TEST REPORT

KCTL Inc. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr	Report No.: KR21-SRF0188-D Page (1) of (46)	KCTL

1. Client

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
- Date of Receipt : 2021-08-19

2. Use of Report : Class II Permissive change

3. Name of Product / Model name: Smart Wearable / SM-R890

4. Manufacturer / Country of Origin : Samsung Electronics Co., Ltd. / Vietnam

5. FCC ID : A3LSMR890

6. Date of Test : 2021-08-25 to 2021-09-04

7. Location of Test : ■ Permanent Testing Lab ☐ On Site Testing
(Address:65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

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

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

Affirmation	Tested by Name : Kwonse Kim (Signature)	Technical Manager Name : Seungyong Kim (Signature)

2021-09-22

KCTL Inc.

As a test result of the sample which was submitted from the client, this report does not guar antee 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
2021-09-07	Originally issued	-
2021-09-10	Updated	1, 29~30
2021-09-17	Removed the IC information and change from the original report to the C2PC report	All page
2021-09-18	Added output power section 6.1.	8, 9, 10 ~ 13, 46
2021-09-22	Added output power of 5720 MHz	13

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Note. The report No. KR21-SRF0188-C is superseded by the report No. KR21-SRF0188-D.

General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ **Statement not required by the standard or client used for type testing**

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1. General information

Client	:	Samsung Electronics Co., Ltd.
Address	:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Manufacturer	:	Samsung Electronics Co., Ltd.
Address	:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
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 CAB Identifier: KR0040 ISED Number: 8035A KOLAS No.: KT231

2. Device information

Equipment under test	:	Smart Wearable
Model	:	SM-R890
Modulation technique	:	Bluetooth(BDR/EDR)_GFSK, π/4DQPSK, 8DPSK Bluetooth(BLE)_GFSK WIFI(802.11a/b/g/n)_DSSS, OFDM
Number of channels	:	Bluetooth(BDR/EDR)_79 ch / Bluetooth(BLE)_40 ch 802.11b/g/n_HT20 : 13 ch UNII-1: 4 ch (20 MHz) UNII-2A: 4 ch (20 MHz) UNII-2C: 12 ch (20 MHz) UNII-3: 5 ch (20 MHz)
Power source	:	DC 3.88 V
Antenna specification	:	WIFI/Bluetooth(BDR/EDR/BLE)_LDS Antenna
Antenna gain	:	WIFI/Bluetooth(BDR/EDR/BLE)_-7.70 dBi UNII-1 : -4.10 dBi UNII-2A : -2.30 dBi UNII-2C : -5.20 dBi UNII-3 : -10.60 dBi
Frequency range	:	Bluetooth(BDR/EDR/BLE)_2 402 MHz ~ 2 480 MHz 2 412 MHz ~ 2 472 MHz (802.11b/g/n_HT20) UNII-1: 5 180 MHz ~ 5 240 MHz (802.11a/n_HT20) UNII-2A: 5 260 MHz ~ 5 320 MHz (802.11a/n_HT20) UNII-2C: 5 500 MHz ~ 5 720 MHz (802.11a/n_HT20) UNII-3: 5 745 MHz ~ 5 825 MHz (802.11a/n_HT20)
Software version	:	R890.001
Hardware version	:	REV1.0
Test device serial No.	:	Conducted(R3AR501PZGY, R3AR501PZFR) Radiated(RAR404SPYB, R3AR404SPBM, R3AR404SS5W, R3AR404SPRN)
Operation temperature	:	-30 ℃ ~ 50 ℃

2.1. Frequency/channel operations

This device contains the following capabilities:
WiFi (802.11a/b/g/n), Bluetooth (BDR/EDR/BLE)

UNII-1

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

UNII-2A

Ch.	Frequency (MHz)
52	5 260
56	5 280
⋮	⋮
64	5 320

UNII-2C

Ch.	Frequency (MHz)
100	5 500
⋮	⋮
120	5 600
⋮	⋮
140	5 700
144	5 720

UNII-3

Ch.	Frequency (MHz)
149	5 745
⋮	⋮
157	5 785
⋮	⋮
165	5 825

Table 2.1-1. 802.11a/n_HT20 mode

2.2. Simultaneous Tx Condition

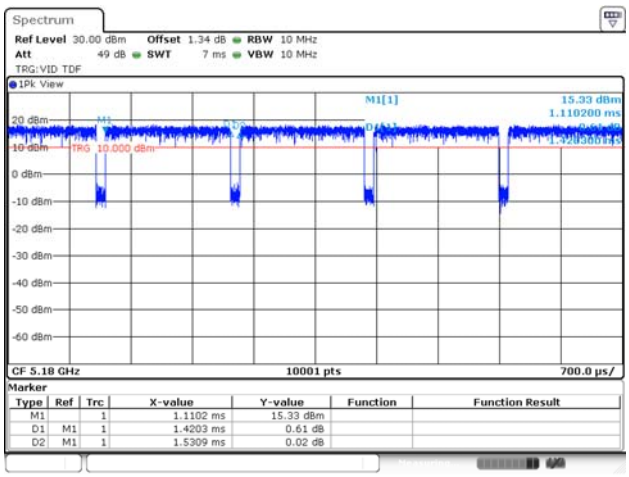
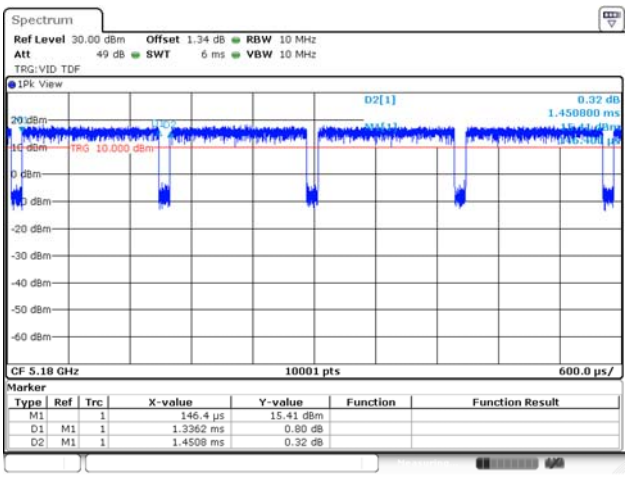
Mode	Bluetooth	WLAN 5 GHz
WLAN 5 GHz + Bluetooth	O	O

2.3. Duty Cycle Factor

Test mode	Period (ms)	T_{on} time (ms)	Duty cycle		Duty cycle factor (dB)
			(Linear)	(%)	
802.11a	1.530 9	1.420 3	0.927 8	92.78	0.33
802.11n_HT20	1.450 8	1.336 2	0.921 0	92.10	0.36

Notes.

1. Duty cycle (Linear) = T_{on} time / Period
2. DCF(Duty cycle factor) = 10log(1/duty cycle)
3. DCF is not compensated to average result if duty cycle is more than 98%

802.11a	802.11n_HT20
	

3. Antenna requirement

Requirement of FCC part section 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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 LDS Antenna (Internal antenna) on board.
- The E.U.T Complies with the requirement of §15.203, §15.247.

4. Summary of tests

FCC Part section(s)	Parameter	Test Condition	Test results
15.407(a)	Maximum conducted output power	Conducted	Pass
15.407(b), 15.205(a), 15.209(a)	Spurious emission	Radiated	Pass

Notes:

1. For this C2PC report regarding SM-R890, as documented in the C2PC letter that the change does not affect RF characteristics therefore, only radiated spurious emission test was done. All the rest tests were documented in the original filing approved in 06/15/2021 under SM-R890.
2. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
3. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. 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.
4. All the radiated tests have been performed two modes (with charger and without charger) and the fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z.

	with charger	without charger		
	X-axis	X-axis	Y-axis	Z-axis
Band-edge				√
Spurious				√

5. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.10-2013
   - KDB 789033 D02 v02r01
6. Based on the baseline scan, the worst-case data rates were:
   802.11a mode: 6Mbps
   802.11n HT20 mode: MCS0

5. Measurement uncertainty

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

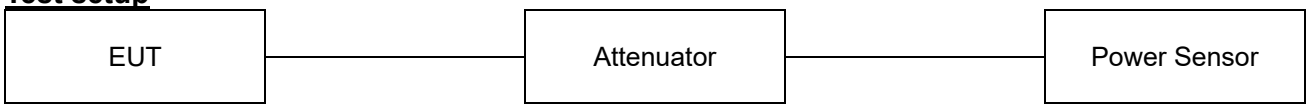
All measurement uncertainty values are shown with a coverage factor of *k*=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty (±)	
Conducted RF Power	0.9 dB	
Radiated spurious emissions	9 kHz ~ 30 MHz	2.3 dB
	30 MHz ~ 1 000 MHz	2.2 dB
	1 000 MHz ~ 18 000 MHz	5.6 dB
	Above 18 000 GHz	5.7 dB

6. Test results

6.1. Maximum conducted output power

Test setup



Limit

According to §15.407(a)

Band	EUT category		Conducted output power 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[1)]
UNII-2C	√		250 mW or 11 dBm + 10logB[1)]
UNII-3	√		1 W (30 dBm)

Note:

1) Conducted output power 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)

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 X 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 X 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 X (number of points in sweep) X (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

Test mode	Band	Frequency (MHz)	Measured output power	
			Conducted output power (dBm)	Limit (dBm)
802.11a	UNII 1	5 180	14.66	23.98
		5 200	14.60	
		5 240	14.61	
	UNII 2A	5 260	15.49	23.98
		5 280	15.47	
		5 320	15.28	
	UNII 2C	5 500	15.12	23.98
		5 600	15.17	
		5 700	14.75	
		5 720	14.32	
	UNII 3	5 745	14.63	30.00
		5 785	14.37	
		5 825	14.27	
802.11n HT20	UNII 1	5 180	14.73	23.98
		5 200	14.30	
		5 240	14.72	
	UNII 2A	5 260	15.26	23.98
		5 280	15.49	
		5 320	15.37	
	UNII 2C	5 500	15.26	23.98
		5 600	14.95	
		5 700	14.57	
		5 720	14.27	
	UNII 3	5 745	14.57	30.00
		5 785	14.40	
		5 825	14.43	

