

# RF TEST REPORT

Test Equipment : IRON-MD Receiver  
Model Name : IRON-MD-RD  
FCC ID : 2BHL8-IRON-MD-RD  
IC : 32779-IRONMDRD  
Date of receipt : 2024-06-14  
Test duration : 2024-07-18 ~ 2024-08-13  
Date of issue : 2024-08-23

Applicant : DAS Co., Ltd  
61, Jipyeongseonsandan 3-gil, Gimje-si, Jeollabuk-do, Korea

Test Laboratory : Lab-T, Inc.  
2182-42, Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si  
Gyeonggi-do 17036, Korea (Republic of)

Test specification : FCC Part 15 Subpart C 15.231  
RSS-210 Issue 10 A1(2020-04)  
RSS-GEN Issue 5 A2(2021-02)  
RF Output Power : 98.90 dB $\mu$ V/m  
Test result : Pass

The above equipment was tested by Lab-T Testing Laboratory for compliance  
with the requirements of FCC,IC Rules and Regulations.

The test results presented in this test report are limited only to the sample supplied by applicant  
and the use of this test report is inhibited other than its purpose.

This test report shall not be reproduced except in full, without the written approval of Lab-T, Inc  
This test report is not related to KOLAS.

Tested by:



Engineer  
HyunWoo Lee

Reviewed by:



Technical Manager  
SangHoon Yu

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## 1. Revision history

| Test Report No.  | Date       | Description   |
|------------------|------------|---|
| TRRFCC24-0014    | 2024-08-13 | Initial issue   |
| TRRFCC24-0014(1) | 2024-08-23 | IC Number Corrected<br>Bluetooth Module Information Added |
|                  |            |   |

## 2. Information

### 2.1 Applicant Information

|                  |   |
|------------------|---|
| Applicant name   | DAS Co., Ltd  |
| Address          | 61, Jipyeongseonsandan 3-gil, Gimje-si, Jeollabuk-do, Korea |
| Telephone No.    | +82-63-548-9420   |
| Person in charge | Doosik Joo / rnd3@das-co.com                                |
| Manufacturer     | DAS Co., Ltd  |
| Address          | 61, Jipyeongseonsandan 3-gil, Gimje-si, Jeollabuk-do, Korea |

### 2.2 Test Laboratory information

|                     |  |
|---------------------|--|
| Corporate name      | Lab-T, Inc.  |
| Representative      | Duke (Jongyoung) Kim   |
| Address             | 2182-42 Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea(Republic of) |
| Telephone           | +82-31-322-6767  |
| Fax                 | +82-31-322-6768  |
| E-mail              | <a href="mailto:info@lab-t.net">info@lab-t.net</a>   |
| FCC Designation No. | KR0159   |

### 2.3 Test Site

| Test Site  | used                                | Address  |
|------------|-------------------------------------|--|
| Building L | <input checked="" type="checkbox"/> | 2182-40 Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea(Republic of) |
| Building T | <input checked="" type="checkbox"/> | 2182-42 Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea(Republic of) |
| Building A | <input type="checkbox"/>            | 2182-44 Baegok-daero, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea(Republic of) |

### 3. Information About Test Equipment

#### 3.1 Equipment Information

|                    |   |
|--------------------|---|
| Equipment type     | IRON-MD Receiver  |
| Model name         | IRON-MD-RD  |
| Variant model name | -   |
| Frequency          | 433.125 MHz ~ 434.375 MHz<br>Bluetooth : 2 402 MHz ~ 2 480 MHz <sup>NOTE3</sup> |
| Modulation type    | FSK<br>Bluetooth : GFSK, π/4-DQPSK, 8DPSK <sup>NOTE3</sup>                      |
| Power supply       | DC 12 V, 24 V   |
| H/W version        | 6.0   |
| S/W version        | 1.0   |

NOTE1: The above EUT information was declared by the manufacturer.

NOTE2: The test was performed only at DC 24 V.

NOTE3: pre-certified module used. (FCC ID : S7A-IW05 / IC : 8154A-IW05)

Report No. : DRTFCC1612-0159(1)

#### 3.2 Antenna Information

| Type           | Model No.  | Gain     | Note. |
|----------------|------------|----------|-------|
| Dipole Antenna | WE-433O-10 | 0.87 dBi | -     |

#### 3.3 Test Frequency

| Test mode | Test frequency (MHz) |                  |                   |
|-----------|----------------------|------------------|-------------------|
|           | Lowest frequency     | Middle frequency | Highest frequency |
| FSK       | 433.125              | 433.725          | 434.375           |

#### 3.4 Operating conditions for the EUT

|                               |                          |  |  |
|-------------------------------|--------------------------|--|--|
| Firmware state                | 1.0                      |  |  |
| Test software name(version)   | Used native test mode(-) |  |  |
| Test power setting            | default                  |  |  |
| Serial number<br>(Setup mode) | EUT #1                   | #1 (Conducted Emission)                            |  |
|                               | EUT #2                   | #2 (Radiated Emission)                             |  |
|                               | EUT #3                   | #3 (Normal Operation for Transmitter Deactivation) |  |

## 4. Test Report

### 4.1 Summary

| FCC Part 15 & RSS-GEN Issue 5 A2 & RSS-210 Issue 10 A1   |   |  |        |                      |
|--|---|--|--------|----------------------|
| FCC Rule   | IC Rule   | Parameter                              | Clause | Status               |
| <b>Transmitter Requirements</b>  |   |  |        |                      |
| 15.203   | -   | Antenna Requirement                    | 4.4.1  | C                    |
| 15.231(a)(1)   | RSS-210 A.1.1(a)                                | Transmitter Deactivation               | 4.4.2  | C                    |
| 15.231(b)  | RSS-210 A.1.2(b)                                | Field Strength of Emissions            | 4.4.3  | C                    |
| 15.231(c)  | RSS-210 A.1.3                                   | Emission Bandwidth                     | 4.4.4  | C                    |
| 15.231(b)<br>15.205(a)<br>15.209(a)  | RSS-210 A.1.2(b)<br>RSS-GEN 8.9<br>RSS-GEN 8.10 | Spurious Emission and Restricted bands | 4.4.5  | C                    |
| 15.207(a)  | RSS-GEN 8.8                                     | Conducted Emissions                    | 4.4.6  | N/A <sup>Note2</sup> |
| -  | -   | Duty cycle                             | 4.4.7  | -                    |
| Note 1 : C = Comply N/C = Not Comply N/T = Not Tested N/A = Not Applicable<br>Note 2 : This device only uses DC power. |   |  |        |                      |

\* The general test methods used to test this device is ANSI C63.10:2020

### 4.2 Measurement Uncertainty

| Mesurement items                             | Expanded Uncertainty |  |
|--|----------------------|--|
| Occupied Channel Bandwidth                   | 6.95 kHz             | (The confidence level is about 95 %, $k=2$ ) |
| Conducted Spurious Emissions                 | 0.47 dB              | (The confidence level is about 95 %, $k=2$ ) |
| Radiated Spurious Emissions<br>(1 GHz under) | 4.78 dB              | (The confidence level is about 95 %, $k=2$ ) |
| Radiated Spurious Emissions<br>(Above 1 GHz) | 5.96 dB              | (The confidence level is about 95 %, $k=2$ ) |

## 4.4 Transmitter Requirements

### 4.4.1 Antenna Requirement

#### 4.4.1.1 Regulation

According to §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 manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

#### 4.4.1.2 Result

**Comply**

(The transmitter has a Dipole Antenna. The directional peak gain of the antenna is 0.87 dBi.)

