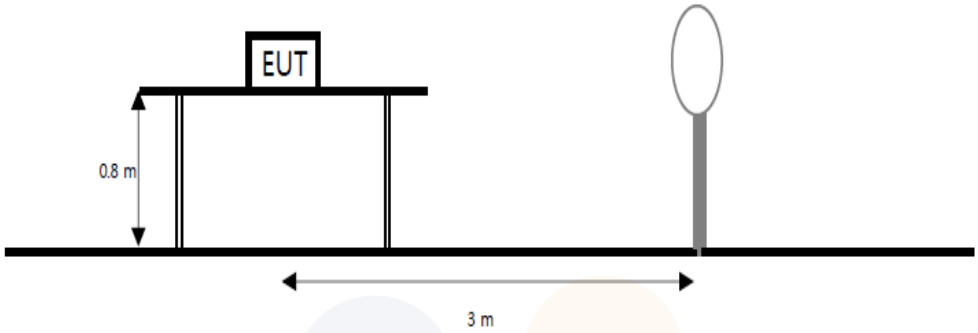
7.7. Spurious Emission, Band Edge and Restricted bands

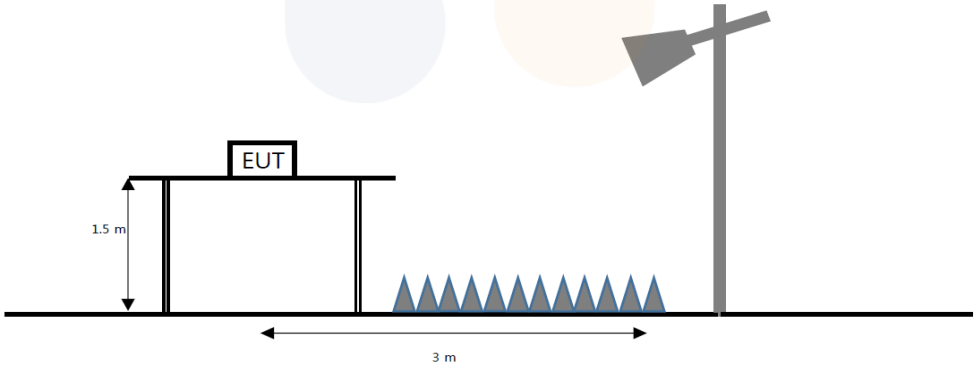
Test setup

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 5.725-5.85 ㎓ 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 ㏈ 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 the transmit cycle, then no duty cycle correction is required for that emission.

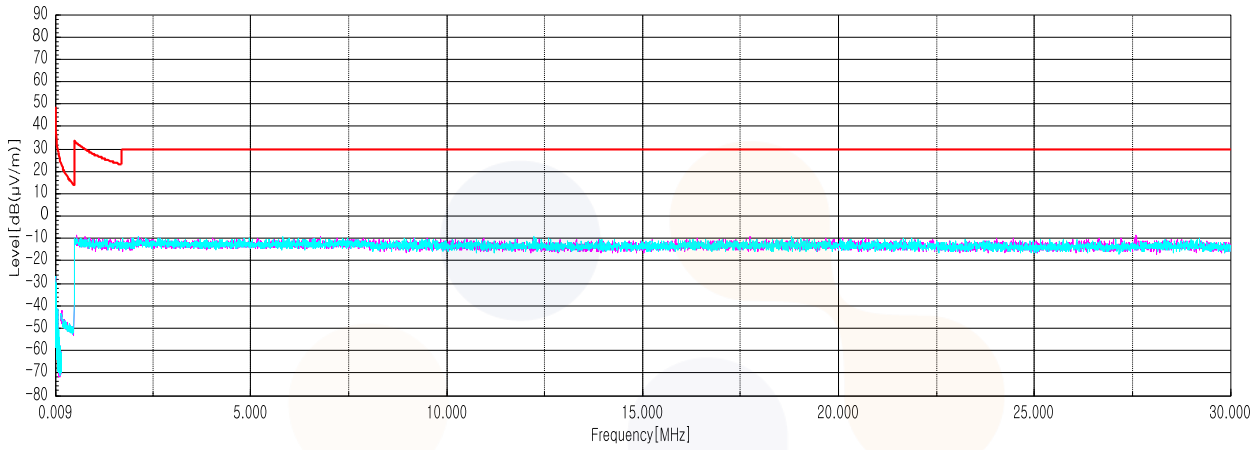
Notes:

1. *f* <30 ㎒, extrapolation factor of 40 ㏈/decade of distance. $F_d = 40\log(D_m/D_s)$
   f ≥30 ㎒, extrapolation factor of 20 ㏈/decade of distance. $F_d = 20\log(D_m/D_s)$
   Where:
   F_d= Distance factor in ㏈
   D_m= Measurement distance in meters
   D_s= Specification distance in meters
2. Factors(㏈) = Antenna factor(㏈/m) + Cable loss(㏈) + or Amp. gain(㏈) + or F_d(㏈)
3. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ 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. Below 30 ㎒ 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 ㏈ of the limit, then the following statement shall be made: “No spurious emissions were detected within 20 ㏈ of the limit.”
7. Above 1 ㎓ the worst results between two antenna polarizations (H and V) were documented in the test report.
8. For above 1 ㎓ pre-scan to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 ㎒; the video bandwidth is set to 30 ㎑ for peak measurements.

Test results (Below 30 ㎒) – Worst case: 802.11a / UNII 2A_5 280 ㎒

Frequency	Pol.	Reading	Ant. Factor	Amp. + Cable	DCCF	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.								

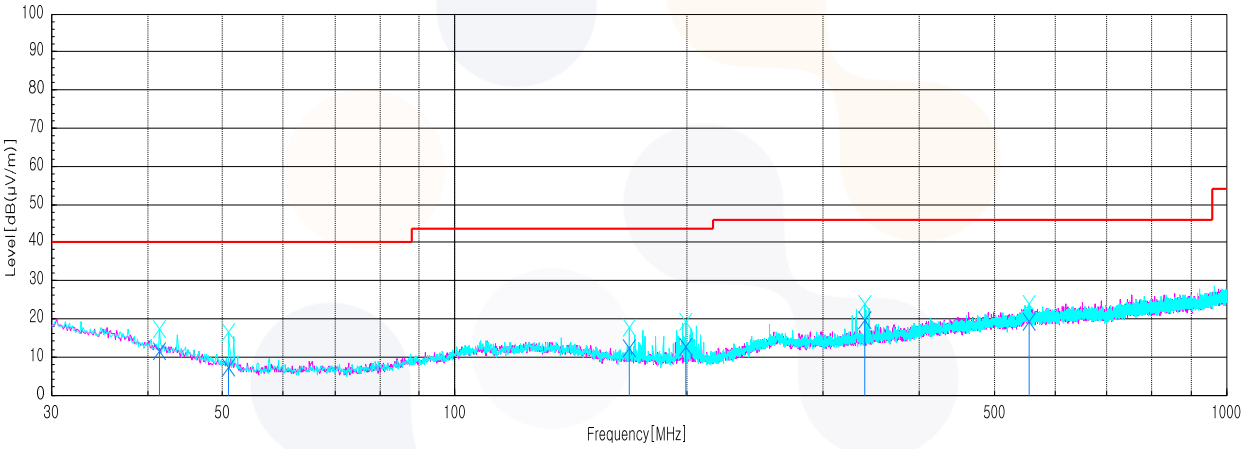
Horizontal/Vertical



Test results (Below 1 000 ㎒) – Worst case: 802.11a / UNII 2A_5 280 ㎒

Frequency	Pol.	Reading	Ant. Factor	Amp. + Cable	DCCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Quasi peak data								
41.40	V	23.50	18.48	-30.65	-	11.33	40.00	28.67
50.98	V	24.30	13.41	-30.45	-	7.26	40.00	32.74
168.35[1)]	V	25.30	15.30	-28.35	-	12.25	43.50	31.25
199.51	V	25.60	15.10	-28.04	-	12.66	43.50	30.84
340.40	V	26.10	19.60	-26.24	-	19.46	46.00	26.54
554.77	V	19.30	24.26	-24.28	-	19.28	46.00	26.72

Horizontal/Vertical



Test results (Above 1 000 ㎒)

UNII 1

802.11a_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								
5 139.85[1)]	V	40.18	34.21	-24.30	-	50.09	74.00	23.91
10 362.08	H	58.25	37.52	-48.99	-	46.78	68.20	21.42
15 545.13[1)]	V	57.99	39.90	-47.32	-	50.57	74.00	23.43
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

802.11a_Middle Channel (5 200 ㎒)