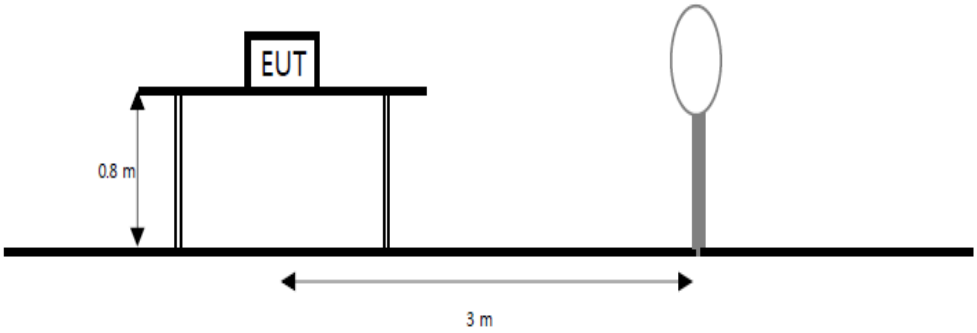
Notes:

1. Conducted output power(Average) = reading value of average power + D.C.F

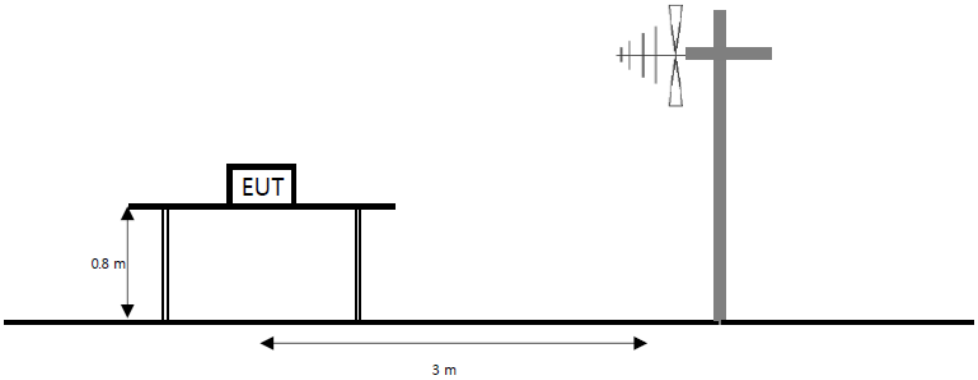
6.2. Spurious Emission, Band Edge and Restricted bands

Test setup

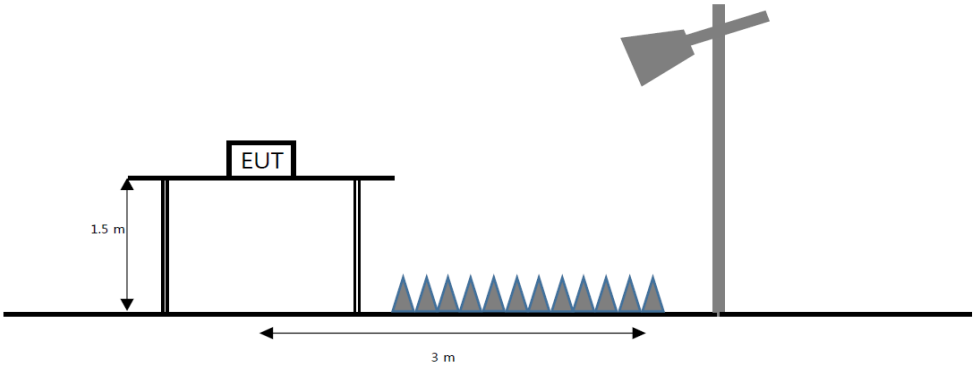
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions



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 (㎒)	Field strength (㎶/m)	Measurement distance (m)
0.009 - 0.490	2 400/F(㎑)	300
0.490 - 1.705	24 000/F(㎑)	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 ㎒, 76–88 ㎒, 174–216 ㎒ or 470–806 ㎒. 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:

㎒	㎒	㎒	㎓
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	156.7 - 156.9	2 690 – 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 – 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 – 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 – 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 – 4 400	Above 38.6
13.36 - 13.41			

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 ㎒, compliance with the limits in section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 ㎒, 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 ㎓ 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 5.25-5.35 ㎓ 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 5.47-5.725 ㎓ band: All emissions outside of the 5.47-5.725 ㎓ 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 12.7.7.2, 12.7.5, 12.7.6
KDB 789033 D02 v02r01 – Section G

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.

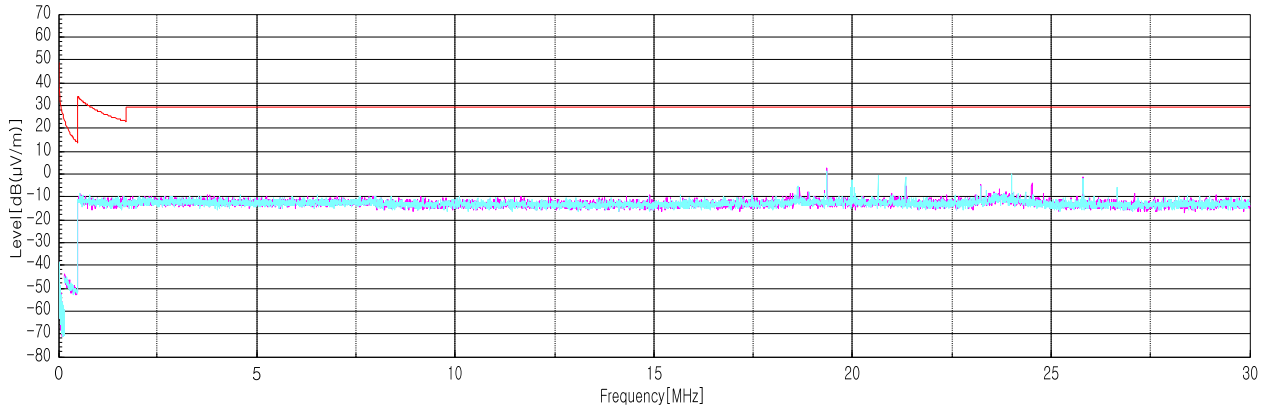
Notes:

1. *f* <30 MHz, extrapolation factor of 40 dB/decade of distance. $F_d = 40\log(D_m/D_s)$
   f ≥30 MHz, extrapolation factor of 20 dB/decade of distance. $F_d = 20\log(D_m/D_s)$
   Where:
   F_d= Distance factor in dB
   D_m= Measurement distance in meters
   D_s= Specification distance in meters
2. Factors(dB) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB) + or F_d(dB)
3. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
4. Average test would be performed if the peak result were greater than the average limit.
5. 1) means restricted band.
6. According to part 15.31(f)(2), an extrapolation factor of 40 dB/decade is applied because measured distance of radiated emission is 3m
7. 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.”
8. For above 1 GHz pre-scan to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 kHz for peak measurements.

Test results (Below 30 ㎒) – Worst case: 802.11a / UNII-2A 5 260 ㎒

Frequency	Pol.	Reading	Ant. Factor	Amp. +Cable	Distance Factor	DCF	Result	Limit	Margin
[MHz]	[V/H]	[dB(μV)]	[dB]	[dB]	[dB]	[dB]	[dB(μV/m)]	[dB(μV/m)]	[dB]
No spurious emissions were detected within 20 dB of the limit.									

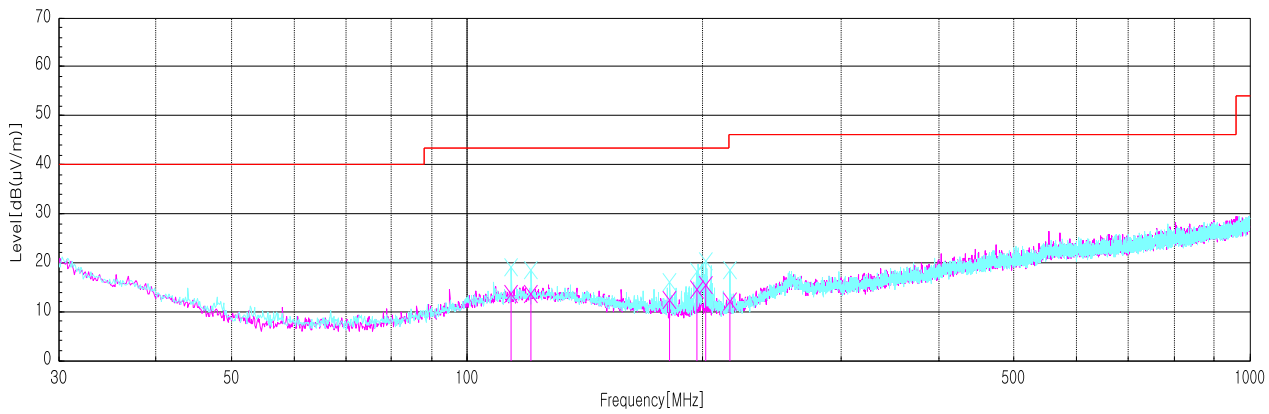
Horizontal/Vertical



Test results (Below 1 000 ㎒) – Worst case: 802.11a / UNII-2A 5 260 ㎒

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Quasi peak data								
113.78	V	24.10	17.78	-28.48	-	13.40	43.50	30.10
120.70	V	23.70	18.07	-28.40	-	13.37	43.50	30.13
181.44	V	24.70	14.90	-27.36	-	12.24	43.50	31.26
196.60	V	26.50	15.06	-27.16	-	14.40	43.50	29.10
201.57	V	27.40	15.23	-27.14	-	15.49	43.50	28.01
216.48	V	23.90	14.89	-26.92	-	11.87	46.00	34.13

Horizontal/Vertical



Test results (Above 1 000 ㎒)

802.11a_UNII-1

Lowest Channel (5 180 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 149.61[1)]	H	48.90	34.17	-26.51	-	56.56	74.00	17.44
10 311.89	V	58.39	37.51	-49.69	-	46.21	68.20	21.99
15 354.64[1)]	V	54.34	40.13	-44.26	-	50.21	74.00	23.79
Average Data								
5 149.61[1)]	H	36.34	34.17	-26.51	0.33	44.33	54.00	9.67

Middle Channel (5 200 ㎒)

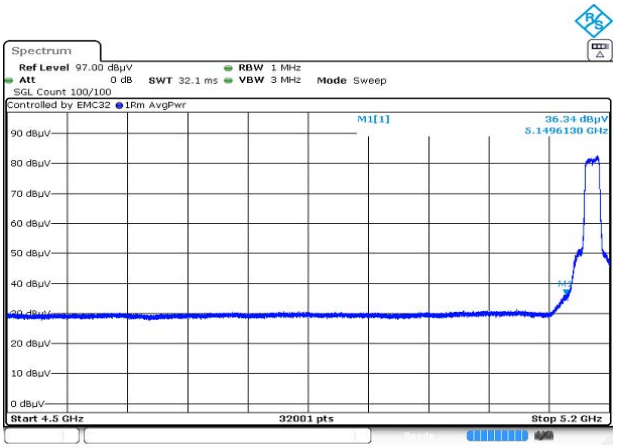
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 449.17	H	57.10	37.65	-49.76	-	44.99	68.20	23.21
15 836.92	H	56.26	39.87	-45.76	-	50.37	74.00	23.63
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

