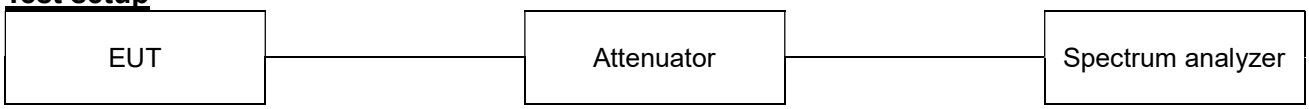
## 7.3. 6 dB Bandwidth(DTS Channel Bandwidth)

**Test setup**




**Limit**

According to §15.247(a)(2) and RSS-247(5.2) For Systems using digital modulation techniques may operate in the 902–928 ㎒, 2 400–2 483.5 ㎒, and 5 725–5 850 ㎒ bands. The minimum 6 ㏈ bandwidth shall be at least 500 ㎑.

**Test procedure**

ANSI C63.10 – Section 11.8.2

**Test settings**

**DTS bandwidth**

One of the following procedures may be used to determine the modulated DTS bandwidth.

**Option 1**

1) Set RBW = 100 ㎑.
2) Set the video bandwidth (VBW) ≥ 3 x RBW.
3) Detector = Peak.
4) Trace mode = max hold.
5) Sweep = auto couple.
6) Allow the trace to stabilize.
7) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 ㏈ relative to the maximum level measured in the fundamental emission.

**Option 2**

The automatic bandwidth measurement capability of an instrument may be employed using the X ㏈ bandwidth mode with X set to 6 ㏈, if the functionality described in 11.8.1 (i.e., RBW = 100 ㎑, VBW ≥ 3 × RBW, and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥6 ㏈.

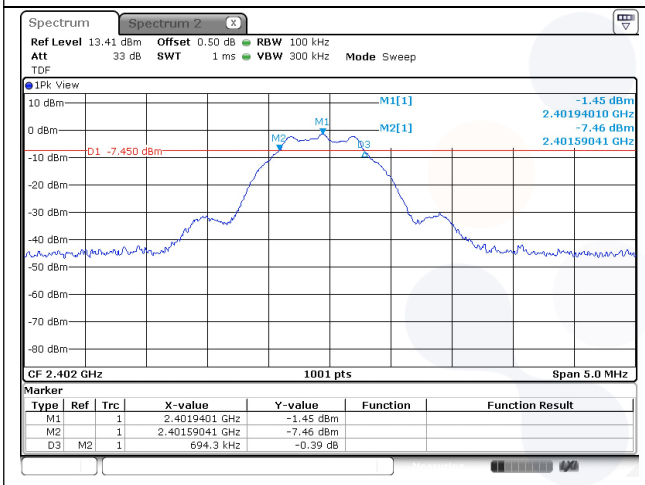
## Test results

| Frequency(㎒) | Data rate (Bits/s) | Packet length (Bytes) | 6 ㏈ bandwidth (㎒) | 99 % Bandwidth (㎒) |
|---|---|---|---|---|
| 2 402 | 1M | 37 | 0.694 | 1.039 |
| 2 440 | | | 0.704 | 1.039 |
| 2 480 | | | 0.704 | 1.044 |
| **Frequency(㎒)** | **Data rate (Bits/s)** | **Packet length (Bytes)** | **6 ㏈ bandwidth (㎒)** | **99 % Bandwidth (㎒)** |
| 2 402 | 2M | 37 | 1.144 | 2.043 |
| 2 440 | | | 1.144 | 2.043 |
| 2 480 | | | 1.154 | 2.053 |