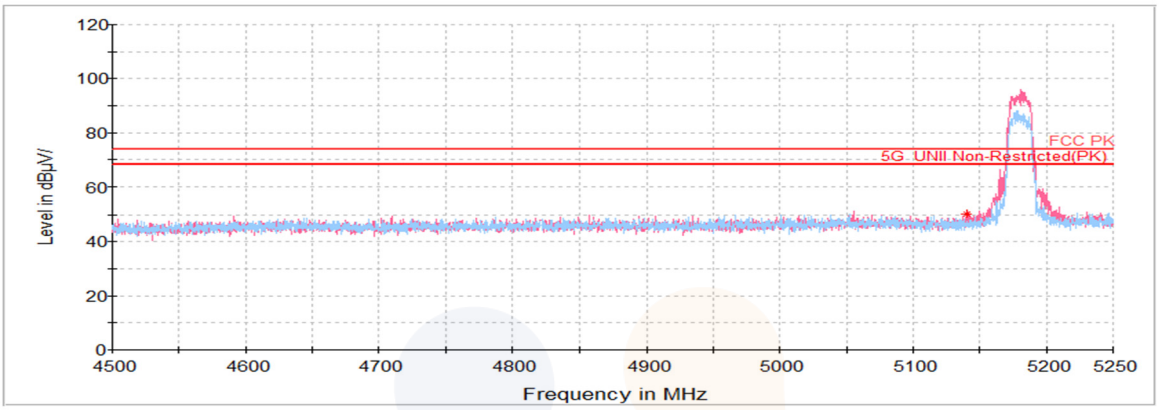
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 381.63	V	58.09	37.53	-48.96	-	46.66	68.20	21.54
15 599.18[1)]	H	58.31	39.90	-47.32	-	50.89	74.00	23.11
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

802.11a_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								
10 482.83	V	57.06	37.59	-48.84	-	45.81	68.20	22.39
15 671.25[1)]	V	57.88	39.90	-47.31	-	50.47	74.00	23.53
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

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

802.11a_Lowest Channel (5 180 ㎒)

Horizontal/Vertical for Band-edge


802.11n_HT20_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								
5 013.53[1)]	V	40.63	34.11	-24.36	-	50.38	74.00	23.62
10 314.17	H	57.65	37.49	-49.05	-	46.09	68.20	22.11
15 545.52[1)]	V	57.81	39.90	-47.32	-	50.39	74.00	23.61
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

802.11n_HT20_Middle Channel (5 200 ㎒)

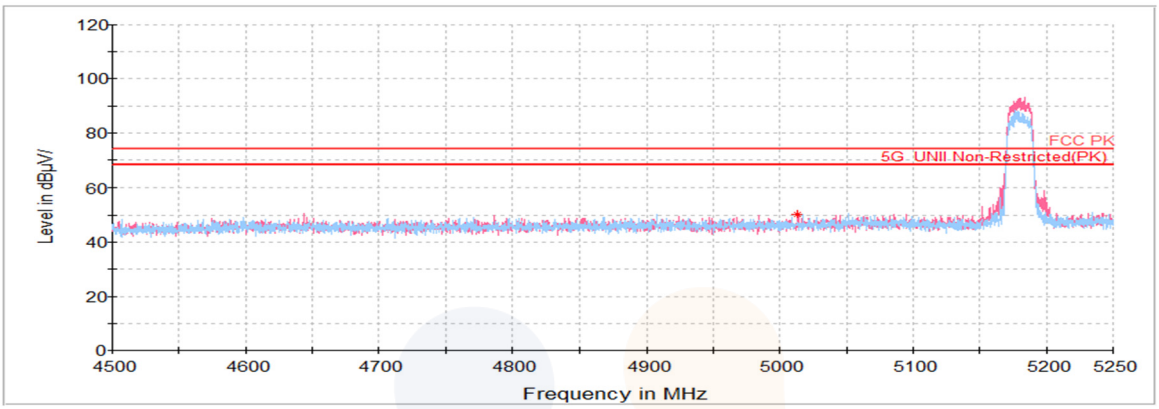
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 385.08	H	57.17	37.53	-48.96	-	45.74	68.20	22.46
15 651.32[1)]	V	56.93	39.90	-47.31	-	49.52	74.00	24.48
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

802.11n_HT20_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								
10 472.10	H	57.16	37.58	-48.85	-	45.89	68.20	22.31
15 771.68[1)]	V	56.67	39.90	-47.30	-	49.27	74.00	24.73
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit								

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

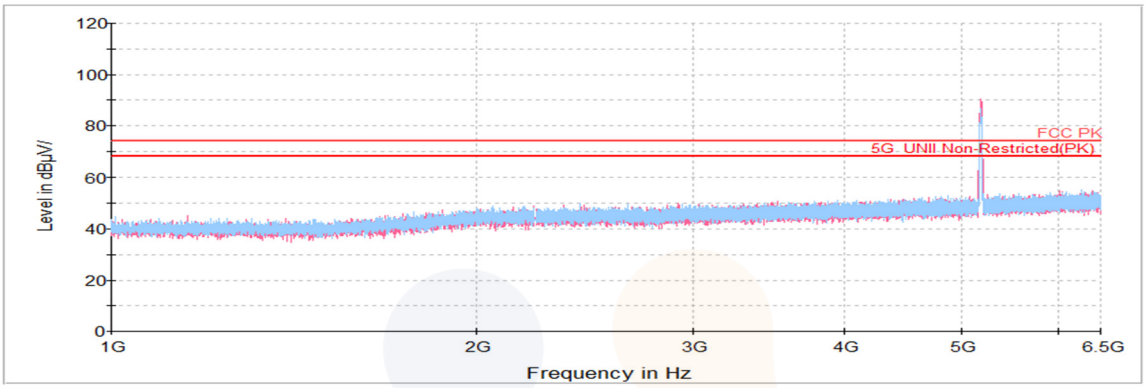
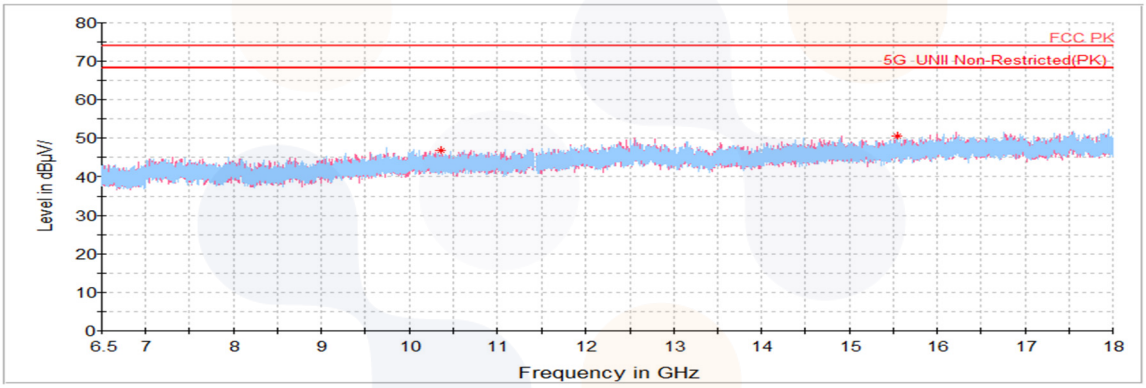
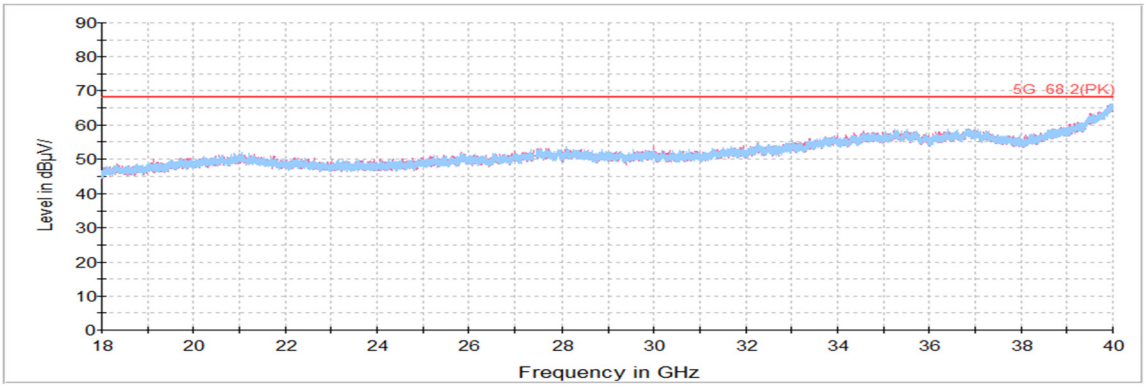
802.11n_HT20_Lowest Channel (5 180 ㎒)

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 ㎓


UNII 2A

802.11a_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								
7 079.98	H	63.70	35.80	-53.08	-	46.42	68.20	21.78
10 587.10	H	57.41	37.65	-48.89	-	46.17	68.20	22.03
15 778.97[1)]	H	57.68	39.90	-47.29	-	50.29	74.00	23.71
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

802.11a_Middle Channel (5 280 ㎒)

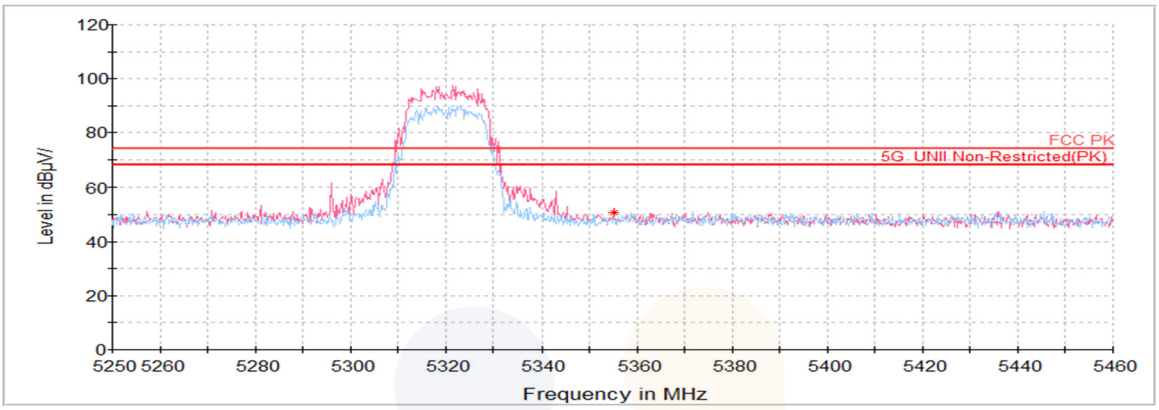
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 594.77	H	57.31	37.66	-48.89	-	46.08	68.20	22.12
15 837.23[1)]	V	57.73	39.90	-47.29	-	50.34	74.00	23.66
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

