# TEST REPORT

# Part 15 Subpart C 15.247

| | |
|---|---|
| **Equipment under test** | Instant Square Printer |
| **Model name** | P300 |
| **Derivative name** | P300R |
| **FCC ID** | PO5P300R |
| **Applicant** | Prinics Co.Ltd |
| **Manufacturer** | Prinics Co.Ltd |
| **Date of test(s)** | 2021.01.19 ~ 2021.01.28 |
| **Date of issue** | 2021.02.02 |

**Issued to**
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| Test and report completed by : | Report approval by : |
|---|---|
|  |  |
| Jang-yeon, Hwang<br>Test engineer | Young-Jin, Lee<br>Technical manager |

## Revision history

| Revision | Date of issue | Test report No. | Description |
|---|---|---|---|
| - | 2021.02.02 | KES-RF1-21T0008 | Initial |
| | | | |

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## 1. General information

| | |
|---|---|
| Applicant: | Prinics Co.Ltd |
| Applicant address: | 228-92, Saneop-ro 155beon-gil,<br>Gwonseon-gu, Suwon-si, Gyeonggi-do, 16648, Korea |
| Test site: | KES Co., Ltd. |
| Test site address: | 3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,<br>Gyeonggi-do, 14057, 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): | 15.247 |
| FCC ID: | PO5P300R |
| Test device serial No.: | ☒ Production ☐ Pre-production ☐ Engineering |

### 1.1. EUT description

| | |
|---|---|
| Equipment under test | Instant Square Printer |
| Frequency range | 2 402 ㎒ ~ 2 480 ㎒ (BDR/EDR) |
| Model | P300 |
| Derivative name | P300R |
| Modulation technique | GFSK, π/4DQPSK, 8DPSK |
| Number of channels | 79 ch |
| Antenna specification | Antenna type : PCB antenna, Peak gain : -0.37 ㏈i |
| Power source | DC 7.4 V (Li-ion Battery) |

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted signals.

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate it channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

**Pseudorandom frequency hopping sequence**
The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

**Equal hopping frequency use**
The channels of this system will be used equally over the long-term distribution of the hopsets.

**System receiver input bandwidth**
Each channel bandwidth is 1 ㎒.
The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

## 1.2. Test configuration
The **Prinics Co.Ltd P300 FCC ID: PO5P300R** 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. Device modifications
N/A

## 1.4. Frequency/channel operations

| Ch. | Frequency (㎒) | Rate(Mbps) |
|---|---|---|
| 00 | 2402 | 1,2,3 |
| . . | . . | . . |
| 40 | 2442 | 1,2,3 |
| . . | . . | . . |
| 78 | 2480 | 1,2,3 |

## 1.5. Accessory information

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

## 1.6. Software and Firmware description
The software and firmware installed in the EUT is version 3.0.

## 1.7. Information about derivative model

- P300R

The circuit diagram and software of the basic model and derivative are fundamentally the same.
It is for model management purpose per business partner.

## 1.8. Measurement results explanation example

For all conducted test items

The offset level is set in the spectrum analyzer to compensate the RF cable loss 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(dB) = RF cable loss(dB)
= 0.76

## 1.9. Measurement Uncertainty

| Test Item | | Uncertainty |
|---|---|---|
| Uncertainty for Conduction emission test | | 2.46 dB |
| Uncertainty for Radiation emission test (include Fundamental emission) | Below 1 GHz | 4.40 dB |
| | Above 1GHz | 5.94 dB |
| Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. | | |

## 2. Summary of tests

| Reference | Test description | Test results |
|---|---|---|
| 15.247(a)(1) | 20 dB bandwidth | Pass |
| 15.247(b)(1) | Output power | Pass |
| 15.247(a)(1) | Channel separation | Pass |
| 15.247(a)(1)(iii) | Number of channels | Pass |
| 15.247(a)(1)(iii) | Time of occupancy | Pass |
| 15.205, 15.209 | Radiated restricted band and emission | Pass |
| 15.247(d) | Conducted band edge and out of band emissions | Pass |
| 15.207(a) | AC conducted emissions | Pass |

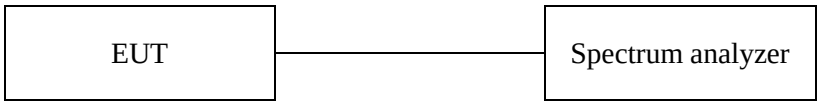
# 3. Test results

## 3.1. 20 dB bandwidth

**Test procedure**

ANSI C63.10-2013 clause 6.9.2 and 6.9.3

**Test setup**




**Test setting**

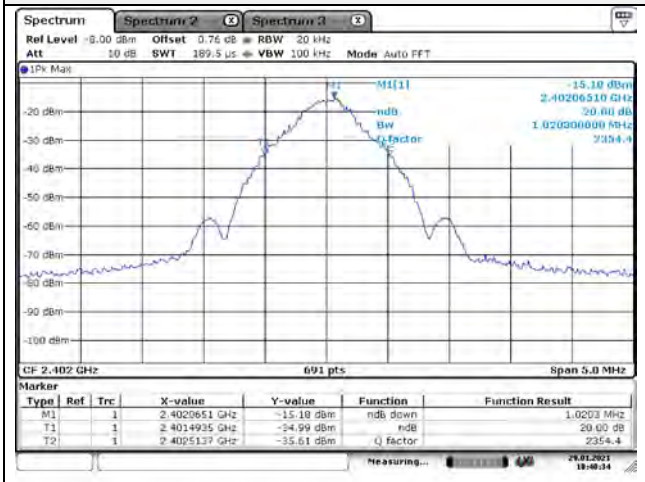
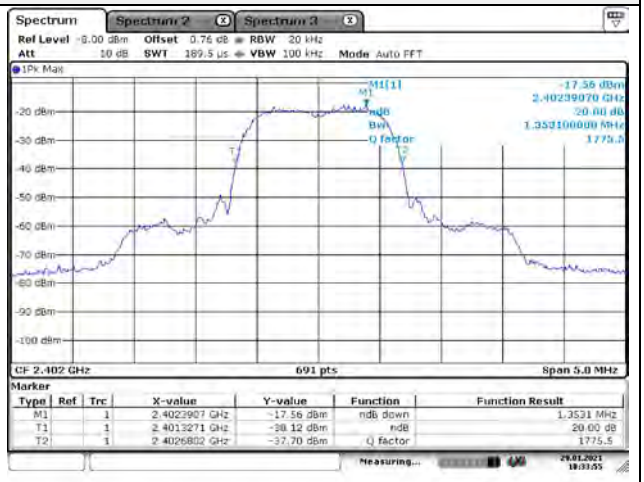
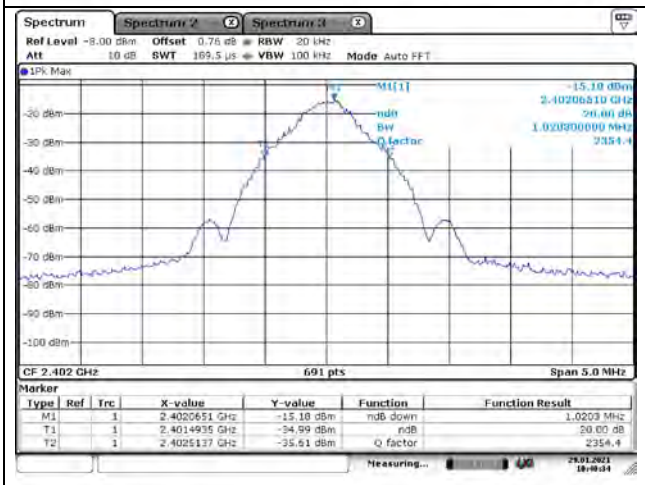
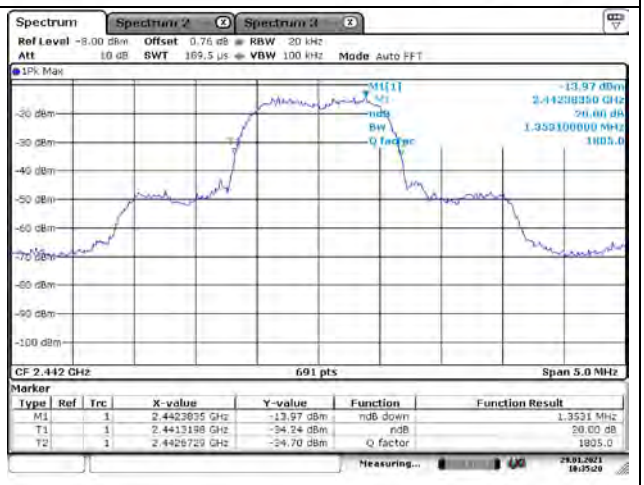
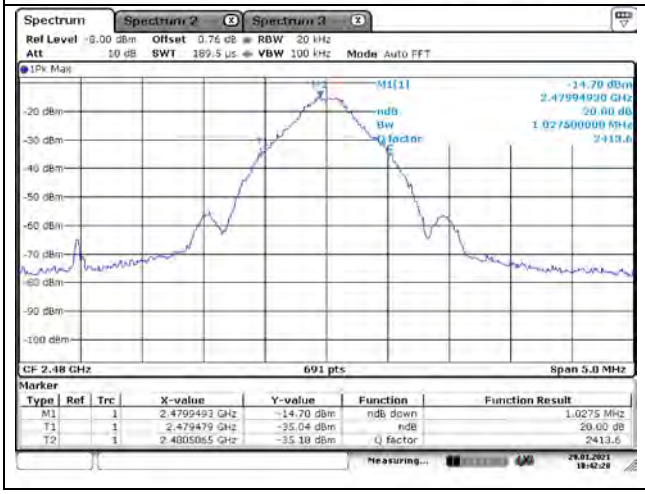
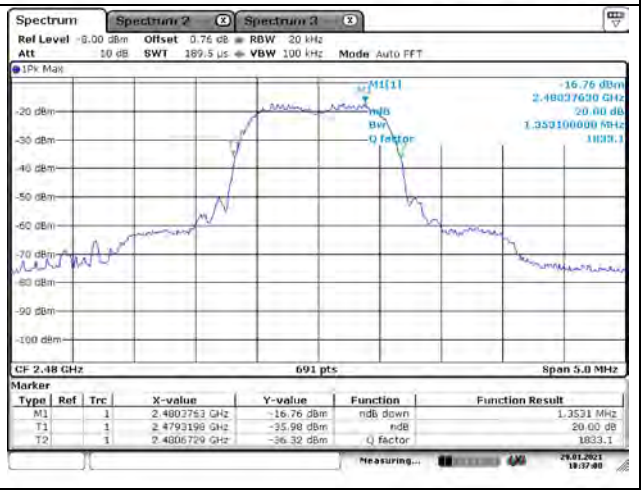
1. Span = The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 2.0 times and 5.0 times the OBW.
2. RBW = The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW.
3. VBW = Shall be approximately three times the RBW.
4. Sweep = auto
5. Detector function = peak
6. Trace mode = max hold

**Limit**

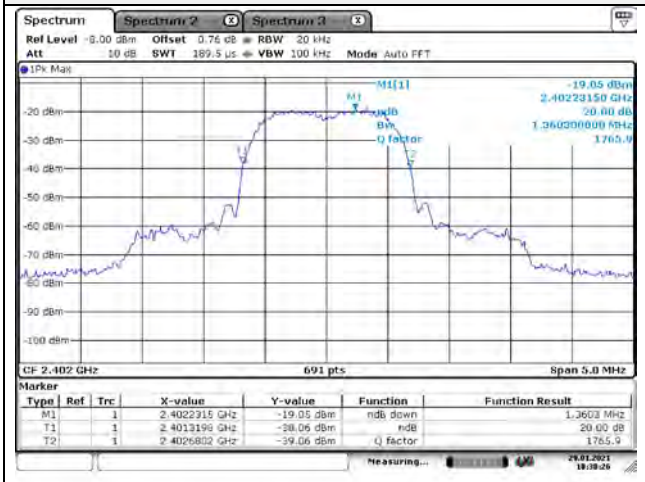
Not applicable

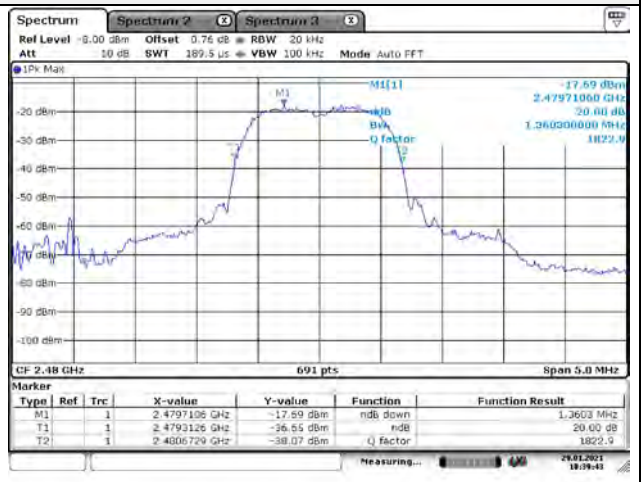
**Test results**

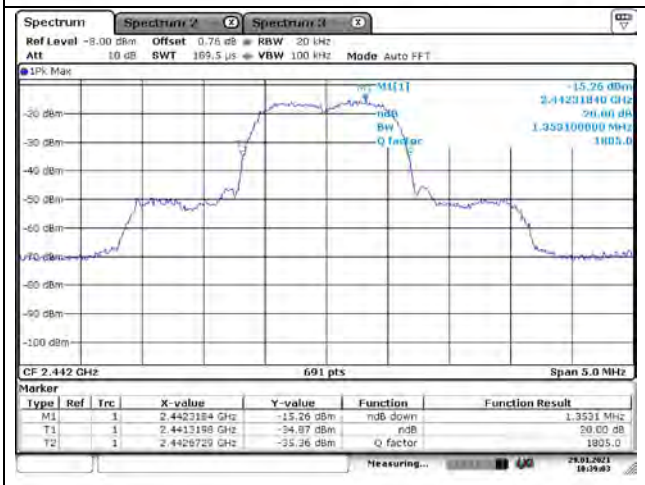
| Frequency(㎒) | Channel no. | Data rate(Mbps) | Measured bandwidth(㎒) |
|---|---|---|---|
| 2 402 | 00 | 1 | 1.020 |
| 2 442 | 40 | | 1.020 |
| 2 480 | 78 | | 1.028 |
| 2 402 | 00 | 2 | 1.353 |
| 2 442 | 40 | | 1.353 |
| 2 480 | 78 | | 1.353 |
| 2 402 | 00 | 3 | 1.360 |
| 2 442 | 40 | | 1.353 |
| 2 480 | 78 | | 1.360 |

| BDR(1Mbps) | EDR(2Mbps) |
|---|---|
|  |  |
|  |  |
|  |  |

## EDR(3Mbps)

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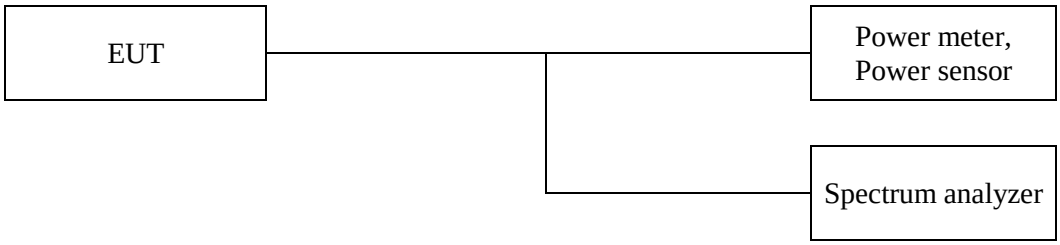
## 3.2. Output power

**Test procedure**

ANSI C63.10-2013 - Section 7.8.5

**Test setup**




**Test setting**

1. Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
2. RBW > the 20 dB bandwidth of the emission being measured
3. VBW ≥ RBW
4. Sweep = Auto
5. Detector function = Peak
6. Trace = Max hold