#### 4.4.2 Transmitter Deactivation

##### 4.4.2.1 Regulation

According to §15.231(a)(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

According to RSS-210 A.1.1(a) A manually operated transmitter shall be equipped with a push-to-operate switch and be under manual control at all times during transmission. When released, the transmitter shall cease transmission within no more than 5 seconds of being released.

According to §15.231(a)(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

According to RSS-210 A1.1(c) Periodic transmissions at regular, predetermined intervals are not permitted, except as specified in section A.1.4. However, polling or supervision transmissions that determine system integrity of transmitters used in security or safety applications are permitted, provided the total duration of transmission does not exceed 2 seconds per hour for each transmitter.

##### 4.4.2.2 Measurement Procedure

ANSI C63.10 § 7.4 determining compliance of unlicensed wireless devices having periodic operation

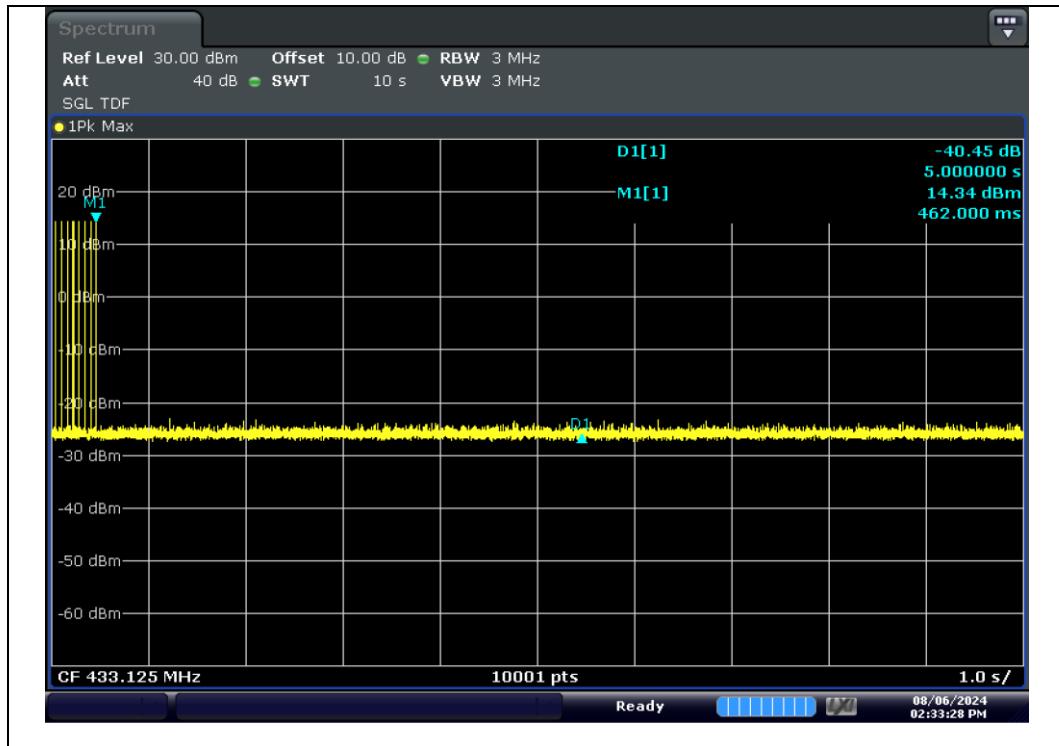
##### 4.4.2.3 Result

Comply

## 4.4.2.4 Measurement data

Test mode : FSK

| Frequency(MHz) | Condition          | Limit(s) |
|----------------|--------------------|----------|
| 433.725        | Manually operation | < 5      |

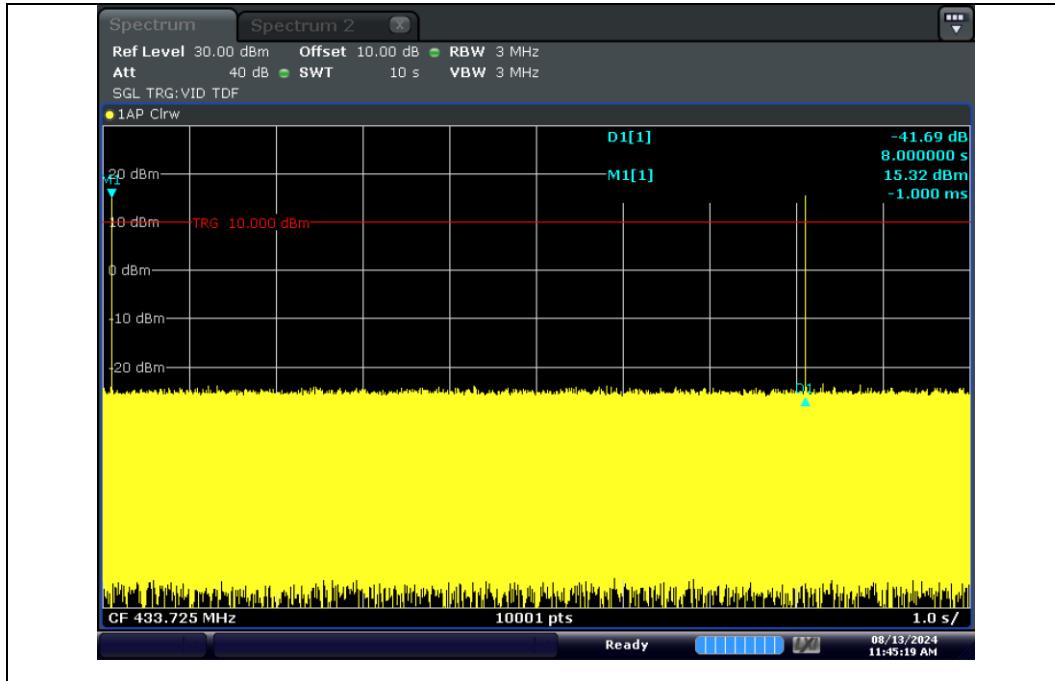
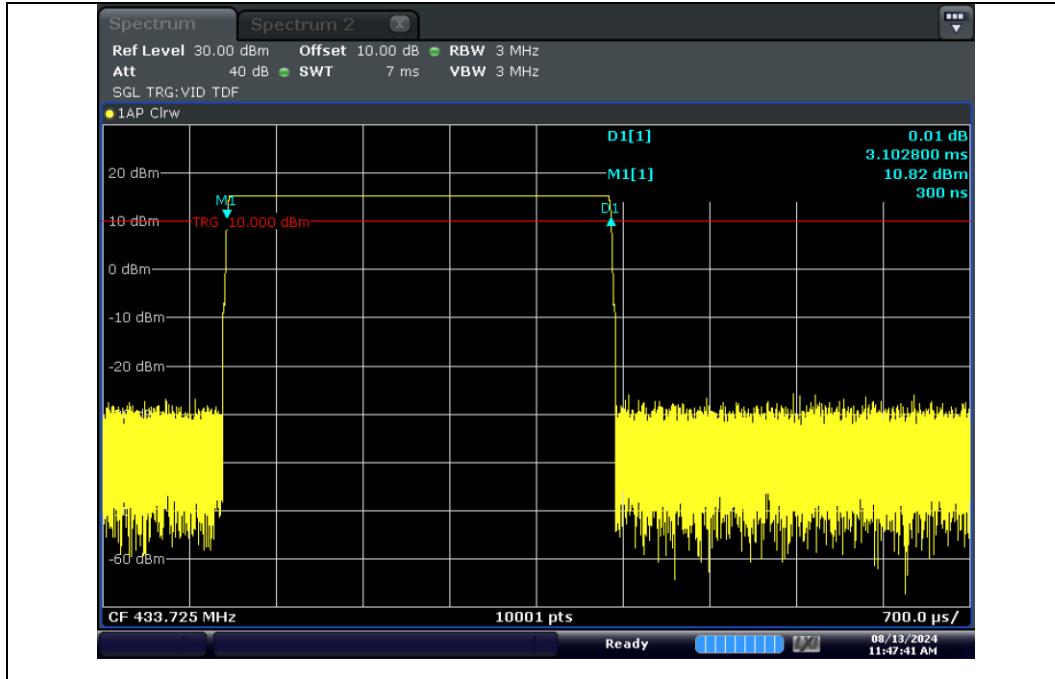