802.11a_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								
5 355.08[1)]	V	40.32	34.38	-24.10	-	50.60	74.00	23.40
7 065.03	V	63.62	35.80	-53.09	-	46.33	68.20	21.87
10 651.50[1)]	V	57.82	37.69	-48.93	-	46.58	74.00	27.42
15 995.93[1)]	H	57.58	39.90	-47.27	-	50.21	74.00	23.79
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

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

802.11a_Highest Channel (5 320 ㎒)

Horizontal/Vertical for Band-edge


802.11n_HT20_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								
10 502.38	H	57.60	37.60	-48.82	-	46.38	68.20	21.82
15 783.95[1)]	V	57.40	39.90	-47.29	-	50.01	74.00	23.99
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

802.11n_HT20_Middle Channel (5 280 ㎒)

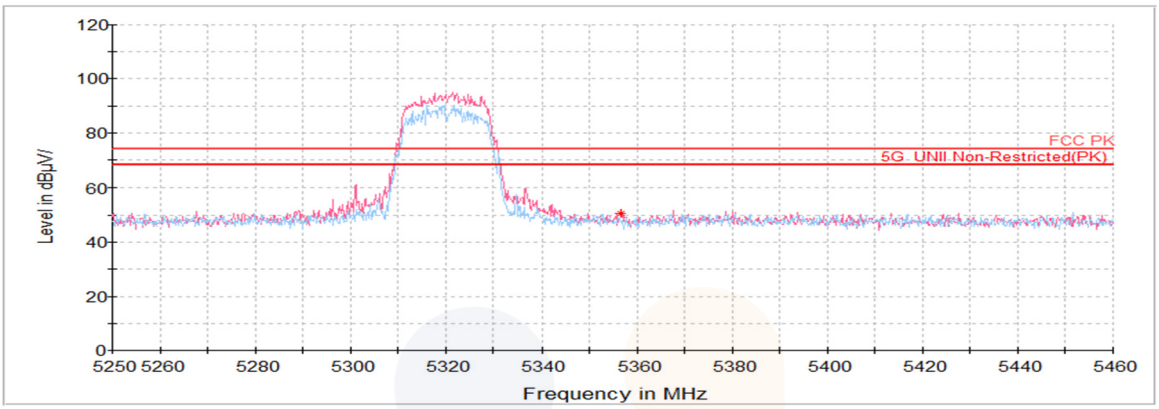
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
10 541.87	H	57.27	37.63	-48.85	-	46.05	68.20	22.15
15 838.77[1)]	V	58.24	39.90	-47.29	-	50.85	74.00	23.15
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

802.11n_HT20_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								
5 356.73[1)]	V	40.47	34.39	-24.10	-	50.76	74.00	23.24
10 636.17[1)]	H	58.44	37.68	-48.92	-	47.20	74.00	26.80
15 965.65[1)]	V	57.27	39.90	-47.27	-	49.90	74.00	24.10
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

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

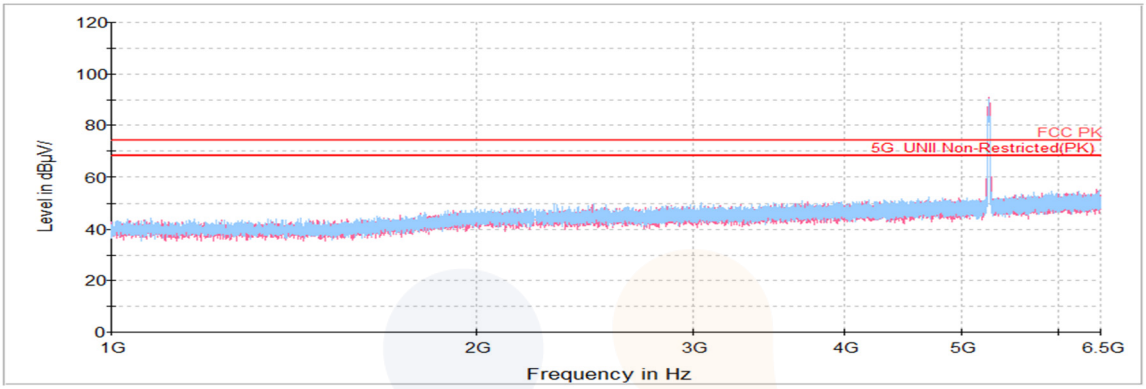
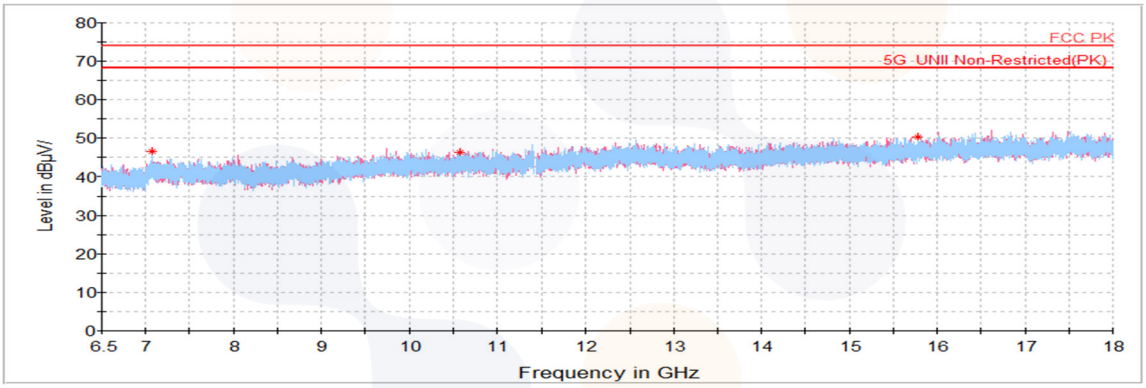
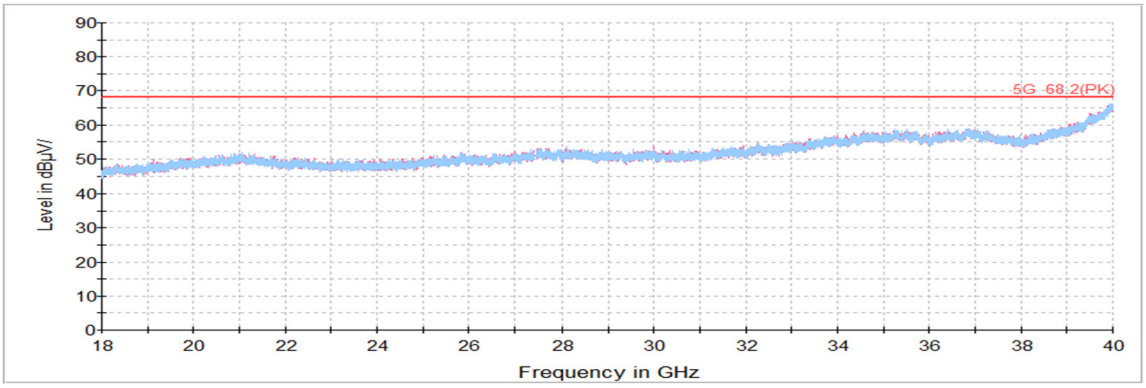
802.11n_HT20_Highest Channel (5 320 ㎒)

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_ Lowest Channel (5 260 ㎒)

Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓

Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

Horizontal/Vertical for 18 ㎓ ~ 40 ㎓


UNII 2C

802.11a_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								
5 415.77[1)]	V	40.57	34.43	-24.02	-	50.98	74.00	23.02
10 950.88[1)]	V	58.63	37.87	-49.16	-	47.34	74.00	26.66
16 495.80	V	54.76	41.49	-46.50	-	49.75	68.20	18.45
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

802.11a_Middle Channel (5 600 ㎒)