**Limit**

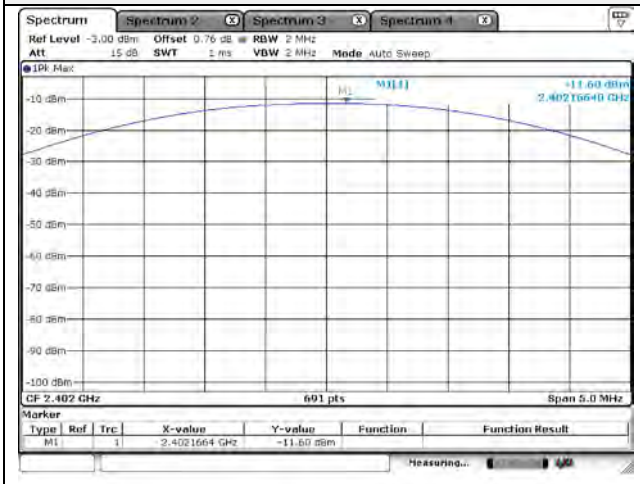
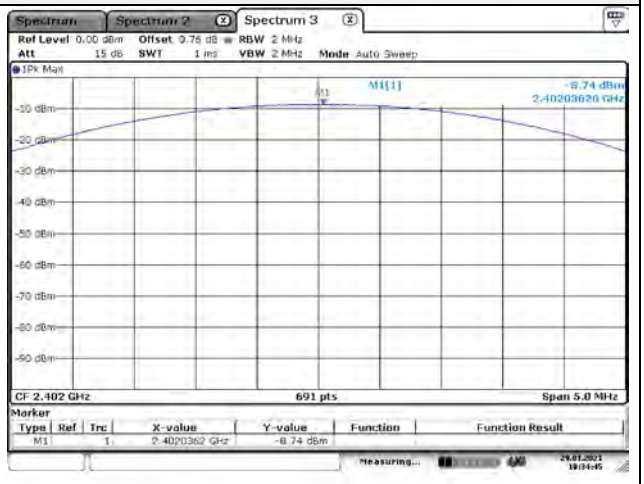
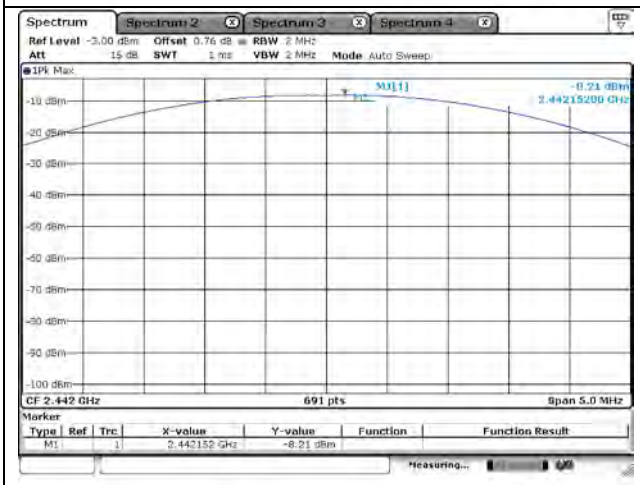
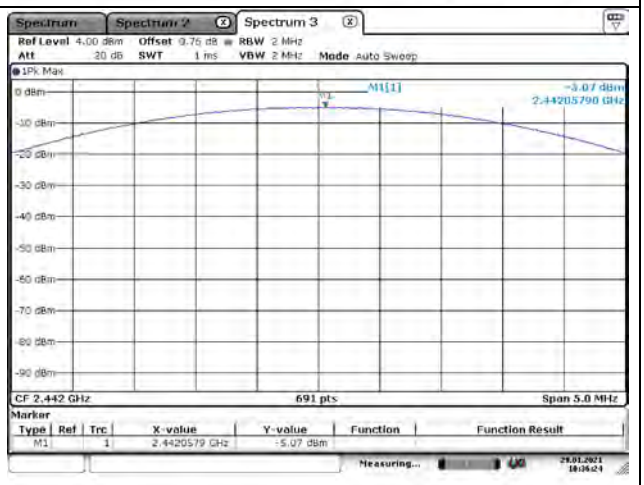
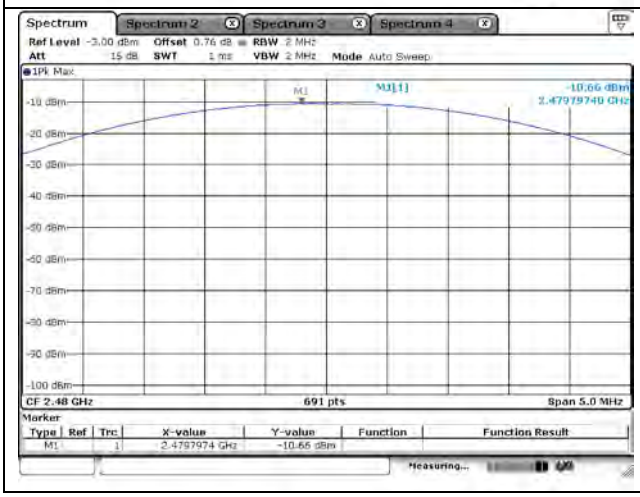
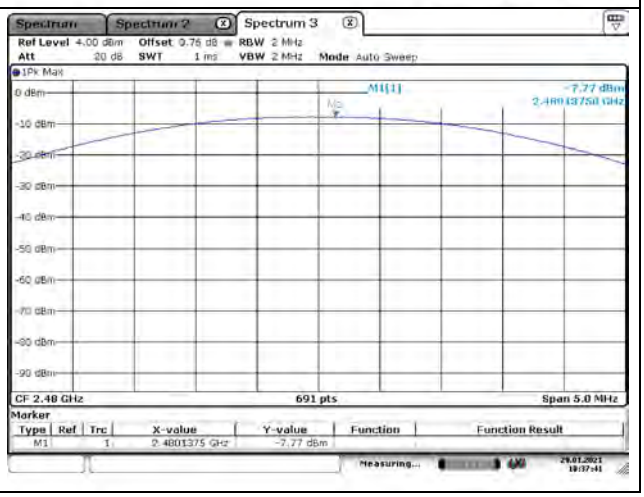
According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

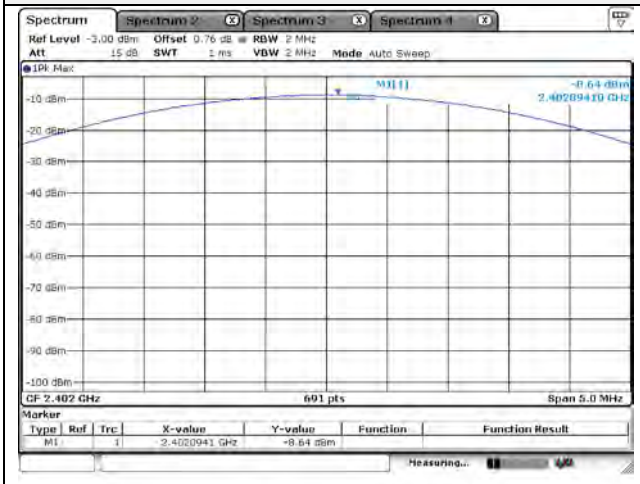
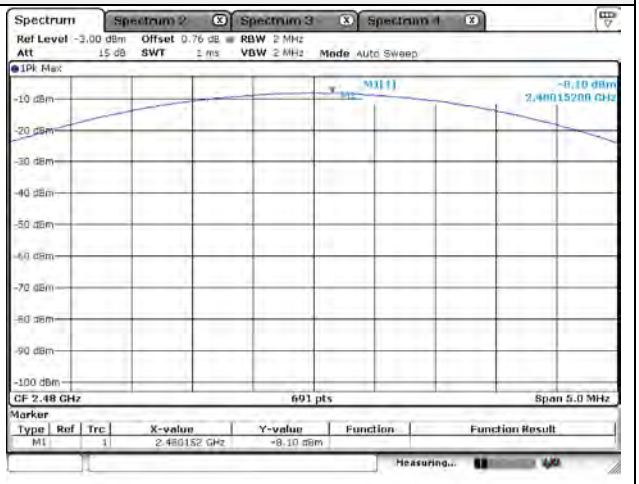
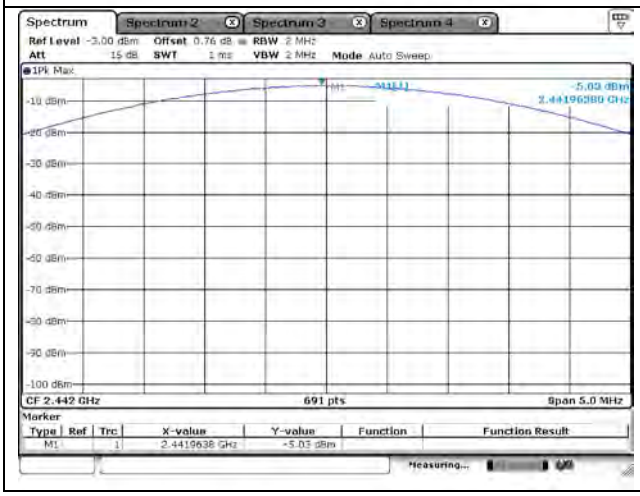
According to §15.247(b)(1), For frequency hopping systems operating in the 2 400 ~ 2 483.5 ㎒ employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 ~ 5 805 ㎒ band: 1 Watt.

**Test results**

| Frequency(㎒) | Channel no. | Data rate(Mbps) | Peak Power (dBm) | Average Power (dBm) Note1 | Power Limit (dBm) |
|---|---|---|---|---|---|
| 2 402 | 00 | 1 | -11.60 | -12.62 | 20.97 |
| 2 442 | 40 | | -8.21 | -9.42 | 20.97 |
| 2 480 | 78 | | -10.66 | -11.45 | 20.97 |
| 2 402 | 00 | 2 | -8.74 | -10.72 | 20.97 |
| 2 442 | 40 | | -5.07 | -7.55 | 20.97 |
| 2 480 | 78 | | -7.77 | -9.72 | 20.97 |
| 2 402 | 00 | 3 | -8.64 | -10.60 | 20.97 |
| 2 442 | 40 | | -5.03 | -7.48 | 20.97 |
| 2 480 | 78 | | -8.10 | -9.66 | 20.97 |

**Note.**
1. The average power was tested using an average power meter.

| BDR(1Mbps) | EDR(2Mbps) |
|---|---|
|  |  |
|  |  |
|  |  |

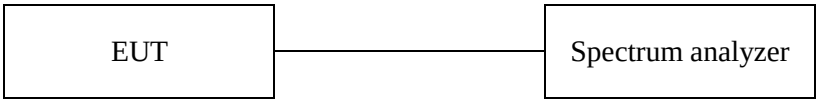
| EDR(3Mbps) | |
|---|---|
|  |  |
|  | Blank |

## 3.3. Carrier frequency separation

**Test procedure**

ANSI C63.10-2013 - Section 7.8.2

**Test setup**




**Test Setting**

1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = wide enough to capture the peaks of two adjacent channels
3. RBW = Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
4. Video (or Average) Bandwidth (VBW) ≥ RBW
5. Sweep = auto
6. Detector function = peak
7. Trace = max hold

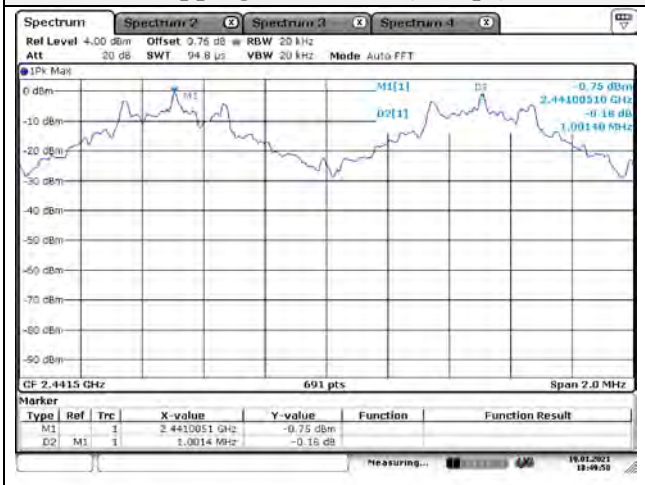
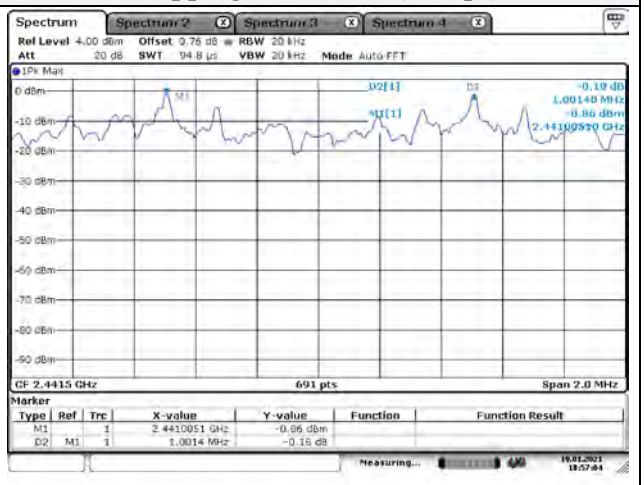
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

**Limit**

According to 15.247(a)(1), frequency hopping system operating in 2 400 ~ 2 483.5 ㎒. Band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-third of 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

## Test results

| Mode | Data rate(Mbps) | Channel Separation (㎒) | Minimum limit (㎒) |
|---|---|---|---|
| BDR (Hopping) | 1 | 1.001 | 0.685 |
| EDR (Hopping) | 3 | 1.001 | 0.907 |

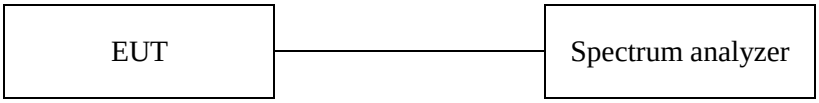
| Hopping mode_BDR(1Mbps) | Hopping mode_EDR(3Mbps) |
|---|---|
|  |  |

## 3.4. Number of hopping frequency

**Test procedure**

ANSI C63.10-2013 - Section 7.8.3

**Test setup**




**Test setting**

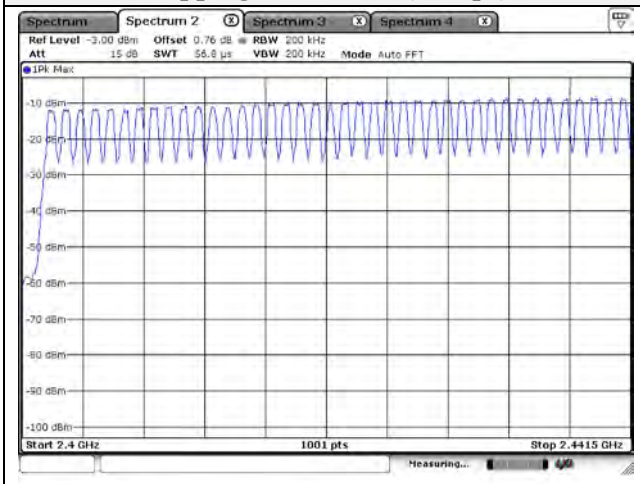
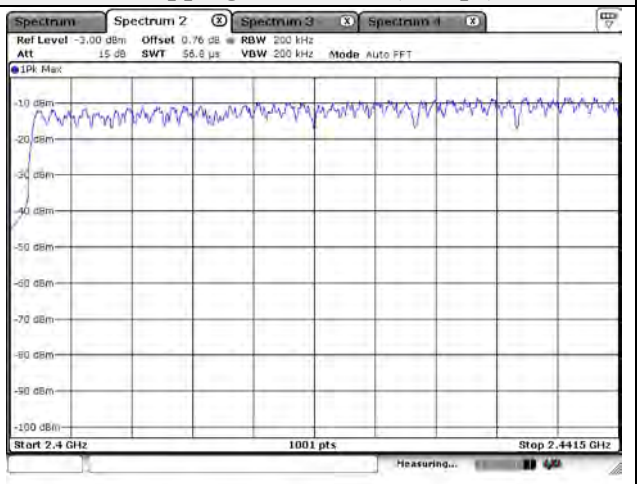
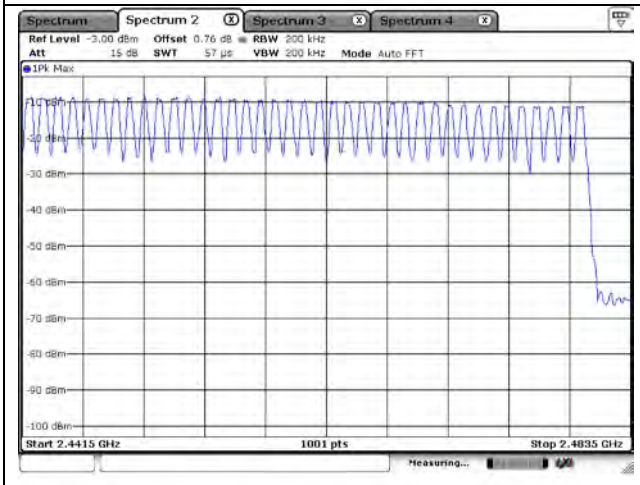
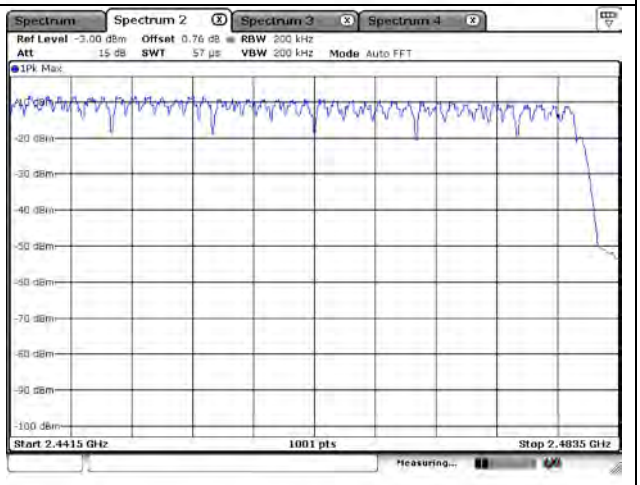
1. The EUT must have its hopping function enabled.
2. Frequency range: 2 400 ㎒ ~ 2 441.5 ㎒, 2 441.5 ㎒ ~ 2 483.5 ㎒
3. Span = the frequency band of operation
4. RBW = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
5. VBW ≥ RBW
6. Sweep = auto
7. Detector function = peak
8. Trace = max hold

Allow the trace to stabilize. It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

**Limit**

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 ㎒ bands shall use at least 15 hopping frequencies.