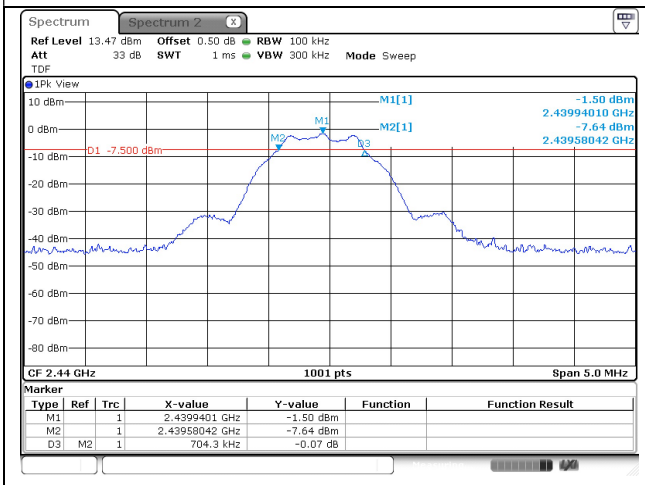
## 6 ㏈ bandwidth

**BLE_1MBits/s**

2 402 ㎒

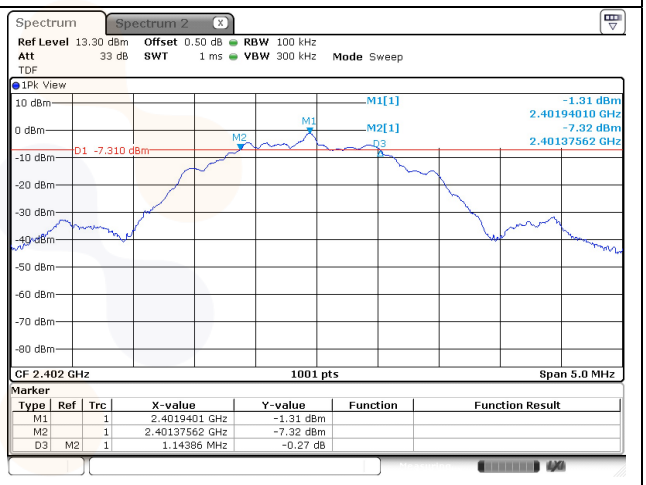



2 440 ㎒

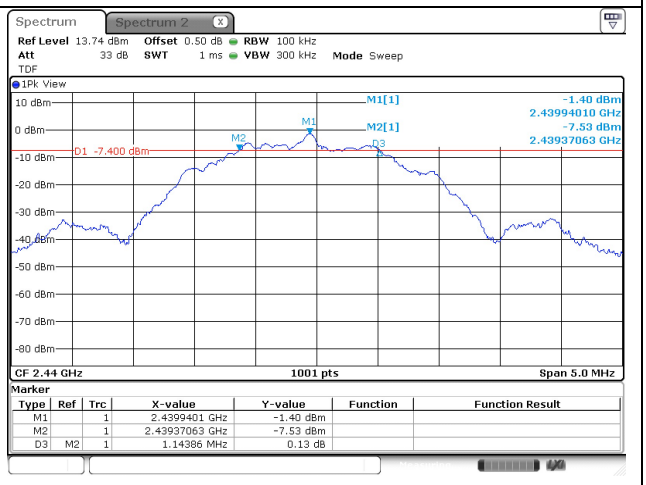


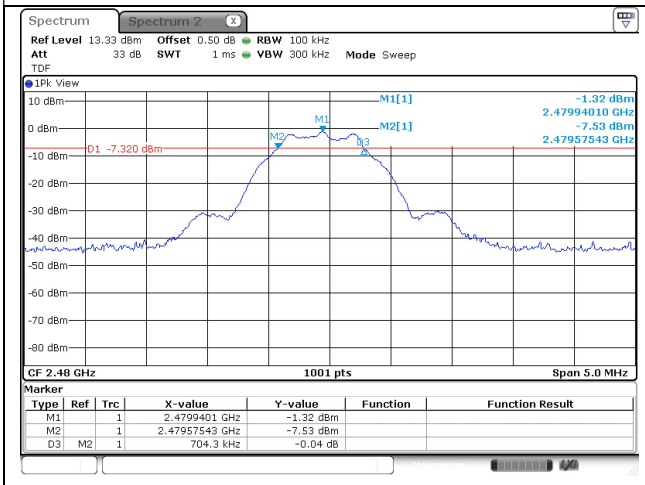
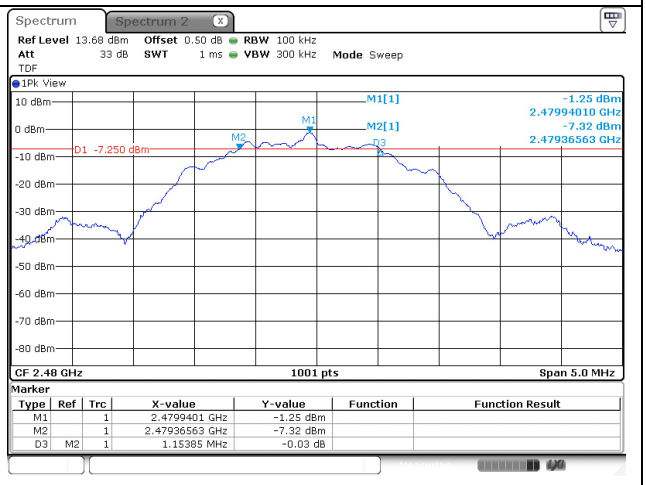

**BLE_2MBits/s**

2 402 ㎒




2 440 ㎒

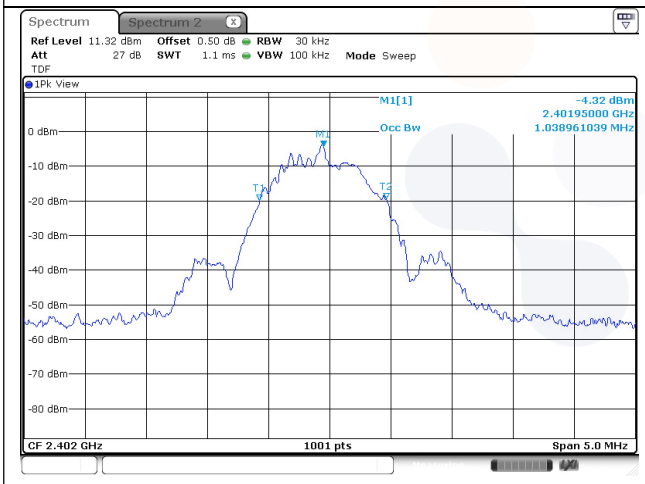
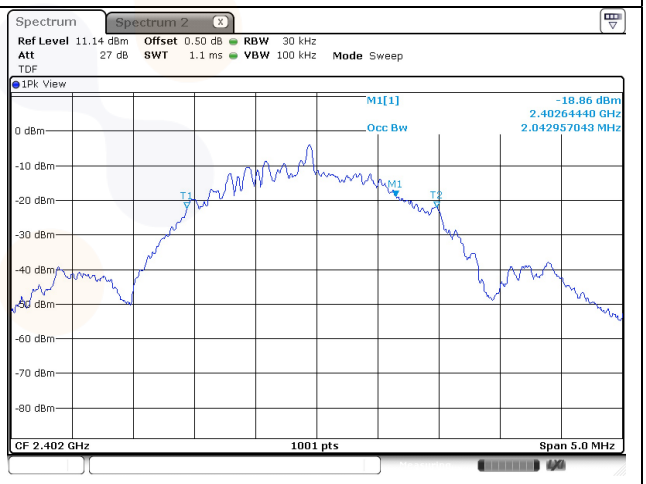
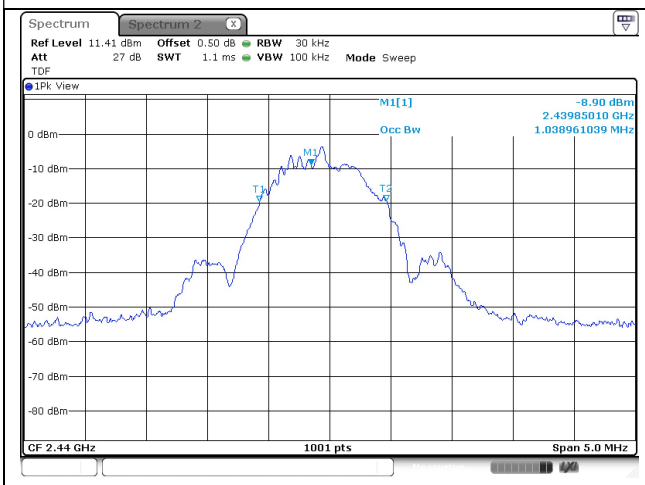
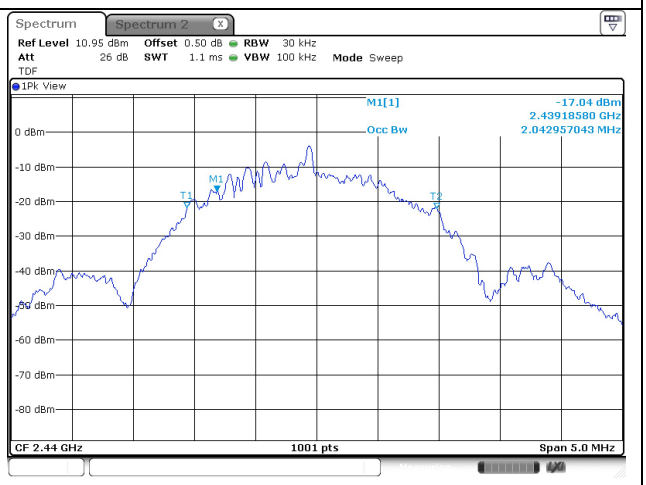