Test mode : FSK

| Frequency(MHz) | Condition             | Limit          |            |
|----------------|-----------------------|----------------|------------|
| 433.725        | Periodic transmission | < 2 s per hour |            |
| on time(s)     | period(s)             | Number of TX   | Result (s) |
| 0.003 1        | 8.00                  | 450            | 1.40       |

Note 1 : Number of TX = 3600 s / period

Result = on time \* Number of TX



#### 4.4.3 Field Strength of Emissions

##### 4.4.3.1 Regulation

According to §15.231(b) In addition to the provisions of § 15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

| Fundamental frequency (MHz) | Field strength of fundamental (microvolts/meter) | Field strength of spurious emissions (microvolts/meter) |
|-----------------------------|--|---|
| 40.66-40.70                 | 2,250  | 225   |
| 70-130                      | 1,250  | 125   |
| 130-174                     | <sup>1</sup> 1,250 to 3,750                      | <sup>1</sup> 125 to 375                                 |
| 174-260                     | 3,750  | 375   |
| <u>260-470</u>              | <u>13,750 to 12,500</u>                          | <sup>1</sup> 375 to 1,250                               |
| Above 470                   | 12,500   | 1,250   |

<sup>1</sup> Linear interpolations.

According to RSS-210 A.1.2 Following are the requirements for field strength of emissions::

| Fundamental frequency (MHz), excluding restricted frequency bands specified in RSS-Gen | Field strength of the fundamental emissions ( $\mu$ V/m at 3 m) |
|--|---|
| 70-130   | 1,250   |
| 130-174  | 1,250 to 3,750*   |
| 174-260**  | 3,750   |
| <u>260-470**</u>   | <u>3,750 to 12,500*</u>   |
| Above 470  | 12,500  |

\* Linear interpolation with frequency, f, in MHz:

- For 130-174 MHz: Field Strength ( $\mu$ V/m) = (56.82 x f)-6136
- For 260-470 MHz: Field Strength ( $\mu$ V/m) = (41.67 x f)-7083

\*\* Frequency bands 225-328.6 MHz and 335.4-399.9 MHz are designated for the exclusive use of the Government of Canada. Manufacturers should be aware of possible harmful interference and degradation of their licence-exempt radio equipment in these frequency bands.

##### 4.4.3.2 Measurement Procedure

ANSI C63.10 § 4.1.4 FFT-based measurement instrument

ANSI C63.10 § 6.5 Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz

##### 4.4.3.3 Result

**Comply** (measurement data : refer to the next page)

## 4.4.3.4 Measurement data

| Frequency (MHz) | Detector | Pol. (V/H) | Reading (dB $\mu$ V) | Factor (dB) | Duty factor (dB) | Result (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|----------|------------|----------------------|-------------|------------------|-----------------------|----------------------|-------------|
| 433.125         | PK       | H          | 103.40               | -4.50       | 0.00             | 98.90                 | 100.83               | 1.93        |
|                 | AV       | H          | 103.40               | -4.50       | -20.90           | 78.00                 | 80.83                | 2.83        |
|                 | PK       | V          | 96.30                | -4.50       | 0.00             | 91.80                 | 100.83               | 9.03        |
|                 | AV       | V          | 96.30                | -4.50       | -20.90           | 70.90                 | 80.83                | 9.93        |
| 433.725         | PK       | H          | 103.00               | -4.50       | 0.00             | 98.50                 | 100.83               | 2.33        |
|                 | AV       | H          | 103.00               | -4.50       | -20.90           | 77.60                 | 80.83                | 3.23        |
|                 | PK       | V          | 94.80                | -4.50       | 0.00             | 90.30                 | 100.83               | 10.53       |
|                 | AV       | V          | 94.80                | -4.50       | -20.90           | 69.40                 | 80.83                | 11.43       |
| 434.375         | PK       | H          | 102.10               | -4.50       | 0.00             | 97.60                 | 100.83               | 3.23        |
|                 | AV       | H          | 102.10               | -4.50       | -20.90           | 76.70                 | 80.83                | 4.13        |
|                 | PK       | V          | 96.60                | -4.50       | 0.00             | 92.10                 | 100.83               | 8.73        |
|                 | AV       | V          | 96.60                | -4.50       | -20.90           | 71.20                 | 80.83                | 9.63        |

Note 1 : Measured distance : 3 m

Note 2 : Peak Result : Peak Reading + Factor

 Duty factor :  $20 \times \log(\text{Duty cycle})$  dB, refer to 4.4.7

Average Result : Peak Reading + Factor + Duty factor

#### 4.4.4 Emission Bandwidth

##### 4.4.4.1 Regulation

According to §15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

According to RSS-210 A.1.3 The occupied bandwidth of momentarily operated devices shall be less than or equal to 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the occupied bandwidth shall be less than or equal to 0.5% of the centre frequency.

##### 4.4.4.2 Measurement Procedure

ANSI C63.10 § 6.9.2 Occupied bandwidth-relative measurement procedure

ANSI C63.10 § 6.9.2 Occupied bandwidth-power bandwidth (99%) measurement procedure

##### 4.4.4.3 Result

Comply

##### 4.4.4.4 Measurement data

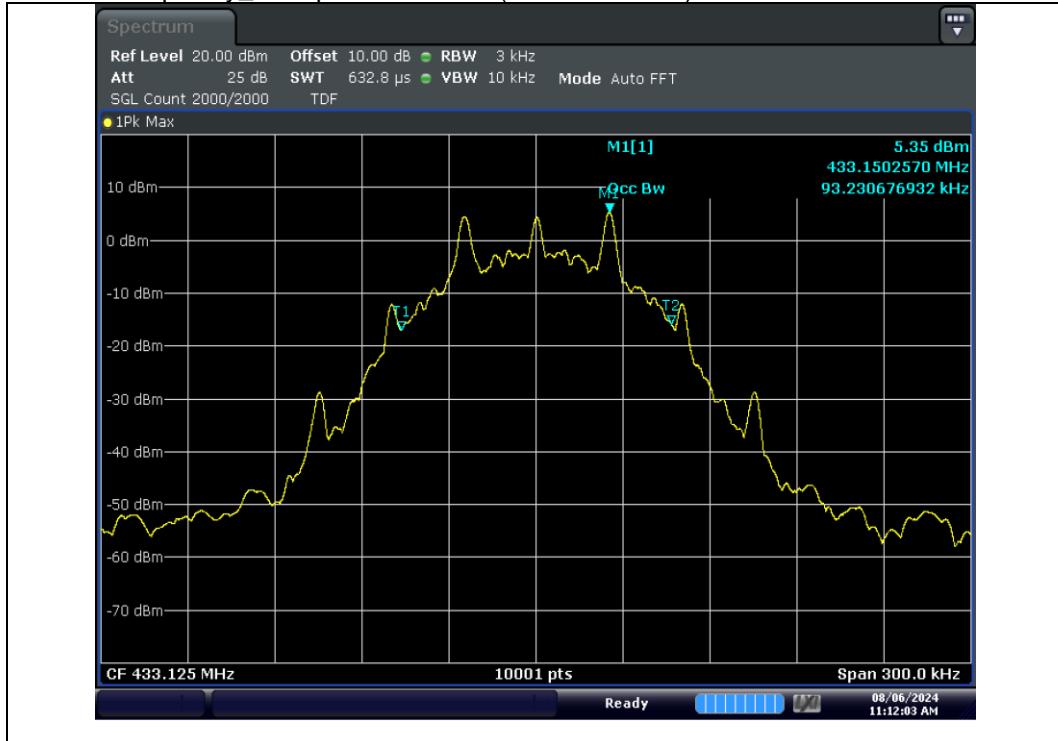
| Frequency (MHz) | 20 dB Bandwidth (kHz) | Occupied Bandwidth (99 % Bandwidth)(kHz) | Limit (MHz) |
|-----------------|-----------------------|--|-------------|
| 433.125         | 86.30                 | 93.23                                    | 1.083       |
| 433.725         | 84.71                 | 92.69                                    | 1.084       |
| 434.375         | 84.74                 | 93.26                                    | 1.086       |