**Test results**

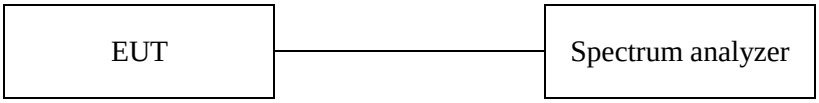
| Hopping mode_BDR(1Mbps) | Hopping mode_EDR(3Mbps) |
|---|---|
|  |  |
|  |  |

## 3.5. Time of occupancy

**Test procedure**

ANSI C63.10-2013 - Section 7.8.4

**Test setup**




**Test setting**

1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = zero span, centered on a hopping channel
4. RBW = shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
5. VBW = 1 ㎒ (≥ RBW)
6. Sweep = as necessary to capture the entire dwell time per hopping channel
7. Detector function = peak
8. Trace = max hold

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

**Limit**

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 ㎒ band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

A period time = 0.4(s) × 79 = 31.6(s)

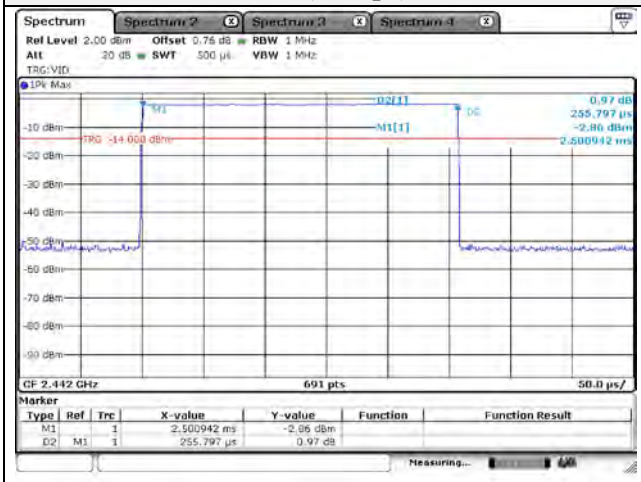
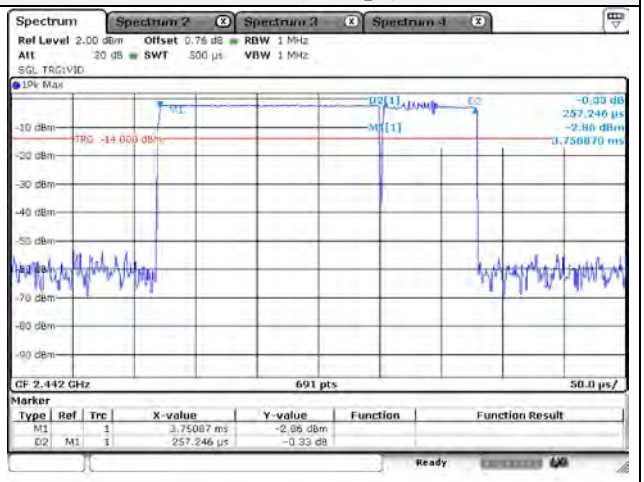
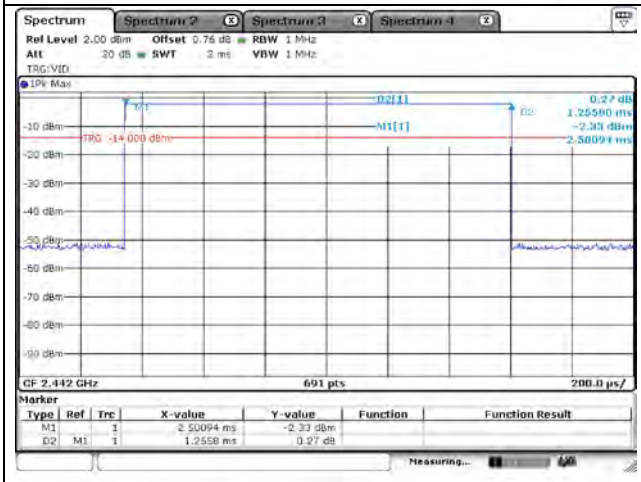
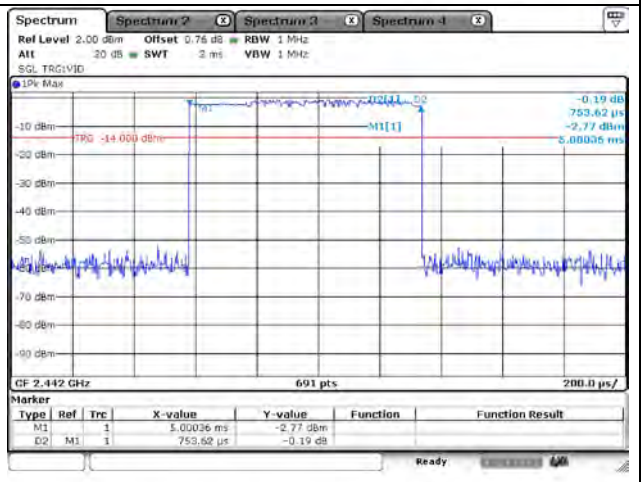
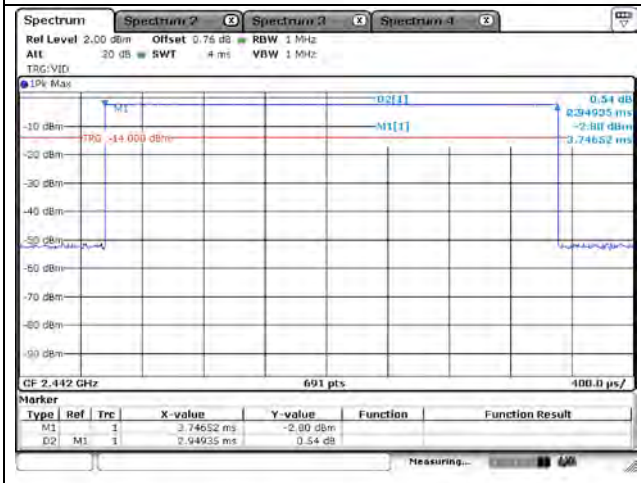
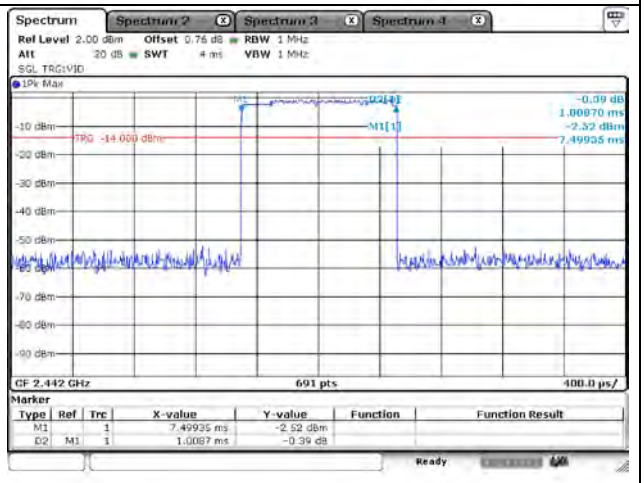
Time of occupancy on the TX channel in 31.6 sec
= time domain slot length × (hop rate ÷ number of hop per channel) × 31.6

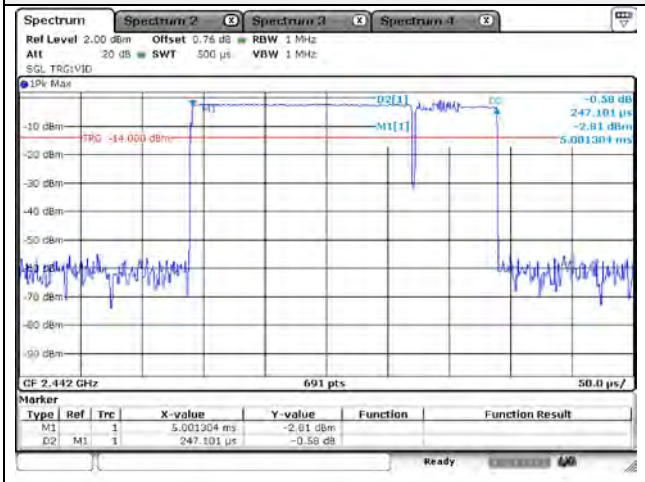
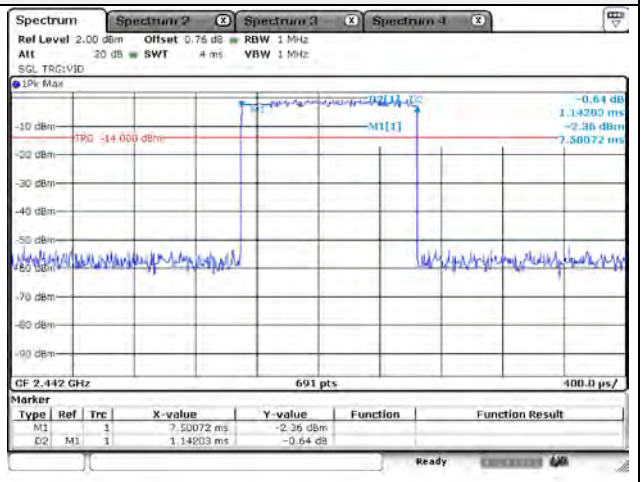
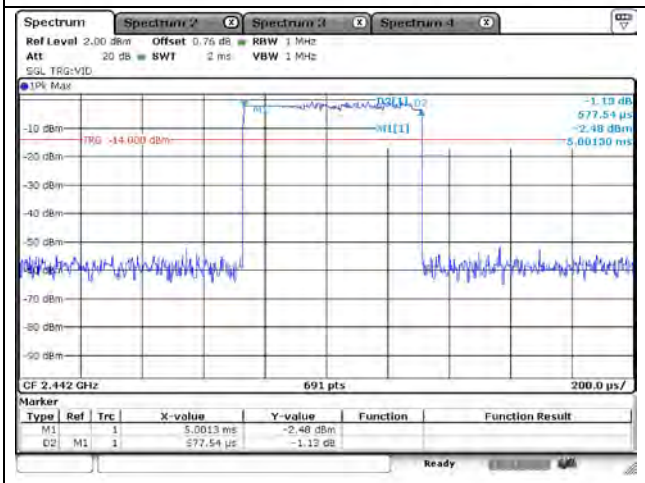
**Test results**

| Packet type | Frequency (㎒) | Dwell time (ms) | Time of occupancy on the Tx channel in 31.6 sec (ms) | Limit for time of occupancy on the Tx channel in 31.6 sec (ms) |
|---|---|---|---|---|
| DH1 | 2 442 | 0.256 | 81.92 | 400 |
| DH3 | 2 442 | 1.256 | 200.96 | 400 |
| DH5 | 2 442 | 2.949 | 314.56 | 400 |
| 2-DH1 | 2 442 | 0.257 | 82.24 | 400 |
| 2-DH3 | 2 442 | 0.754 | 120.64 | 400 |
| 2-DH5 | 2 442 | 1.009 | 107.63 | 400 |
| 3-DH1 | 2 442 | 0.247 | 79.04 | 400 |
| 3-DH3 | 2 442 | 0.577 | 92.32 | 400 |
| 3-DH5 | 2 442 | 1.142 | 121.81 | 400 |

**Note:**

DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 79] × 31.6(s) = 81.92
DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 79] × 31.6(s) = 200.96
DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 314.56
2-DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 79] × 31.6(s) = 82.24
2-DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 79] × 31.6(s) = 120.64
2-DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 107.63
3-DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 79] × 31.6(s) = 79.04
3-DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 79] × 31.6(s) = 92.32
3-DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 121.81

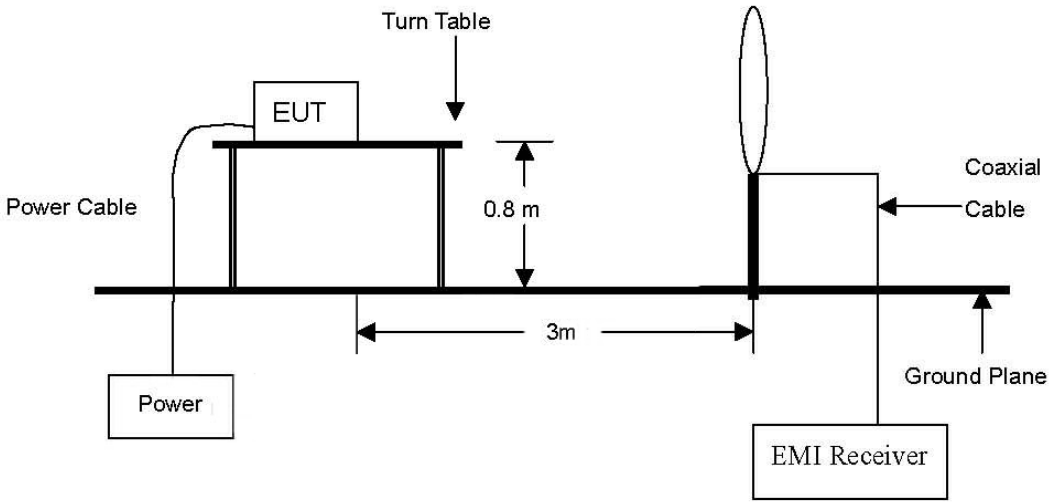
| BDR(1Mbps) | EDR(2Mbps) |
|---|---|
|  |  |
|  |  |
|  |  |

| EDR(3Mbps) | |
|---|---|
|  |  |
|  | Blank |

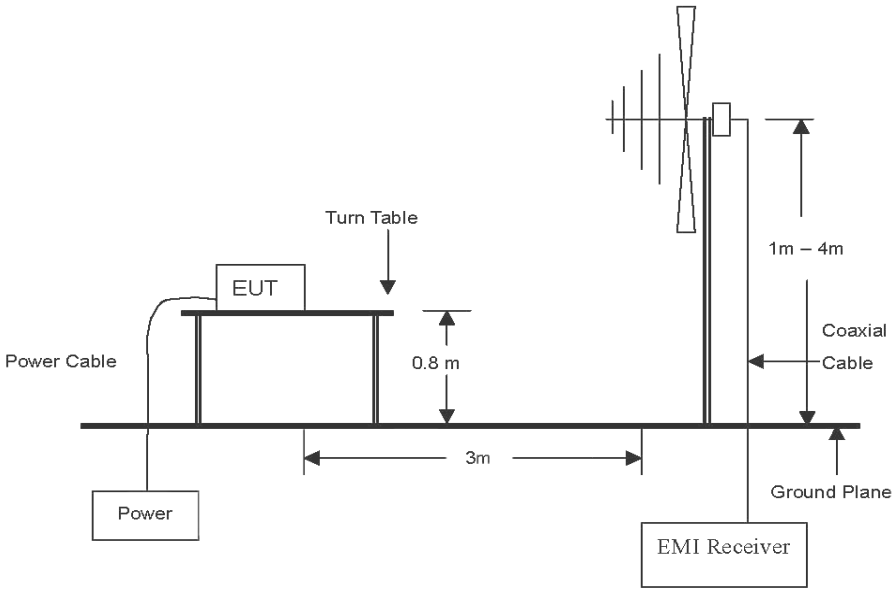
## 3.6. Radiated restricted band and emissions

