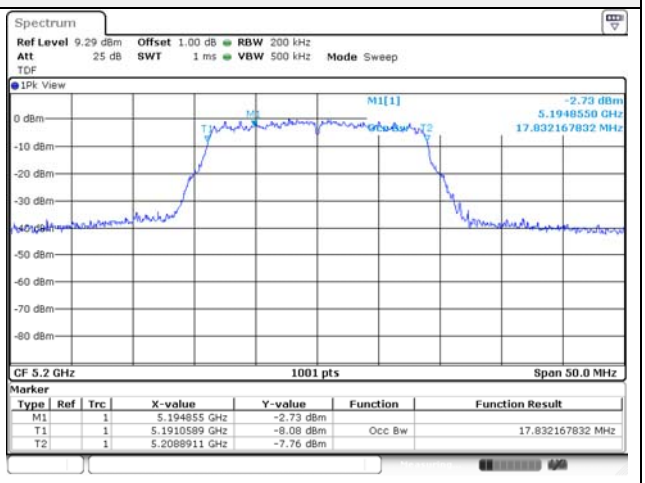

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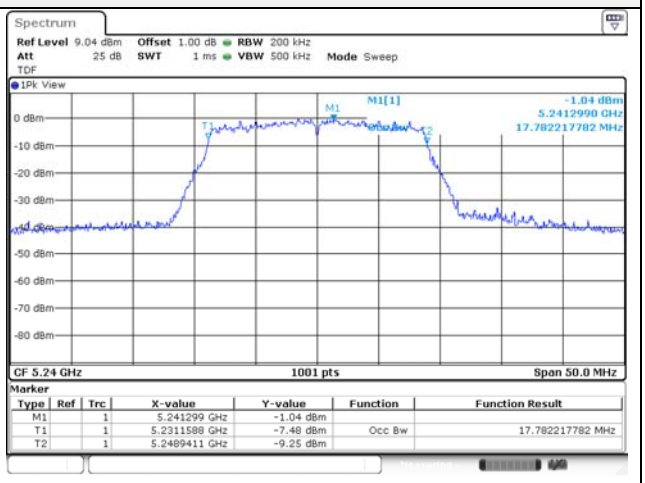

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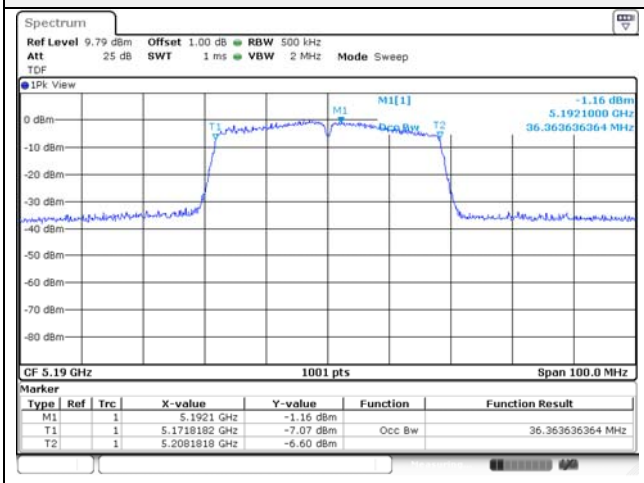

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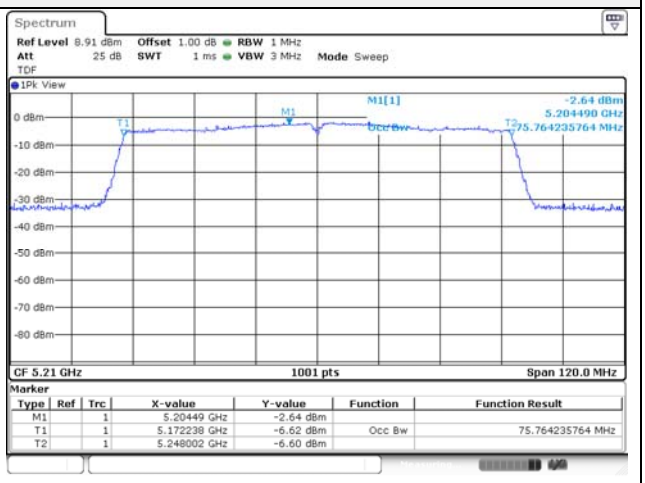

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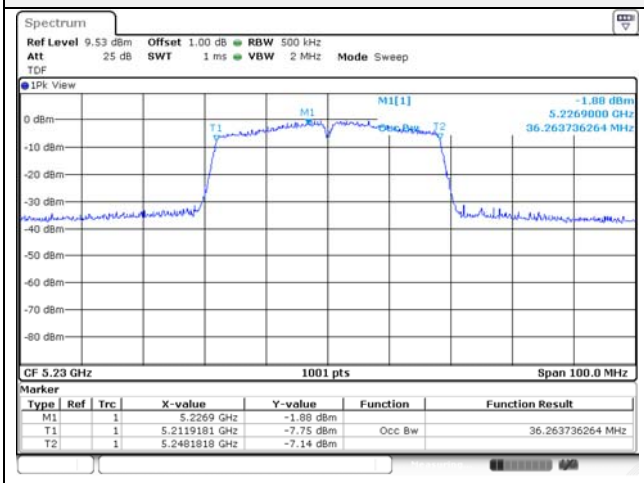

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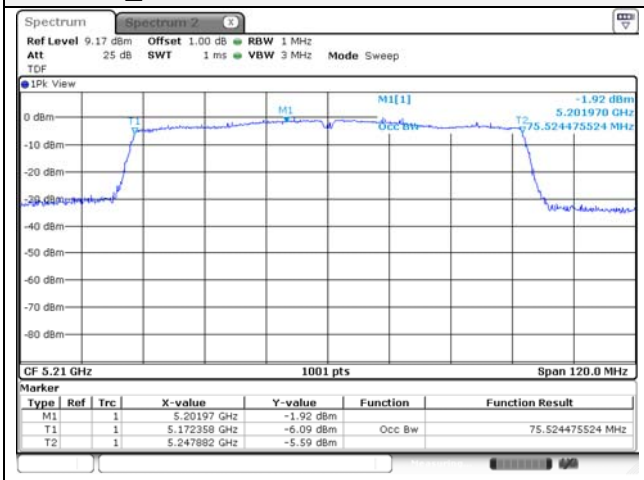
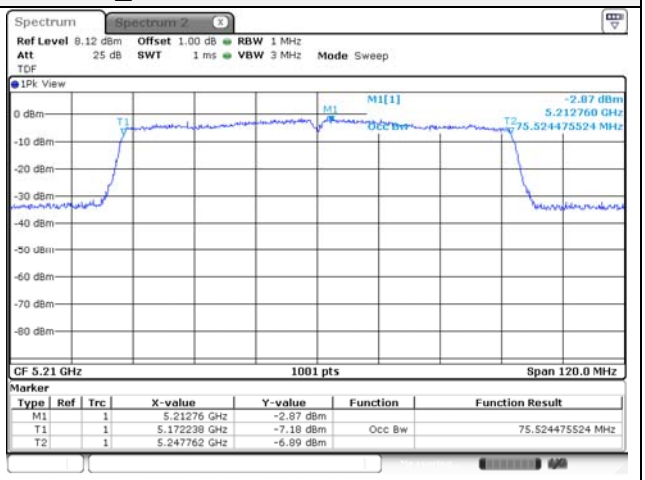
MIMO

ANT 1_UNII-1 / 802.11ac VHT80 / 5 210 ㎒



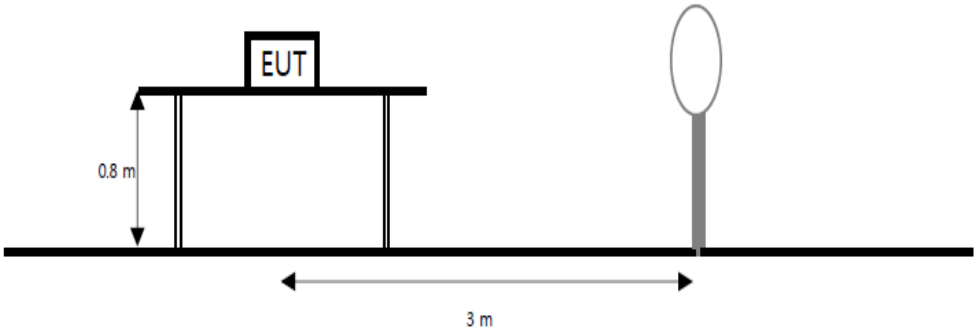
ANT 2_UNII-1 / 802.11ac VHT80 / 5 210 ㎒



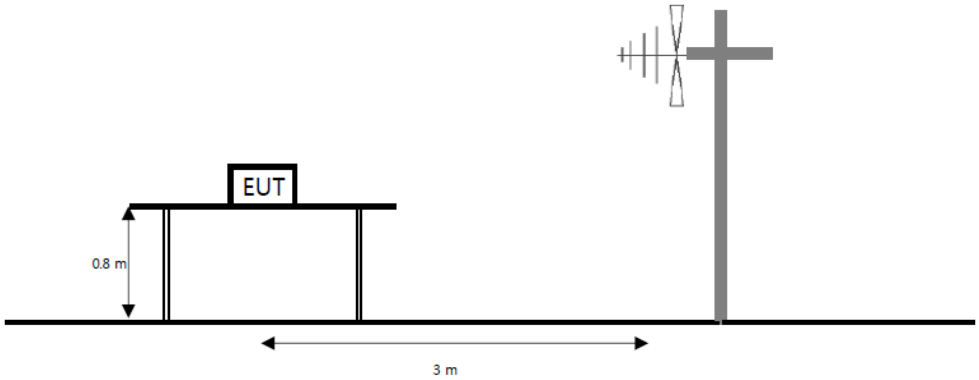
7.4. Spurious Emission, Band Edge and Restricted bands

Test setup

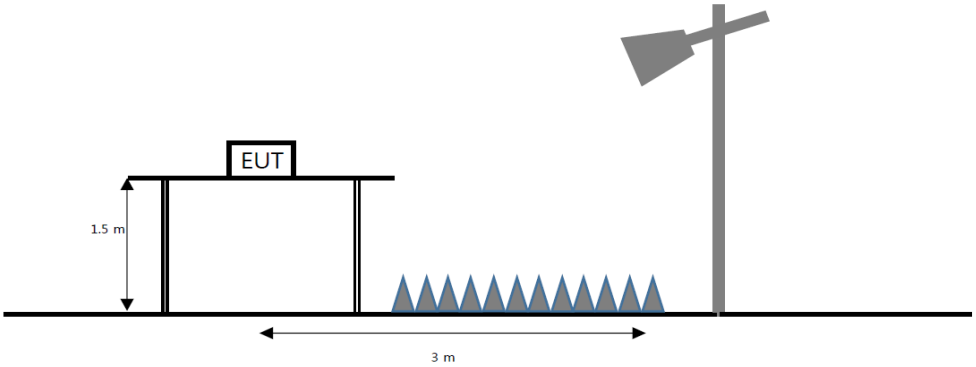
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



Limit

According to section 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 (μV/m)	Measurement distance (m)
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/F(kHz)	30
1.705 - 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., Section15.231 and 15.241.

According to section 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 – 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 – 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 – 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 – 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 – 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 – 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 – 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 – 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 – 2 500	17.7 - 21.4
8.376 25 - 8.386 75		2 690 – 2 900	22.01 - 23.12
8.414 25 - 8.414 75	156.7 - 156.9	3 260 – 3 267	23.6 - 24.0
12.29 - 12.293	162.012 5 - 167.17	3 332 – 3 339	31.2 - 31.8
12.519 75 - 12.520 25	167.72 - 173.2	3 345.8 – 3 358	36.43 - 36.5
12.576 75 - 12.577 25	240 - 285	3 600 – 4 400	Above 38.6
13.36 - 13.41	322 - 335.4		

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 1 000 MHz, compliance with the limits in section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 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.

According to section 15.407(b), undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz

For transmitters operating in the 5.25-5.35 ㎓ band: All emissions outside of the 5.15-5.35 ㎓ band shall not exceed an e.i.r.p. of −27 ㏈m/㎒.

For transmitters operating in the 5.725-5.85 ㎓ band: All emissions shall be limited to a level of -27 ㏈m/㎒ at 75 ㎒ or more above or below the band edge increasing linearly to 10 ㏈m/㎒ at 25 ㎒ above or below the band edge, and form 25 ㎒ above or below the band edge increasing linearly to a level of 15.6 ㏈m/㎒ at 5 ㎒ above or below the band edge, and from 5 ㎒ above or below the band edge increasing linearly to a level of 27 ㏈m/㎒ at the band edge.

Test procedure
ANSI C63.10-2013 Section 6.4.6
KDB 558074 D01 V05r02

Test settings
Peak field strength measurements
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in table
3. VBW ≥ (3×RBW)
4. Detector = peak
5. Sweep time = auto
6. Trace mode = max hold
7. Allow sweeps to continue until the trace stabilizes

Table. RBW as a function of frequency

Frequency	RBW
9 ㎑ to 150 ㎑	200 ㎐ to 300 ㎐
0.15 ㎒ to 30 ㎒	9 ㎑ to 10 ㎑
30 ㎒ to 1 000 ㎒	100 ㎑ to 120 ㎑
> 1 000 ㎒	1 ㎒

Average field strength measurements

Trace averaging with continuous EUT transmission at full power

If the EUT can be configured or modified to transmit continuously (D ≥ 98%), then the average emission levels shall be measured using the following method (with EUT transmitting continuously):
1. RBW = 1 ㎒ (unless otherwise specified).
2. VBW ≥ (3×RBW).
3. Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
4. Averaging type = power (i.e., rms):
   1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
   2) Some instruments require linear display mode to use linear voltage averaging. Log or ㏈ averaging shall not be used.
5. Sweep time = auto.
6. Perform a trace average of at least 100 traces.

Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT (D ≥ 98%) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±2%), then the following procedure shall be used:
1. The EUT shall be configured to operate at the maximum achievable duty cycle.
2. Measure the duty cycle D of the transmitter output signal as described in 11.6.
3. RBW = 1 ㎒ (unless otherwise specified).
4. VBW ≥ [3 × RBW].
5. Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this

condition cannot be satisfied, then the detector mode shall be set to peak.

6. Averaging type = power (i.e., rms):
   1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
   2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.
7. Sweep time = auto.
8. Perform a trace average of at least 100 traces.
9. A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
   1) If power averaging (rms) mode was used in step f), then the applicable correction factor is [10 log (1 / D)], where D is the duty cycle.
   2) If linear voltage averaging mode was used in step f), then the applicable correction factor is [20 log (1 / D)], where D is the duty cycle.
   3) If a specific emission is demonstrated to be continuous (D ≥ 98%) rather than turning ON and OFF with with the transmit cycle, then no duty cycle correction is required for that emission.

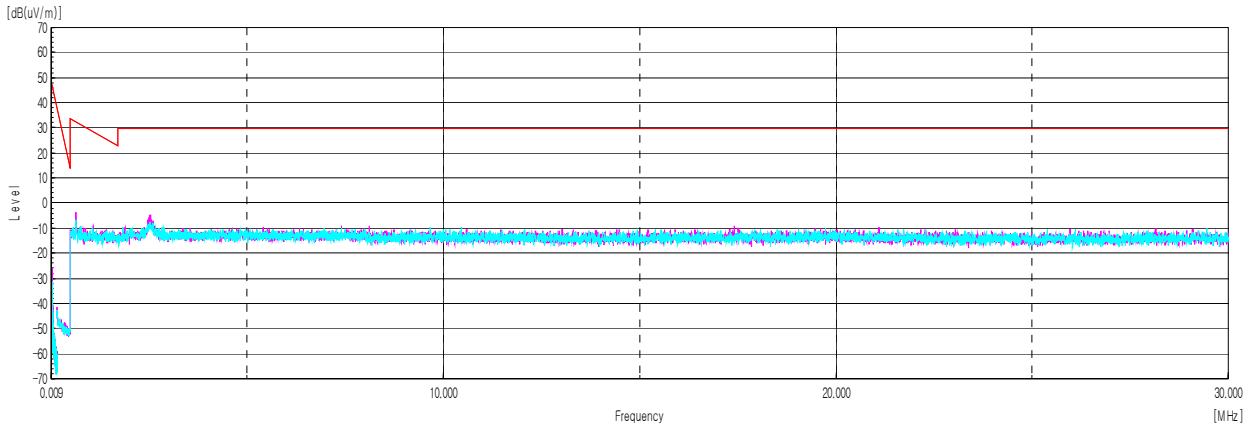
Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1 kHz(≥1/T) for Average detection (AV) at frequency above 1 GHz. (where T = pulse width)
2. *f* <30 MHz, extrapolation factor of 40 dB/decade of distance. $F_d = 40\log(D_m/Ds)$
   f ≥30 MHz, extrapolation factor of 20 dB/decade of distance. $F_d = 20\log(D_m/Ds)$
   Where:
   F_d= Distance factor in dB
   D_m= Measurement distance in meters
   D_s= Specification distance in meters
3. Factors(dB) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB) + or F_d(dB)
4. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
5. Average test would be performed if the peak result were greater than the average limit.
6. 1) means restricted band.
7. According to part 15.31(f)(2), an extrapolation factor of 40 dB/decade is applied because measured distance of radiated emission is 3 m.
8. Below 30 MHz frequency range, In order to search for the worst result, all orientations about parallel, perpendicular, and ground-parallel were investigated then reported. when the emission level was higher than 20 dB of the limit, then the following statement shall be made: “No spurious emissions were detected within 20 dB of the limit.”
9. Radiated test is performed at the highest power of 802.11HT_n20 and 802.11VHT_ac20. (SISO: 802.11HT_n20 / MIMO: 802.11VHT_ac20)
10. Radiated test is performed at the highest power of 802.11HT_n40 and 802.11VHT_ac40. (SISO, MIMO: 802.11HT_n40)

Test results (Below 30 ㎒) – Worst case: 802.11a_UNII 1_5 180 ㎒_ ANT 2

Frequency	Pol.	Reading	Amp. + Cable	Antenna Factor	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Quasi peak data								
No spurious emissions were detected within 20 ㏈ of the limit.								

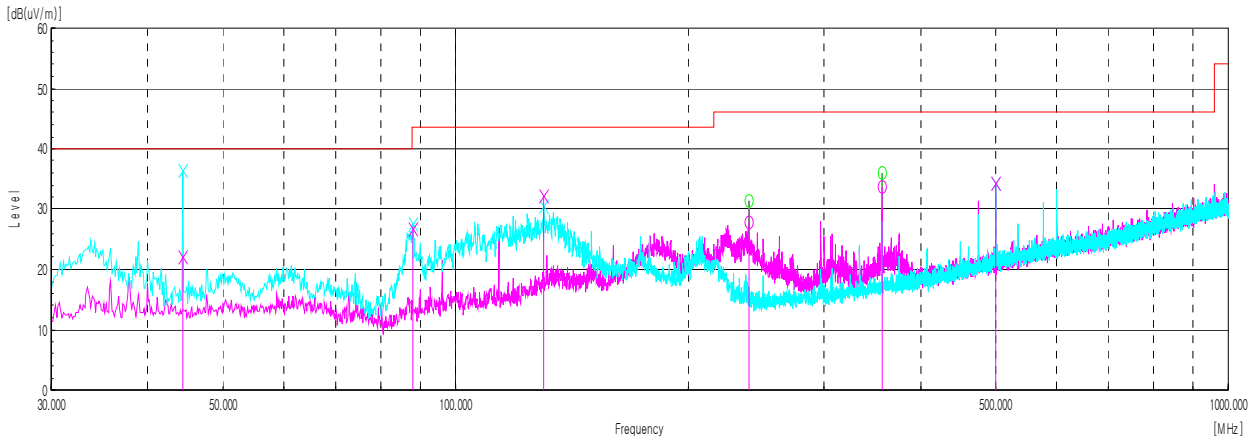
Horizontal/Vertical



Test results (Below 1 000 ㎒) –Worst case: 802.11a_UNII 1_5 180 ㎒_ ANT 2

Frequency	Pol.	Reading	Amp. + Cable	Antenna Factor	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Quasi peak data								
44.43	V	34.20	18.21	-30.42	-	21.99	40.00	18.01
88.20	V	42.60	13.69	-29.55	-	26.74	43.50	16.76
130.03[1)]	V	42.90	17.95	-28.96	-	31.89	43.50	11.61
240.01[1)]	H	38.10	17.26	-27.52	-	27.84	46.00	18.16
356.41[1)]	H	39.50	20.54	-26.33	-	33.71	46.00	12.29
499.97	V	35.60	23.70	-25.02	-	34.28	46.00	11.72

Horizontal/Vertical



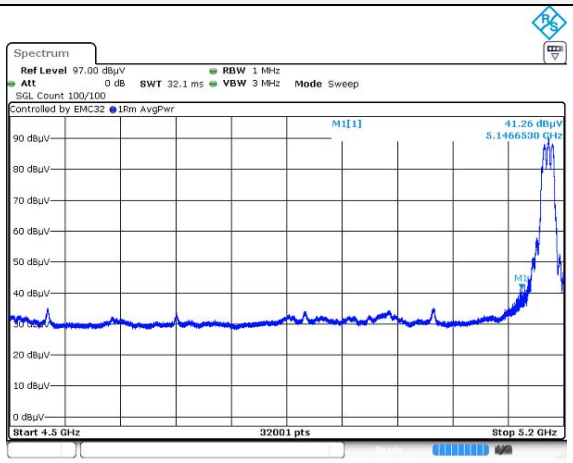
Test results (Above 1 000 ㎒)

