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# TEST REPORT

**KCTL Inc.**
65, Sinwon-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Korea
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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** : 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 C, 15.247

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

| | | |
|---|---|---|
| Affirmation | Tested by<br><br>Name : Kwonse Kim (Signature) | Technical 7Manager<br><br>Name : Seungyong Kim (Signature) |

2021-09-18

## 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 |
|---|---|---|
| 2021-09-17 | Originally issued | - |
| 2021-09-10 | Updated | 1 |
| 2021-09-17 | Removed the IC information and<br>change from the original report to the C2PC report | All page |
| 2021-09-18 | Added output power section 6.1. | 8, 9, 10 ~ 13, 48 |
| | | |

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Note. The report No. KR21-SRF0187-B is superseded by the report No. KR21-SRF0187-C.

## 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<br>VCCI Registration No. : R-20080, G-20078, C-20059, T-20056<br>CAB Identifier: KR0040<br>ISED Number: 8035A<br>KOLAS No.: KT231 |

# 2. Device information

| | | |
|---|---|---|
| Equipment under test | : | Smart Wearable |
| Model | : | SM-R890 |
| Modulation technique | : | Bluetooth(BDR/EDR)_GFSK, π/4DQPSK, 8DPSK<br>Bluetooth(BLE)_GFSK<br>WIFI(802.11a/b/g/n)_DSSS, OFDM |
| Number of channels | : | Bluetooth(BDR/EDR)_79 ch / Bluetooth(BLE)_40 ch<br>802.11b/g/n_HT20 : 13 ch<br>UNII-1: 4 ch (20 ㎒)<br>UNII-2A: 4 ch (20 ㎒)<br>UNII-2C: 12 ch (20 ㎒)<br>UNII-3: 5 ch (20 ㎒) |
| Power source | : | DC 3.88 V |
| Antenna specification | : | WIFI/Bluetooth(BDR/EDR/BLE)_LDS Antenna |
| Antenna gain | : | WIFI/Bluetooth(BDR/EDR/BLE)_-7.70 ㏈i<br>UNII-1 : -4.10 ㏈i<br>UNII-2A : -2.30 ㏈i<br>UNII-2C : -5.20 ㏈i<br>UNII-3 : -10.60 ㏈i |
| Frequency range | : | Bluetooth(BDR/EDR/BLE)_2 402 ㎒ ~ 2 480 ㎒<br>2 412 ㎒ ~ 2 472 ㎒ (802.11b/g/n_HT20)<br>UNII-1: 5 180 ㎒ ~ 5 240 ㎒ (802.11a/n_HT20)<br>UNII-2A: 5 260 ㎒ ~ 5 320 ㎒ (802.11a/n_HT20)<br>UNII-2C: 5 500 ㎒ ~ 5 720 ㎒ (802.11a/n_HT20)<br>UNII-3: 5 745 ㎒ ~ 5 825 ㎒ (802.11a/n_HT20) |
| Software version | : | R890.001 |
| Hardware version | : | REV1.0 |
| Test device serial No. | : | Conducted(R3AR501PZGY, R3AR501PZFR)<br>Radiated(R3AR404SPYB, R3AR404SPBM, R3AR404SS5W, R3AR404SPYB) |
| 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)

| Ch. | Frequency (㎒) |
|---|---|
| 01 | 2 412 |
| . . | . . |
| 06 | 2 437 |
| . . | . . |
| 11 | 2 462 |
| 12 | 2 467 |
| 13 | 2 472 |

Table 2.1.1. 802.11b/g/n_HT20 mode

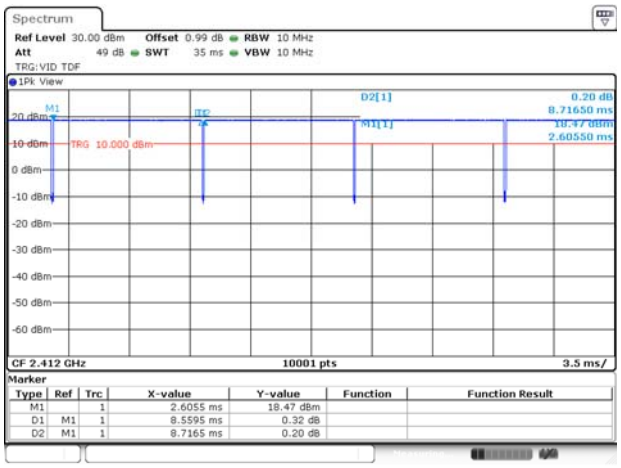
## 2.2. Duty Cycle Factor

| Test mode | Period (ms) | $T_{On}$ time (ms) | Duty cycle | | Duty Cycle Factor (dB) |
|---|---|---|---|---|---|
| | | | (Linear) | (%) | |
| 802.11b | 8.716 5 | 8.559 5 | 0.982 0 | 98.20 | 0.08 |
| 802.11g | 1.530 9 | 1.419 6 | 0.927 3 | 92.73 | 0.33 |
| 802.11n_HT20 | 1.448 4 | 1.334 4 | 0.921 3 | 92.13 | 0.36 |

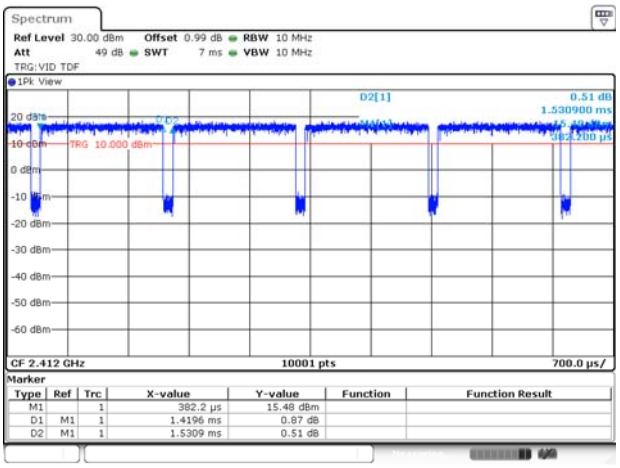
**Notes.**

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%

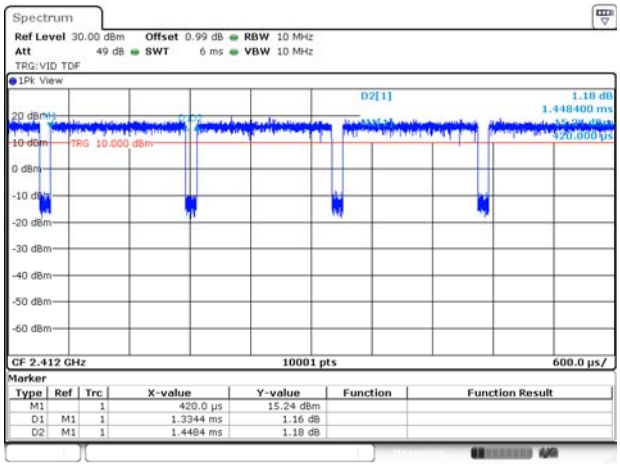
**802.11b**




**802.11g**




**802.11n_HT20**

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# 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 |
|---|---|---|---|
| 15.247(b)(3) | Maximum peak output power | Conducted | Pass |
| 15.205(a), 15.209(a) | Spurious emission | Radiated | Pass |
| | Band-edge, restricted band | | 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 558074 D01 V05r02
6. The worst-case data rate were:
   802.11b mode: 1Mbps
   802.11g 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.

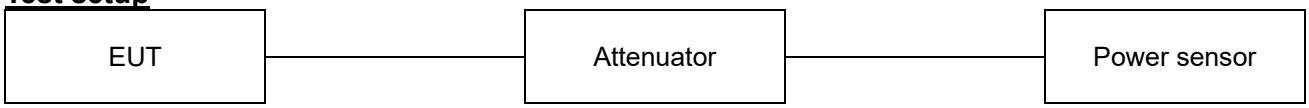
All measurement uncertainty values are shown with a coverage factor of *k*=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine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

**Test setup**




**Limit**

According to §15.247(b)(3), For systems using digital modulation in the 902-928 ㎒, 2 400-2 483.5 ㎒, and 5 725-5 850 ㎒ bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 ㏈i. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 ㏈i are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i.

**Test procedure**

ANSI C63.10 - Section 11.9
Used test method is section 11.9.1.3 and 11.9.2.3.1

**Test settings**

**General**
Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth (see ANSI C63.10 for measurement guidance).

When using a spectrum analyzer or EMI receiver to perform these measurements, it shall be capable of utilizing a number of measurement points in each sweep that is greater than or equal to twice the span/RBW to set a bin-to-bin spacing of ≤ RBW/2 so that narrowband signals are not lost between frequency bins.

If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level. The intent is to test at 100 % duty cycle; however a small reduction in duty cycle (to no lower than 98 %) is permitted, if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.

If continuous transmission (or at least 98 % duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level, with the transmit duration as long as possible, and the duty cycle as high as possible during which sweep triggering/signal gating techniques may be used to perform the measurement over the transmission duration.

**11.9.1. Maximum peak conducted output power**
One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

**11.9.1.1. RBW ≥ DTS bandwidth**
The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

**11.9.1.3. PKPM1 Peak power meter method**
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

**11.9.2.3.1. Measurement using a power meter (PM)**

Method AVGPM is a measurement using an RF average power meter, as follows:

a) As an alternative to spectrum analyzer or EMI receiver measurements, 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:
   1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
   2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
   3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

b) If the transmitter does not transmit continuously, measure the duty cycle, D, of the transmitter output signal as described in 11.6.

c) Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter.

d) Adjust the measurement in dBm by adding [10 log(1/D)], where D is the duty cycle

**Notes:**

A peak responding power sensor is used, where the power sensor system video bandwidth is greater than the occupied bandwidth of the EUT.

**Test results**

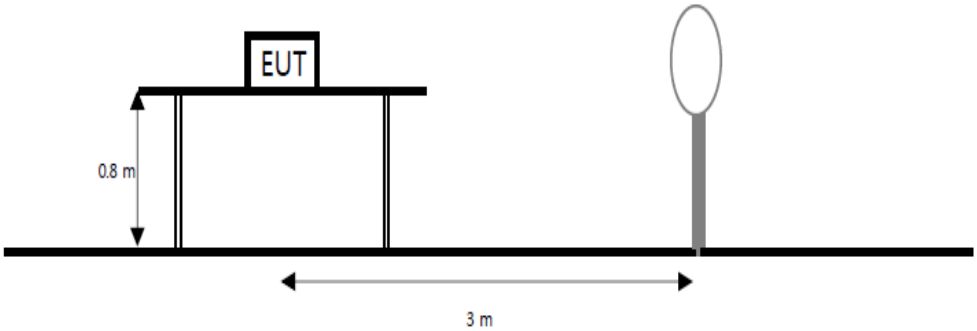
| Test mode | Frequency (㎒) | Measured output power | | |
|---|---|---|---|---|
| | | Conducted output power (dBm) | | Limit (dBm) |
| | | Peak | Average | |
| 802.11b | 2 412 | 20.28 | 16.62 | 30.00 |
| | 2 437 | 20.46 | 16.81 | |
| | 2 462 | 20.41 | 16.85 | |
| | 2 467 | 13.97 | 10.15 | |
| | 2 472 | 10.39 | 6.40 | |
| 802.11g | 2 412 | 24.35 | 16.13 | |
| | 2 437 | 24.31 | 15.95 | |
| | 2 462 | 24.31 | 16.04 | |
| | 2 467 | 18.67 | 9.89 | |
| | 2 472 | 14.33 | 6.20 | |
| 802.11n HT20 | 2 412 | 25.16 | 15.52 | |
| | 2 437 | 24.70 | 15.46 | |
| | 2 462 | 24.91 | 15.45 | |
| | 2 467 | 20.46 | 10.15 | |
| | 2 472 | 15.86 | 6.27 | |

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

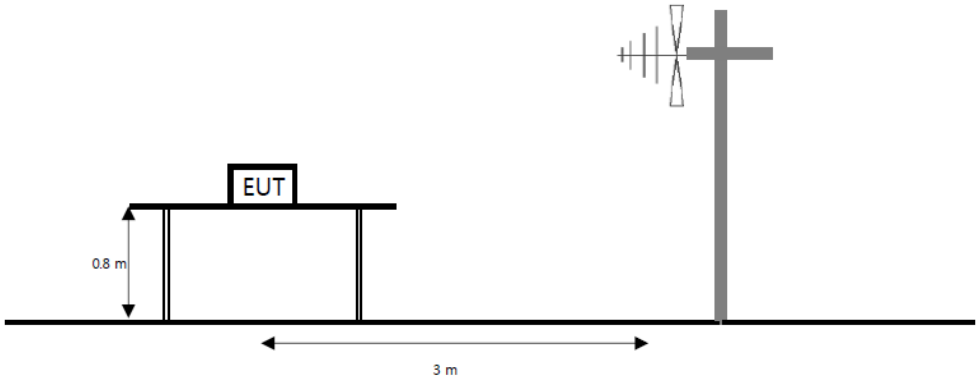
## 6.2. Spurious Emission, Band Edge and Restricted bands

**Test setup**

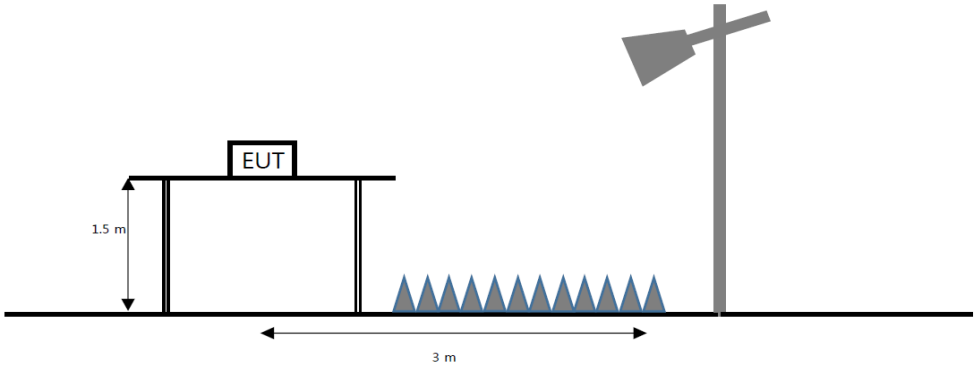
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions




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 | | 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 ㎒, 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.