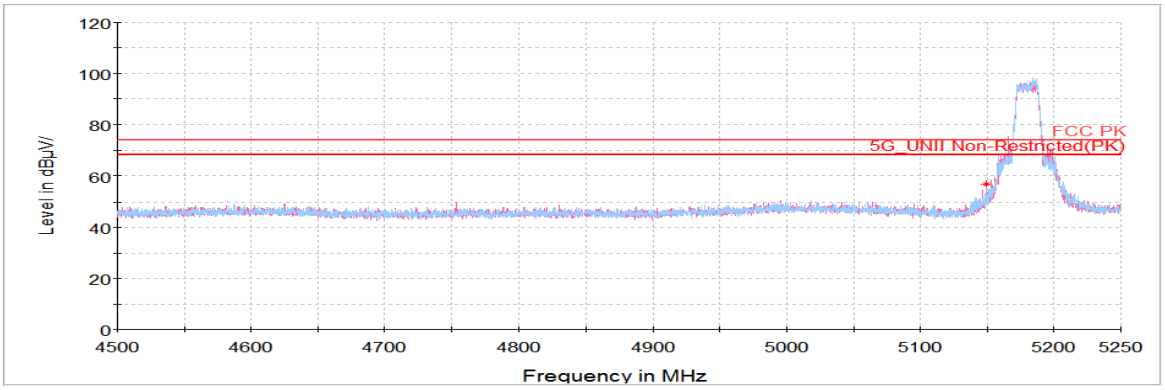
Highest Channel (5 240 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 457.80	H	57.62	37.66	-49.76	-	45.52	68.20	22.68
15 704.67	H	55.71	39.92	-45.66	-	49.97	74.00	24.03
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

802.11a UNII-1

Lowest Channel (5 180 ㎒)

Average data	
	Blank

Horizontal/Vertical for Band-edge


802.11n HT20 UNII-1

Lowest Channel (5 180 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 147.51[1)]	V	47.68	34.17	-26.52	-	55.33	74.00	18.67
10 538.66	H	57.40	37.74	-49.74	-	45.40	68.20	22.80
15 799.19[1)]	V	54.65	39.88	-45.73	-	48.80	74.00	25.20
Average Data								
5 147.51[1)]	V	35.32	34.17	-26.52	0.36	43.33	54.00	10.67

Middle Channel (5 200 ㎒)

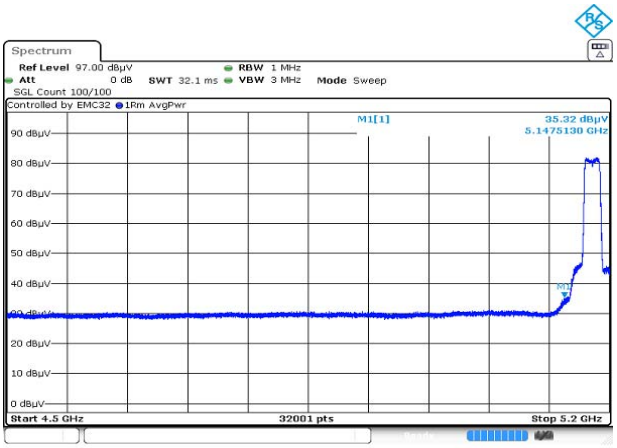
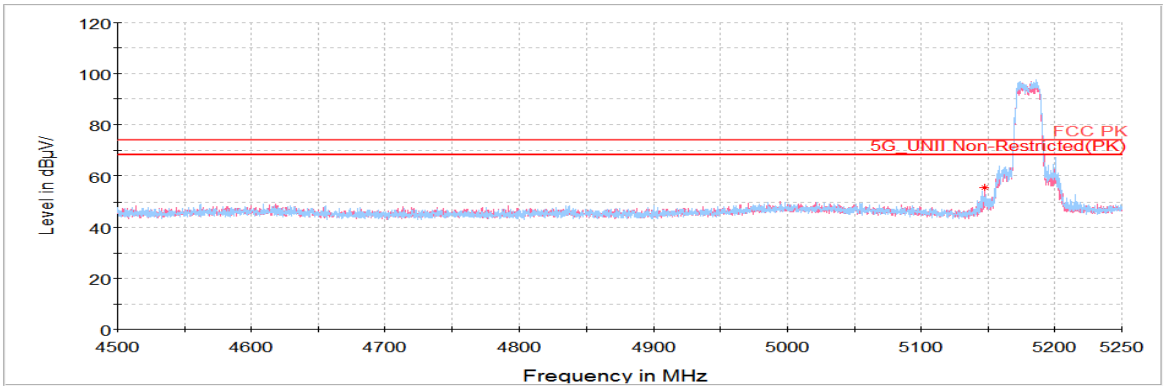
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 391.31	V	57.12	37.59	-49.73	-	44.98	68.20	23.22
15 650.77[1)]	V	56.11	39.94	-45.62	-	50.43	74.00	23.57
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Highest Channel (5 240 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 461.03	H	57.05	37.66	-49.76	-	44.95	68.20	23.25
15 721.92[1)]	H	54.73	39.91	-45.67	-	48.97	74.00	25.03
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

802.11n HT20 UNII-1

Lowest Channel (5 180 ㎒)

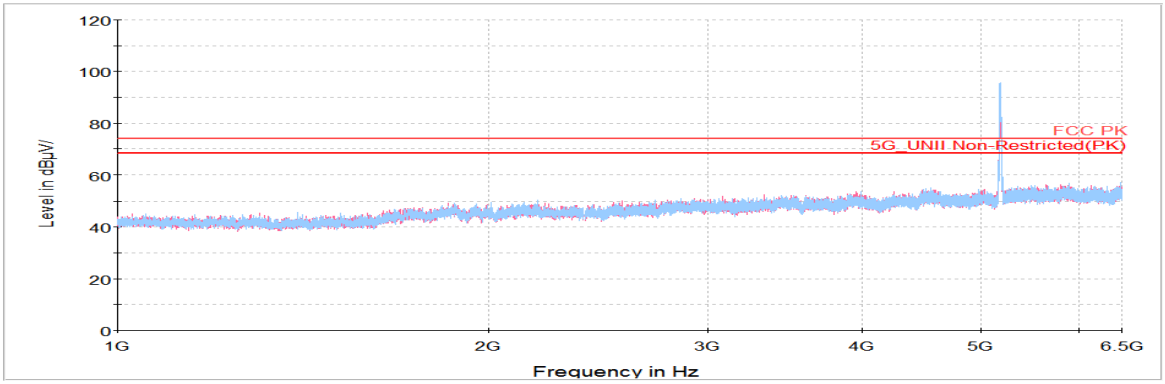
Average data	
	Blank
Horizontal/Vertical for Band-edge	
	

Plot of Harmonics and Spurious Emissions

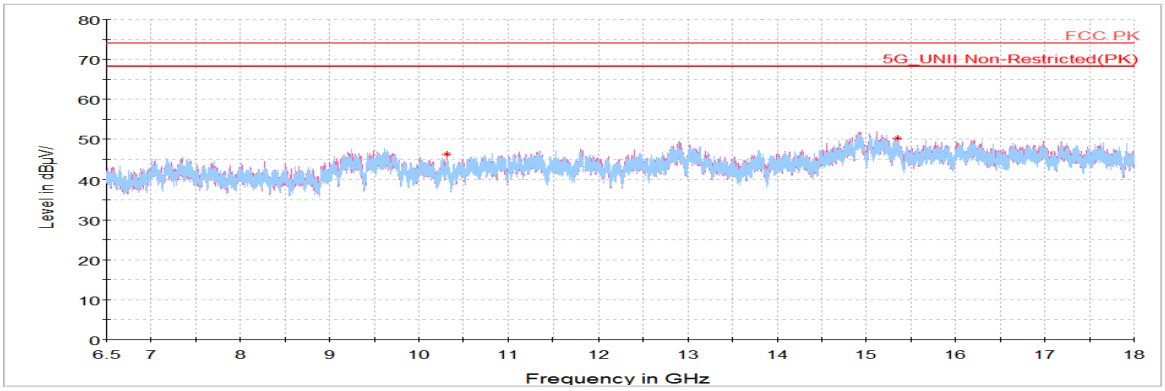
In order to simplify the report, attached plots were only the lowest margin condition

802.11a_UNII-1_Lowest Channel (5 180 ㎒)

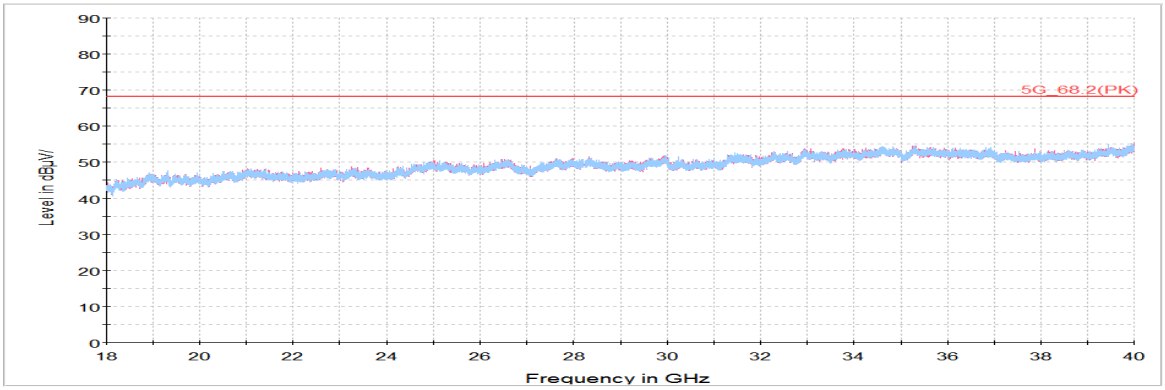
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



802.11a UNII-2A

Lowest Channel (5 260 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 450.25	H	57.55	37.65	-49.76	-	45.44	68.20	22.76
15 770.80[1)]	H	54.70	39.89	-45.71	-	48.88	74.00	25.12
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Middle Channel (5 280 ㎒)