802.11a_UNII 1_ANT 2

5 180 ㎒

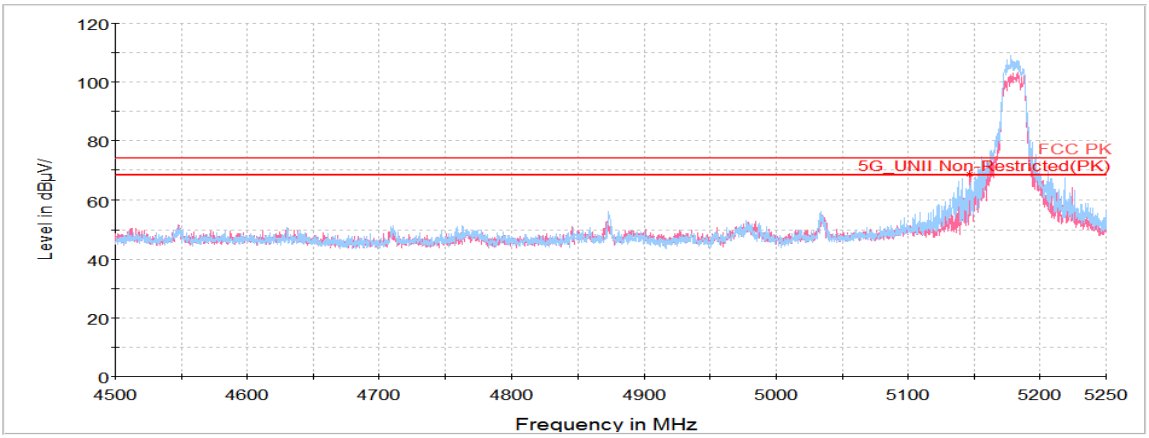
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 146.65[1)]	H	59.19	34.16	-24.73	-	68.62	74.00	5.38
10 360.41	H	60.79	37.56	-50.04	-	48.31	68.20	19.89
15 511.33[1)]	H	55.68	40.00	-46.84	-	48.84	74.00	25.16
Average Data								
5 146.65[1)]	H	41.26	34.16	-24.73	0.26	50.95	54.00	3.05

Average data (5 146.65 ㎒)

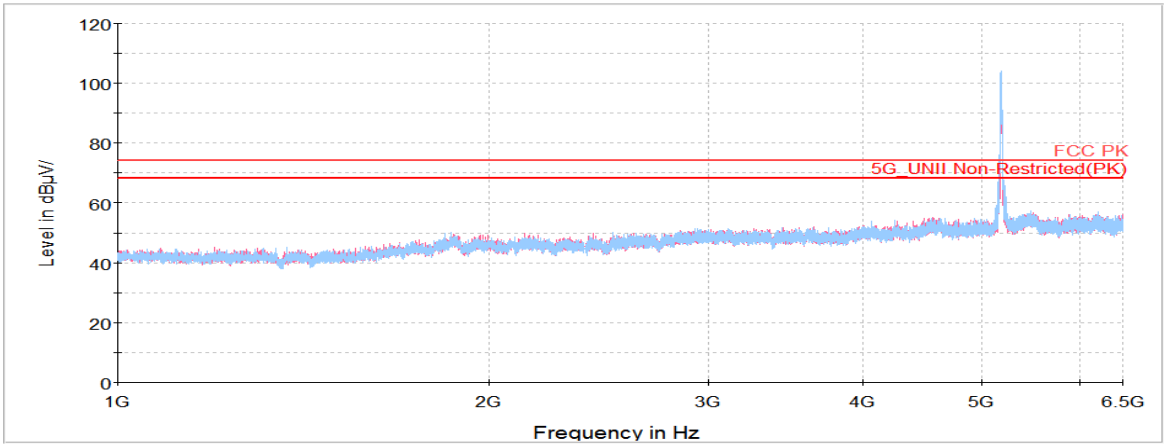


Blank

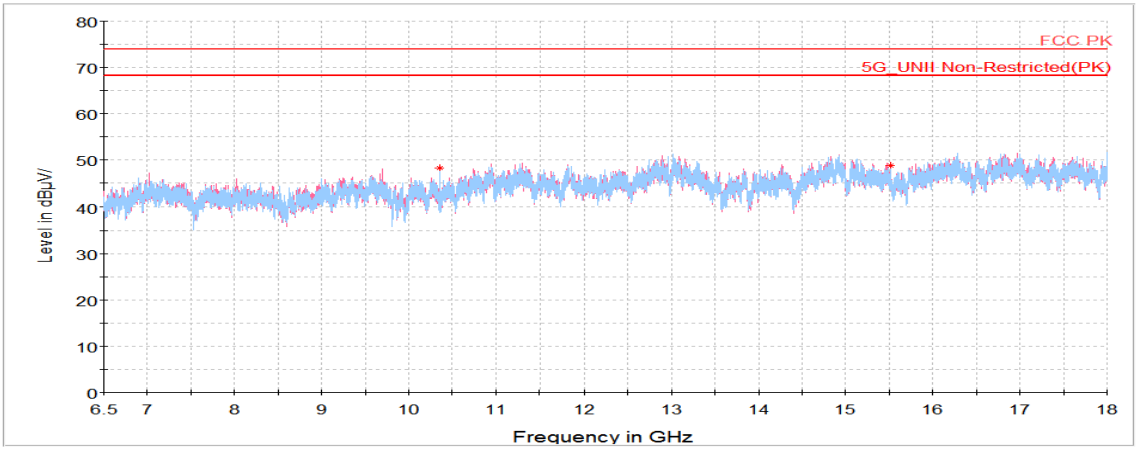
Horizontal/Vertical for Band-edge



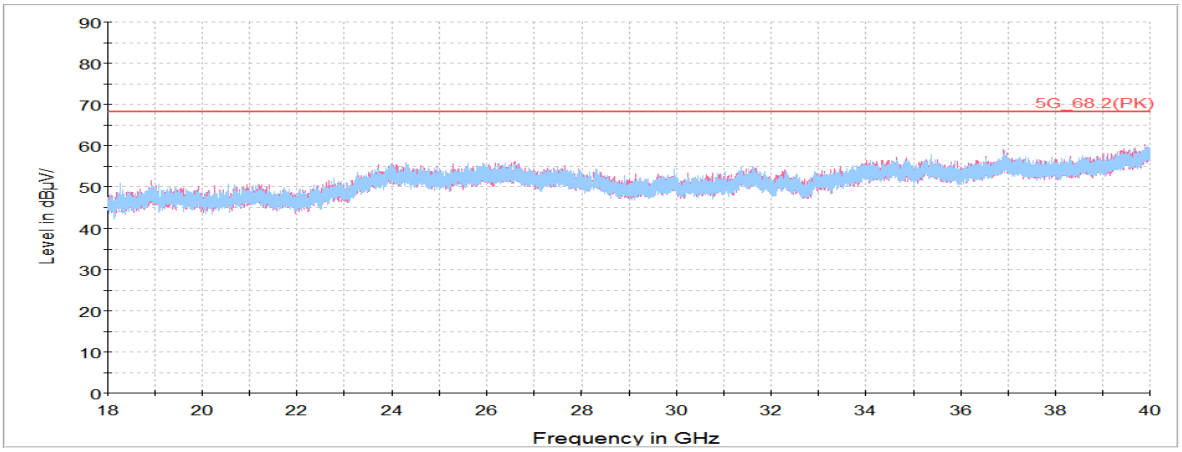
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

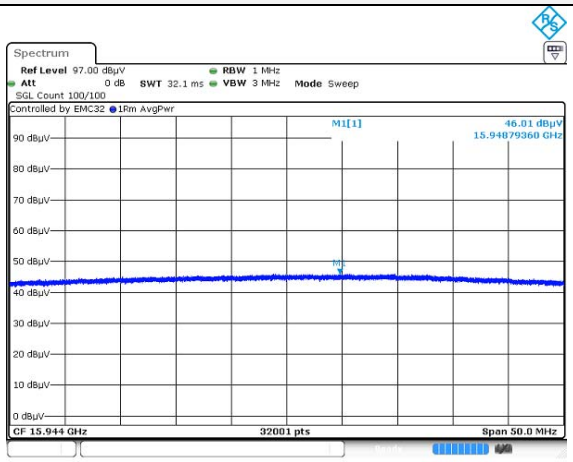


Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

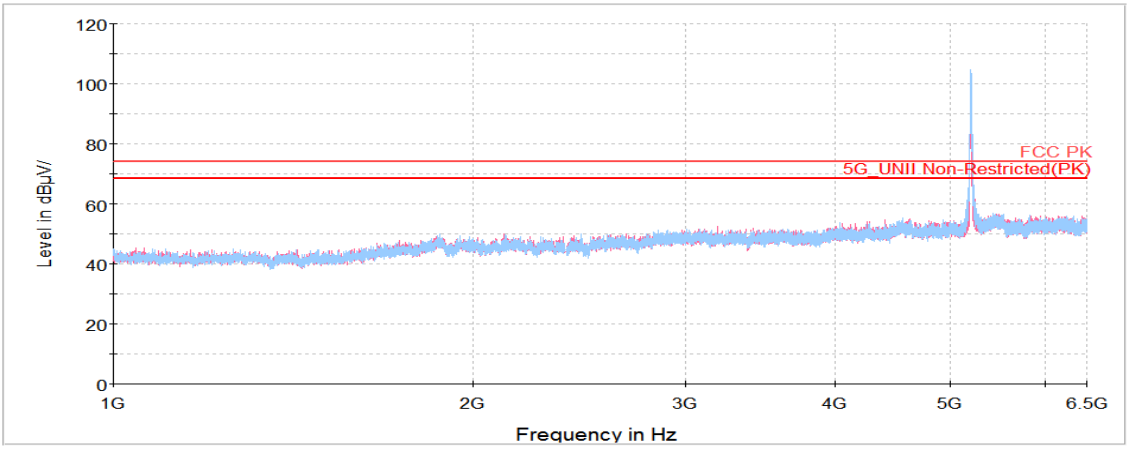


5 200 ㎒

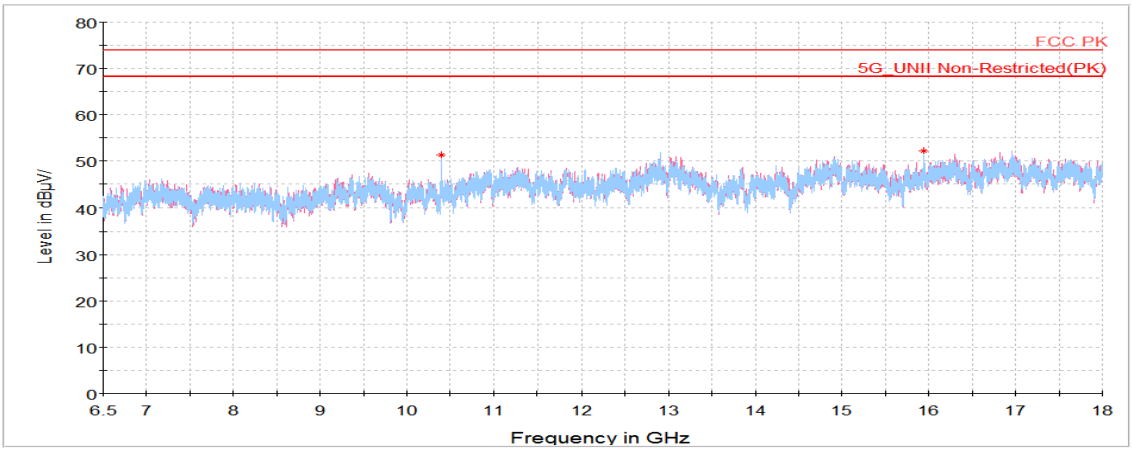
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 400.30	H	63.74	37.60	-49.97	-	51.37	68.20	16.83
15 948.79[1)]	H	59.29	39.82	-46.88	-	52.23	74.00	21.77
Average Data								
15 948.79[1)]	H	46.01	39.82	-46.88	0.27	39.22	54.00	14.78

Average data (15 948.79 ㎒)	
	Blank

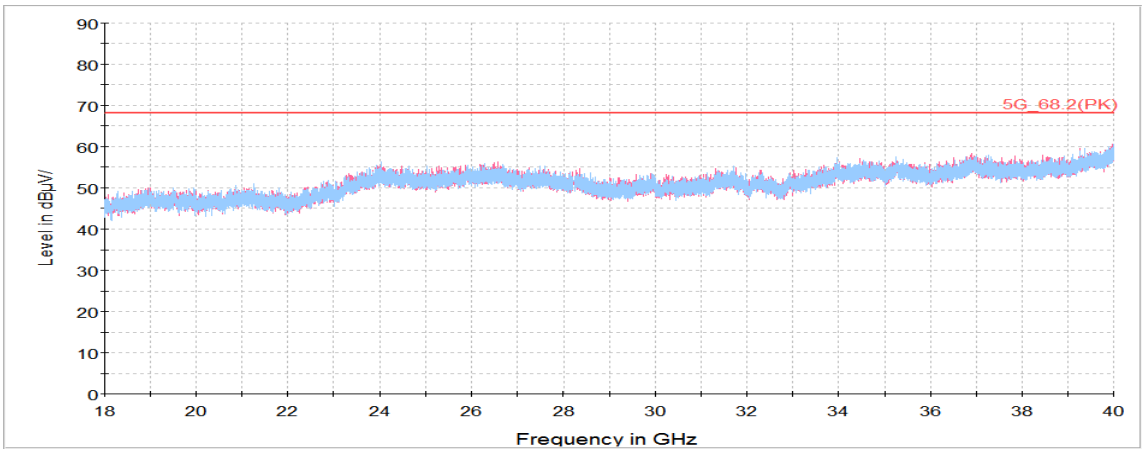
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



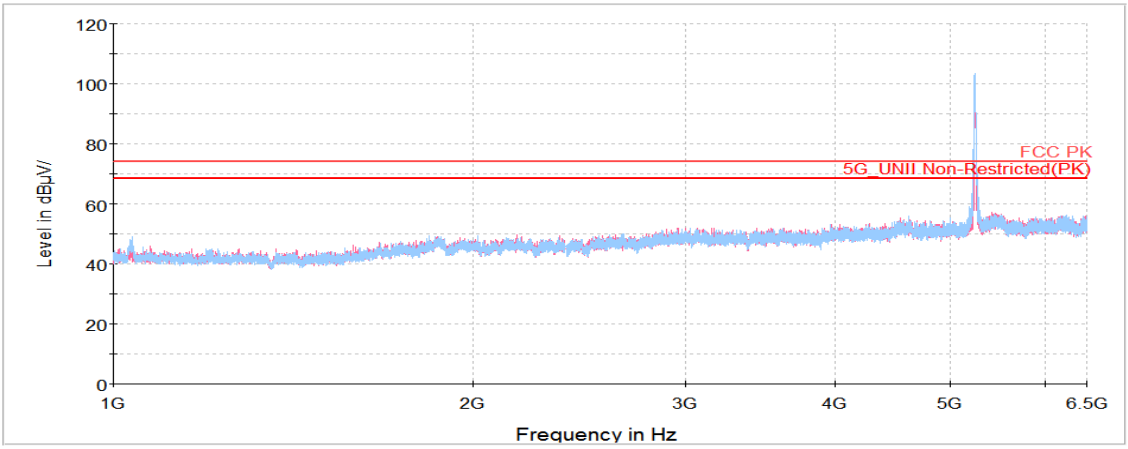
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



5 240 ㎒

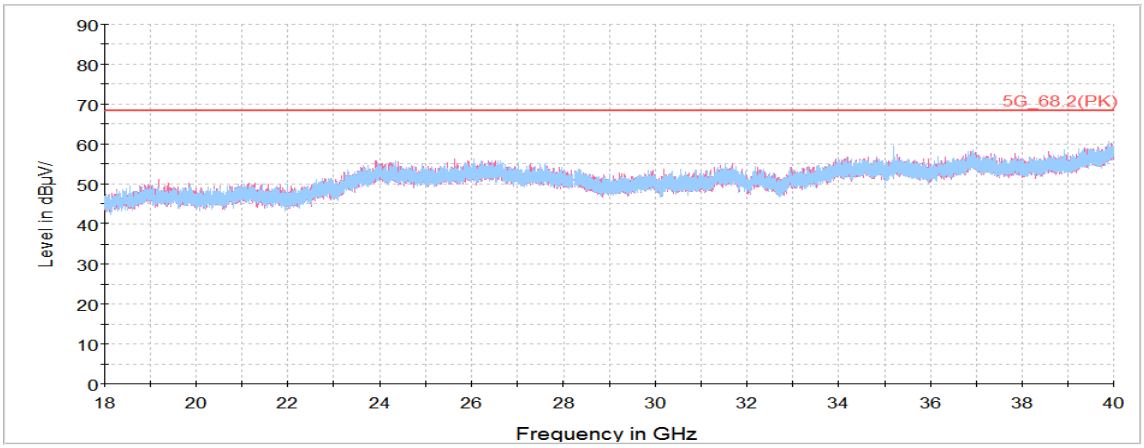
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 480.08	V	63.89	37.68	-49.85	-	51.72	68.20	16.48
15 735.94[1)]	H	57.02	39.91	-46.86	-	50.07	74.00	23.93
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

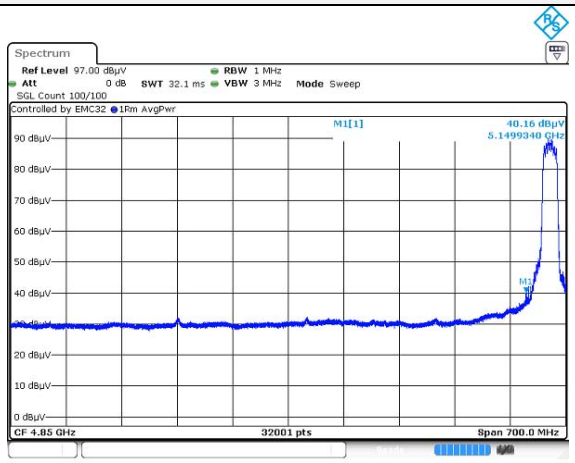


802.11n HT20_UNII 1_ANT 2

5 180 ㎒

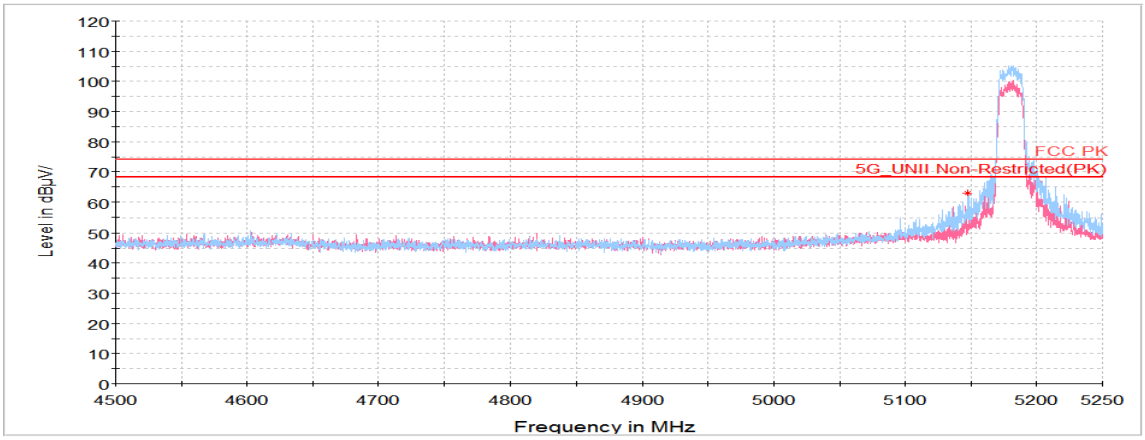
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 149.93[1)]	H	53.56	34.17	-24.73	-	63.00	74.00	11.00
10 360.05	V	61.09	37.56	-50.04	-	48.61	68.20	19.59
15 587.52[1)]	V	54.77	39.96	-46.85	-	47.88	74.00	26.12
Average Data								
5 149.93[1)]	H	40.16	34.17	-24.73	0.27	49.87	54.00	4.13

Average data (5 149.93 ㎒)