**Test procedure**
ANSI C63.10-2013

**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.

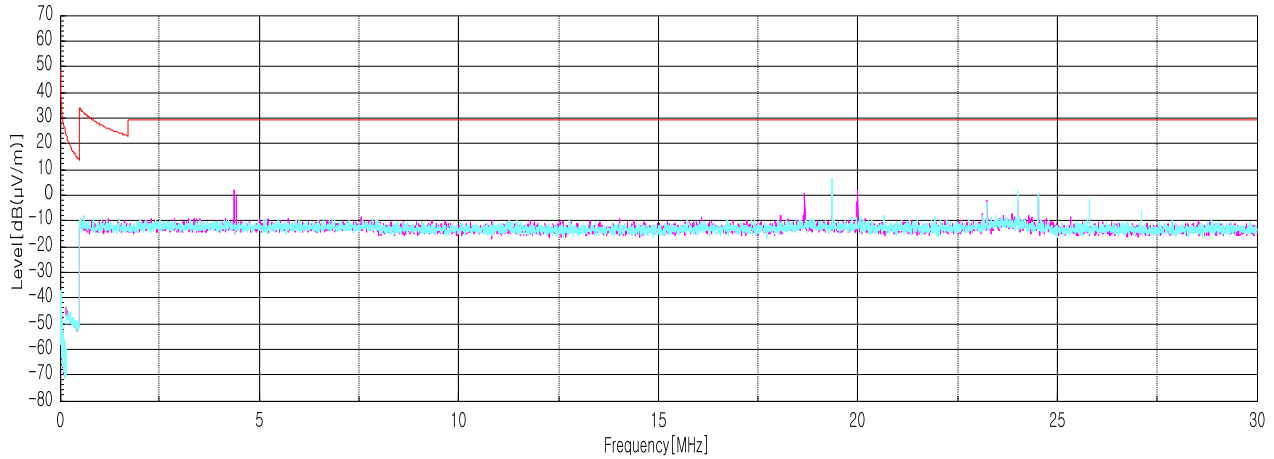
**Notes:**

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.

**Test results (Below 30 ㎒) – Worst case: 802.11n HT20 mode / 2 412 ㎒**

| 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 ㏈ of the limit. | | | | | | | | | |

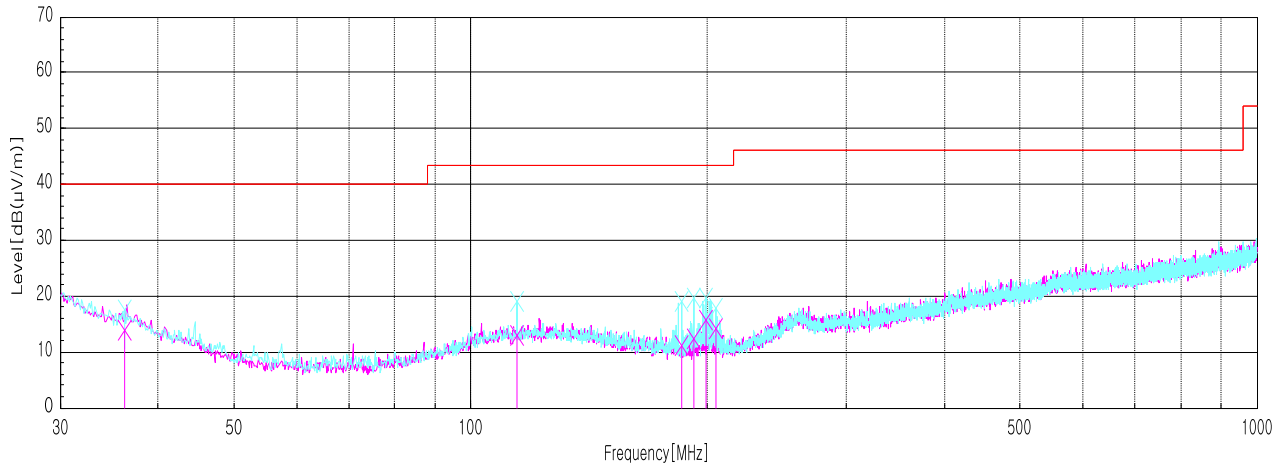
**Horizontal/Vertical**



**Test results (Below 1 000 ㎒) – Worst case: 802.11n HT20 mode / 2 412 ㎒**

| 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** | | | | | | | | |
| 36.31 | V | 22.90 | 21.08 | -30.29 | - | 13.69 | 40.00 | 26.31 |
| 114.39[1)] | V | 23.40 | 17.80 | -28.45 | - | 12.75 | 43.50 | 30.75 |
| 185.44 | V | 23.70 | 14.80 | -27.32 | - | 11.18 | 43.50 | 32.32 |
| 192.23 | V | 24.80 | 14.90 | -27.24 | - | 12.46 | 43.50 | 31.04 |
| 198.90 | V | 27.60 | 15.19 | -27.15 | - | 15.64 | 43.50 | 27.86 |
| 204.72 | V | 25.90 | 15.29 | -27.04 | - | 14.15 | 43.50 | 29.35 |

**Horizontal/Vertical**



## Test results (Above 1 000 ㎒)

### 802.11b_2 412 ㎒

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 389.61[1)] | H | 55.63 | 32.00 | -27.27 | - | 60.36 | 74.00 | 13.64 |
| 4 823.58[1)] | H | 63.39 | 33.79 | -53.11 | - | 44.07 | 74.00 | 29.93 |
| 7 381.02[1)] | H | 60.41 | 35.30 | -50.30 | - | 45.41 | 74.00 | 28.59 |
| **Average Data** | | | | | | | | |
| 2 389.61[1)] | H | 38.47 | 32.00 | -27.27 | - | 43.20 | 54.00 | 10.80 |

**Average data**

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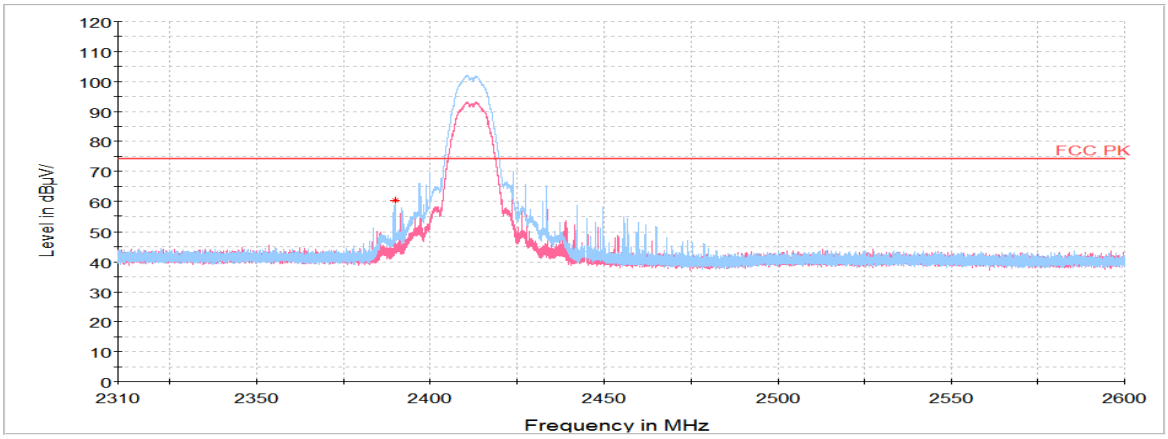
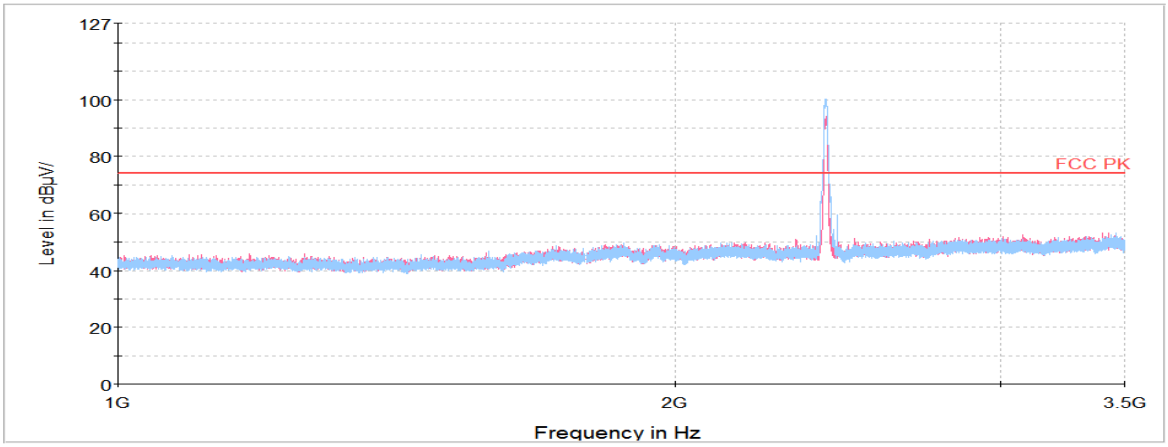
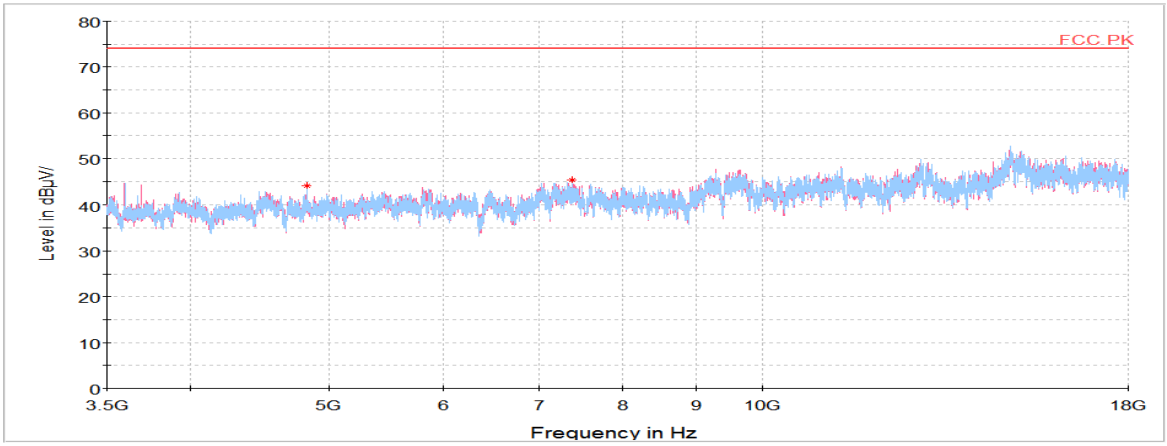
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



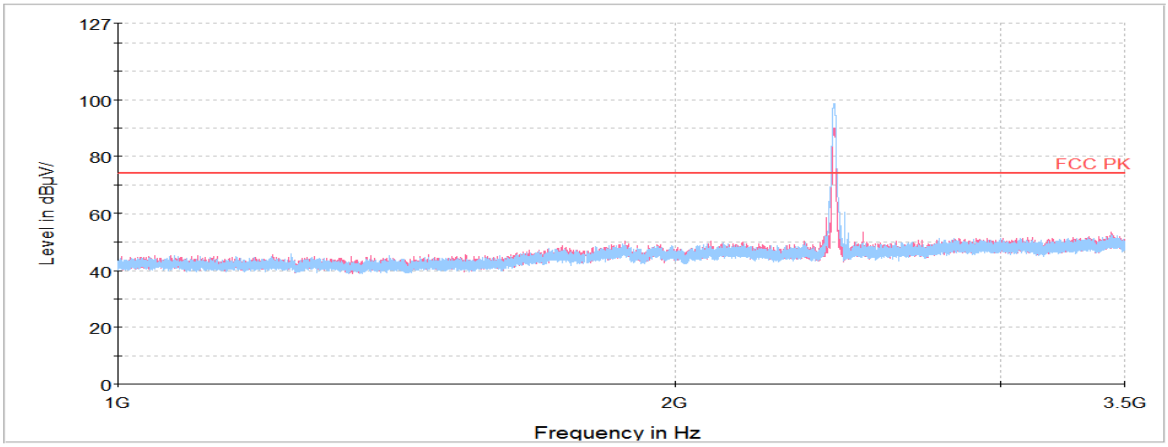

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



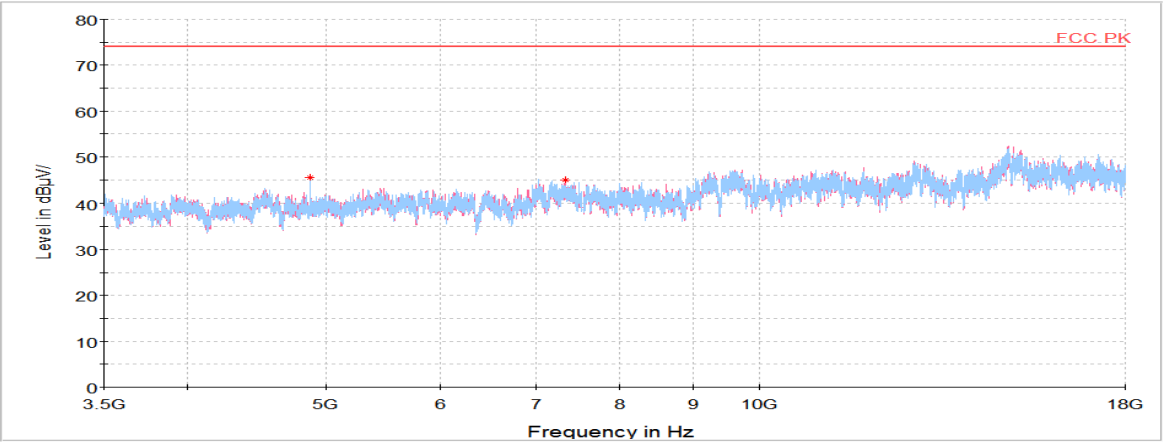
**802.11b_2 437 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 4 873.88[1)] | H | 64.76 | 33.82 | -53.15 | - | 45.43 | 74.00 | 28.57 |
| 7 336.16[1)] | V | 60.12 | 35.30 | -50.39 | - | 45.03 | 74.00 | 28.97 |
| **Average Data** | | | | | | | | |
| No spurious emissions were detected within 20 ㏈ of the limit. | | | | | | | | |