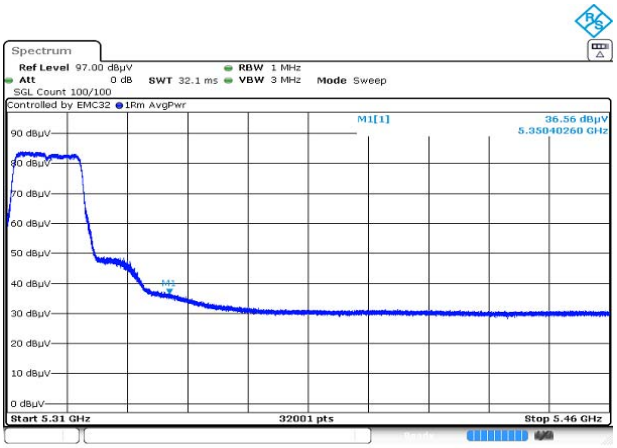
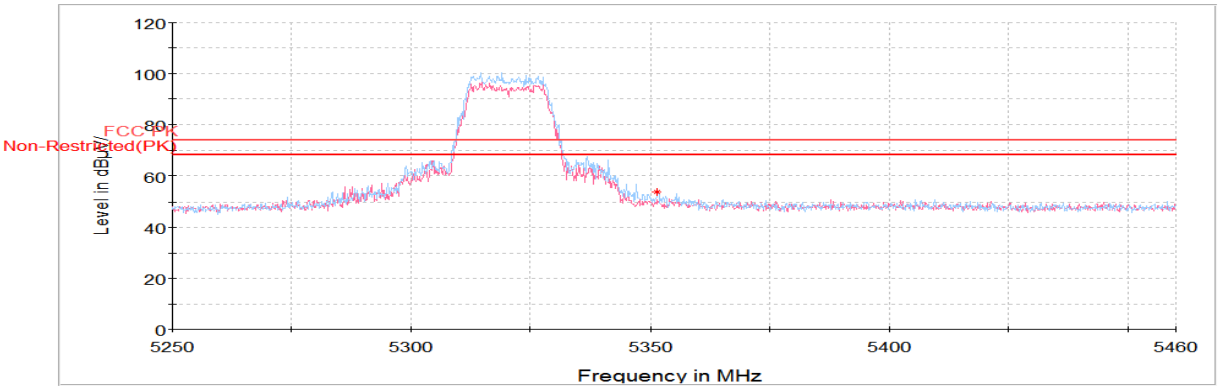
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 495.53	H	57.21	37.70	-49.78	-	45.13	68.20	23.07
15 881.48[1)]	H	55.70	39.85	-45.79	-	49.76	74.00	24.24
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Highest Channel (5 320 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 350.40[1)]	H	44.46	34.53	-25.48	-	53.51	74.00	20.49
10 589.69	V	58.34	37.79	-49.67	-	46.46	68.20	21.74
15 896.22[1)]	H	54.65	39.84	-45.80	-	48.69	74.00	25.31
Average Data								
5 350.40[1)]	H	36.56	34.53	-25.48	0.33	45.94	54.00	8.06

802.11a UNII-2A

Highest Channel (5 320 ㎒)

Average data	
	Blank
Horizontal/Vertical for Band-edge	
	

802.11n HT20_UNII-2A

Lowest Channel (5 260 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 585.38	V	58.55	37.79	-49.68	-	46.66	68.20	21.54
15 710.78[1)]	H	55.32	39.92	-45.67	-	49.57	74.00	24.43
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Middle Channel (5 280 ㎒)

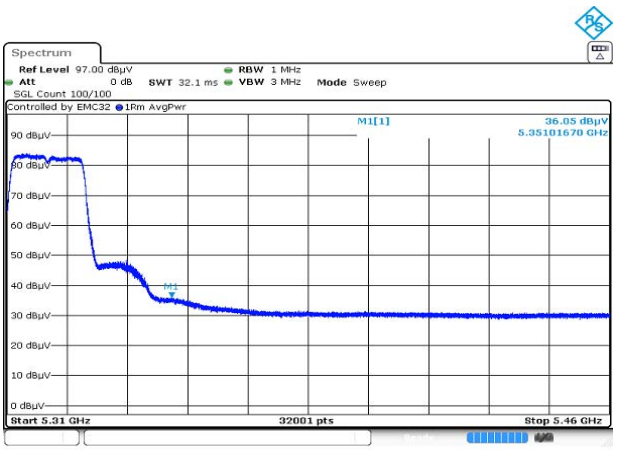
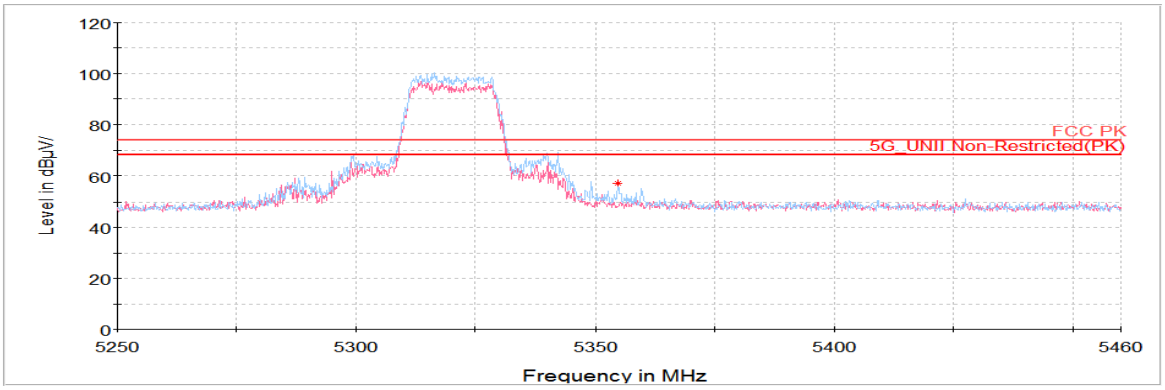
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 387.36	V	58.35	37.59	-49.73	-	46.21	68.20	21.99
15 691.73[1)]	V	54.99	39.92	-45.65	-	49.26	74.00	24.74
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Highest Channel (5 320 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 351.02[1)]	H	47.78	34.53	-25.48	-	56.83	74.00	17.17
10 579.27	H	58.09	37.78	-49.69	-	46.18	68.20	22.02
15 800.63[1)]	V	54.91	39.88	-45.73	-	49.06	74.00	24.94
Average Data								
5 351.02[1)]	H	36.05	34.53	-25.48	0.36	45.46	54.00	8.54

802.11n HT20_UNII-2A

Highest Channel (5 320 ㎒)

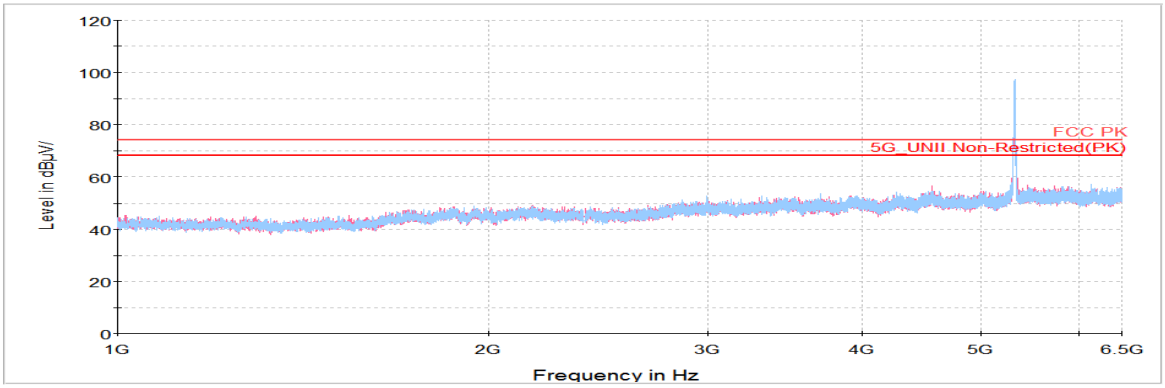
Average data	
	Blank
Horizontal/Vertical for Band-edge	
	

Plot of Harmonics and Spurious Emissions

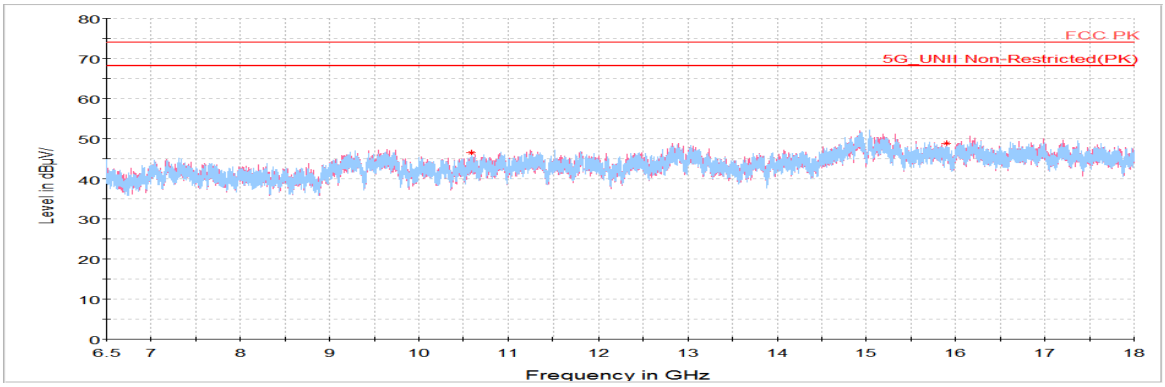
In order to simplify the report, attached plots were only the lowest margin condition

802.11a_UNII-2A_Highest Channel (5 320 ㎒)

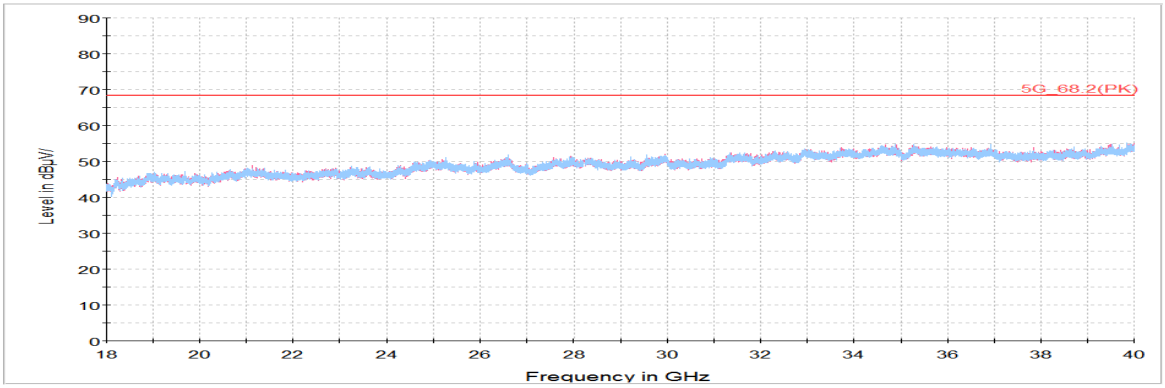
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