## 4.4.4.5 Test Plot

Lowest Frequency\_20 dB Bandwidth



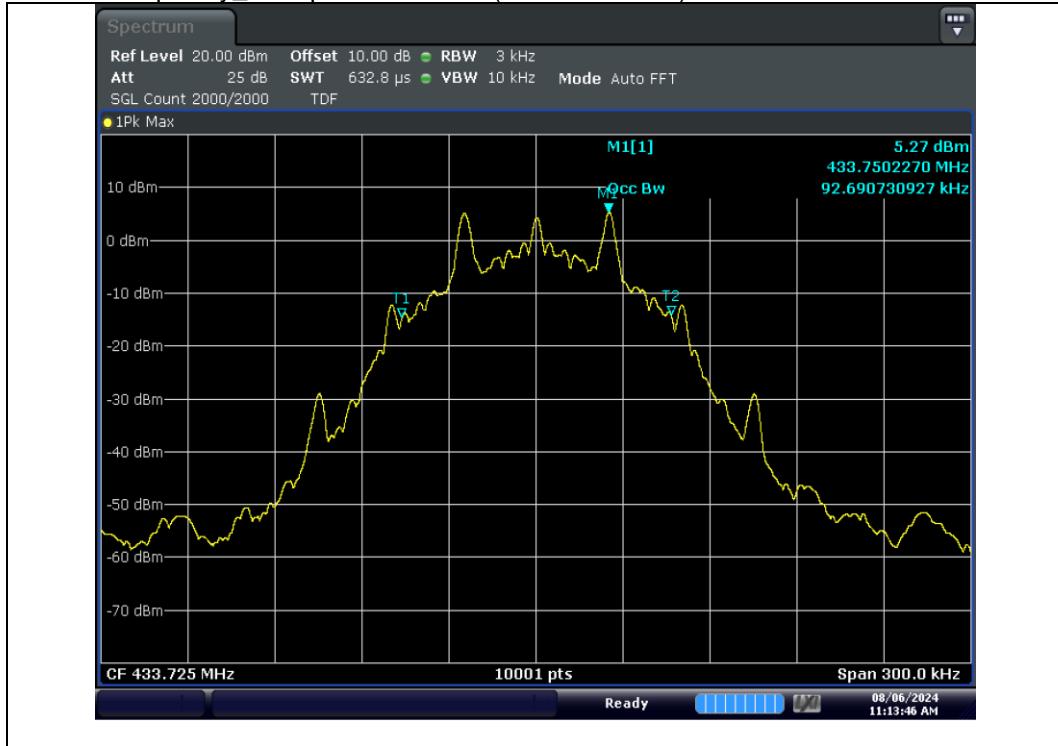
Lowest Frequency\_Occupied Bandwidth(99 % Bandwidth)



## Middle Frequency\_20 dB Bandwidth



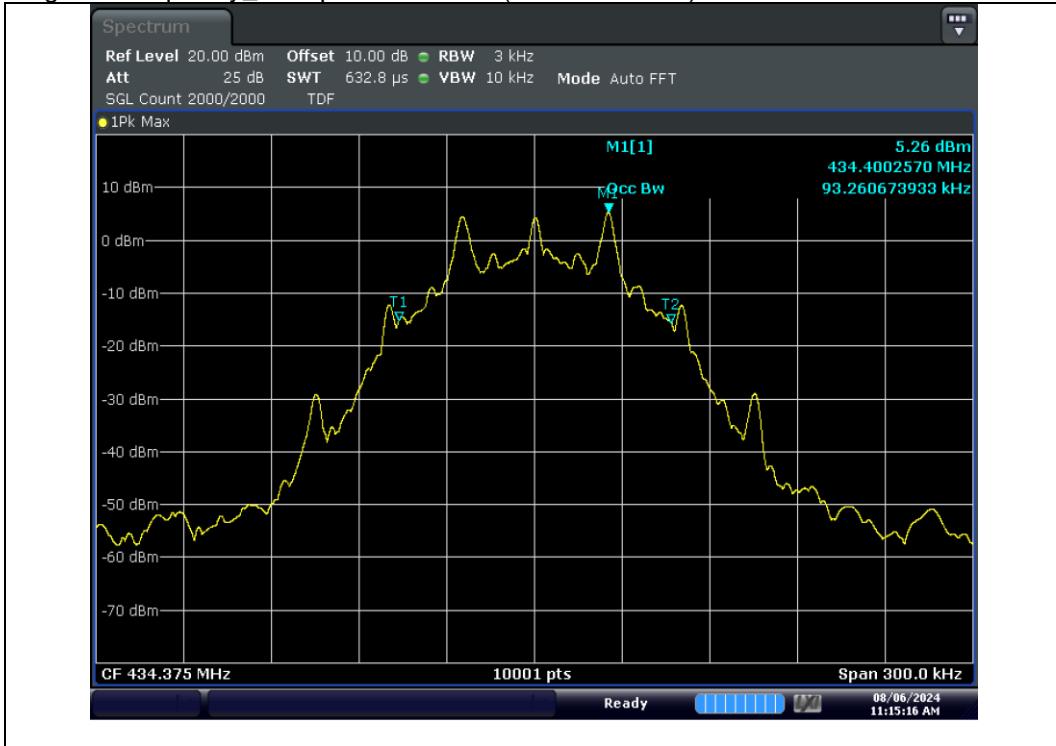
## Middle Frequency\_Occupied Bandwidth(99 % Bandwidth)



## Highest Frequency\_20 dB Bandwidth



## Highest Frequency\_Occupied Bandwidth(99 % Bandwidth)



#### 4.4.5 Spurious Emission and Restricted bands

##### 4.4.5.1 Regulation

According to §15.231(b) In addition to the provisions of § 15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

| Fundamental frequency (MHz) | Field strength of fundamental (microvolts/meter) | Field strength of spurious emissions (microvolts/meter) |
|-----------------------------|--|---|
| 40.66-40.70                 | 2,250  | 225   |
| 70-130                      | 1,250  | 125   |
| 130-174                     | <sup>1</sup> 1,250 to 3,750                      | <sup>1</sup> 125 to 375                                 |
| 174-260                     | 3,750  | 375   |
| <u>260-470</u>              | <sup>1</sup> 3,750 to 12,500                     | <sup>1</sup> 375 to 1,250                               |
| Above 470                   | 12,500   | 1,250   |

<sup>1</sup> Linear interpolations.

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in § 15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of § 15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in § 15.209, whichever limit permits a higher field strength.

According to RSS-210 A.1.2(b) Unwanted emissions shall be 10 times below the fundamental emissions field strength limits in table A1 or comply with the limits specified in RSS-Gen, whichever is less stringent.