**Test setup**

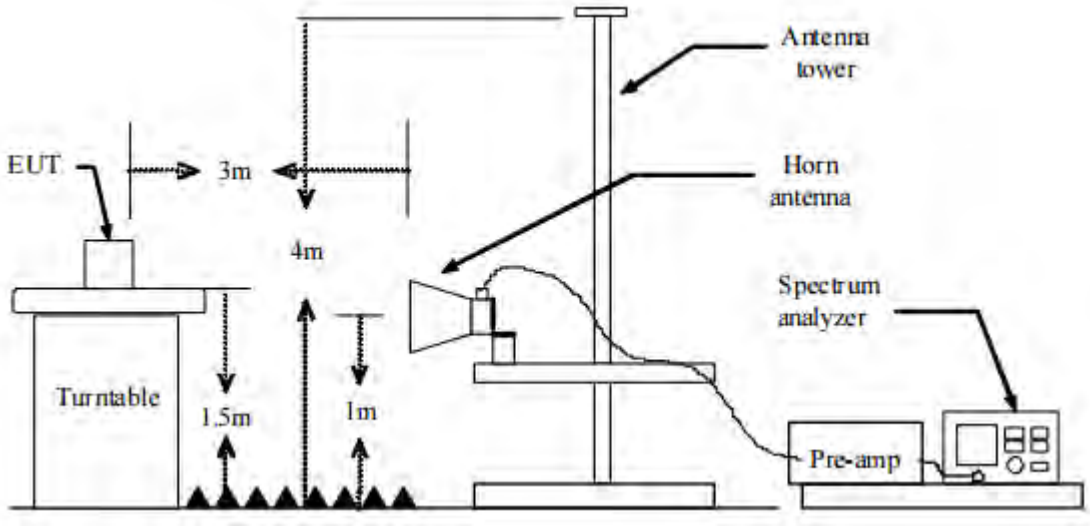
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.




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**

1. The EUT is placed on a turntable, which is 0.8 m (below 1 ㎓) and 1.5 m (above 1 ㎓) ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Spectrum analyzer settings for $f$ < 1 ㎓:
   Span = wide enough to fully capture the emission being measured
   RBW = 100 ㎑
   VBW ≥ RBW
   Sweep = auto
   Detector function = quasi peak
   Trace = max hold
8. Spectrum analyzer settings for $f$ ≥1 ㎓: Peak
   Span = wide enough to fully capture the emission being measured
   RBW = 1 ㎒
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
9. Spectrum analyzer settings for $f$ ≥1 ㎓: Average
   Average value of pulsed emissions.
   Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determined from the peak field strength after correcting for the worst-case duty cycle as described in 7.5 in ANSI 63.10-2013 & Procedure 9(b) in the KDB 558074 v05r02.
10. Duty Cycle Correction Factor (79 channel hopping)
    a. Time to cycle through all channels = Δt=τ[㎳] × 79 channels = **233.05** ㎳, where τ = pulse width
    b. 100 ㎳/ Δt[㎳] = H → Round up to next highest integer, H '=1
    c. Worst Case Dwell Time = τ[㎳] × H' = **2.950** ㎳
    d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100㎳) ㏈ = **-30.60** ㏈
11. Both 2Mbps & 3Mbps data rate were investigated. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

**Note:**

1. The spectrum is measured from 9 ㎑ to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1 ㎓. Above 1 ㎓, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ of the respective limits were not reported.
2. The loop antenna was investigated with three polarizations, and horizontal and vertical polarizations were reported as the worst case**.**
3. According to 15.35 (c), as a "duty cycle correction factor", pulse averaging with 20 log(duty cycle) has to be used.
   Duty cycle correction factor = 20log(dwell time/100 ㎳)
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. Average test would be performed if the peak result were greater than the average limit.
6. Field strength(㏈㎶/m) = Level(㏈㎶) + Correction factors(㏈/m) + Cable loss(㏈) + or $F_d$(㏈)
7. Correction factors(㏈/m) = Antenna factor(㏈/m) + Cable loss(㏈) + or Amp. gain(㏈)
8. Margin(㏈) = Limit(㏈㎶/m) - Field strength(㏈㎶/m)
9. 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.
10. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ of respective limits were not reported.
11. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test 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.
12. $f$ < 30 ㎒, extrapolation factor of 40 ㏈/decade of distance. $F_d = 40\log(D_m / Ds)$
    $f \geq$ 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

**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：

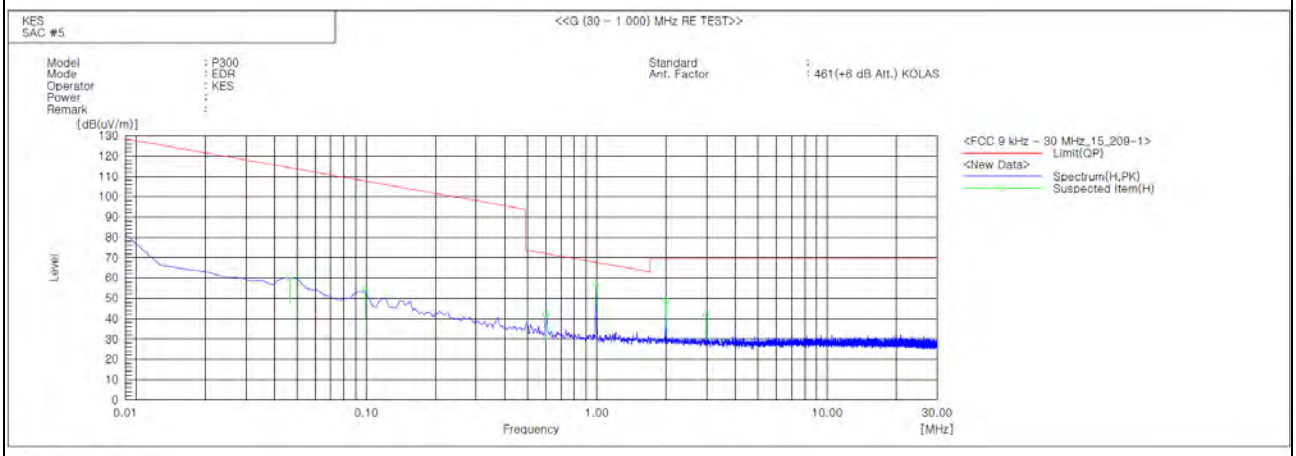
| Frequency (㎒) | Distance (Meters) | Radiated (㎶/m) |
|---|---|---|
| 0.009 ~ 0.490 | 300 | 2 400 / F(㎑) |
| 0.490 ~ 1.705 | 30 | 24 000 / F(㎑) |
| 1.705 ~ 30.0 | 30 | 30 |
| 30 ~ 88 | 3 | 100** |
| 88 ~ 216 | 3 | 150** |
| 216 ~ 960 | 3 | 200** |
| Above 960 | 3 | 500 |

**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.

**Test results (Below 30 ㎒)**

| | |
|---|---|
| Mode: | EDR |
| Transfer rate: | 3 Mbps |
| Distance of measurement: | 3 meter |
| Channel: | 40(Worst case) |

**Horizontal**



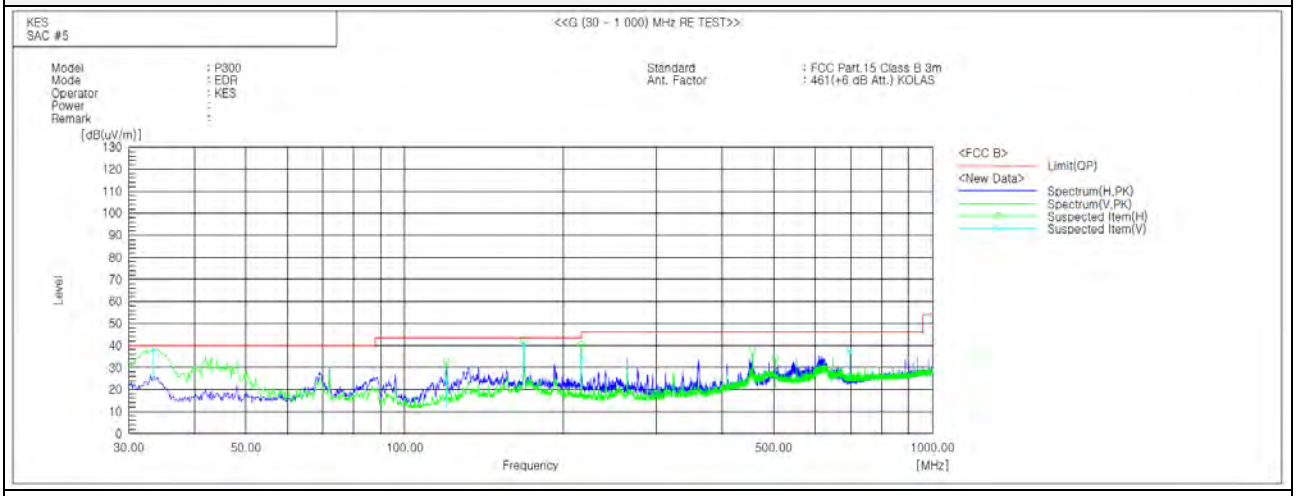

Spectrum Selection

| No. | Frequency [MHz] | (P) | Reading [dB(uV)] | c.f [dB(1/m)] | Result PK [dB(uV/m)] | Limit QP [dB(uV/m)] | Margin QP [dB] | Height [cm] | Angle [deg] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.046 | H | 40.3 | 19.8 | 60.1 | 114.2 | 54.1 | 99.8 | 339.5 | |
| 2 | 0.099 | H | 33.7 | 19.7 | 53.4 | 107.7 | 54.3 | 99.8 | 331.6 | |
| 3 | 0.601 | H | 22.1 | 20.3 | 42.4 | 72.0 | 29.6 | 99.8 | 321.6 | |
| 4 | 0.995 | H | 35.5 | 20.7 | 56.2 | 67.7 | 11.5 | 99.8 | 291.0 | |
| 5 | 1.992 | H | 28.1 | 20.7 | 48.8 | 69.5 | 20.7 | 99.8 | 295.8 | |
| 6 | 2.989 | H | 21.9 | 20.2 | 42.1 | 69.5 | 27.4 | 99.8 | 279.2 | |

**Test results (Below 1 000 ㎒) – Worst case**

| | |
|---|---|
| Mode: | EDR |
| Transfer rate: | 3 Mbps |
| Distance of measurement: | 3 meter |
| Channel: | 40(Worst case) |

**Horizontal // Vertical**




Spectrum Selection

| No. | Frequency [MHz] | (P) | Reading [dB(uV)] | c.f [dB(1/m)] | Result PK [dB(uV/m)] | Limit QP [dB(uV/m)] | Margin QP [dB] | Height [cm] | Angle [deg] | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 119.968 | H | 47.9 | -15.3 | 32.6 | 43.5 | 10.9 | 400.3 | 347.9 | |
| 2 | 167.983 | H | 55.5 | -13.3 | 42.2 | 43.5 | 1.3 | 200.2 | 129.3 | |
| 3 | 215.998 | H | 55.8 | -15.3 | 40.5 | 43.5 | 3.0 | 200.2 | 358.4 | |
| 4 | 456.073 | H | 45.5 | -8.0 | 37.5 | 46.0 | 8.5 | 99.7 | 221.1 | |
| 5 | 503.724 | H | 41.3 | -7.3 | 34.0 | 46.0 | 12.0 | 99.7 | 78.9 | |
| 6 | 33.395 | V | 52.2 | -13.9 | 38.3 | 40.0 | 1.7 | 149.9 | 245.4 | |
| 7 | 119.968 | V | 39.9 | -15.3 | 24.6 | 43.5 | 18.9 | 400.3 | 319.3 | |
| 8 | 167.983 | V | 53.5 | -13.3 | 40.2 | 43.5 | 3.3 | 99.8 | 121.9 | |
| 9 | 215.998 | V | 49.7 | -15.3 | 34.4 | 43.5 | 9.1 | 149.9 | 319.4 | |
| 10 | 696.026 | V | 41.5 | -4.0 | 37.5 | 46.0 | 8.5 | 99.8 | 64.1 | |

**Test results (Above 1 000 ㎒)**

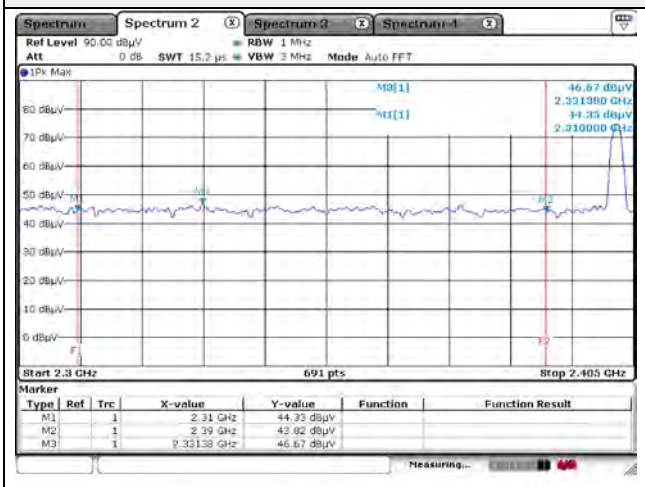
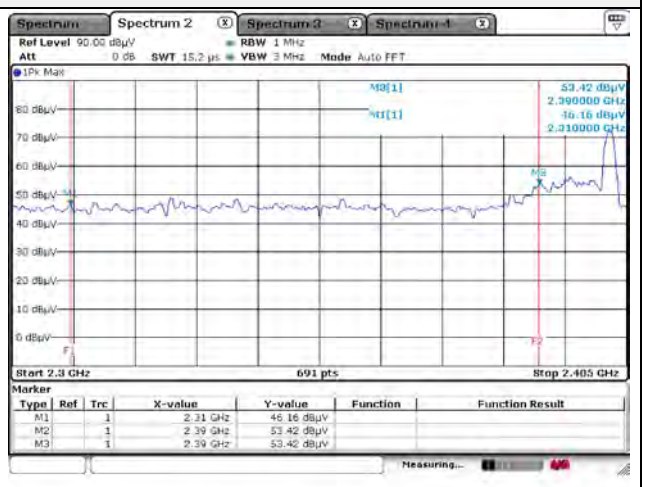
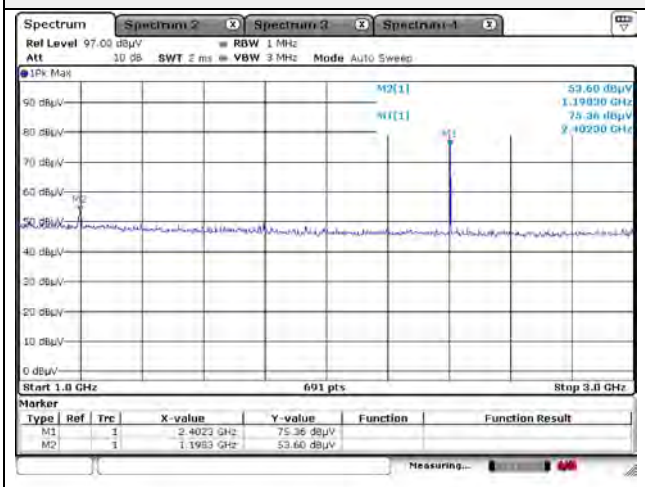
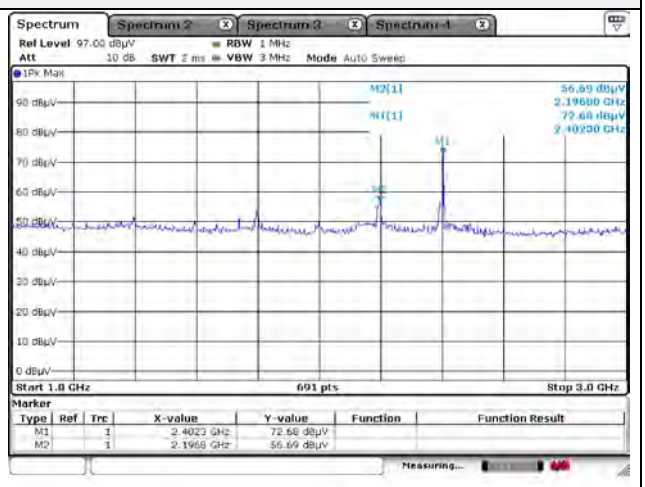
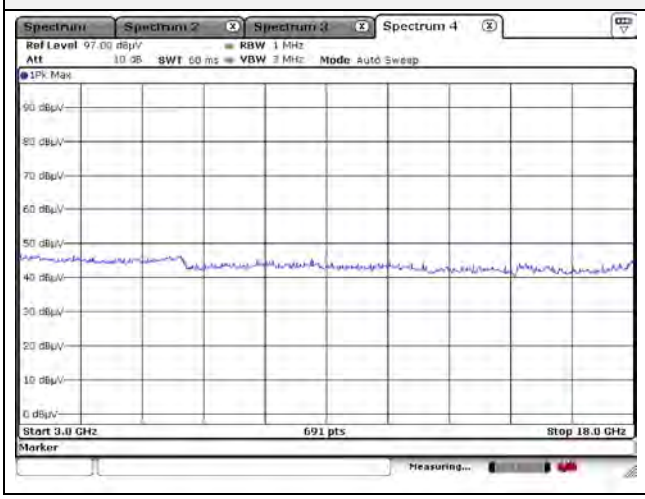
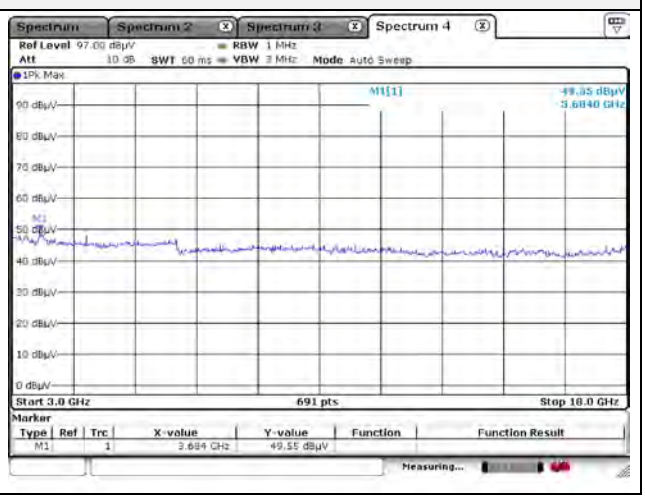
| | |
|---|---|
| Mode: | BDR |
| Transfer rate: | 1 Mbps |
| Distance of measurement: | 3 meter |
| Channel: | 00 |