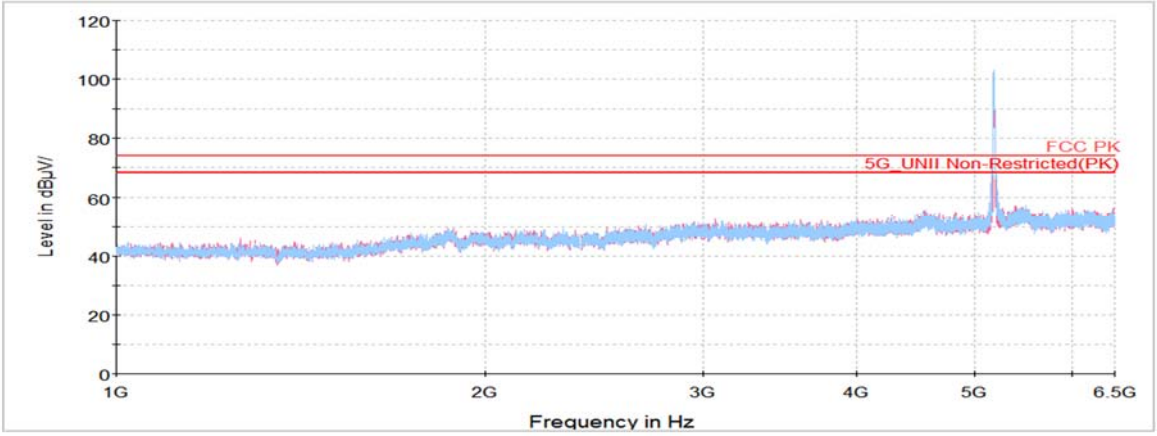


Blank

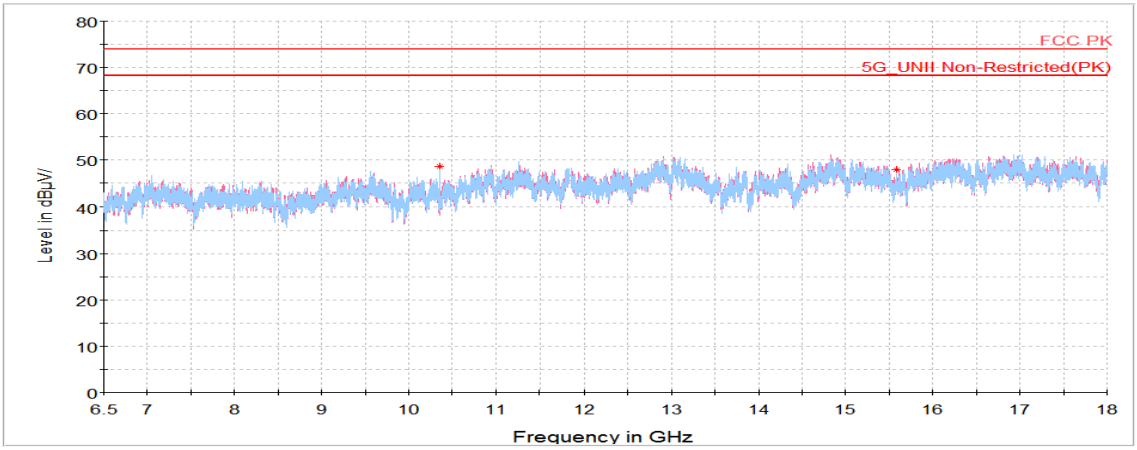
Horizontal/Vertical for Band-edge



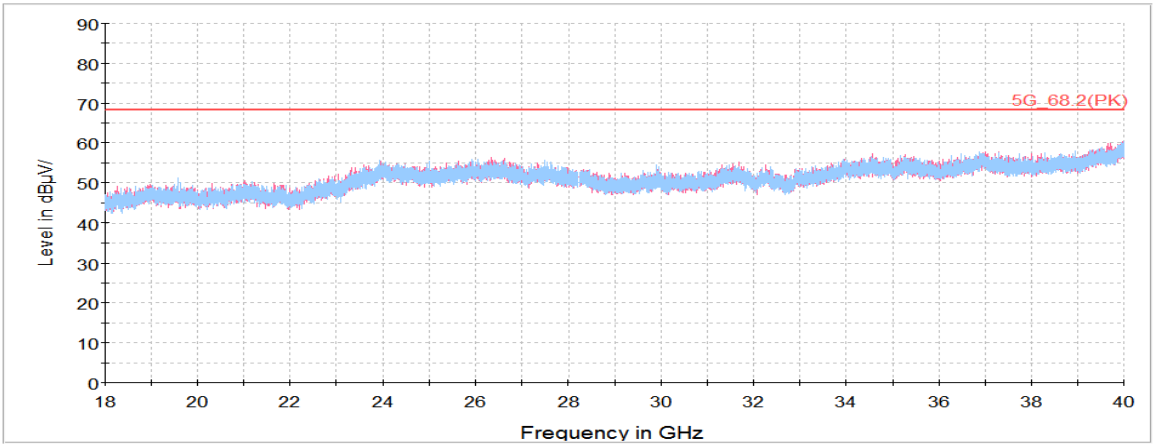
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



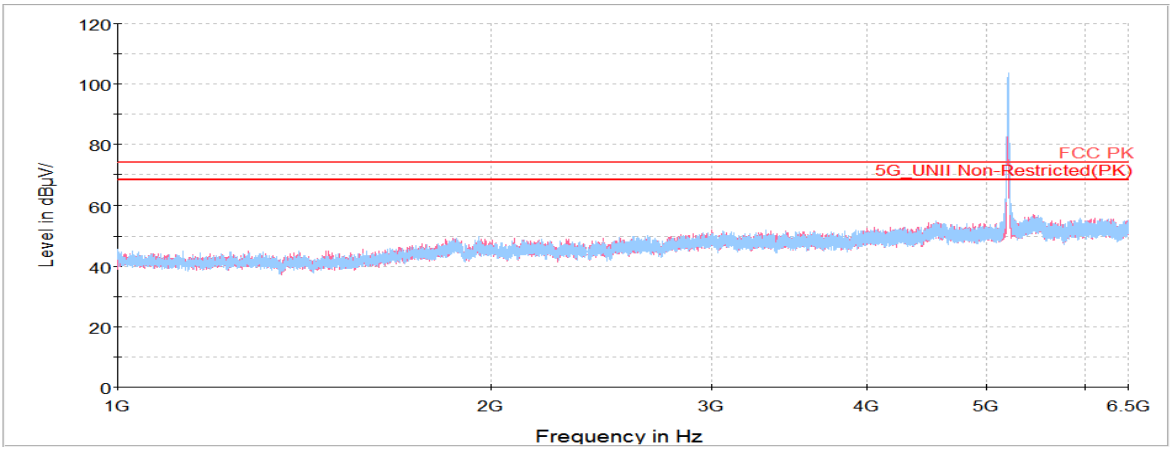
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



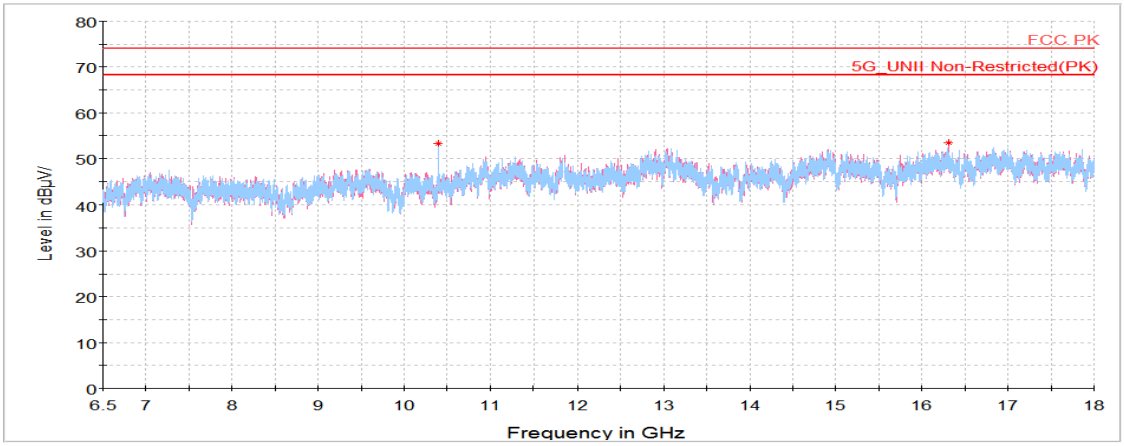
5 200 ㎒

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 400.30	H	65.69	37.60	-49.97	-	53.32	68.20	14.88
16 309.50	V	59.62	40.97	-47.07	-	53.52	68.20	14.68
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

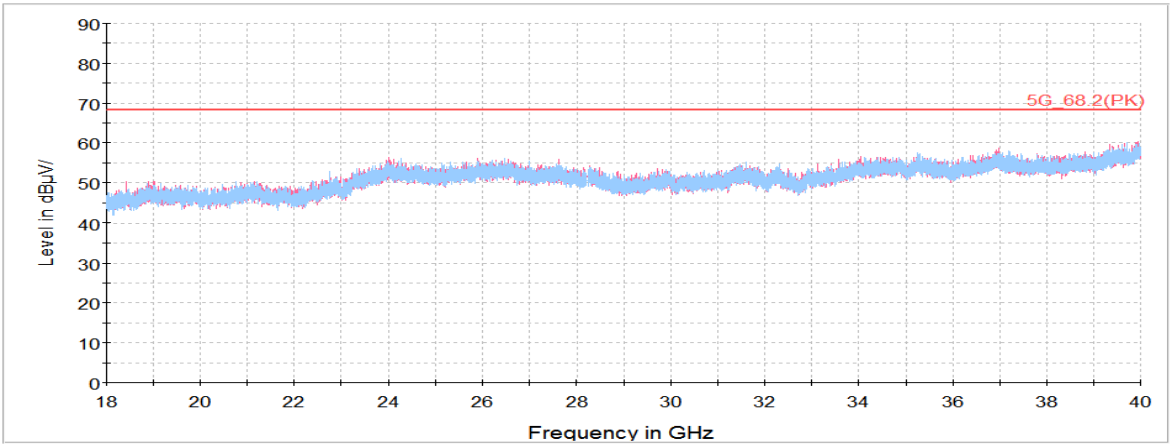
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



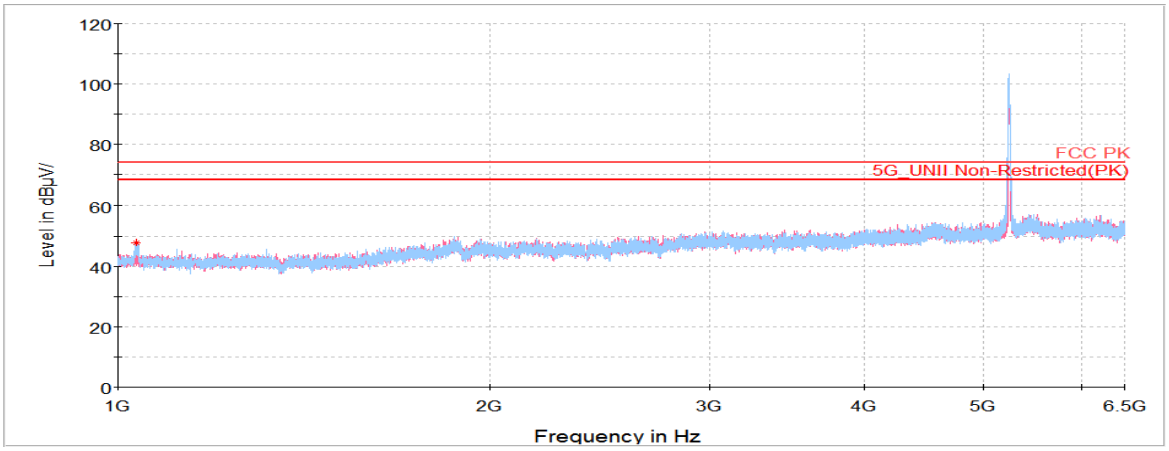
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



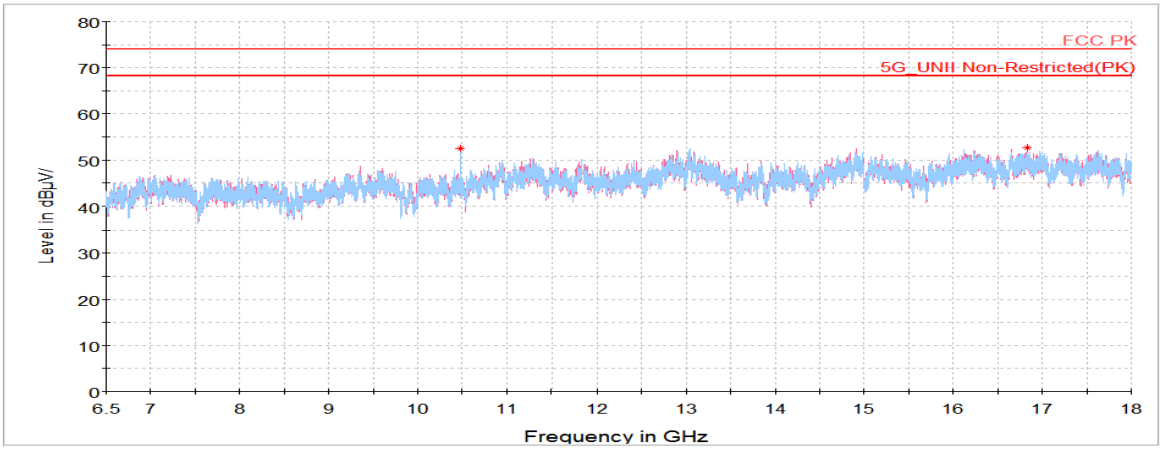
5 240 ㎒

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
1 033.86[1)]	H	68.08	28.81	-49.01	-	47.88	74.00	26.12
10 480.08	V	64.75	37.68	-49.85	-	52.58	68.20	15.62
16 827.36	V	58.32	41.26	-46.94	-	52.64	68.20	15.56
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

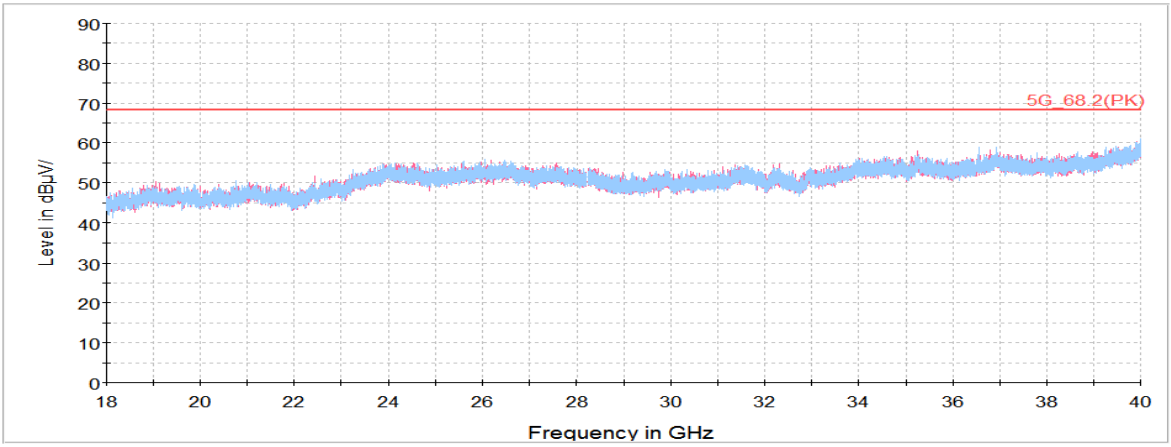
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

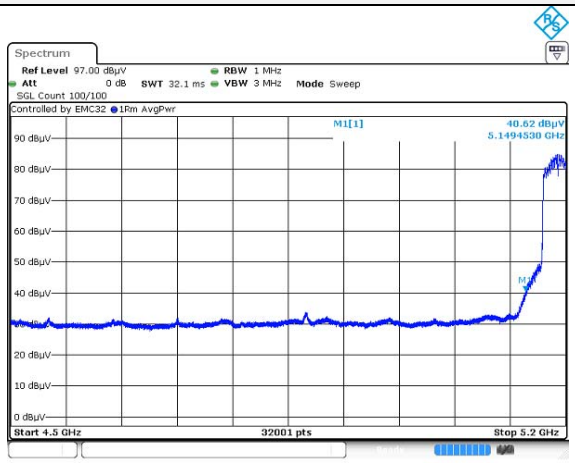


802.11n HT40_UNII 1_ANT 2

5 190 ㎒

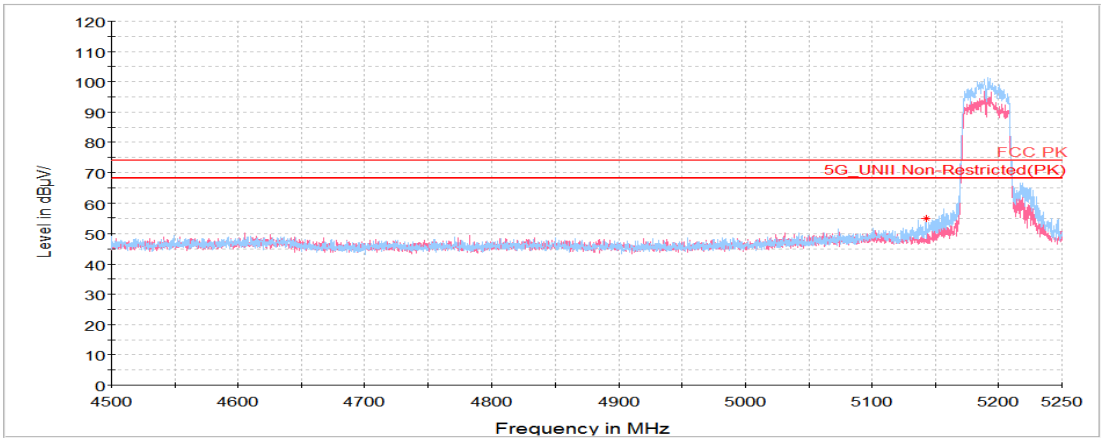
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 149.45[1)]	H	45.25	34.17	-24.73	-	54.69	74.00	19.31
10 380.17	H	62.53	37.58	-50.00	-	50.11	68.20	18.09
16 781.36	H	58.22	41.23	-46.97	-	52.48	68.20	15.72
Average Data								
5 149.45[1)]	H	40.62	34.17	-24.73	0.52	50.58	54.00	3.42

Average data (5 149.45 ㎒)

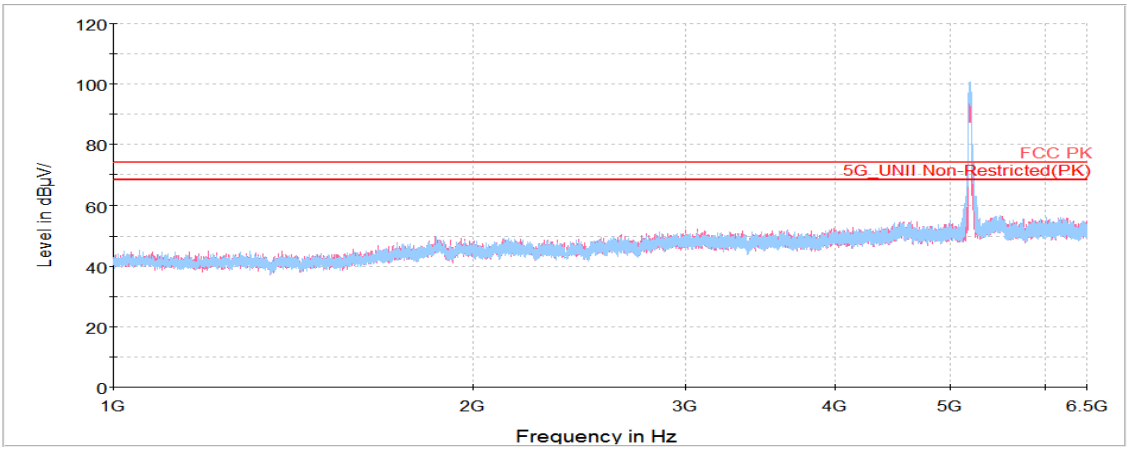


Blank

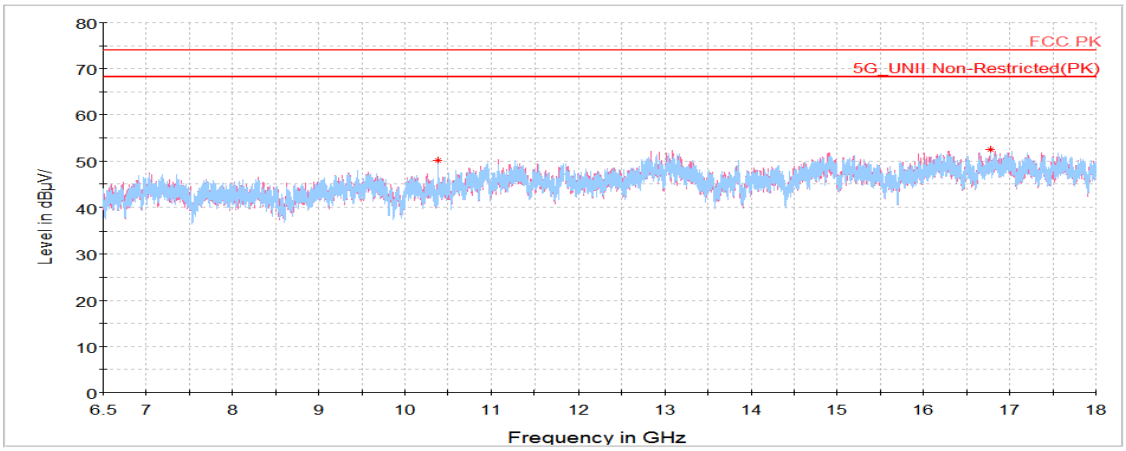
Horizontal/Vertical for Band-edge



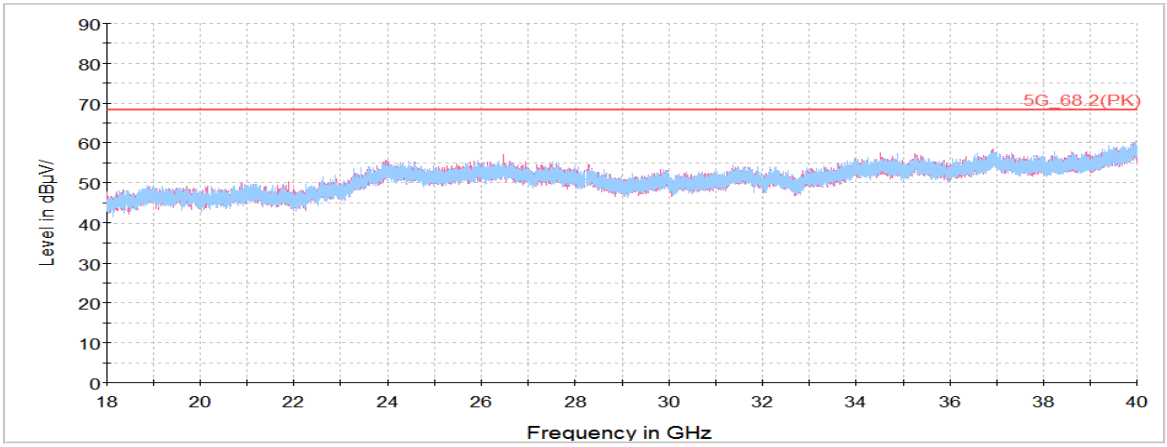
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