Table A1— Permissible field strength limits for momentarily operated devices

| Fundamental frequency (MHz), excluding restricted frequency bands specified in RSS-Gen | Field strength of the fundamental emissions ( $\mu$ V/m at 3 m) |
|--|---|
| 70-130   | 1,250   |
| 130-174  | 1,250 to 3,750*   |
| 174-260**  | 3,750   |
| <u>260-470**</u>   | <u>3,750 to 12,500*</u>   |
| Above 470  | 12,500  |

\* Linear interpolation with frequency, f, in MHz:

- For 130-174 MHz: Field Strength ( $\mu$ V/m) =  $(56.82 \times f) - 6136$
- For 260-470 MHz: Field Strength ( $\mu$ V/m) =  $(41.67 \times f) - 7083$

\*\* Frequency bands 225-328.6 MHz and 335.4-399.9 MHz are designated for the exclusive use of the Government of Canada. Manufacturers should be aware of possible harmful interference and degradation of their licence-exempt radio equipment in these frequency bands.

According to §15.209(a) and RSS-GEN §8.9 Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency(MHz) | Field strength(microvolts/meter) | Measurement distance(meters) |
|----------------|----------------------------------|------------------------------|
| 0.009 - 0.490  | 2 400/F(kHz)                     | 300                          |
| 0.490 - 1.705  | 24 000/F(kHz)                    | 30                           |
| 1.705 - 30.0   | 30                               | 30                           |
| 30 - 88        | 100**                            | 3                            |
| 88 - 216       | 150**                            | 3                            |
| 216 - 960      | 200**                            | 3                            |
| Above 960      | 500                              | 3                            |

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

According to §15.205(a),(b) and RSS-GEN §8.10 only spurious emissions are permitted in any of the frequency bands listed below:

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

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurement

#### 4.4.5.2 Measurement Procedure

ANSI C63.10 § 6.4 Radiated emissions from unlicensed wireless devices below 30 MHz

ANSI C63.10 § 6.5 Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz

ANSI C63.10 § 6.6 Radiated emissions from unlicensed wireless devices from 1 GHz to 40 GHz

#### 4.4.5.3 Result

Comply

#### 4.4.5.4 Measurement data

Test mode : Lowest Frequency 433.125 MHz

| Frequency (MHz) | Detector | Pol. (V/H) | Reading (dB $\mu$ V) | Factor (dB) | Duty factor (dB) | Result (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|----------|------------|----------------------|-------------|------------------|-----------------------|----------------------|-------------|
| 132.67          | QP       | H          | 47.50                | -10.10      | -                | 37.40                 | 43.50                | 6.10        |
| 137.37          | QP       | V          | 47.70                | -9.60       | -                | 38.10                 | 43.50                | 5.40        |
| 141.79          | QP       | V          | 45.30                | -9.20       | -                | 36.10                 | 43.50                | 7.40        |
| 186.75          | QP       | H          | 46.60                | -11.10      | -                | 35.50                 | 43.50                | 8.00        |
| 866.19          | QP       | H          | 32.10                | 2.40        | -                | 34.50                 | 46.00                | 11.50       |

Test mode : Middle Frequency 433.725 MHz

| Frequency (MHz) | Detector | Pol. (V/H) | Reading (dB $\mu$ V) | Factor (dB) | Duty factor (dB) | Result (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|----------|------------|----------------------|-------------|------------------|-----------------------|----------------------|-------------|
| 132.82          | QP       | V          | 45.90                | -10.10      | -                | 35.80                 | 43.50                | 7.70        |
| 191.38          | QP       | H          | 48.80                | -11.10      | -                | 37.70                 | 43.50                | 5.80        |
| 290.41          | QP       | H          | 46.60                | -8.00       | -                | 38.60                 | 46.00                | 7.40        |
| 867.49          | QP       | H          | 30.40                | 2.40        | -                | 32.80                 | 46.00                | 13.20       |

Test mode : Highest Frequency 434.375 MHz

| Frequency (MHz) | Detector | Pol. (V/H) | Reading (dB $\mu$ V) | Factor (dB) | Duty factor (dB) | Result (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|----------|------------|----------------------|-------------|------------------|-----------------------|----------------------|-------------|
| 132.82          | QP       | H          | 50.50                | -10.10      | -                | 40.40                 | 43.50                | 3.10        |
| 137.23          | QP       | V          | 48.90                | -9.60       | -                | 39.30                 | 43.50                | 4.20        |
| 191.16          | QP       | V          | 45.70                | -11.10      | -                | 34.60                 | 43.50                | 8.90        |
| 272.31          | QP       | H          | 47.00                | -8.70       | -                | 38.30                 | 46.00                | 7.70        |
| 868.63          | QP       | H          | 30.30                | 2.40        | -                | 32.70                 | 46.00                | 13.30       |

Test mode : Simultaneous operation (FSK + Bluetooth) <sup>NOTE7</sup>

| Frequency (MHz) | Detector | Pol. (V/H) | Reading (dB $\mu$ V) | Factor (dB) | Duty factor (dB) | Result (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-----------------|----------|------------|----------------------|-------------|------------------|-----------------------|----------------------|-------------|
| s               | QP       | V          | 49.80                | -10.10      | -                | 39.70                 | 43.50                | 3.80        |
| 137.16          | QP       | V          | 49.90                | -9.60       | -                | 40.30                 | 43.50                | 3.20        |
| 191.23          | QP       | H          | 50.10                | -11.10      | -                | 39.00                 | 43.50                | 4.50        |
| 866.19          | QP       | H          | 31.40                | 2.40        | -                | 33.80                 | 46.00                | 12.20       |
| 1 601.50        | PK       | H          | 59.30                | -8.64       | -                | 50.66                 | 74.00                | 23.34       |
| 1 601.50        | PK       | V          | 56.50                | -8.64       | -                | 47.86                 | 74.00                | 26.14       |
| 9 608.91        | PK       | H          | 45.30                | 9.46        | -                | 54.76                 | 74.00                | 19.24       |
|                 | AV       | H          | 45.30                | 9.46        | -24.70           | 30.06                 | 54.00                | 23.94       |
| 12 009.28       | PK       | H          | 40.50                | 14.06       | -                | 54.56                 | 74.00                | 19.44       |
|                 | AV       | H          | 40.50                | 14.06       | -24.70           | 29.86                 | 54.00                | 24.14       |
| 12 009.28       | PK       | V          | 41.50                | 14.06       | -                | 55.56                 | 74.00                | 18.44       |
|                 | AV       | V          | 41.50                | 14.06       | -24.70           | 30.86                 | 54.00                | 23.14       |

NOTE1 : The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.

NOTE2 : The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection at frequency above 1 GHz.