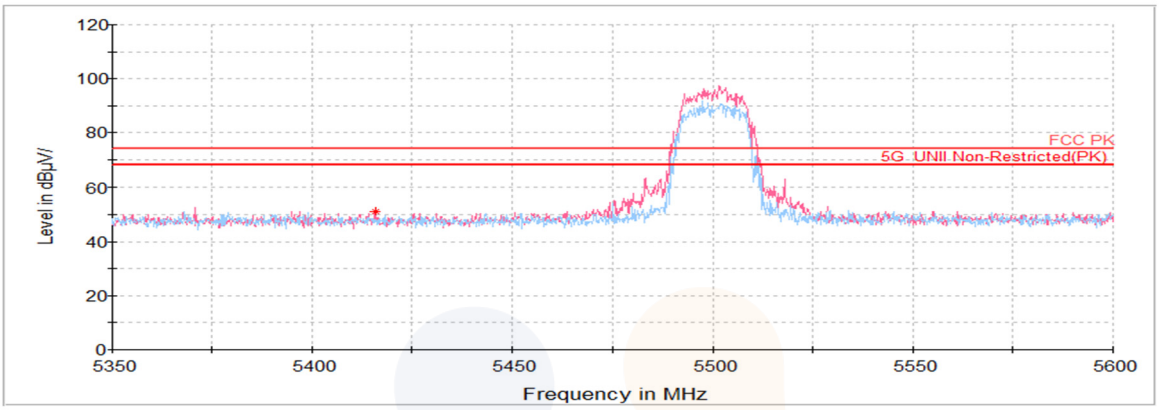
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 187.02[1)]	H	57.81	38.05	-49.16	-	46.70	74.00	27.30
16 765.28	H	56.13	41.47	-46.65	-	50.95	68.20	17.25
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

802.11a_Highest Channel (5 700 ㎒)

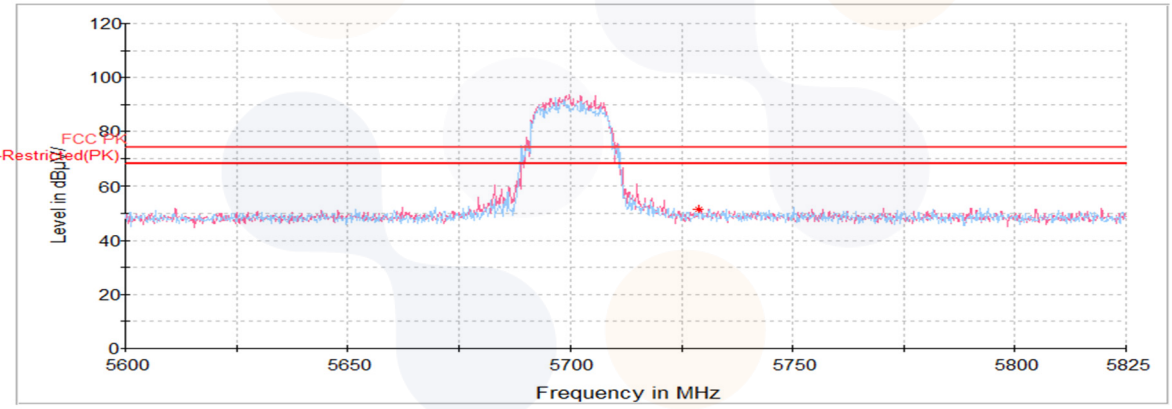
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 728.90	V	39.97	34.87	-23.43	-	51.41	68.20	16.79
11 368.72[1)]	H	58.88	38.19	-49.12	-	47.95	74.00	26.05
17 166.63	H	55.71	41.47	-46.47	-	50.71	68.20	17.49
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

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

802.11a_Lowest Channel (5 500 ㎒)

Horizontal/Vertical for Band-edge


Highest Channel (5 700 ㎒)

Horizontal/Vertical for Band-edge


802.11n_HT20_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								
5 455.92[1)]	V	39.97	34.46	-23.82	-	50.61	74.00	23.39
10 993.82[1)]	V	60.44	37.90	-49.19	-	49.15	74.00	24.85
16 513.05	H	56.04	41.21	-46.50	-	50.75	68.20	17.45
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

802.11n_HT20_Middle Channel (5 600 ㎒)

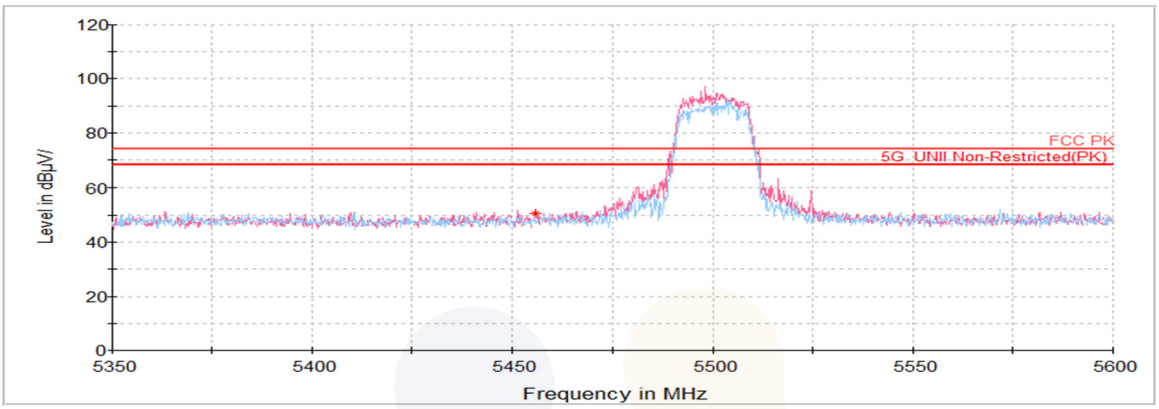
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 199.67[1)]	V	59.50	38.06	-49.16	-	48.40	74.00	25.60
16 804.38	H	57.51	41.50	-46.67	-	52.34	68.20	15.86
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

802.11n_HT20_Highest Channel (5 700 ㎒)

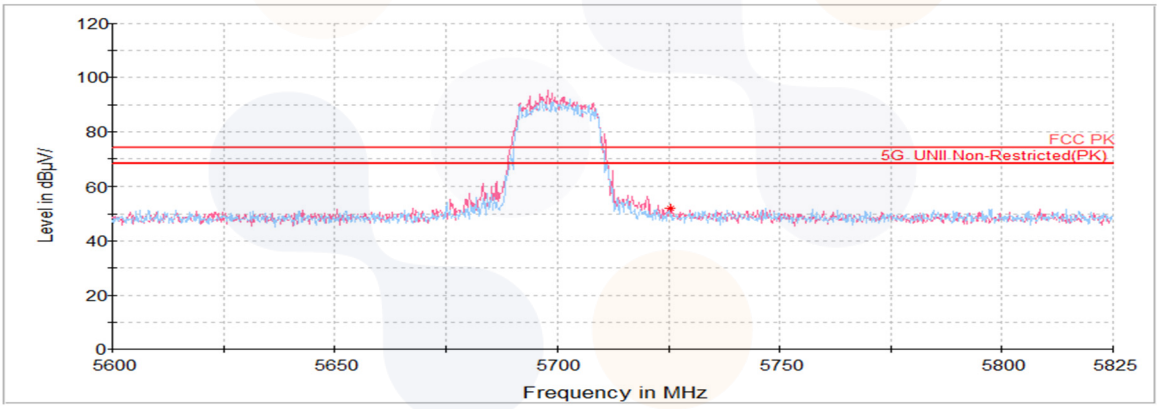
Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 725.42	V	40.77	34.86	-23.44	-	52.19	68.20	16.01
11 401.30[1)]	V	59.27	38.22	-49.12	-	48.37	74.00	25.63
17 128.30	H	55.13	41.45	-46.54	-	50.04	68.20	18.16
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

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

802.11n_HT20_ Lowest Channel (5 500 ㎒)