802.11a_UNII-2C

Lowest Channel (5 500 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 459.93[1)]	H	42.09	34.73	-25.55	-	51.27	74.00	22.73
10 903.42[1)]	H	58.11	38.10	-49.28	-	46.93	74.00	27.07
16 613.17	V	55.08	41.09	-47.20	-	48.97	68.20	19.23
Average Data								
5 459.93[1)]	H	33.67	34.73	-25.55	0.33	43.18	54.00	10.82

Middle Channel (5 600 ㎒)

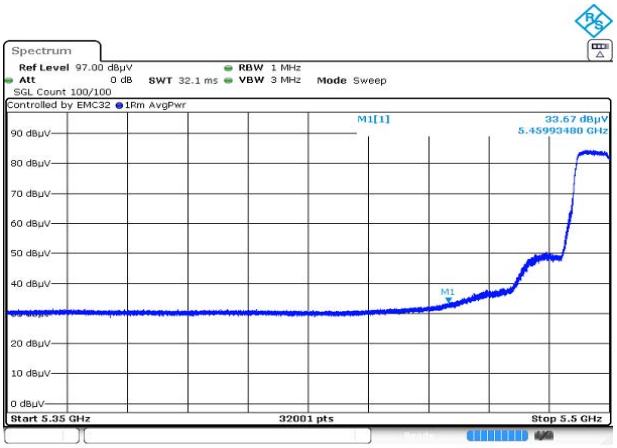
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 196.31[1)]	V	57.18	38.24	-49.22	-	46.20	74.00	27.80
16 822.69	V	55.86	41.26	-46.91	-	50.21	68.20	17.99
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Highest Channel (5 700 ㎒)

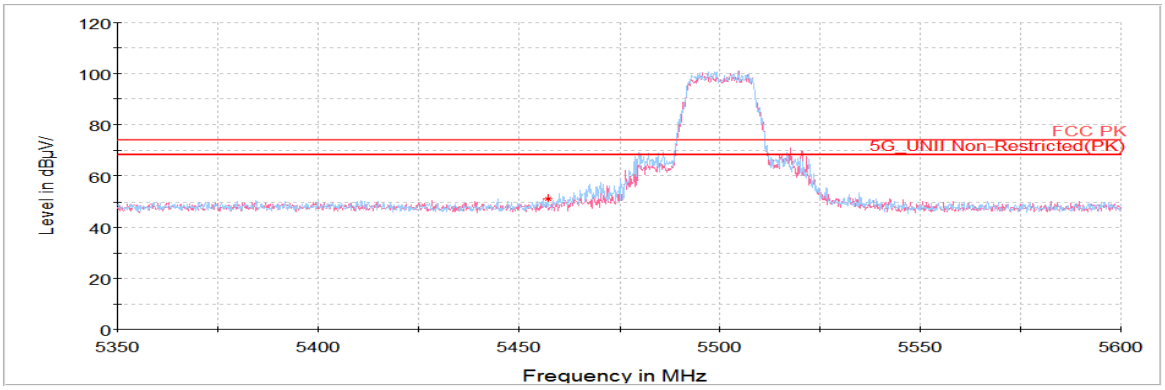
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 728.45	H	55.84	35.03	-25.48	-	65.39	68.20	2.81
11 361.27[1)]	H	57.92	38.27	-49.27	-	46.92	74.00	27.08
17 167.33	H	55.47	40.60	-46.71	-	49.36	68.20	18.84
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

802.11a UNII-2C

Lowest Channel (5 500 ㎒)

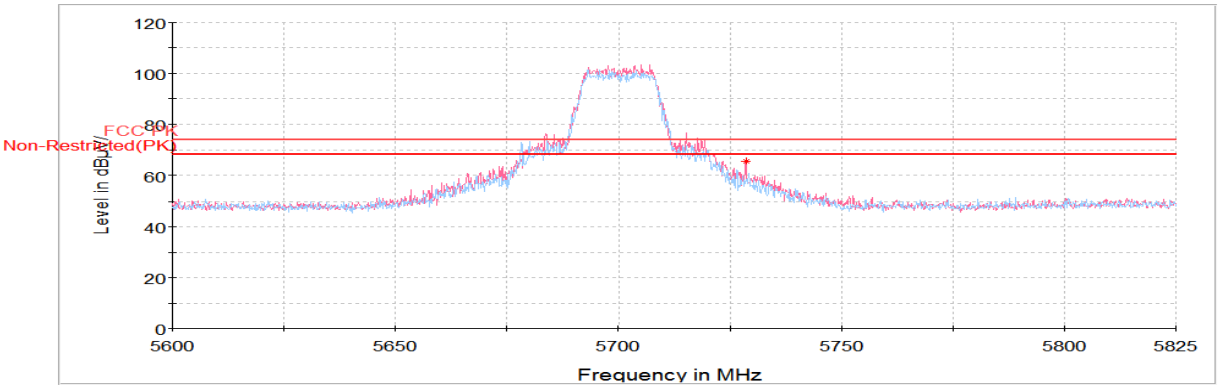
Average data	
	Blank

Horizontal/Vertical for Band-edge



Highest Channel (5 700 ㎒)

Horizontal/Vertical for Band-edge



802.11n HT20_UNII-2C

Lowest Channel (5 500 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 459.84[1)]	H	44.33	34.73	-25.55	-	53.51	74.00	20.49
10 906.30[1)]	V	57.26	38.11	-49.28	-	46.09	74.00	27.91
16 646.23	V	54.71	41.12	-47.16	-	48.67	68.20	19.53
Average Data								
5 459.84[1)]	H	33.89	34.73	-25.55	0.36	43.43	54.00	10.57

Middle Channel (5 600 ㎒)

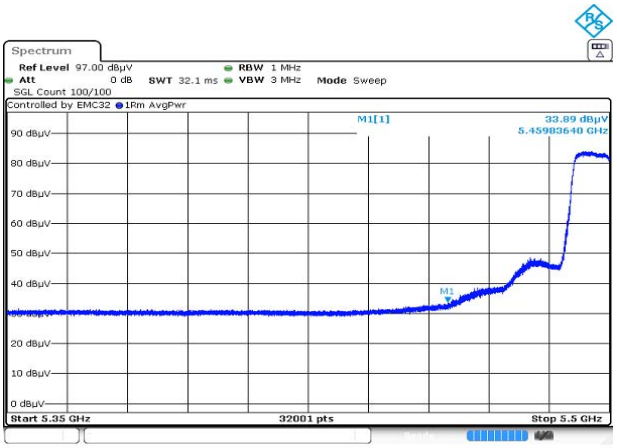
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 254.89[1)]	V	58.06	38.25	-49.24	-	47.07	74.00	26.93
16 814.42	V	54.38	41.25	-46.92	-	48.71	68.20	19.49
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Highest Channel (5 700 ㎒)

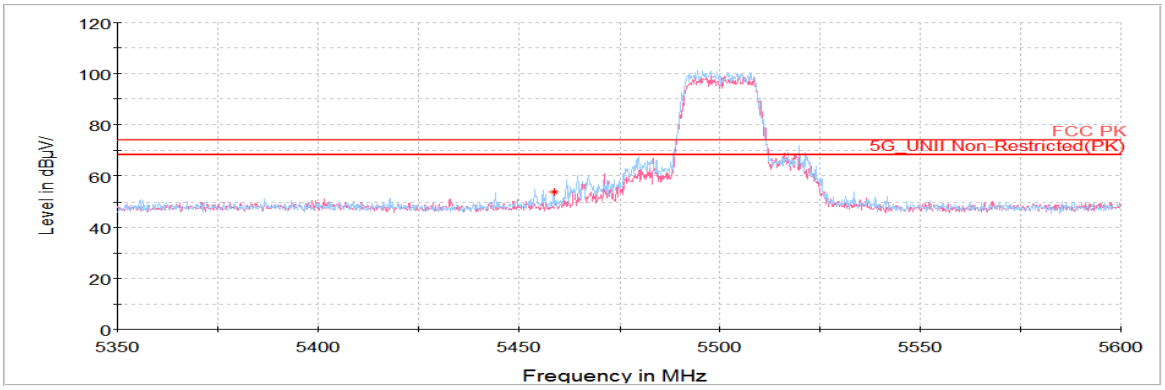
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 734.98	H	49.92	35.03	-25.35	-	59.60	68.20	8.60
11 271.42[1)]	H	58.36	38.25	-49.24	-	47.37	74.00	26.63
17 251.42	V	56.14	40.55	-46.73	-	49.96	68.20	18.24
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

802.11n HT20_UNII-2C

Lowest Channel (5 500 ㎒)

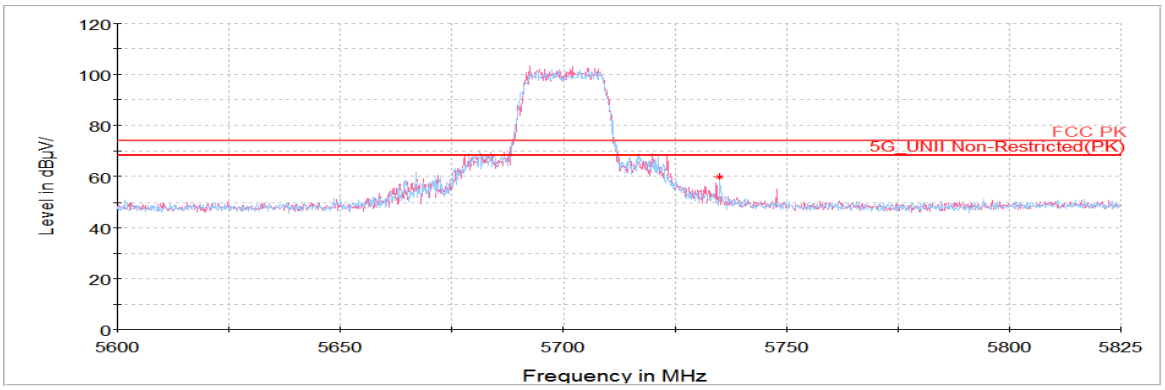
Average data	
	Blank

Horizontal/Vertical for Band-edge



Highest Channel (5 700 ㎒)