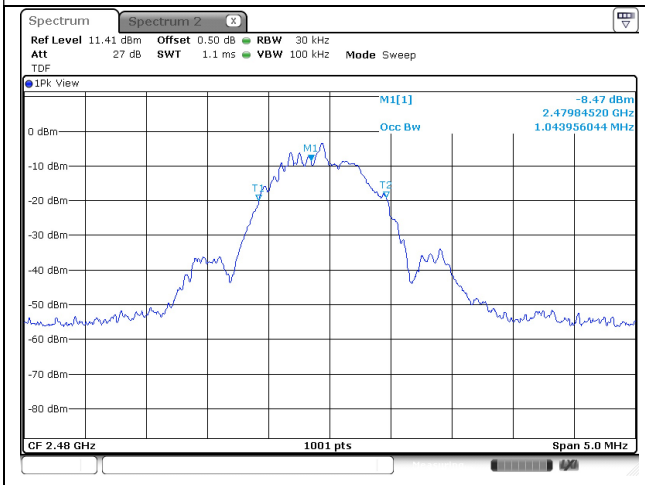
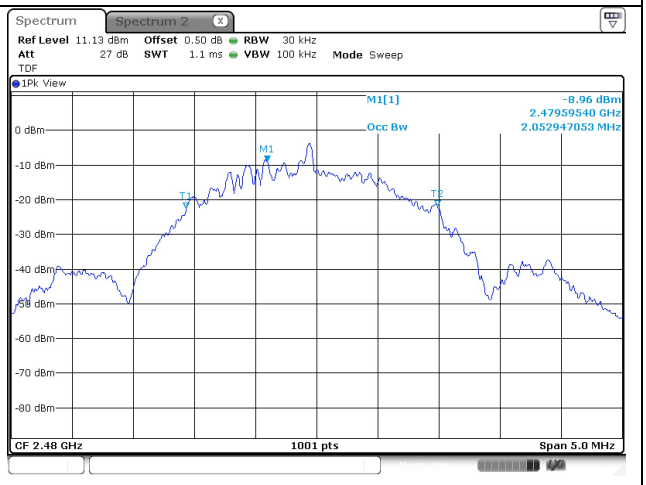
| BLE_1MBits/s | BLE_2MBits/s |
|---|---|
| 2 480 ㎒ | 2 480 ㎒ |
|  |  |





## 99% bandwidth

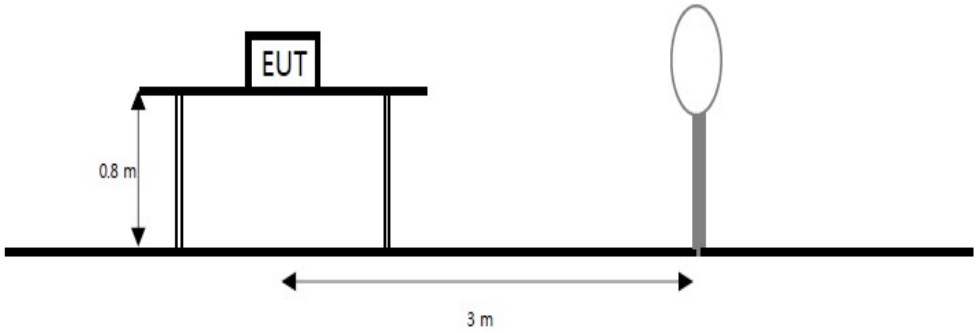
| BLE_1MBits/s | BLE_2MBits/s |
|---|---|
| 2 402 ㎒ | 2 402 ㎒ |
|  |  |
| 2 440 ㎒ | 2 440 ㎒ |
|  |  |

| BLE_1MBits/s | BLE_2MBits/s |
|---|---|
| 2 480 ㎒ | 2 480 ㎒ |
|  |  |

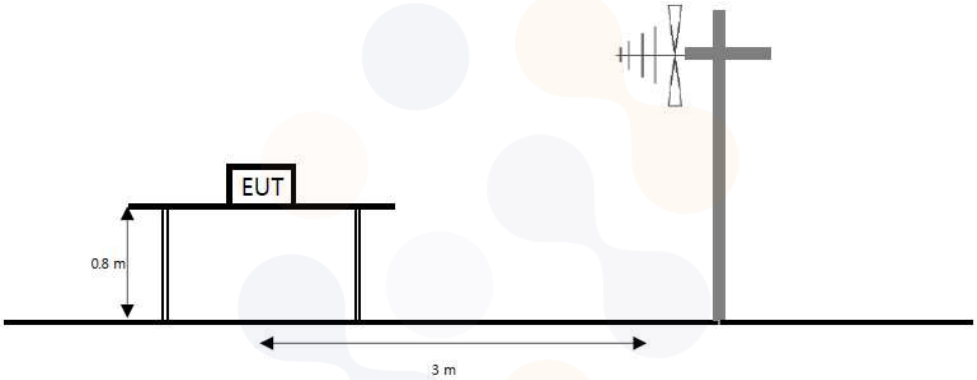
## 7.4. Spurious Emission, Band Edge and Restricted bands

**Test setup**

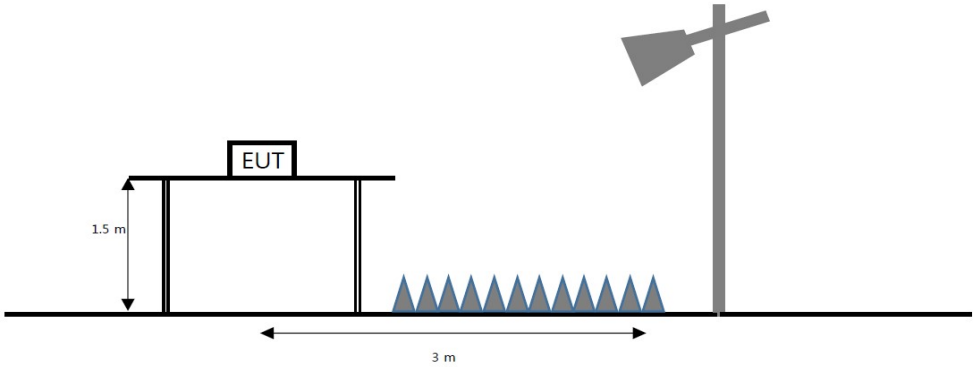
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions




The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.




The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



## Limit

### FCC

According to section 15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 ㎒, 76–88 ㎒, 174–216 ㎒ or 470–806 ㎒. However, operation within these frequency bands is permitted under other sections of this part, e.g., Section15.231 and 15.241.

According to section 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

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

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in section 15.209. At frequencies equal to or less than 1 000 ㎒, compliance with the limits in section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 ㎒, compliance with the emission limits in section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in section 15.35 apply to these measurements.

**IC**

According to RSS-247(5.5), In any 100 ㎑ bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 ㏈ instead of 20 ㏈. Attenuation below the general field strength limits specified in RSS-Gen is not required.

According to RSS-Gen(8.9), Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

**Table 5- General field strength limits at frequencies above 30 ㎒**

| Frequency(㎒) | Field strength (㎶/m at 3 m) |
|---|---|
| 30 to 88 | 100 |
| 88 to 216 | 150 |
| 216 to 960 | 200 |
| Above 960 | 500 |

**Table 6- General field strength limits at frequencies below 30 ㎒**

| Frequency | Magnetic field strength (H-Field) (㎂/m) | Measurement distance(m) |
|---|---|---|
| 9 – 490 ㎑ 1) | 6.37/F (F in ㎑) | 300 |
| 490 – 1 705 ㎑ | 63.7/F (F in ㎑) | 30 |
| 1.705 - 30 ㎒ | 0.08 | 30 |

**Note 1:** The emission limits for the ranges 9-90 ㎑ and 110-490 ㎑ are based on measurements employing a linear average detector.