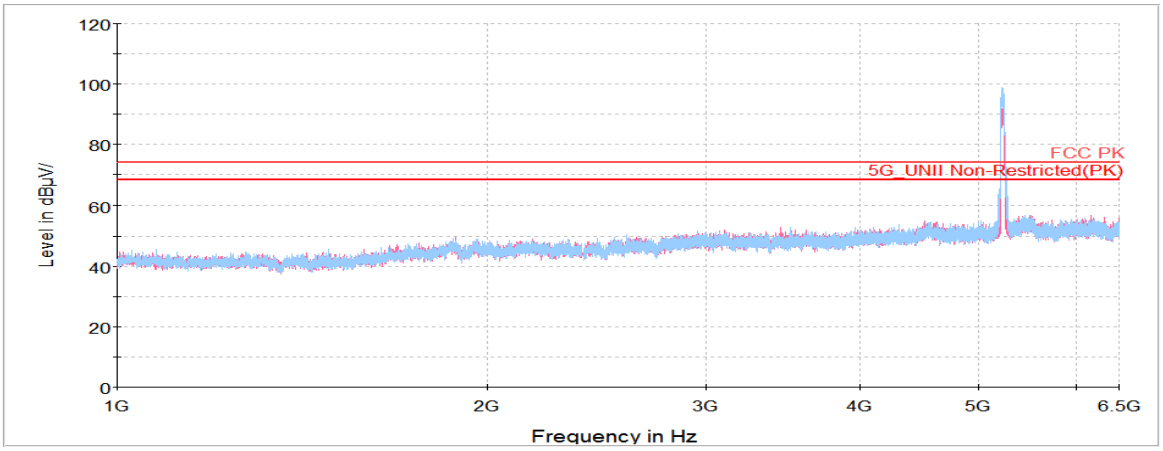
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



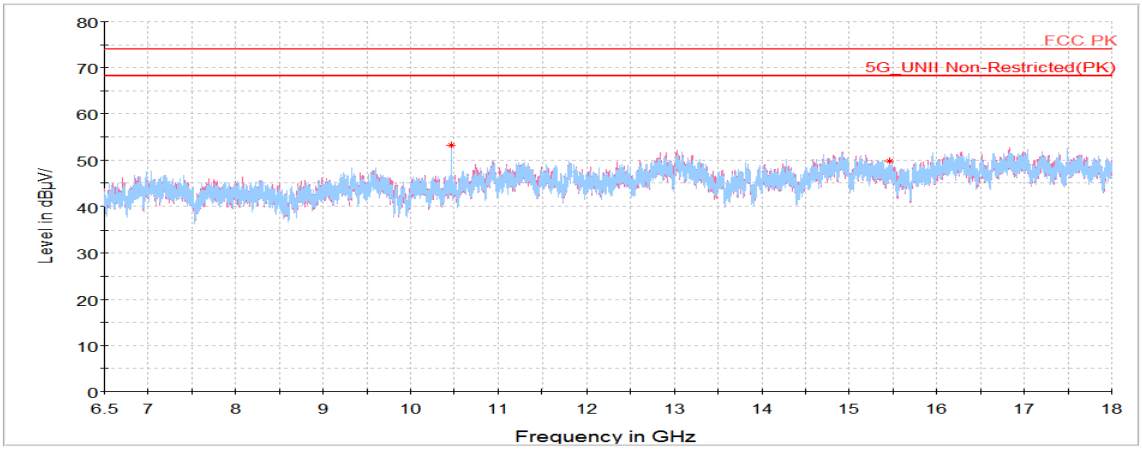
5 230 ㎒

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 460.31	H	65.41	37.66	-49.88	-	53.19	68.20	15.01
15 466.05[1)]	H	56.27	40.11	-46.69	-	49.69	74.00	24.31
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

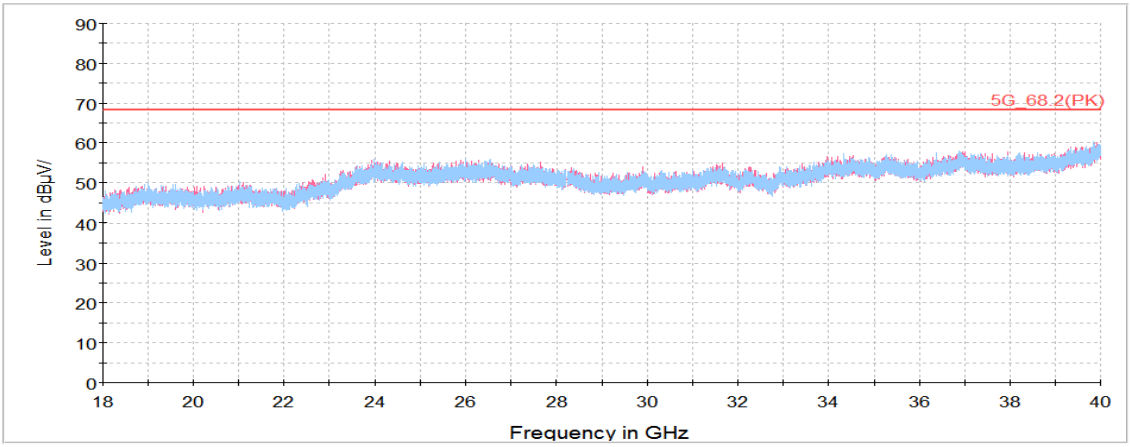
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

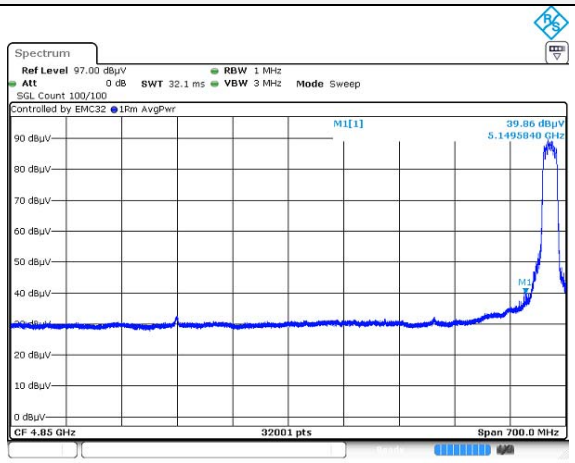


802.11ac VHT20_UNII 1_ANT 2

5 180 ㎒

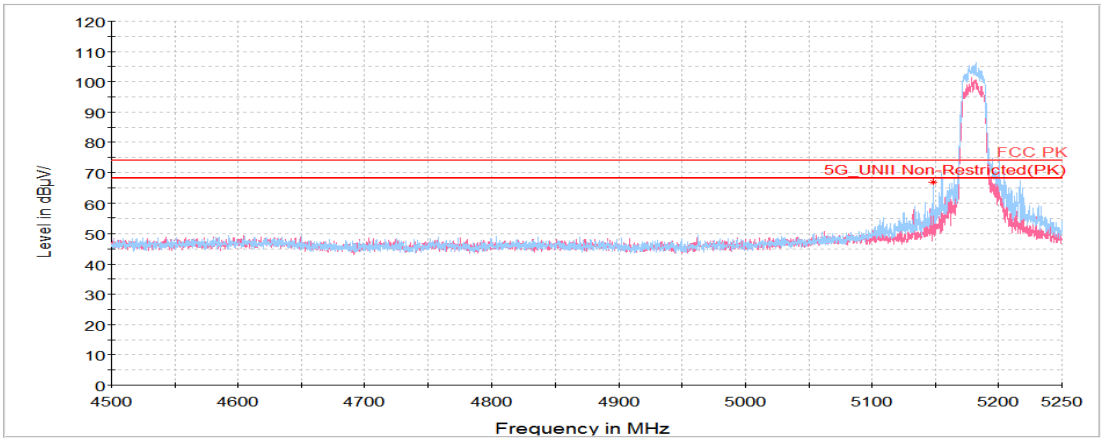
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 149.58[1)]	H	57.47	34.17	-24.73	-	66.91	74.00	7.09
10 360.05	H	62.45	37.56	-50.04	-	49.97	68.20	18.23
17 031.48	V	58.57	40.68	-46.85	-	52.40	68.20	15.80
Average Data								
5 149.58[1)]	H	39.86	34.17	-24.73	0.27	49.57	54.00	4.43

Average data (5 149.58 ㎒)

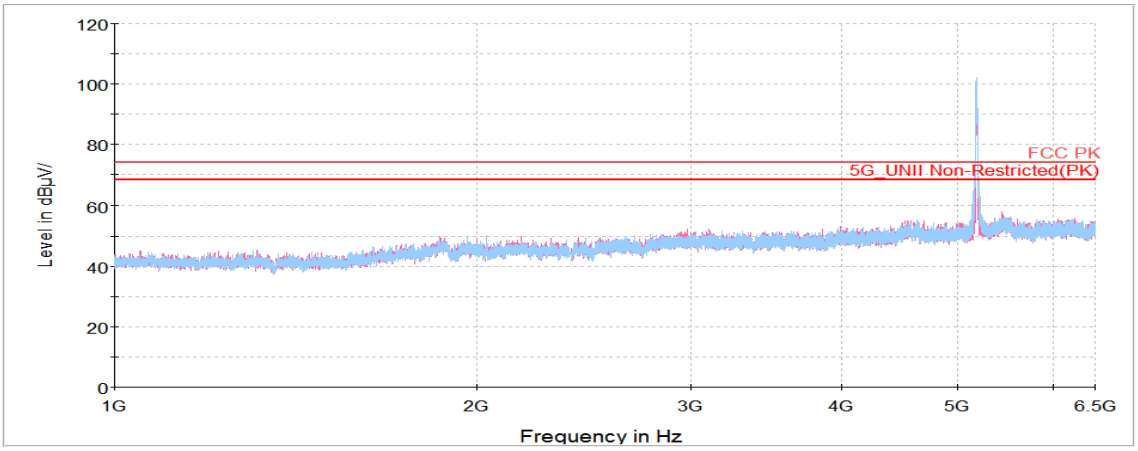


Blank

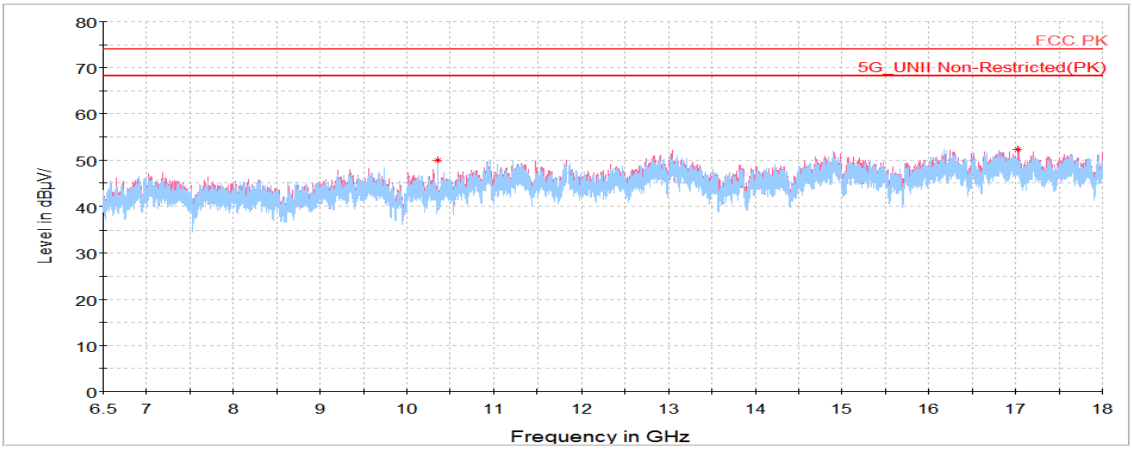
Horizontal/Vertical for Band-edge



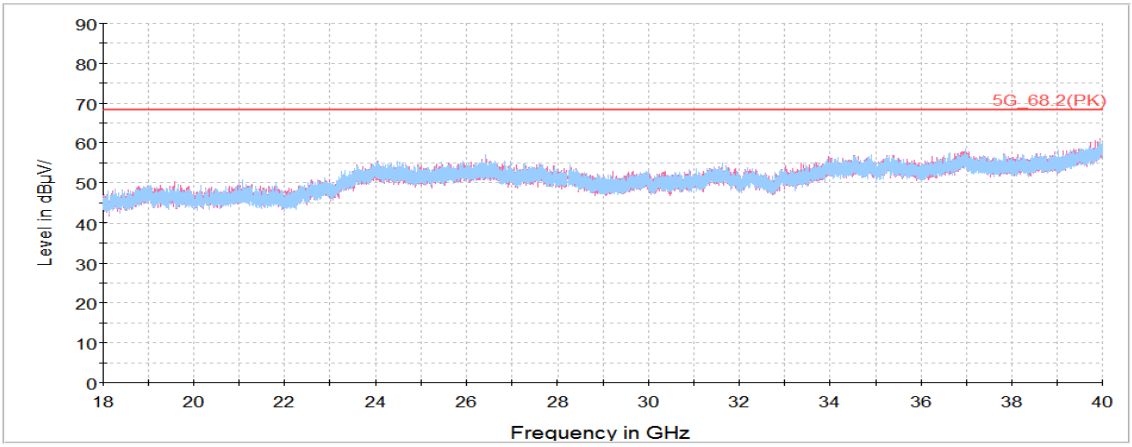
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



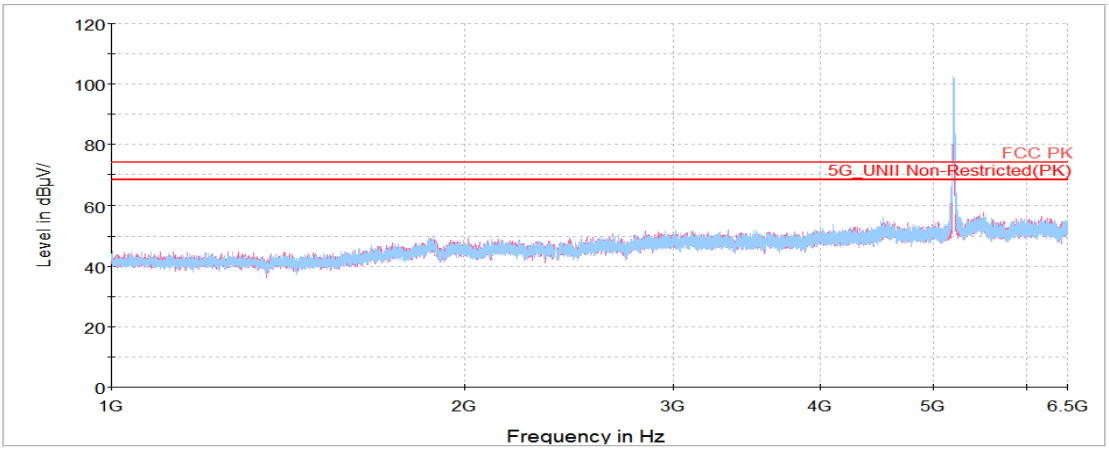
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



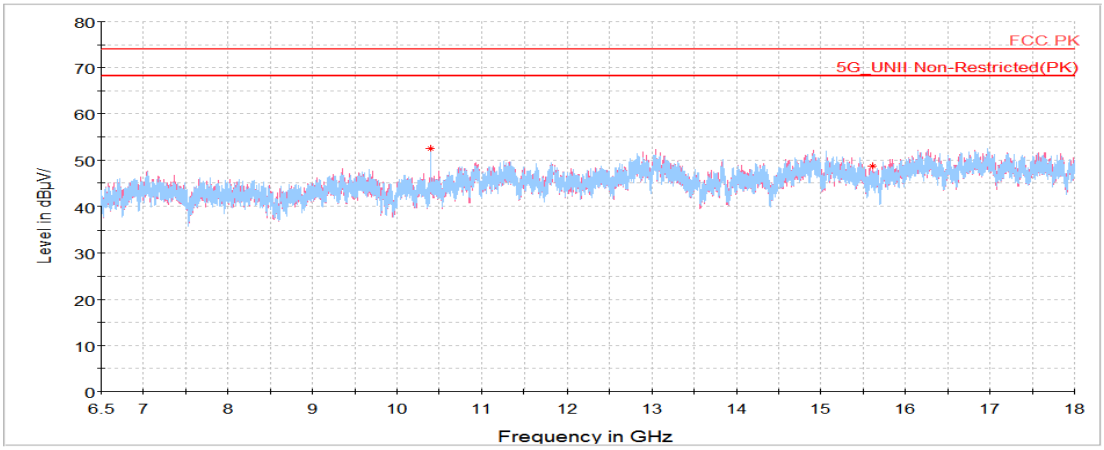
5 200 ㎒

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 400.30	V	64.83	37.60	-49.97	-	52.46	68.20	15.74
15 613.03[1)]	V	55.59	39.95	-46.85	-	48.69	74.00	25.31
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

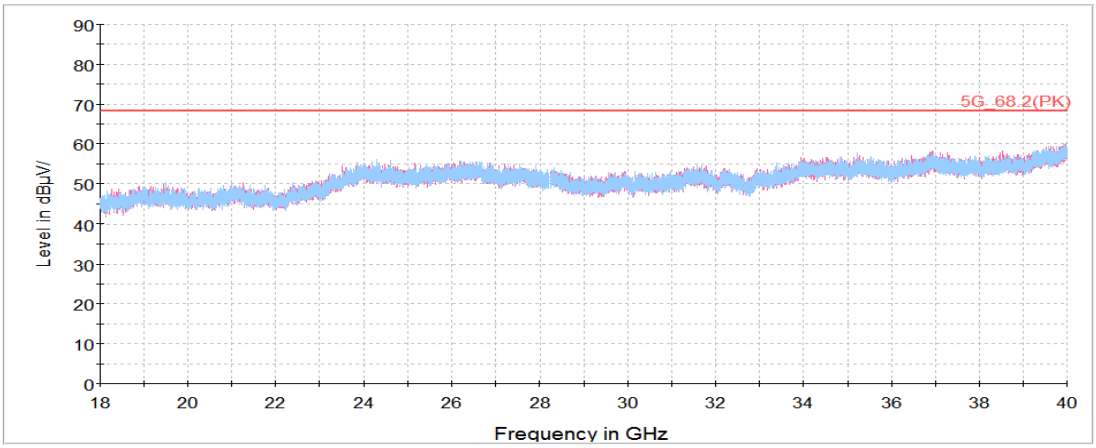
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



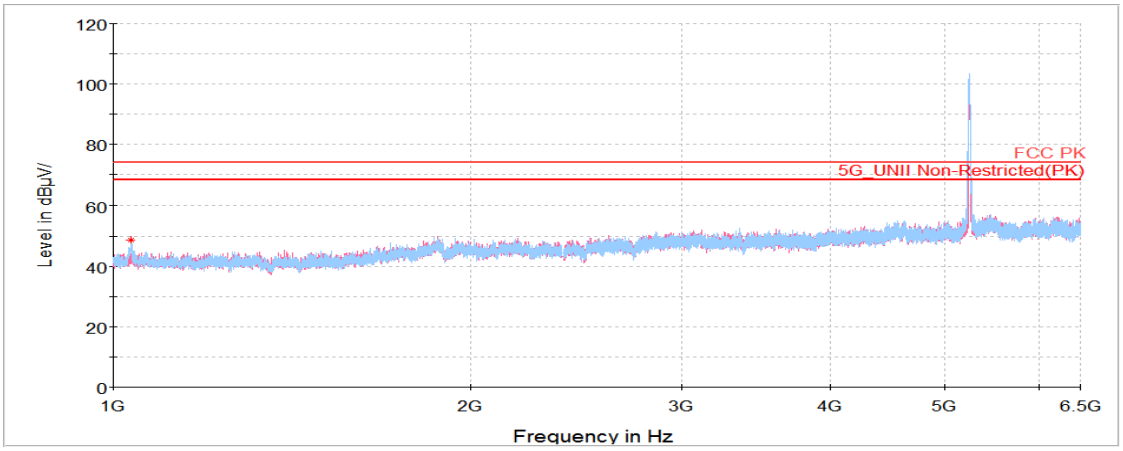
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



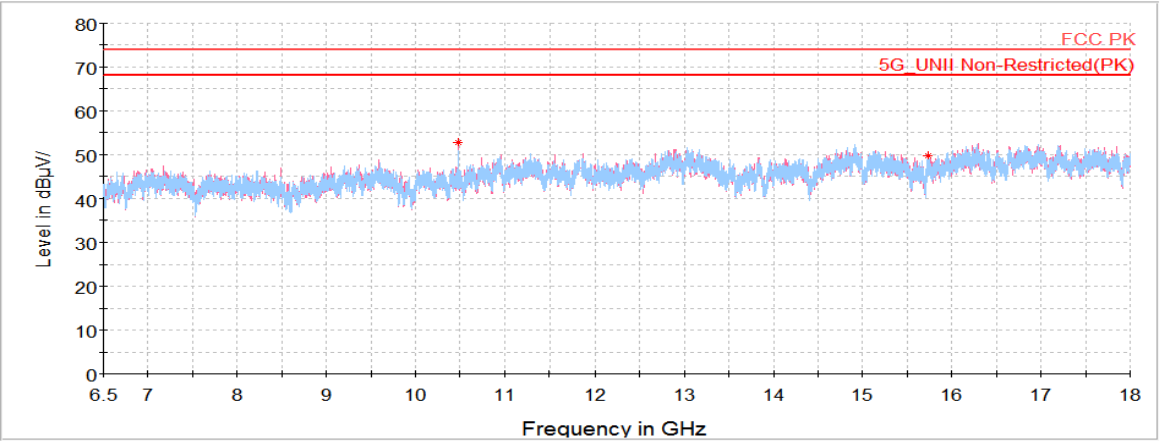
5 240 ㎒

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
1 034.55[1)]	H	68.90	28.81	-49.01	-	48.70	74.00	25.30
10 480.08	V	64.83	37.68	-49.85	-	52.66	68.20	15.54
15 735.94[1)]	H	56.62	39.91	-46.86	-	49.67	74.00	24.33
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