NOTE3 : EUT height : 0.8 m is for below 1 GHz testing, and 1.5 m is for above 1 GHz testing

NOTE4 : Below 1 GHz Measured distance : 3 m, Above 1 GHz Measured distance : 1 m

Above 1 GHz Distance Factor =  $20\log(1 / 3) = -9.54$

NOTE5 : Factor : Ant Factor + Cable loss - Amp gain + Distance Factor

NOTE6 : Peak Result : Peak Reading + Factor

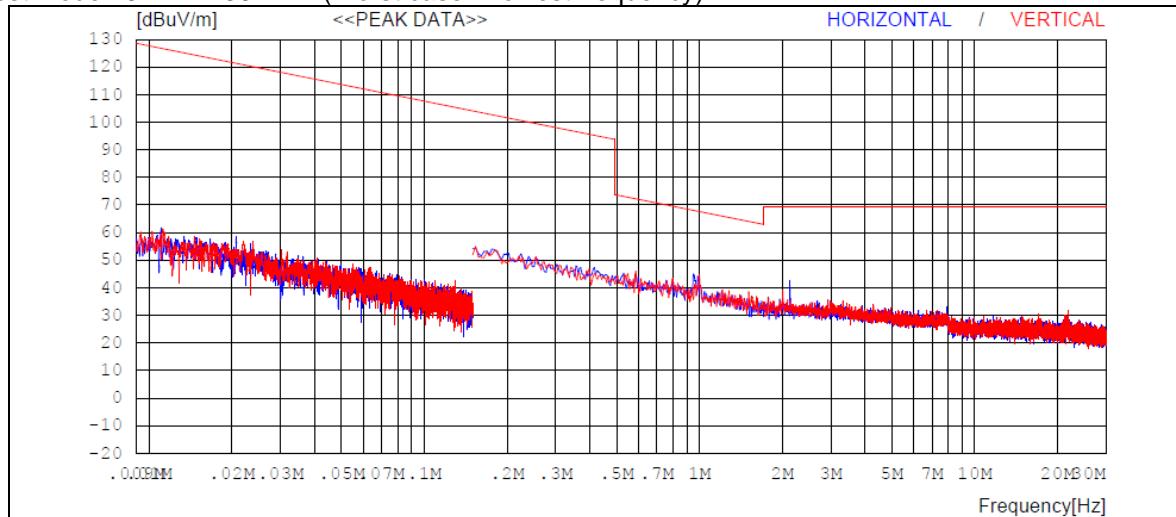
Average Result : Peak Reading + Factor + Duty factor

Duty factor : Refer to Report No. : DRTFCC1612-0159(1)

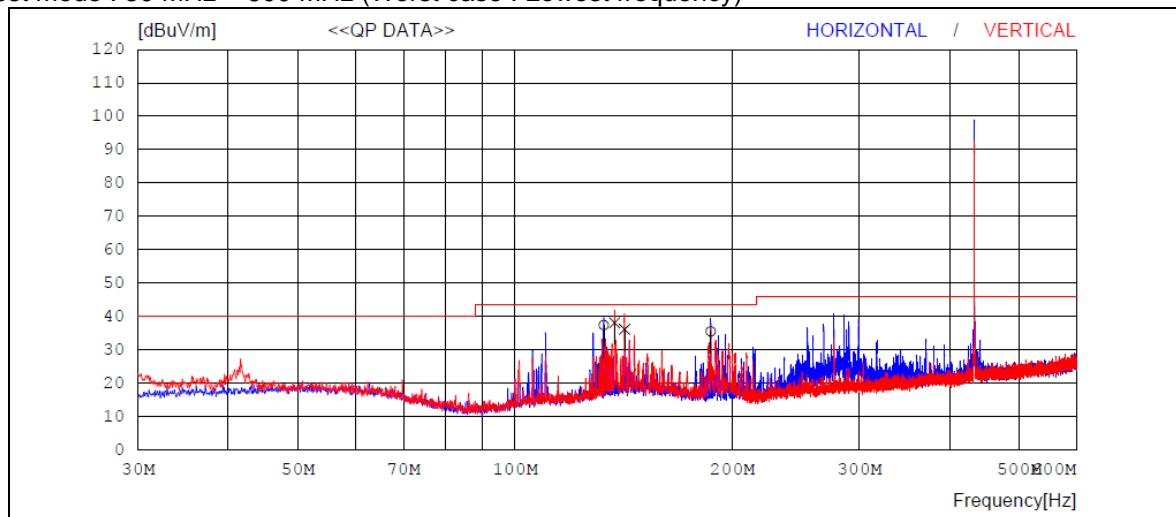
NOTE7 : Tested under FSK and BT simultaneous operation conditions.

## 4.4.5.5 Measurement Plot

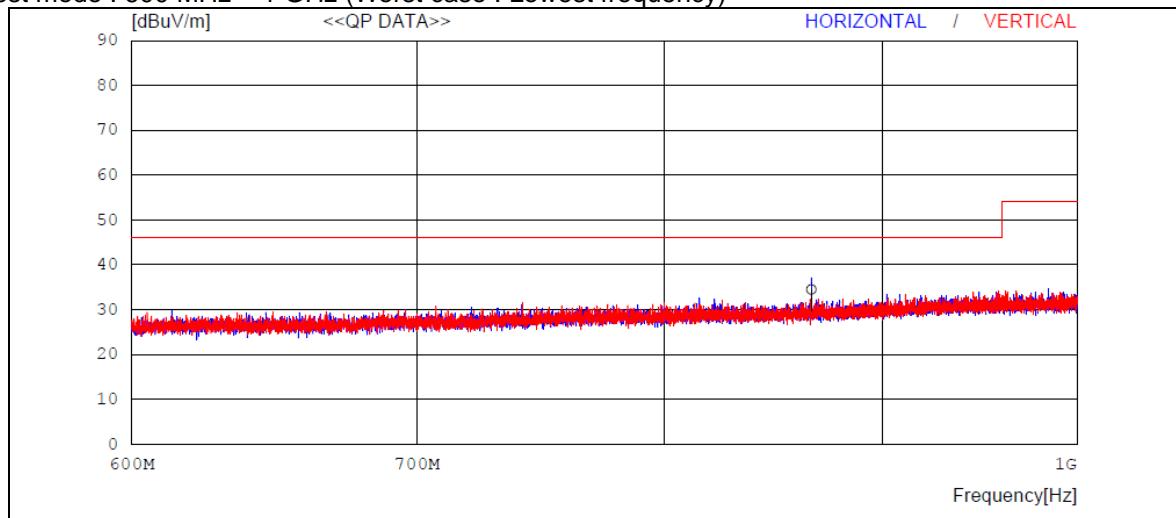
Test mode : 9 kHz ~ 30 MHz (Worst case : Lowest frequency)



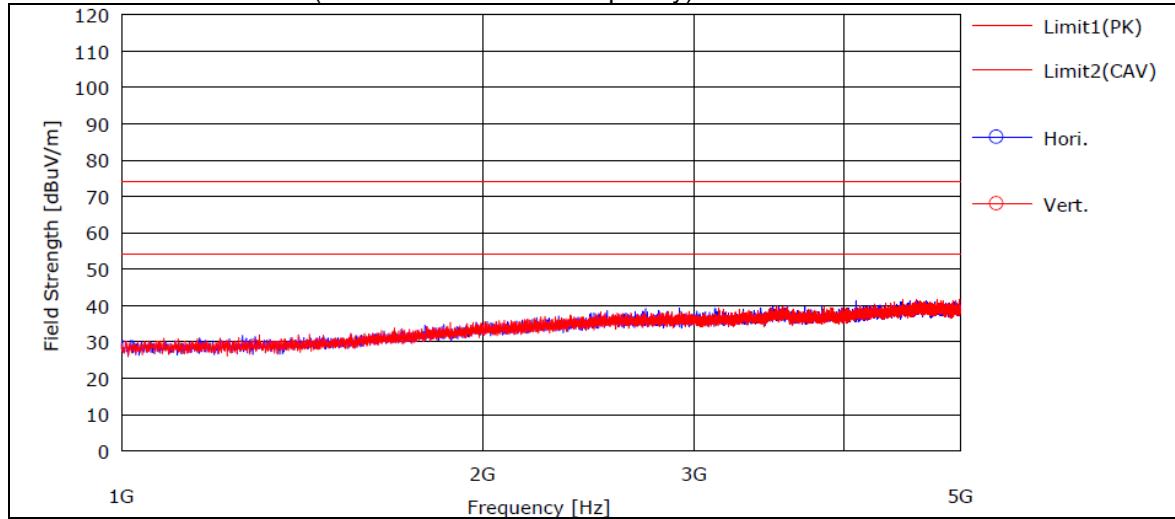
Test mode : 30 MHz ~ 600 MHz (Worst case : Lowest frequency)



