# TEST REPORT



**KES Co., Ltd.**
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■ **FCC TEST REPORT**

**1. Client**

○ Name : TOVNET CO., LTD
○ Address : F8, Daeil BLDG, 680, Tongil-ro, Eunpyeong-gu, Seoul, Republic of Korea

**2. Sample Description**

○ Product item : TOVNETcam
○ Model name : TOVNETcam
○ Manufacturer etc. : TOVNET CO., LTD

**3. Date of test :** 2024.04.02 ~ 2024.04.04

**4. Location of Test :** ☑ Permanent Testing Lab ☐ On Site Testing

○ Adress : 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea

**5. Test method used :** Part 15.247

**6. Test result :** PASS

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This laboratory is not accredited for the test results marked*.
This test report is not related to KOLAS accreditation.

| | | |
|---|---|---|
| Affirmation | Tested by<br>Name : Bong-Seok Kim (Signature) [김봉석]2024/04/25 | Technical Manager<br>Name : Yeong-Jun Cho (Signature) [조영준]2024/04/25 |

**2024. 04. 25.**

# KES Co., Ltd.

## Accredited by KOLAS, Republic of KOREA

# REPORT REVISION HISTORY

| Date | Test Report No. | Revision History |
|---|---|---|
| 2024.04.08 | KES-RF240151 | Initial |
| 2024.04.19 | KES-RF240151-R1 | Modified Rate(Mbps) / Page 6<br>(802.11n_HT20 -> MCS0) |
| 2024.04.25 | KES-RF240151-R2 | Page 4,5<br>Add variant models |



**Use of uncertainty of measurement for decisions on conformity (decision rule):**

■ No decision rule is specified by the standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty(“simple acceptance” decision rule, previously known as “accuracy method”).

☐ Other (to be specified, for example when required by the standard or client)

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## 1. General information

| | |
|---|---|
| Applicant: | TOVNET CO., LTD |
| Applicant address: | F8, Daeil BLDG, 680, Tongil-ro, Eunpyeong-gu, Seoul, Republic of Korea |
| Test site: | KES Co., Ltd. |
| Test site address: | ☐ #3002, #3503, #3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do,14057,Republic of Korea<br>☒473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea |
| Test Facility | FCC Accreditation Designation No.: KR0100, Registration No.: 444148 |
| FCC rule Part(s): | Part 15.247 |
| FCC ID: | 2BFPS-TOVNETCAM |
| Test device serial No.: | ☒ Production ☐ Pre-production ☐ Engineering |

### 1.1. EUT description

| | |
|---|---|
| Equipment under test | TOVNETcam |
| Frequency range | 2 412 ㎒ ~ 2 462 ㎒ (802.11n_HT20) |
| Model | TOVNETcam |
| Variant Model: | TOVNET-147 WiFi, TOVNETcam WiFi, TOVNET-WiFi, TOV-WiFi |
| Modulation technique | OFDM |
| Number of channels | 2 412 ㎒ ~ 2 462 ㎒ (802.11n_HT20) : 11 ch |
| Antenna specification | Dipole Antenna // Peak gain: 5.09 ㏈i |
| Power source | DC 3.7 V(Battery) |
| H/W Version | 1.0 |
| S/W Version | 1.0 |

### 1.2. Test configuration

The **TOVNET CO., LTD // TOVNETcam // TOVNETcam // FCC ID: 2BFPS-TOVNETCAM** was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15.247
KDB 558074 D01 v05 r02
ANSI C63.10-2013

## 1.3. Information about variant model

| Model name | Difference |
|---|---|
| TOVNETcam | Basic Model |
| TOVNET-147 WiFi | All electronic circuits are the same. Add simple variant model for marketing |
| TOVNETcam WiFi | All electronic circuits are the same. Add simple variant model for marketing |
| TOVNET-WiFi | All electronic circuits are the same. Add simple variant model for marketing |
| TOV-WiFi | All electronic circuits are the same. Add simple variant model for marketing |

## 1.4. Accessory information

| Equipment | Manufacturer | Model | Serial No. | Power source |
|---|---|---|---|---|
| - | - | - | - | - |

## 1.5. Sample calculation

Where relevant, the following sample calculation is provided
For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Offset(㏈) = RF cable loss(㏈) + attenuator factor(㏈).
= 0.77 + 10 = 10.77 (㏈)

For Radiation test :
Field strength level (㏈㎶/m) = Measured level (㏈㎶) + Antenna factor (㏈) + Cable loss (㏈) – Amplifier gain (㏈)

## 1.6. Measurement Uncertainty

| Test Item | | Uncertainty |
|---|---|---|
| Uncertainty for Conduction emission test | | 2.22 ㏈ ( SHIELD ROOM #6 ) |
| Uncertainty for Radiation emission test (include Fundamental emission) | Below 1㎓ | 4.04 ㏈ ( SAC #6 ) |
| | Above 1㎓ | 5.32 ㏈ ( SAC #5 ) |
| Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. | | |

## 1.7. Frequency/channel operations

| Ch. | Frequency (㎒) | Rate(Mbps) |
|---|---|---|
| **01** | **2 412** | **MCS0** |
| . . | . . | . . |
| **06** | **2 437** | **MCS0** |
| . . | . . | . . |
| **11** | **2 462** | **MCS0** |

## 2. Summary of tests

| Section in FCC Part 15 | Test description | Test results |
|---|---|---|
| 15.247(a)(2) | 6 dB bandwidth | Pass |
| 15.247(b)(3) | Output power | Pass |
| 15.247(e) | Power spectral density | Pass |
| 15.205 15.209 | Radiated restricted band and emission | Pass |
| 15.247(d) | Conducted spurious emission and band edge | Pass |
| 15.207(a) | AC Conducted emissions | Pass |
| 15.203 | Antenna Requirement | Pass note.1 |

**N/T: Not Tested**

**Note**

1. Please check the antenna spec. for the Antenna Requirement.

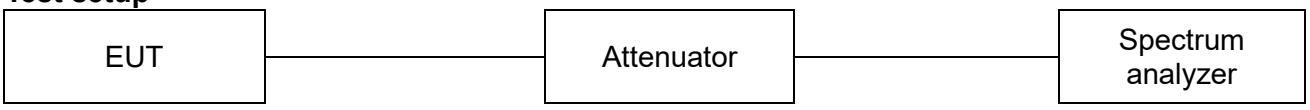
# 3. Test results

## 3.1. 6 dB bandwidth

**Test procedure**

ANSI C63.10-2013 - Section 11.8.2

**Test setup**




**ANSI C63.10-2013 - Section 11.8.2**

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, 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 dB.

**Limit**

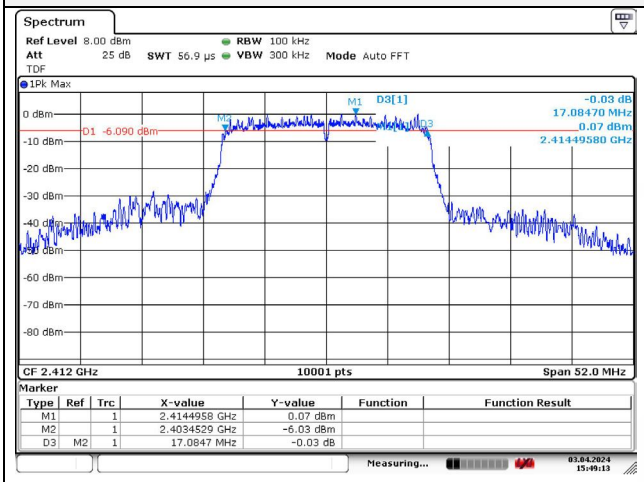
According to §15.247(a)(2), systems using digital modulation techniques may operate 902 ~ 928 MHz, 2 400 ~ 2 483.5 MHz, and 5 725 ~ 5 850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

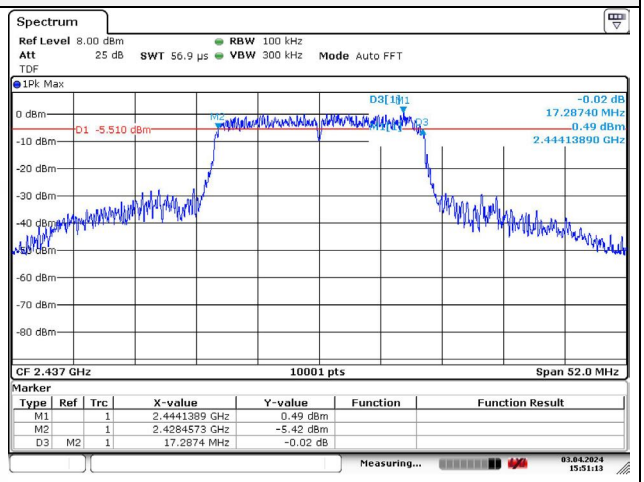
## Test results

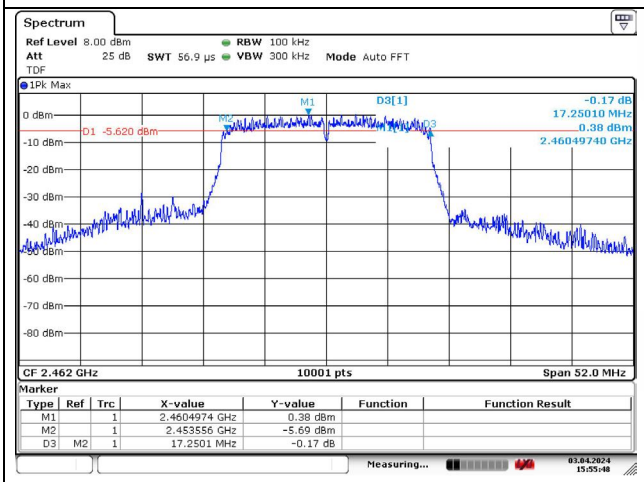
**Mode : LE 1Mbps**

| Frequency(㎒) | 6 ㏈ bandwidth(㎒) | Limit(㎒) |
|---|---|---|
| 2 412 | 17.09 | ≥ 0.500 |
| 2 437 | 17.29 | |
| 2 462 | 17.25 | |