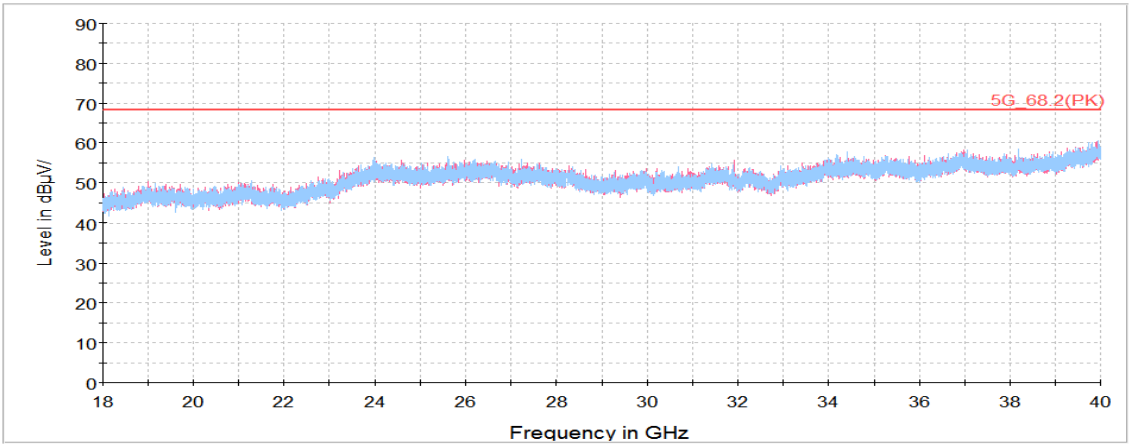
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

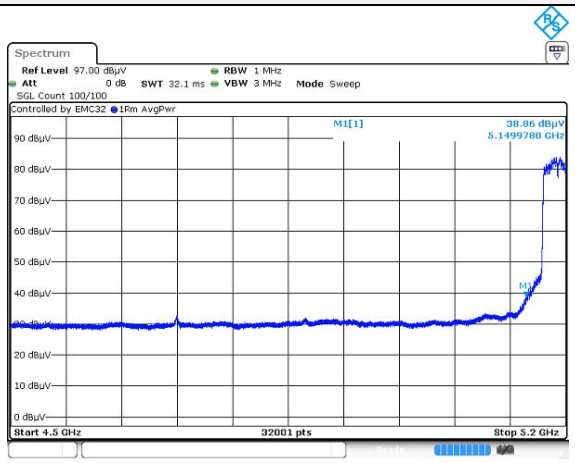


802.11ac VHT40_UNII 1_ANT 2

5 190 ㎒

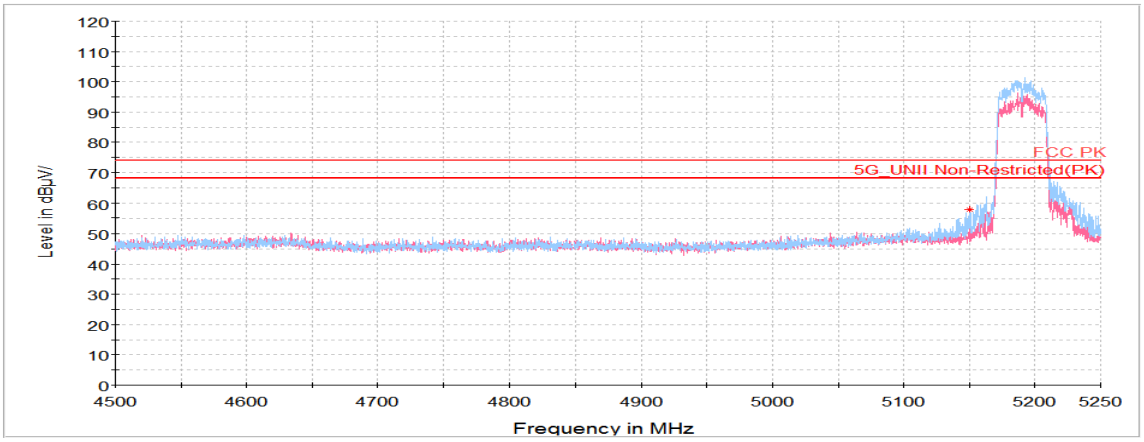
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 149.98[1)]	H	48.27	34.17	-24.73	-	57.71	74.00	16.29
10 380.17	H	63.39	37.58	-50.00	-	50.97	68.20	17.23
16 651.27	H	58.36	41.12	-47.06	-	52.42	68.20	15.78
Average Data								
5 149.98[1)]	H	38.86	34.17	-24.73	0.52	48.82	54.00	5.18

Average data (5 149.98 ㎒)

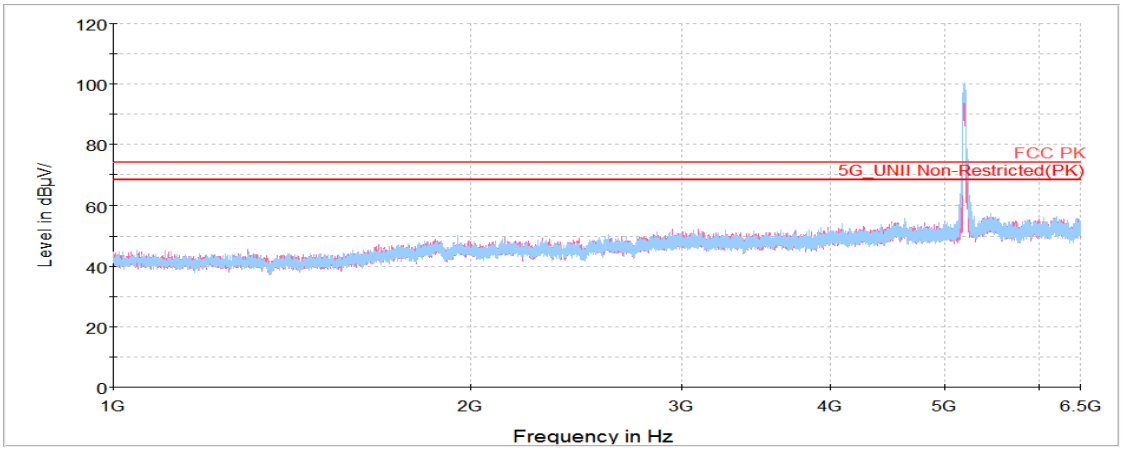


Blank

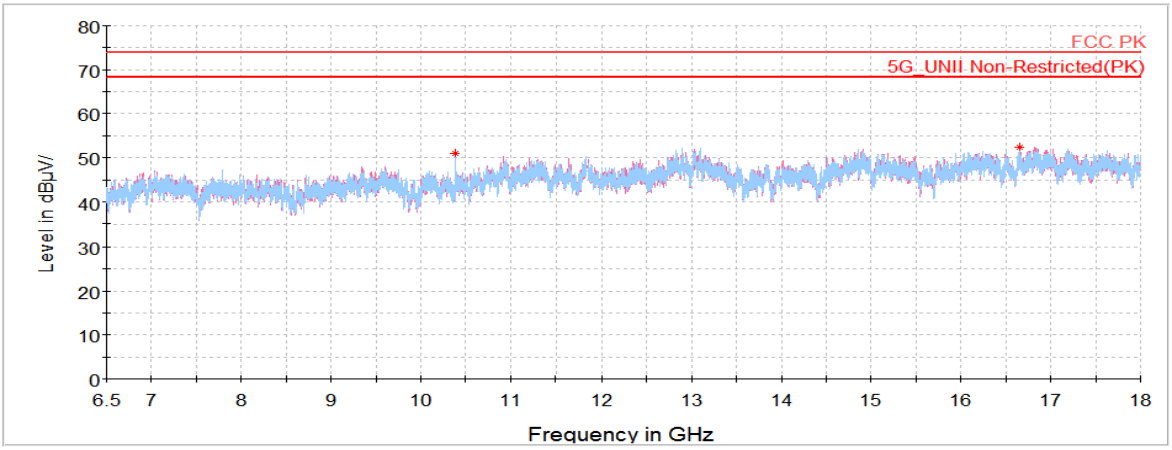
Horizontal/Vertical for Band-edge



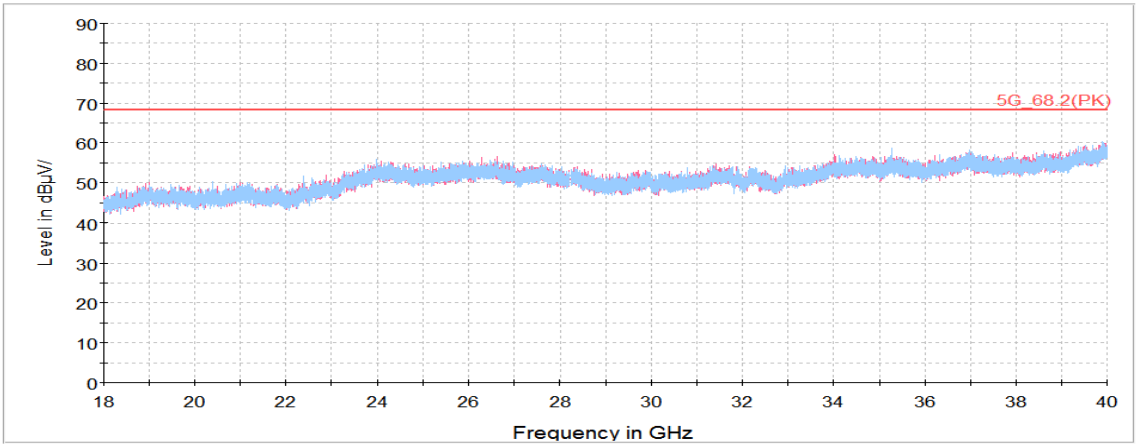
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



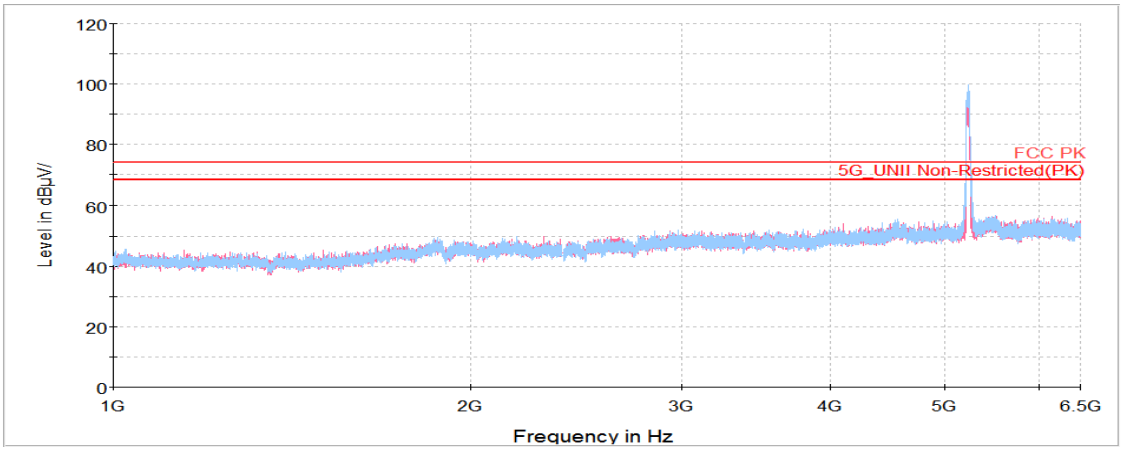
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



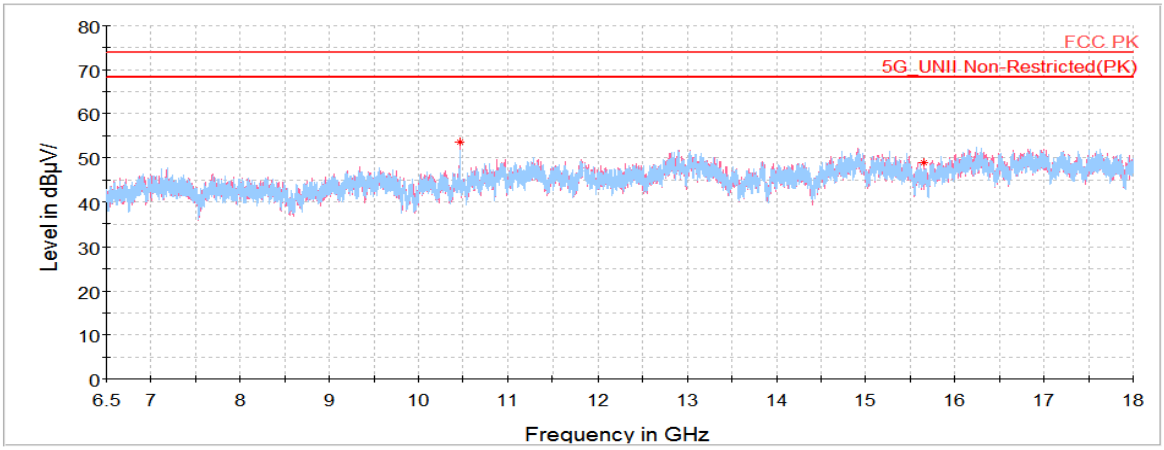
5 230 ㎒

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 459.95	V	65.85	37.66	-49.88	-	53.63	68.20	14.57
15 651.13[1)]	V	55.78	39.94	-46.85	-	48.87	74.00	25.13
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

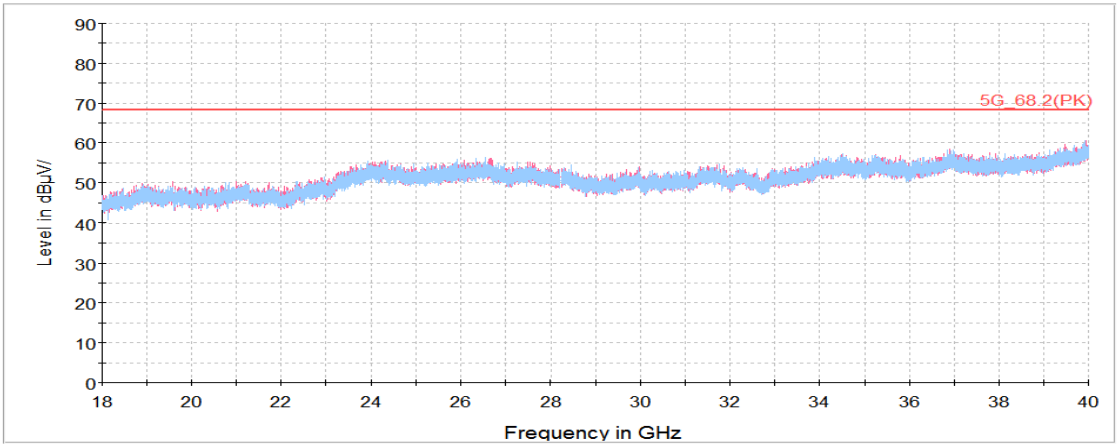
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

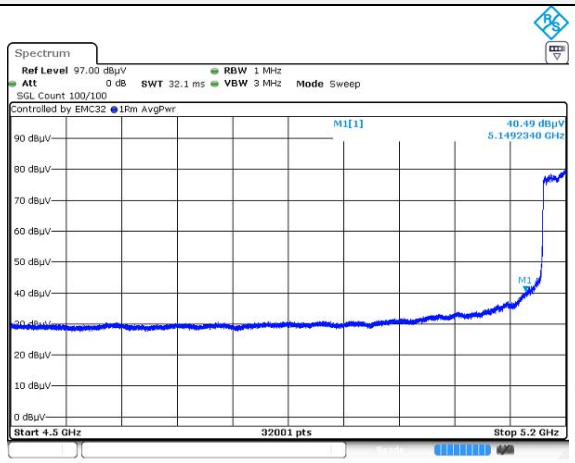


802.11ac VHT80_UNII 1_ANT 1

5 210 ㎒

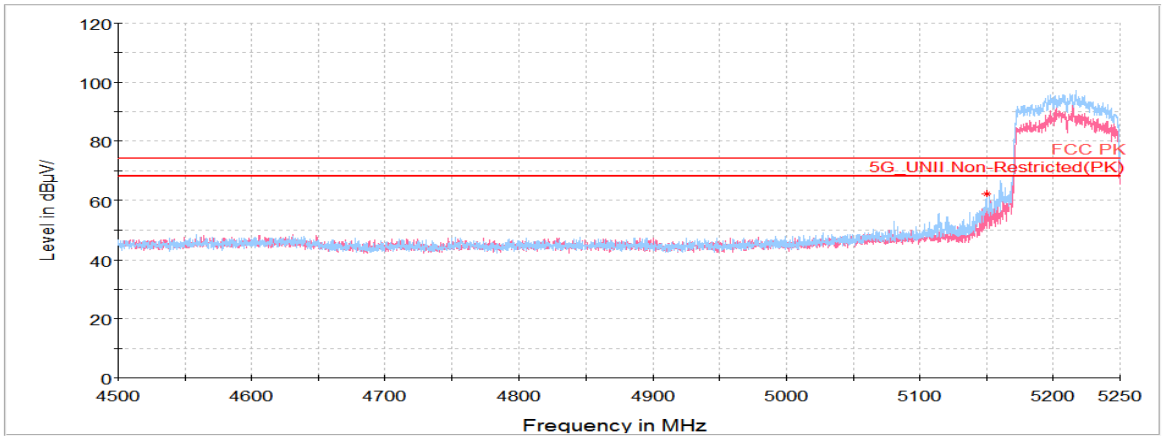
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 149.23[1)]	H	52.80	34.17	-24.73	-	62.24	74.00	11.76
10 420.42	V	65.68	37.62	-49.94	-	53.36	68.20	14.84
Average Data								
5 149.23[1)]	H	40.49	34.17	-24.73	0.96	50.89	54.00	3.11

Average data (5 149.23 ㎒)

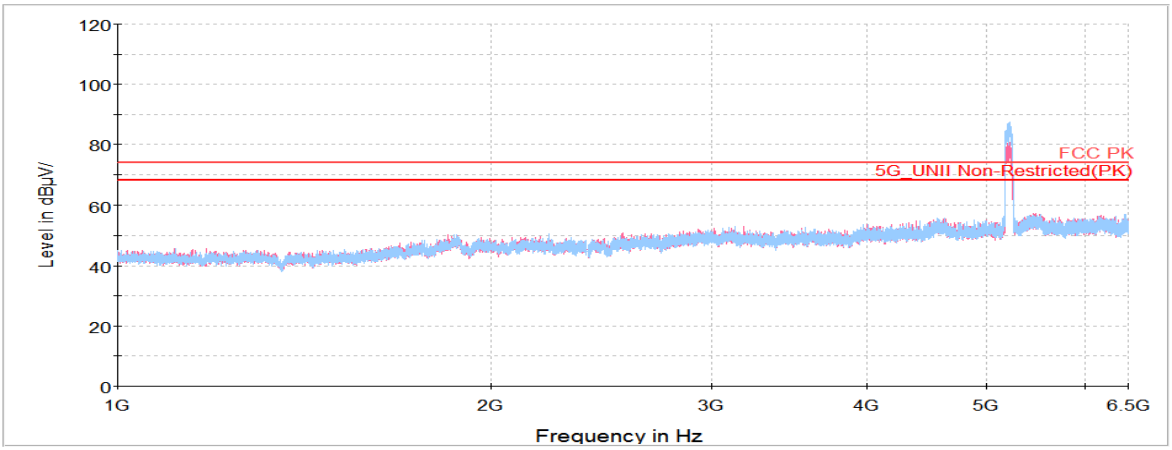


Blank

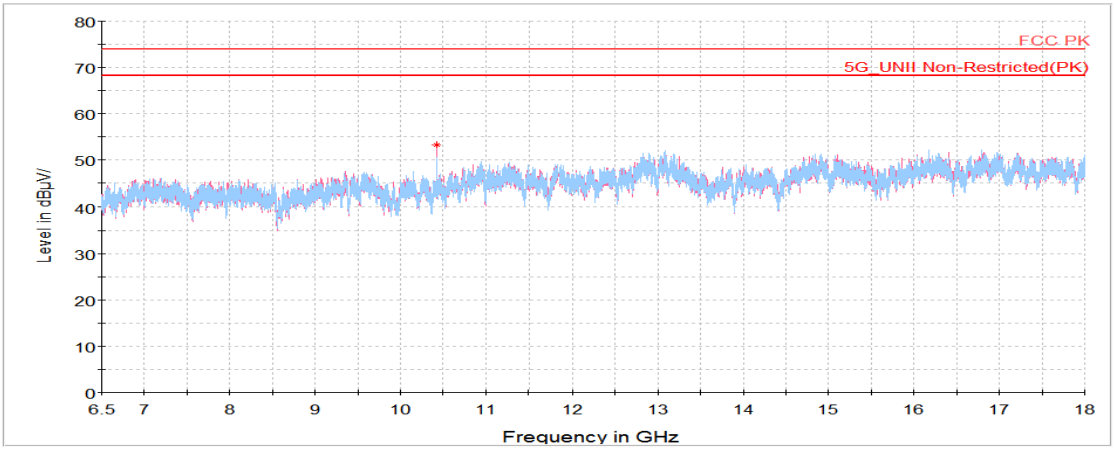
Horizontal/Vertical for Band-edge



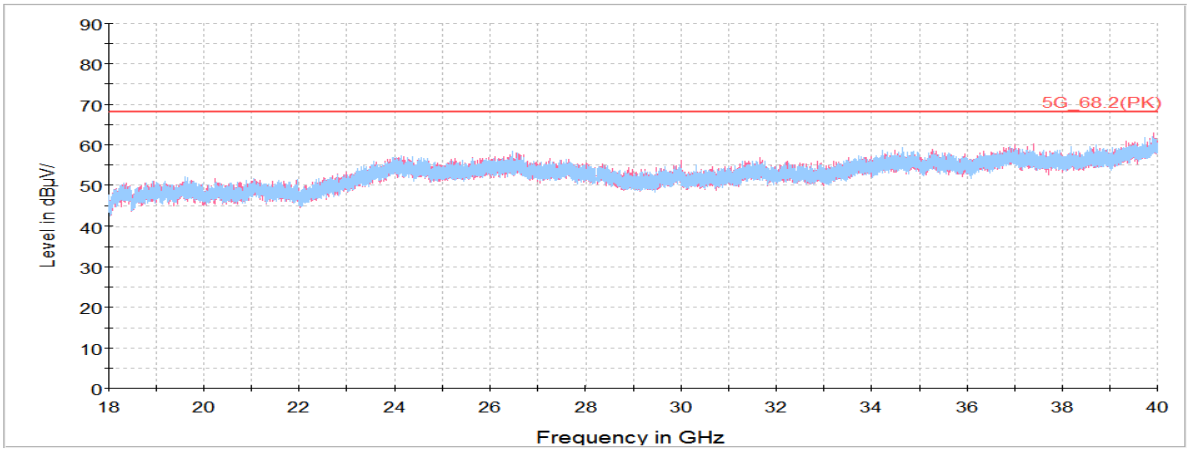
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