**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



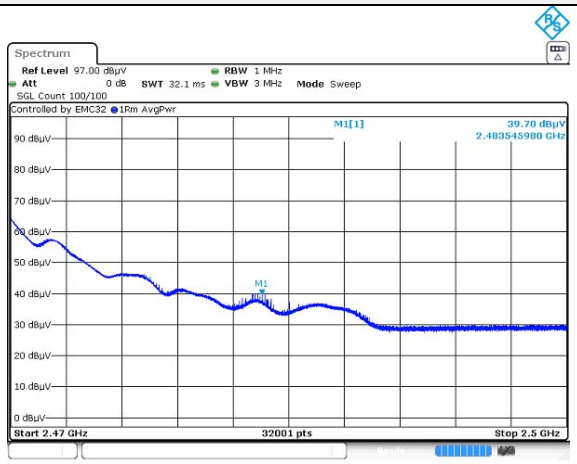

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



**802.11b_2 462 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 483.55[1)] | H | 51.46 | 32.17 | -28.30 | - | 55.33 | 74.00 | 18.67 |
| 4 923.72[1)] | H | 63.16 | 33.85 | -52.90 | - | 44.11 | 74.00 | 29.89 |
| 7 183.91 | V | 61.41 | 35.30 | -50.69 | - | 46.02 | 74.00 | 27.98 |
| **Average Data** | | | | | | | | |
| 2 483.55[1)] | H | 39.70 | 32.17 | -28.30 | - | 43.57 | 54.00 | 10.43 |
| No spurious emissions were detected within 20 ㏈ of the limit. | | | | | | | | |

**Average data**

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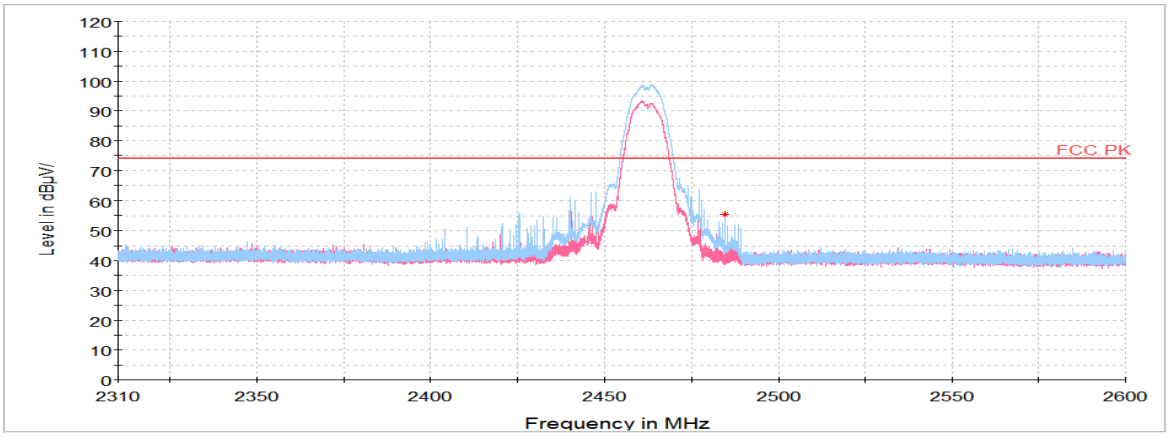
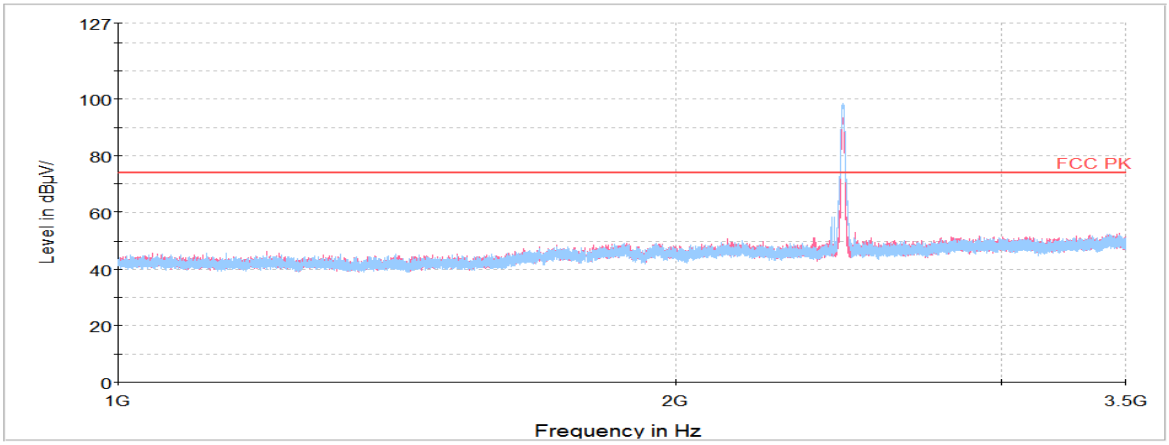
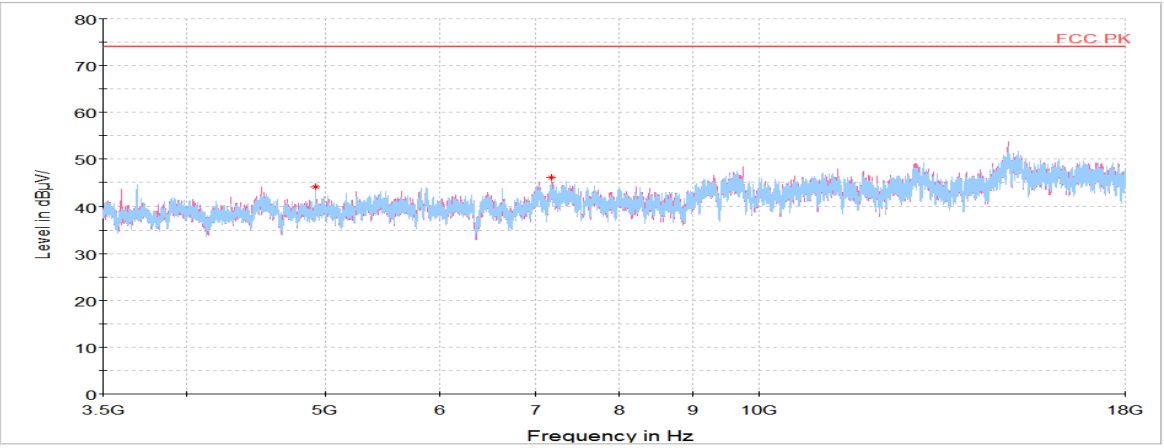
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



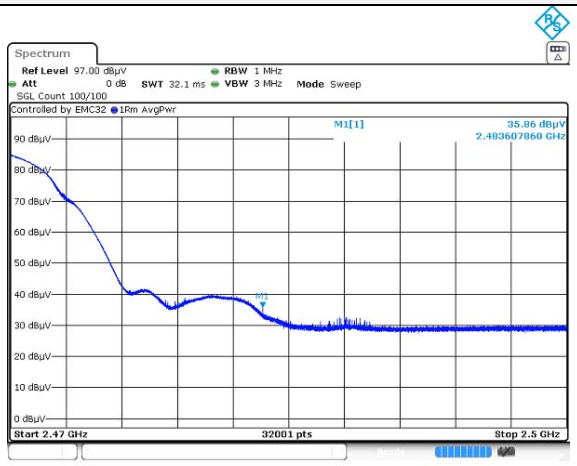

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



**802.11b_2 467 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 483.61[1)] | H | 51.25 | 32.17 | -28.30 | - | 55.12 | 74.00 | 18.88 |
| 3 693.94[1)] | H | 65.11 | 33.06 | -53.48 | - | 44.69 | 74.00 | 29.31 |
| 4 939.58[1)] | V | 60.66 | 33.86 | -52.72 | - | 41.80 | 74.00 | 32.20 |
| **Average Data** | | | | | | | | |
| 2 483.61[1)] | H | 35.86 | 32.17 | -28.30 | - | 39.73 | 54.00 | 14.27 |

**Average data**

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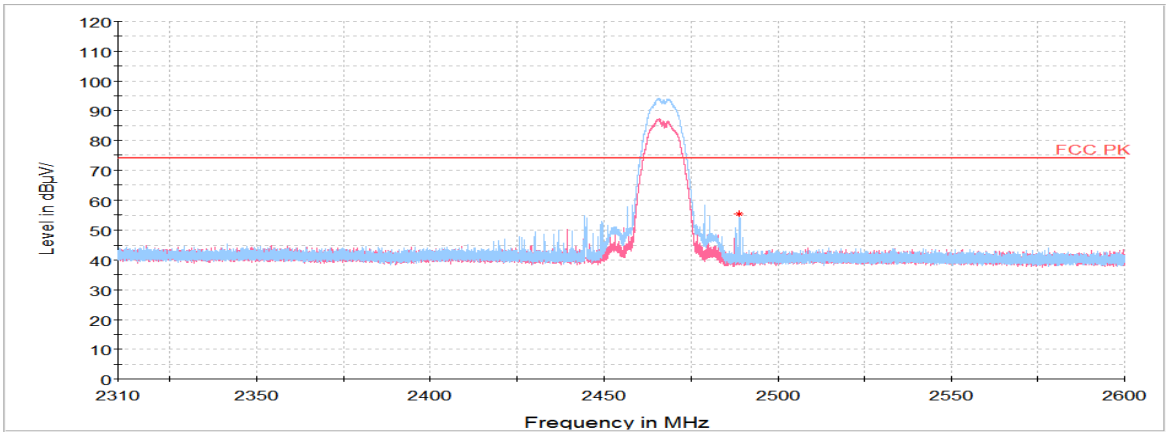
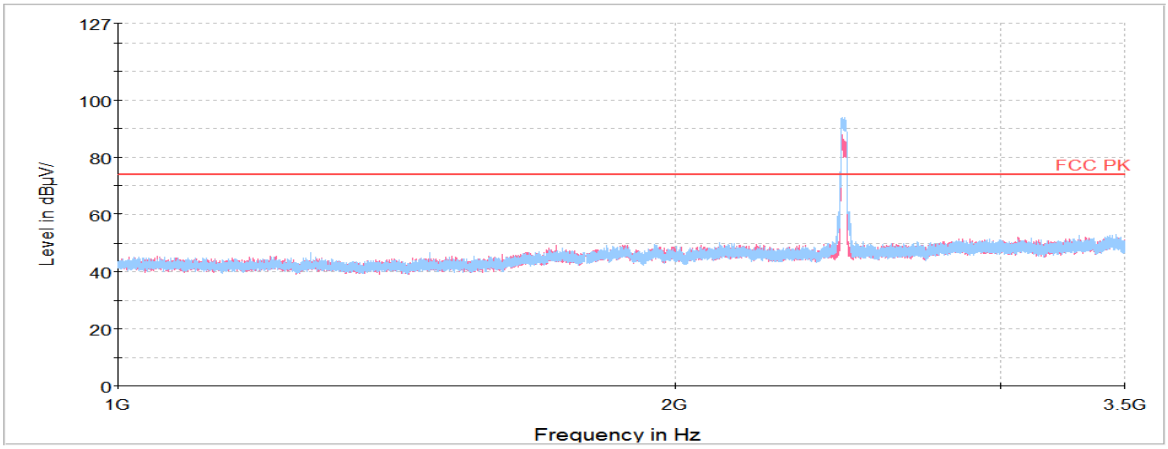
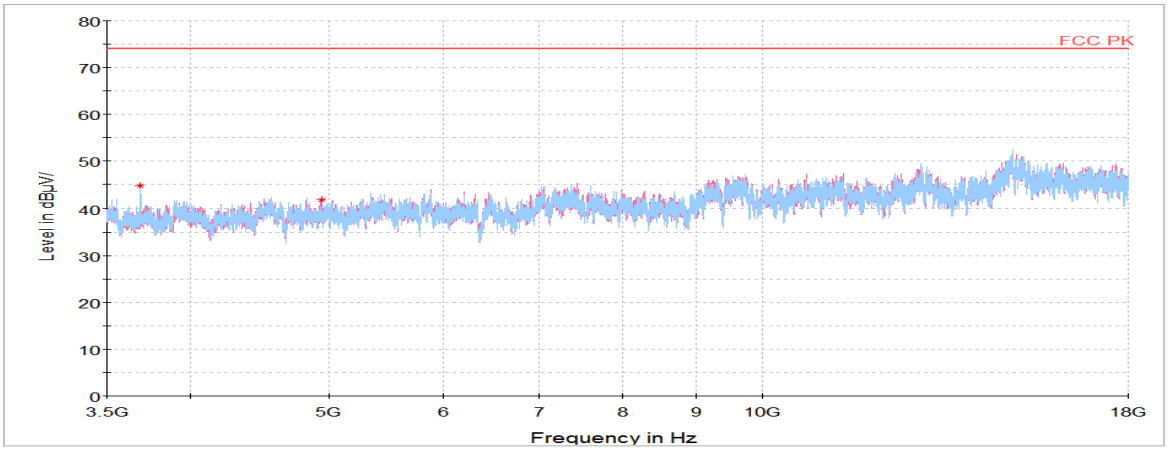
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