According to RSS-Gen(8.10), Restricted frequency bands, identified in table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to the restricted frequency bands apply:

(a) The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands listed in table 7 except for apparatus compliant with RSS-287, Emergency Position Indicating Radio Beacons (EPIRB), Emergency Locator Transmitters (ELT), Personal Locator Beacons (PLB), and Maritime Survivor Locator Devices (MSLD).
(b) Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in table 5 and table 6.
(c) Unwanted emissions that do not fall within the restricted frequency bands listed in table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

**Table 7- Restricted frequency bands***

| MHz | MHz | GHz |
|---|---|---|
| 0.090 - 0.110 | 149.9 - 150.05 | 9.0 - 9.2 |
| 0.495 - 0.505 | 156.52475 - 156.52525 | 9.3 - 9.5 |
| 2.1735 - 2.1905 | 156.7 - 156.9 | 10.6 - 12.7 |
| 3.020 - 3.026 | 162.0125 - 167.17 | 13.25 - 13.4 |
| 4.125 - 4.128 | 167.72 - 173.2 | 14.47 - 14.5 |
| 4.17725 - 4.17775 | 240 - 285 | 15.35 - 16.2 |
| 4.20725 - 4.20775 | 322 - 335.4 | 17.7 - 21.4 |
| 5.677 - 5.683 | 399.9 - 410 | 22.01 - 23.12 |
| 6.215 - 6.218 | 608 - 614 | 23.6 - 24.0 |
| 6.26775 - 6.26825 | 960 - 1427 | 31.2 - 31.8 |
| 6.31175 - 6.31225 | 1435 - 1626.5 | 36.43 - 36.5 |
| 8.291 - 8.294 | 1645.5 - 1646.5 | Above 38.6 |
| 8.362 - 8.366 | 1660 - 1710 | |
| 8.37625 - 8.38675 | 1718.8 - 1722.2 | |
| 8.41425 - 8.41475 | 2200 - 2300 | |
| 12.29 - 12.293 | 2310 - 2390 | |
| 12.51975 - 12.52025 | 2483.5 - 2500 | |
| 12.57675 - 12.57725 | 2655 - 2900 | |
| 13.36 - 13.41 | 3260 - 3267 | |
| 16.42 - 16.423 | 3332 - 3339 | |
| 16.69475 - 16.69525 | 3345.8 - 3358 | |
| 16.80425 - 16.80475 | 3500 - 4400 | |
| 25.5 - 25.67 | 4500 - 5150 | |
| 37.5 - 38.25 | 5350 - 5460 | |
| 73 - 74.6 | 7250 - 7750 | |
| 74.8 - 75.2 | 8025 - 8500 | |
| 108 - 138 | -- | |

* Certain frequency bands listed in table 7 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

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

**Test settings**
**Peak field strength measurements**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in table
3. VBW ≥ (3×RBW)
4. Detector = peak
5. Sweep time = auto
6. Trace mode = max hold
7. Allow sweeps to continue until the trace stabilizes

**Table. RBW as a function of frequency**

| Frequency | RBW |
|---|---|
| 9 ㎑ to 150 ㎑ | 200 ㎐ to 300 ㎐ |
| 0.15 ㎒ to 30 ㎒ | 9 ㎑ to 10 ㎑ |
| 30 ㎒ to 1 000 ㎒ | 100 ㎑ to 120 ㎑ |
| > 1 000 ㎒ | 1 ㎒ |

**Average field strength measurements**

**Trace averaging with continuous EUT transmission at full power**

If the EUT can be configured or modified to transmit continuously (D ≥ 98%), then the average emission levels shall be measured using the following method (with EUT transmitting continuously):

1. RBW = 1 ㎒ (unless otherwise specified).
2. VBW ≥ (3×RBW).
3. Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
4. Averaging type = power (i.e., rms):
   1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
   2) Some instruments require linear display mode to use linear voltage averaging. Log or ㏈ averaging shall not be used.
5. Sweep time = auto.
6. Perform a trace average of at least 100 traces.

**Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction**

If continuous transmission of the EUT (D ≥ 98%) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±2%), then the following procedure shall be used:

1. The EUT shall be configured to operate at the maximum achievable duty cycle.
2. Measure the duty cycle D of the transmitter output signal as described in 11.6.
3. RBW = 1 ㎒ (unless otherwise specified).
4. VBW ≥ [3 × RBW].
5. Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
6. Averaging type = power (i.e., rms):

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.

7. Sweep time = auto.
8. Perform a trace average of at least 100 traces.
9. A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
   1) If power averaging (rms) mode was used in step f), then the applicable correction factor is [10 log (1 / D)], where D is the duty cycle.
   2) If linear voltage averaging mode was used in step f), then the applicable correction factor is [20 log (1 / D)], where D is the duty cycle.
   3) If a specific emission is demonstrated to be continuous (D ≥ 98%) rather than turning ON and OFF with with the transmit cycle, then no duty cycle correction is required for that emission.

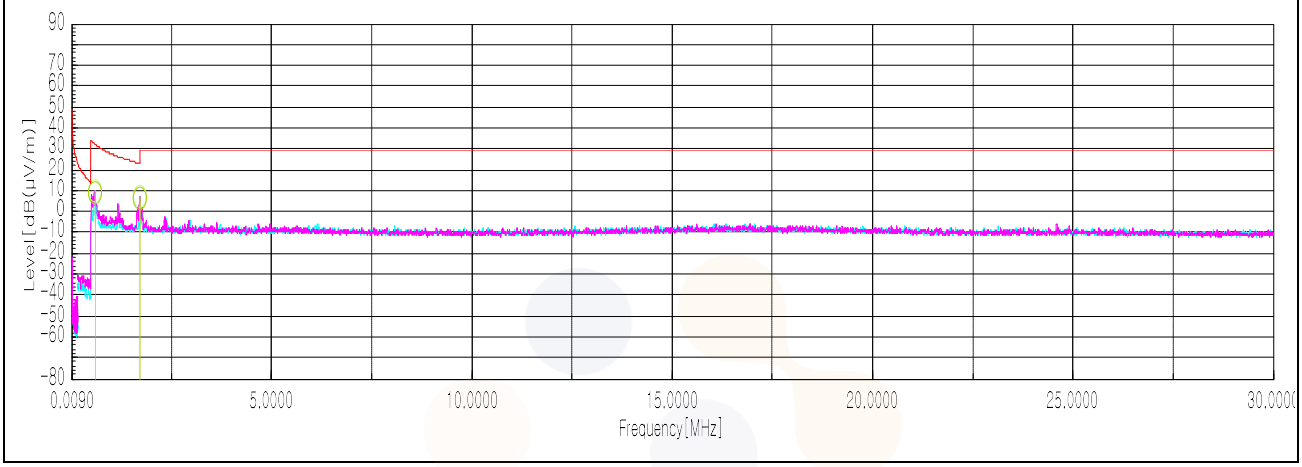
**Notes:**

1. *f* <30 ㎒, extrapolation factor of 40 dB/decade of distance. $F_d = 40\log(D_m/D_s)$
   *f* ≥30 ㎒, extrapolation factor of 20 dB/decade of distance. $F_d = 20\log(D_m/D_s)$
   Where:
   $F_d$= Distance factor in dB
   $D_m$= Measurement distance in meters
   $D_s$= Specification distance in meters
2. Factors(dB) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB) - or $F_d$(dB)
3. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
4. Average test would be performed if the peak result were greater than the average limit.
5. 1) means restricted band.
6. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X ㎑ resulted in a level of Y dBμV /m, which is equivalent to Y-51.5 = Z dBμA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.

