



# TEST REPORT

|                                                                                                                                                                                                                       |                                             |                                                        |                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------|------------------------------------------------------|
| <b>KCTL Inc.</b><br>65, Sinwon-ro, Yeongtong-gu,<br>Suwon-si, Gyeonggi-do, 16677, Korea<br>TEL: 82-31-285-0894 FAX: 82-505-299-8311<br><a href="http://www.kctl.co.kr">www.kctl.co.kr</a>                             |                                             | Report No.:<br><b>KR19-SRF0179</b><br>Page (1) of (60) |                                                      |
| <b>1. Client</b><br>◦ Name : Samsung Electronics Co., Ltd.<br>◦ Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea<br>◦ Date of Receipt : 2019-10-25                                |                                             |                                                        |                                                      |
| <b>2. Use of Report</b> : -                                                                                                                                                                                           |                                             |                                                        |                                                      |
| <b>3. Name of Product and Model</b> : Mobile Phone / SM-A515F/DS                                                                                                                                                      |                                             |                                                        |                                                      |
| <b>4. Manufacturer and Country of Origin</b> : SAMSUNG ELECTRONICS VIETNAM CO.,LTD./ Vietnam                                                                                                                          |                                             |                                                        |                                                      |
| <b>5. FCC ID</b> : A3LSMA515F                                                                                                                                                                                         |                                             |                                                        |                                                      |
| <b>6. Date of Test</b> : 2019-11-11 to 2019-11-27                                                                                                                                                                     |                                             |                                                        |                                                      |
| <b>7. Test Standards</b> : FCC Part 2 , Part 15.247 subpart C,<br>FCC Part 15.249 subpart C, Part 15.407 subpart E<br>FCC Part 22 subpart H, Part 24 subpart E<br>FCC Part 27 subpart C, Part 90 subpart S            |                                             |                                                        |                                                      |
| <b>8. Test Results</b> : Refer to the test result in the test report                                                                                                                                                  |                                             |                                                        |                                                      |
| Affirmation                                                                                                                                                                                                           | Tested by<br>Name : Euijung Kim (Signature) |                                                        | Technical Manager<br>Name : Jaehyong Lee (Signature) |
|                                                                                                                                                                                                                       |                                             |                                                        |                                                      |
| 2019-11-28                                                                                                                                                                                                            |                                             |                                                        |                                                      |
| <b>KCTL Inc.</b>                                                                                                                                                                                                      |                                             |                                                        |                                                      |
| As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by KCTL Inc. |                                             |                                                        |                                                      |

#### Report revision history

| Date       | Revision       | Page No |
|------------|----------------|---------|
| 2019-11-28 | Initial report | -       |
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*KCTL*

## 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 VIETNAM CO.,LTD.  
Address : Kcn Yen Binh1, huyen pho Yen Tinh Thai Nguyen Vietnam  
Laboratory : KCTL Inc.  
Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea  
Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132  
VCCI Registration No. : R-20080, G-20078, C-20059, T-20056  
Industry Canada Registration No. : 8035A  
KOLAS No.: KT231

## 2. Spot-check information

This report referenced from the FCC ID : A3LSMA515FN.

The difference between the FCC ID: A3LSMA515F and FCC ID: A3LSMA515N is NFC functionality, all the functions are same except circuit diagram and software.

As for all bands, they have been verified and the parent model test results under FCC ID : A3LSMA515FN shall remain representative of FCC ID : A3LSMA515F.

| Reference FCC ID | Equipment class | Spot check bands | Report title              |
|------------------|-----------------|------------------|---------------------------|
| A3LSMA515FN      | PCE             | GSM 850          | 2G3G(Part22,24,27) report |
|                  |                 | GSM 1900         |                           |
|                  |                 | WCDMA 850        |                           |
|                  |                 | WCDMA 1700       |                           |
|                  |                 | WCDMA 1900       |                           |
|                  |                 | LTE Band 2       | LTE(Part22,24,27) report  |
|                  |                 | LTE Band 4       |                           |
|                  |                 | LTE Band 5       |                           |
|                  |                 | LTE Band 12      |                           |
|                  |                 | LTE Band 13      |                           |
|                  |                 | LTE Band 17      |                           |
|                  |                 | LTE Band 41      |                           |
|                  |                 | LTE Band 66      |                           |
|                  |                 | LTE Band 26      | LTE(Part22,90) report     |
|                  | DTS             | WIFI             | WIFI(Part 15.247) report  |
|                  |                 | BLE              | BLE(Part 15.247) report   |
|                  | DSS             | Bluetooth        | BT(Part 15.247) report    |
|                  | DXX             | ANT+             | ANT+(Part 15.249) report  |
|                  | NII             | WIFI             | WIFI(Part 15.407) report  |

**Notes:**

- For FCC ID: ASLSMA515F has been verified the performance as for LTE Band2/4/5/12/13/17 /26/41/66, GSM850/1900, WCDMA 850/1700/1900, WIFI, BT, BLE and ANT+ identical with the FCC ID: A3LSMA515FN.
- Comparison of two models, upper deviation is within 3 dB range and all test results are under FCC technical limits.
- The test procedure(s) in this report were performed in accordance as following.
  - ♦ KDB 484596 D01 v01

### 3. Spot-check verification data

#### 3.1. Radiated power (ERP/EIRP) & spurious emissions

##### Test results

##### 3.1.1. Radiated power (ERP/EIRP) for licensed bands

| Test band    | Test item | Worst mode   | Channel | Measured frequency (MHz) | SM-A515F/DSN (dBm) | SM-A515F/DS (dBm) | Deviation (dB) |
|--------------|-----------|--------------|---------|--------------------------|--------------------|-------------------|----------------|
| GSM 850      | ERP       | GSM          | 251     | 848.80                   | 26.36              | 26.30             | 0.06           |
| GSM 1900     | EIRP      | GSM          | 810     | 1 909.80                 | 28.10              | 27.02             | 1.08           |
| WCDMA V      | ERP       | RMC          | 4132    | 826.40                   | 19.44              | 18.57             | 0.87           |
| WCDMA IV     | EIRP      | RMC          | 1513    | 1 752.60                 | 18.96              | 18.59             | 0.37           |
| WCDMA II     | EIRP      | RMC          | 9538    | 1 907.60                 | 20.85              | 19.80             | 1.05           |
| LTE 2        | EIRP      | QPSK 1.4 MHz | 19193   | 1 909.30                 | 20.52              | 19.54             | 0.98           |
| LTE 4        | EIRP      | QPSK 20 MHz  | 20050   | 1 720.00                 | 21.22              | 20.83             | 0.39           |
| LTE 5        | ERP       | QPSK 10 MHz  | 20450   | 829.00                   | 19.37              | 18.64             | 0.73           |
| LTE 12       | ERP       | QPSK 3 MHz   | 23165   | 714.50                   | 19.06              | 18.86             | 0.20           |
| LTE 13       | ERP       | QPSK 5 MHz   | 23205   | 779.50                   | 18.83              | 18.37             | 0.46           |
| LTE 17       | ERP       | QPSK 5 MHz   | 23825   | 713.50                   | 18.96              | 18.09             | 0.87           |
| LTE 26(P22H) | ERP       | QPSK 3 MHz   | 26805   | 825.50                   | 18.90              | 18.20             | 0.70           |
| LTE 26(P22H) | ERP       | QPSK 3 MHz   | 26790   | 824.00                   | 19.35              | 18.26             | 1.09           |
| LTE 26(P90S) | ERP       | QPSK 1.4 MHz | 26783   | 823.30                   | 18.69              | 18.42             | 0.27           |
| LTE 41       | EIRP      | QPSK 20 MHz  | 40620   | 2 593.00                 | 23.87              | 23.38             | 0.49           |
| LTE 66       | EIRP      | QPSK 3 MHz   | 132657  | 1 778.50                 | 22.66              | 21.77             | 0.89           |

### 3.1.2. Spurious emissions for licensed bands

| Test band    | Test item | Worst mode   | Channel | Measured frequency (MHz) | SM-A515F/DSN (dBm) | SM-A515F/DS (dBm) | Deviation (dB) |
|--------------|-----------|--------------|---------|--------------------------|--------------------|-------------------|----------------|
| GSM 850      | RSE       | GSM          | 251     | 4 241.70                 | -55.80             | -59.10            | 3.30           |
| GSM 1900     | RSE       | GSM          | 810     | 9 550.50                 | -53.80             | -54.50            | 0.70           |
| WCDMA V      | RSE       | RMC          | 4132    | 3 302.64                 | -55.80             | -56.10            | 0.30           |
| WCDMA IV     | RSE       | RMC          | 1513    | 7 011.00                 | -55.40             | -54.00            | -1.40          |
| WCDMA II     | RSE       | RMC          | 9538    | 7 642.00                 | -54.20             | -55.40            | 1.20           |
| LTE 2        | RSE       | QPSK 1.4 MHz | 19193   | 9 546.44                 | -52.80             | -54.00            | 1.20           |
| LTE 4/66     | RSE       | QPSK 3 MHz   | 132657  | 3 557.00                 | -52.30             | -55.10            | 2.80           |
| LTE 5        | RSE       | QPSK 10 MHz  | 20450   | 3 316.15                 | -46.10             | -51.70            | 5.60           |
| LTE 12       | RSE       | QPSK 3 MHz   | 23165   | 3 573.16                 | -51.90             | -54.60            | 2.70           |
| LTE 13       | RSE       | QPSK 5 MHz   | 23205   | 3 886.68                 | -54.10             | -53.80            | -0.30          |
| LTE 17       | RSE       | QPSK 5 MHz   | 23825   | 3 578.32                 | -52.50             | -51.80            | -0.70          |
| LTE 26(P22H) | RSE       | QPSK 3 MHz   | 26805   | 3 296.29                 | -47.40             | -52.30            | 4.90           |
| LTE 26(P22H) | RSE       | QPSK 3 MHz   | 26790   | 3 291.29                 | -51.50             | -50.90            | -0.60          |
| LTE 26(P90S) | RSE       | QPSK 1.4 MHz | 26783   | 3 291.14                 | -53.40             | -55.10            | 1.70           |
| LTE 41       | RSE       | QPSK 20 MHz  | 40620   | 7 779.32                 | -41.10             | -41.00            | -0.10          |