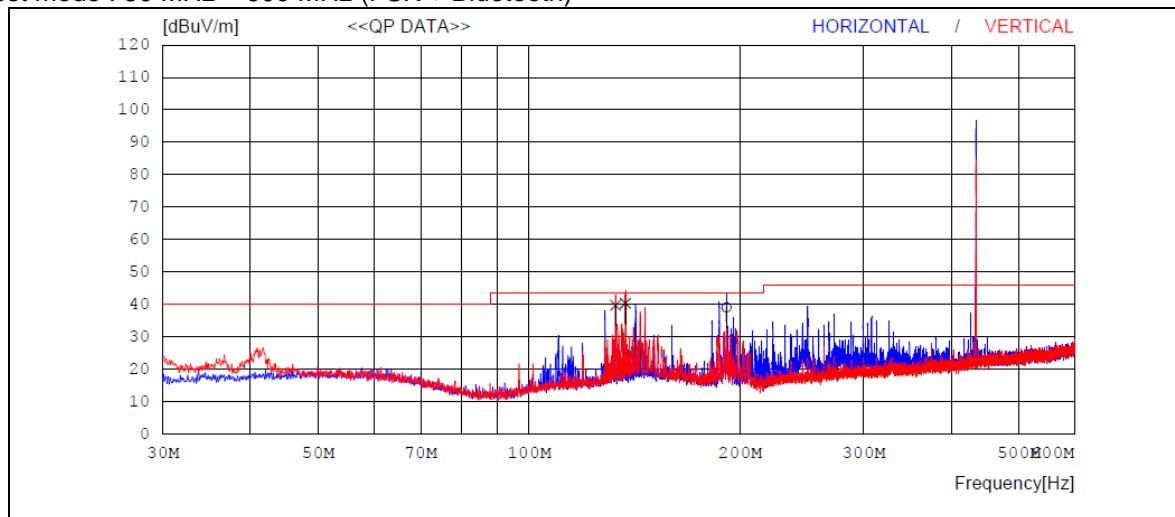
Test mode : 600 MHz ~ 1 GHz (Worst case : Lowest frequency)



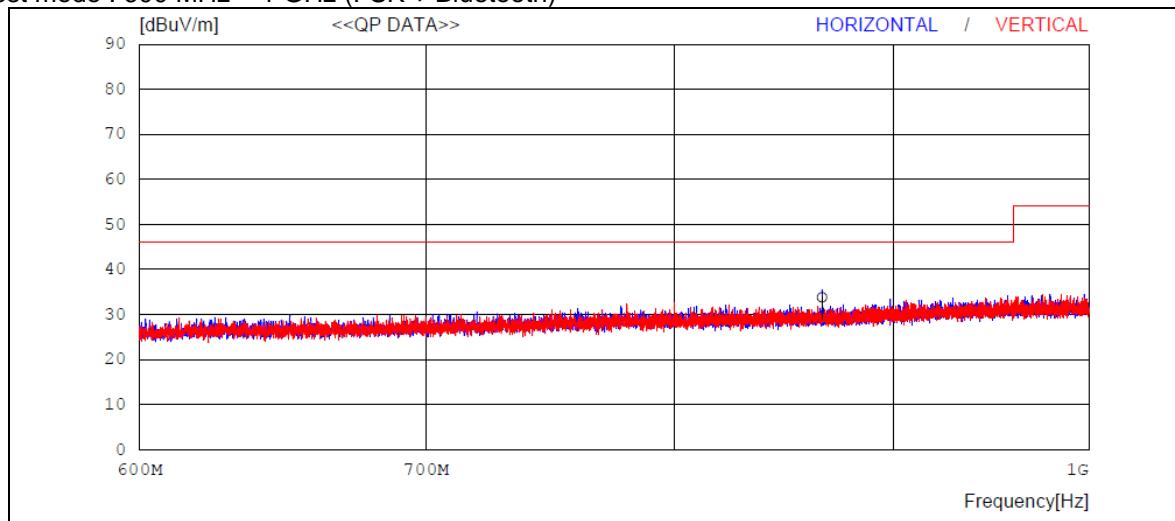
Test mode : 1 GHz ~ 5 GHz (Worst case : Lowest frequency)



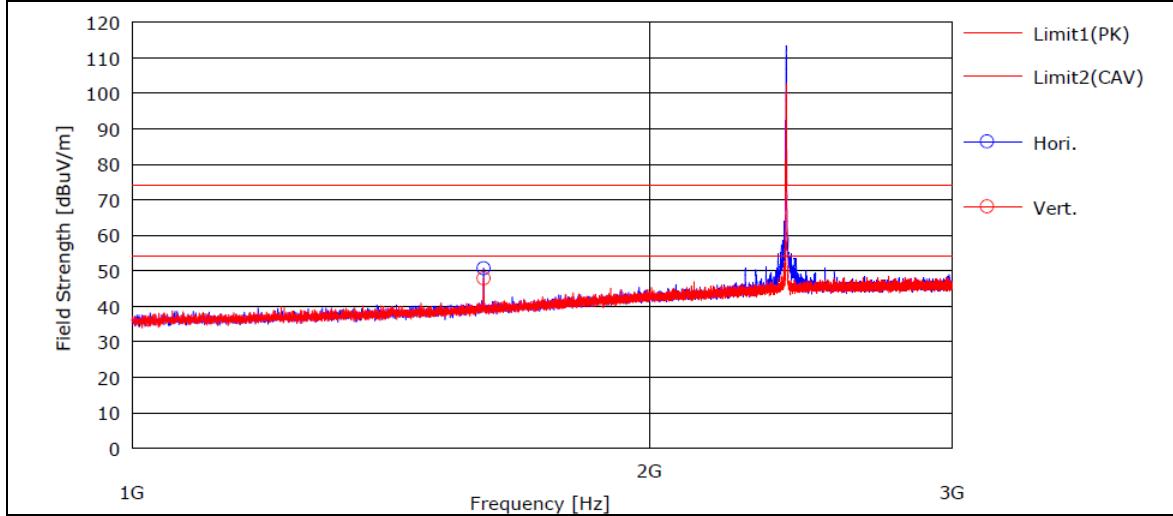
Test mode : 30 MHz ~ 600 MHz (FSK + Bluetooth)



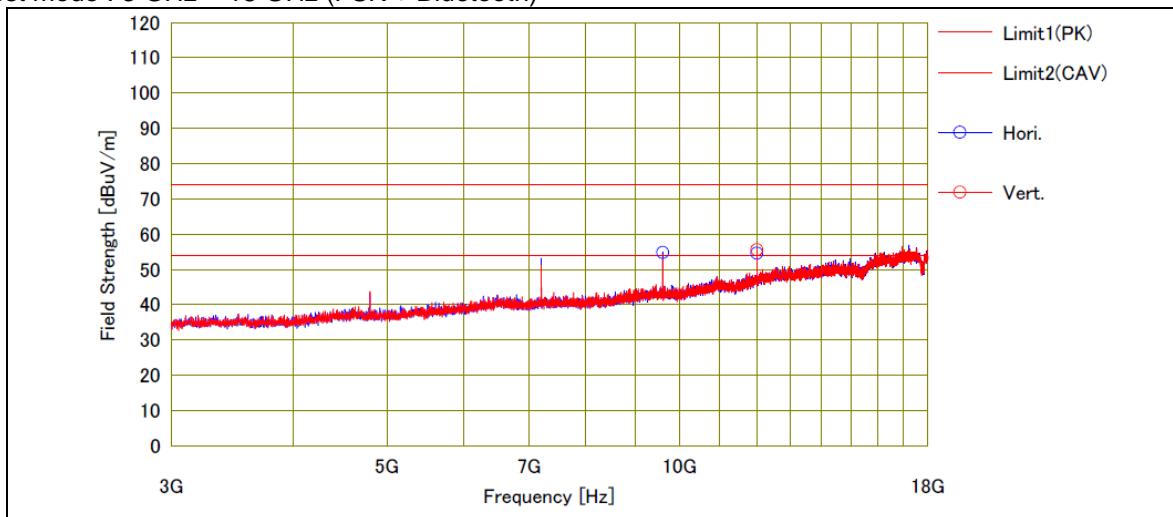
Test mode : 600 MHz ~ 1 GHz (FSK + Bluetooth)