**802.11n_HT20**



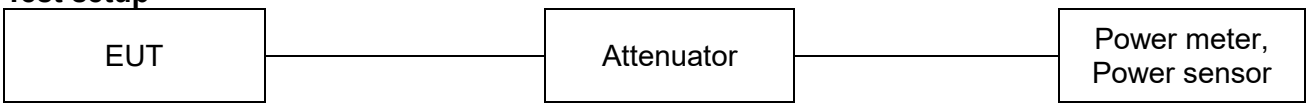

N/A

## 3.2. Output power

**Test procedure**

ANSI C63.10-2013 - Section 11.9.1.3 and 11.9.2.3.2

**Test setup**




**ANSI C63.10-2013 - Section 11.9.1.3**

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

**ANSI C63.10-2013 - Section 11.9.2.3.2**

Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

**Limit**

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

**Test results**

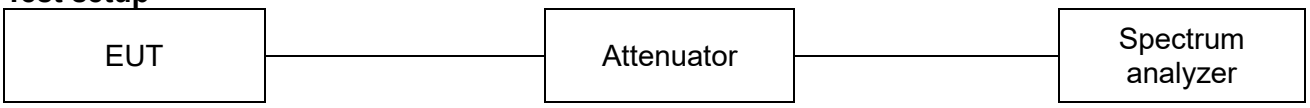
| Mode | 2 412 ㎒ | | 2 437 ㎒ | | 2 462 ㎒ | |
|---|---|---|---|---|---|---|
| | Average (dBm) | Peak (dBm) | Average (dBm) | Peak (dBm) | Average (dBm) | Peak (dBm) |
| 802.11n_HT20 | 12.38 | 22.10 | 12.36 | 21.69 | 12.35 | 22.07 |

## 3.3. Power spectral density

**Test procedure**

ANSI C63.10-2013 - Section 11.10.2

**Test setup**




**Section 10.2 & ANSI C63.10-2013 - Section 11.10.2**

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to 3 ㎑ ≤ RBW ≤ 100 ㎑
d. Set the VBW ≥ [3 × RBW].
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level within the RBW.
j. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

**Limit**

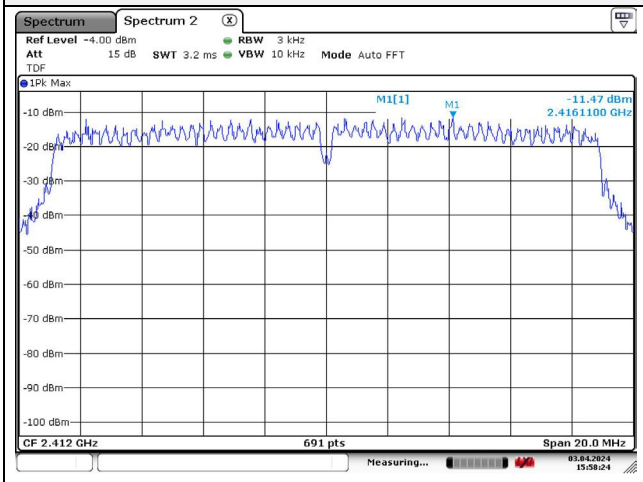
According to §15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 ㏈m in any 3 ㎑ band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

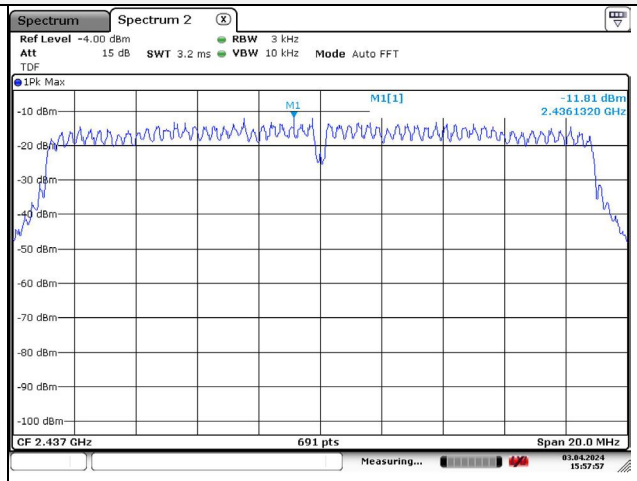
**Results**

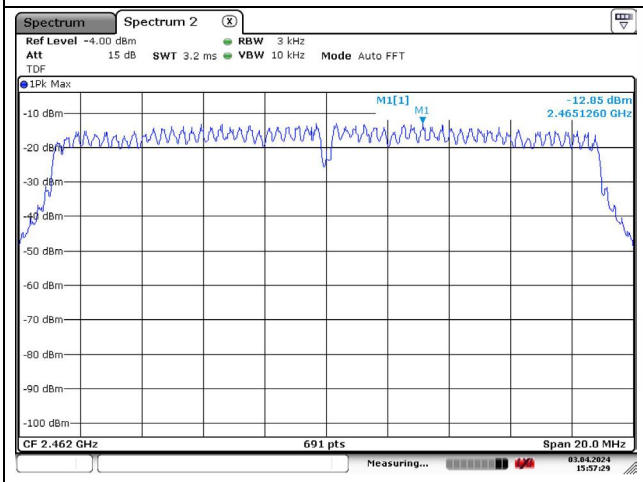
**Mode : LE 1 Mbps**

| Frequency(㎒) | PSD (㏈m/3㎑) | Limit(㏈m/3㎑) |
|---|---|---|
| 2 412 | -11.47 | 8 |
| 2 437 | -11.81 | |
| 2 462 | -12.85 | |

**802.11n_HT20**

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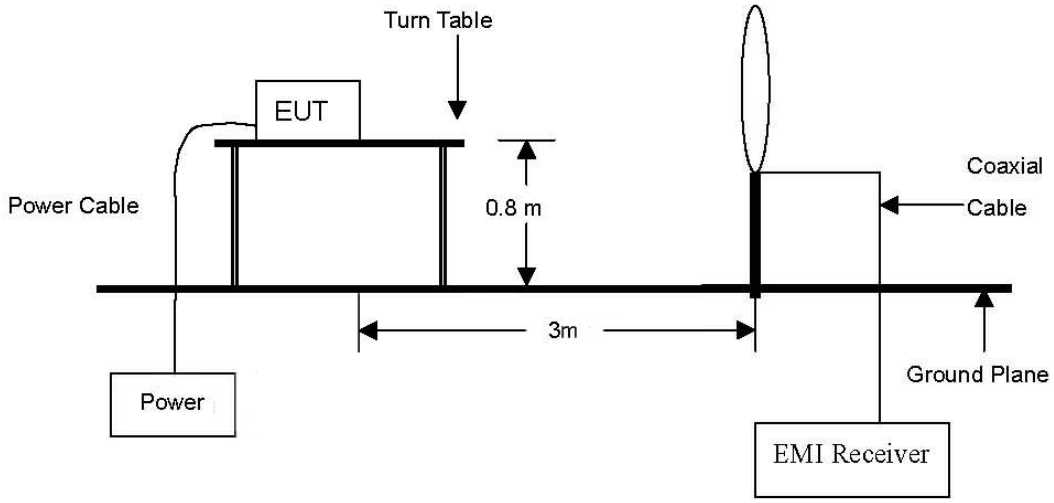
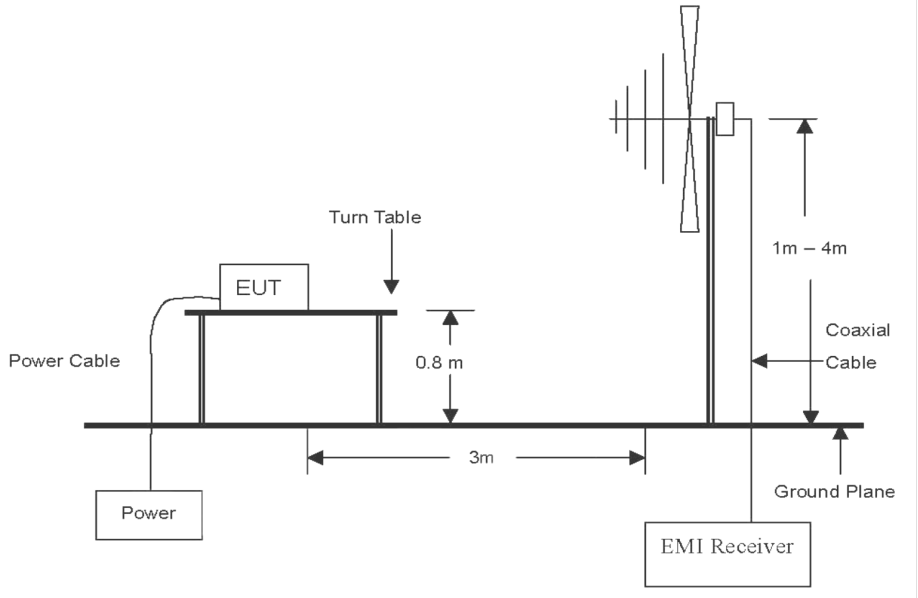
## 3.4. Radiated restricted band and emissions