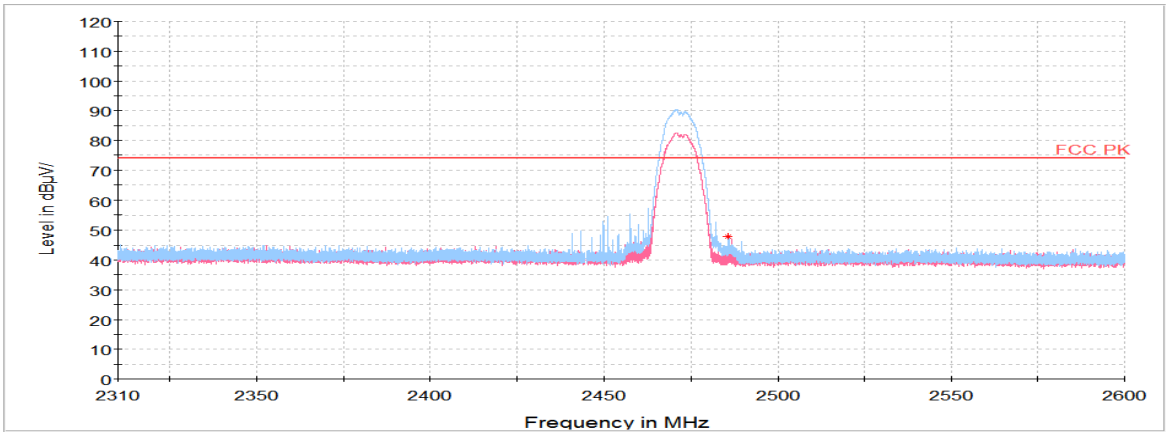

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



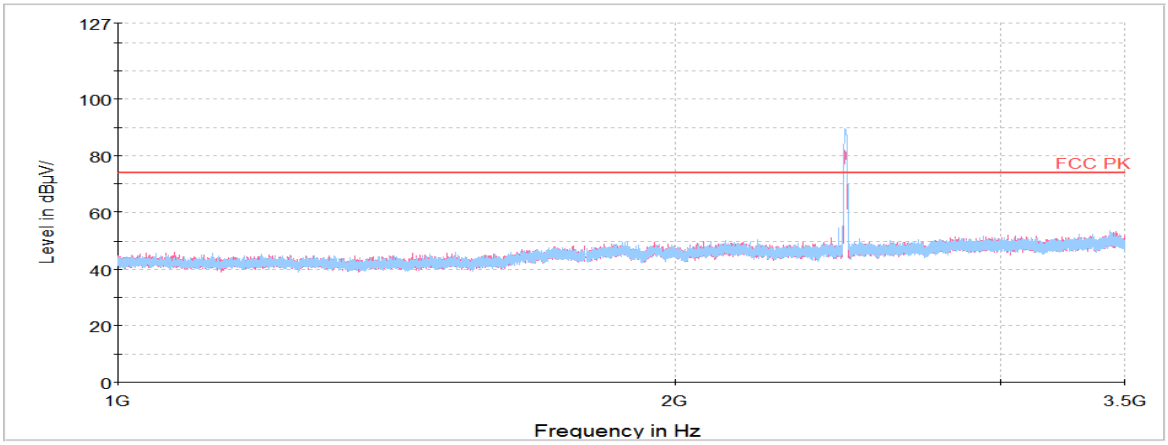
**802.11b_2 472 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 485.52[1)] | H | 44.08 | 32.17 | -28.32 | - | 47.93 | 74.00 | 26.07 |
| 5 024.77[1)] | H | 60.56 | 33.94 | -52.41 | - | 42.09 | 74.00 | 31.91 |
| 7 666.94[1)] | V | 59.57 | 35.40 | -50.40 | - | 44.57 | 74.00 | 29.43 |
| **Average Data** | | | | | | | | |
| No spurious emissions were detected within 20 ㏈ of the limit. | | | | | | | | |

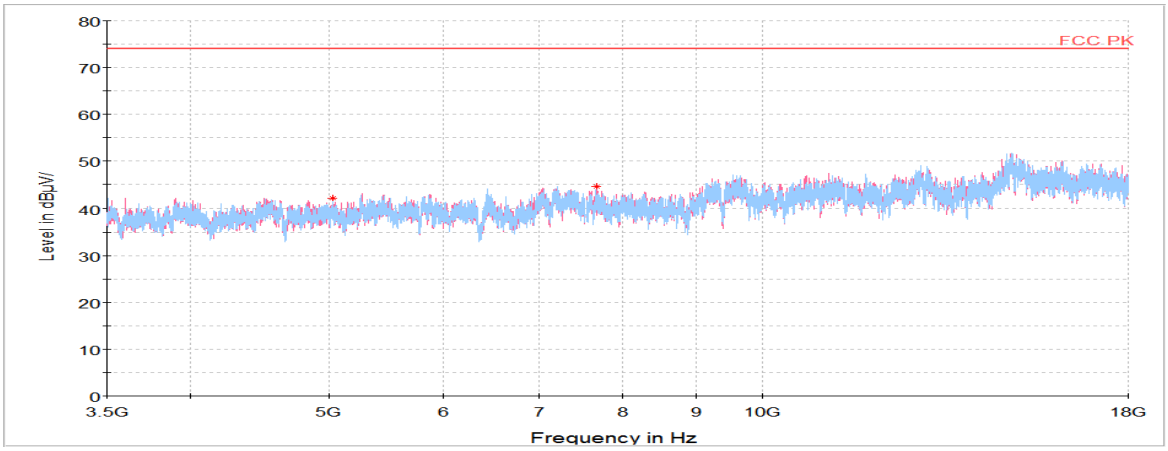
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



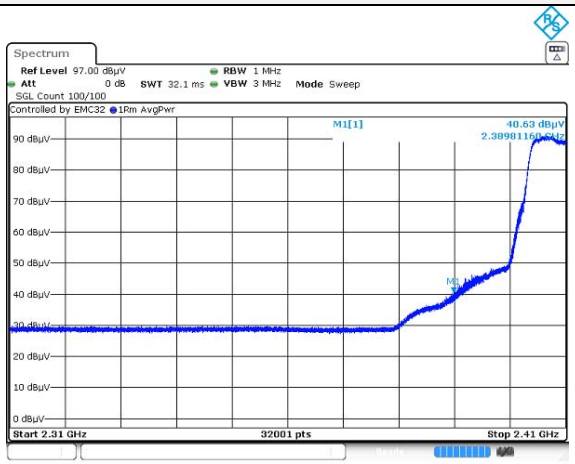

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



**802.11g_2 412 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 389.81[1)] | H | 56.17 | 32.00 | -27.27 | - | 60.90 | 74.00 | 13.10 |
| 4 816.78[1)] | H | 61.05 | 33.79 | -53.11 | - | 41.73 | 74.00 | 32.27 |
| 7 326.19[1)] | V | 60.06 | 35.30 | -50.41 | - | 44.95 | 74.00 | 29.05 |
| **Average Data** | | | | | | | | |
| 2 389.81[1)] | H | 40.63 | 32.00 | -27.27 | 0.33 | 45.69 | 54.00 | 8.31 |

**Average data**

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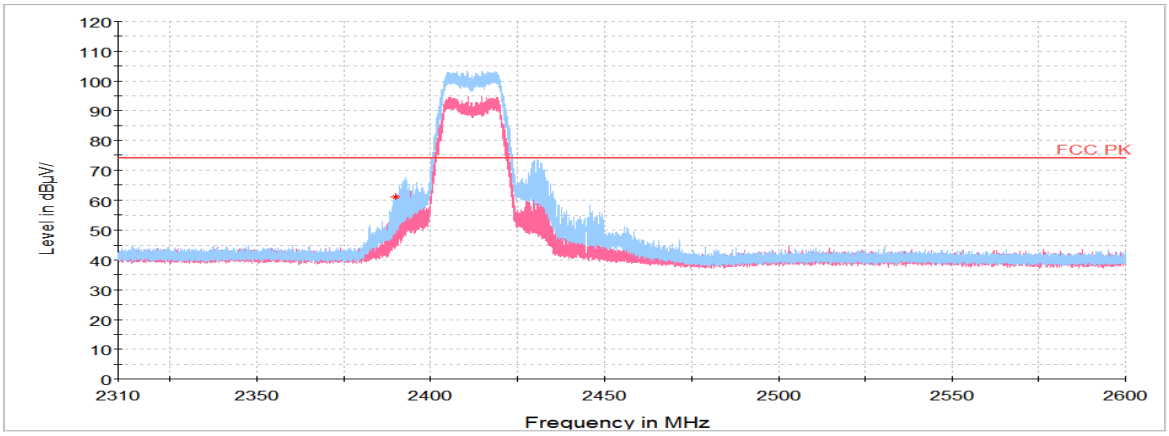
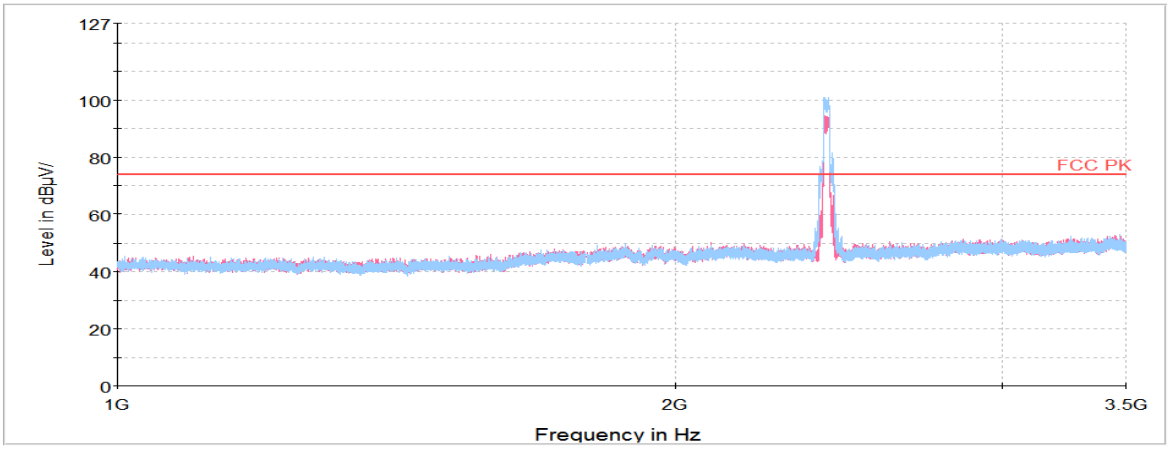
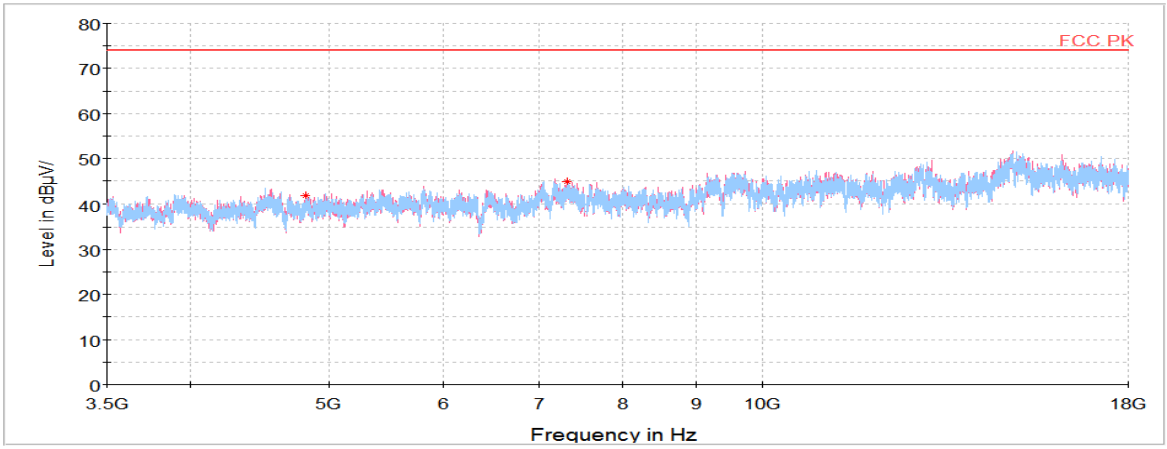
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