## 3.2. Radiated spurious emissions & band edge

### Test results

#### 3.2.1. Unlicensed bands

| Test band | Test item | Test mode        | Channel | Measured frequency (MHz) | SM-A515F/DSN (dBμV) |       | SM-A515F/DS (dBμV) |       | Deviation (dB) |       |
|-----------|-----------|------------------|---------|--------------------------|---------------------|-------|--------------------|-------|----------------|-------|
|           |           |                  |         |                          | Avg.                | Peak  | Avg.               | Peak  | Avg.           | Peak  |
| 2.4G WIFI | Band edge | 802.11b          | 13      | 2 483.5 ~ 2 500          | -                   | 50.33 | -                  | 52.12 | -              | -1.79 |
|           | RSE       |                  | 6       | 7 311                    | 50.59               | 54.56 | 50.98              | 55.58 | -0.39          | -1.02 |
|           | Band edge | 802.11g          | 13      | 2 483.5 ~ 2 500          | 50.69               | 63.92 | 50.55              | 65.24 | 0.14           | -1.32 |
|           | RSE       |                  | 1       | 7 236                    | 43.01               | 56.22 | 45.98              | 55.09 | -2.97          | 1.13  |
|           | Band edge | 802.11n HT20     | 13      | 2 483.5 ~ 2 500          | 50.95               | 63.19 | 50.89              | 64.91 | 0.06           | -1.72 |
|           | RSE       |                  | 6       | 7 311                    | 45.66               | 54.48 | 47.42              | 56.33 | -1.76          | -1.85 |
| BT        | Band edge | DH5              | 0       | 2 310 ~ 2 390            | 36.33               | 63.56 | 29.52              | 54.79 | 6.81           | 8.77  |
|           | RSE       |                  | 78      | 7 440                    | 49.87               | 54.64 | 47.41              | 51.14 | 2.46           | 3.50  |
|           | Band edge | 3DH5             | 78      | 2 483.5 ~ 2 500          | 36.49               | 63.33 | 29.27              | 52.35 | 7.22           | 10.98 |
|           | RSE       |                  | 78      | 7 440                    | -                   | 53.45 | -                  | 50.05 | -              | 3.40  |
| BLE       | Band edge | 1Mbps Packet 37  | 39      | 2 483.5 ~ 2 500          | 43.62               | 57.96 | 37.48              | 53.17 | 6.14           | 4.79  |
|           | RSE       |                  | 39      | 7 440                    | -                   | 48.08 | -                  | 47.81 | -              | 0.27  |
|           | Band edge | 1Mbps Packet 255 | 39      | 2 483.5 ~ 2 500          | -                   | 47.86 | -                  | 50.28 | -              | -2.42 |
|           | RSE       |                  | 39      | 7 440                    | -                   | 46.37 | -                  | 47.76 | -              | -1.39 |
|           | Band edge | 2Mbps Packet 37  | 39      | 2 483.5 ~ 2 500          | 44.55               | 57.78 | 42.18              | 51.98 | 2.37           | 5.80  |
|           | RSE       |                  | 39      | 7 440                    | -                   | 47.79 | -                  | 48.42 | -              | -0.63 |
|           | Band edge | 2Mbps Packet 255 | 39      | 2 483.5 ~ 2 500          | -                   | 49.61 | -                  | 50.07 | -              | -0.46 |
|           | RSE       |                  | 39      | 7 440                    | -                   | 45.50 | -                  | 45.60 | -              | -0.10 |

| Test band | Test item | Test mode      | Channel | Measured frequency (MHz) | SM-A515F/DSN (dBμV) |       | SM-A515F/DS (dBμV) |       | Deviation (dB) |       |
|-----------|-----------|----------------|---------|--------------------------|---------------------|-------|--------------------|-------|----------------|-------|
|           |           |                |         |                          | Avg.                | Peak  | Avg.               | Peak  | Avg.           | Peak  |
| ANT+      | Band edge | GFSK           | 78      | 2 483.5 ~ 2 500          | -                   | 46.01 | -                  | 42.17 | -              | 3.84  |
|           | RSE       | GFSK           | 39      | 7 323                    | -                   | 43.43 | -                  | 45.51 | -              | -2.08 |
| 5G WIFI   | Band edge | 802.11a        | 64      | 5 350 ~ 5 460            | 50.68               | 62.50 | 49.26              | 59.09 | 1.42           | 3.41  |
|           | RSE       |                | 120     | 16 800                   | -                   | 51.75 | -                  | 47.76 | -              | 3.99  |
|           | Band edge | 802.11n HT20   | 64      | 5 350 ~ 5 460            | 50.60               | 60.28 | 49.53              | 61.21 | 1.07           | -0.93 |
|           | RSE       |                | 120     | 16 800                   | -                   | 50.60 | -                  | 46.89 | -              | 3.71  |
|           | Band edge | 802.11n HT40   | 62      | 5 350 ~ 5 460            | 50.89               | 59.70 | 49.66              | 61.13 | 1.23           | -1.43 |
|           | RSE       |                | 118     | 16 770                   | -                   | 50.65 | -                  | 47.79 | -              | 2.86  |
|           | Band edge | 802.11ac VHT20 | 36      | 4 500 ~ 5 150            | 50.55               | 59.99 | 50.95              | 60.92 | -0.40          | -0.93 |
|           | RSE       |                | 120     | 16 800                   | -                   | 51.02 | -                  | 49.14 | -              | 1.88  |
|           | Band edge | 802.11ac VHT40 | 38      | 4 500 ~ 5 150            | 50.84               | 58.63 | 47.15              | 55.78 | 3.69           | 2.85  |
|           | RSE       |                | 118     | 16 770                   | -                   | 51.03 | -                  | 47.37 | -              | 3.66  |
|           | Band edge | 802.11ac VHT80 | 58      | 5 350 ~ 5 460            | 50.88               | 57.79 | 48.76              | 56.81 | 2.12           | 0.98  |
|           | RSE       |                | 42      | 10 420                   | -                   | 50.31 | -                  | 44.35 | -              | 5.96  |

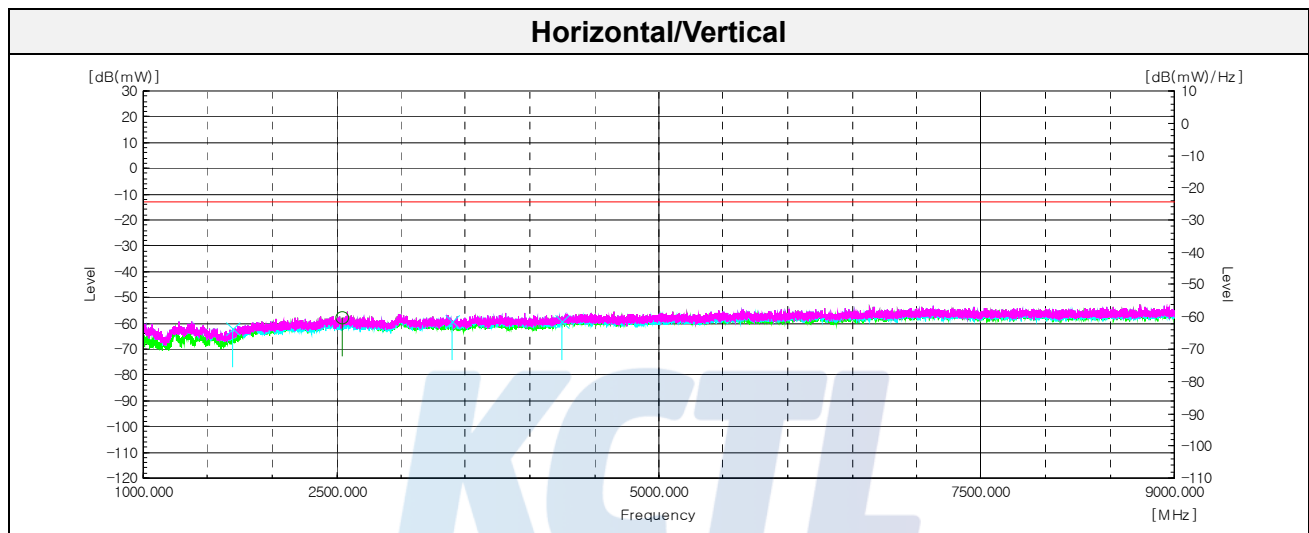
### 3.2.2 Field strength of fundamental for ANT+

| Test band | Test item   | Test mode | Pol.  | Channel | Measured frequency (MHz) | SM-A105F/DS (dBμV) |       | SM-A105M/DS (dBμV) |       | Deviation (dB) |       |
|-----------|-------------|-----------|-------|---------|--------------------------|--------------------|-------|--------------------|-------|----------------|-------|
|           |             |           | (V/H) |         |                          | Avg.               | Peak  | Avg.               | Peak  | Avg.           | Peak  |
| ANT+      | Fundamental | GFSK      | H     | 0       | 2 402                    | 48.14              | 80.88 | 39.65              | 72.81 | 8.49           | 8.07  |
|           |             |           | V     |         |                          | 43.70              | 76.44 | 35.88              | 69.05 | 7.82           | 7.39  |
|           |             |           | H     | 39      | 2 441                    | 48.67              | 81.41 | 40.56              | 73.72 | 8.11           | 7.69  |
|           |             |           | V     |         |                          | 42.06              | 74.80 | 34.81              | 67.98 | 7.25           | 6.82  |
|           |             |           | H     | 78      | 2 480                    | 48.43              | 81.18 | 37.36              | 70.52 | 11.07          | 10.66 |
|           |             |           | V     |         |                          | 44.68              | 77.43 | 30.61              | 63.78 | 14.07          | 13.65 |

### 3.3. Test results

#### 3.3.1 Licensed bands

##### Test results (Above 1 000 MHz)

Test mode : GSM 850Frequency (MHz) : 848.8Channel : 251

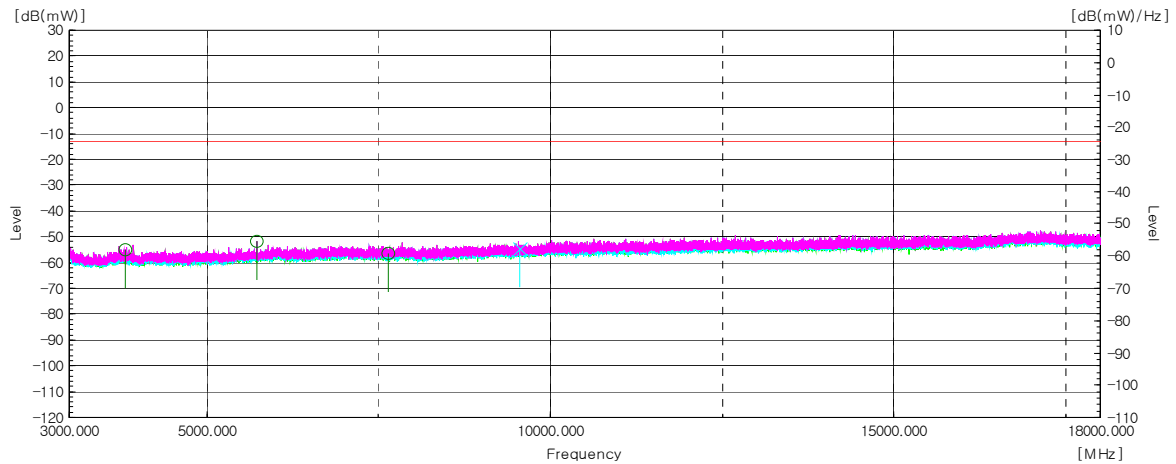
| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 4 242.20  | V     | 8.84         | 8.70       | -59.24           | -59.10 | -13.00 | 46.10  |

Note.