**Test setup**

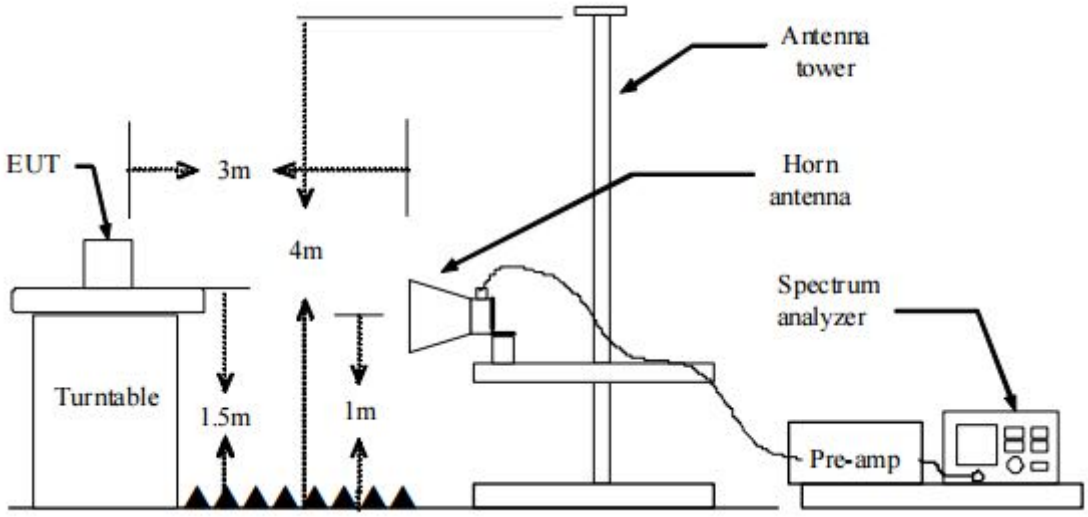
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.




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.




**Test procedure**

Radiated emissions from the EUT were measured according to the dictates in section 11.11 & 11.12 of ANSI C63.10-2013.

**Test procedure below 30 ㎒**

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel, ground parallel and perpendicular of the antenna are set to make the measurement. It was determined that **parallel** was worst-case orientation; therefore, all final radiated testing was performed with the EUT in **parallel.**
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum hold mode.

**Test procedure above 30 ㎒ ~ 1 000 ㎒**

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The antenna is a bi-log antenna, a horn antenna, and its height are varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

**Test procedure above 1 000 ㎒**

1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The antenna is a bi-log antenna, a horn antenna, and its height are varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

5. Spectrum analyzer settings for *f* < 1 ㎓:
   ① Span = wide enough to fully capture the emission being measured
   ② RBW = 100 ㎑
   ③ VBW ≥ RBW
   ④ Detector = quasi peak
   ⑤ Sweep time = auto
   ⑥ Trace = max hold
6. Spectrum analyzer settings for *f* ≥1 ㎓: Peak
   ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
   ② RBW = 1 ㎒
   ③ VBW ≥ 3 ㎒
   ④ Detector = peak
   ⑤ Sweep time = auto
   ⑥ Trace = max hold
   ⑦ Trace was allowed to stabilize

7. Spectrum analyzer settings for *f* ≥1 ㎓: Average
   ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
   ② RBW = 1 ㎒
   ③ VBW ≥ 3 × RBW
   ④ Detector = RMS, 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.
   ⑤ 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 in order to use linear voltage averaging. Log or ㏈ averaging shall not be used.
   ⑥ Sweep = auto
   ⑦ Trace = max hold
   ⑧ Perform a trace average of at least 100 traces.A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
      1) If power averaging (RMS) mode was used in step ⑤, then the applicable correction factor is 10 log(1/x), where x is the duty cycle.
      2) If linear voltage averaging mode was used in step ⑤, then the applicable correction factor is 20 log(1/x), where x is the duty cycle.
      3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

**Note.**

1. *f* <30 ㎒, extrapolation factor of 40 ㏈/decade of distance. $F_d = 40\log(D_m/Ds)$
   *f* ≥30 ㎒, extrapolation factor of 20 ㏈/decade of distance. $F_d = 20\log(D_m/Ds)$
   Where:
   $F_d$ = Distance factor in ㏈
   $D_m$ = Measurement distance in meters
   $D_s$ = Specification distance in meters
2. Field strength(㏈㎶/m) = Level(㏈㎶) + CF (㏈) + or DCF(㏈)
3. Margin(㏈) = Limit(㏈㎶/m) - Field strength(㏈㎶/m)
4. Emissions below 18 ㎓ were measured at a 3 meter test distance while emissions above 18 ㎓ were measured at a 1 meter test distance with the application of a distance correction factor.
5. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z, it was determined that **X orientation** was worst-case orientation; therefore, all final radiated testing was performed with the EUT in **X orientation.**
6. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ of respective limits were not reported.
7. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

**Limit**

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

| Frequency (㎒) | Distance (Meters) | Radiated (㎶/m) |
|---|---|---|
| 0.009 ~ 0.490 | 300 | 2 400/F(㎑) |
| 0.490 ~ 1.705 | 30 | 24 000/F(㎑) |
| 1.705 ~ 30.0 | 30 | 30 |
| 30 ~ 88 | 3 | 100** |
| 88 ~ 216 | 3 | 150** |
| 216 ~ 960 | 3 | 200** |
| Above 960 | 3 | 500 |

**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., Sections 15.231 and 15.241.

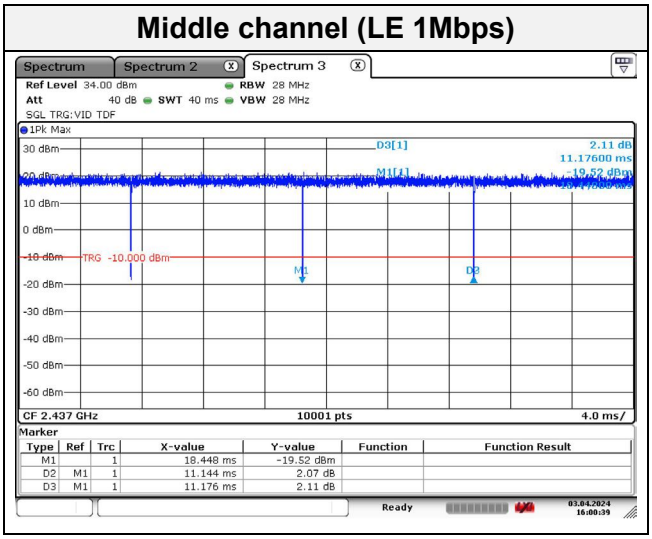
**Duty cycle**

Regarding to KDB 558074 D01_v05 r02, 6. Measurements of duty cycle and transmission duration shall be performed using one of the following techniques:
a) A diode detector and an oscilloscope that together have sufficiently short response time to permit accurate measurements of the on- and off-times of the transmitted signal.
b) The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on- and off-times of the transmitted signal.

| Mode | $T_{on}$ time (㎳) | Period (㎳) | Duty cycle (Linear) | Duty cycle (%) | Duty cycle correction factor (㏈) |
|---|---|---|---|---|---|
| 802.11n_HT20 | 11.14 | 11.18 | 1.00 | 99.71 | 0.00 |

Duty cycle (Linear) = $T_{on}$ time/Period
DCF(Duty cycle correction factor (㏈)) = 10log(1/duty cycle)

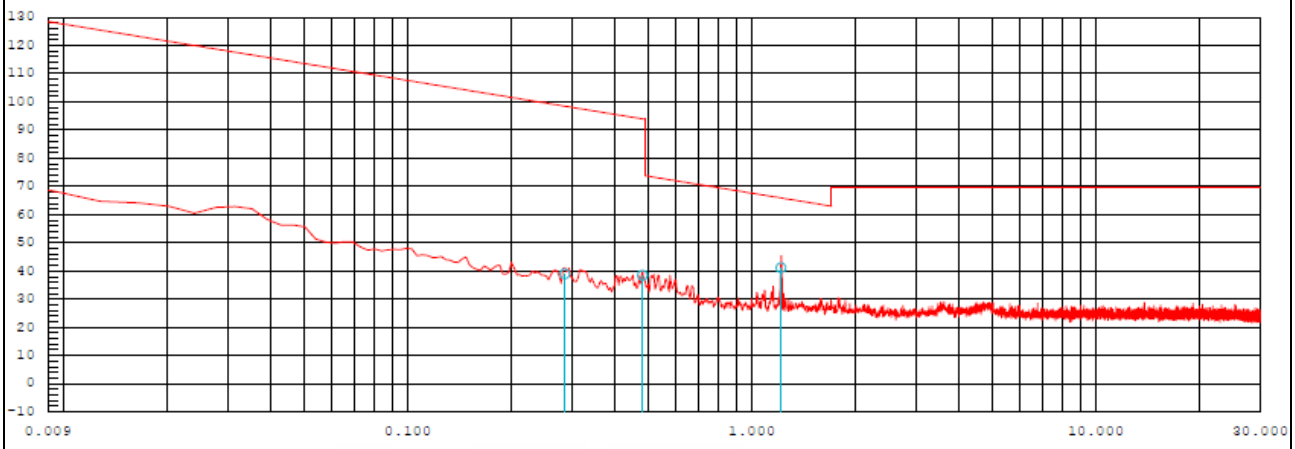
**Middle channel (LE 1Mbps)**



**Test results (Below 30 ㎒)**

| | |
|---|---|
| Mode: | 802.11n_HT20 |
| Distance of measurement: | 3 meter |
| Channel: | 01 (Worst case) |