Horizontal/Vertical for Band-edge

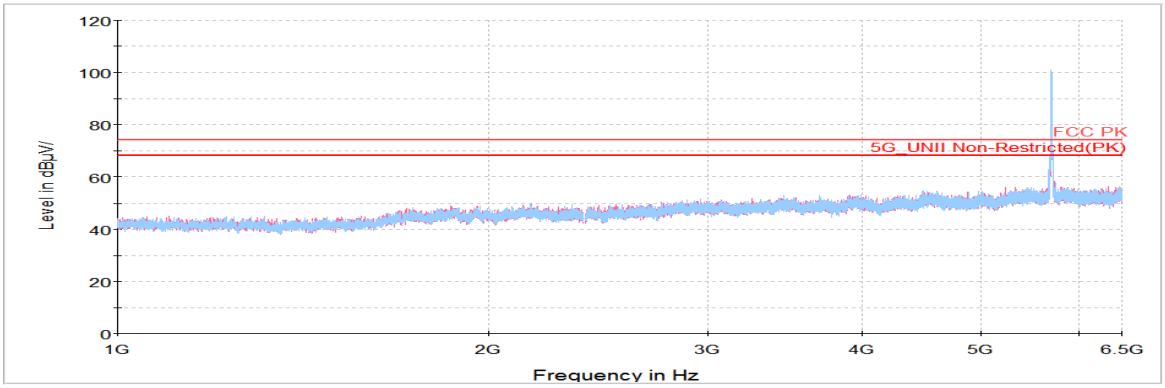


Plot of Harmonics and Spurious Emissions

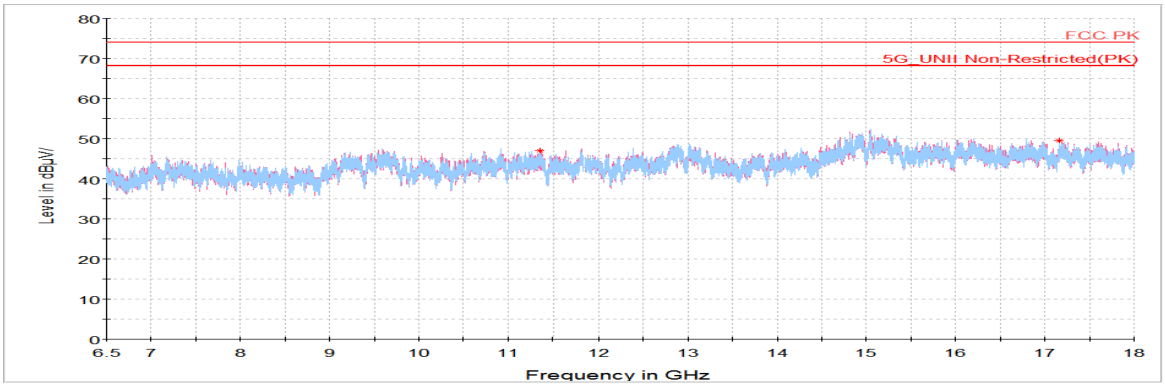
In order to simplify the report, attached plots were only the lowest margin condition

802.11a_UNII-2C_Highest Channel (5 700 ㎒)

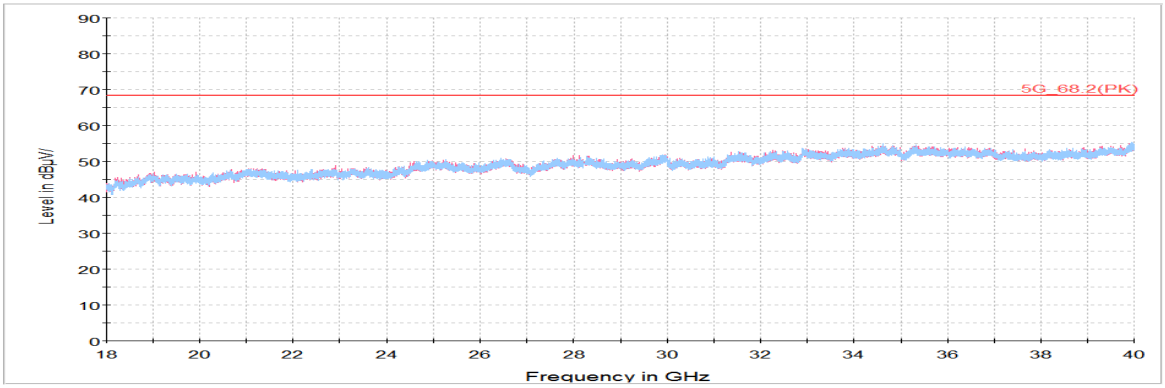
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



Straddle Channel

802.11a (5 720 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 330.00[1)]	V	58.40	38.27	-49.26	-	47.41	74.00	26.59
17 199.67	V	55.44	40.58	-46.72	-	49.30	68.20	18.90
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

802.11n HT20 (5 720 ㎒)

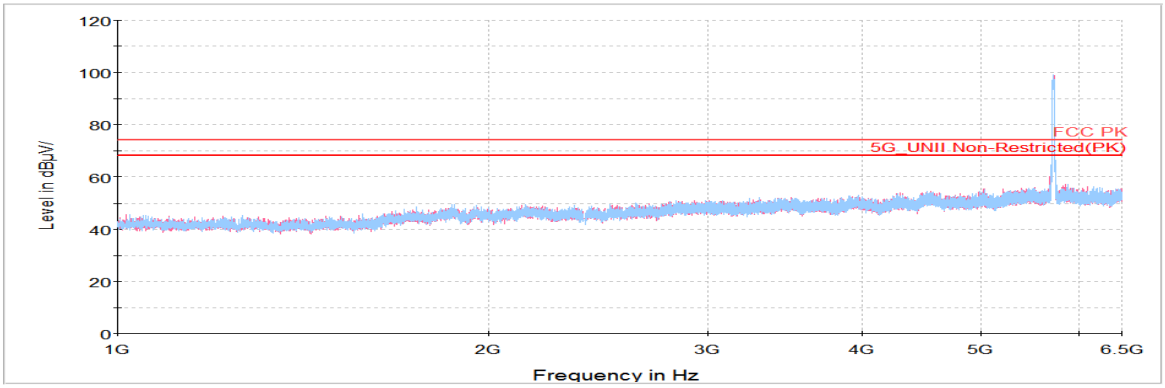
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 357.67[1)]	H	57.85	38.27	-49.26	-	46.86	74.00	27.14
17 169.48	H	54.53	40.60	-46.71	-	48.42	68.20	19.78
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Plot of Harmonics and Spurious Emissions

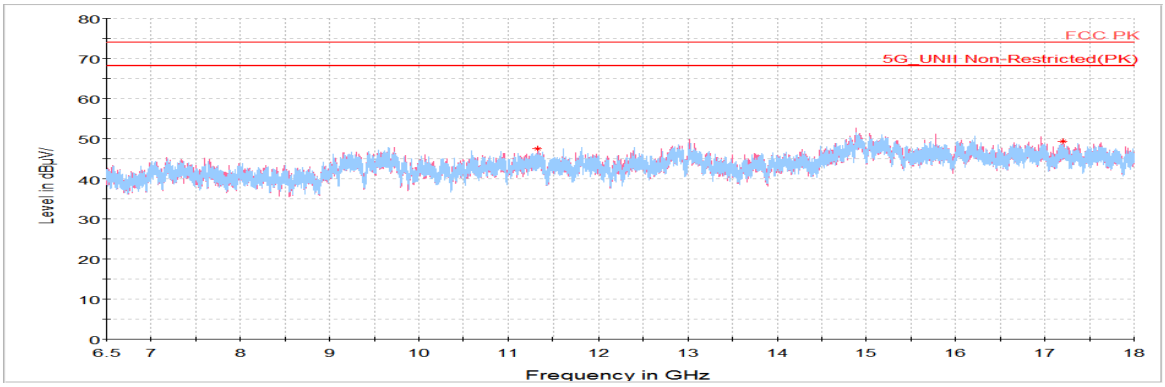
In order to simplify the report, attached plots were only the lowest margin condition

802.11a_Straddle Channel (5 720 ㎒)

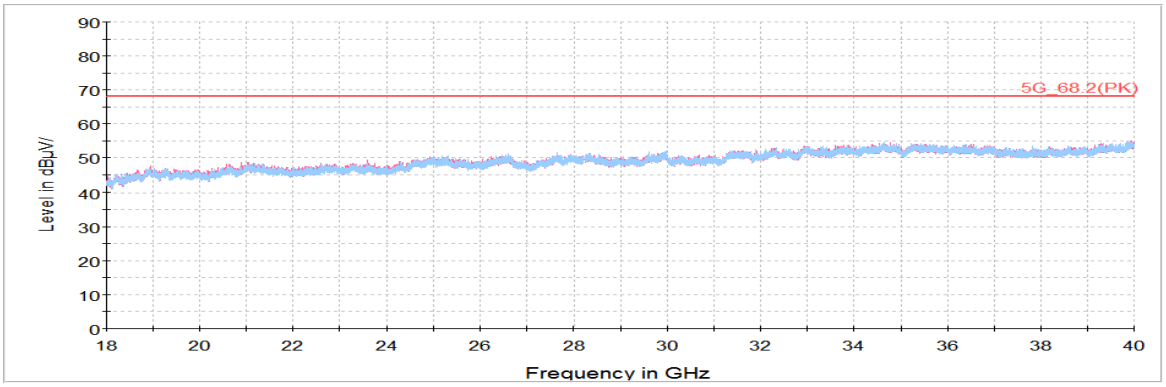
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



802.11a_UNII-3

Lowest Channel (5 745 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 709.20	V	58.92	35.01	-25.85	-	68.08	107.78	39.70
11 541.31[1)]	V	57.22	38.33	-49.34	-	46.21	74.00	27.79
17 172.72	H	55.17	40.60	-46.71	-	49.06	68.20	19.14
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Middle Channel (5 785 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 626.13[1)]	V	56.90	38.40	-49.41	-	45.89	74.00	28.11
17 254.30	V	55.44	40.55	-46.73	-	49.26	68.20	18.94
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