- **Spurious**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 198.30 | 53.60 | Peak | H | -10.11 | - | 43.49 | 74.00 | 30.51 |
| 2 196.80 | 56.69 | Peak | V | -3.60 | - | 53.09 | 74.00 | 20.91 |
| 3 684.00 | 49.55 | Peak | V | 0.93 | - | 50.48 | 74.00 | 23.52 |

- **Band edge**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2 331.38 | 46.67 | Peak | H | -3.02 | - | 43.65 | 74.00 | 30.35 |
| 2 390.00 | 53.42 | Peak | V | -2.77 | - | 50.65 | 74.00 | 23.35 |

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

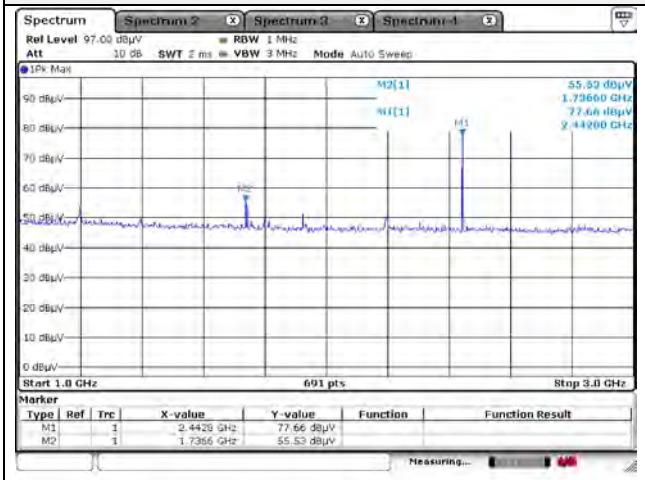
**Note.**

1. No spurious emission were detected above 3 ㎓.

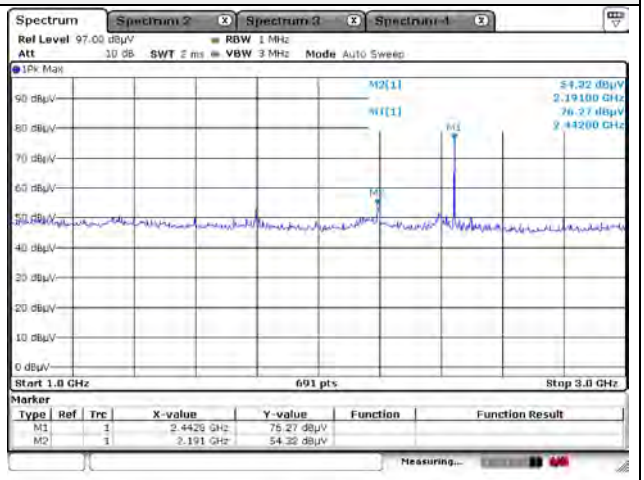
| | |
|---|---|
| Mode: | BDR |
| Transfer rate: | 1 Mbps |
| Distance of measurement: | 3 meter |
| Channel: | 40 |

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 736.60 | 55.53 | Peak | H | -6.58 | - | 48.95 | 74.00 | 25.05 |
| 2 191.00 | 54.32 | Peak | V | -3.62 | - | 50.70 | 74.00 | 23.30 |
| 4 878.00 | 50.45 | Peak | H | 5.39 | - | 55.84 | 74.00 | 18.16 |
| 4 878.00 | 50.45 | Average | H | 5.39 | -30.60 | 25.24 | 54.00 | 28.76 |
| 4 878.00 | 54.20 | Peak | V | 5.39 | - | 59.59 | 74.00 | 14.41 |
| 4 878.00 | 54.20 | Average | V | 5.39 | -30.60 | 28.99 | 54.00 | 25.01 |

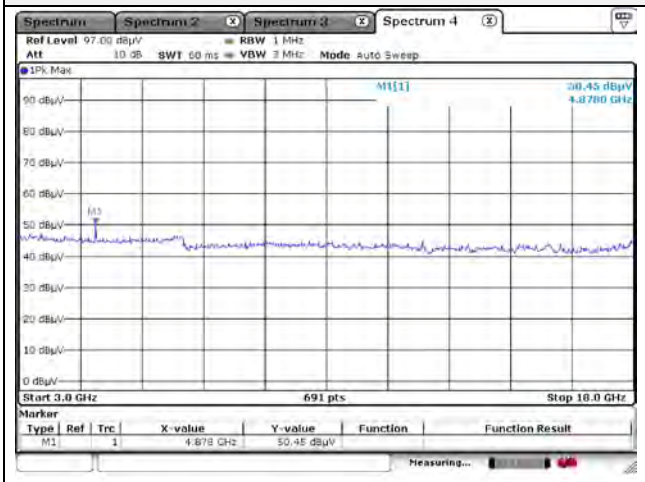
**Horizontal // Peak for 1 ㎓ to 3 ㎓**



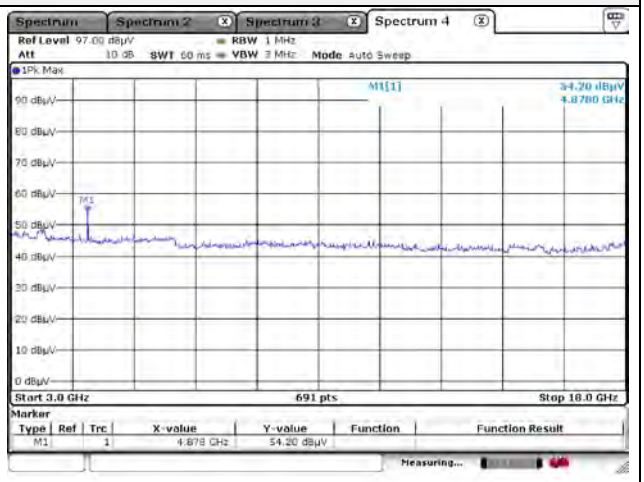

**Vertical // Peak for 1 ㎓ to 3 ㎓**




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




**Vertical // Peak for 3 ㎓ to 18 ㎓**




**Note.**

1. Average test would be performed if the peak result were greater than the average limit.

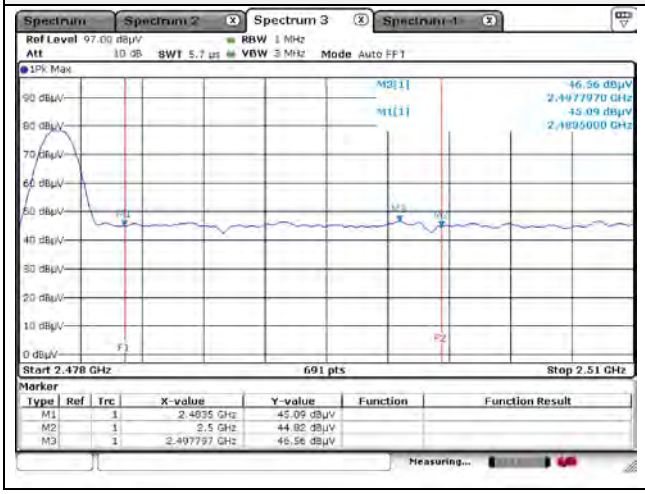
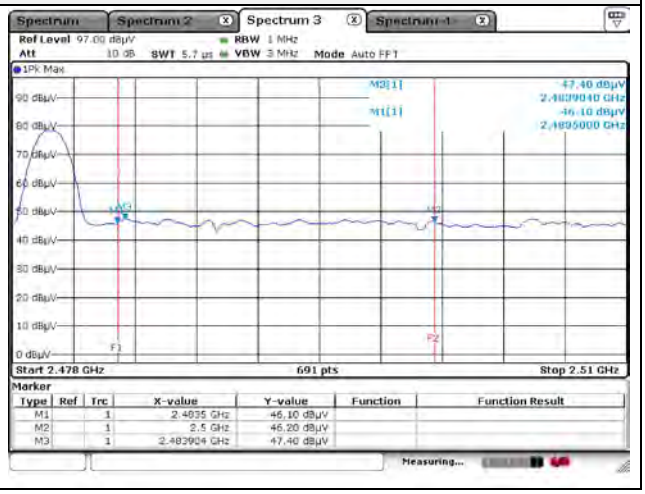
| | |
|---|---|
| Mode: | BDR |
| Transfer rate: | 1 Mbps |
| Distance of measurement: | 3 meter |
| Channel: | 78 |

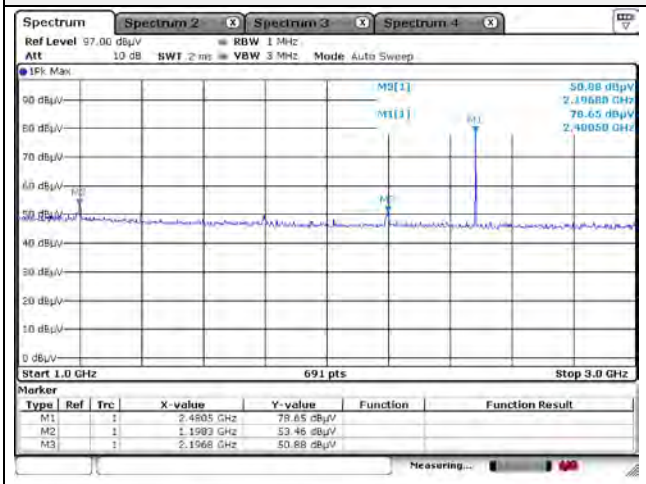
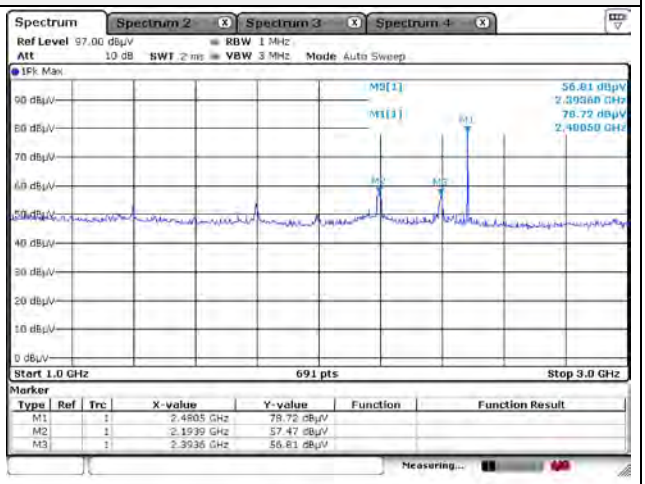
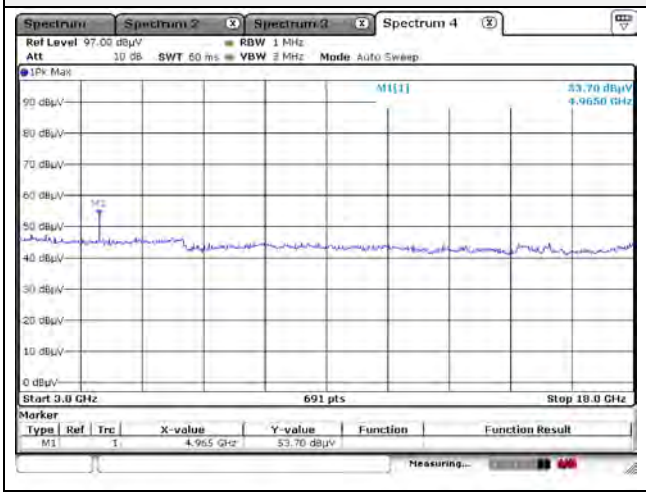
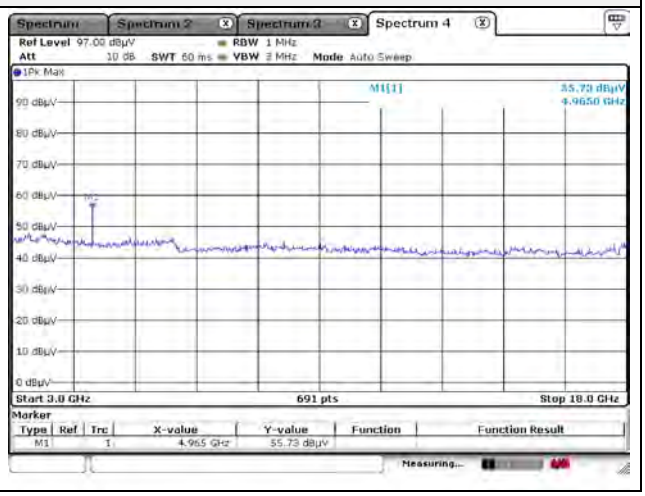
- **Spurious**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 198.30 | 53.46 | Peak | H | -10.11 | - | 43.35 | 74.00 | 30.65 |
| 2 196.80 | 50.88 | Peak | H | -3.60 | - | 47.28 | 74.00 | 26.72 |
| 2 193.90 | 57.47 | Peak | V | -3.61 | - | 53.86 | 74.00 | 20.14 |
| 2 393.60 | 56.81 | Peak | V | -2.75 | - | 54.06 | 74.00 | 19.94 |
| 2 393.60 | 56.81 | Average | V | -2.75 | -30.60 | 23.46 | 54.00 | 30.54 |
| 4 965.00 | 53.70 | Peak | H | 6.03 | - | 59.73 | 74.00 | 14.27 |
| 4 965.00 | 53.70 | Average | H | 6.03 | -30.60 | 29.13 | 54.00 | 24.87 |
| 4 965.00 | 55.73 | Peak | V | 6.03 | - | 61.76 | 74.00 | 12.24 |
| 4 965.00 | 55.73 | Average | V | 6.03 | -30.60 | 31.10 | 54.00 | 22.90 |