**Parallel**



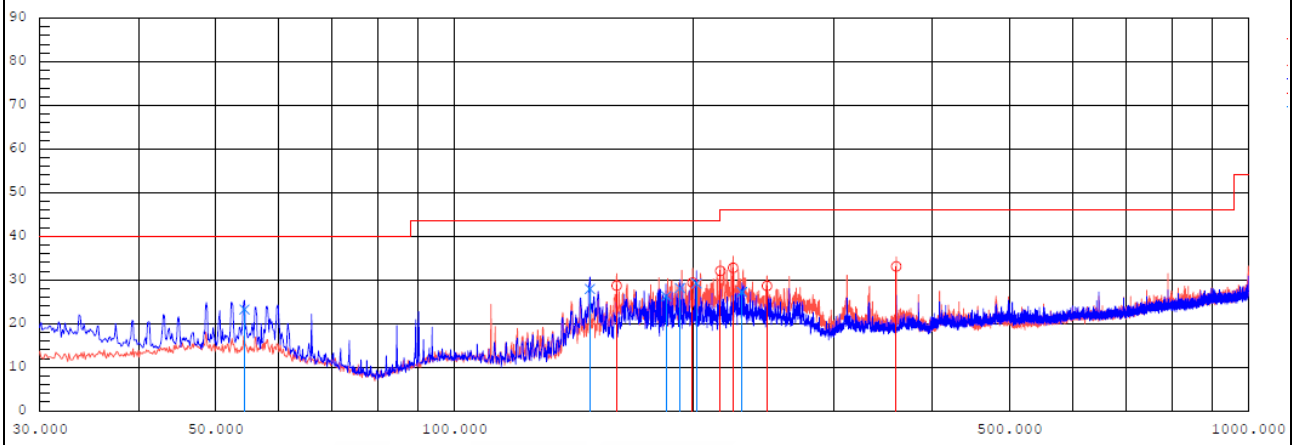

Final Result

| No. | Frequency [MHz] | Reading QP [dB(μV)] | c.f [dB(1/m)] | Result QP [dB(μV/m)] | Limit QP [dB(μV/m)] | Margin QP [dB] | Angle [deg] | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.286 | 20.3 | 18.7 | 39.0 | 98.5 | 59.5 | 198.1 | |
| 2 | 0.481 | 19.8 | 18.7 | 38.5 | 94.0 | 55.5 | 351.5 | |
| 3 | 1.216 | 22.4 | 18.8 | 41.2 | 65.9 | 24.7 | 23.6 | |

**Test results (Below 1 000 ㎒)**

| | |
|---|---|
| Mode: | 802.11n_HT20 |
| Distance of measurement: | 3 meter |
| Channel: | 01 (Worst case) |

**Horizontal // Vertical**




Final Result

| No. | Frequency [MHz] | Pol | Reading QP [dB(μV)] | c.f [dB(1/m)] | Result QP [dB(μV/m)] | Limit QP [dB(μV/m)] | Margin QP [dB] | Height [cm] | Angle [deg] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 54.371 | V | 35.0 | -11.8 | 23.2 | 40.0 | 16.8 | 146.0 | 202.9 | |
| 2 | 148.098 | V | 44.2 | -16.3 | 27.9 | 43.5 | 15.6 | 187.0 | 159.3 | |
| 3 | 159.980 | H | 44.2 | -15.5 | 28.7 | 43.5 | 14.8 | 269.0 | 270.3 | |
| 4 | 184.594 | V | 40.0 | -13.7 | 26.3 | 43.5 | 17.2 | 100.0 | 337.2 | |
| 5 | 192.233 | V | 41.3 | -13.2 | 28.1 | 43.5 | 15.4 | 187.0 | 246.4 | |
| 6 | 199.386 | H | 42.1 | -12.7 | 29.4 | 43.5 | 14.1 | 254.0 | 264.7 | |
| 7 | 201.569 | V | 41.8 | -12.6 | 29.2 | 43.5 | 14.3 | 189.0 | 268.7 | |
| 8 | 216.119 | H | 44.2 | -12.1 | 32.1 | 46.0 | 13.9 | 287.0 | 45.5 | |
| 9 | 224.243 | H | 44.7 | -11.9 | 32.8 | 46.0 | 13.2 | 264.0 | 264.7 | |
| 10 | 230.063 | V | 38.9 | -11.7 | 27.2 | 46.0 | 18.8 | 178.0 | 305.2 | |
| 11 | 247.401 | H | 39.8 | -11.2 | 28.6 | 46.0 | 17.4 | 288.0 | 264.7 | |
| 12 | 360.043 | H | 41.2 | -8.1 | 33.1 | 46.0 | 12.9 | 217.0 | 222.2 | |

**Test results (Above 1 000 ㎒)**

Mode: 802.11n_HT20

Distance of measurement: 3 meter

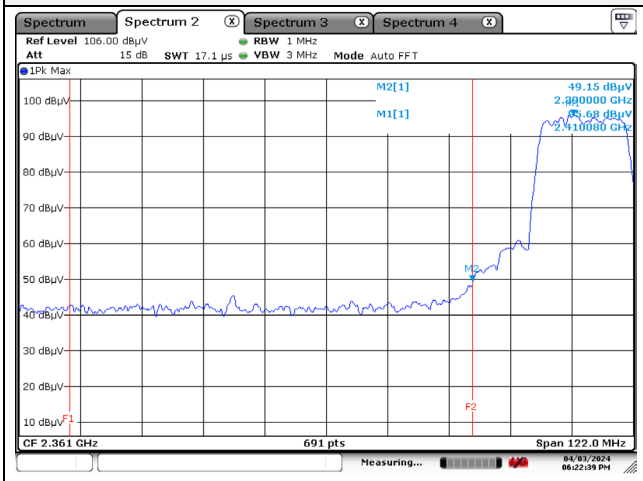
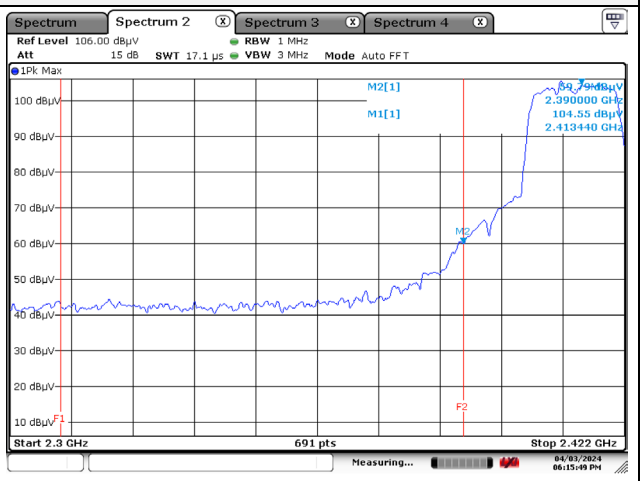
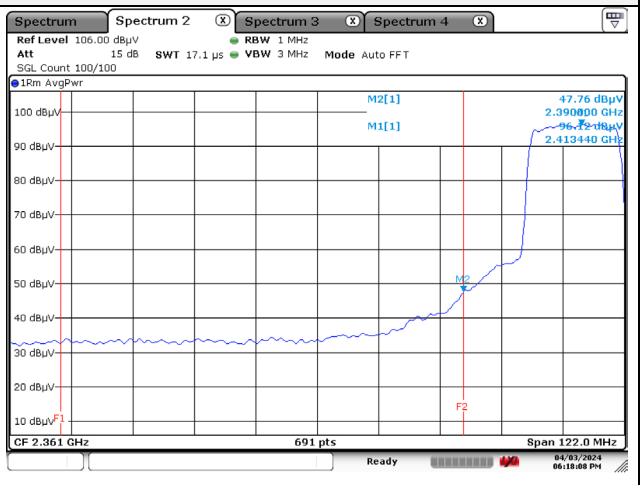
Channel: 01