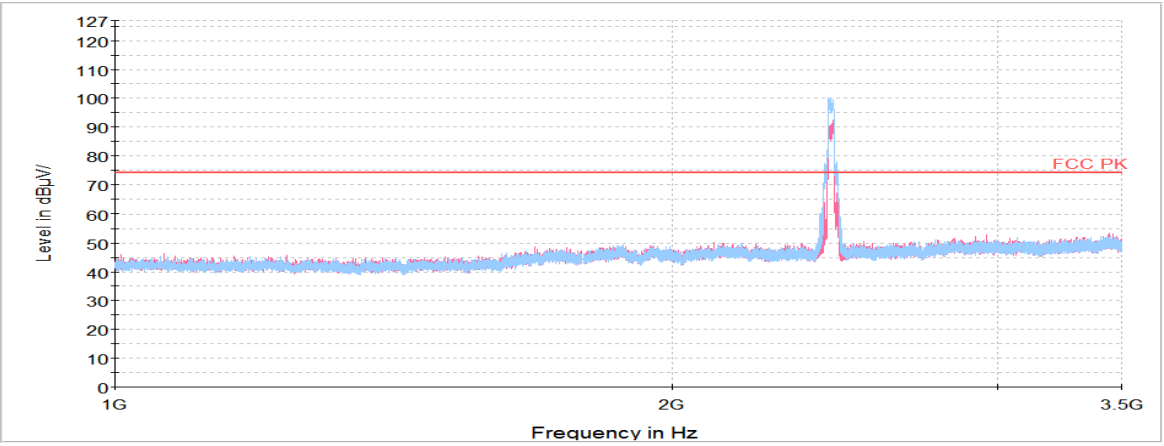

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



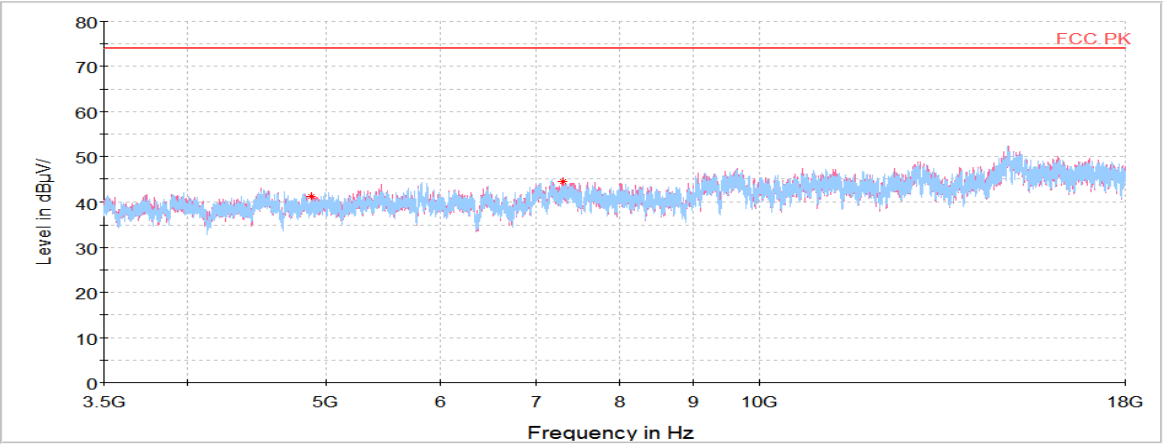
**802.11g_2 437 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 4 882.48[1)] | V | 60.48 | 33.83 | -53.16 | - | 41.15 | 74.00 | 32.85 |
| 7 312.14[1)] | V | 59.54 | 35.30 | -50.43 | - | 44.41 | 74.00 | 29.59 |
| **Average Data** | | | | | | | | |
| No spurious emissions were detected within 20 ㏈ of the limit. | | | | | | | | |

**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



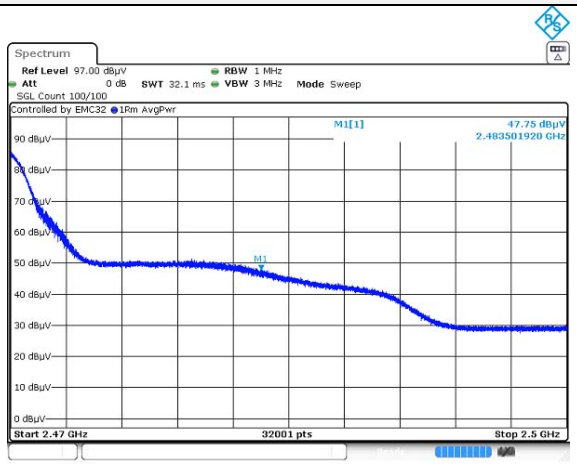

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



**802.11g_2 462 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 547.73 | V | 65.81 | 32.25 | -46.34 | - | 51.72 | 74.00 | 22.28 |
| 2 483.50[1)] | H | 61.10 | 32.17 | -28.29 | - | 64.98 | 74.00 | 9.02 |
| 4 976.28[1)] | V | 60.45 | 33.89 | -52.30 | - | 42.04 | 74.00 | 31.96 |
| 7 417.72[1)] | V | 59.96 | 35.30 | -50.23 | - | 45.03 | 74.00 | 28.97 |
| **Average Data** | | | | | | | | |
| 2 483.50[1)] | H | 47.75 | 32.17 | -28.29 | 0.33 | 51.96 | 54.00 | 2.04 |

**Average data**

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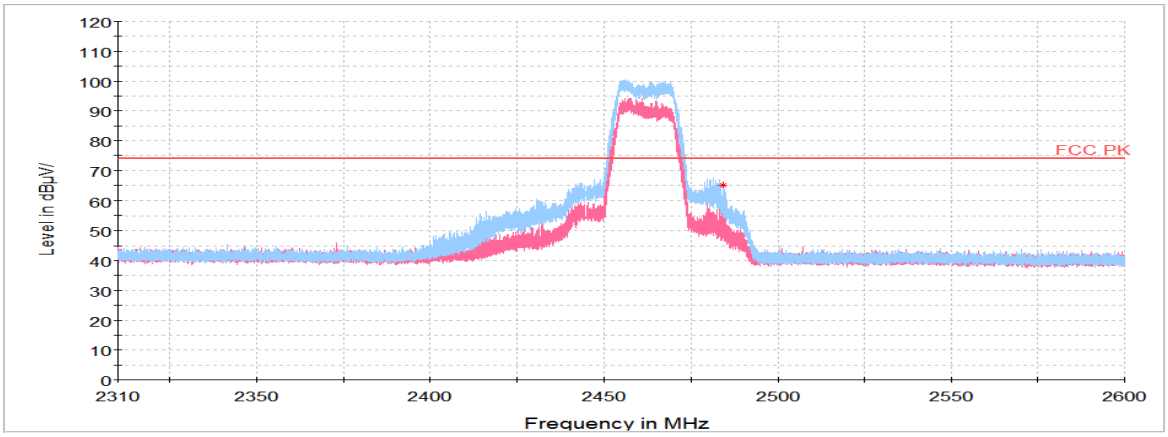
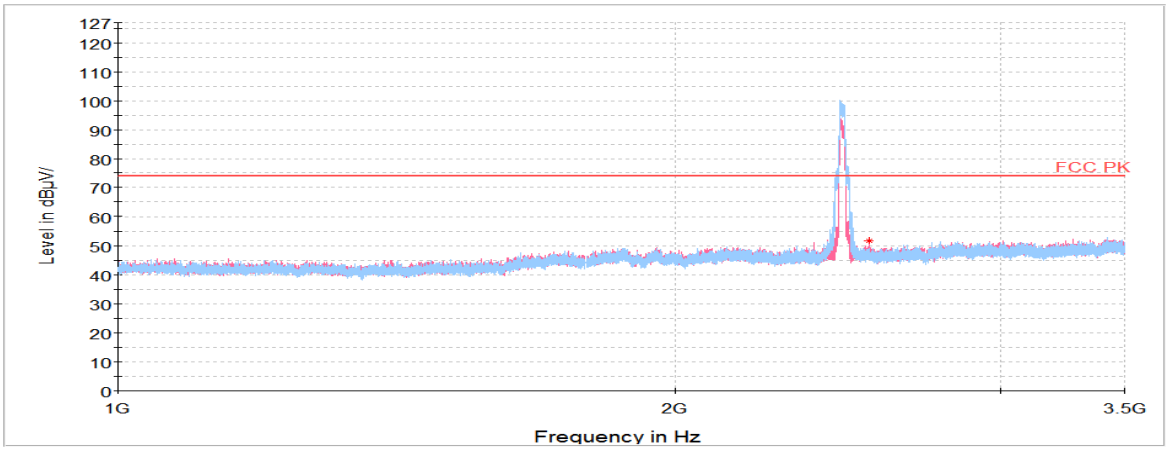
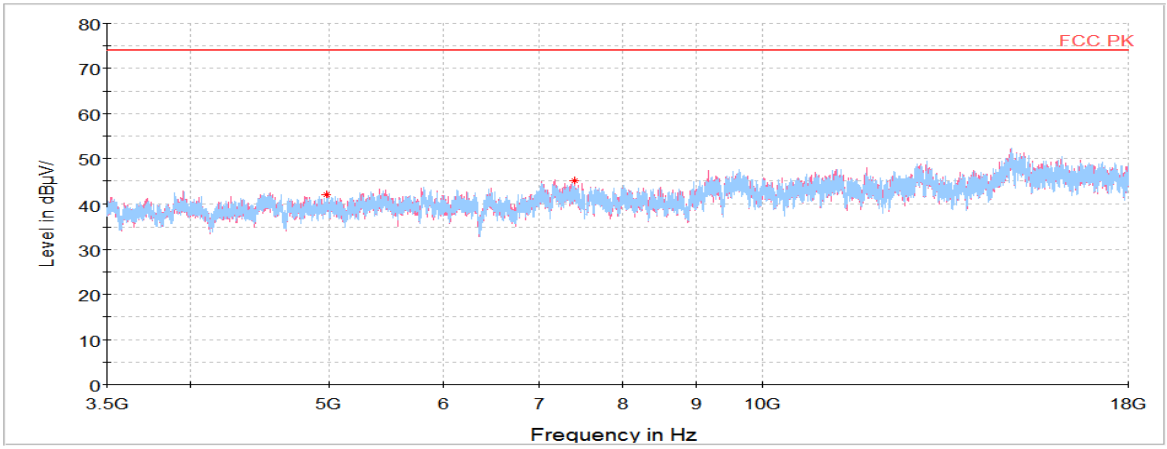
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



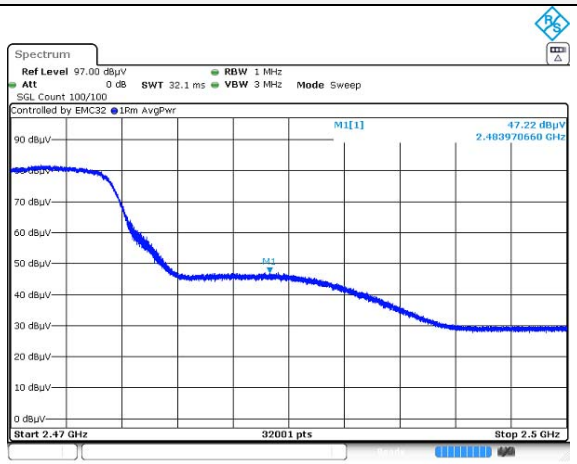

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



**802.11g_2 467 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 483.97[1)] | H | 57.17 | 32.17 | -28.30 | - | 61.04 | 74.00 | 12.96 |
| 5 042.89[1)] | V | 60.57 | 33.98 | -52.69 | - | 41.86 | 74.00 | 32.14 |
| 7 415.45[1)] | H | 60.08 | 35.30 | -50.23 | - | 45.15 | 74.00 | 28.85 |
| **Average Data** | | | | | | | | |
| 2 483.97[1)] | H | 47.22 | 32.17 | -28.30 | 0.33 | 51.42 | 54.00 | 2.58 |

**Average data**

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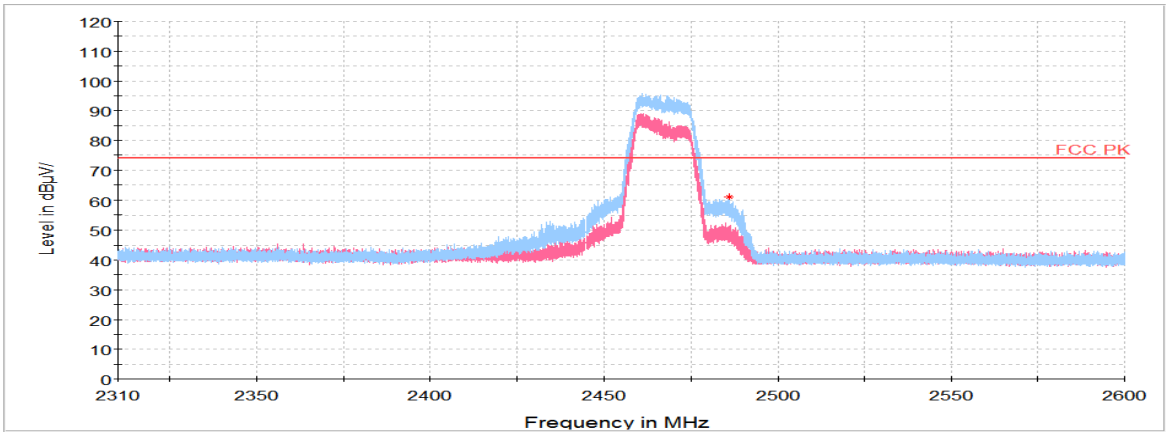
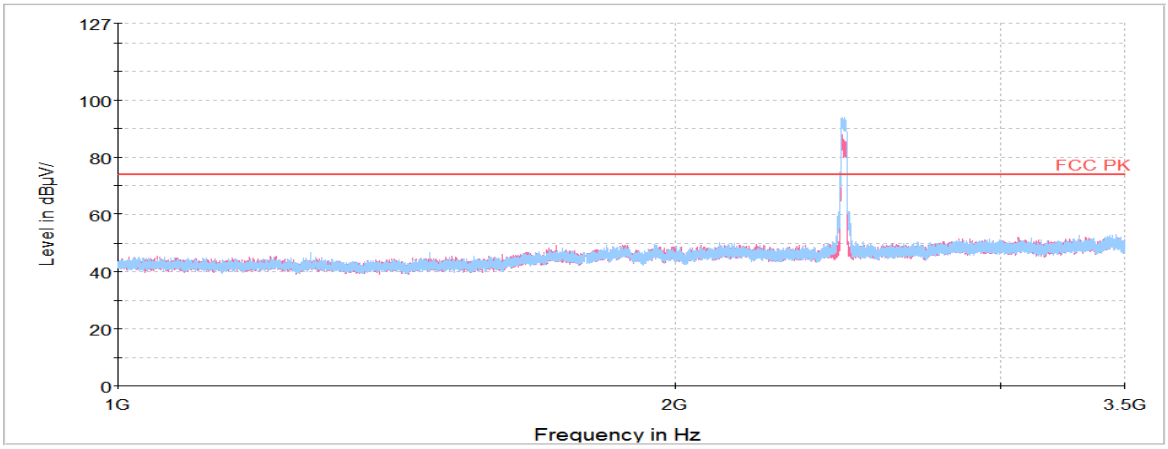
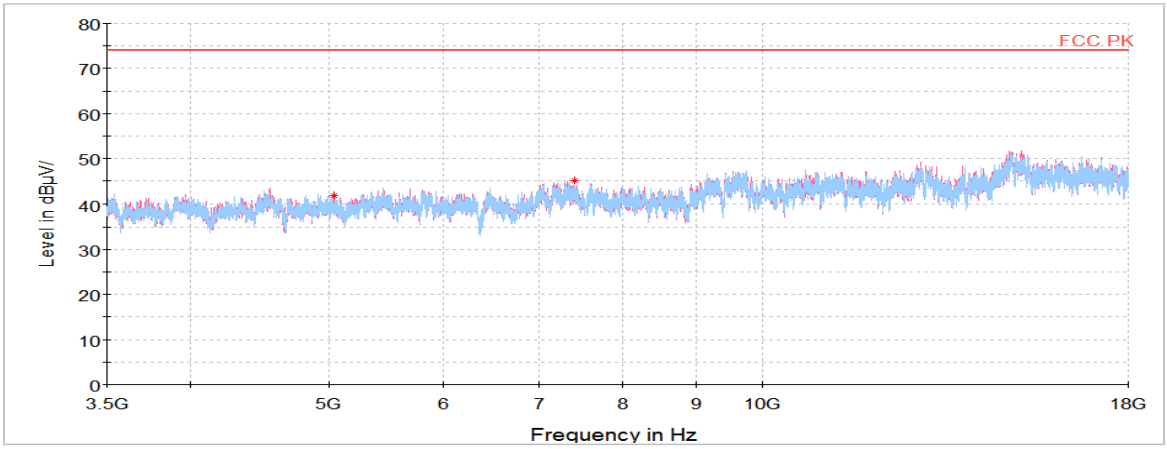
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