1. Limit Calculation(dBm)= 43 + 10log(P<sub>Watts</sub>)

2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

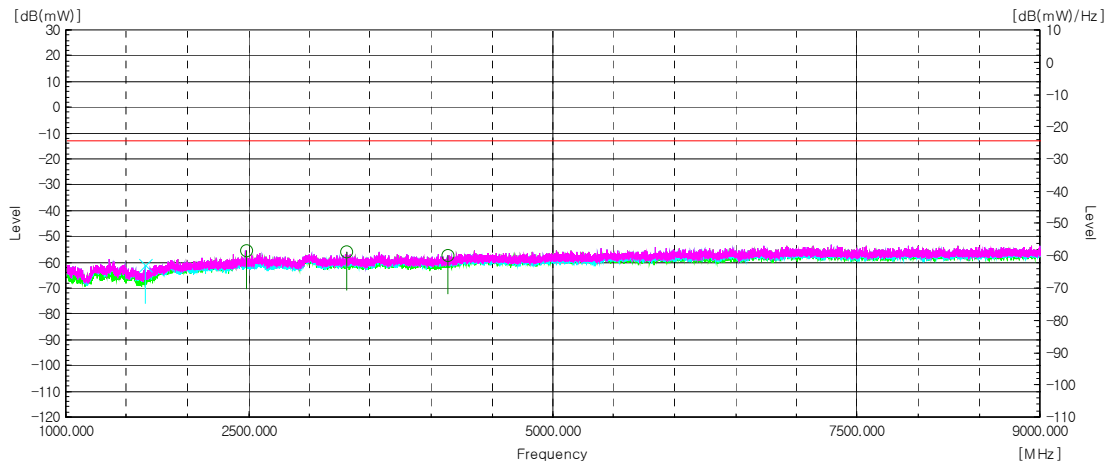
Test mode : GSM 1900  
 Frequency (MHz) : 1 909.8  
 Channel : 810

**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 9 549.50  | V     | 13.06        | 13.32      | -54.24           | -54.50 | -13.00 | 41.50  |

Note.

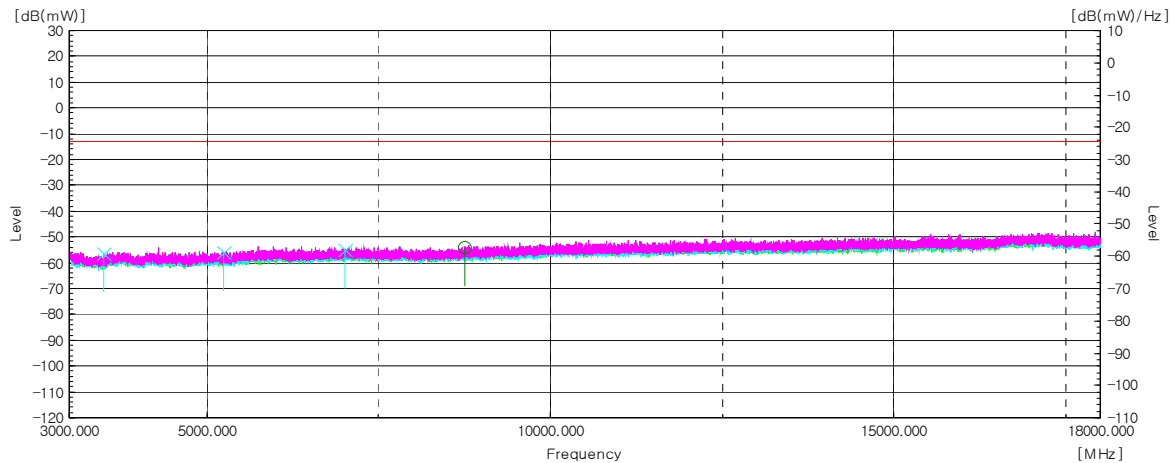
1. Limit Calculation(dBm)=  $43 + 10\log(P_{\text{Watts}})$
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : WCDMA 850Frequency (MHz) : 826.4Channel : 4132**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 3 303.14  | H     | 7.38         | 7.68       | -55.80           | -56.10 | -13.00 | 43.10  |

Note.

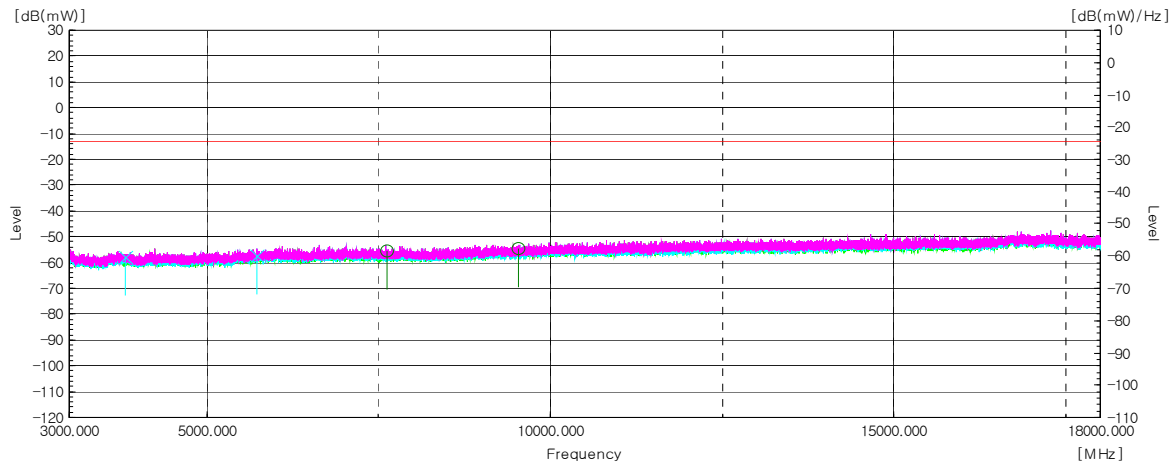
- Limit Calculation(dBm)= 43 + 10log(P<sub>Watts</sub>)
- Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : WCDMA 1700Frequency (MHz) : 1 752.6Channel : 1513**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 7 010.50  | V     | 11.12        | 11.33      | -53.79           | -54.00 | -13.00 | 41.00  |

Note.

1. Limit Calculation(dBm)=  $43 + 10\log(P_{\text{Watts}})$
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

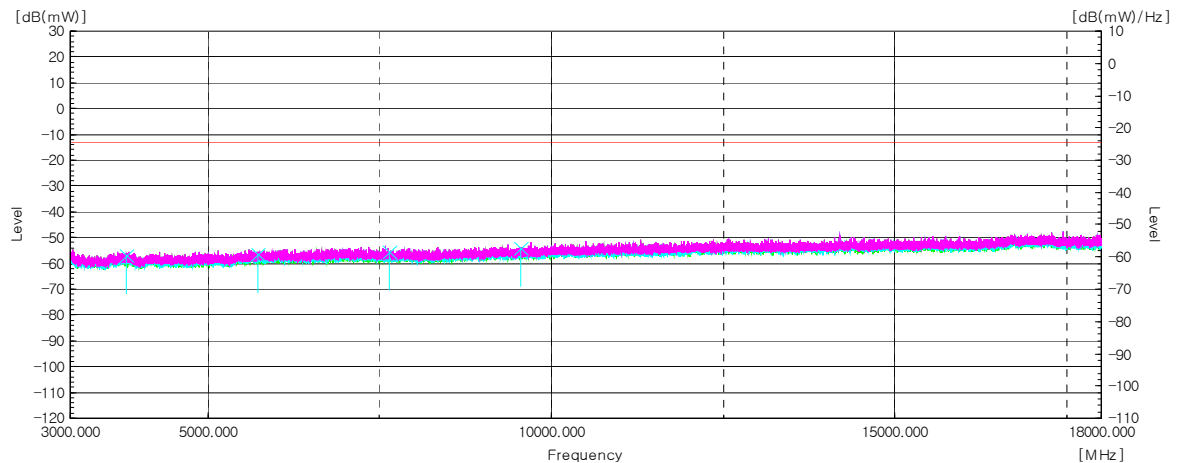
Test mode : WCDMA 1900Frequency (MHz) : 1 907.6Channel : 9538**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 7 642.00  | H     | 12.13        | 11.92      | -55.61           | -55.40 | -13.00 | 42.40  |

Note.

1. Limit Calculation(dBm)= 43 + 10log(P<sub>Watts</sub>)
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : LTE Band 2  
Frequency (MHz) : 1 909.3  
Channel : 19193  
Bandwidth (MHz) : 1.4

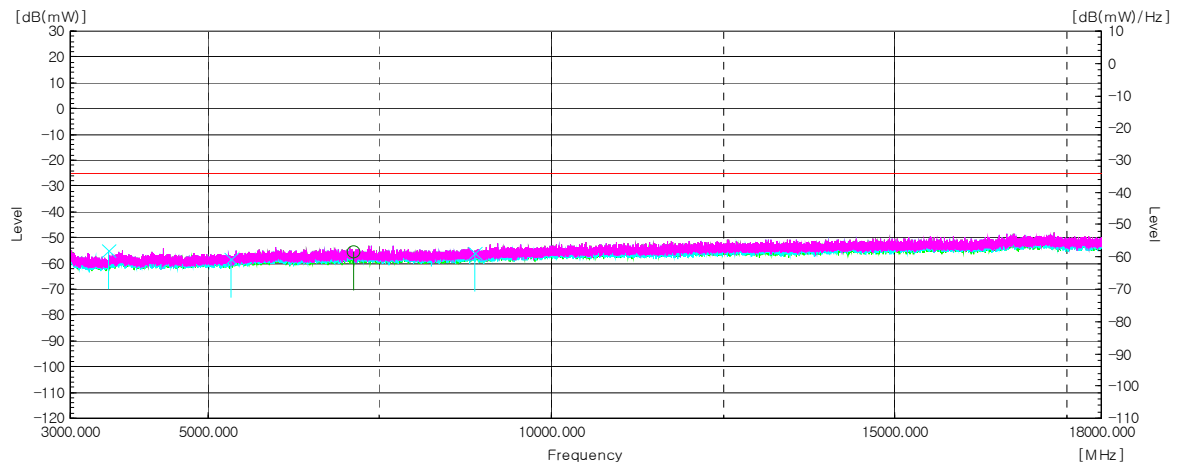
**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 9 546.98  | V     | 13.06        | 13.32      | -53.74           | -54.00 | -13.00 | 41.00  |

Note.

1. Limit Calculation(dBm)= 43 + 10log( $P_{\text{Watts}}$ )
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : LTE Band 4/66  
Frequency (MHz) : 1 778.5  
Channel : 132657  
Bandwidth (MHz) : 3

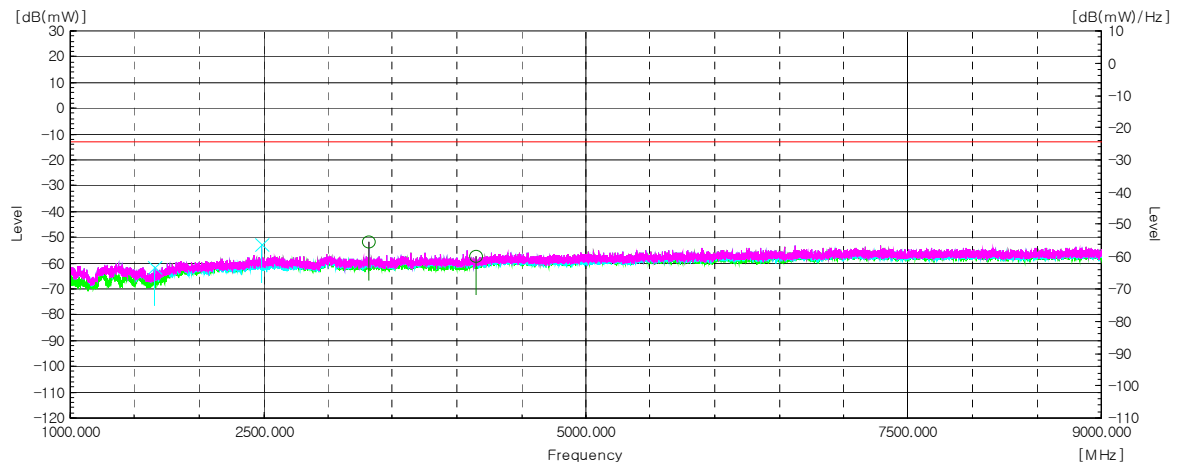
**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 3 557.50  | V     | 7.89         | 7.94       | -55.05           | -55.10 | -25.00 | 30.10  |

Note.