**Test results (Below 30 ㎒) –Worst case: 1 MBits/s(37 Bytes)_2 402 ㎒**

| Frequency | Pol. | Reading | Antenna Factor | Amp. + Cable | Distance Factor | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|---|
| [㎒] | [V/H] | [dB(㎶)] | [dB] | [dB] | [dB] | [dB] | [dB(㎶/m)] | [dB(㎶/m)] | [dB] |
| 0.59 | H | 61.80 | 19.92 | -32.89 | 40.00 | - | 8.83 | 32.20 | 23.37 |
| 1.71 | H | 58.90 | 20.04 | -32.75 | 40.00 | - | 6.19 | 29.50 | 23.31 |

**Horizontal/Vertical**

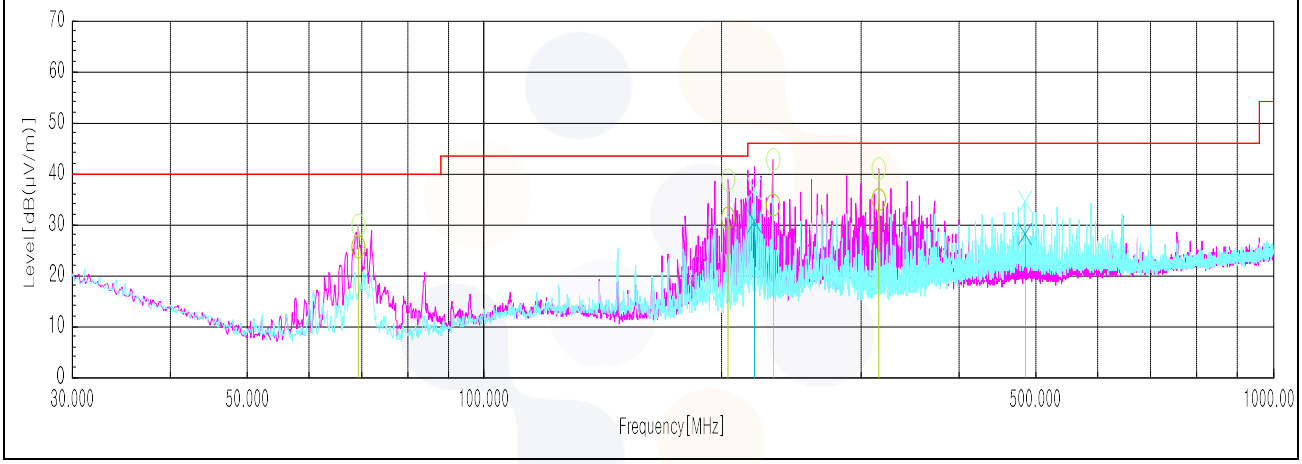



Note. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X ㎑ resulted in a level of Y dB㎶/m, which is equivalent to Y-51.5 = Z dB㎂/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.

**Test results (Below 1 000 ㎒) –Worst case: 1 MBits/s(37 Bytes)_2 402 ㎒**

| Frequency | Pol. | Reading | Antenna Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (㎒) | (V/H) | (dB(㎶)) | (dB) | (dB) | (dB) | (dB(㎶/m)) | (dB(㎶/m)) | (dB) |
| **Quasi peak data** | | | | | | | | |
| 69.29 | H | 45.10 | 12.10 | -31.71 | - | 25.49 | 40.00 | 14.51 |
| 203.99 | H | 47.20 | 15.40 | -31.32 | - | 31.28 | 43.50 | 12.22 |
| 220.00 | V | 46.90 | 15.10 | -31.31 | - | 30.69 | 46.00 | 15.31 |
| 232.00 | H | 49.00 | 16.20 | -31.39 | - | 33.81 | 46.00 | 12.19 |
| 316.03 | H | 46.50 | 19.40 | -31.08 | - | 34.82 | 46.00 | 11.18 |
| 484.08 | V | 35.70 | 23.10 | -30.63 | - | 28.17 | 46.00 | 17.83 |