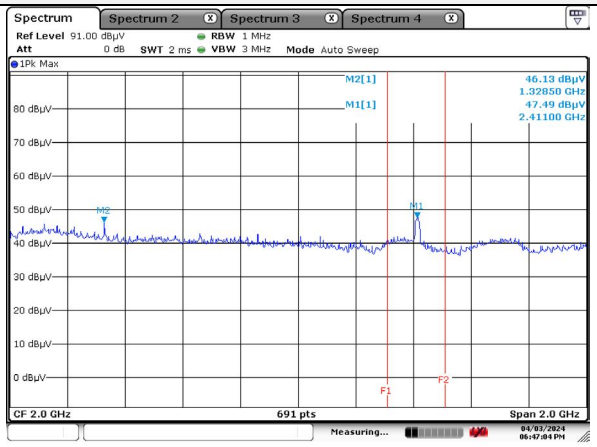
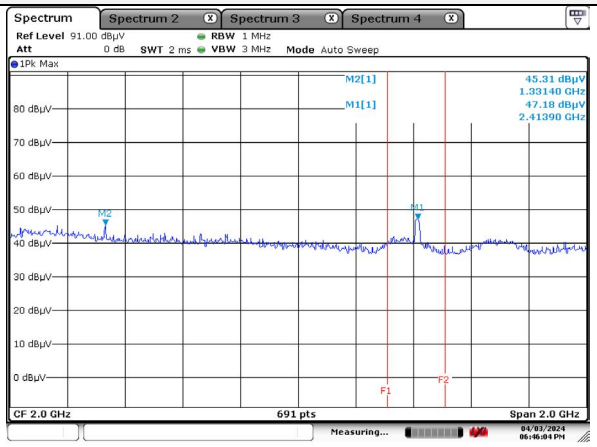
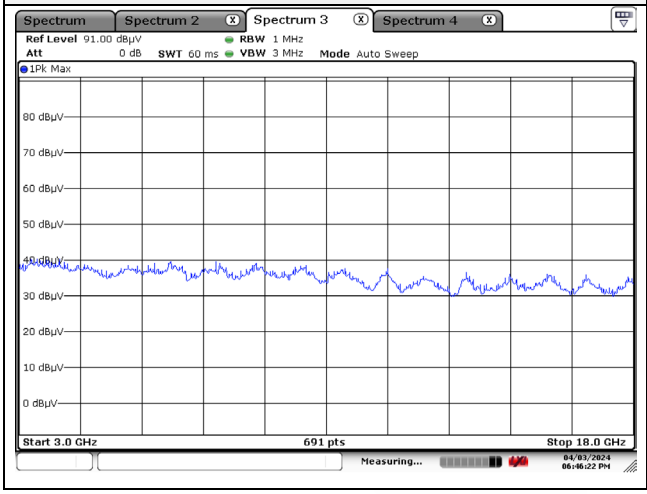
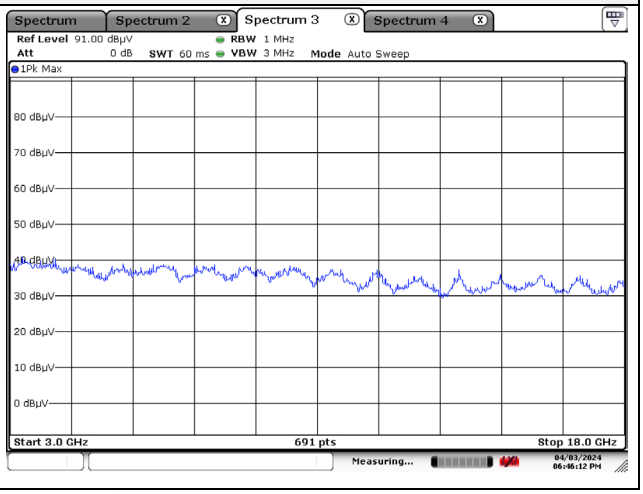
- **Spurious**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 328.50 | 46.13 | Peak | H | -7.35 | - | 38.78 | 74.00 | 35.22 |
| 1 331.40 | 45.31 | Peak | V | -7.33 | - | 37.98 | 74.00 | 36.02 |

- **Band edge**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2 390.00 | 49.15 | Peak | H | -0.34 | - | 48.81 | 74.00 | 25.19 |
| 2 390.00 | 59.79 | Peak | V | -0.34 | - | 59.45 | 74.00 | 14.55 |
| 2 390.00 | 47.76 | Average | H | -0.34 | 0.00 | 47.42 | 54.00 | 6.58 |

| Restricted band // Horizontal // Peak | Restricted band // Vertical // Peak |
|---|---|
|  |  |
| **Restricted band // Horizontal // Average** | **Restricted band // Vertical // Average** |
| Blank |  |

| Horizontal // Peak for 1 ㎓ to 3 ㎓ | Vertical // Peak for 1 ㎓ to 3 ㎓ |
|---|---|
|  |  |
| **Horizontal // Peak for 3 ㎓ to 18 ㎓** | **Vertical // Peak for 3 ㎓ to 18 ㎓** |
|  |  |

Mode: 802.11n_HT20

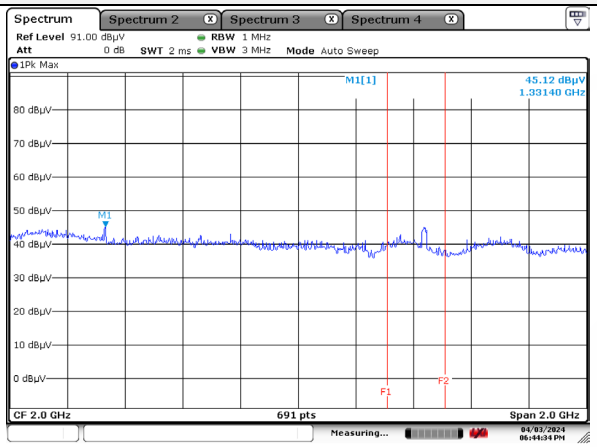
Distance of measurement: 3 meter

Channel: 06

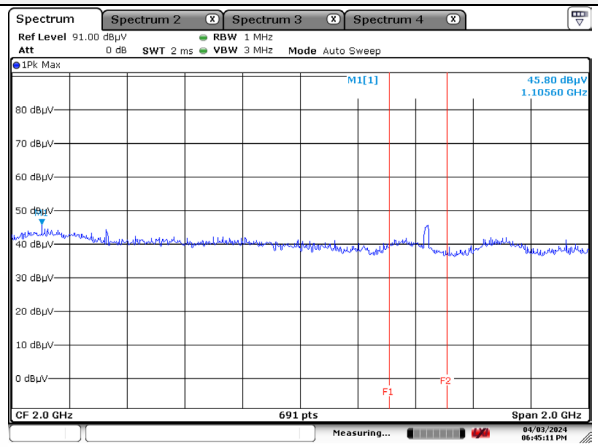
- **Spurious**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 105.60 | 45.80 | Peak | V | -8.74 | - | 37.06 | 74.00 | 36.94 |
| 1 331.40 | 45.12 | Peak | H | -7.33 | - | 37.79 | 74.00 | 36.21 |