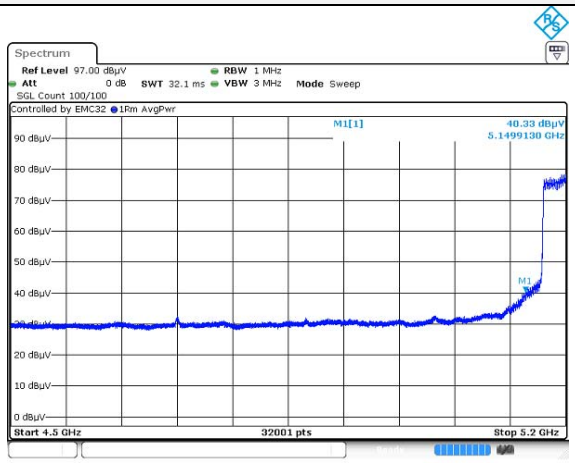


802.11ac VHT80_UNII 1_ANT 2

5 210 ㎒

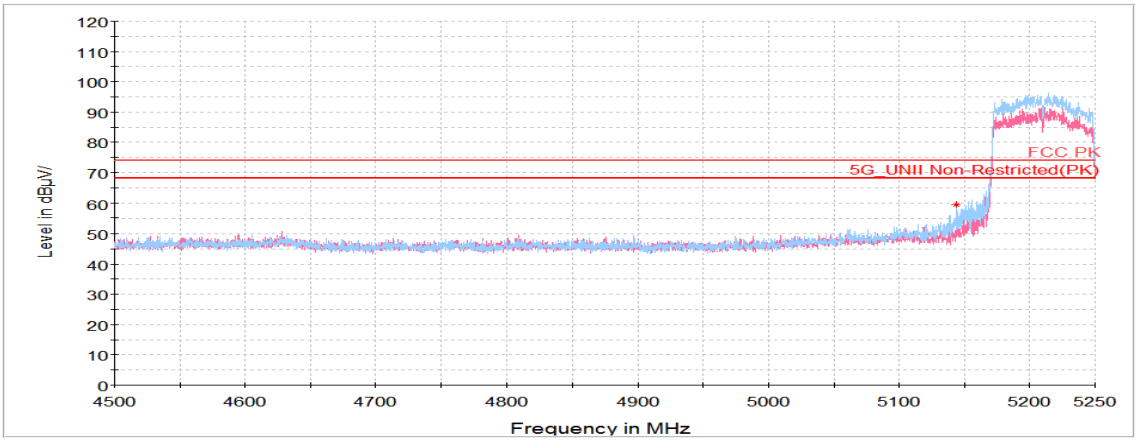
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 149.91[1)]	H	49.99	34.17	-24.73	-	59.43	74.00	14.57
10 420.06	H	64.58	37.62	-49.94	-	52.26	68.20	15.94
14 910.81	H	57.30	41.04	-45.12	-	53.22	68.20	14.98
Average Data								
5 149.91[1)]	H	40.33	34.17	-24.73	0.96	50.73	54.00	3.27

Average data (5 149.91 ㎒)

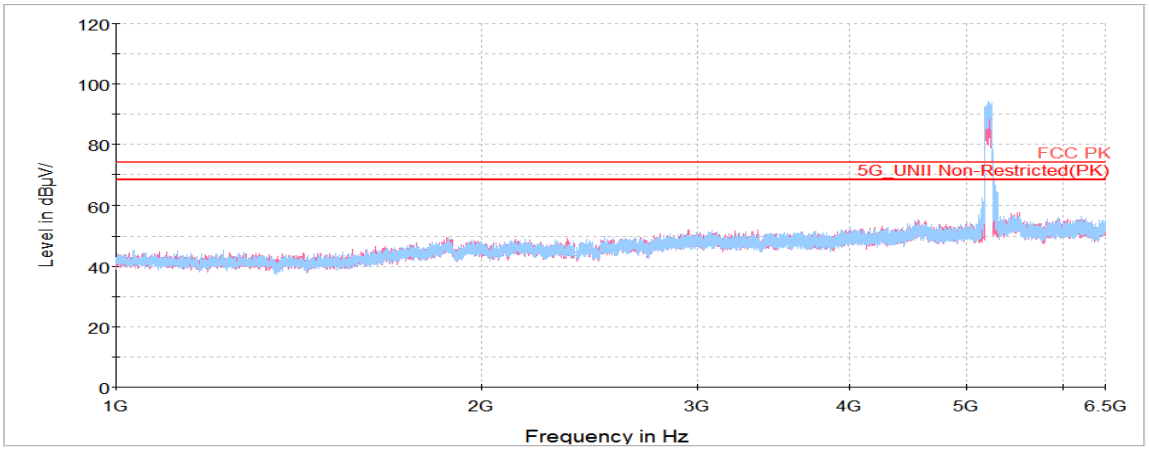


Blank

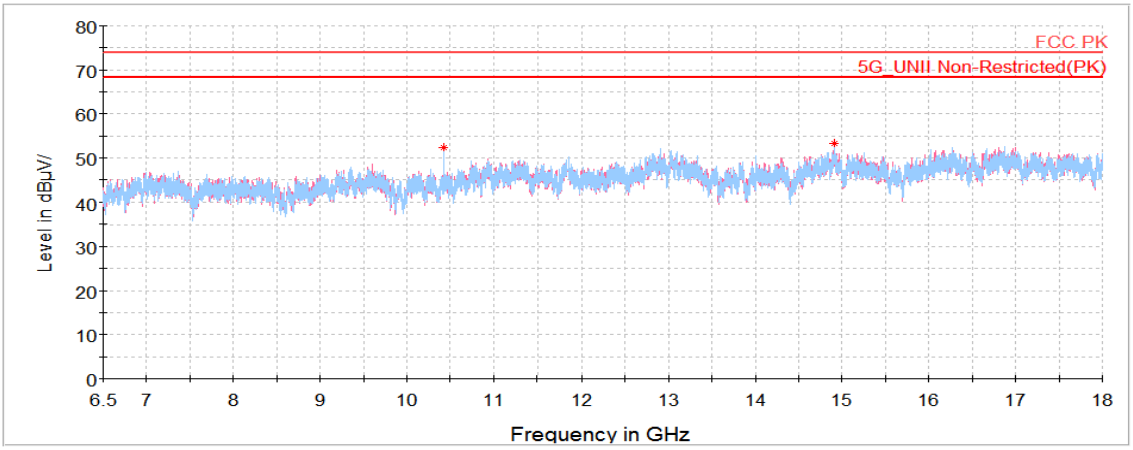
Horizontal/Vertical for Band-edge



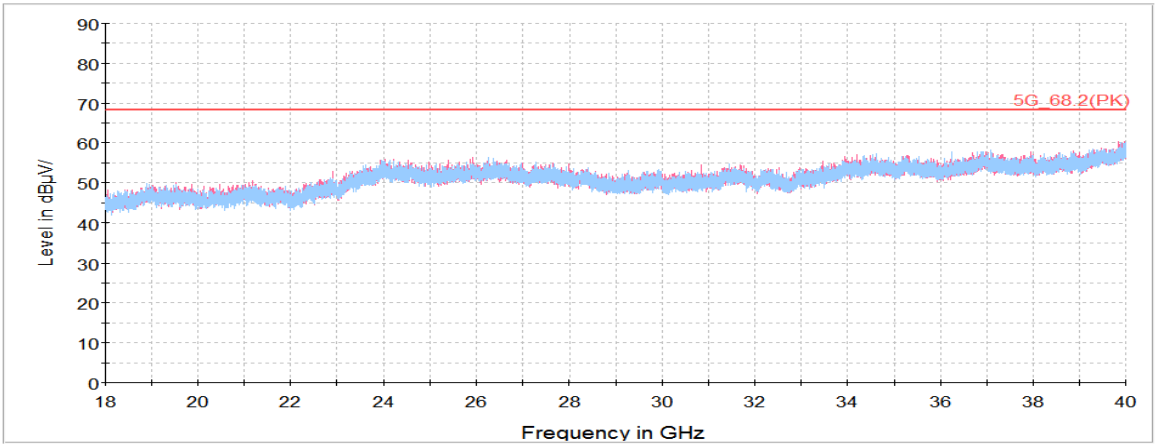
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓

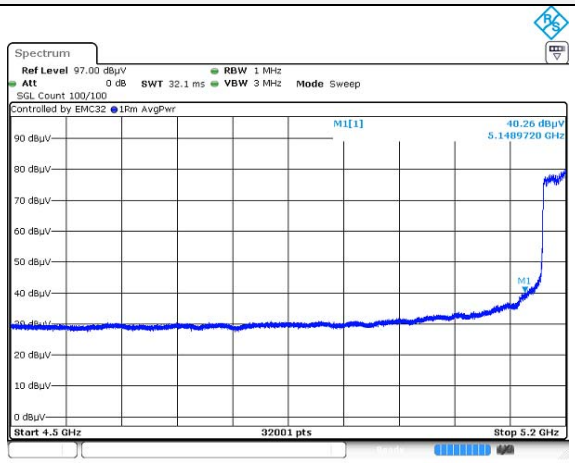


802.11ac VHT80_UNII 1_2TX MIMO

5 210 ㎒

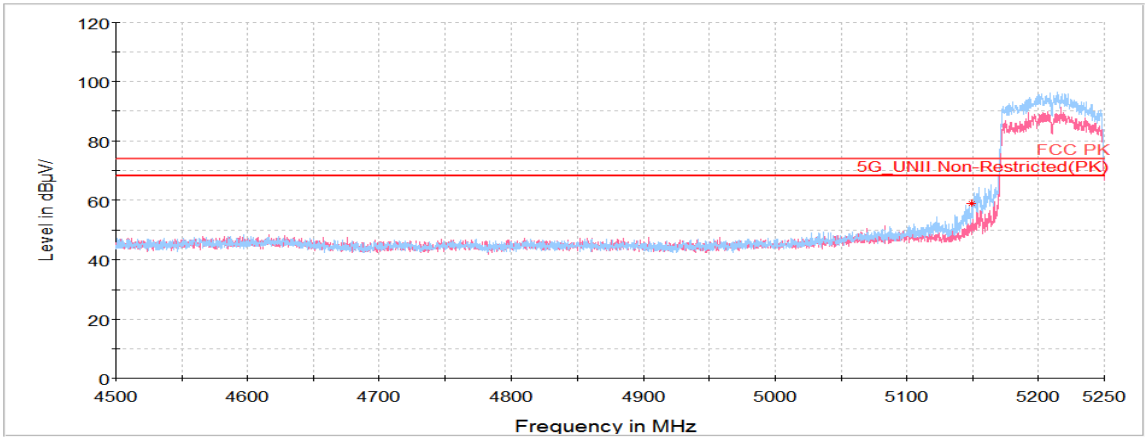
Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 148.97[1)]	H	49.31	34.17	-24.73	-	58.75	74.00	15.25
10 420.06	V	65.34	37.62	-49.94	-	53.02	68.20	15.18
Average Data								
5 148.97[1)]	H	40.26	34.17	-24.73	0.96	50.66	54.00	3.34

Average data (5 148.97 ㎒)

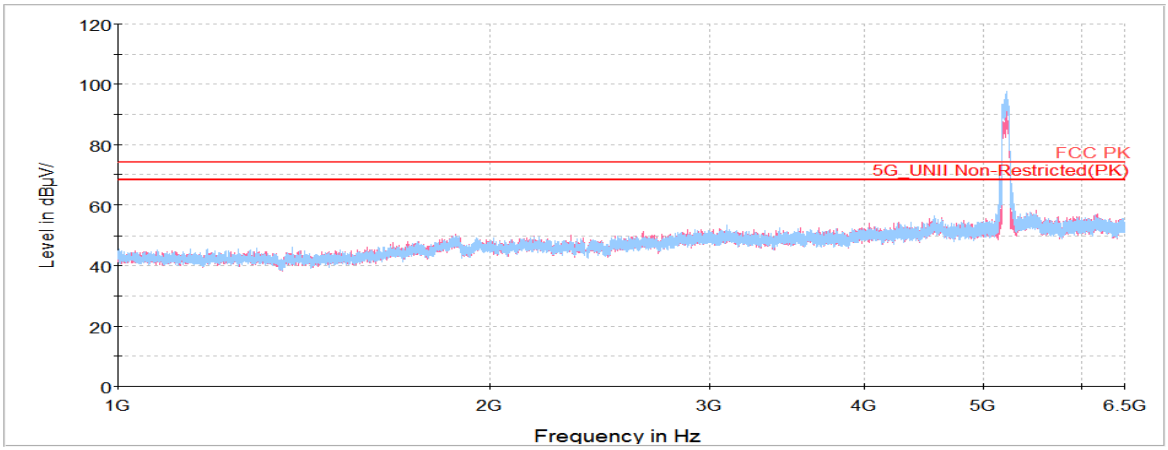


Blank

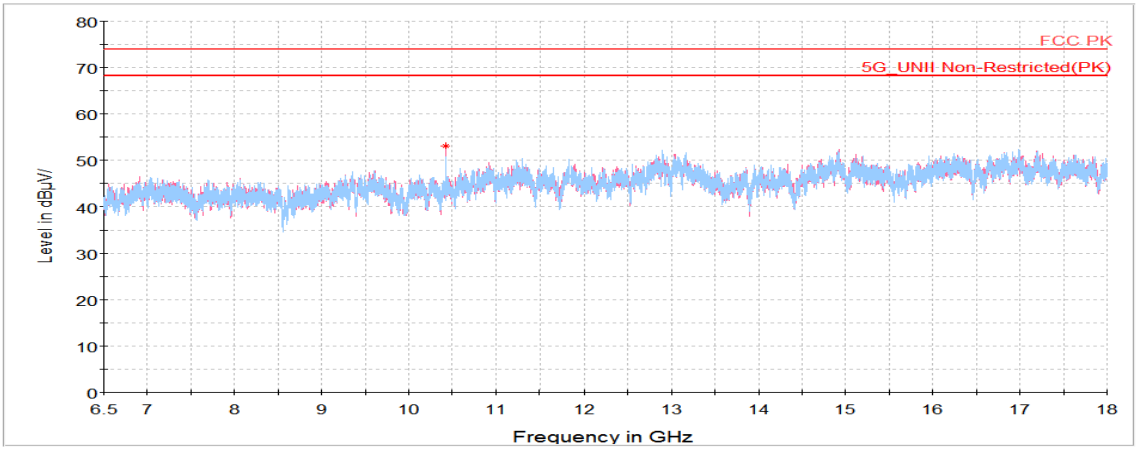
Horizontal/Vertical for Band-edge



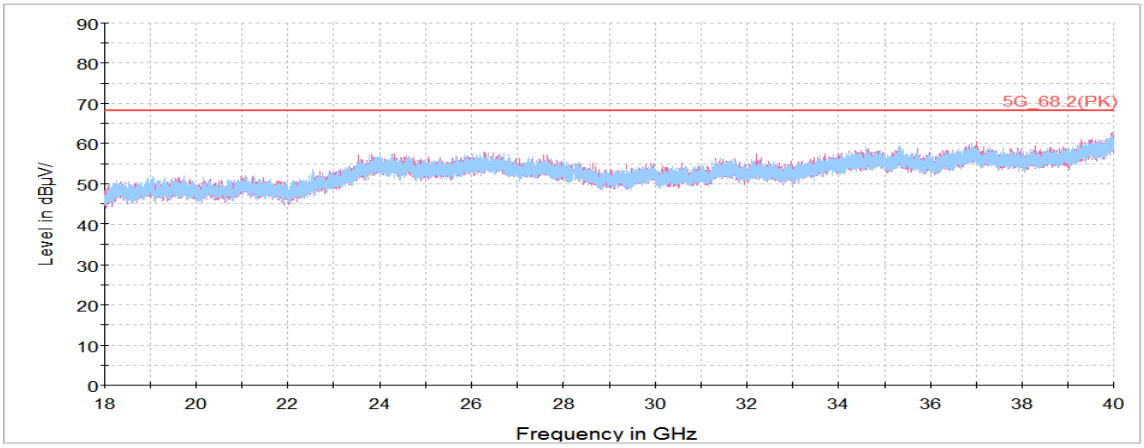
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



Spurious Emission for Simultaneous Tx Condition

Case 1	Antenna 1 5 GHz WLAN	Antenna 1 BT
Mode	ac80	GFSK
Channel	42	39
Frequency	5 210	2 441
Data Rate	MCS0	DH5

Case 2	Antenna 2 5 GHz WLAN	Antenna 1 BT
Mode	a	GFSK
Channel	36	39
Frequency	5 180	2 441
Data Rate	6M	DH5

Case 3	Antenna ALL 5 GHz WLAN	Antenna 1 BT
Mode	ac80	GFSK
Channel	42	39
Frequency	5 210	2 441
Data Rate	MCS0	DH5

Case 4	Antenna 1 5 GHz WLAN	Antenna 1 BLE
Mode	ac80	GFSK
Channel	42	19
Frequency	5 210	2 440
Data Rate	MCS0	1M

Case 5	Antenna 2 5 GHz WLAN	Antenna 1 BLE
Mode	a	GFSK
Channel	36	19
Frequency	5 180	2 440
Data Rate	6M	1M

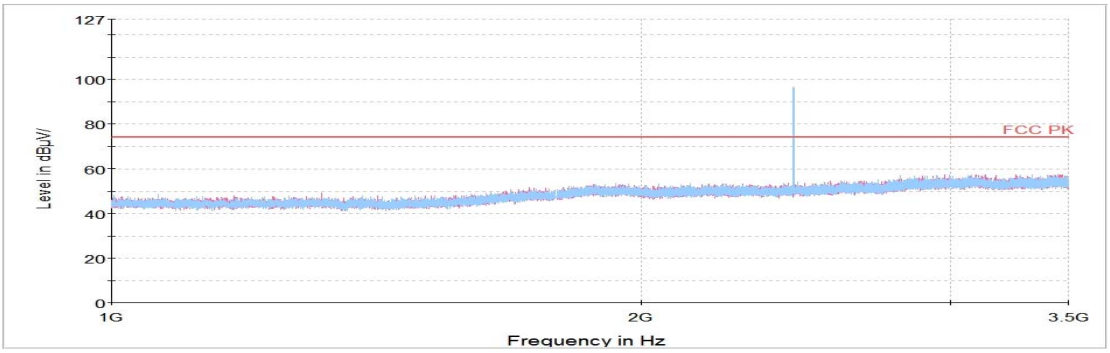
Case 6	Antenna ALL 5 GHz WLAN	Antenna 1 BLE
Mode	ac80	GFSK
Channel	42	19
Frequency	5 210	2 440
Data Rate	MCS0	1M

Notes.
The lowest margin condition among the channels and modes were selected for test.