Horizontal/Vertical for Band-edge


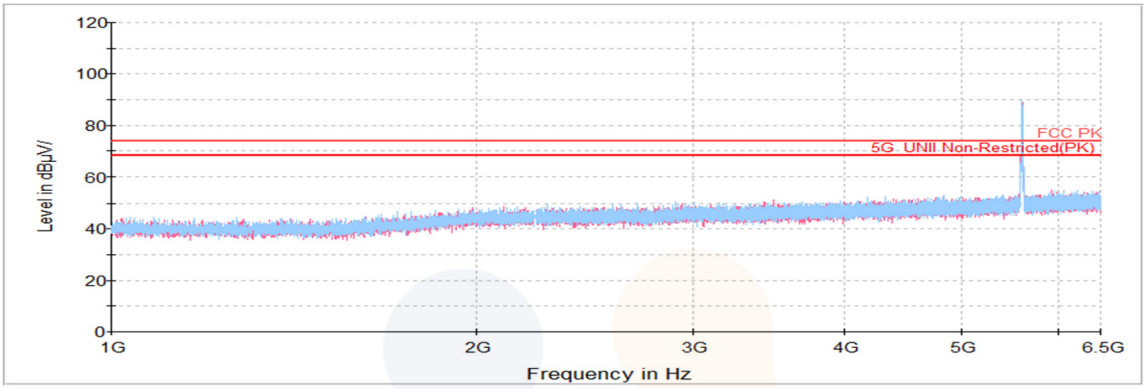
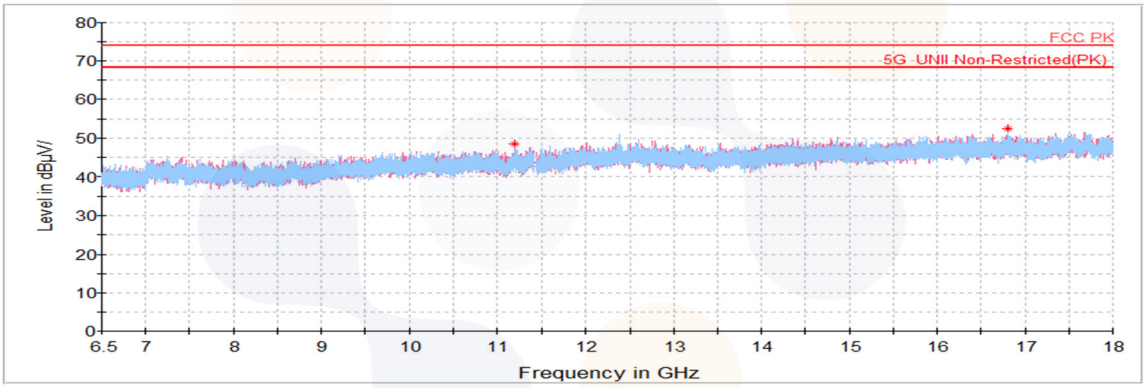
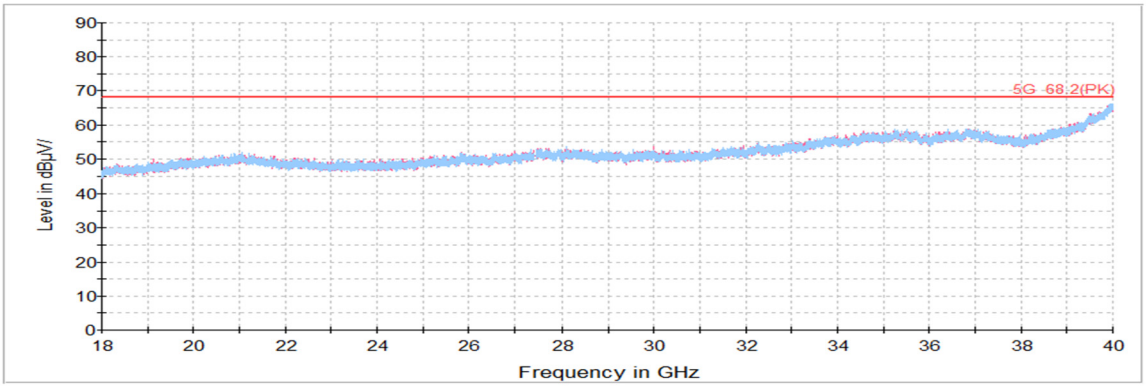
Highest Channel (5 700 ㎒)

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

802.11n_HT20_UNII 2C_Middle Channel (5 600 ㎒)

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								
11 416.25[1)]	H	58.47	38.23	-49.11	-	47.59	74.00	26.41
17 132.13	H	55.08	41.45	-46.54	-	49.99	68.20	18.21
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

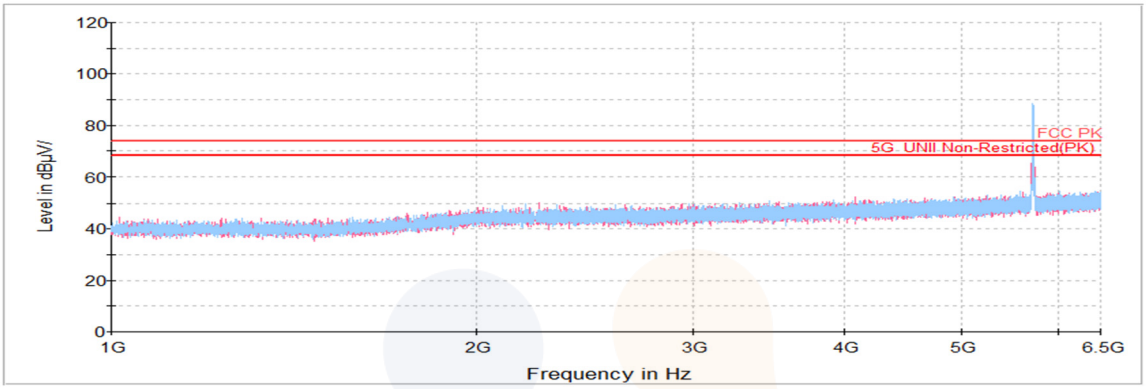
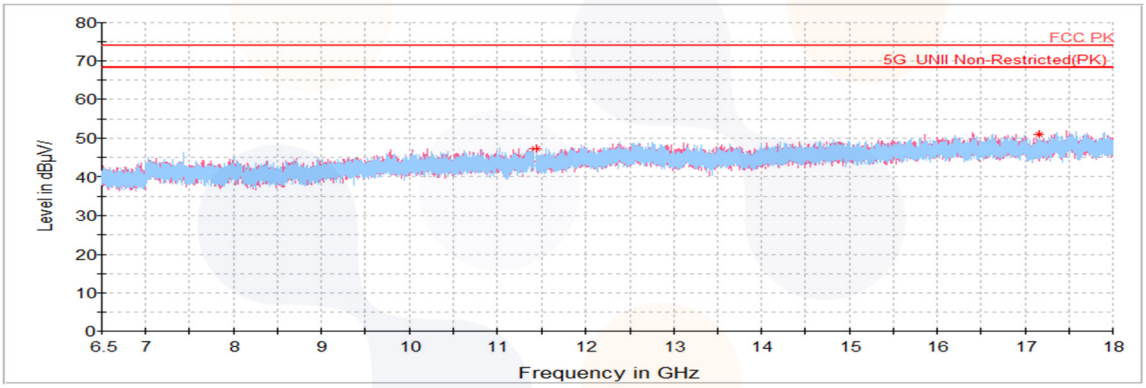
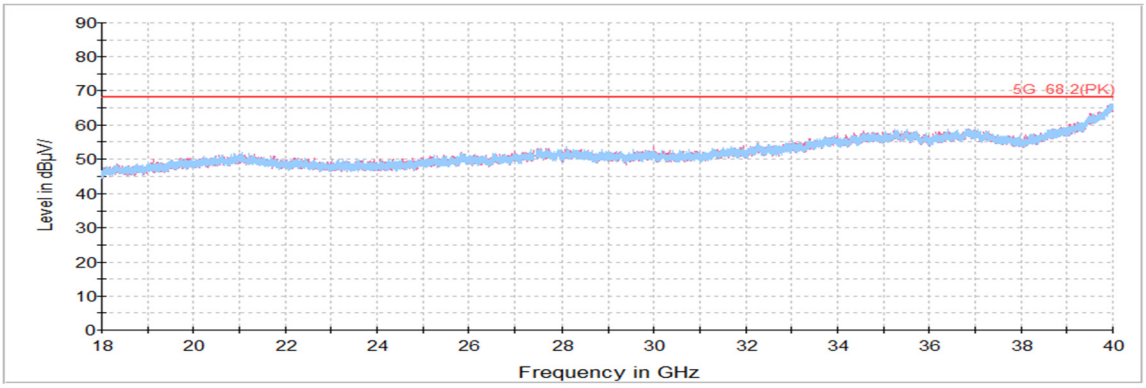
802.11n HT20 (5 720 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 440.78[1)]	H	58.07	38.25	-49.11	-	47.21	74.00	26.79
17 166.25	V	55.93	41.47	-46.48	-	50.92	68.20	17.28
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

Plot of Harmonics and Spurious Emissions

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

802.11n HT20_Straddle Channel (5 720 ㎒)

Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓

Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

Horizontal/Vertical for 18 ㎓ ~ 40 ㎓


UNII 3

802.11a_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								
5 723.58	H	44.00	34.86	-23.45	-	55.41	118.97	63.56
11 400.53[1)]	V	58.36	38.22	-49.12	-	47.46	74.00	26.54
13 938.97	V	59.57	38.64	-48.44	-	49.77	68.20	18.43
17 289.30	V	55.72	41.52	-46.25	-	50.99	68.20	17.21
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

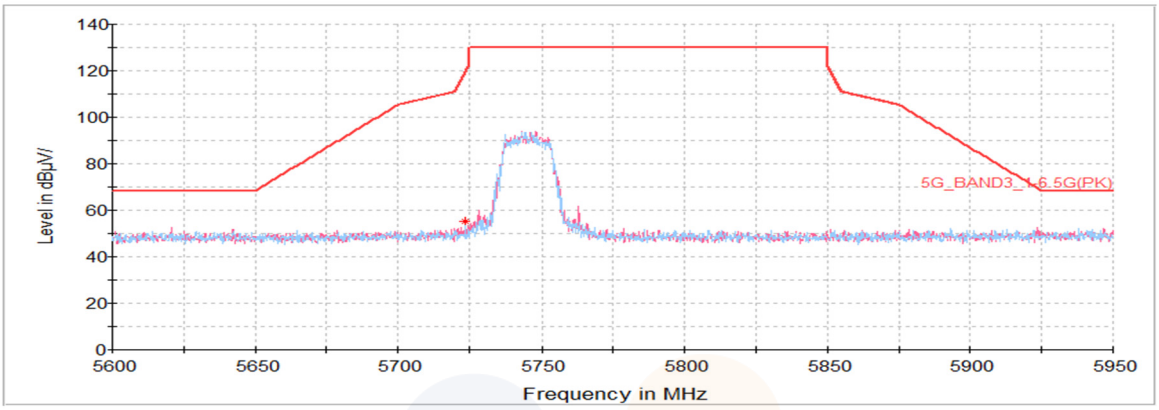
802.11a_Middle Channel (5 785 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 573.42[1)]	V	59.24	38.39	-49.10	-	48.53	74.00	25.47
13 524.97	V	60.84	38.89	-48.90	-	50.83	68.20	17.37
17 323.80	V	55.79	41.53	-46.19	-	51.13	68.20	17.07
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