1. Limit Calculation(dBm)= 43 + 10log( $P_{\text{Watts}}$ )
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : LTE Band 5  
Frequency (MHz) : 829.0  
Channel : 20450  
Bandwidth (MHz) : 10

**Horizontal/Vertical**

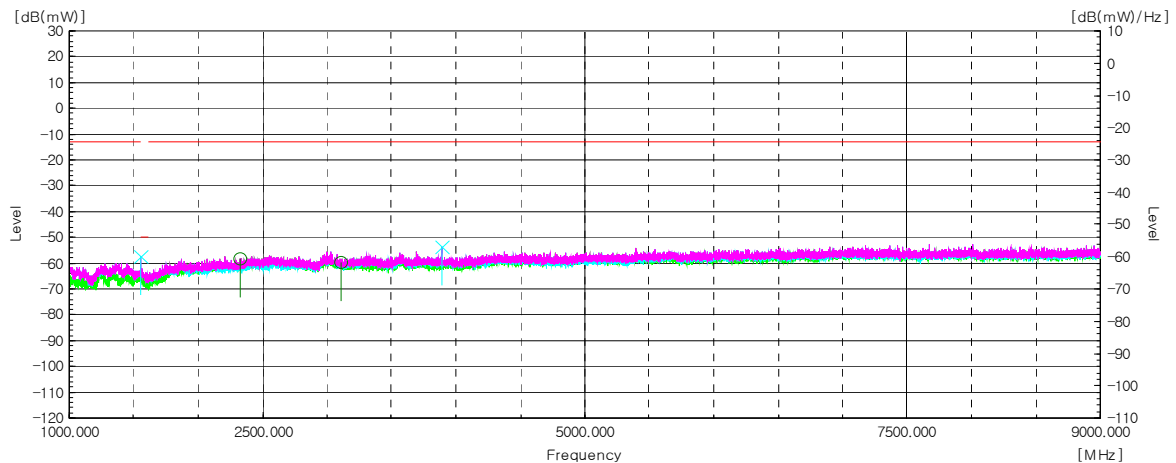
| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 3 316.65  | H     | 7.40         | 7.68       | -51.42           | -51.70 | -13.00 | 38.70  |

Note.

1. Limit Calculation(dBm)= 43 + 10log(P<sub>Watts</sub>)

2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : LTE Band 13  
Frequency (MHz) : 779.5  
Channel : 23205  
Bandwidth (MHz) : 5

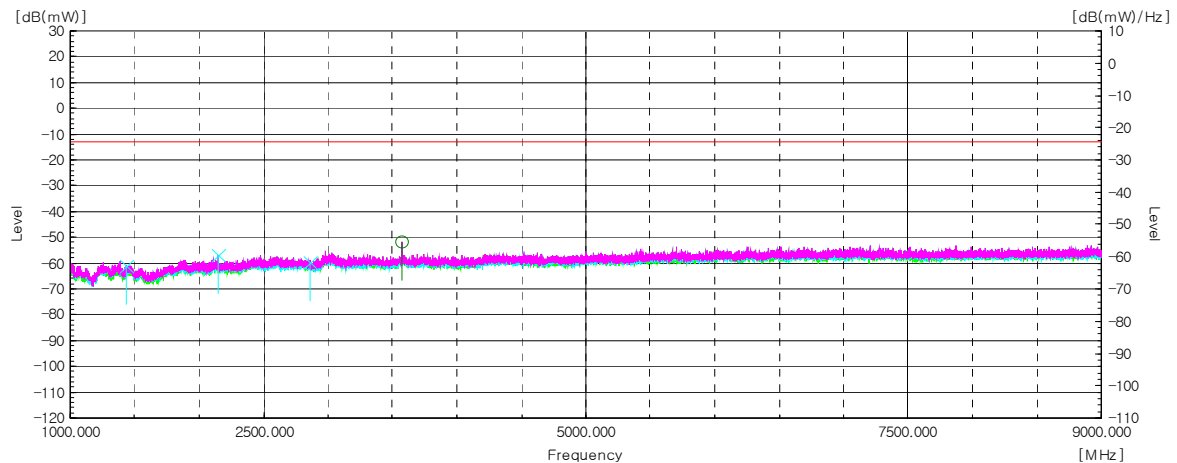
**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 3 886.68  | V     | 8.42         | 8.35       | -53.87           | -53.80 | -13.00 | 40.80  |

Note.

1. Limit Calculation(dBm)=  $43 + 10\log(P_{\text{Watts}})$
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : LTE Band 17  
Frequency (MHz) : 713.5  
Channel : 23825  
Bandwidth (MHz) : 5

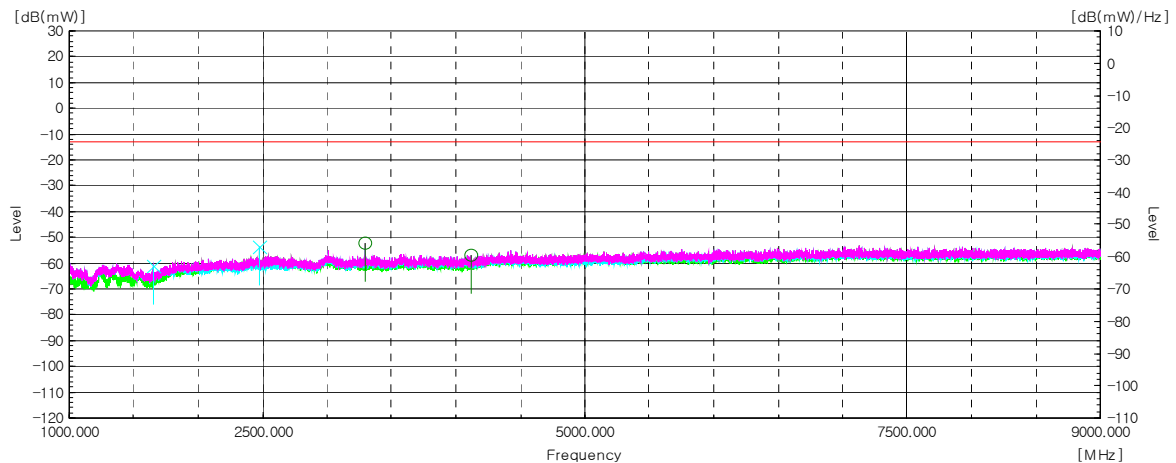
**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin   |
|------|-----------|-------|--------------|------------|------------------|--------|--------|----------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]     |
| QPSK | 3 578.16  | H     | 7.93         | 7.96       | -51.77           | -51.80 | -13.00 | 3 578.16 |

Note.

1. Limit Calculation(dBm)=  $43 + 10\log(P_{\text{Watts}})$
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : LTE Band 26 (Part 22H)  
Frequency (MHz) : 825.5  
Channel : 26805  
Bandwidth (MHz) : 3

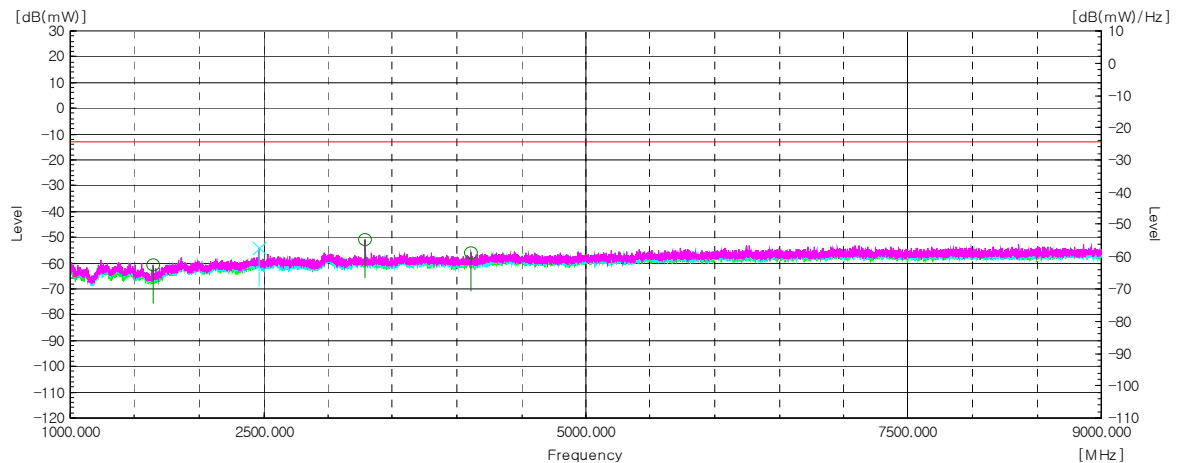
**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 3 296.64  | H     | 7.35         | 7.66       | -51.99           | -52.30 | -13.00 | 39.30  |

Note.

1. Limit Calculation(dBm)=  $43 + 10\log(P_{\text{Watts}})$
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : LTE Band 26 (Part 22H)  
Frequency (MHz) : 824.0  
Channel : 26790  
Bandwidth (MHz) : 3

**Horizontal/Vertical**

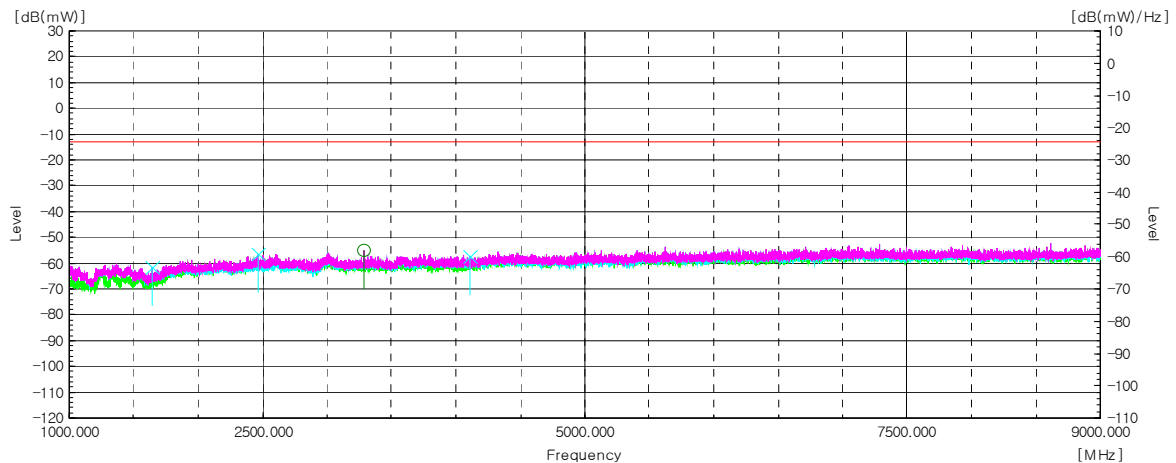
| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 3 290.64  | H     | 7.34         | 7.65       | -50.59           | -50.90 | -13.00 | 37.90  |

Note.