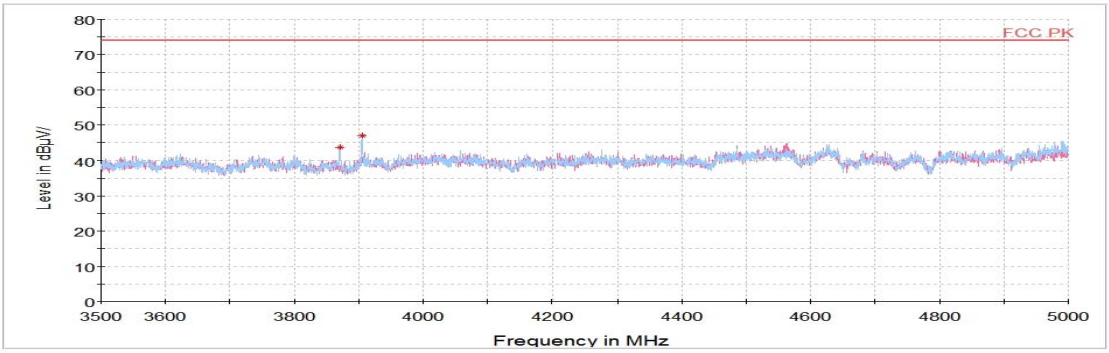
Case 1

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
3 870.66[1)]	H	64.89	33.03	-54.21	-	43.71	74.00	30.29
3 905.09[1)]	H	68.04	33.02	-54.16	-	46.90	74.00	27.10
10 420.06	V	64.07	37.62	-49.94	-	51.75	68.20	16.45
16 848.20	H	57.83	41.28	-46.92	-	52.19	68.20	16.01
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

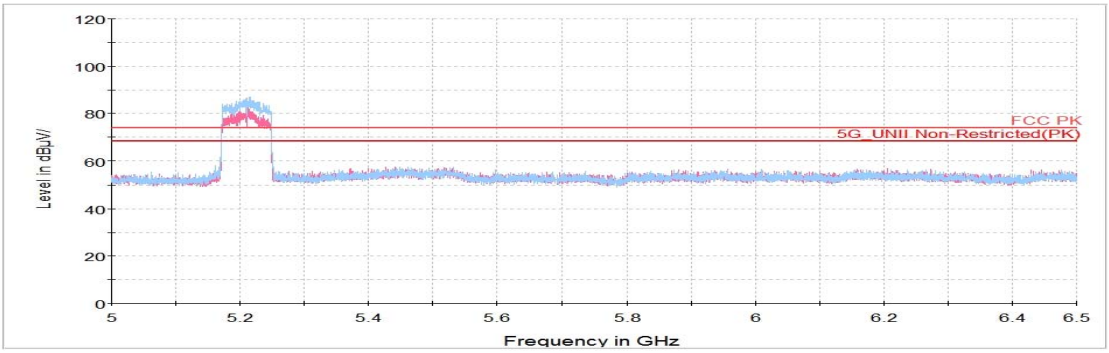
Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓



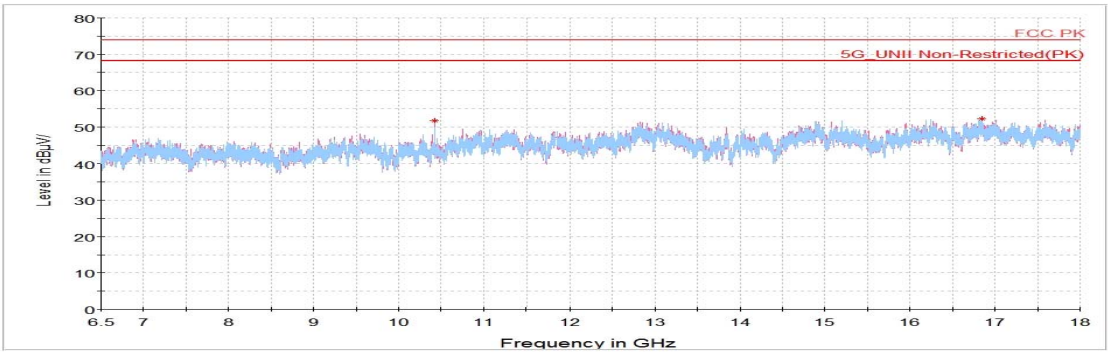
Horizontal/Vertical for 3.5 ㎓ ~ 5 ㎓



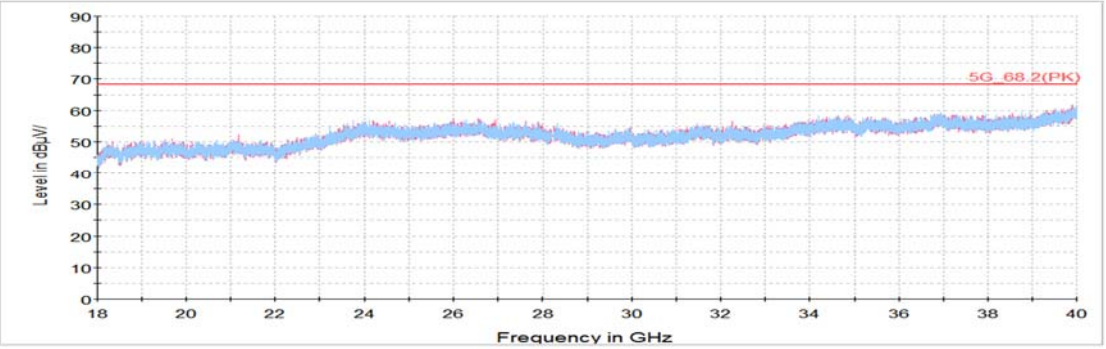
Horizontal/Vertical for 5 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



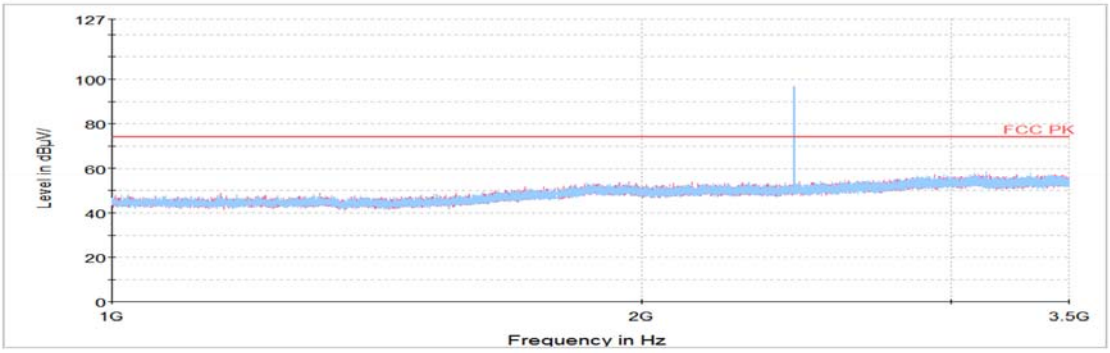
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



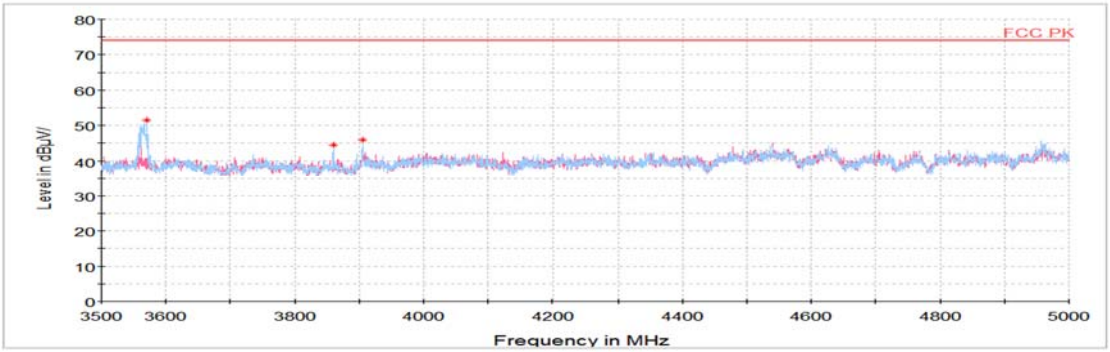
Case 2

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
3 571.14	H	72.47	33.09	-54.19	-	51.37	68.20	16.83
3 859.78[1)]	H	65.70	33.03	-54.22	-	44.51	74.00	29.49
3 905.55[1)]	H	66.99	33.02	-54.16	-	45.85	74.00	28.15
10 359.69	V	65.46	37.56	-50.04	-	52.98	68.20	15.22
15 515.28[1)]	V	55.34	39.99	-46.84	-	48.49	74.00	25.51
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

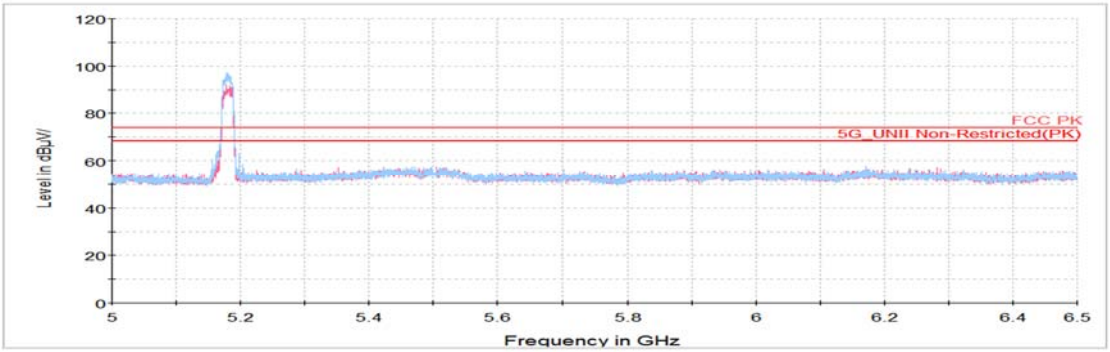
Horizontal/Vertical for 1 GHz ~ 3.5 GHz



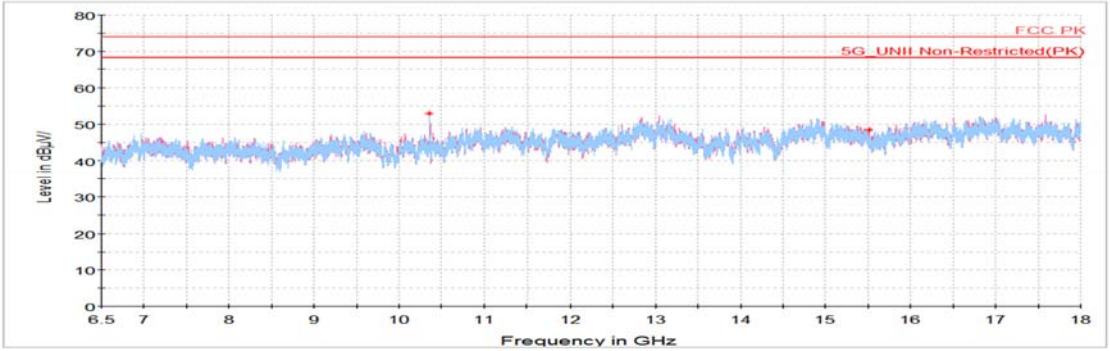
Horizontal/Vertical for 3.5 GHz ~ 5 GHz



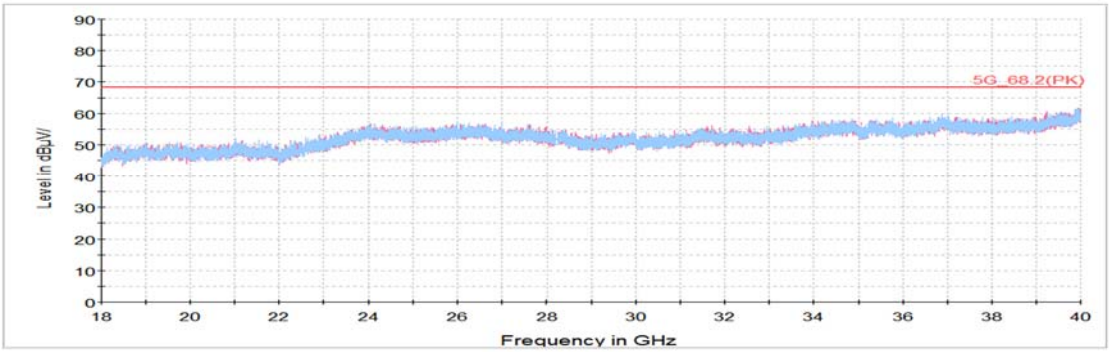
Horizontal/Vertical for 5 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



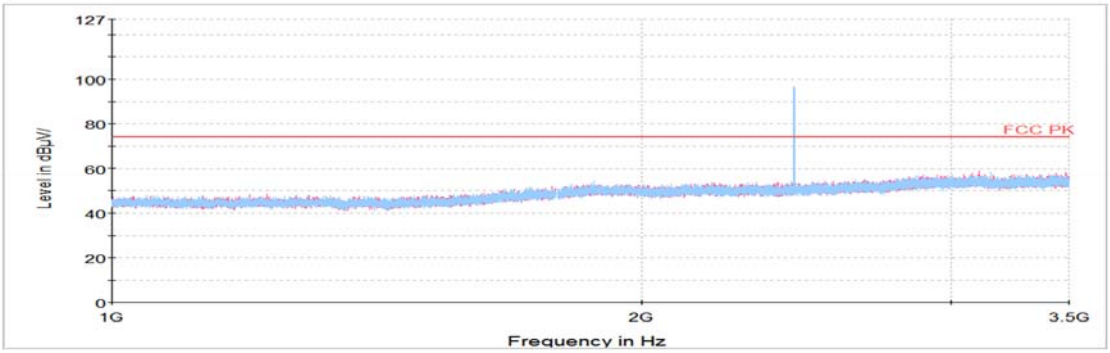
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



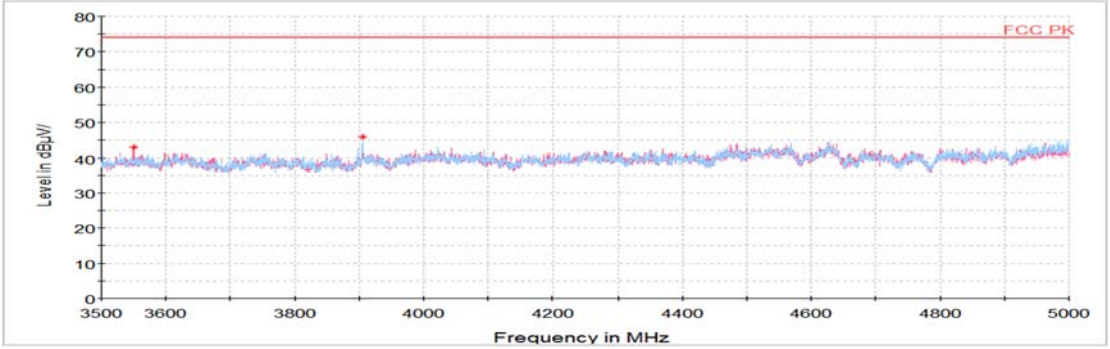
Case 3

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
3 549.84	V	64.04	33.09	-54.22	-	42.91	68.20	25.29
3 905.09[1)]	H	67.10	33.02	-54.16	-	45.96	74.00	28.04
10 420.42	V	64.61	37.62	-49.94	-	52.29	68.20	15.91
16 286.14	H	59.04	40.94	-47.05	-	52.93	68.20	15.27
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

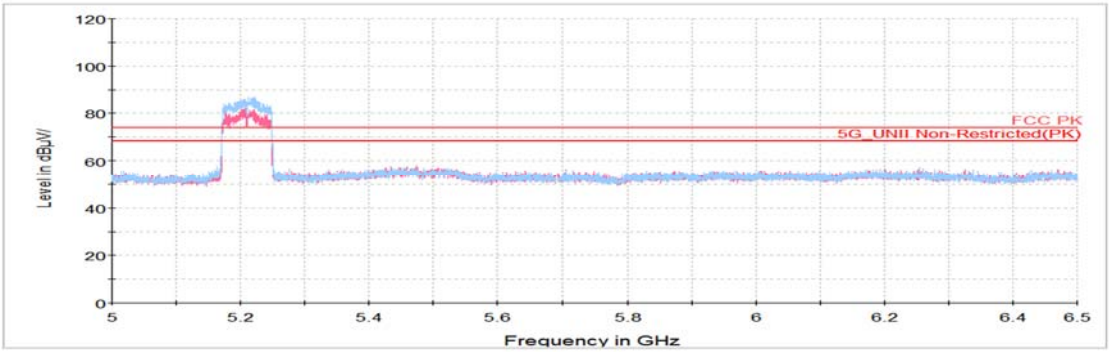
Horizontal/Vertical for 1 GHz ~ 3.5 GHz



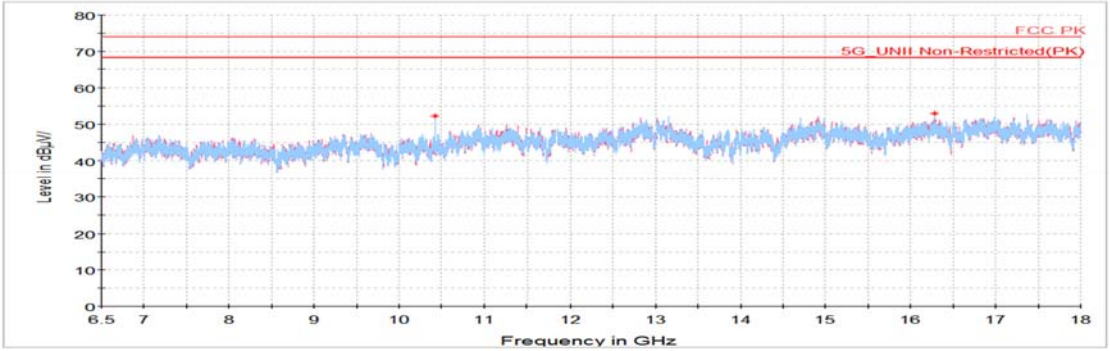
Horizontal/Vertical for 3.5 GHz ~ 5 GHz



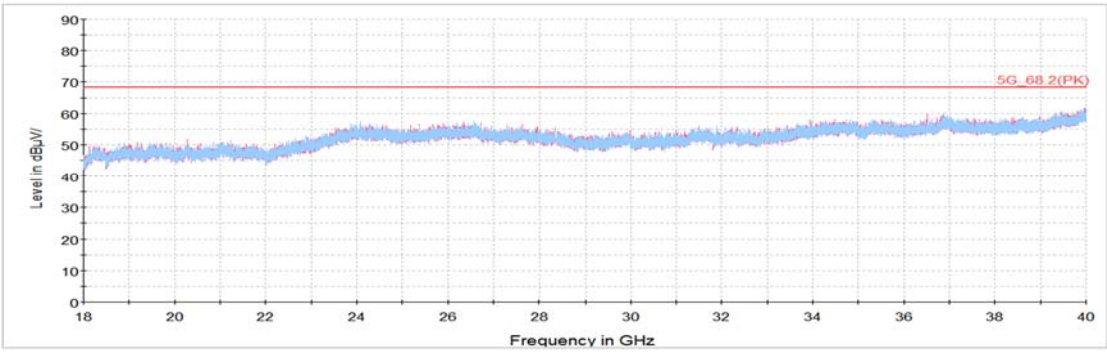
Horizontal/Vertical for 5 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



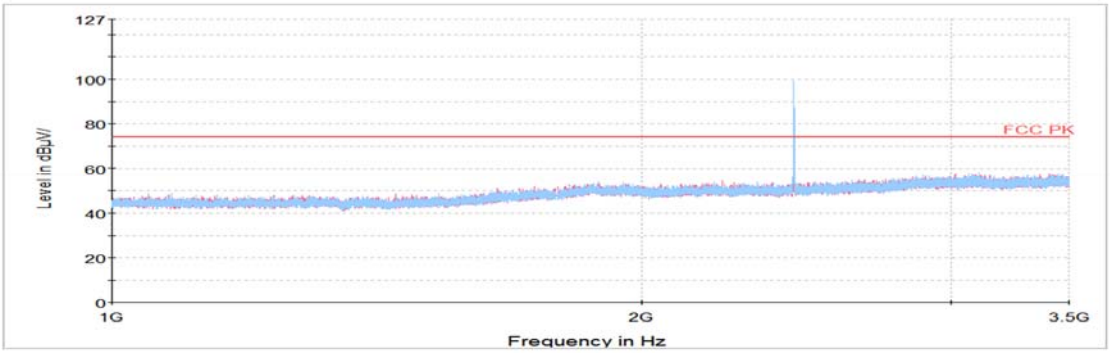
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



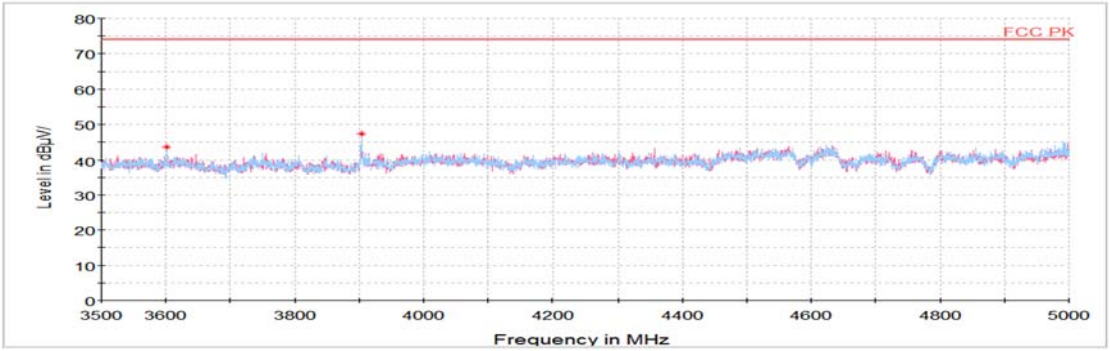
Case 4

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
3 601.95[1)]	H	64.70	33.08	-54.16	-	43.62	74.00	30.38
3 903.73[1)]	H	68.57	33.02	-54.17	-	47.42	74.00	26.58
10 419.70	V	63.60	37.62	-49.94	-	51.28	68.20	16.92
16 824.84	V	58.06	41.26	-46.94	-	52.38	68.20	15.82
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

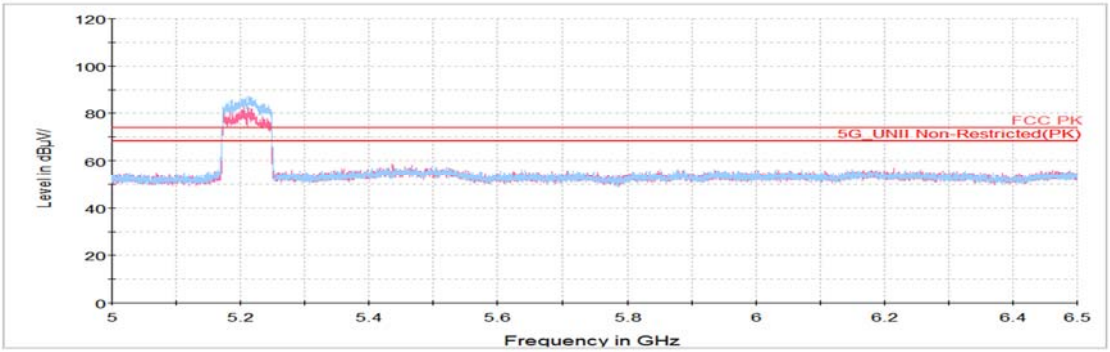
Horizontal/Vertical for 1 GHz ~ 3.5 GHz



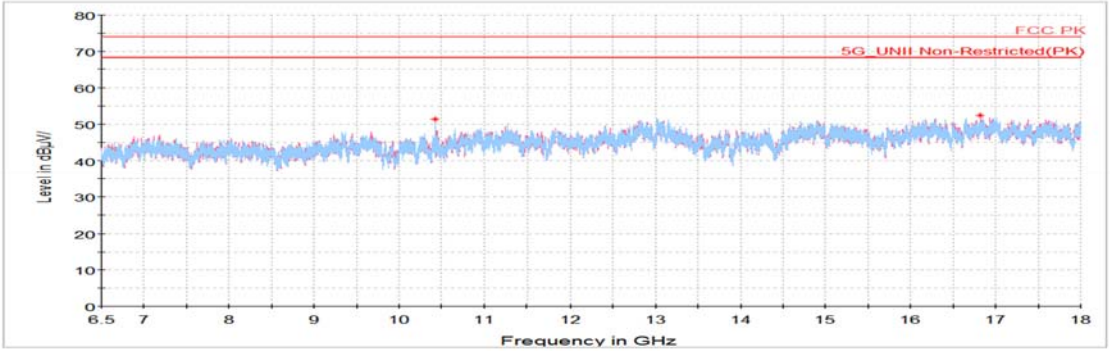
Horizontal/Vertical for 3.5 GHz ~ 5 GHz



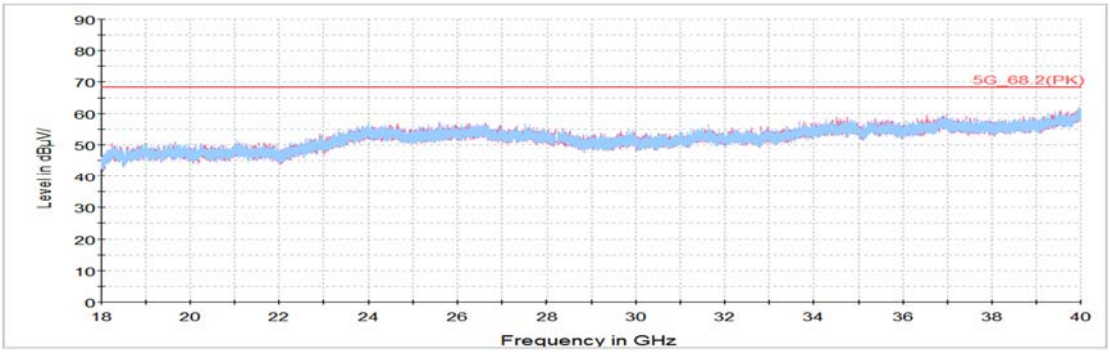
Horizontal/Vertical for 5 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