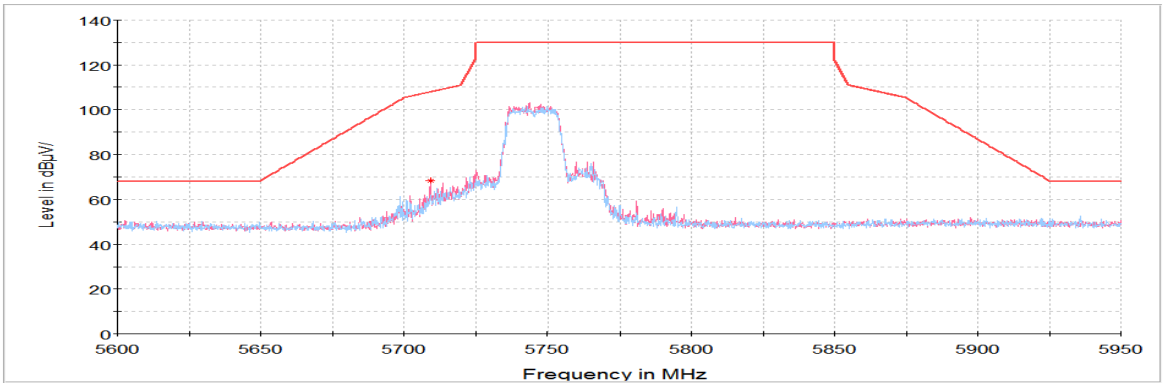
Highest Channel (5 825 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 850.66	V	52.03	35.15	-23.85	-	63.33	120.70	57.37
11 642.30[1)]	H	56.87	38.41	-49.42	-	45.86	74.00	28.14
17 545.39	H	54.75	40.81	-46.89	-	48.67	68.20	19.53
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

802.11a_UNII-3

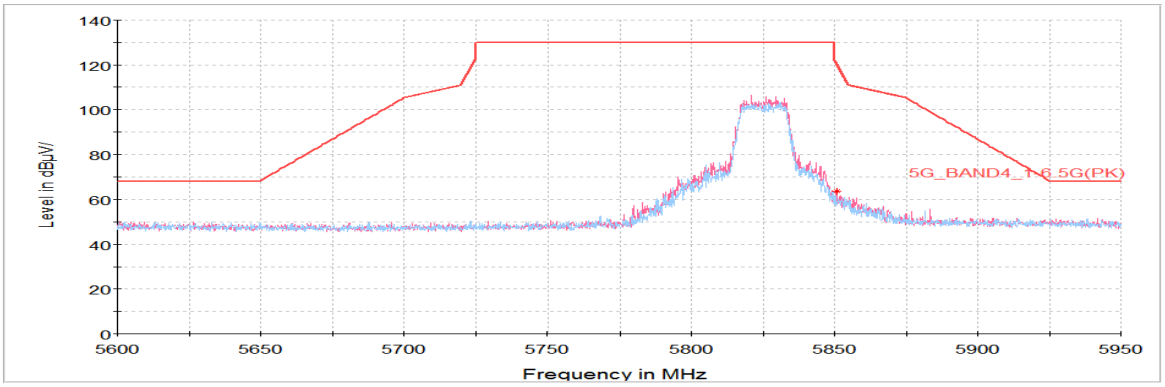
Lowest Channel (5 745 ㎒)

Horizontal/Vertical for Band-edge



Highest Channel (5 825 ㎒)

Horizontal/Vertical for Band-edge



802.11n HT20_UNII-3

Lowest Channel (5 745 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 723.81	H	60.95	35.02	-25.57	-	70.40	119.49	49.09
11 486.33[1)]	H	58.11	38.30	-49.30	-	47.11	74.00	26.89
17 229.86	V	54.78	40.56	-46.72	-	48.62	68.20	19.58
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

Middle Channel (5 785 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 630.80[1)]	V	58.84	38.40	-49.41	-	47.83	74.00	26.17
17 368.22	V	55.03	40.48	-46.76	-	48.75	68.20	19.45
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

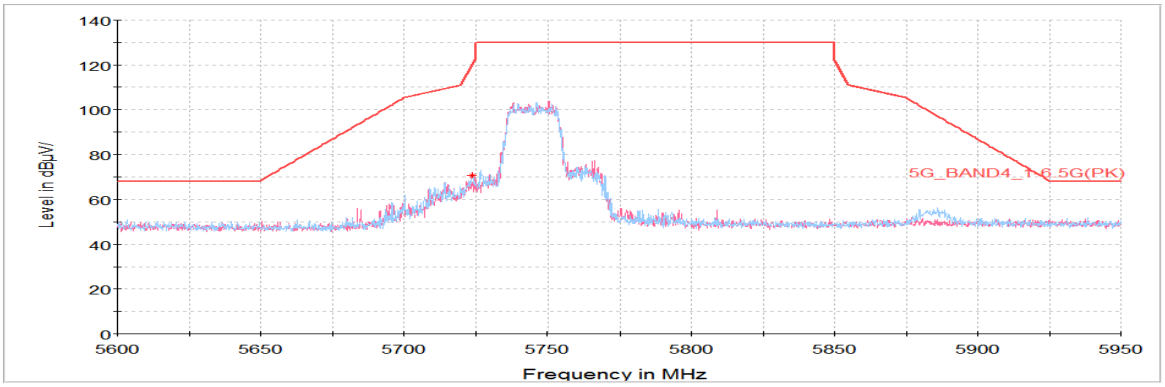
Highest Channel (5 825 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 850.66	V	50.40	35.15	-23.85	-	61.70	121.49	59.79
11 650.20[1)]	V	57.69	38.42	-49.43	-	46.68	74.00	27.32
17 378.64	V	54.46	40.47	-46.76	-	48.17	68.20	20.03
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

802.11n HT20_UNII-3

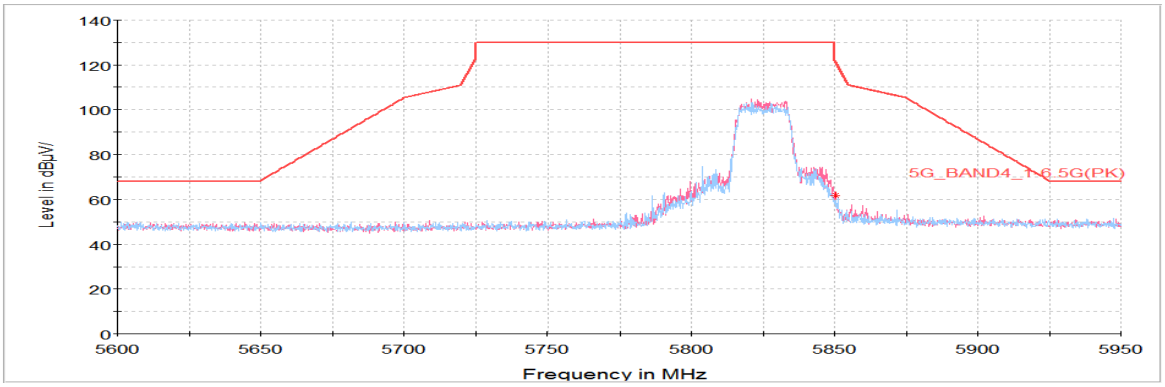
Lowest Channel (5 745 ㎒)

Horizontal/Vertical for Band-edge



Highest Channel (5 825 ㎒)

Horizontal/Vertical for Band-edge

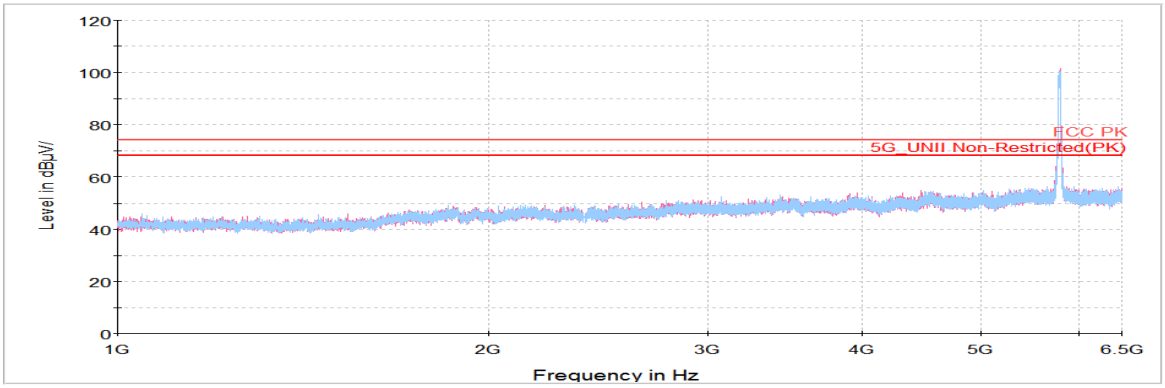


Plot of Harmonics and Spurious Emissions

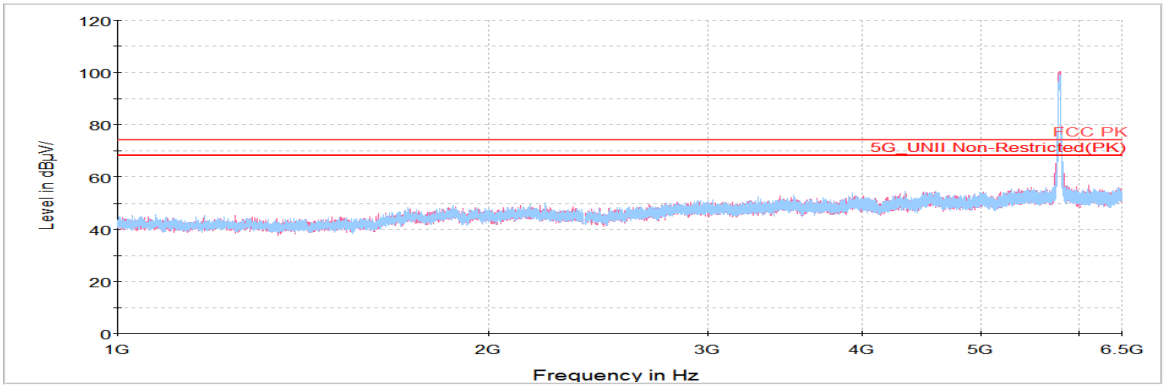
In order to simplify the report, attached plots were only the lowest margin condition

802.11a_UNII-3_Middle Channel (5 785 ㎒)