1. Limit Calculation(dBm)= 43 + 10log(P<sub>Watts</sub>)

2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : LTE Band 26 (Part 90S)  
Frequency (MHz) : 823.3  
Channel : 26783  
Bandwidth (MHz) : 1.4

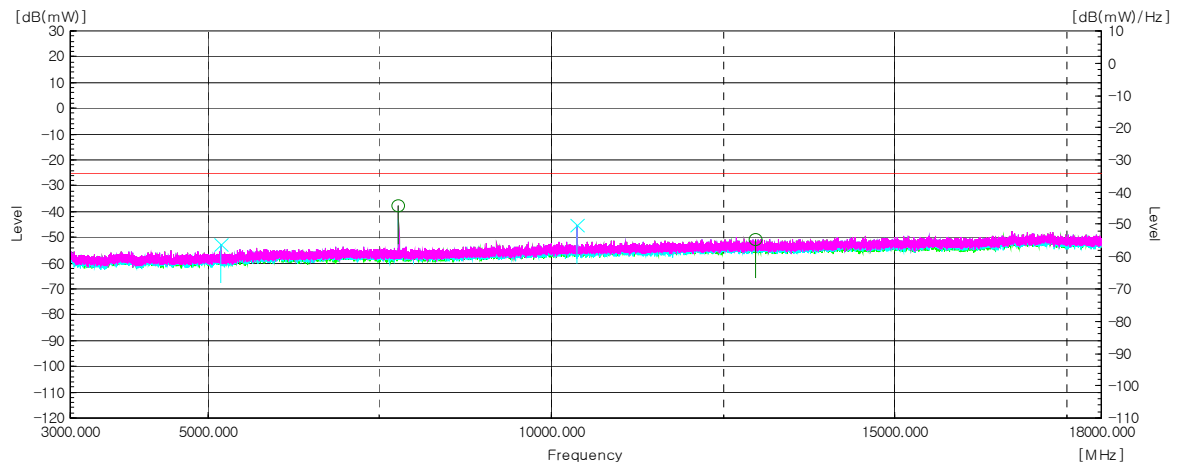
**Horizontal/Vertical**

| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 3 291.14  | H     | 7.34         | 7.65       | -54.79           | -55.10 | -13.00 | 42.10  |

Note.

1. Limit Calculation(dBm)=  $43 + 10\log(P_{\text{Watts}})$
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

Test mode : LTE Band 41  
Frequency (MHz) : 2 593.0  
Channel : 40620  
Bandwidth (MHz) : 20

**Horizontal/Vertical**

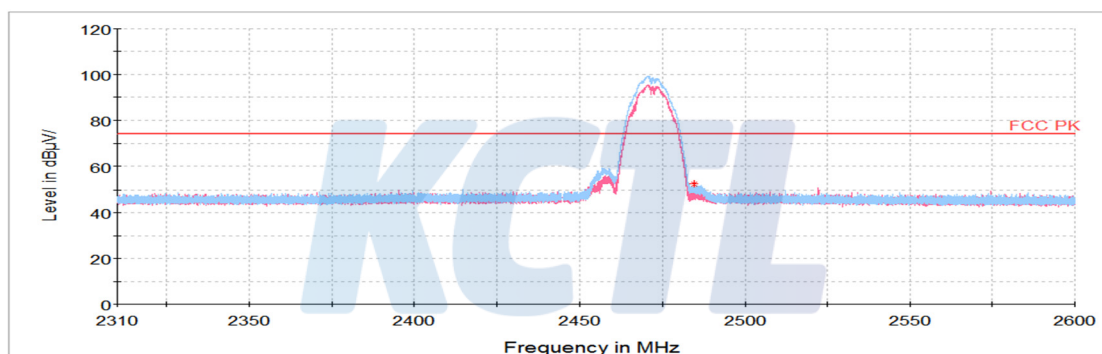
| Mode | Frequency | Pol.  | Antenna Gain | Cable loss | Substitute Level | Level  | Limit  | Margin |
|------|-----------|-------|--------------|------------|------------------|--------|--------|--------|
|      | [MHz]     | [V/H] | [dBi]        | [dB]       | [dBm]            | [dBm]  | [dBm]  | [dB]   |
| QPSK | 7 779.00  | H     | 12.28        | 11.98      | -41.30           | -41.00 | -25.00 | 16.00  |

Note.

1. Limit Calculation(dBm)=  $55 + 10\log(P_{\text{Watts}})$
2. Result level(dBm) = Substitute Level(dBm) + Antenna gain(dBi) – Cable loss (dB)

**3.3.2 Unlicensed bands****Test results (2.4G WIFI)****802.11b / Band-edge****13 Channel**

| Frequency                                                      | Pol.  | Reading        | Ant. Factor | Amp. + Cable | DCCF | Result           | Limit            | Margin |
|----------------------------------------------------------------|-------|----------------|-------------|--------------|------|------------------|------------------|--------|
| (MHz)                                                          | (V/H) | (dB( $\mu$ V)) | (dB)        | (dB)         | (dB) | (dB( $\mu$ V/m)) | (dB( $\mu$ V/m)) | (dB)   |
| <b>Peak data</b>                                               |       |                |             |              |      |                  |                  |        |
| 2 484.65 <sup>1)</sup>                                         | H     | 49.27          | 32.07       | -29.22       | -    | 52.12            | 74.00            | 21.88  |
| <b>Average Data</b>                                            |       |                |             |              |      |                  |                  |        |
| No spurious emissions were detected within 20 dB of the limit. |       |                |             |              |      |                  |                  |        |

**Horizontal/Vertical for Band-edge**

**KCTL Inc.**

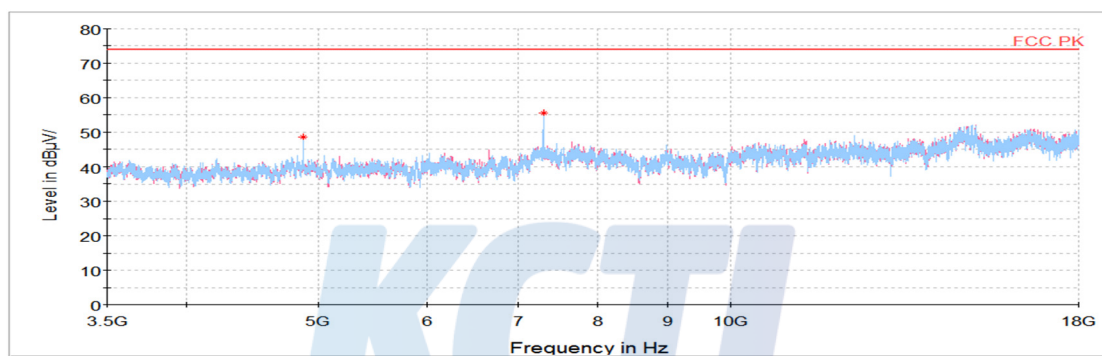
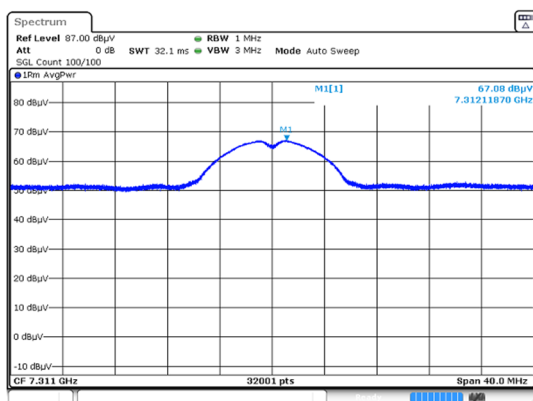
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Suwon-si, Gyeonggi-do, 16677, Korea  
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**KCTL****802.11b / Harmonic****6 Channel**

| Frequency              | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                  | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>       |       |          |             |              |      |            |            |        |
| 7 312.12 <sup>1)</sup> | H     | 71.68    | 35.40       | -51.50       | -    | 55.58      | 74.00      | 18.42  |
| <b>Average Data</b>    |       |          |             |              |      |            |            |        |
| 7 312.12 <sup>1)</sup> | H     | 67.08    | 35.40       | -51.50       | -    | 50.98      | 54.00      | 3.02   |

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

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**KCTL Inc.**

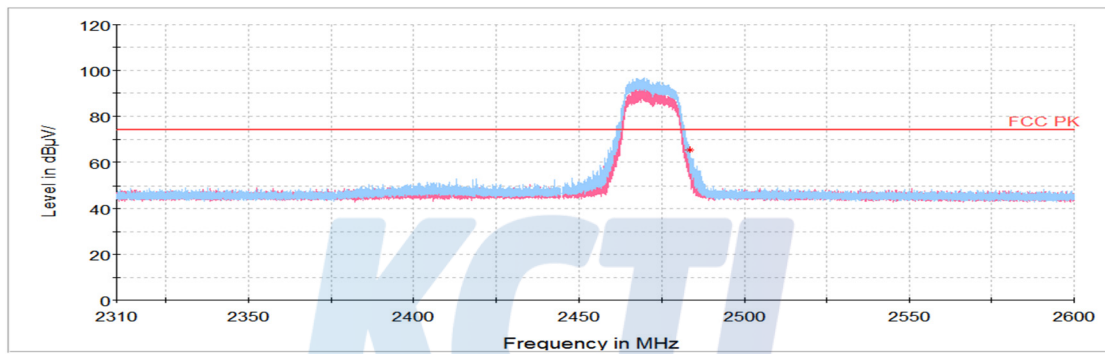
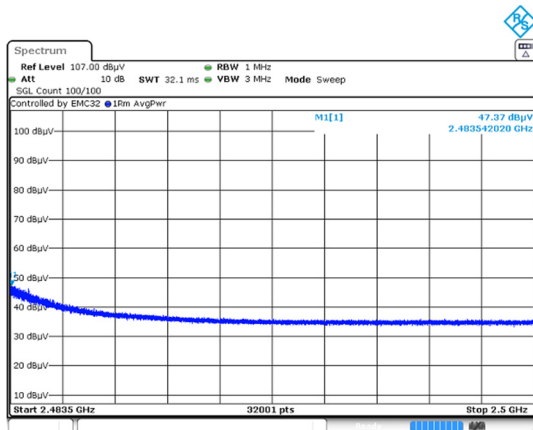
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**802.11g / Band-edge****13 Channel**

| Frequency              | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                  | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>       |       |          |             |              |      |            |            |        |
| 2 483.54 <sup>1)</sup> | H     | 62.38    | 32.07       | -29.21       | -    | 65.24      | 74.00      | 8.76   |
| <b>Average Data</b>    |       |          |             |              |      |            |            |        |
| 2 483.54 <sup>1)</sup> | H     | 47.37    | 32.07       | -29.21       | 0.32 | 50.55      | 54.00      | 3.45   |