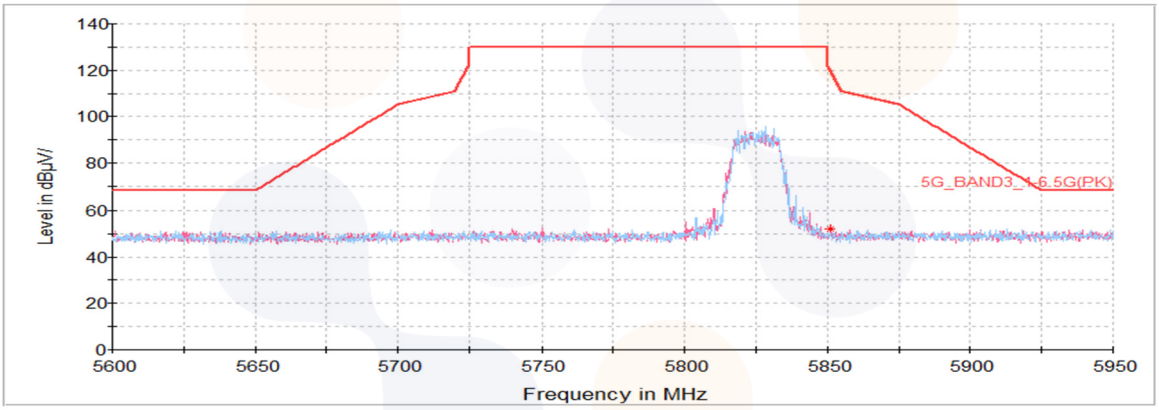
802.11a_Highest Channel (5 825 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 851.00	V	40.40	35.06	-23.37	-	52.09	119.92	67.83
11 651.23[1)]	H	57.66	38.48	-49.10	-	47.04	74.00	26.96
17 480.20	V	55.50	41.59	-45.90	-	51.19	68.20	17.01
Average Data								
No spurious emissions were detected within 20 dB of the limit.								

802.11a_Lowest Channel (5 745 ㎒)

Horizontal/Vertical for Band-edge


802.11a_Highest Channel (5 825 ㎒)

Horizontal/Vertical for Band-edge


802.11n_HT20_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								
5 724.87	V	47.28	34.86	-23.44	-	58.70	121.90	63.19
11 585.68[1)]	V	58.95	38.40	-49.10	-	48.25	74.00	25.75
17 222.98	H	54.71	41.49	-46.37	-	49.83	68.20	18.37
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

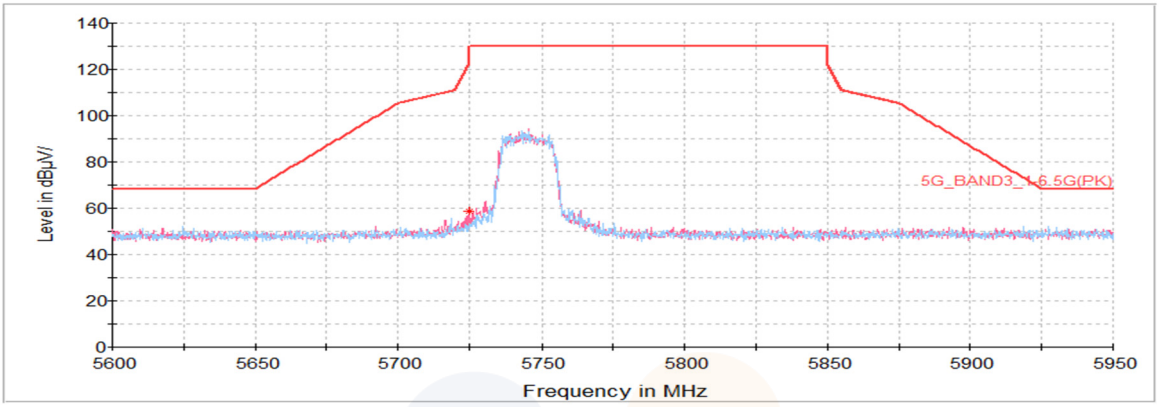
802.11n_HT20_Middle Channel (5 785 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
11 571.12[1)]	V	59.33	38.39	-49.10	-	48.62	74.00	25.38
17 342.20	H	55.28	41.54	-46.15	-	50.67	68.20	17.53
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

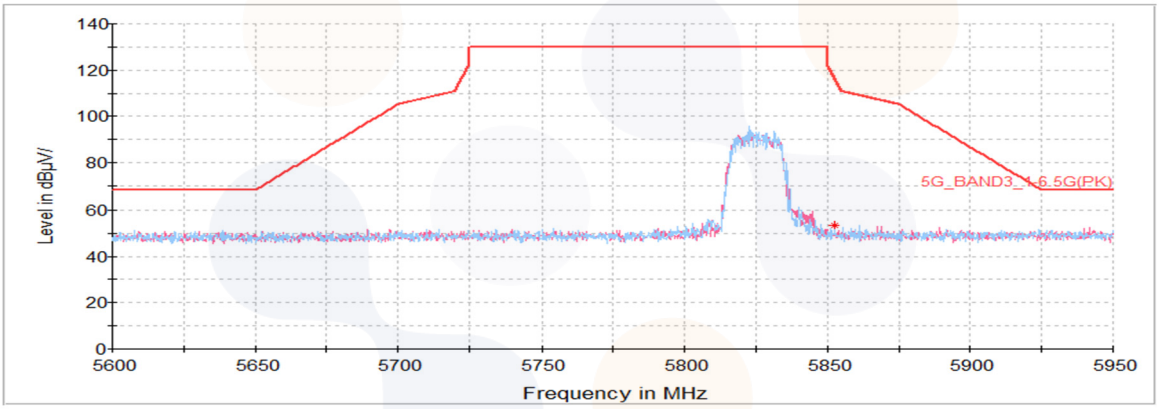
802.11n_HT20_Highest Channel (5 825 ㎒)

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
5 852.47	V	41.84	35.06	-23.37	-	53.53	116.58	63.05
11 591.82[1)]	V	58.50	38.41	-49.10	-	47.81	74.00	26.19
17 422.70	V	55.11	41.57	-46.01	-	50.67	68.20	17.53
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

802.11n_HT20_Lowest Channel (5 745 ㎒)

Horizontal/Vertical for Band-edge


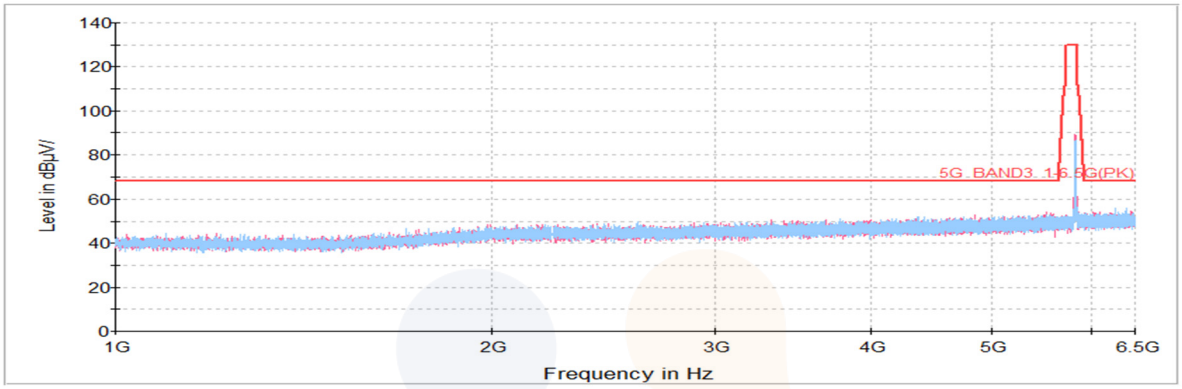
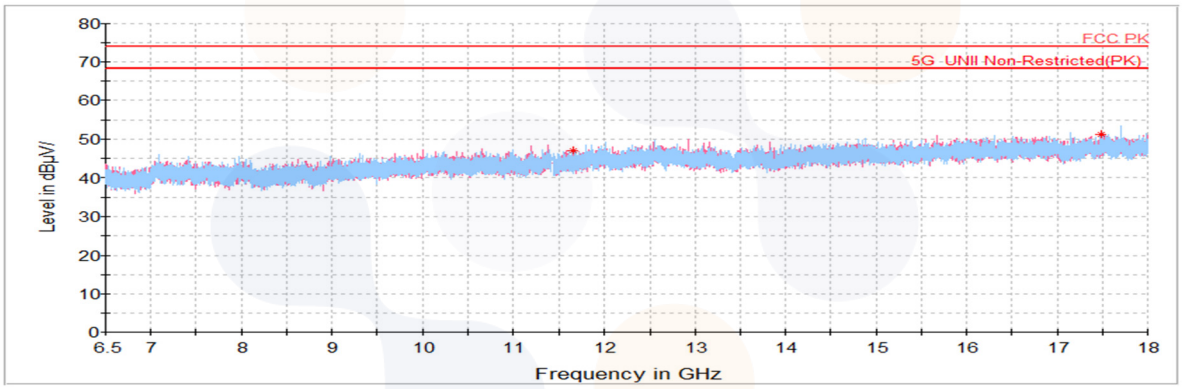
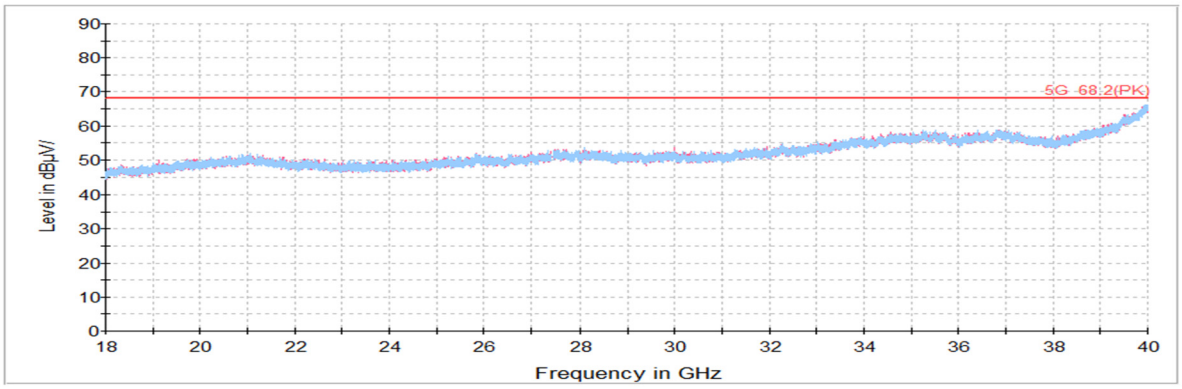
802.11n_HT20_Highest Channel (5 825 ㎒)