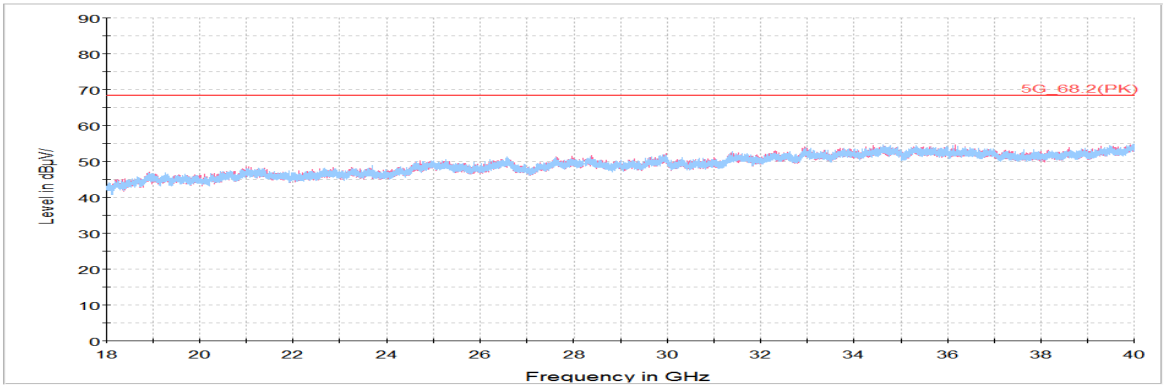
Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



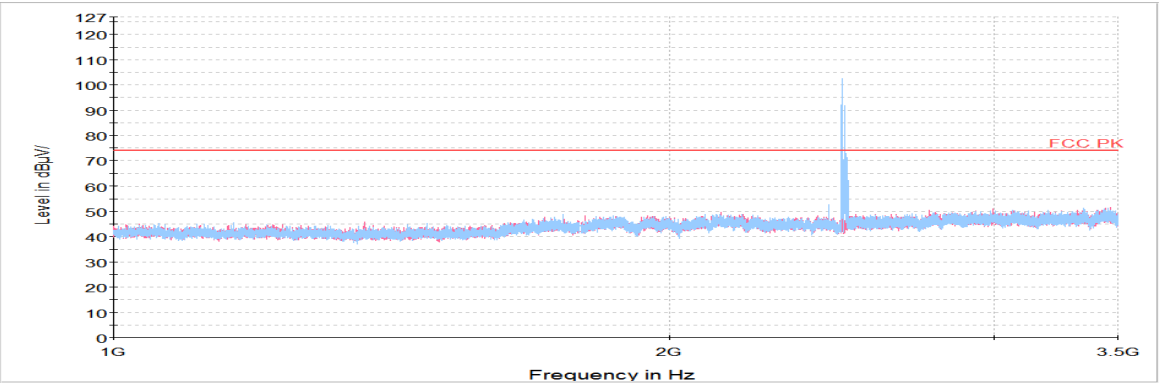
Spurious Emission for Simultaneous Tx Condition

Case	WLAN 5 GHz	Bluetooth
Mode	802.11a	BDR
Channel	140	78
Frequency	5 700	2 480
Data Rate	6	DH1

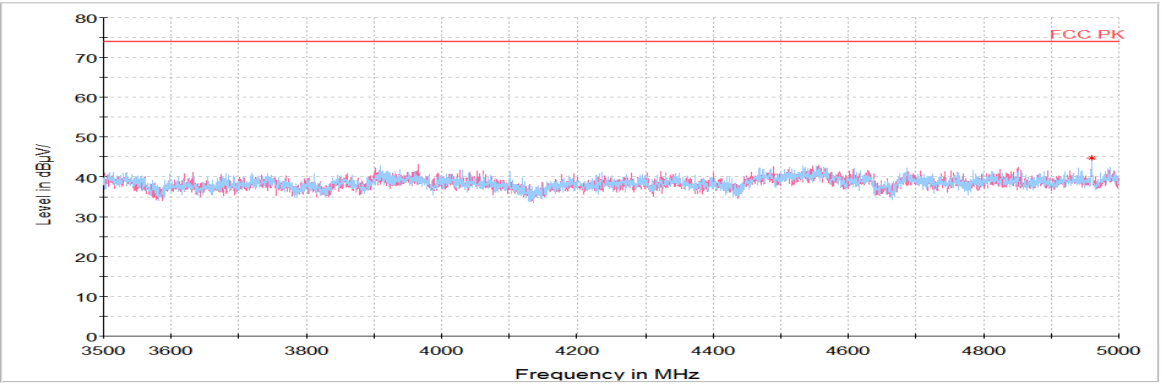
Notes.
The lowest margin condition among the channels and modes were selected for test.

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								
2 440.86	H	67.01	32.09	-46.42	-	52.68	74.00	21.32
4 959.52[1)]	H	63.31	33.88	-52.49	-	44.70	74.00	29.30
11 351.56[1)]	V	58.87	38.27	-49.26	-	47.88	74.00	26.12
17 141.09	H	55.48	40.62	-46.70	-	49.40	74.00	24.60
Average Data								
No spurious emissions were detected within 20 dB of the limit								

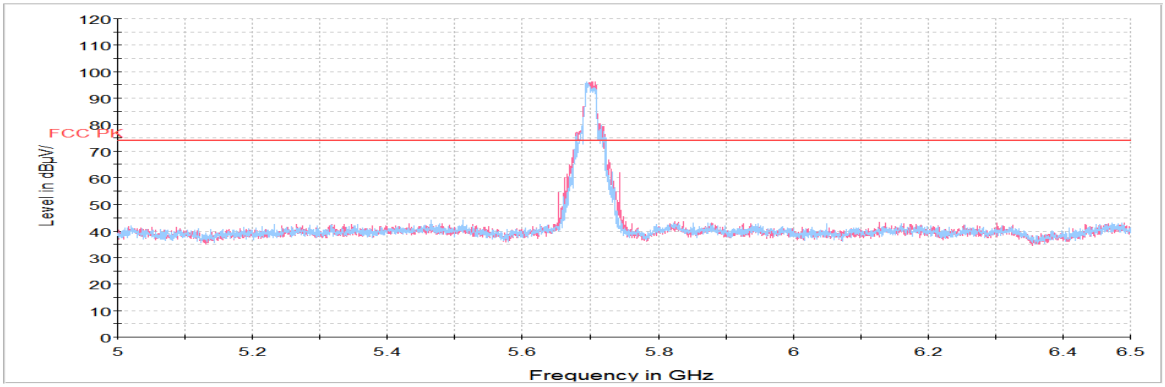
Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓



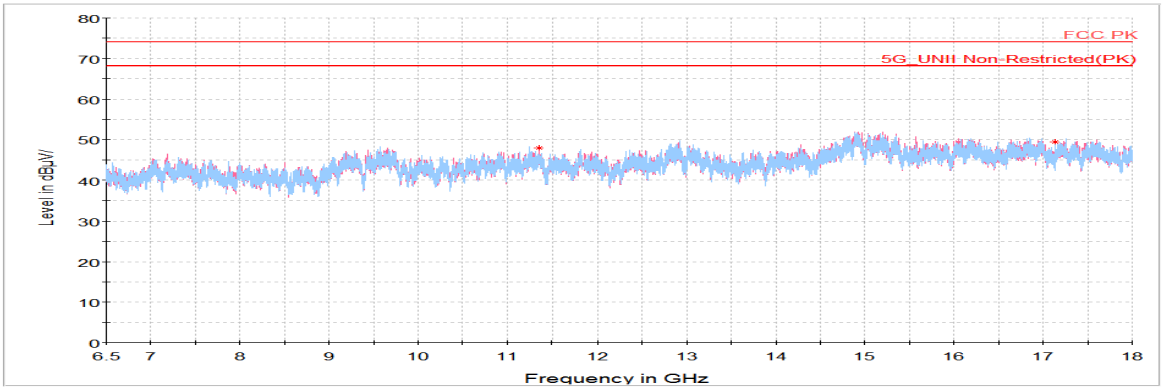
Horizontal/Vertical for 3.5 ㎓ ~ 5 ㎓



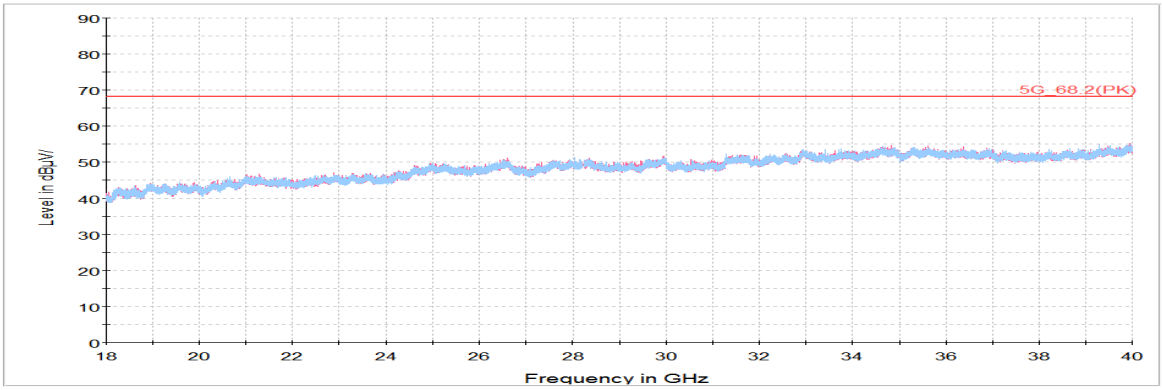
Horizontal/Vertical for 5 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓



Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



7. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSV30	100807	22.07.27
Attenuator	API Inmet	40AH2W-10	16	22.05.11
Signal Generator	R&S	SMB100A	176206	22.01.20
Vector Signal Generator	R&S	SMBV100A	257566	22.07.09
DC Power Supply	Agilent	E3632A	MY40007371	22.05.10
Spectrum Analyzer	R&S	FSV40	100989	21.12.23
High pass Filter	WT	WT-A1699-HS	WT160411002	22.05.10
EMI TEST RECEIVER	R&S	ESCI7	100732	22.03.05
Bi-Log Antenna	TESEQ	CBL 6112D	55545	23.01.14
Attenuator	KEYSIGHT	8491B-6dB	MY39271060	21.12.24
Power Sensor	R&S	NRP-Z81	1137.9009.02-106223-bB	22.05.11
ISOLATION TRANSFORMER	ONETECH CO., LTD	OT-IT500VA	OTR1-16026	22.04.02
Amplifier	SONOMA INSTRUMENT	310N	284608	22.08.19
COAXIAL FIXED ATTENUATOR	Agilent	8491B-003	2708A18758	22.04.23
Horn antenna	ETS.lindgren	3117	00155787	21.10.28
Horn antenna	ETS.lindgren	3116	00086632	22.01.29
Attenuator	API Inmet	40AH2W-10	12	22.05.11
Broadband Pre-Amplifier	SCHWARZBECK	BBV9718	216	22.07.27
AMPLIFIER	L-3 Narda-MITEQ	AMF-7D-01001800-22-10P	2003683	22.08.19
AMPLIFIER	L-3 Narda-MITEQ	JS44-18004000-33-8P	2000996	22.01.21
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	-

End of test report