**Horizontal/Vertical for Band-edge****Average data**

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**KCTL Inc.**

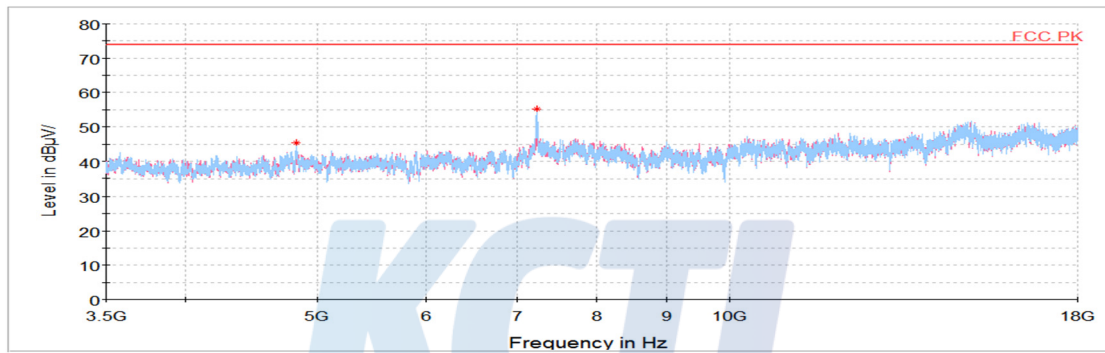
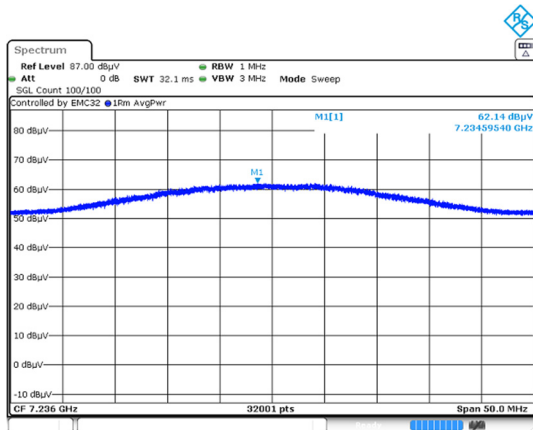
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**KCTL****802.11g / Harmonic****1 Channel**

| Frequency              | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                  | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>       |       |          |             |              |      |            |            |        |
| 7 234.60 <sup>1)</sup> | H     | 71.57    | 35.40       | -51.88       | -    | 55.09      | 74.00      | 18.91  |
| <b>Average Data</b>    |       |          |             |              |      |            |            |        |
| 7 234.60 <sup>1)</sup> | H     | 62.14    | 35.40       | -51.88       | 0.32 | 45.98      | 54.00      | 8.02   |

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

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**KCTL Inc.**

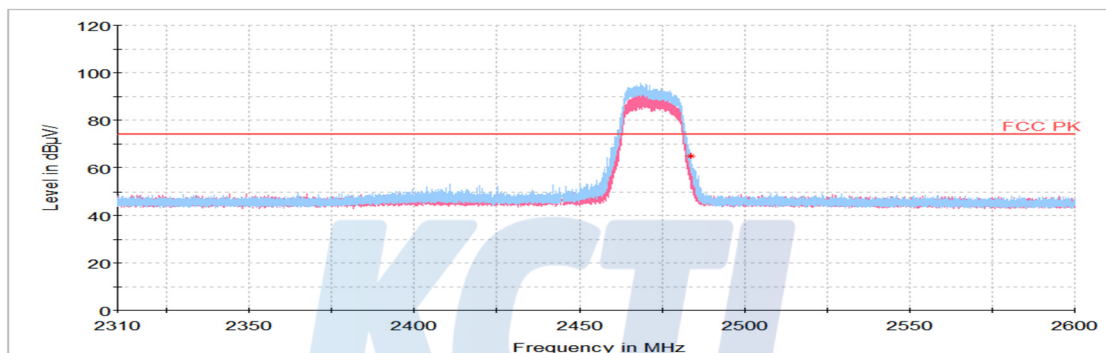
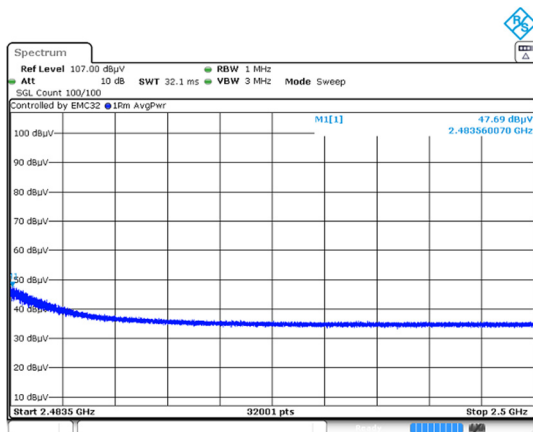
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**KCTL****802.11n HT20 / Band-edge****13 Channel**

| Frequency              | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                  | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>       |       |          |             |              |      |            |            |        |
| 2 483.56 <sup>1)</sup> | H     | 62.05    | 32.07       | -29.21       | -    | 64.91      | 74.00      | 9.09   |
| <b>Average Data</b>    |       |          |             |              |      |            |            |        |
| 2 483.56 <sup>1)</sup> | H     | 47.69    | 32.07       | -29.21       | 0.34 | 50.89      | 54.00      | 3.11   |

**Horizontal/Vertical for Band-edge****Average data**

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**KCTL Inc.**

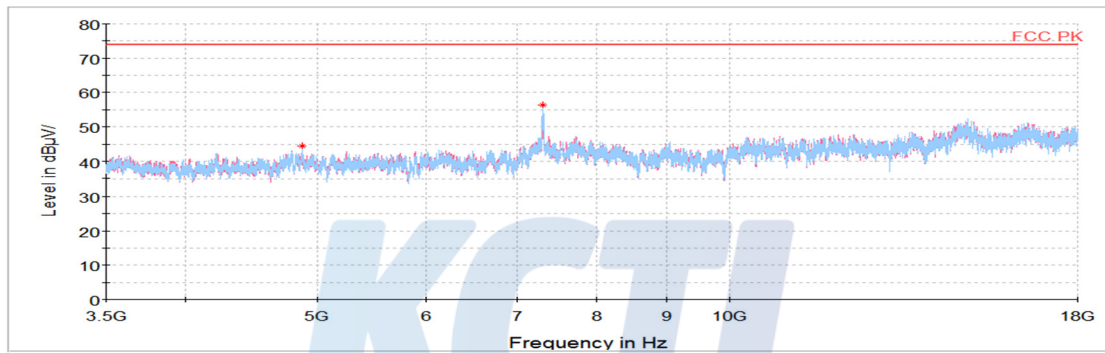
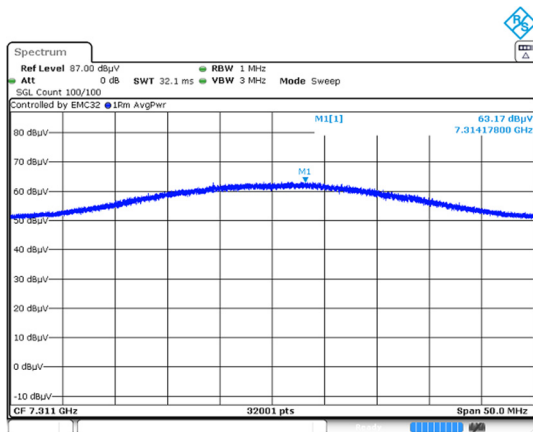
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**KCTL****802.11n HT20 / Harmonic****6 Channel**

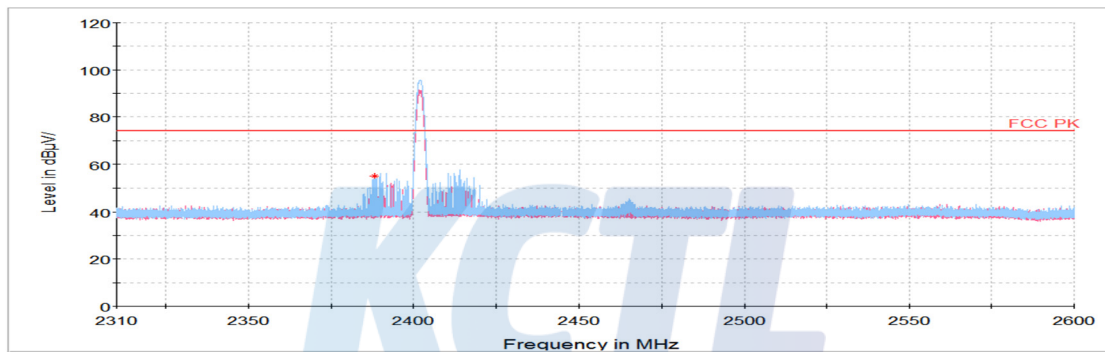
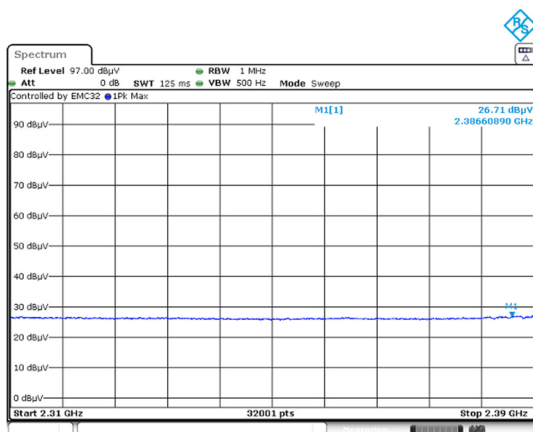
| Frequency              | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                  | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>       |       |          |             |              |      |            |            |        |
| 7 314.18 <sup>1)</sup> | H     | 72.42    | 35.40       | -51.49       | -    | 56.33      | 74.00      | 17.67  |
| <b>Average Data</b>    |       |          |             |              |      |            |            |        |
| 7 314.18 <sup>1)</sup> | H     | 63.17    | 35.40       | -51.49       | 0.34 | 47.42      | 54.00      | 6.58   |

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

Blank

**Test results (Bluetooth)**  
**GFSK / Band-edge****0 Channel**

| Frequency              | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                  | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>       |       |          |             |              |      |            |            |        |
| 2 386.61 <sup>1)</sup> | H     | 51.98    | 31.87       | -29.06       | -    | 54.79      | 74.00      | 19.21  |
| <b>Average Data</b>    |       |          |             |              |      |            |            |        |
| 2 386.61 <sup>1)</sup> | H     | 26.71    | 31.87       | -29.06       | -    | 29.52      | 54.00      | 24.48  |