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_Highest Channel (5 825 ㎒)

Horizontal/Vertical for 1 ㎓ ~ 6.5 ㎓

Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

Horizontal/Vertical for 18 ㎓ ~ 40 ㎓


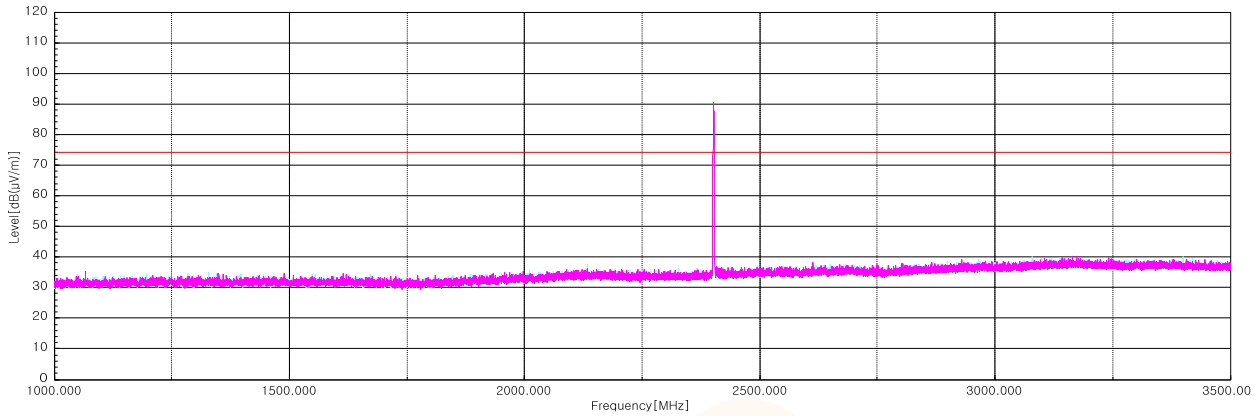
Spurious Emission for Simultaneous Tx Condition

Case	WLAN 5 ㎓	Bluetooth
Mode	802.11n HT20	BLE
Channel	120	0
Frequency	5 600 ㎒	2 402 ㎒
Data Rate	MCS0	1M Bits/s, 37 Packet

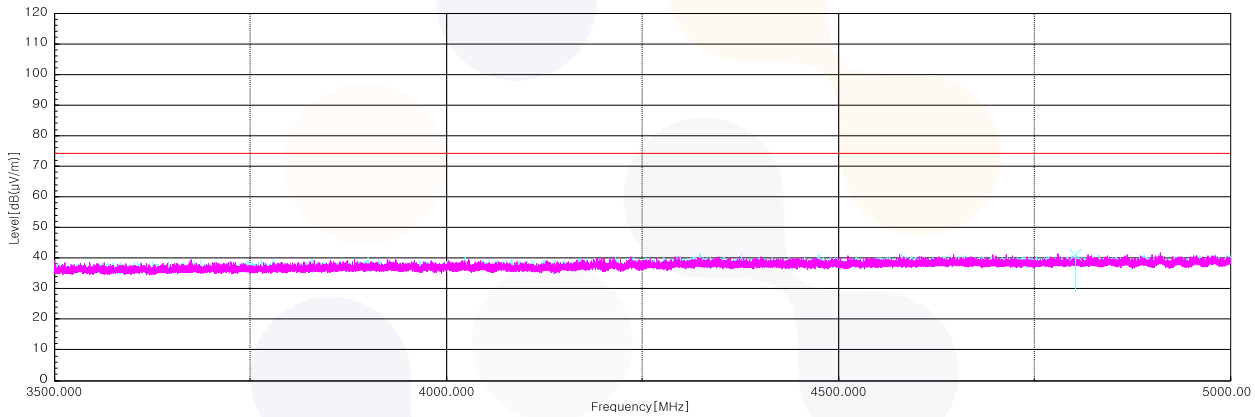
Notes.
The lowest margin condition among the channels and modes were selected for test.

Frequency	Pol.	Reading	Ant. Factor	Amp.+Cable	DCF	Result	Limit	Margin
(㎒)	(V/H)	(dB(㎶))	(dB)	(dB)	(dB)	(dB(㎶/m))	(dB(㎶/m))	(dB)
Peak data								
4 802.25[1)]	V	54.70	32.31	-46.14	-	40.87	74.00	33.13
7 234.08	V	53.60	37.17	-43.79	-	46.98	74.00	27.02
11 403.22[1)]	V	54.80	39.20	-43.43	-	50.57	74.00	23.43
16 808.60	V	55.30	38.10	-41.46	-	51.94	68.20	16.26
Average Data								
No spurious emissions were detected within 20 ㏈ of the limit.								

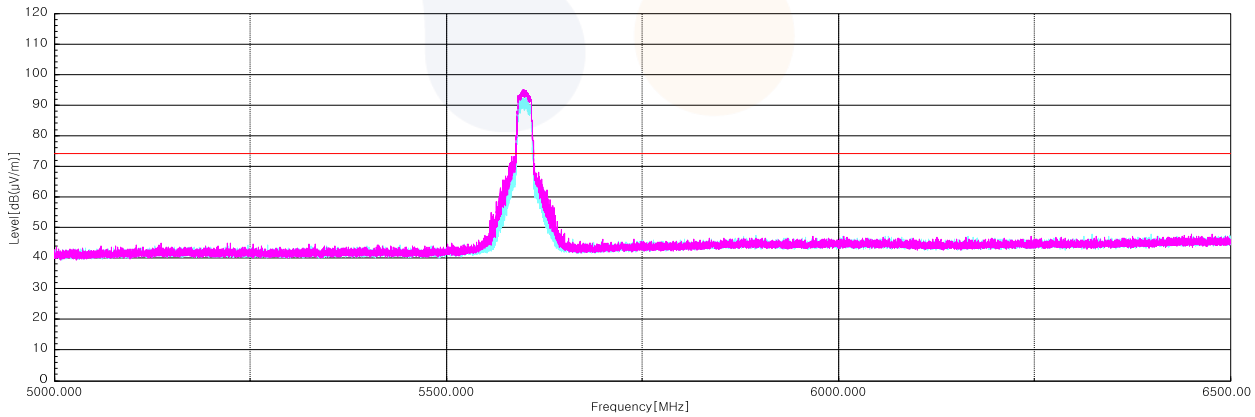
Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓