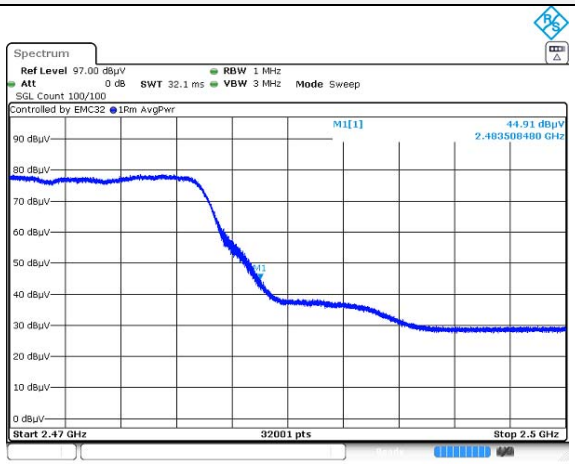

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



**802.11g_2 472 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 512.50 | H | 66.40 | 32.21 | -46.22 | - | 52.39 | 74.00 | 21.61 |
| 2 483.51[1)] | H | 56.27 | 32.17 | -28.29 | - | 60.15 | 74.00 | 13.85 |
| 5 027.03[1)] | H | 60.64 | 33.95 | -52.45 | - | 42.14 | 74.00 | 31.86 |
| 7 424.06[1)] | V | 58.93 | 35.30 | -50.21 | - | 44.02 | 74.00 | 29.98 |
| **Average Data** | | | | | | | | |
| 2 483.51[1)] | H | 44.91 | 32.17 | -28.29 | 0.33 | 49.12 | 54.00 | 4.88 |

**Average data**

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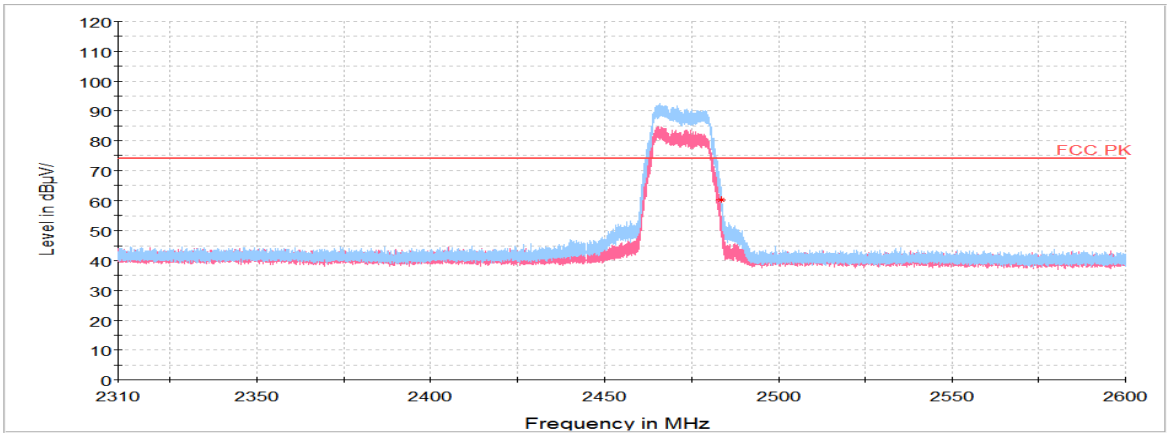
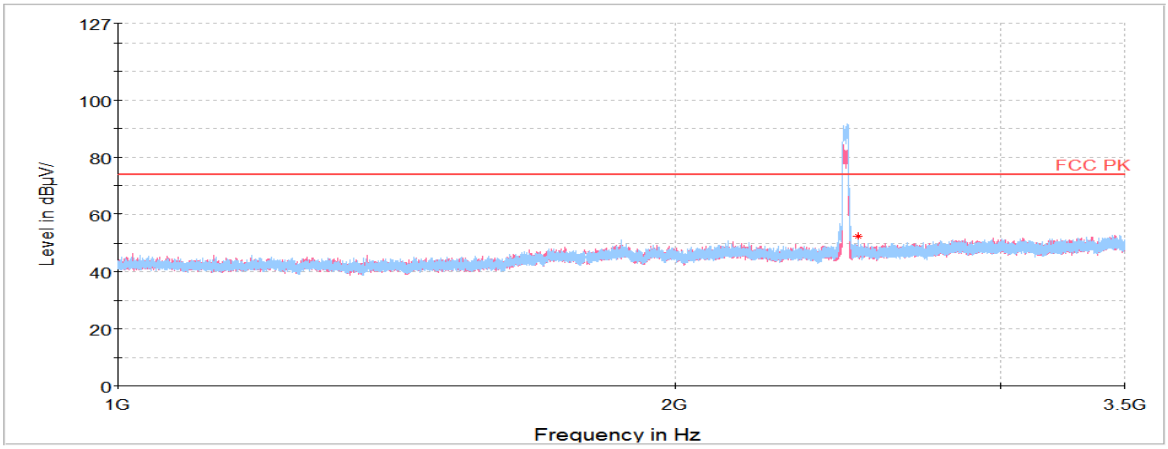
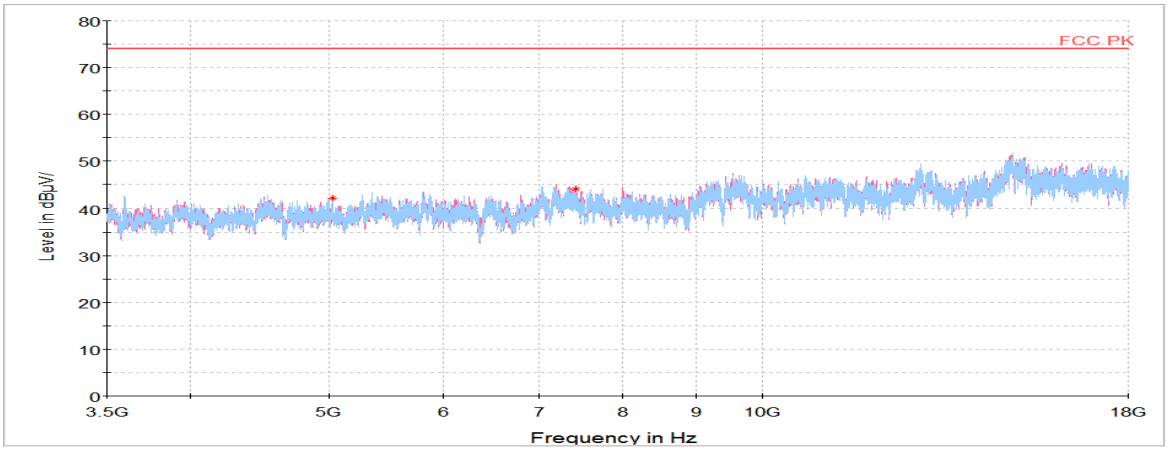
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



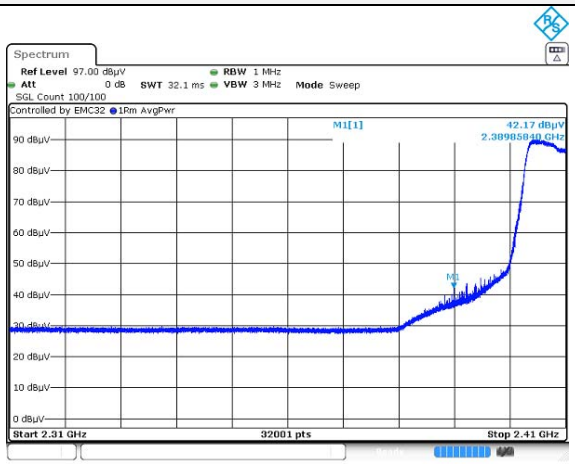

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



### 802.11n HT20_2 412 ㎒

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 389.86[1)] | H | 60.16 | 32.00 | -27.27 | - | 64.89 | 74.00 | 9.11 |
| 4 811.80[1)] | H | 61.56 | 33.79 | -53.10 | - | 42.25 | 74.00 | 31.75 |
| 7 180.73 | V | 60.06 | 35.30 | -50.69 | - | 44.67 | 74.00 | 29.33 |
| **Average Data** | | | | | | | | |
| 2 389.86[1)] | H | 42.17 | 32.00 | -27.27 | 0.36 | 47.26 | 54.00 | 6.74 |

**Average data**

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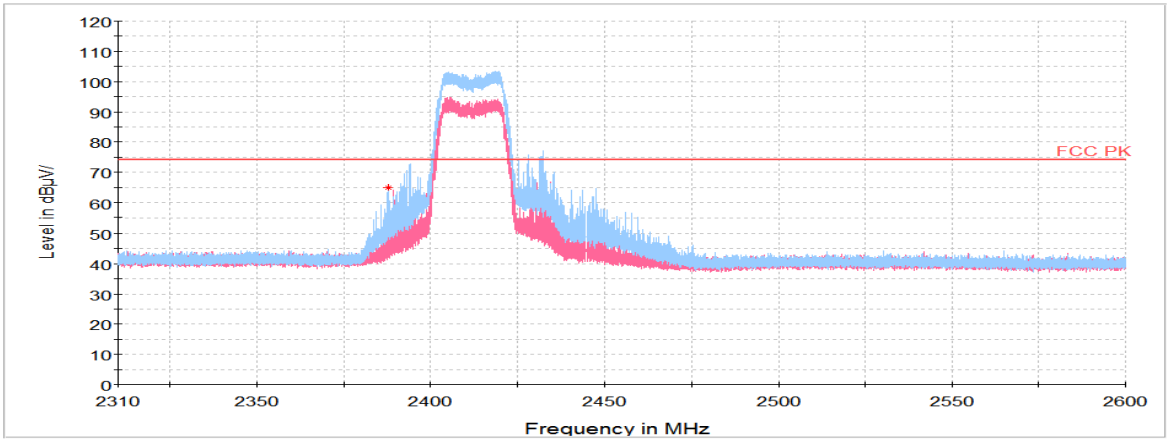
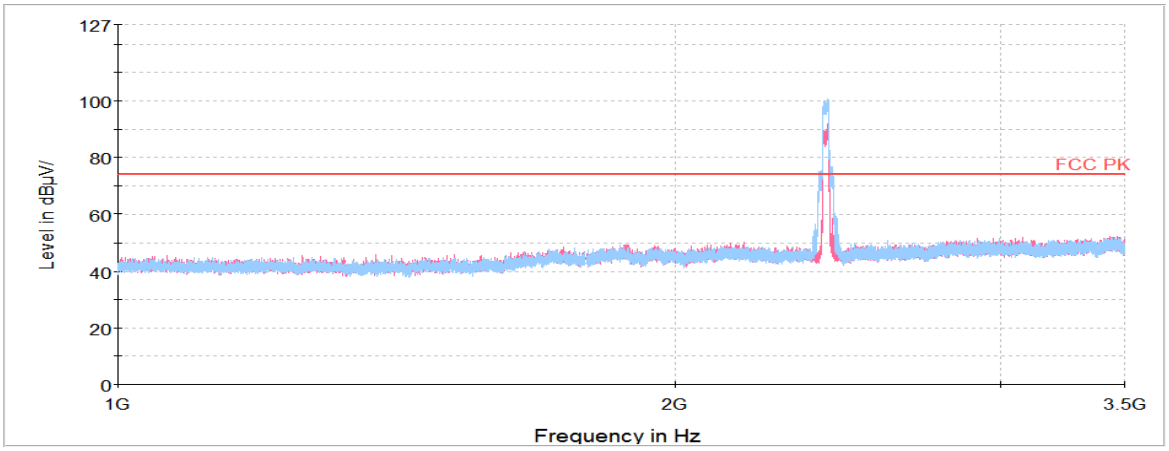
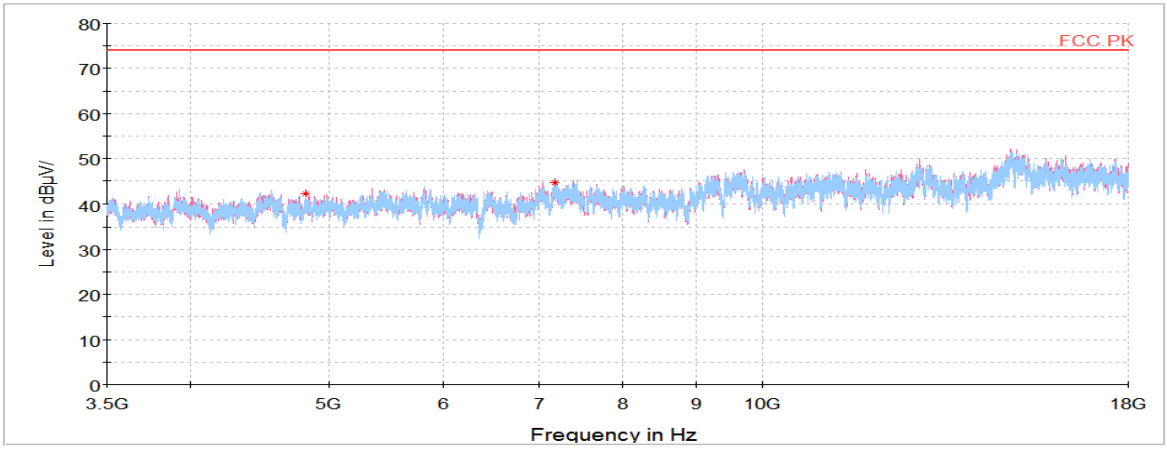
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