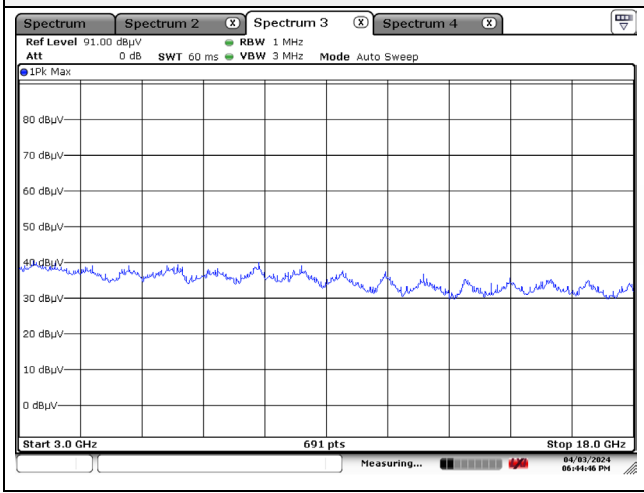
**Horizontal // Peak for 1 ㎓ to 3 ㎓**



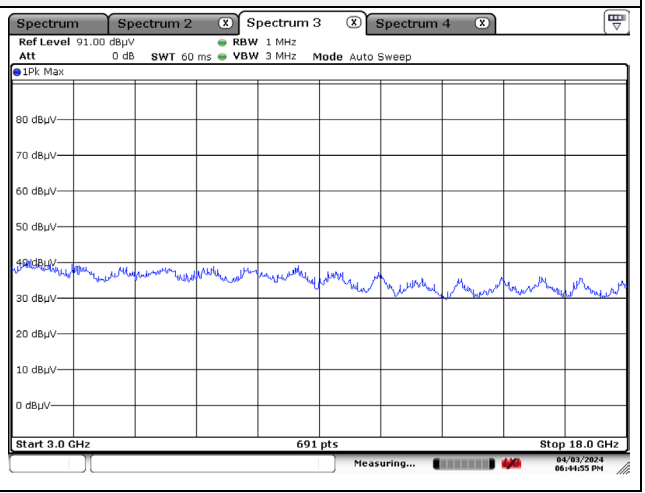

**Vertical // Peak for 1 ㎓ to 3 ㎓**




**Horizontal // Peak for 3 ㎓ to 18 ㎓**




**Vertical // Peak for 3 ㎓ to 18 ㎓**



Mode: 802.11n_HT20

Distance of measurement: 3 meter

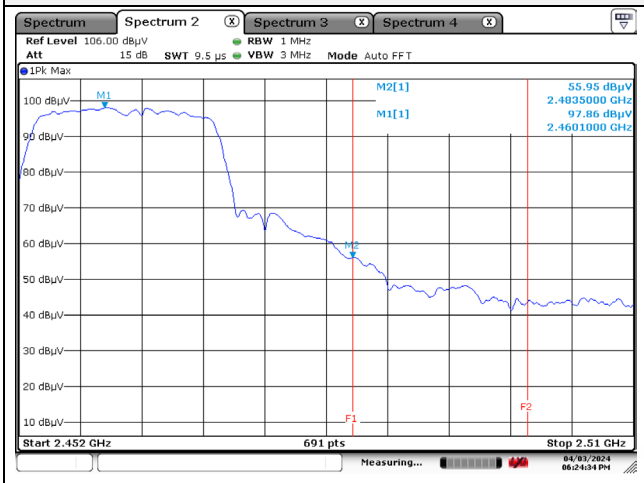
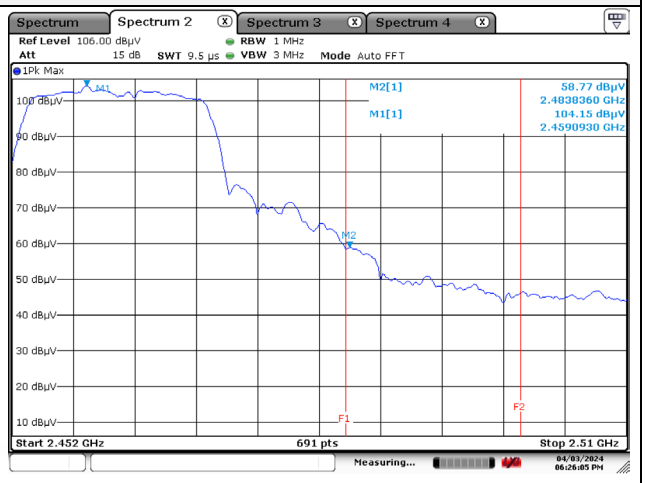
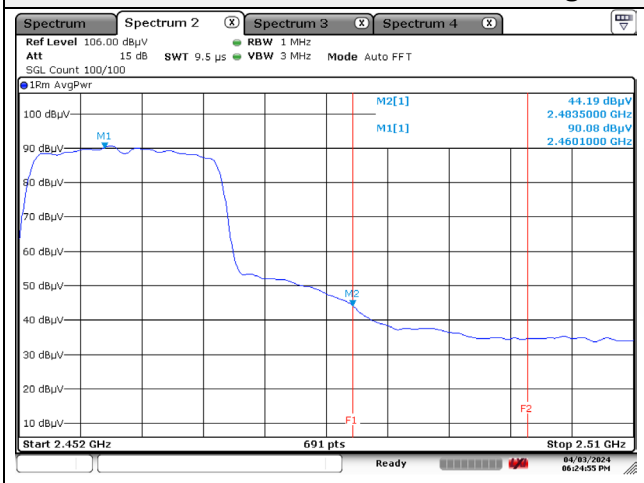
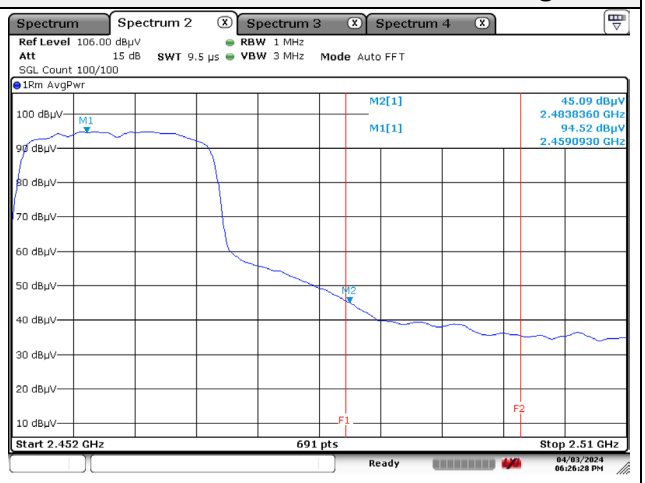
Channel: 11

- **Spurious**

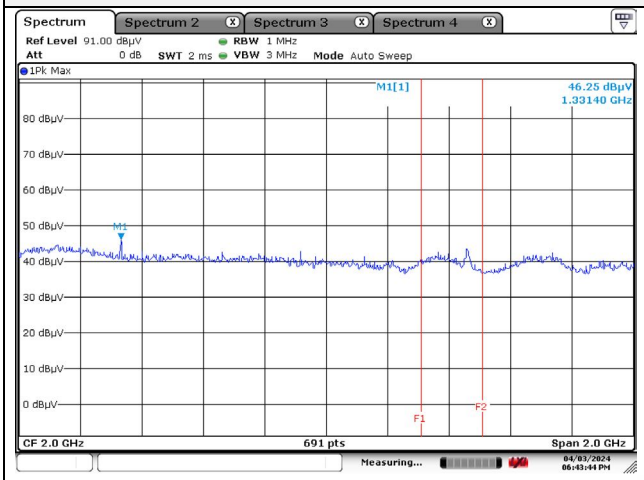
| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 331.40 | 46.25 | Peak | H | -7.33 | - | 38.92 | 74.00 | 35.08 |
| 1 331.40 | 44.87 | Peak | V | -7.33 | - | 37.54 | 74.00 | 36.46 |

- **Band edge**

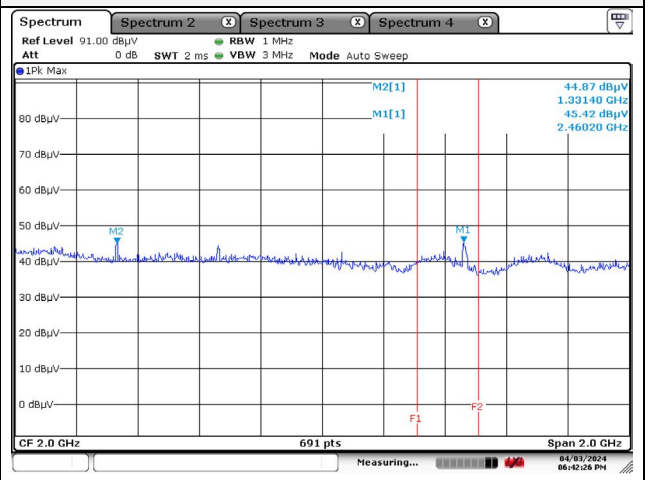
| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2 483.50 | 55.95 | Peak | H | -0.26 | - | 55.69 | 74.00 | 18.31 |
| 2 483.50 | 44.19 | Average | H | -0.26 | 0.00 | 43.93 | 54.00 | 10.07 |
| 2 483.84 | 58.77 | Peak | V | -0.26 | - | 58.51 | 74.00 | 15.49 |
| 2 483.84 | 45.09 | Average | V | -0.26 | 0.00 | 44.83 | 54.00 | 9.17 |

| Restricted band // Horizontal // Peak | Restricted band // Vertical // Peak |
|---|---|
|  |  |
| **Restricted band // Horizontal // Average** | **Restricted band // Vertical // Average** |
|  |  |

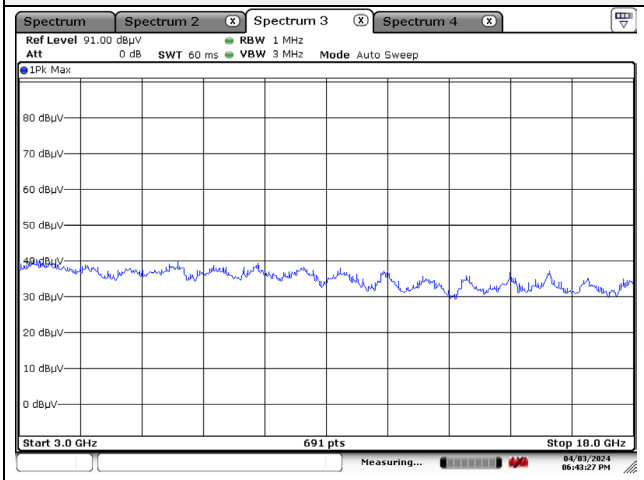
**Horizontal // Peak for 1 ㎓ to 3 ㎓**



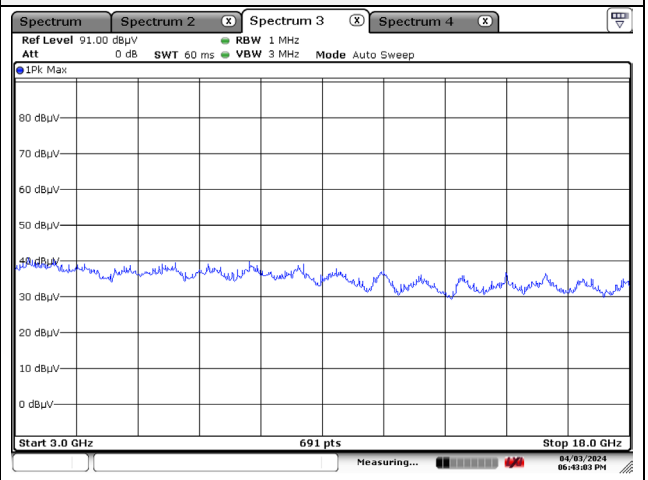

**Vertical // Peak for 1 ㎓ to 3 ㎓**




**Horizontal // Peak for 3 ㎓ to 18 ㎓**

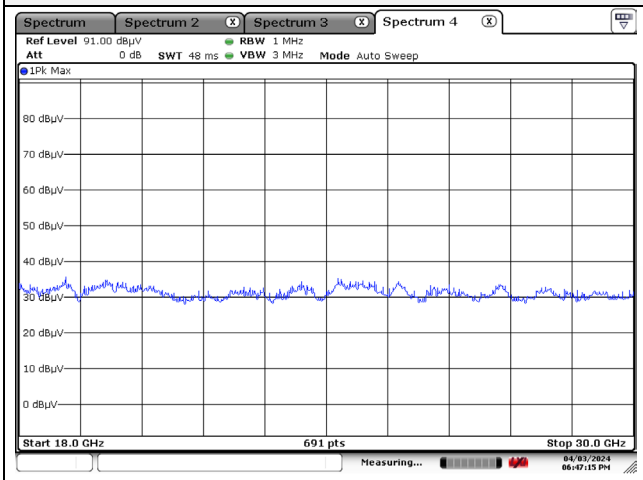
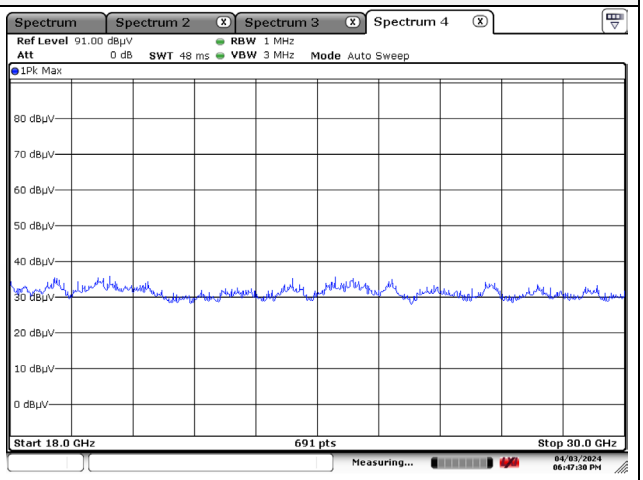



**Vertical // Peak for 3 ㎓ to 18 ㎓**



**Test results (18 ㎓ to 30 ㎓)**

| | |
|---|---|
| Mode: | 802.11n_HT20 |
| Distance of measurement: | 3 meter |
| Channel: | 01 (Worst case) |

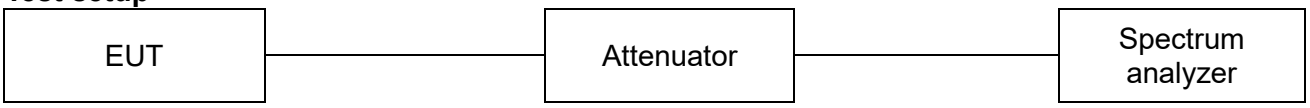
| Horizontal Peak | Vertical Peak |
|---|---|
|  |  |



Note.
No spurious emission were detected above 18 ㎓.