**Horizontal/Vertical**

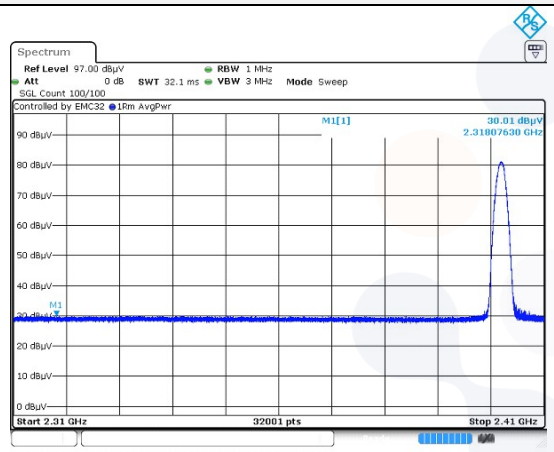


## Test results (Above 1 000 ㎒)_1 MBits/s(37 Bytes)

**2 402 ㎒**

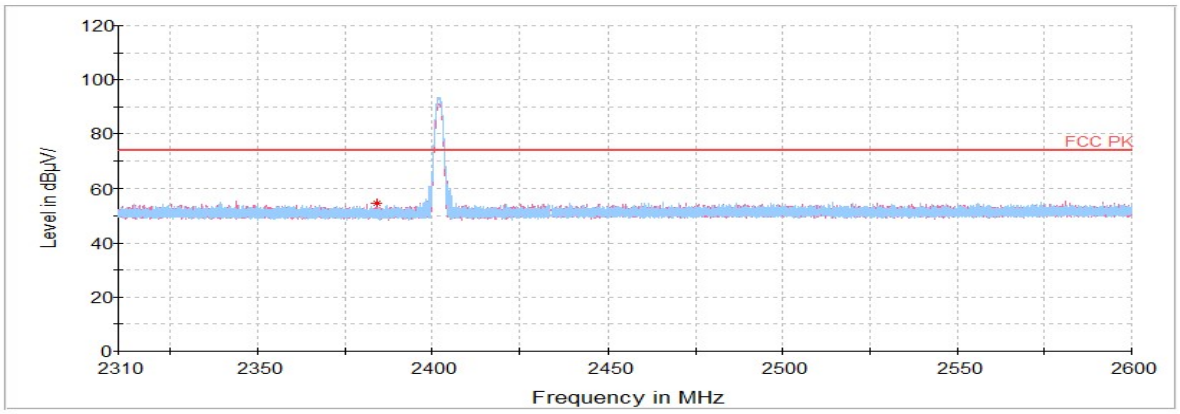
| Frequency | Pol. | Reading | Antenna Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| [㎒] | [V/H] | [dB(μV)] | [dB] | [dB] | [dB] | [dB(μV/m)] | [dB(μV/m)] | [dB] |
| **Peak data** | | | | | | | | |
| 2 318.08[1)] | H | 40.73 | 32.00 | -18.16 | - | 54.57 | 74.00 | 19.43 |
| 3 992.09[1)] | V | 67.63 | 33.59 | -56.35 | - | 44.87 | 74.00 | 29.13 |
| 4 803.64[1)] | V | 68.74 | 33.70 | -55.16 | - | 47.28 | 74.00 | 26.72 |
| 7 204.75 | H | 64.66 | 35.14 | -51.55 | - | 48.25 | 74.00 | 25.75 |
| **Average Data** | | | | | | | | |
| 2 318.08[1)] | H | 30.01 | 32.00 | -18.16 | 2.04 | 45.89 | 54.00 | 8.11 |