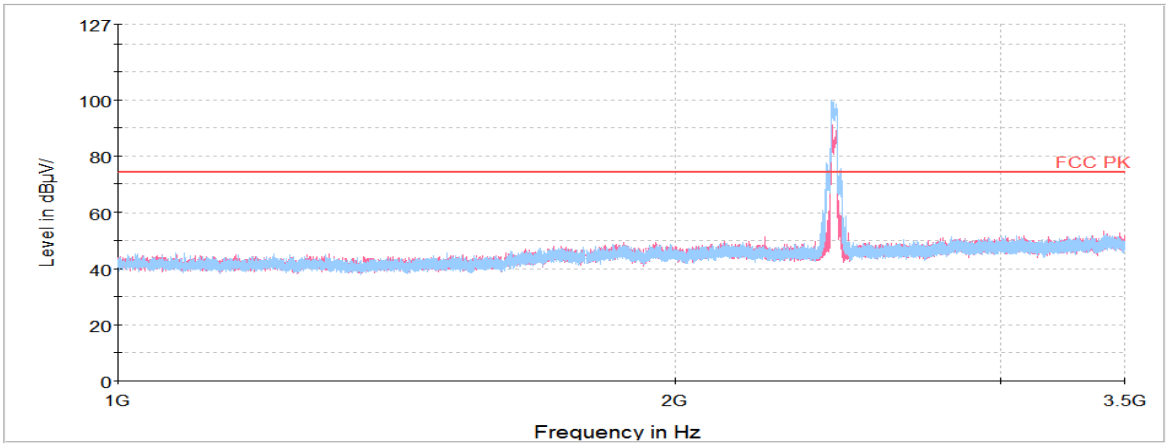

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



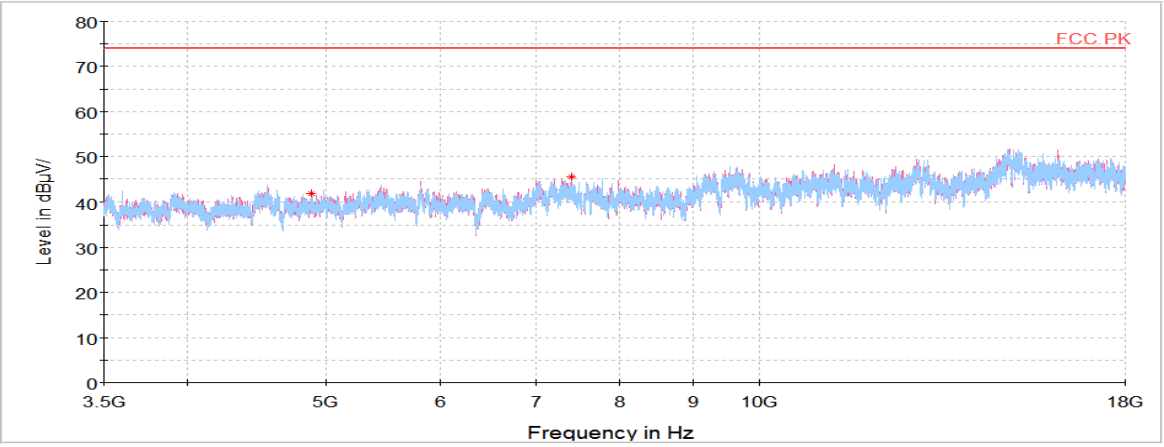
### 802.11n HT20_2 437 ㎒

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 4 887.92[1)] | H | 61.15 | 33.83 | -53.17 | - | 41.81 | 74.00 | 32.19 |
| 7 410.47[1)] | V | 60.37 | 35.30 | -50.24 | - | 45.43 | 74.00 | 28.57 |
| **Average Data** | | | | | | | | |
| No spurious emissions were detected within 20 ㏈ of the limit. | | | | | | | | |

**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



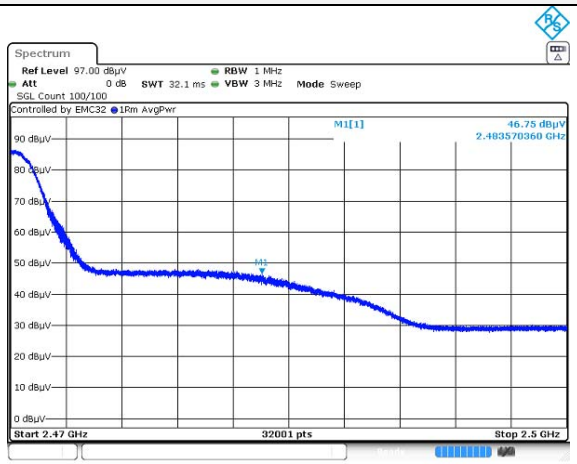

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



### 802.11n HT20_2 462 ㎒

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 483.57[1)] | H | 58.28 | 32.17 | -28.30 | - | 62.15 | 74.00 | 11.85 |
| 4 982.63 | H | 60.57 | 33.89 | -52.23 | - | 42.23 | 74.00 | 31.77 |
| 7 327.55 | V | 60.07 | 35.30 | -50.40 | - | 44.97 | 74.00 | 29.03 |
| **Average Data** | | | | | | | | |
| 2 483.57[1)] | H | 46.75 | 32.17 | -28.30 | 0.36 | 50.98 | 54.00 | 3.02 |

**Average data**

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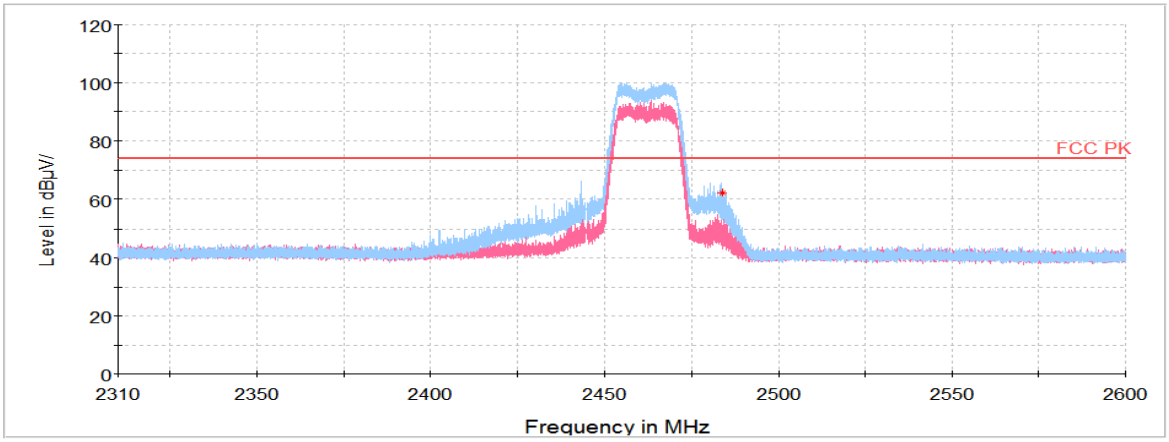
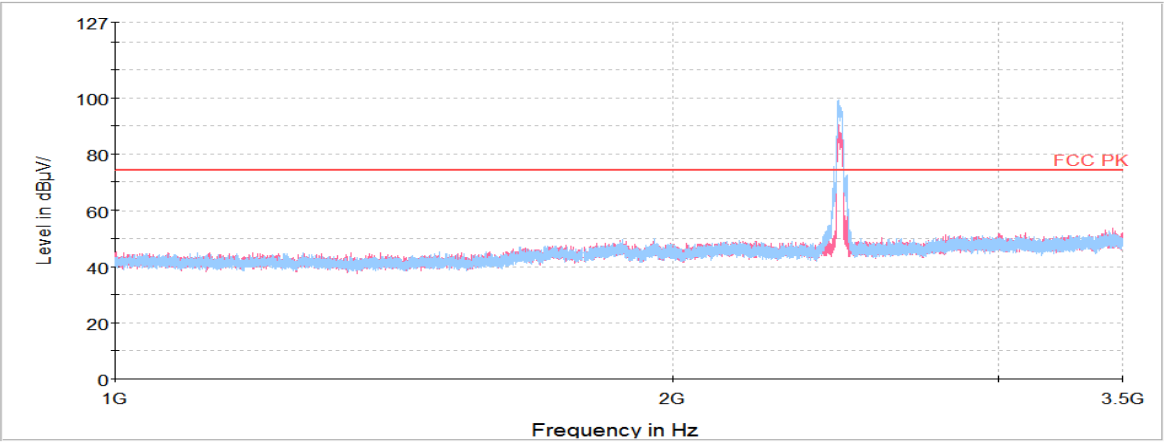
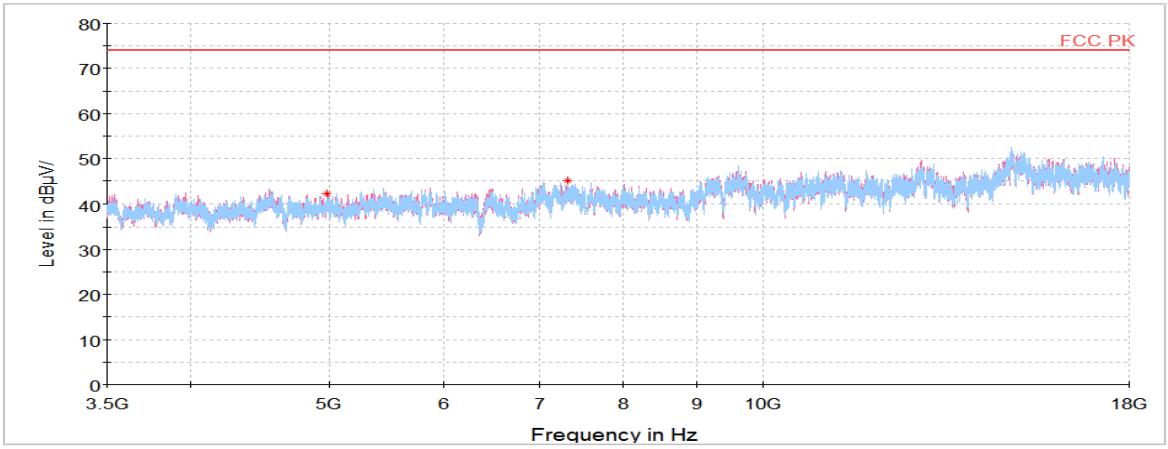
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



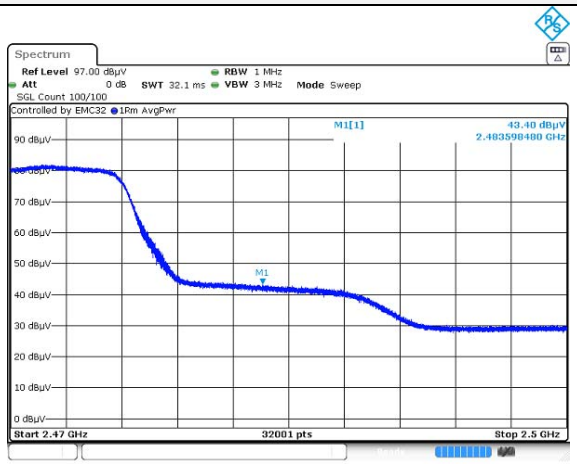

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



**802.11n HT20_2 467 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 483.60[1)] | H | 54.24 | 32.17 | -28.30 | - | 58.11 | 74.00 | 15.89 |
| 4 955.44[1)] | H | 60.49 | 33.87 | -52.54 | - | 41.82 | 74.00 | 32.18 |
| 7 456.69[1)] | V | 59.75 | 35.30 | -50.15 | - | 44.90 | 74.00 | 29.10 |
| **Average Data** | | | | | | | | |
| 2 483.60[1)] | H | 43.40 | 32.17 | -28.30 | 0.36 | 47.63 | 54.00 | 6.37 |