- **Band edge**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2 497.80 | 46.56 | Peak | H | -2.34 | - | 44.22 | 74.00 | 29.78 |
| 2 483.90 | 47.40 | Peak | V | -2.40 | - | 45.00 | 74.00 | 29.00 |

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

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

**Note.**

1. Average test would be performed if the peak result were greater than the average limit.

| | |
|---|---|
| Mode: | EDR |
| Transfer rate: | 3 Mbps(Worst case) |
| Distance of measurement: | 3 meter |
| Channel: | 00 |

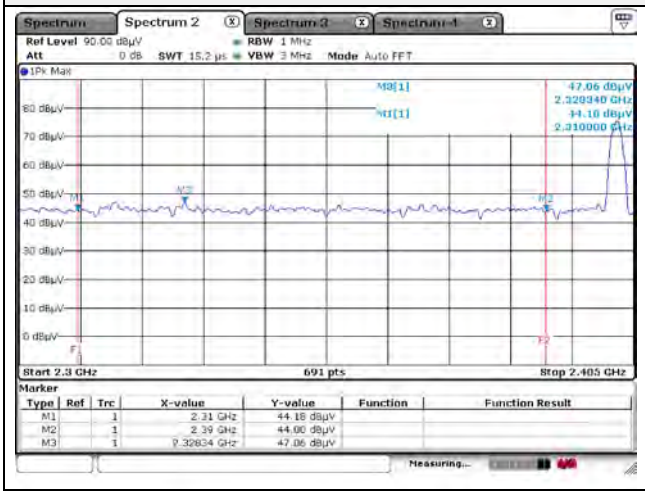
- **Spurious**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 201.20 | 53.65 | Peak | H | -10.09 | - | 43.56 | 74.00 | 30.44 |
| 1 736.60 | 52.25 | Peak | H | -6.58 | - | 45.67 | 74.00 | 28.33 |
| 2 196.80 | 50.94 | Peak | H | -3.60 | - | 47.34 | 74.00 | 26.66 |
| 2 193.90 | 57.20 | Peak | V | -3.61 | - | 53.59 | 74.00 | 20.41 |
| 1 797.40 | 53.98 | Peak | V | -6.11 | - | 47.87 | 74.00 | 26.13 |
| 4 813.00 | 47.13 | Peak | H | 4.92 | - | 52.05 | 74.00 | 21.95 |
| 4 813.00 | 49.45 | Peak | V | 4.92 | - | 54.37 | 74.00 | 19.63 |
| 4 813.00 | 49.45 | Average | V | 4.92 | -30.60 | 23.77 | 54.00 | 30.23 |

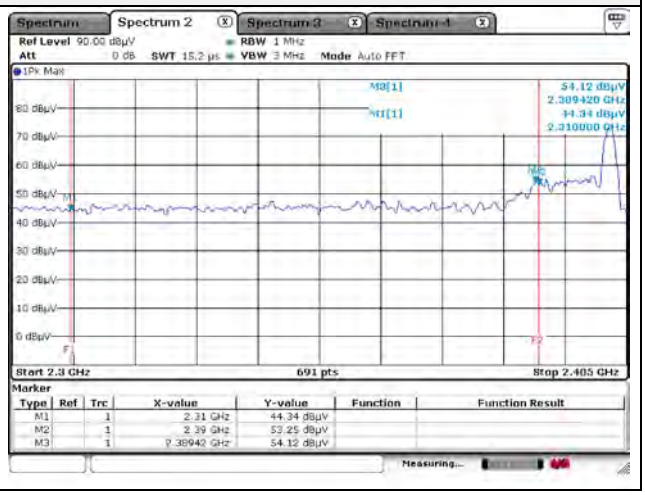
- **Band edge**

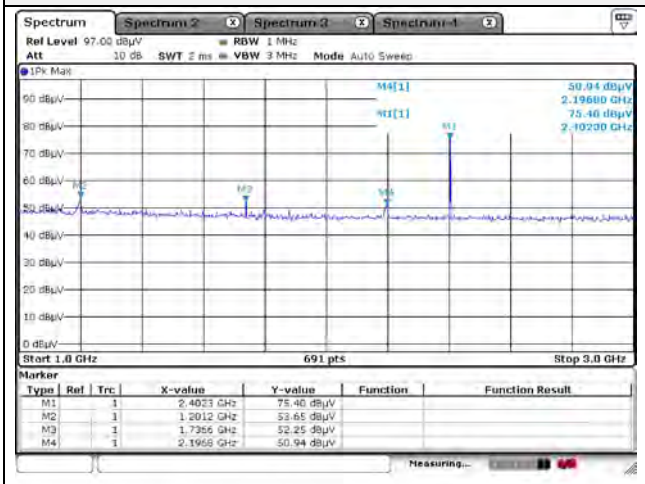
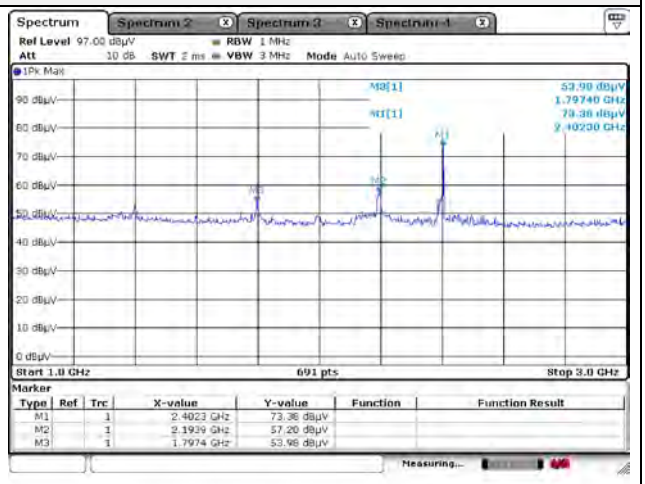
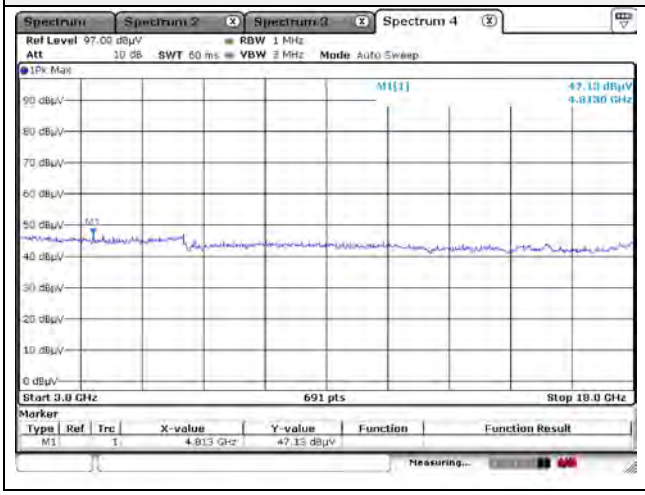
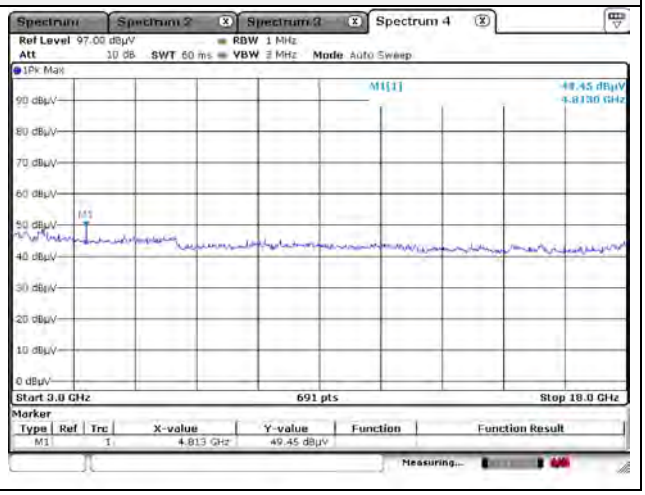
| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2 328.34 | 47.06 | Peak | H | -3.03 | - | 44.03 | 74.00 | 29.97 |
| 2 389.42 | 54.12 | Peak | V | -2.77 | - | 51.35 | 74.00 | 22.65 |

**Restricted band // Horizontal // Peak**




**Restricted band // Vertical // Peak**



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

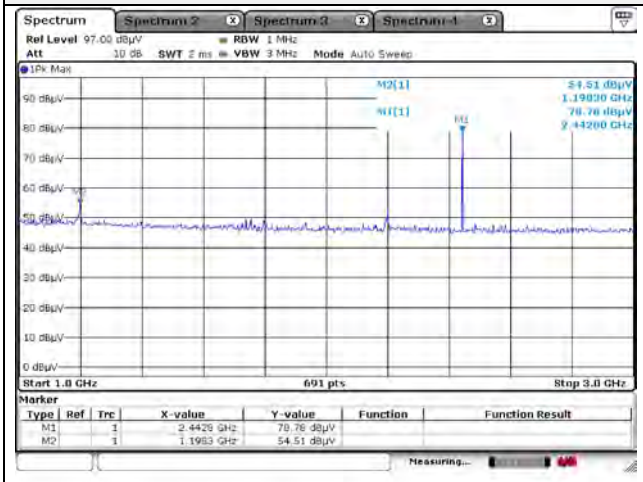
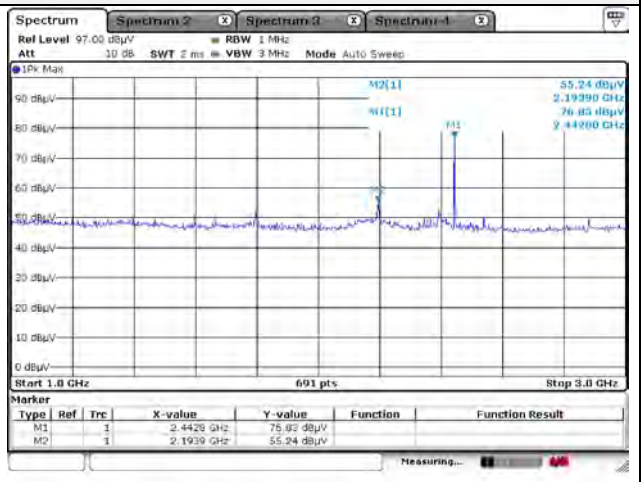
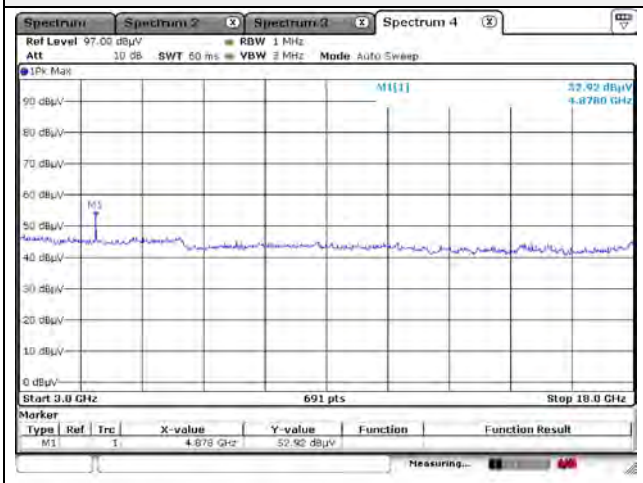
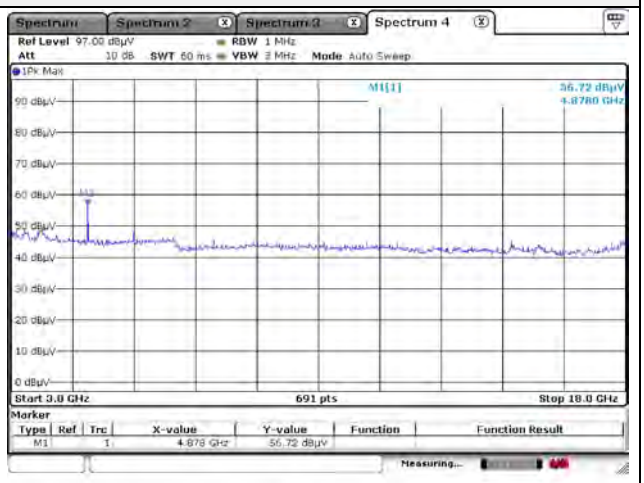
**Note.**

1. Average test would be performed if the peak result were greater than the average limit.

| | |
|---|---|
| Mode: | EDR |
| Transfer rate: | 3 Mbps(Worst case) |
| Distance of measurement: | 3 meter |
| Channel: | 40 |

- **Spurious**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 198.30 | 54.51 | Peak | H | -10.11 | - | 44.40 | 74.00 | 29.60 |
| 2 193.90 | 55.24 | Peak | V | -3.61 | - | 51.63 | 74.00 | 22.37 |
| 4 878.00 | 52.92 | Peak | H | 5.39 | - | 58.31 | 74.00 | 15.69 |
| 4 878.00 | 52.92 | Average | H | 5.39 | -30.60 | 27.71 | 54.00 | 26.29 |
| 4 878.00 | 56.72 | Peak | V | 5.39 | - | 62.11 | 74.00 | 11.89 |
| 4 878.00 | 56.72 | Average | V | 5.39 | -30.60 | 31.51 | 54.00 | 22.49 |

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

**Note.**

1. Average test would be performed if the peak result were greater than the average limit.

| | |
|---|---|
| Mode: | EDR |
| Transfer rate: | 3 Mbps(Worst case) |
| Distance of measurement: | 3 meter |
| Channel: | 78 |

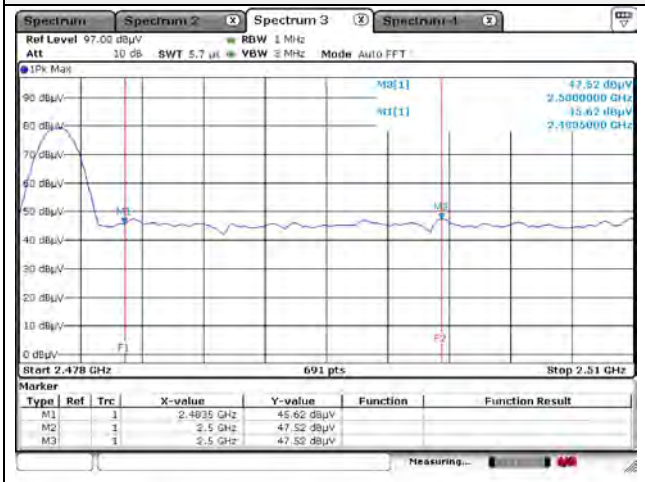
- **Spurious**

| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1 198.30 | 53.05 | Peak | H | -10.11 | - | 42.94 | 74.00 | 31.06 |
| 1 924.70 | 51.63 | Peak | H | -5.05 | - | 46.58 | 74.00 | 27.42 |
| 2 196.80 | 56.15 | Peak | H | -3.60 | - | 52.55 | 74.00 | 21.45 |
| 2 396.50 | 55.70 | Peak | V | -2.74 | - | 52.96 | 74.00 | 21.04 |
| 4 965.00 | 55.19 | Peak | H | 6.03 | - | 61.22 | 74.00 | 12.78 |
| 4 965.00 | 55.19 | Average | H | 6.03 | -30.60 | 30.62 | 54.00 | 23.38 |
| 4 965.00 | 58.25 | Peak | V | 6.03 | - | 64.28 | 74.00 | 9.72 |
| 4 965.00 | 58.25 | Average | V | 6.03 | -30.60 | 33.68 | 54.00 | 20.32 |