**Horizontal/Vertical for Band-edge****Average data**

Blank

**KCTL Inc.**

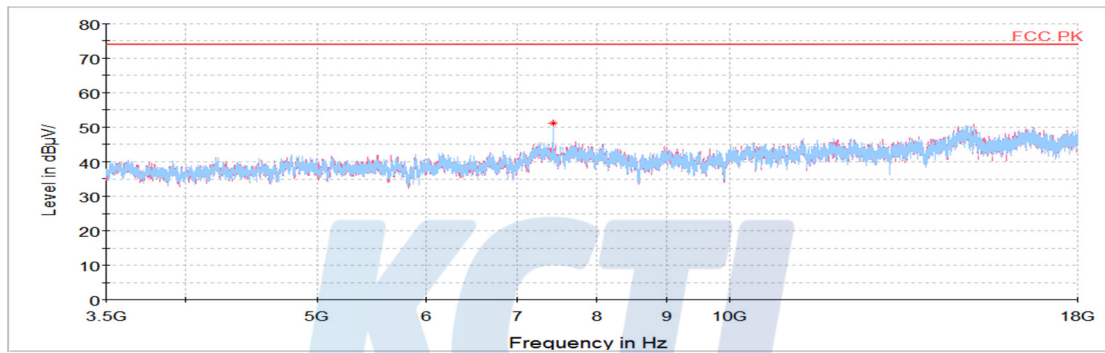
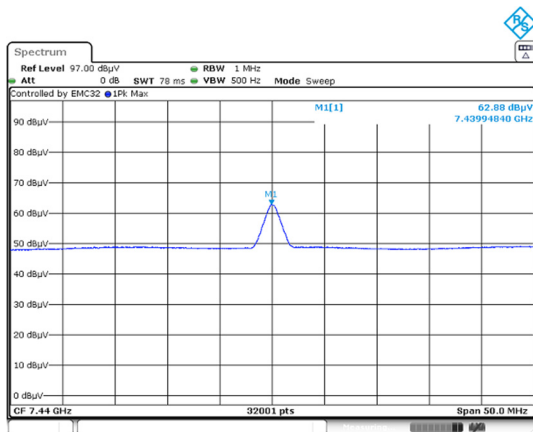
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**KCTL****GFSK / Harmonic****78 Channel**

| Frequency              | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                  | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>       |       |          |             |              |      |            |            |        |
| 7 439.95 <sup>1)</sup> | H     | 66.61    | 35.40       | -50.87       | -    | 51.14      | 74.00      | 22.86  |
| <b>Average Data</b>    |       |          |             |              |      |            |            |        |
| 7 439.95 <sup>1)</sup> | H     | 62.88    | 35.40       | -50.87       | -    | 47.41      | 54.00      | 6.59   |

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

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**KCTL Inc.**

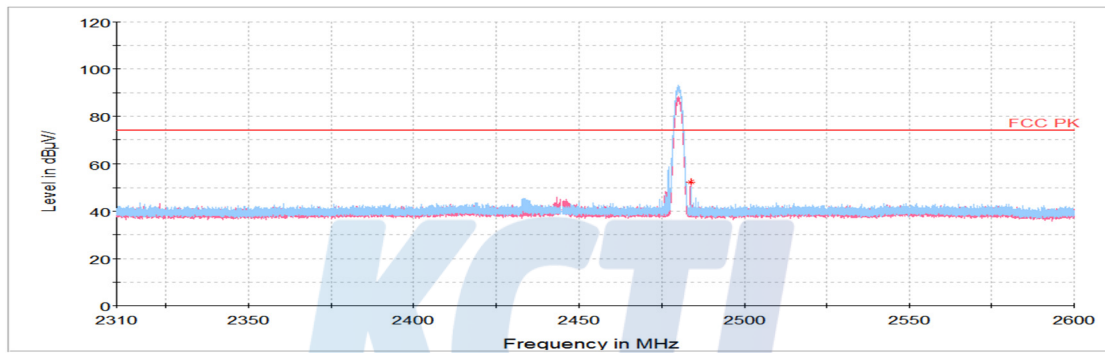
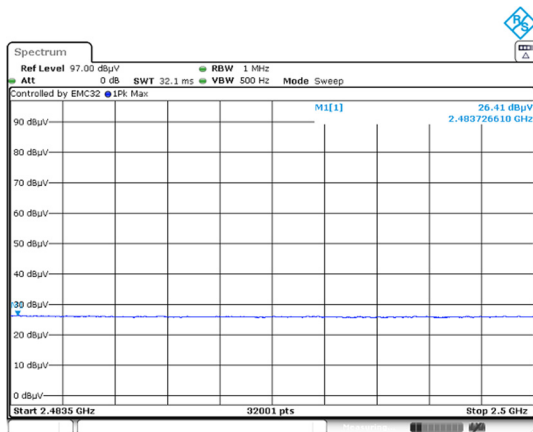
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**KCTL****8DPSK / Band-edge****78 Channel**

| Frequency              | Pol.  | Reading        | Ant. Factor | Amp. + Cable | DCCF | Result           | Limit            | Margin |
|------------------------|-------|----------------|-------------|--------------|------|------------------|------------------|--------|
| (MHz)                  | (V/H) | (dB( $\mu$ V)) | (dB)        | (dB)         | (dB) | (dB( $\mu$ V/m)) | (dB( $\mu$ V/m)) | (dB)   |
| Peak data              |       |                |             |              |      |                  |                  |        |
| 2 483.73 <sup>1)</sup> | V     | 49.49          | 32.07       | -29.21       | -    | 52.35            | 74.00            | 21.65  |
| Average Data           |       |                |             |              |      |                  |                  |        |
| 2 483.73 <sup>1)</sup> | V     | 26.41          | 32.07       | -29.21       | -    | 29.27            | 54.00            | 24.73  |

**Horizontal/Vertical for Band-edge****Average data**

Blank

**KCTL Inc.**

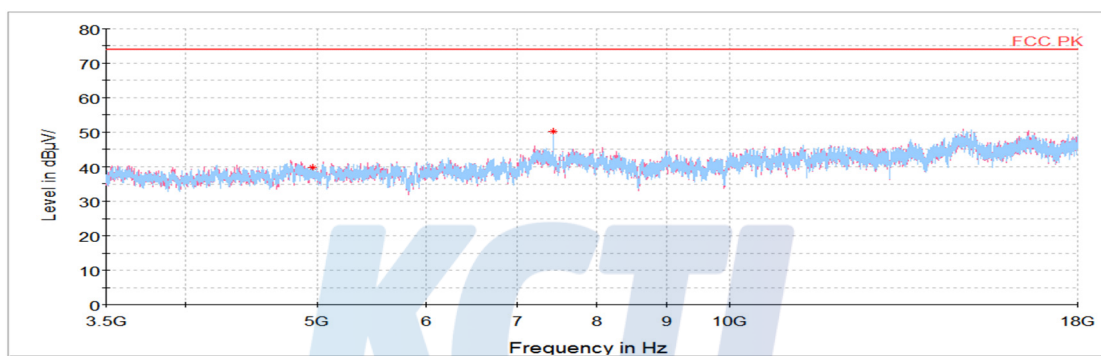
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**KCTL****8DPSK / Harmonic****78 Channel**

| Frequency                                                      | Pol.  | Reading        | Ant. Factor | Amp. + Cable | DCCF | Result           | Limit            | Margin |
|----------------------------------------------------------------|-------|----------------|-------------|--------------|------|------------------|------------------|--------|
| (MHz)                                                          | (V/H) | (dB( $\mu$ V)) | (dB)        | (dB)         | (dB) | (dB( $\mu$ V/m)) | (dB( $\mu$ V/m)) | (dB)   |
| Peak data                                                      |       |                |             |              |      |                  |                  |        |
| 7 440.38 <sup>1)</sup>                                         | V     | 65.51          | 35.40       | -50.86       | -    | 50.05            | 74.00            | 23.95  |
| Average Data                                                   |       |                |             |              |      |                  |                  |        |
| No spurious emissions were detected within 20 dB of the limit. |       |                |             |              |      |                  |                  |        |

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

**KCTL Inc.**

65, Sinwon-ro, Yeongtong-gu,  
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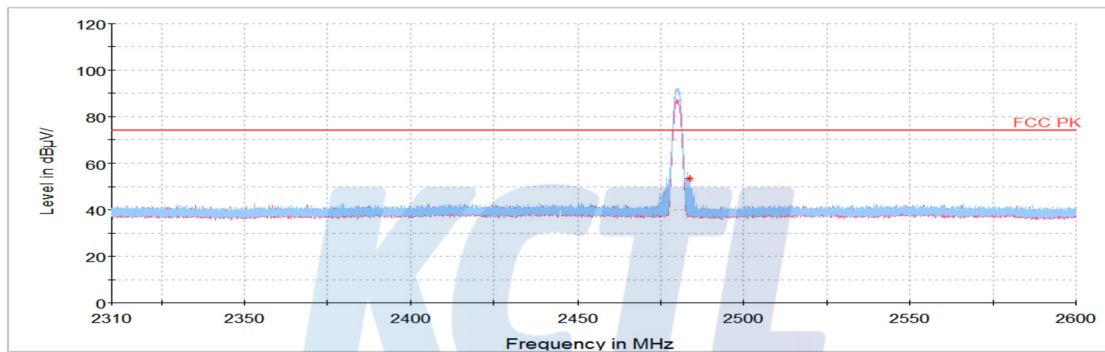


**Test results (Bluetooth Low Energy)**  
**BLE 1 MBit/s(37 Bytes) / Band-edge**

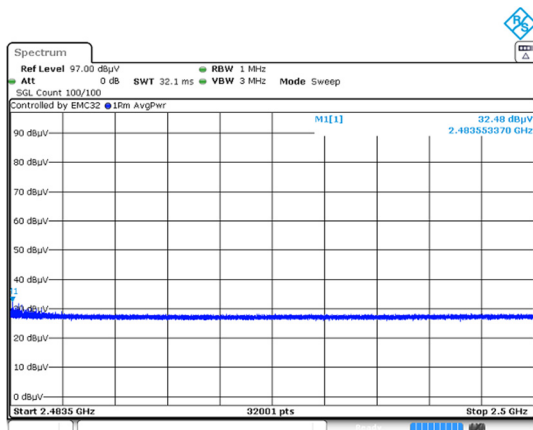
**39 Channel**

| Frequency              | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                  | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>       |       |          |             |              |      |            |            |        |
| 2 483.55 <sup>1)</sup> | H     | 50.31    | 32.07       | -29.21       | -    | 53.17      | 74.00      | 20.83  |
| <b>Average Data</b>    |       |          |             |              |      |            |            |        |
| 2 483.55 <sup>1)</sup> | H     | 32.48    | 32.07       | -29.21       | 2.14 | 37.48      | 54.00      | 16.52  |