**Average data**

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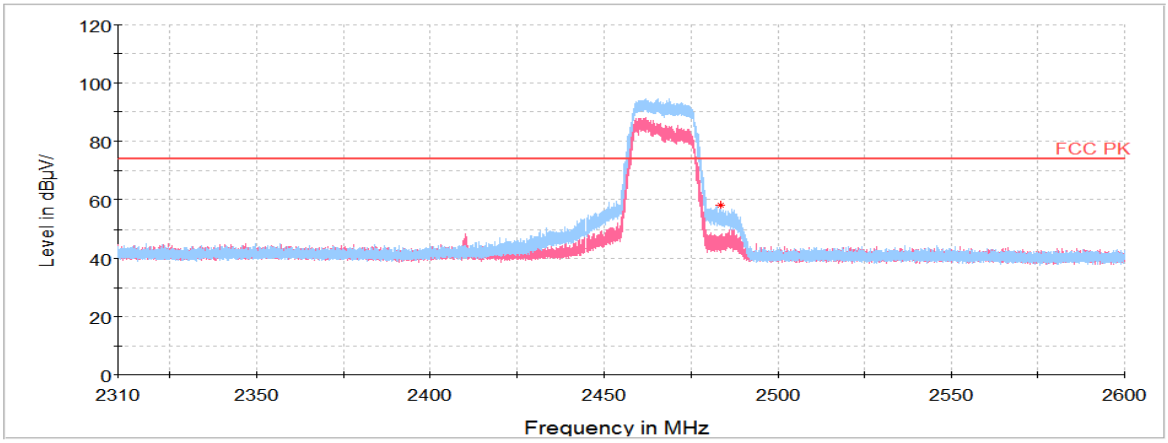
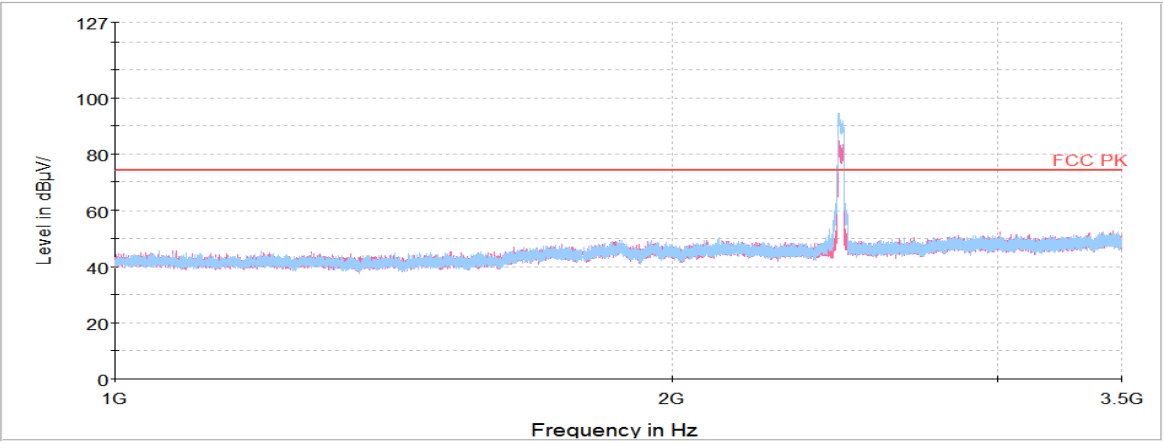
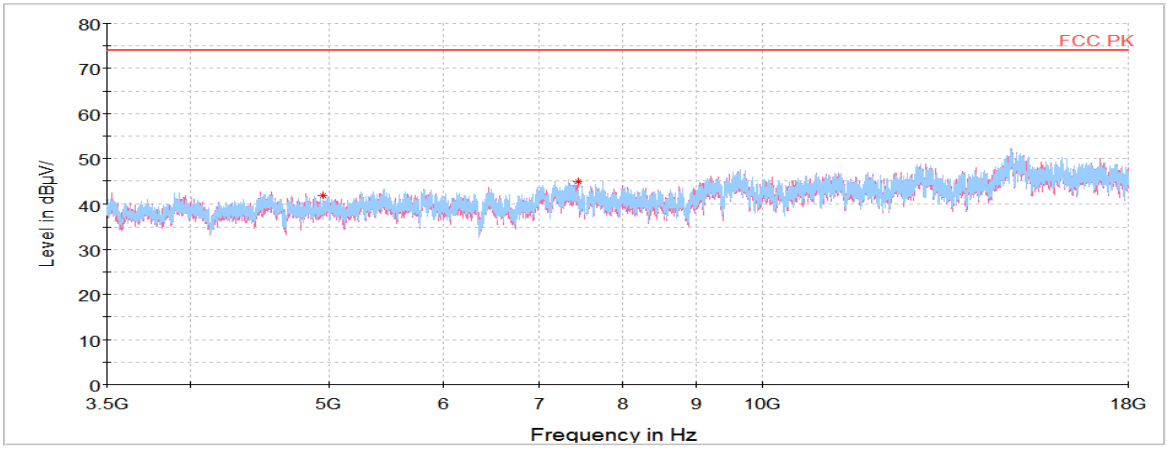
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**



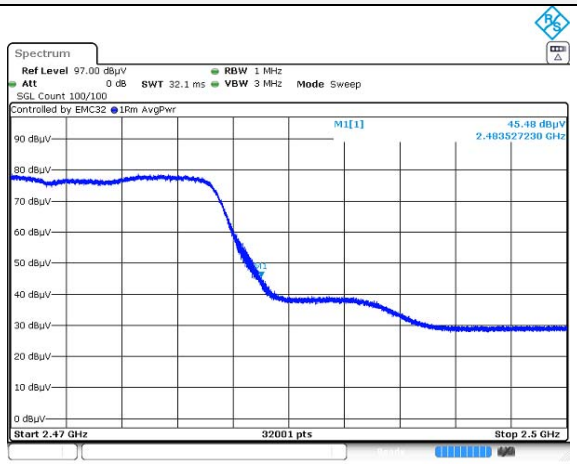

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



**802.11n HT20_2 472 ㎒**

| Frequency | Pol. | Reading | Ant. Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Peak data** | | | | | | | | |
| 2 483.53[1)] | H | 57.75 | 32.17 | -28.30 | - | 61.62 | 74.00 | 12.38 |
| 4 990.78[1)] | V | 60.28 | 33.89 | -52.14 | - | 42.03 | 74.00 | 31.97 |
| 7 405.48[1)] | H | 60.41 | 35.30 | -50.25 | - | 45.46 | 74.00 | 28.54 |
| **Average Data** | | | | | | | | |
| 2 483.53[1)] | H | 45.48 | 32.17 | -28.30 | 0.36 | 49.71 | 54.00 | 4.29 |

**Average data**

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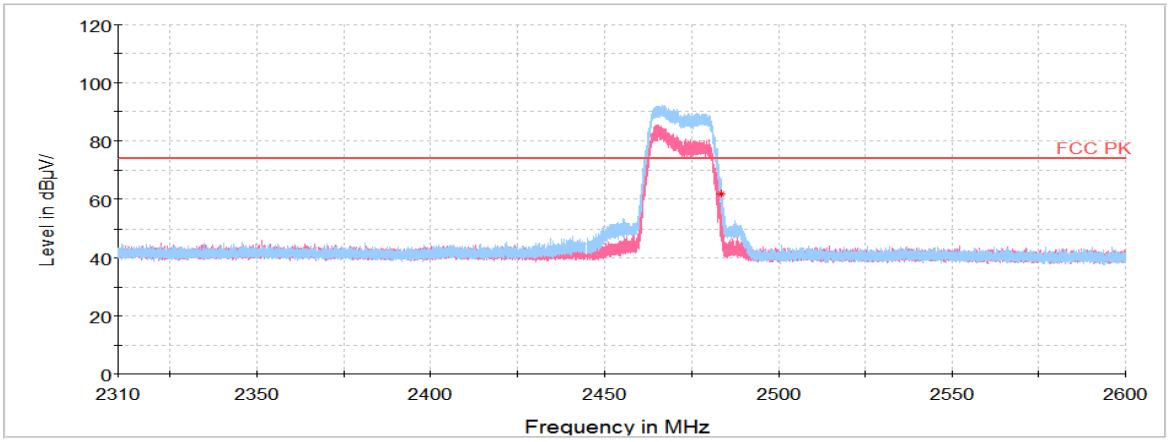
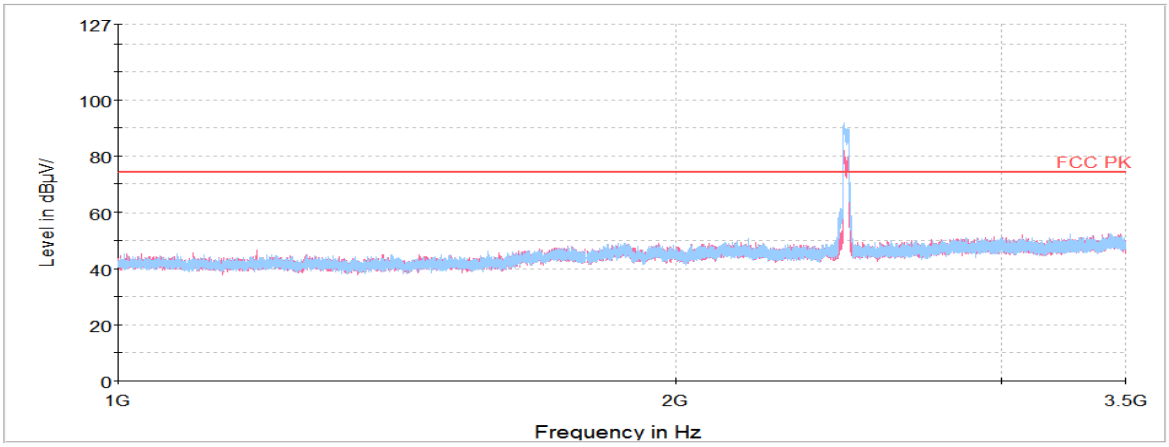
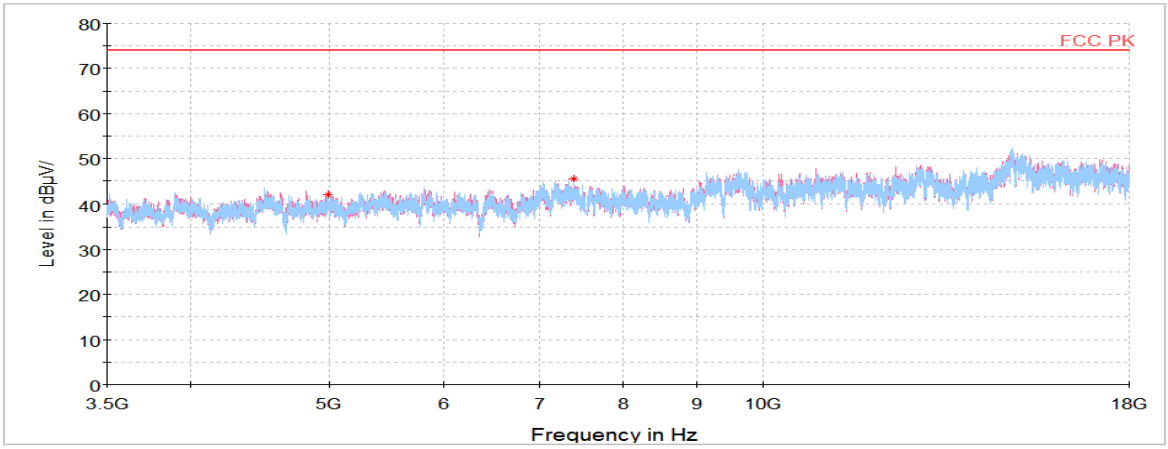
**Horizontal/Vertical for Band-edge**



**Horizontal/Vertical for 1 ㎓ ~ 3.5 ㎓**

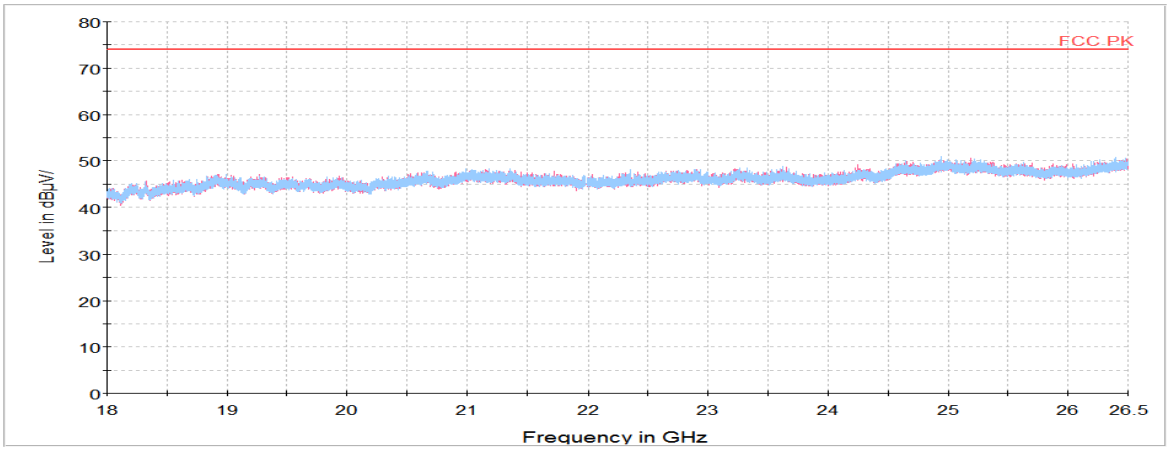



**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



**Test results (Above 18 ㎓) – Worst Case : 802.11g mode / 2 462 ㎒**

**Horizontal/Vertical for 18 ㎓ ~ 26.5 ㎓**




**Note:** The worst case was based on the lowest margin condition considering harmonic and spurious emission

## 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-A1698-HS | WT160411001 | 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**