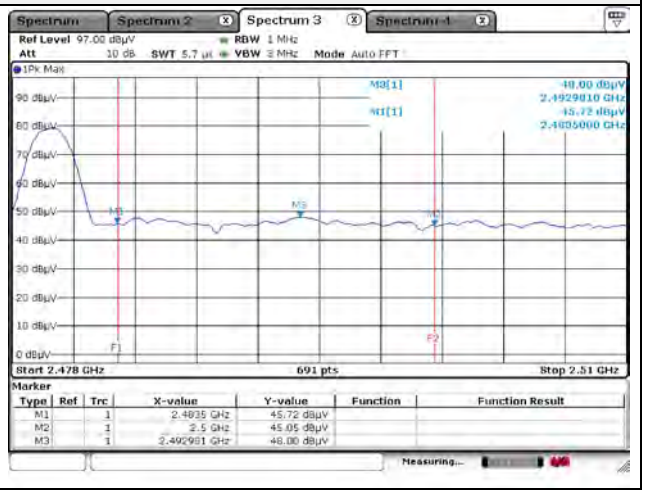
- **Band edge**

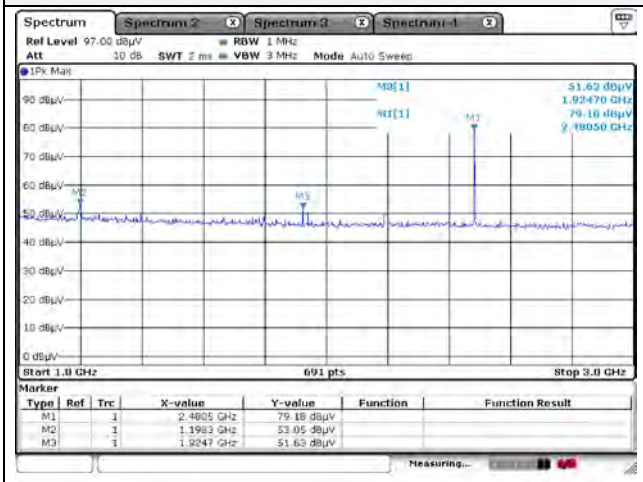
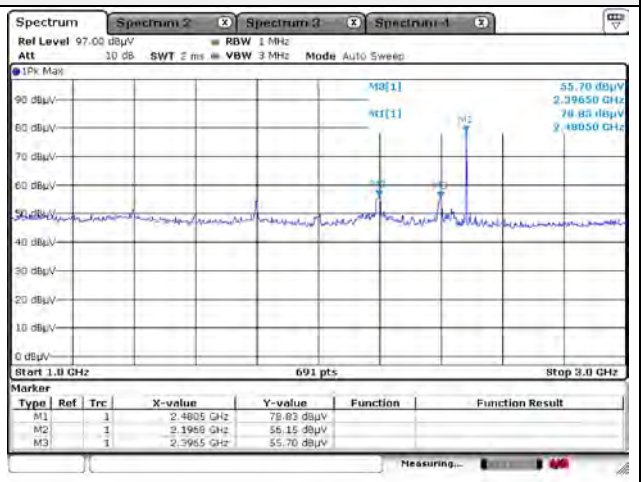
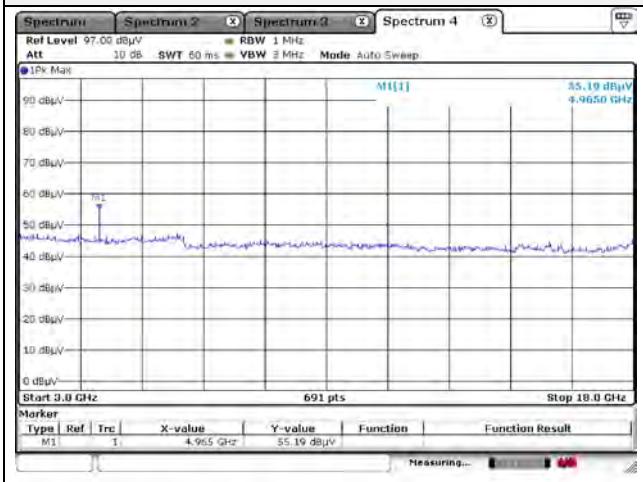
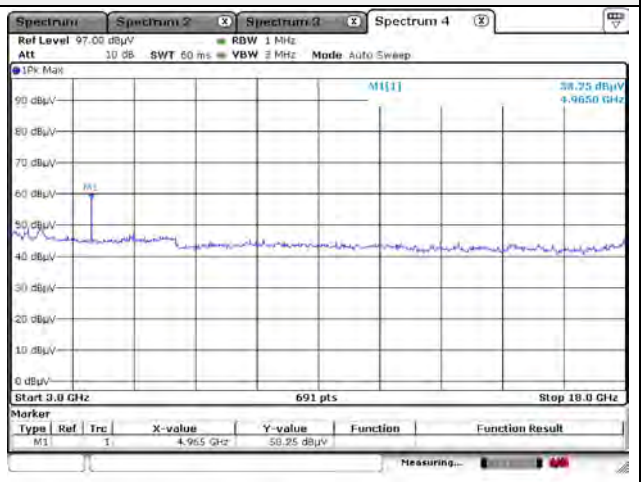
| Frequency (㎒) | Level (dB㎶) | Detect mode | Ant. Pol. (H/V) | CF (dB) | DCF (dB) | Field strength (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2 500.00 | 47.52 | Peak | H | -2.34 | - | 45.19 | 74.00 | 28.82 |
| 2 492.98 | 48.00 | Peak | V | -2.36 | - | 45.64 | 74.00 | 28.36 |

**Restricted band // Horizontal // Peak**




**Restricted band // Vertical // Peak**



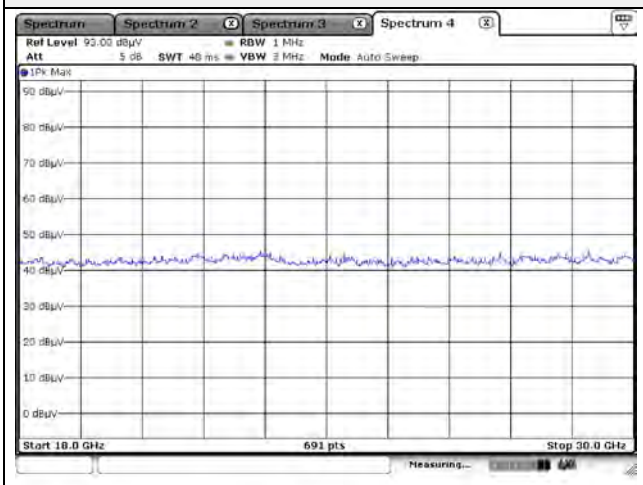
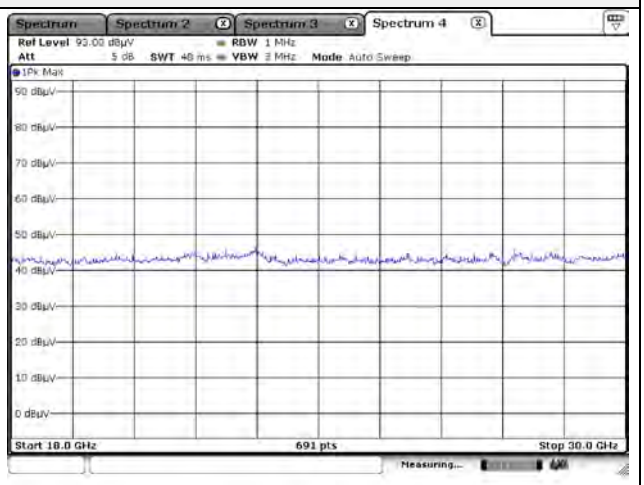
| Horizontal // Peak for 1 ㎓ to 3 ㎓ | Vertical // Peak for 1 ㎓ to 3 ㎓ |
|---|---|
|  |  |
| **Horizontal // Peak for 3 ㎓ to 18 ㎓** | **Vertical // Peak for 3 ㎓ to 18 ㎓** |
|  |  |

**Note.**

1. Average test would be performed if the peak result were greater than the average limit.

**Test results (18 ㎓ to 30 ㎓) – Worst case**

| | |
|---|---|
| Mode: | EDR |
| Transfer rate: | 3 Mbps |
| Distance of measurement: | 3 meter |
| Channel: | 40(Worst case) |

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



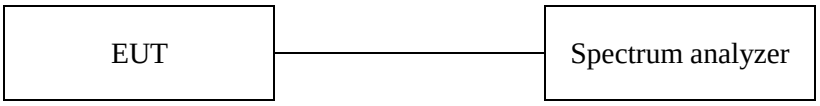
**Note.**

1. No spurious emission were detected above 18 ㎓.

## 3.7. Conducted band edge and out of band emissions

**Test procedure**
ANSI C63.10-2013 - Section 7.8.4 and 7.8.8

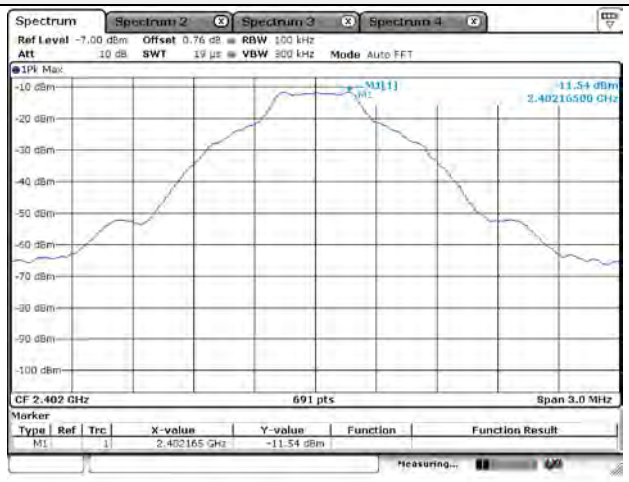
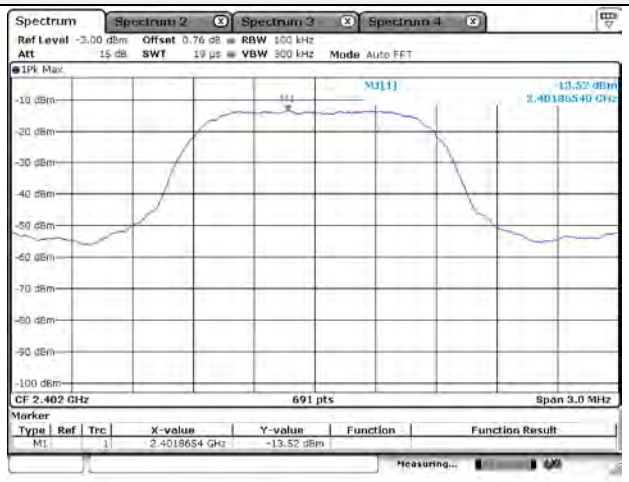
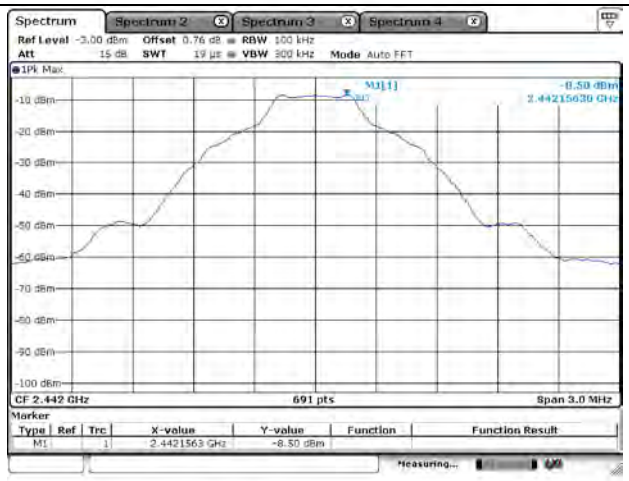
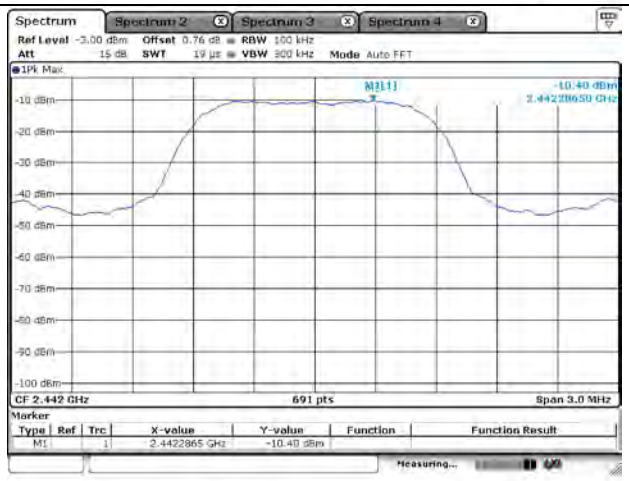
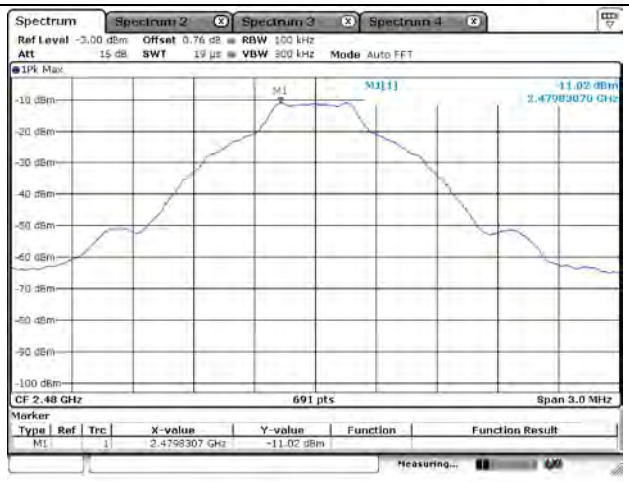
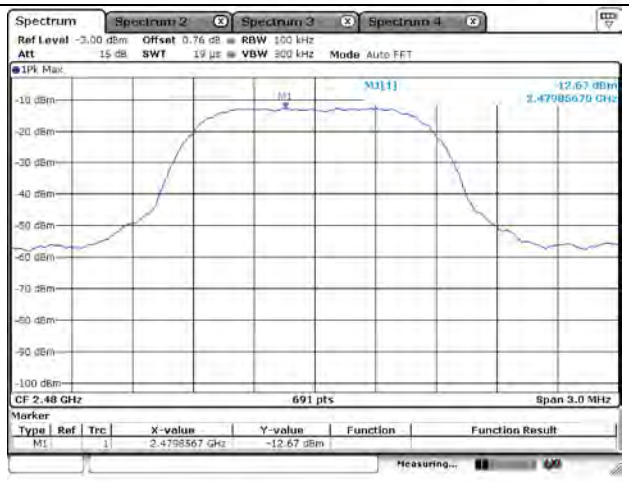
**Test setup**