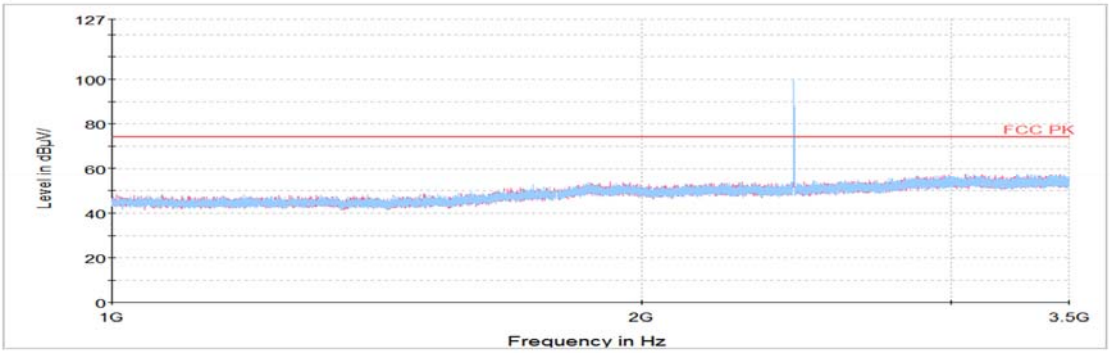
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



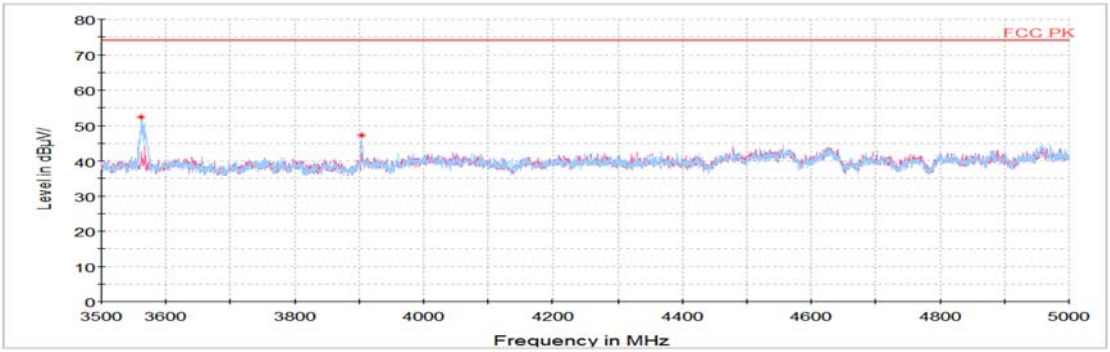
Case 5

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
3 562.08	H	73.38	33.09	-54.20	-	52.27	68.20	15.93
3 903.73[1)]	H	68.33	33.02	-54.17	-	47.18	74.00	26.82
10 360.05	V	65.06	37.56	-50.04	-	52.58	68.20	15.62
16 829.16	V	57.75	41.26	-46.93	-	52.08	68.20	16.12
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

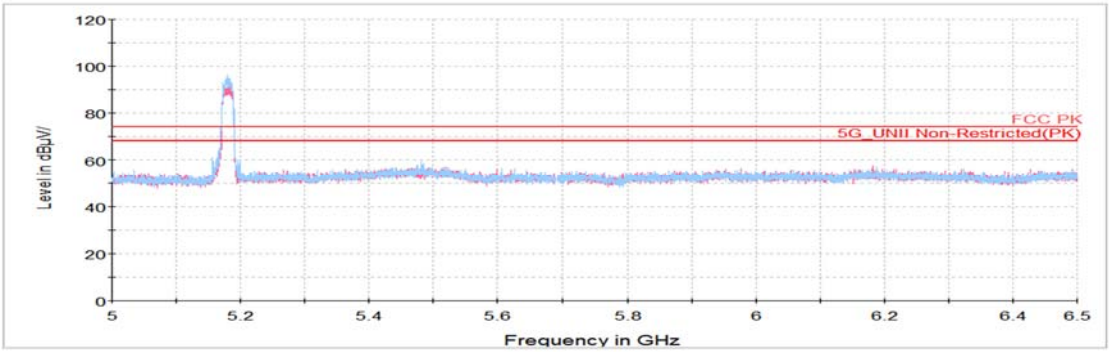
Horizontal/Vertical for 1 GHz ~ 3.5 GHz



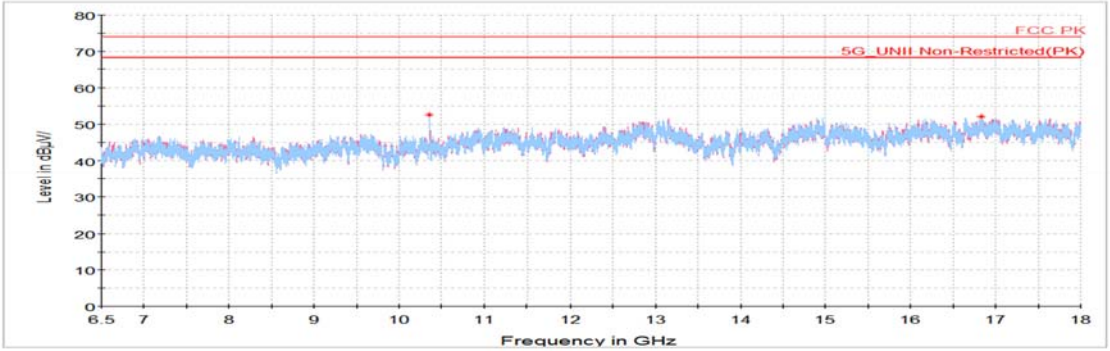
Horizontal/Vertical for 3.5 GHz ~ 5 GHz



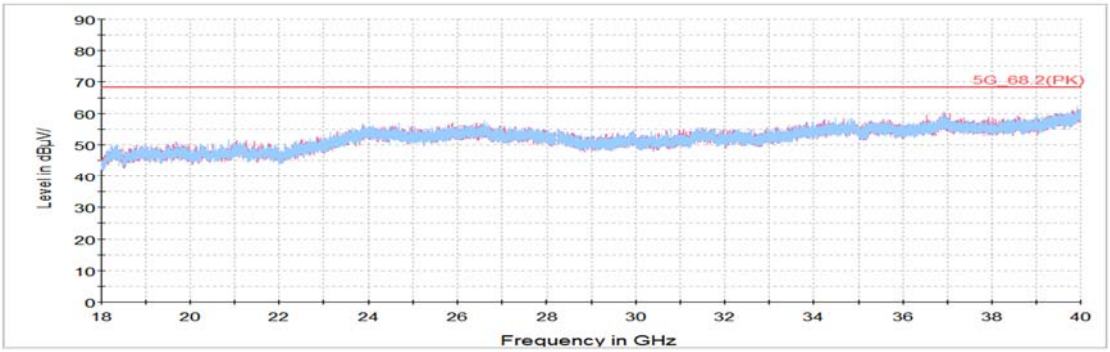
Horizontal/Vertical for 5 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



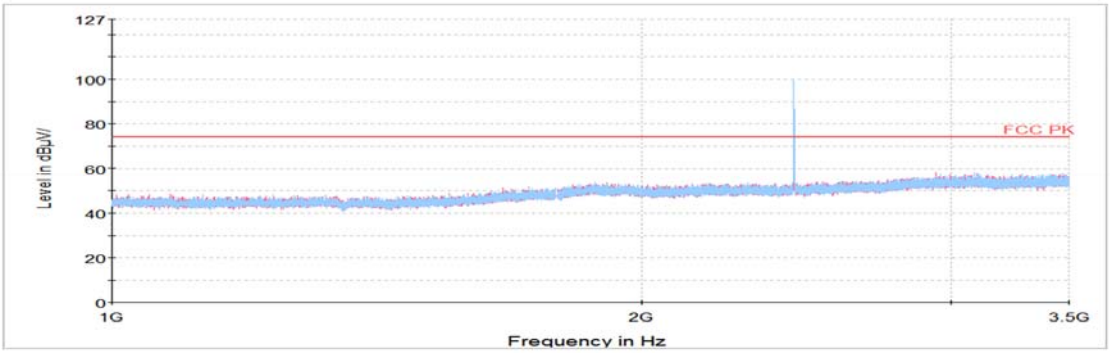
Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



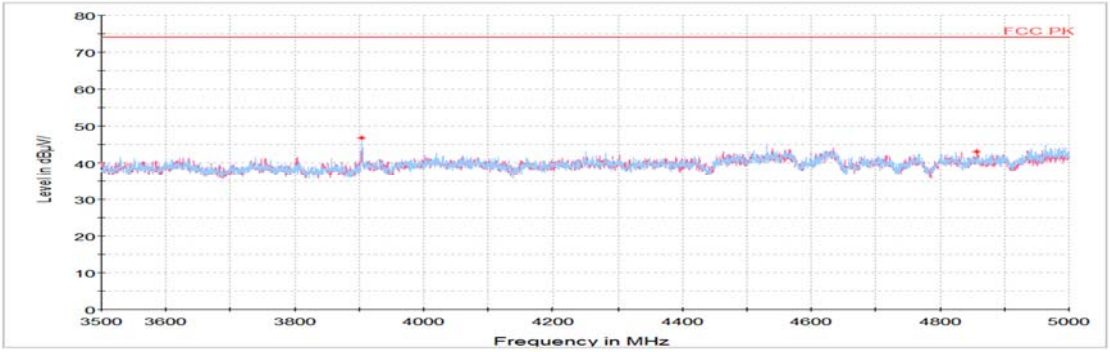
Case 6

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Peak data								
3 904.19[1)]	H	67.94	33.02	-54.17	-	46.79	74.00	27.21
4 856.66[1)]	V	62.12	33.81	-52.87	-	43.06	74.00	30.94
10 420.42	V	63.96	37.62	-49.94	-	51.64	68.20	16.56
14 888.53	H	56.52	41.00	-45.22	-	52.30	68.20	15.90
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

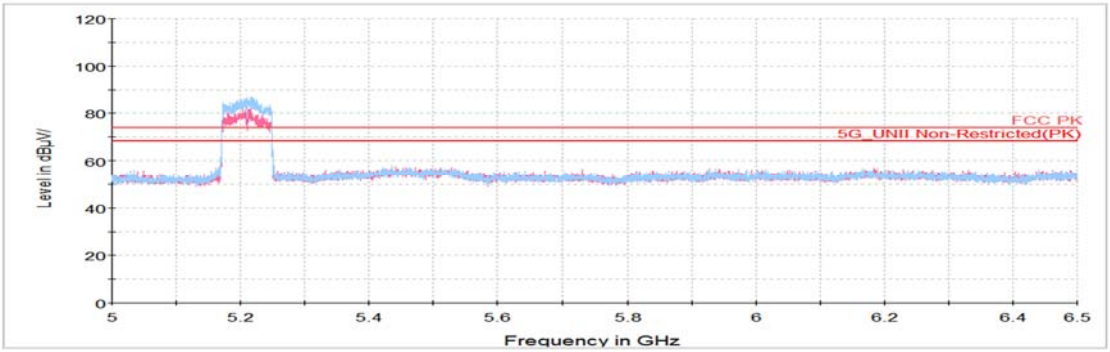
Horizontal/Vertical for 1 GHz ~ 3.5 GHz



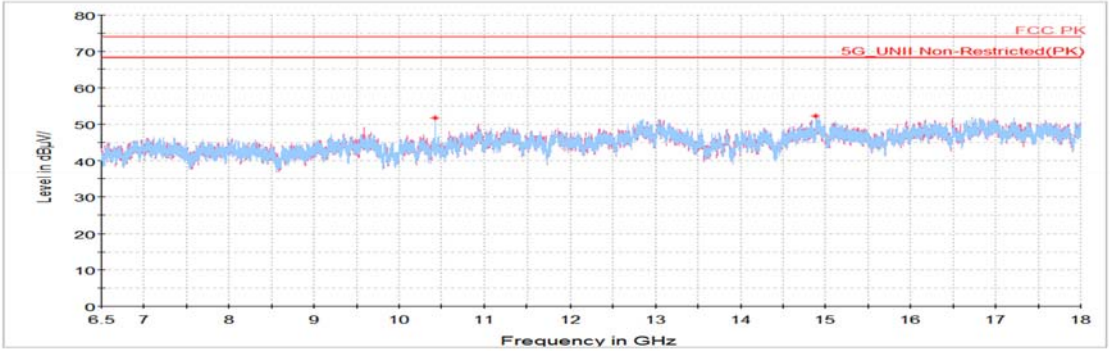
Horizontal/Vertical for 3.5 GHz ~ 5 GHz



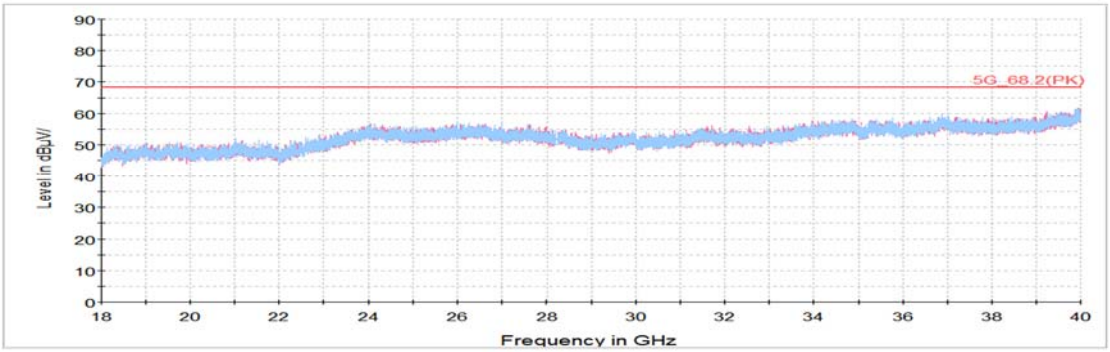
Horizontal/Vertical for 5 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

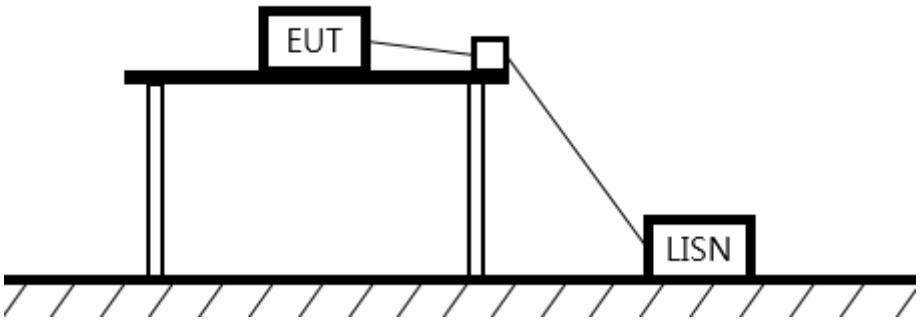


Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



7.5. AC Conducted emission

Test setup



Limit

According to 15.207(a), 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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

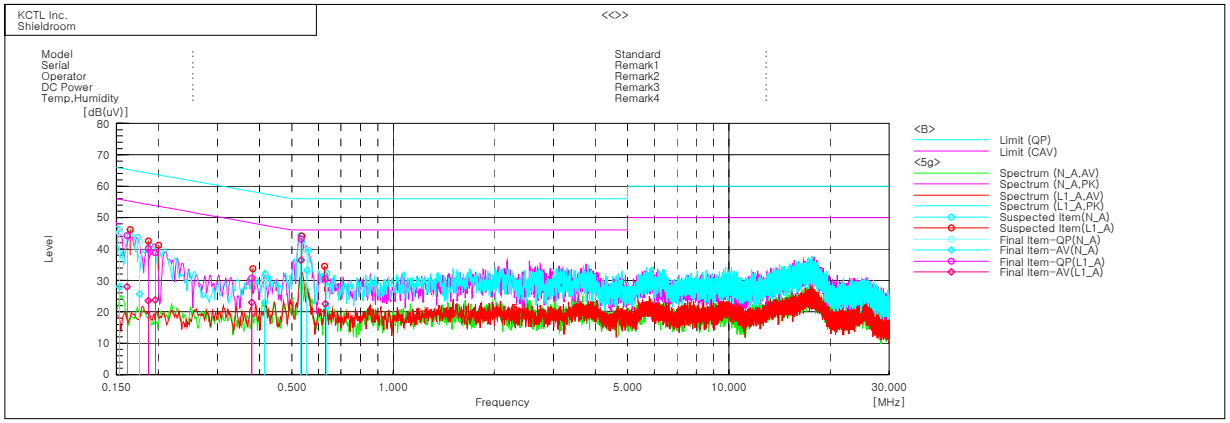
Frequency of Emission (㎒)	Conducted limit (dBμV/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

Measurement procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 ㎝ in which is located 40 ㎝ away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is an input transducer to a spectrum analyzer or an EMI/Field Intensity ㅡ Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 ㎒ to 30 ㎒.
5. The measurements were made with the detector set to peak amplitude within a bandwidth of 10 ㎑ or to quasi-peak and average within a bandwidth of 9 ㎑. The EUT was in transmitting mode during the measurements.

Test results

Worst case: 802.11a_UNII 1_5 180 ㎒_ ANT 2



Final Result

--- N_A Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.15328	35.1	17.8	10.1	45.2	27.9	65.8	55.8	20.6	27.9
2	0.17569	32.1	15.4	10.3	42.4	25.7	64.7	54.7	22.3	29.0
3	0.41379	19.1	12.8	10.2	29.3	23.0	57.6	47.6	28.3	24.6
4	0.53143	32.6	26.0	10.2	42.8	36.2	56.0	46.0	13.2	9.8
5	0.55316	29.3	22.9	10.2	39.5	33.1	56.0	46.0	16.5	12.9
6	0.63493	18.8	11.4	10.1	28.9	21.5	56.0	46.0	27.1	24.5

--- L1_A Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.1614	34.2	17.9	10.0	44.2	27.9	65.4	55.4	21.2	27.5
2	0.18678	30.2	13.5	10.0	40.2	23.5	64.2	54.2	24.0	30.7
3	0.19582	28.8	13.7	10.0	38.8	23.7	63.8	53.8	25.0	30.1
4	0.37905	20.8	13.1	9.9	30.7	23.0	58.3	48.3	27.6	25.3
5	0.53242	33.2	26.4	10.0	43.2	36.4	56.0	46.0	12.8	9.6
6	0.62778	20.7	12.6	9.9	30.6	22.5	56.0	46.0	25.4	23.5

8. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSV30	101437	21.07.29
Spectrum Analyzer	R&S	FSV40	100989	21.01.03
EMI TEST RECEIVER	R&S	ESCI7	100732	21.03.04
Bi-Log Antenna	SCHWARZBECK	VULB9168	583	22.04.23
Amplifier	SONOMA INSTRUMENT	310N	284608	21.08.20
COAXIAL FIXED ATTENUATOR	Agilent	8491B-003	2708A18758	21.04.23
Horn antenna	ETS.lindgren	3117	155787	21.10.28
Horn antenna	ETS.lindgren	3116	00086632	21.02.17
Attenuator	API Inmet	40AH2W-10	12	21.05.12
Broadband PreAmplifier	SCHWARZBECK	BBV9718	216	21.07.28
AMPLIFIER	L-3 Narda-MITEQ	AMF-7D-01001800 -22-10P	2031196	21.02.12
AMPLIFIER	L-3 Narda-MITEQ	JS44-18004000-33-8P	2000996	21.01.22
LOOP Antenna	R&S	HFH2-Z2	100355	22.08.21
Antenna Mast	Innco Systems	MA4640-XP-ET	-	-
Turn Table	Innco Systems	DT2000	79	-
Antenna Mast	Innco Systems	MA4000-EP	303	-
Turn Table	Innco Systems	DT2000	79	-
Highpass Filter	WT	WT-A1699-HS	WT160411002	21.05.11
TWO-LINE V - NETWORK	R&S	ENV216	101584	21.04.06
EMI TEST RECEIVER	R&S	ESCI	101408	21.08.20
Vector Signal Generator	R&S	SMBV100A	257566	21.07.13
Signal Generator	R&S	SMR40	100007	21.04.08
Band Reject Filter	Wainwright Instruments GmbH	WTRCJV8-5100-5850-20-100-50SSK	62	21.10.13

End of test report

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