**Horizontal/Vertical for Band-edge**



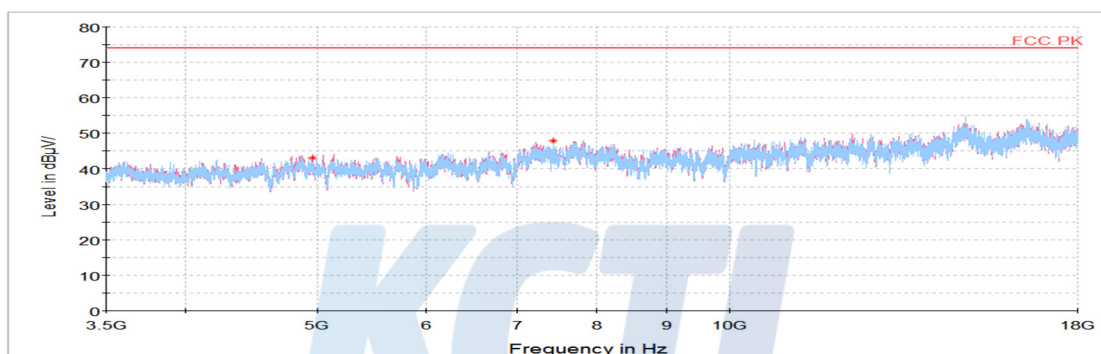
**Average data**



Blank

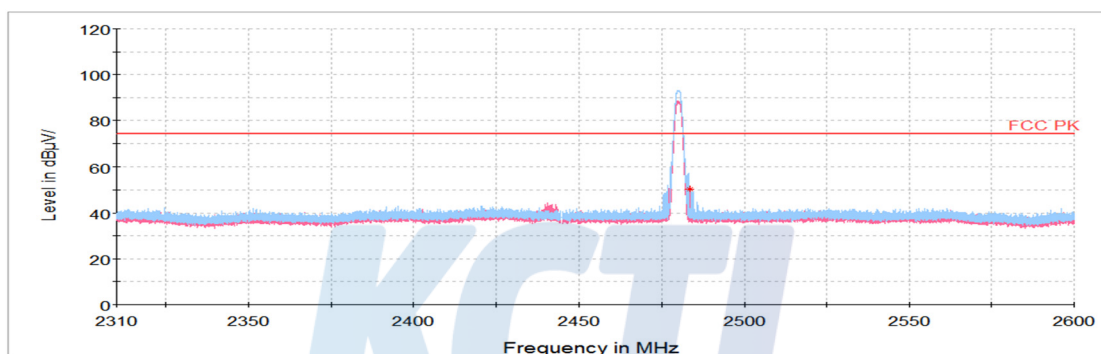
**BLE 1 MBit/s(37 Bytes) / Harmonic****39 Channel**

| Frequency                                                      | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|----------------------------------------------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                                                          | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>                                               |       |          |             |              |      |            |            |        |
| 7 439.92 <sup>1)</sup>                                         | H     | 63.28    | 35.40       | -50.87       | -    | 47.81      | 74.00      | 26.19  |
| <b>Average Data</b>                                            |       |          |             |              |      |            |            |        |
| No spurious emissions were detected within 20 dB of the limit. |       |          |             |              |      |            |            |        |

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

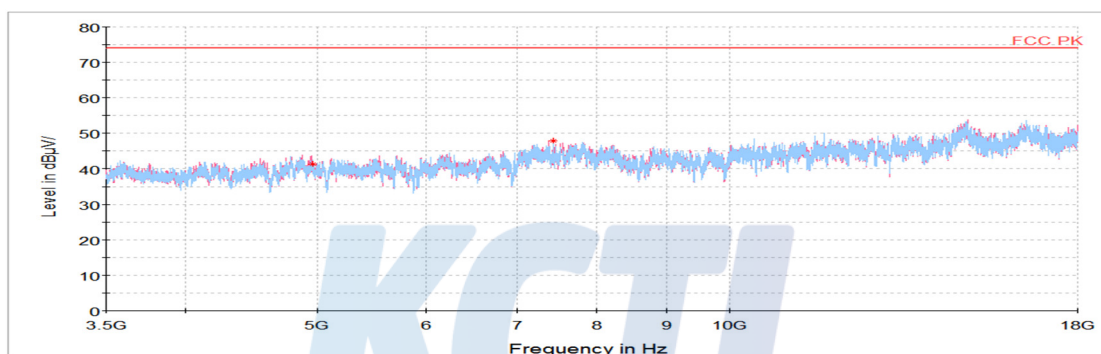
**BLE 1 MBit/s(255 Bytes) / Band-edge****39 Channel**

| Frequency                                                      | Pol.  | Reading        | Ant. Factor | Amp. + Cable | DCCF | Result           | Limit            | Margin |
|----------------------------------------------------------------|-------|----------------|-------------|--------------|------|------------------|------------------|--------|
| (MHz)                                                          | (V/H) | (dB( $\mu$ V)) | (dB)        | (dB)         | (dB) | (dB( $\mu$ V/m)) | (dB( $\mu$ V/m)) | (dB)   |
| <b>Peak data</b>                                               |       |                |             |              |      |                  |                  |        |
| 2 483.60 <sup>1)</sup>                                         | H     | 47.42          | 32.07       | -29.21       | -    | 50.28            | 74.00            | 23.72  |
| <b>Average Data</b>                                            |       |                |             |              |      |                  |                  |        |
| No spurious emissions were detected within 20 dB of the limit. |       |                |             |              |      |                  |                  |        |

**Horizontal/Vertical for Band-edge**

**BLE 1 MBit/s(255 Bytes) / Harmonic****39 Channel**

| Frequency                                                      | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|----------------------------------------------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                                                          | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>                                               |       |          |             |              |      |            |            |        |
| 7 439.92 <sup>1)</sup>                                         | H     | 63.26    | 35.40       | -50.87       | -    | 47.76      | 74.00      | 26.24  |
| <b>Average Data</b>                                            |       |          |             |              |      |            |            |        |
| No spurious emissions were detected within 20 dB of the limit. |       |          |             |              |      |            |            |        |

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

**KCTL Inc.**

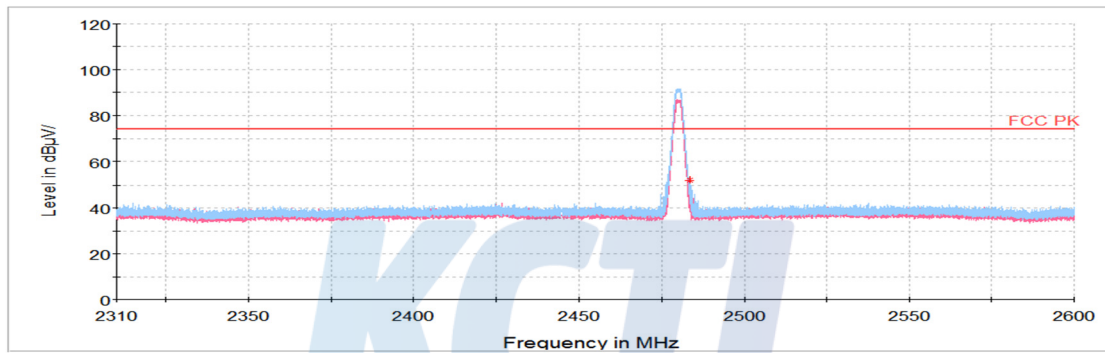
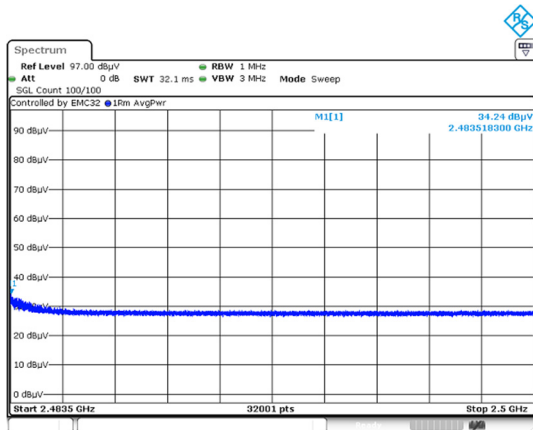
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**BLE 2 MBit/s(37 Bytes) / Band-edge****39 Channel**

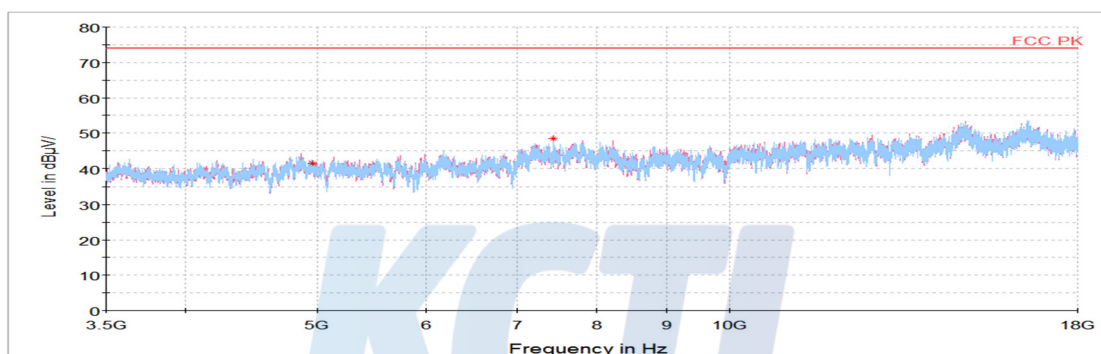
| Frequency              | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                  | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>       |       |          |             |              |      |            |            |        |
| 2 483.52 <sup>1)</sup> | H     | 49.12    | 32.07       | -29.21       | -    | 51.98      | 74.00      | 22.02  |
| <b>Average Data</b>    |       |          |             |              |      |            |            |        |
| 2 483.52 <sup>1)</sup> | H     | 34.24    | 32.07       | -29.21       | 5.08 | 42.18      | 54.00      | 11.82  |

**Horizontal/Vertical for Band-edge****Average data**

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**BLE 2 MBit/s(37 Bytes) / Harmonic****39 Channel**

| Frequency                                                      | Pol.  | Reading  | Ant. Factor | Amp. + Cable | DCCF | Result     | Limit      | Margin |
|----------------------------------------------------------------|-------|----------|-------------|--------------|------|------------|------------|--------|
| (MHz)                                                          | (V/H) | (dB(μV)) | (dB)        | (dB)         | (dB) | (dB(μV/m)) | (dB(μV/m)) | (dB)   |
| <b>Peak data</b>                                               |       |          |             |              |      |            |            |        |
| 7 441.73 <sup>1)</sup>                                         | H     | 63.88    | 35.40       | -50.86       | -    | 48.42      | 74.00      | 25.58  |
| <b>Average Data</b>                                            |       |          |             |              |      |            |            |        |
| No spurious emissions were detected within 20 dB of the limit. |       |          |             |              |      |            |            |        |

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

**BLE 2 MBit/s(255 Bytes) / Band-edge****39 Channel**

| Frequency                                                      | Pol.  | Reading        | Ant. Factor | Amp. + Cable | DCCF | Result           | Limit            | Margin |
|----------------------------------------------------------------|-------|----------------|-------------|--------------|------|------------------|------------------|--------|
| (MHz)                                                          | (V/H) | (dB( $\mu$ V)) | (dB)        | (dB)         | (dB) | (dB( $\mu$ V/m)) | (dB( $\mu$ V/m)) | (dB)   |
| <b>Peak data</b>                                               |       |                |             |              |      |                  |                  |        |
| 2 484.03 <sup>1)</sup>                                         | V     | 47.22          | 32.07       | -29.22       | -    | 50.07            | 74.00            | 23.93  |
| <b>Average Data</b>                                            |       |                |             |              |      |                  |                  |        |
| No spurious emissions were detected within 20 dB of the limit. |       |                |             |              |      |                  |                  |        |

**Horizontal/Vertical for Band-edge**