### 3.5. Conducted spurious emissions & band edge

**Test setup**




**Test procedure**

**Band edge**

ANSI C63.10-2013 - Section 11.11

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. Set the RBW = 100 ㎑
4. Set the VBW = [3 × RBW].
5. Detector = Peak
6. Sweep time = auto
7. Trace mode = max hold
8. Allow trace to fully stabilize.

**Out of band emissions**

ANSI C63.10-2013 - Section 11.11

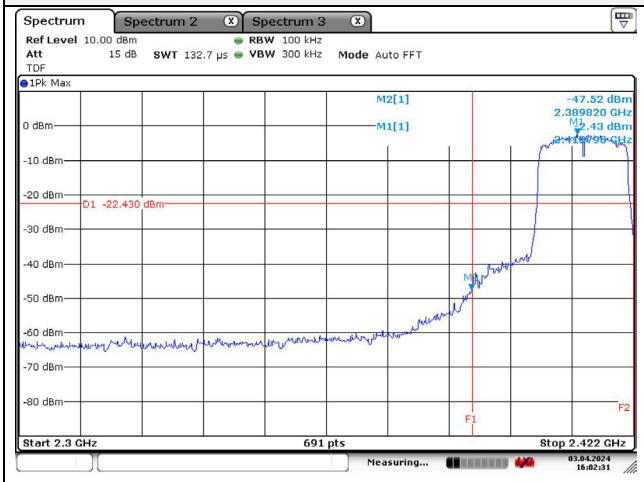
1. Start frequency was set to 30 ㎒ and stop frequency was set to 25 ㎓ for 2.4 ㎓ frequencies and 40 ㎓ for 5 ㎓ frequencies
2. Set the RBW = 100 ㎑
3. Set the VBW = [3 × RBW].
4. Detector = Peak
5. Sweep time = auto
6. Trace mode = max hold
7. Allow trace to fully stabilize.

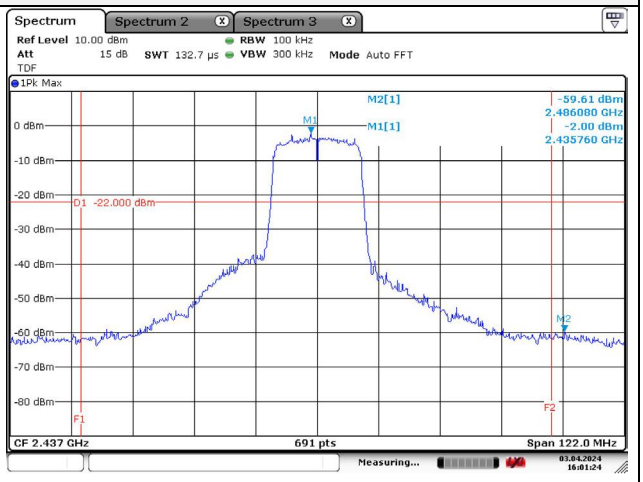
**Limit**

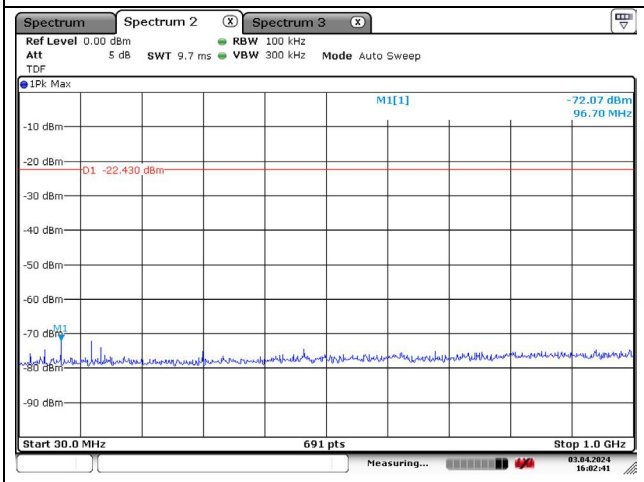
According to 15.247(d), in any 100 ㎑ bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))

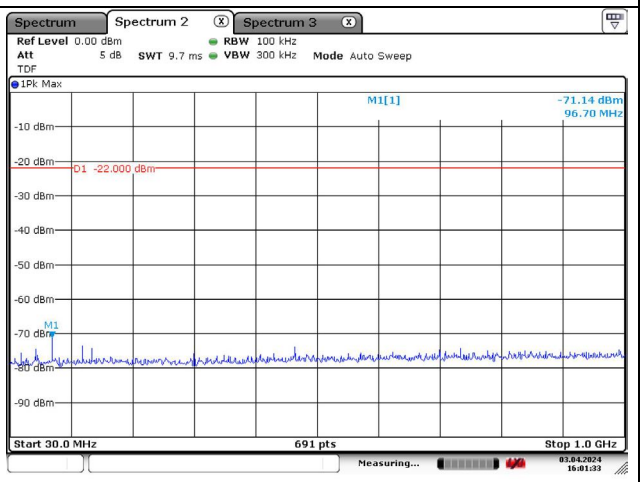
## Test results

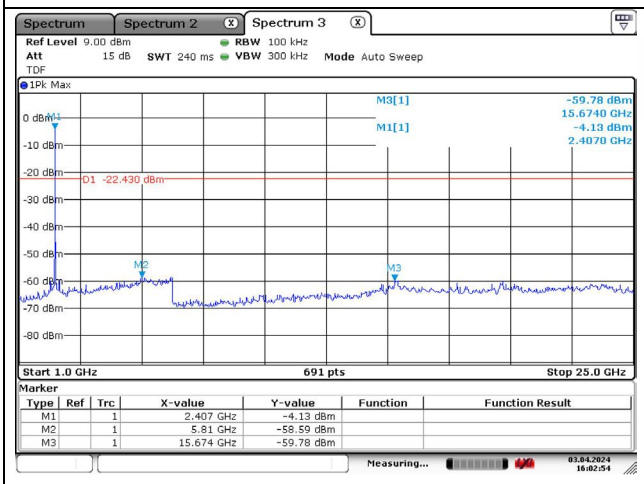
| 802.11n_HT20 | |
|---|---|
| **2 412 MHz** | **2 437 MHz** |