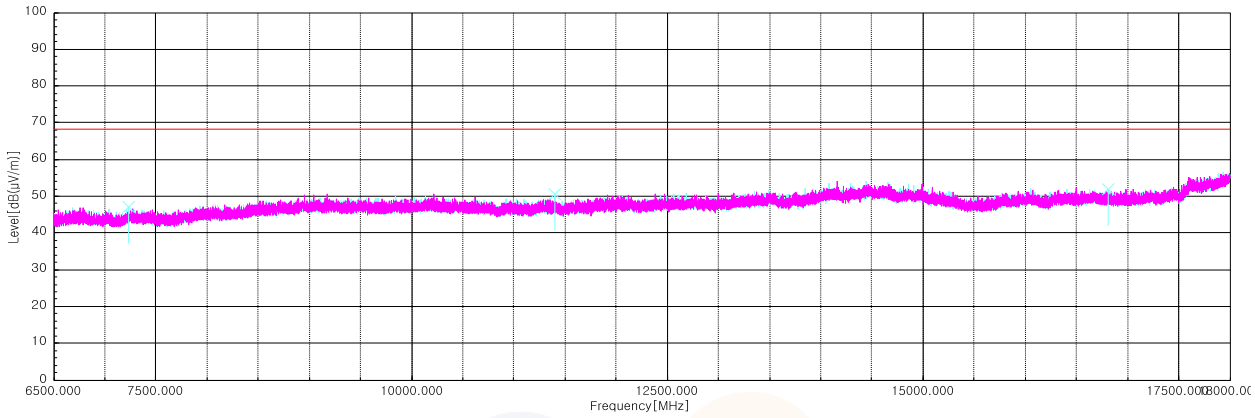
Horizontal/Vertical for 3.5 ㎓ ~ 5 ㎓



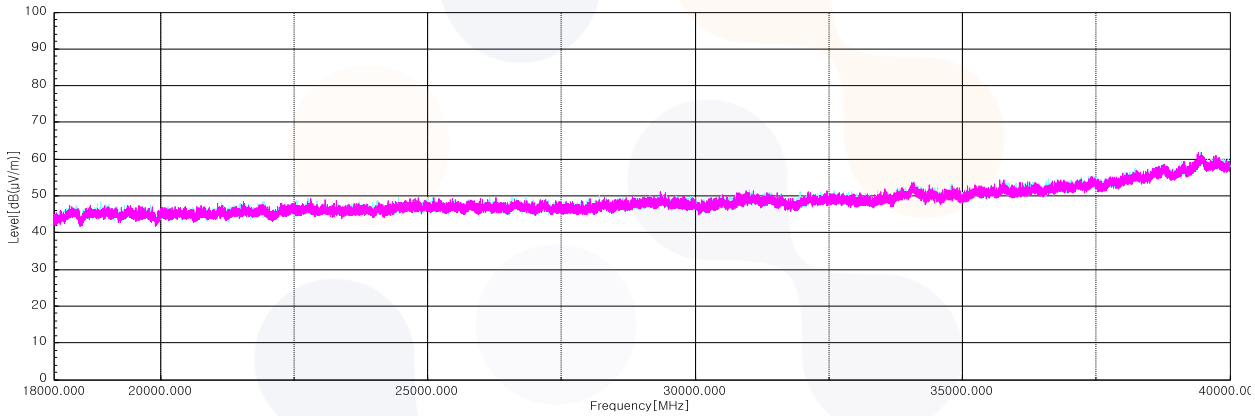
Horizontal/Vertical for 5 ㎓ ~ 6.5 ㎓



Horizontal/Vertical for 6.5 ㎓ ~ 18 ㎓

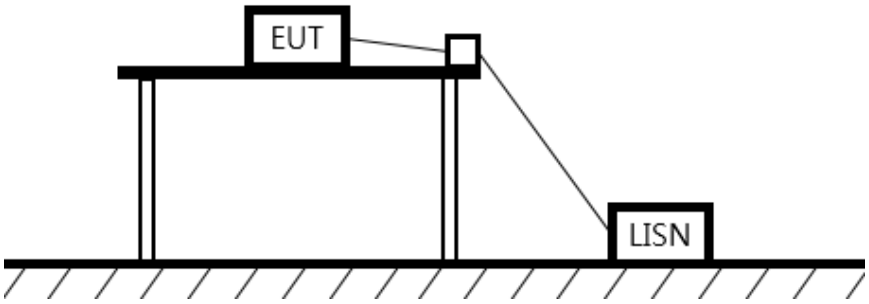


Horizontal/Vertical for 18 ㎓ ~ 40 ㎓



7.8. 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 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

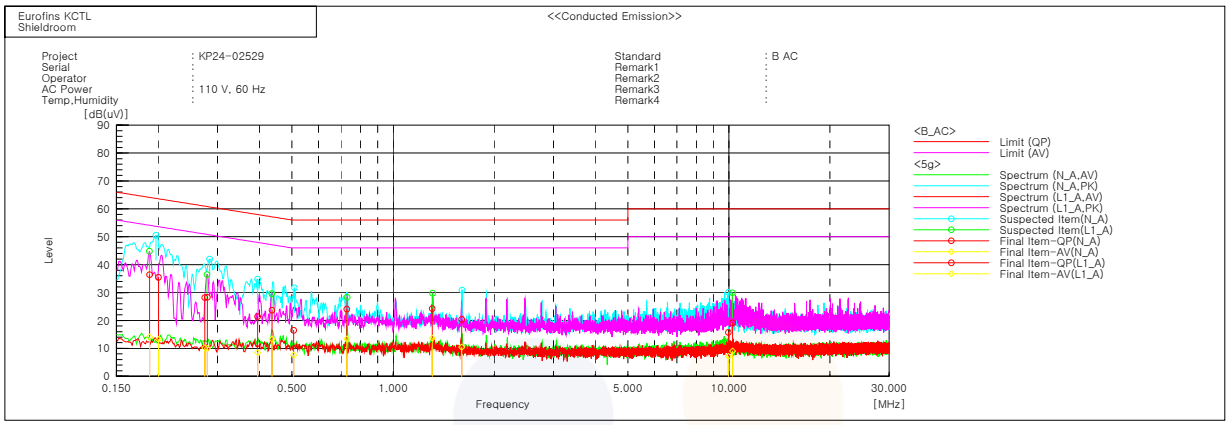
Frequency of Emission (㎒)	Conducted limit (dBμV/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

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 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 2A_5 280 ㎒



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	0.20024	25.2	2.9	10.3	35.5	13.2	63.6	53.6	28.1	40.4
2	0.27975	18.3	0.0	10.0	28.3	10.0	60.8	50.8	32.5	40.8
3	0.39498	11.2	-1.7	10.2	21.4	8.5	58.0	48.0	36.6	39.5
4	0.50556	6.3	-2.6	10.2	16.5	7.6	56.0	46.0	39.5	38.4
5	1.60082	10.3	0.5	10.0	20.3	10.5	56.0	46.0	35.7	35.5
6	9.95781	5.0	-3.5	10.7	15.7	7.2	60.0	50.0	44.3	42.8

--- 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	0.18845	26.0	3.7	10.4	36.4	14.1	64.1	54.1	27.7	40.0
2	0.27504	18.2	0.2	10.0	28.2	10.2	61.0	51.0	32.8	40.8
3	0.4359	13.5	3.1	10.2	23.7	13.3	57.1	47.1	33.4	33.8
4	0.72794	14.0	3.3	10.0	24.0	13.3	56.0	46.0	32.0	32.7
5	1.30749	14.2	3.7	10.0	24.2	13.7	56.0	46.0	31.8	32.3
6	10.25611	8.4	-1.7	10.7	19.1	9.0	60.0	50.0	40.9	41.0

8. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSVA40	101574	25.03.28
Spectrum Analyzer	R&S	FSV40	100989	24.10.12
Spectrum Analyzer	R&S	FSVA40	101575	25.04.24*
Attenuator	API Inmet	40AH2W-10	17	25.04.30*
Signal Generator	R&S	SMB100A	176206	25.01.18
Vector Signal Generator	R&S	SMBV100A	257566	24.07.04
DC Power Supply	AGILENT	E3632A	KR94907664	25.04.24*
Power Divider	Aeroflex/ Weinschel,Inc	1580-1	PE430	24.07.04
Power Divider	AGILENT	11636B	54456	24.10.13
Step Attenuator	KEYSIGHT	8495D	MY42144300	25.01.19
Step Attenuator	AGILENT	8494B	MY42140941	25.01.19
Horn antenna	ETS.lindgren	3117	00251528	25.01.26
Horn antenna	ETS.lindgren	3116	00086635	25.01.25
Horn Antenna	SCHWARZBECK	BBHA9120D	2763	24.10.18
Horn Antenna	SCHWARZBECK	BBHA9170	1267	24.10.16
Bi-Log Antenna	TESEQ	CBL 6112D	62438	25.05.25
LOOP Antenna	R&S	HFH2-Z2	100355	24.08.10
AMPLIFIER	B&Z Technologies	BZRT-00504000-481055-382525	26299-27735	24.07.04
AMPLIFIER	B&Z Technologies	BZR-0050400-551028-252525	27736	24.07.04
Amplifier	SONOMA INSTRUMENT	310N	284608	24.08.18
Low Noise Amplifier	TESTEK	TK-PA18H	220124-L	24.10.12
Low Noise Amplifier	TESTEK	TK-PA1840H	220133-L	24.10.17
Attenuator	API Inmet	40AH2W-10	12	25.05.04
High pass Filter	WT	WT-A1699-HS	WT160411002	25.04.25*
High pass Filter	QOTANA TECHNOLOGIES	DBHF058004000A	20070100016	24.07.04
High Pass Filter	Wainwright Instruments GmbH	WHKX12-2805-3000-18000-40SS	SN58	24.10.16
High Pass Filter	QOTANA TECHNOLOGIES	DBHF0508004000A	23041800061	24.07.10
High Pass Filter	Wainwright Instruments GmbH	WHKX8-5655-6500-18000-40SS	SN8	24.10.16
Band reject Filter	Wainwright Instruments GmbH	WTRCJV8-5100-5850-20-100-50SSK	62	24.10.13
EMI TEST RECEIVER	R&S	ESCI7	100732	25.02.28
EMI TEST RECEIVER	R&S	ESCI3	100001	24.08.18
ISOLATION TRANSFORMER	ONETECH CO.,LTD	OT-IT500VA	OTR1-16026	25.03.21
TWO-LINE V - NETWORK	R&S	ENV216	101358	24.09.27

*This equipment was calibrated during the test period, and was used before calibration.

End of test report