Test mode : 1 GHz ~ 3 GHz (FSK + Bluetooth)



Test mode : 3 GHz ~ 18 GHz (FSK + Bluetooth)



#### 4.4.6 Conducted Emission

##### 4.4.6.1 Regulation

According to §15.207(a) and RSS-GEN §8.8 for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50  $\Omega$  line impedance stabilization network (LISN).

Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of emission (MHz) | Conducted limit (dB $\mu$ V) |            |
|-----------------------------|------------------------------|------------|
|                             | Quasi-peak                   | Average    |
| 0.15 – 0.5                  | 66 to 56 *                   | 56 to 46 * |
| 0.5 – 5                     | 56                           | 46         |
| 5 - 30                      | 60                           | 50         |

\* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

##### 4.4.6.2 Measurement Procedure

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

##### 4.4.6.3 Result

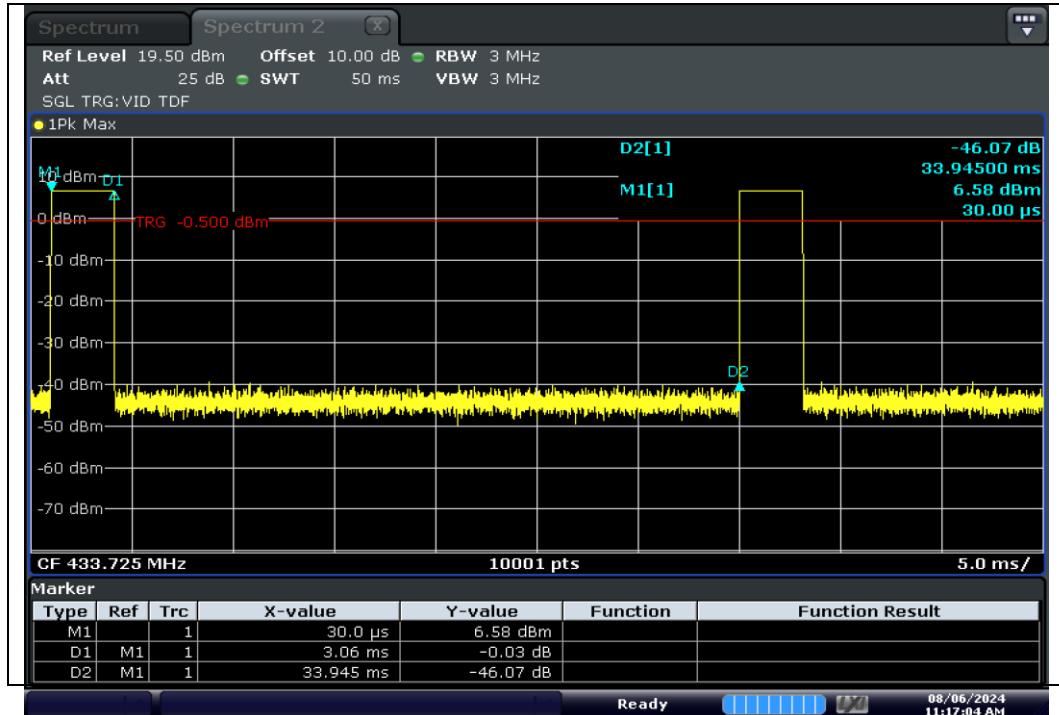
**Not Applicable** (This device only uses DC power.)

#### 4.4.7 Duty cycle

The duty cycle de-rating factor used in the calculation of average radiated limits (per CFR 15.209 and 15.35(c)) is described below.

| Period(ms) | Ontime(ms) | Duty cycle(%) | Duty cycle factor(dB) |
|------------|------------|---------------|-----------------------|
| 33.945     | 3.06       | 9.01          | -20.90                |

Duty cycle factor(dB) :  $20\log(\text{on time}/\text{period})$



# APPENDIX I

## TEST EQUIPMENT USED FOR TESTS

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment.

| Equipment                 | Manufacturer                | Model                       | Serial No. | Cal. Date (yy.mm.dd) | Next Cal.Date (yy.mm.dd) |
|---------------------------|-----------------------------|-----------------------------|------------|----------------------|--------------------------|
| FSV Signal Analyzer       | ROHDE&SCHWARZ               | FSV30                       | 103370     | 2023-10-11           | 2024-10-11               |
| Power Supply              | KIKUSUI                     | PWX1500L                    | SM002050   | 2023-08-16           | 2024-08-16               |
| Temp & Humi Test Chamber  | SJ SCIENCE                  | SJ-TH-S50                   | 170719     | 2024-04-01           | 2025-04-01               |
| Digital MultiMeter        | HP                          | 34401A                      | US36025428 | 2024-01-04           | 2025-01-04               |
| Signal Generator          | ROHDE&SCHWARZ               | SMB100A                     | 178384     | 2023-10-11           | 2024-10-11               |
| ATTENUATOR                | WEINSCHEL                   | 54A-10                      | 69672      | 2023-10-11           | 2024-10-11               |
| EMI Test Receiver         | ROHDE&SCHWARZ               | ESU40                       | 100445     | 2023-09-05           | 2024-09-05               |
| BiLog Antenna             | Schwarzbeck                 | VULB9168                    | 00821      | 2023-03-29           | 2025-03-29               |
| Attenuator                | JFW                         | 50F-006                     | 6 dB-3     | 2024-04-01           | 2025-04-01               |
| Preamplifier              | TSJ                         | MLA-10k01-b01-27            | 1870367    | 2024-04-01           | 2025-04-01               |
| Antenna Mast(10 m)        | TOKIN                       | 5977                        | -          | -                    | -                        |
| Antenna Mast(10 m)        | Innco                       | MA4640-XPET-0800            | 578        | -                    | -                        |
| Controller(10 m)          | TOKIN                       | 5909L                       | 141909L-1  | -                    | -                        |
| Controller(10 m)          | Innco                       | CO3000                      | 40040217   | -                    | -                        |
| Turn Table(10 m)          | TOKIN                       | 5983-1.5                    | -          | -                    | -                        |
| FSV Signal Analyzer       | ROHDE&SCHWARZ               | FSV30                       | 103370     | 2023-10-11           | 2024-10-11               |
| Double Ridge Horn Antenna | ETS                         | 3117                        | 00168719   | 2023-08-10           | 2024-08-10               |
|                           |                             |                             |            | 2024-08-05           | 2025-08-05               |
| PREAMPLIFIER              | Agilent                     | 8449B                       | 3008A02110 | 2024-01-08           | 2025-01-08               |
| High pass filter          | Wainwright Instruments GmbH | WHJ10-516-600-4000-60SS     | 1          | 2023-08-16           | 2024-08-16               |
| High pass filter          | Wainwright Instruments GmbH | WHKX10-2580-3000-18000-60SS | 14         | 2024-01-08           | 2025-01-08               |