**Average Data**

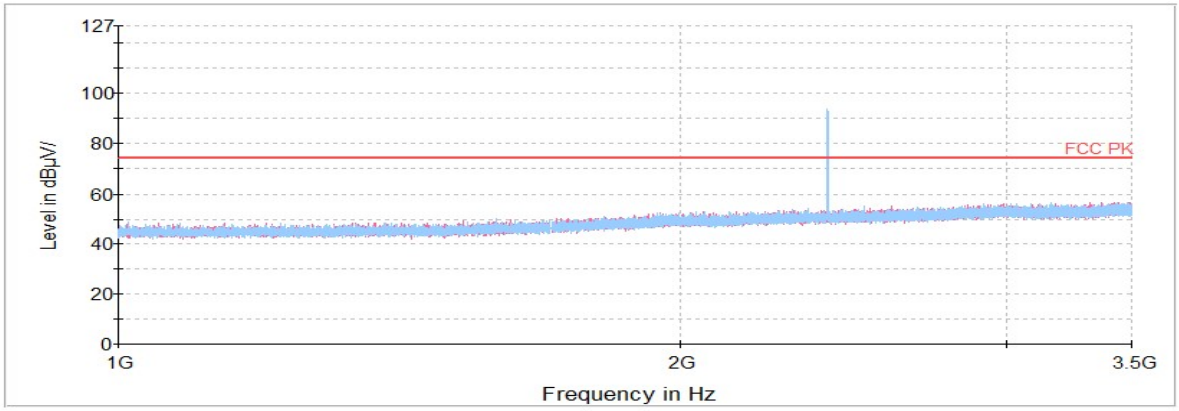



Blank

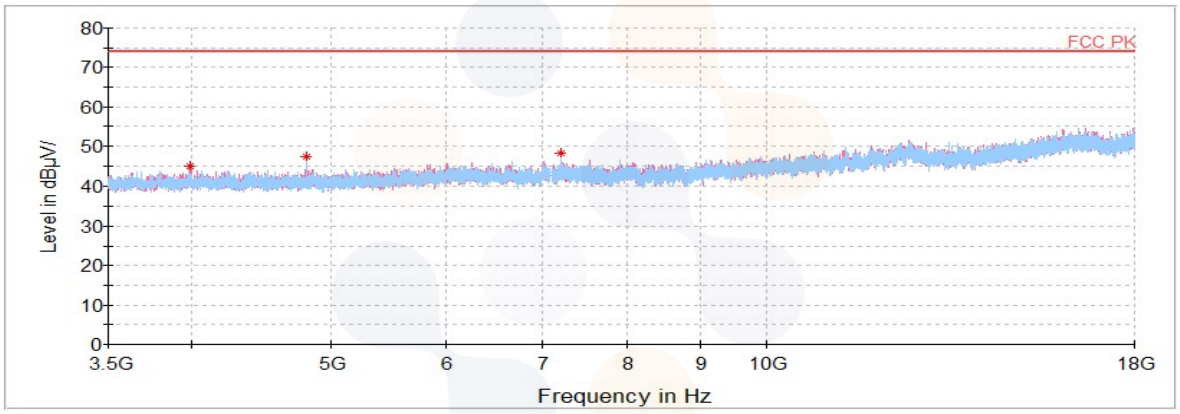
**Horizontal/Vertical for Band-edge**



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



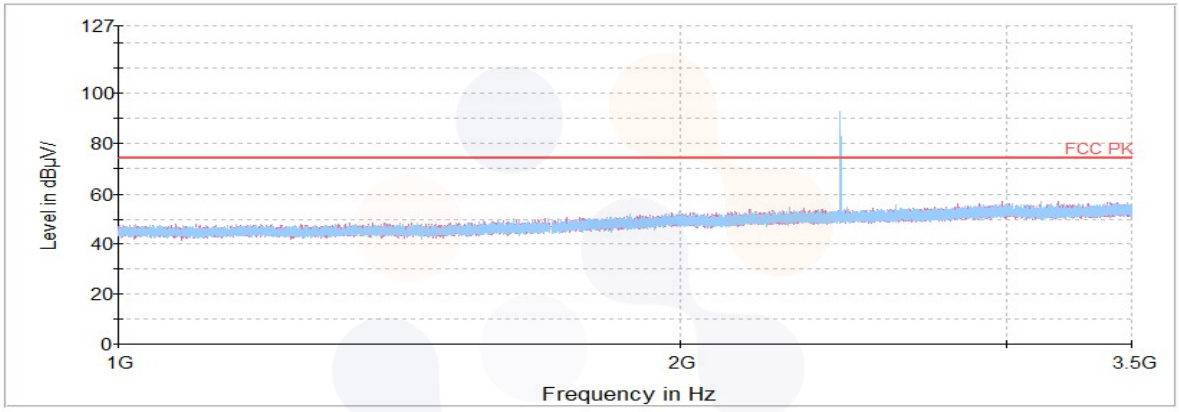

**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**



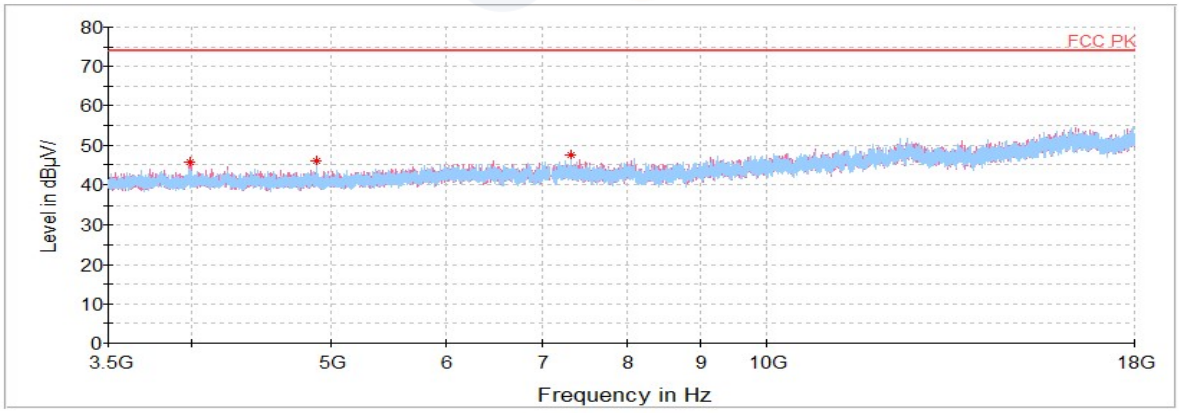
**2 440 ㎒**

| Frequency | Pol. | Reading | Antenna Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| [㎒] | [V/H] | [dB(㎶)] | [dB] | [dB] | [dB] | [dB(㎶/m)] | [dB(㎶/m)] | [dB] |
| **Peak data** | | | | | | | | |
| 3 985.75[1)] | V | 68.51 | 33.58 | -56.36 | - | 45.73 | 74.00 | 28.27 |
| 4 879.31[1)] | H | 67.49 | 33.70 | -55.09 | - | 46.10 | 74.00 | 27.90 |
| 7 318.94[1)] | H | 63.97 | 35.16 | -51.58 | - | 47.55 | 74.00 | 26.45 |
| **Average Data** | | | | | | | | |
| No spurious emissions were detected within 20 ㏈ of the limit. | | | | | | | | |

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

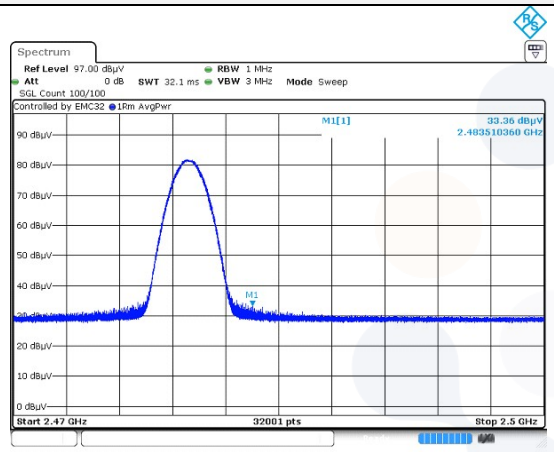
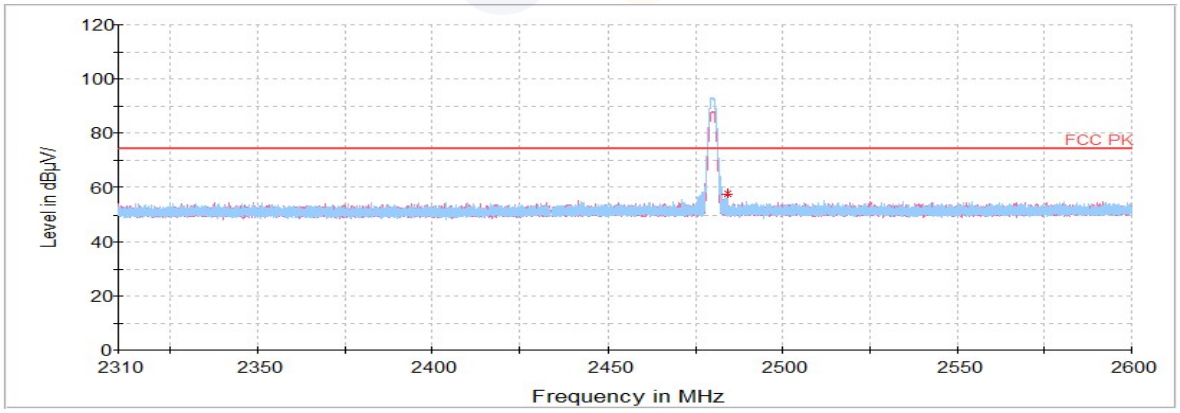