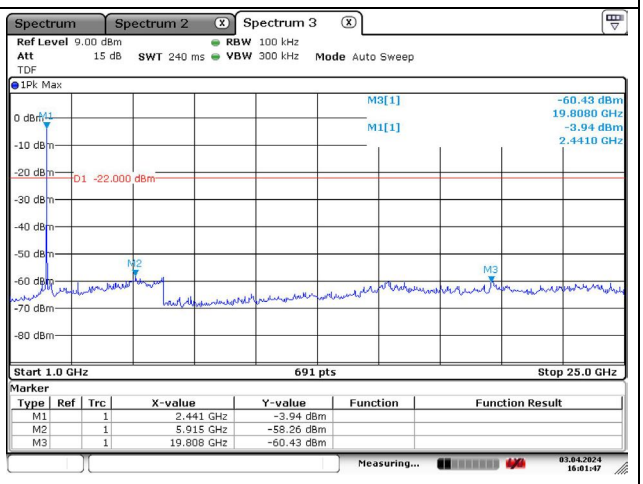


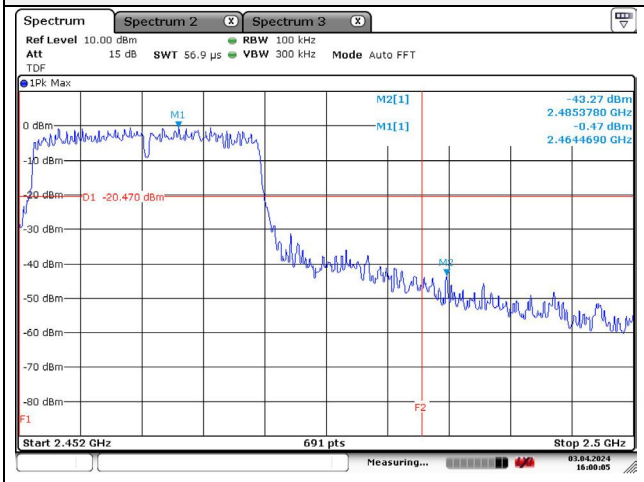
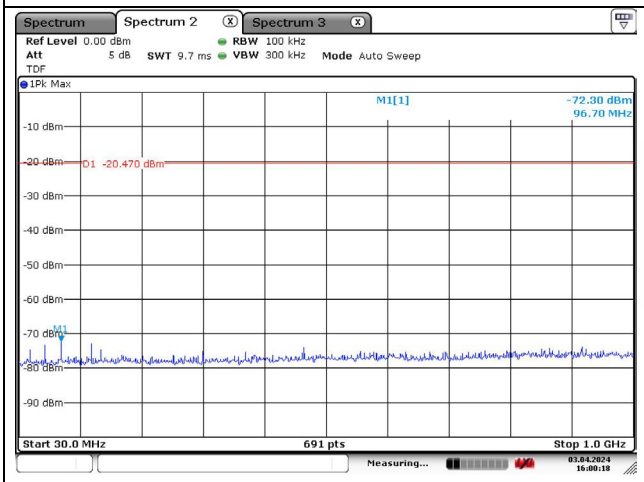
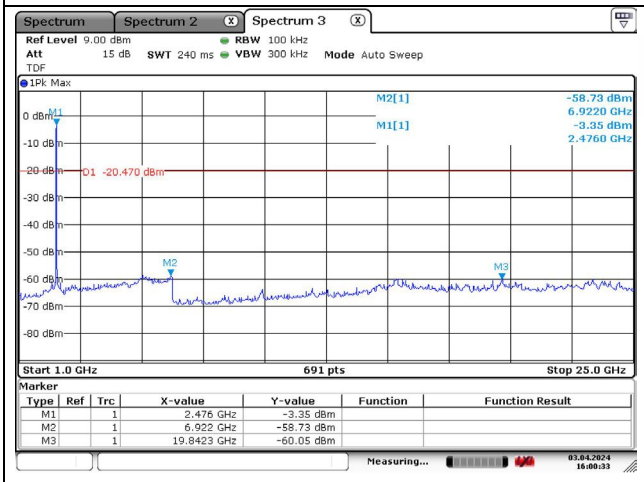



| 802.11n_HT20 | |
|---|---|
| **2 462** MHz | - |
|  | BLANK |
|  | BLANK |
|  | BLANK |

### 3.6. AC conducted emissions

**Limit**

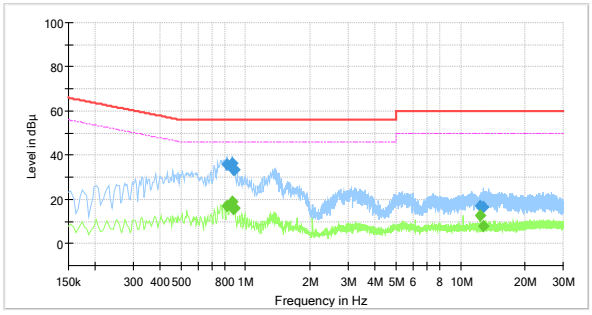
According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

| Frequency of Emission (㎒) | Conducted limit (dB$\mu$V) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 – 0.50 | 66 - 56* | 56 - 46* |
| 0.50 – 5.00 | 56 | 46 |
| 5.00 – 30.0 | 60 | 50 |

**Test results**

| | |
|---|---|
| Mode: | 802.11n_HT20 |
| Distance of measurement: | 3 meter |
| Channel: | 01(Worst case) |

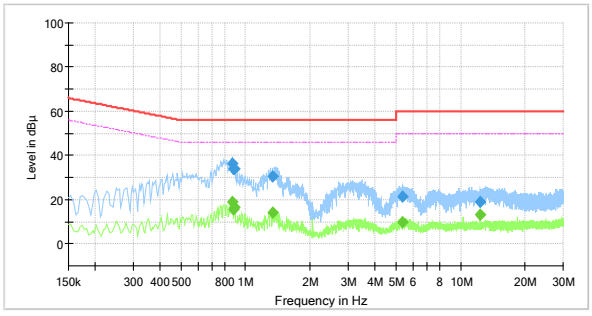
**Hot Line**




**Final_Result**

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.818000 | 35.73 | --- | 56.00 | 20.27 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.818000 | --- | 16.93 | 46.00 | 29.07 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.866000 | --- | 19.03 | 46.00 | 26.97 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.866000 | 36.37 | --- | 56.00 | 19.63 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.878000 | --- | 15.68 | 46.00 | 30.32 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.878000 | 33.52 | --- | 56.00 | 22.48 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.890000 | --- | 16.25 | 46.00 | 29.75 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.890000 | 33.48 | --- | 56.00 | 22.52 | 1000.0 | 9.000 | L1 | 19.5 |
| 12.290000 | --- | 12.79 | 50.00 | 37.21 | 1000.0 | 9.000 | L1 | 20.5 |
| 12.290000 | 17.23 | --- | 60.00 | 42.77 | 1000.0 | 9.000 | L1 | 20.5 |
| 12.786000 | --- | 7.86 | 50.00 | 42.14 | 1000.0 | 9.000 | L1 | 20.5 |
| 12.786000 | 16.67 | --- | 60.00 | 43.33 | 1000.0 | 9.000 | L1 | 20.5 |

**Neutral Line**




**Final_Result**

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.866000 | 36.47 | --- | 56.00 | 19.53 | 1000.0 | 9.000 | N | 19.6 |
| 0.866000 | --- | 19.12 | 46.00 | 26.88 | 1000.0 | 9.000 | N | 19.6 |
| 0.878000 | 33.76 | --- | 56.00 | 22.24 | 1000.0 | 9.000 | N | 19.6 |
| 0.878000 | --- | 15.76 | 46.00 | 30.24 | 1000.0 | 9.000 | N | 19.6 |
| 0.890000 | 33.67 | --- | 56.00 | 22.33 | 1000.0 | 9.000 | N | 19.6 |
| 0.890000 | --- | 16.44 | 46.00 | 29.56 | 1000.0 | 9.000 | N | 19.6 |
| 1.334000 | --- | 14.21 | 46.00 | 31.79 | 1000.0 | 9.000 | N | 19.6 |
| 1.334000 | 30.45 | --- | 56.00 | 25.55 | 1000.0 | 9.000 | N | 19.6 |
| 5.394000 | --- | 9.75 | 50.00 | 40.25 | 1000.0 | 9.000 | N | 20.0 |
| 5.394000 | 21.16 | --- | 60.00 | 38.84 | 1000.0 | 9.000 | N | 20.0 |
| 12.290000 | --- | 13.11 | 50.00 | 36.89 | 1000.0 | 9.000 | N | 20.5 |
| 12.290000 | 19.16 | --- | 60.00 | 40.84 | 1000.0 | 9.000 | N | 20.5 |

## 3.7. Antenna Requirement

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. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

## Appendix A. Measurement equipment

| Equipment | Manufacturer | Model | Serial No. | Calibration interval | Calibration due. |
|---|---|---|---|---|---|
| SPECTRUM ANALYZER | R&S | FSV40 | 101725 | 1 year | 2024.06.15 |
| SPECTRUM ANALYZER | R&S | FSV40-N | 102194 | 1 year | 2024.08.08 |
| SIGNAL GENERATOR | KEYSIGHT | N5182B | MY59100115 | 1 year | 2024.04.19 |
| SIGNAL GENERATOR | Anritsu | 68369B | 002118 | 1 year | 2024.05.12 |
| Power Meter | Anritsu | ML2495A | 2010001 | 1 year | 2024.04.19 |
| Pulse Power Sensor | Anritsu | MA2411B | 1911111 | 1 year | 2024.04.18 |
| ATTENUATOR | Mini-Circuits | BW-S10-2W263+ | 1 | 1 year | 2025.01.12 |
| BAND REJECT FILTER | MICRO-TRONICS | BRM50702 | G272 | 1 year | 2025.01.12 |
| EMI TEST RECEIVER | R&S | ESU26 | 100517 | 1 year | 2024.07.31 |
| Loop Antenna | Schwarzbeck | FMZB1513 | 1513-257 | 2 years | 2025.03.22 |
| BILOG ANTENNA | Schwarzbeck | VULB 9163 | 714 | 2 years | 2024.04.19 |
| DC POWER SUPPLY | SORENSEN | DCS40-75E | 1408A02745 | 1 year | 2025.01.12 |
| Attenuator | HUBER+SHHNER | 6806.17.A | NONE | 1 year | 2025.02.13 |
| Horn Antenna | A.H. | SAS-571 | 414 | 1 year | 2025.01.16 |
| Horn Antenna | SCHWARZBECK | BBHA9170 | BBHA 9170550 | 1 year | 2025.01.16 |
| Amplifier | SONOMA INSTRUMENT | 310N | 186549 | 1 year | 2025.02.13 |
| PREAMPLIFIER | HP | 8449B | 3008A00538 | 1 year | 2024.05.31 |
| BROADBAND AMPLIFIER | SCHWARZBECK | BBV9721 | PS9721-003 | 1 year | 2025.01.15 |
| EMI TEST RECEIVER | R & S | ESR3 | 101783 | 1 year | 2024.11.08 |
| LISN | R & S | ENV216 | 101787 | 1 year | 2024.11.08 |
| LISN | R & S | ESH2-Z5 | 100450 | 1 year | 2024.11.08 |
| PULSE LIMITER | R & S | ESH3-Z2 | 101915 | 1 year | 2024.11.08 |

* Statement of Traceability: KES Co., Ltd. attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Peripheral devices

| Device | Manufacturer | Model No. | Serial No. |
|---|---|---|---|
| Notebook computer | LG Electronics Inc | LGS53 | 306QCZP560949 |

**The end of test report**