**Horizontal/Vertical for 3.5 ㎓ ~ 18 ㎓**

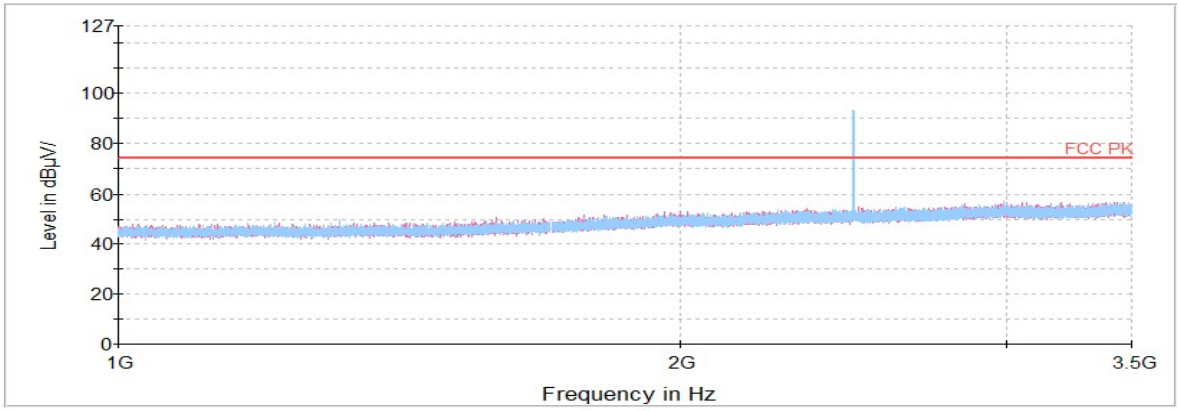


**2 480 ㎒**

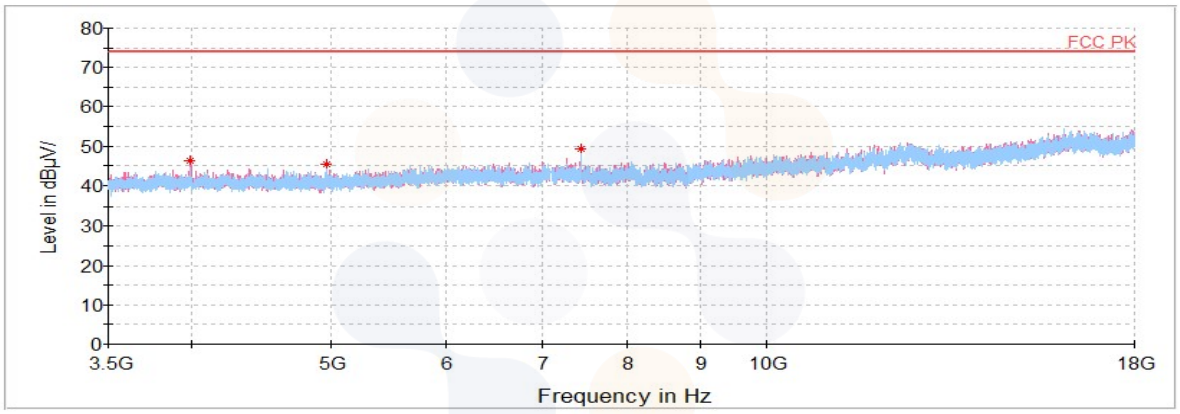
| Frequency | Pol. | Reading | Antenna Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| [㎒] | [V/H] | [dB(㎶)] | [dB] | [dB] | [dB] | [dB(㎶/m)] | [dB(㎶/m)] | [dB] |
| **Peak data** | | | | | | | | |
| 2 483.51[1)] | H | 43.26 | 32.36 | -17.89 | - | 57.73 | 74.00 | 16.27 |
| 3 991.19[1)] | V | 69.20 | 33.59 | -56.35 | - | 46.44 | 74.00 | 27.56 |
| 4 959.06[1)] | H | 66.58 | 33.70 | -54.98 | - | 45.30 | 74.00 | 28.70 |
| 7 438.56[1)] | H | 65.73 | 35.19 | -51.61 | - | 49.31 | 74.00 | 24.69 |
| **Average Data** | | | | | | | | |
| 2 483.51[1)] | H | 33.36 | 32.36 | -17.89 | 2.04 | 49.87 | 54.00 | 4.13 |

| Average Data | |
|---|---|
|  | Blank |
| **Horizontal/Vertical for Band-edge** | |
|  | |

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




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

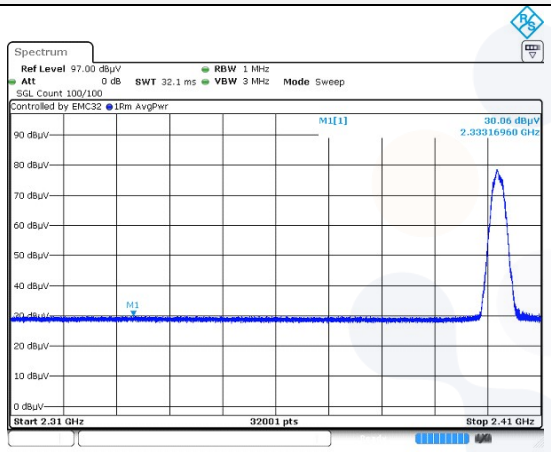


## Test results (Above 1 000 ㎒)_2 MBits/s(37 Bytes)

**2 402 ㎒**

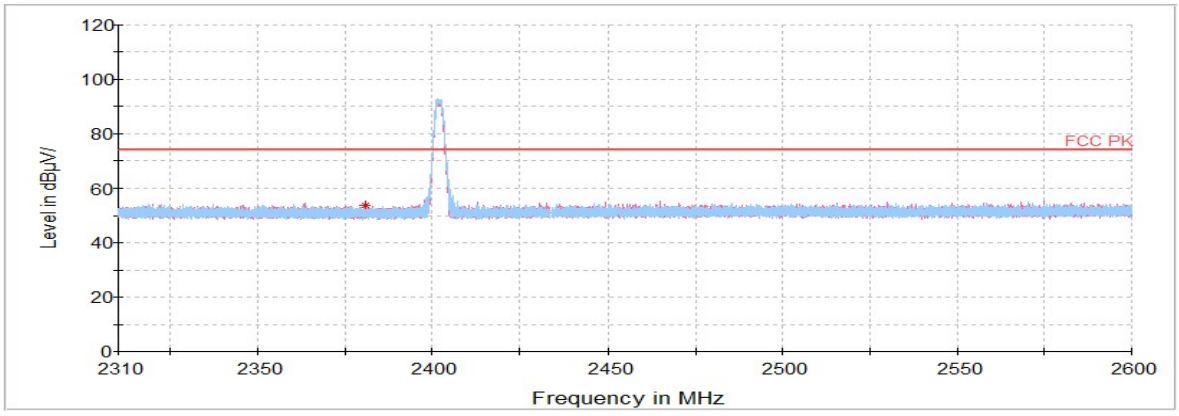
| Frequency | Pol. | Reading | Antenna Factor | Amp. + Cable | DCF | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| [㎒] | [V/H] | [dB(μV)] | [dB] | [dB] | [dB] | [dB(μV/m)] | [dB(μV/m)] | [dB] |
| **Peak data** | | | | | | | | |
| 2 333.17[1)] | H | 40.11 | 32.03 | -18.16 | - | 53.98 | 74.00 | 20.02 |
| 3 995.27[1)] | V | 68.08 | 33.59 | -56.34 | - | 45.33 | 74.00 | 28.67 |
| 4 803.64[1)] | V | 68.07 | 33.70 | -55.16 | - | 46.61 | 74.00 | 27.39 |
| 7 206.11 | H | 64.26 | 35.14 | -51.55 | - | 47.85 | 74.00 | 26.15 |
| **Average Data** | | | | | | | | |
| 2 333.17[1)] | H | 30.06 | 32.03 | -18.16 | 4.84 | 48.77 | 54.00 | 5.23 |

**Average Data**

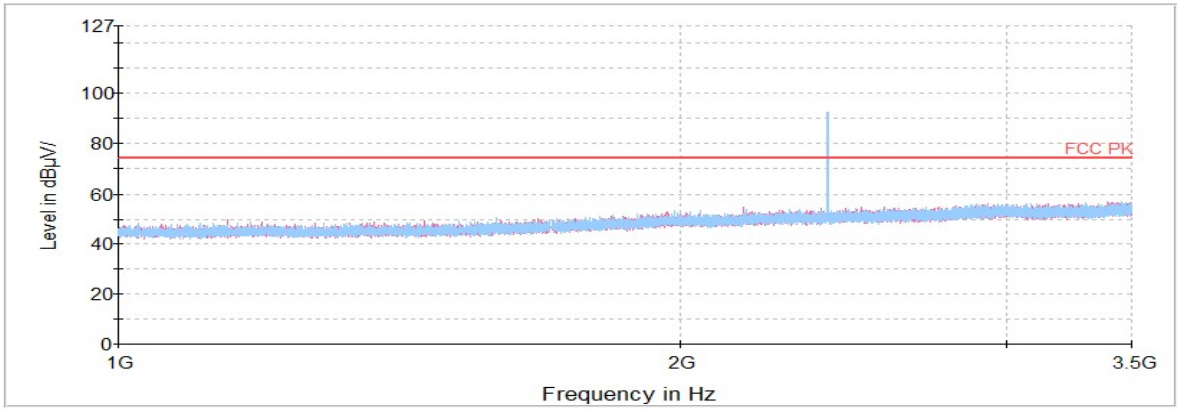



Blank

**Horizontal/Vertical for Band-edge**



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




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