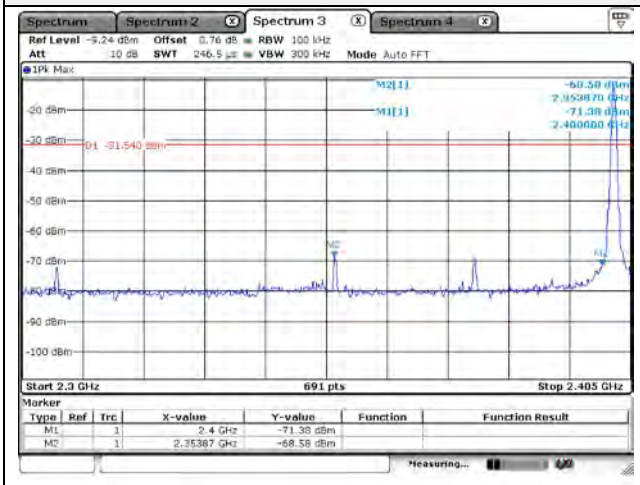
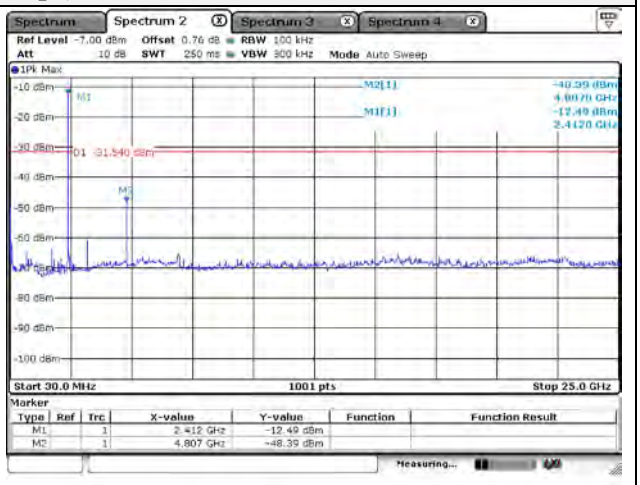
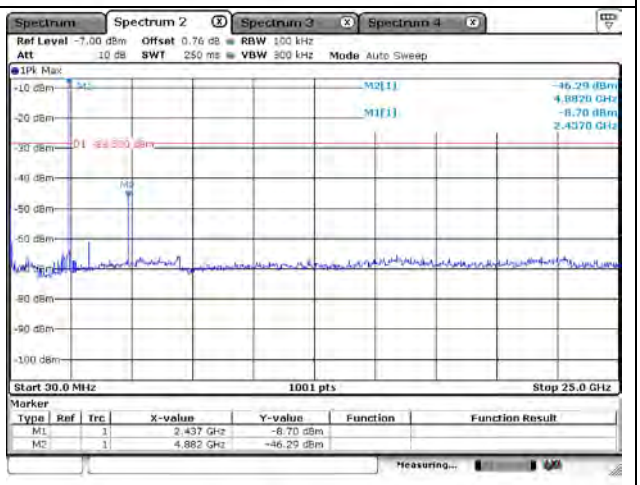
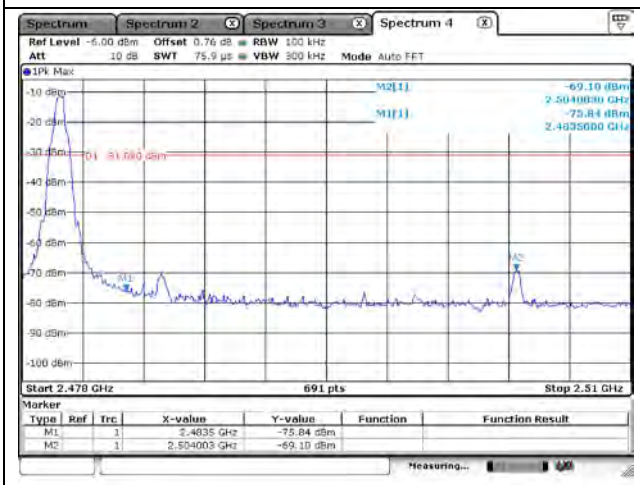
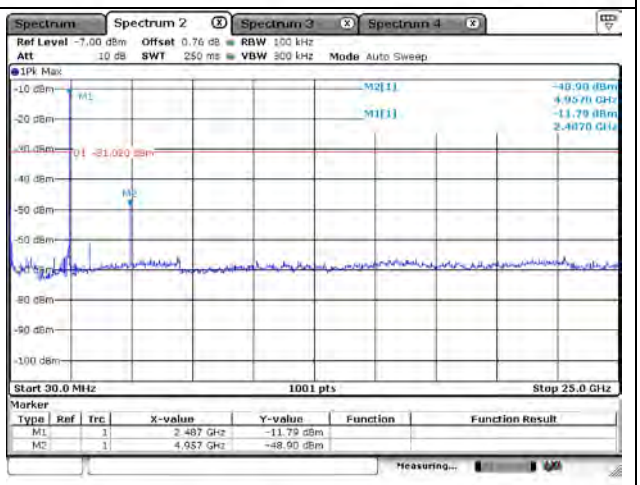


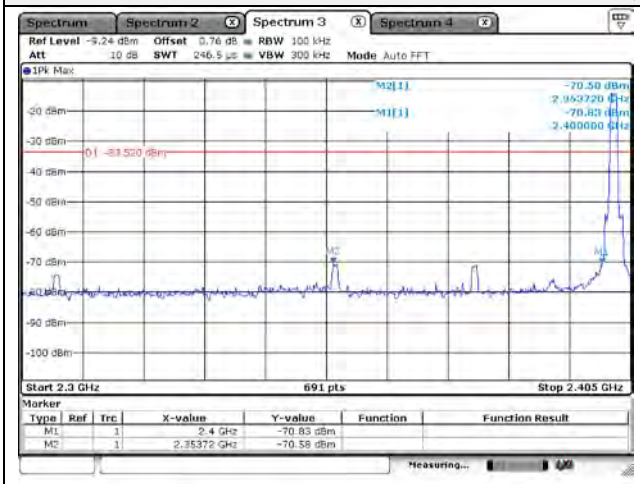
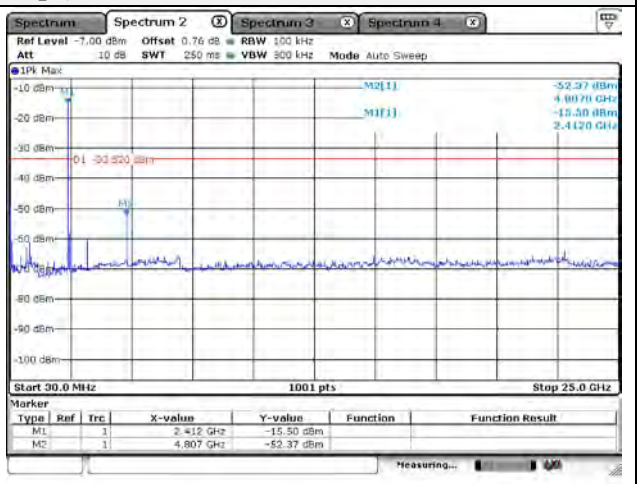
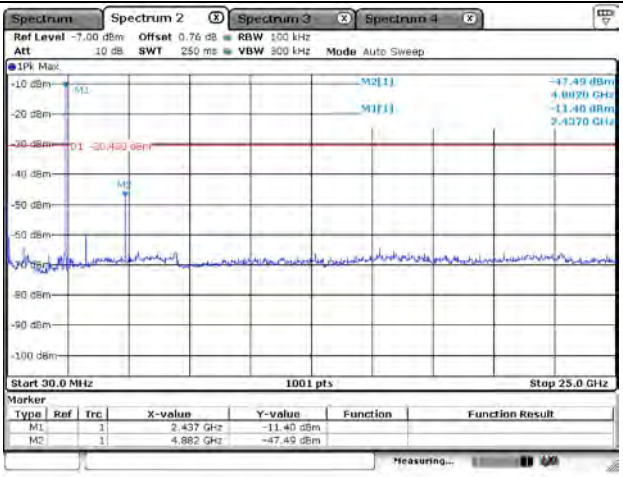
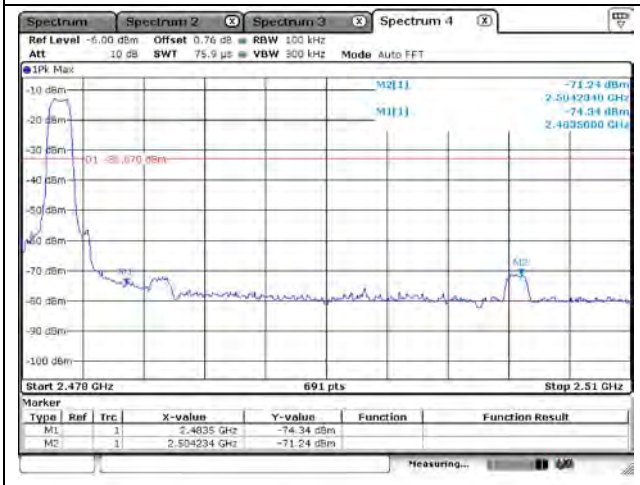
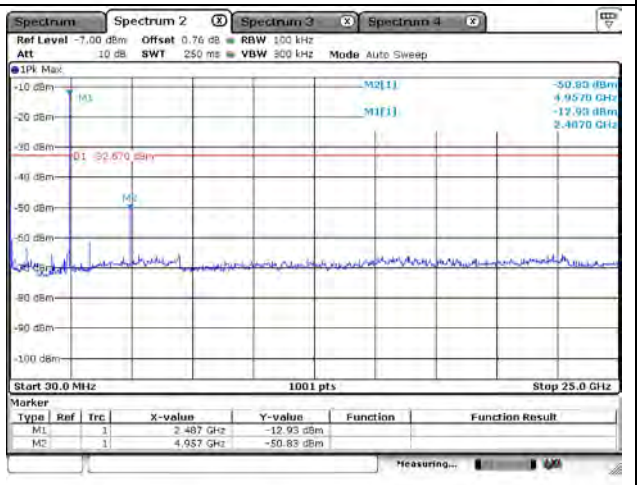

**Test setting**
1. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions(e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
2. RBW = 100 ㎑
3. VBW ≥ 300 ㎑
4. Detector = Peak
5. Number of sweep points ≥ 2 × Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to 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))

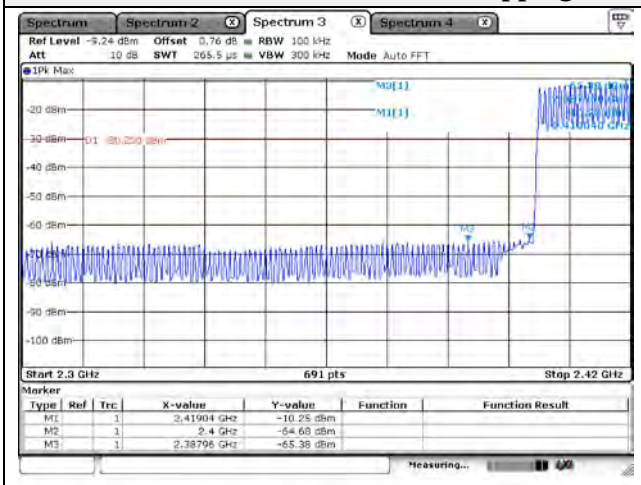
## Test results

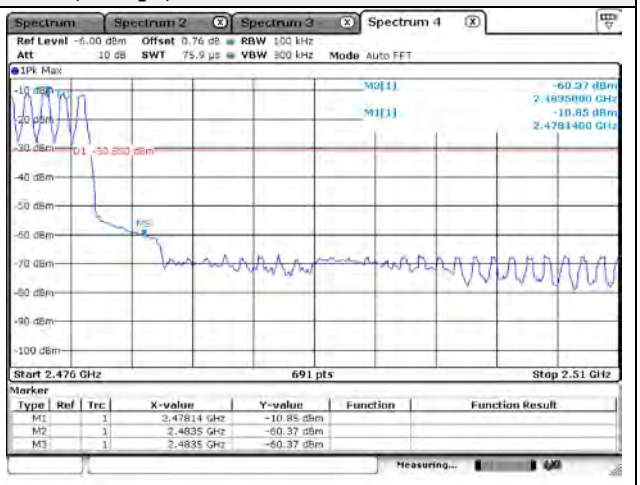
| CH | Reference level | |
|---|---|---|
| | BDR(1Mbps) | EDR(3Mbps) |
| 00 |  |  |
| 40 |  |  |
| 78 |  |  |

| BDR(1Mbps) | |
|---|---|
|  |  |
| Blank |  |
|  |  |

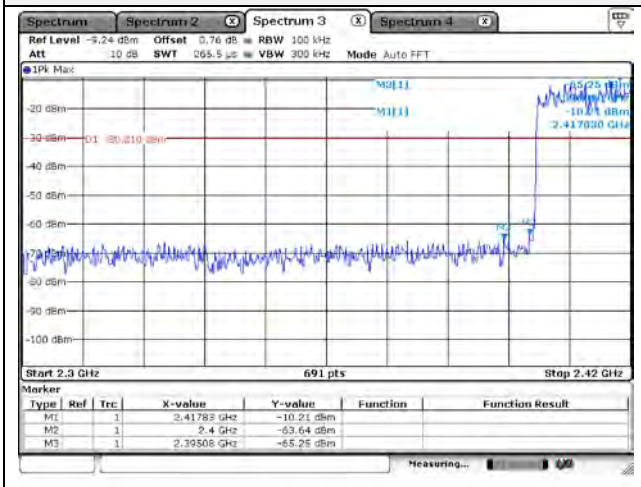
| EDR(3Mbps) | |
|---|---|
|  |  |
| Blank |  |
|  |  |

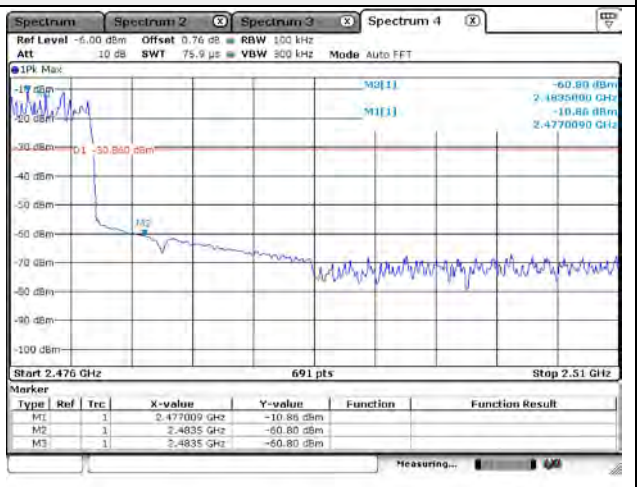
## Hopping mode_BDR(1Mbps)



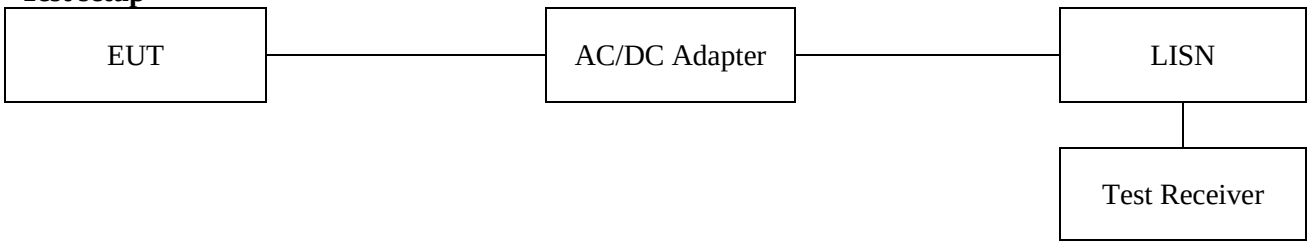

## Hopping mode_EDR(3Mbps)



## 3.8. AC conducted emissions

**Test setup**




**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.

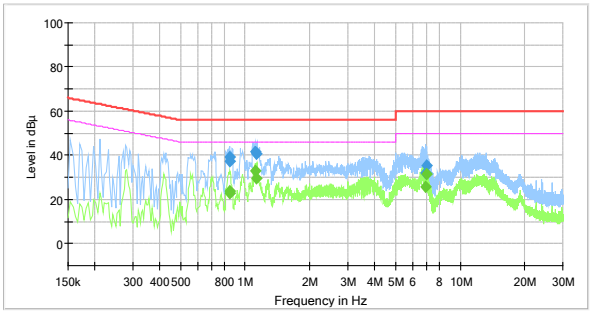
| Frequency of Emission (㎒) | Conducted limit (dB㎶/m) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 – 0.50 | 66 - 56* | 56 - 46* |
| 0.50 – 5.00 | 56 | 46 |
| 5.00 – 30.0 | 60 | 50 |

**Note:**

1. All AC line conducted spurious emission are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and the appropriate frequencies. All data rates and modes were investigated for conducted spurious emission. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.
3. Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).

## Test results

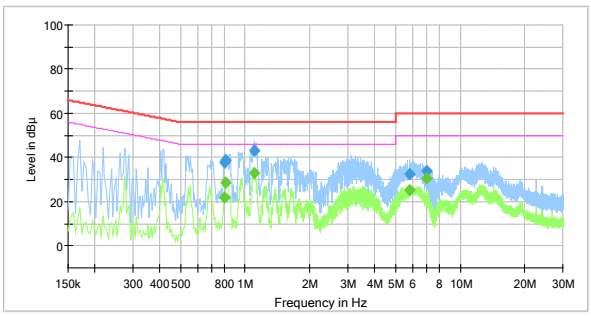
### Hot Line




**Final_Result**

| Frequency (MHz) | QuasiPeak (dBµV) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.846000 | --- | 23.80 | 46.00 | 22.20 | 1000.0 | 9.000 | L1 | 20.3 |
| 0.846000 | 37.10 | --- | 56.00 | 18.90 | 1000.0 | 9.000 | L1 | 20.3 |
| 0.850000 | --- | 22.66 | 46.00 | 23.34 | 1000.0 | 9.000 | L1 | 20.3 |
| 0.850000 | 39.15 | --- | 56.00 | 16.85 | 1000.0 | 9.000 | L1 | 20.3 |
| 1.110000 | --- | 33.07 | 46.00 | 12.93 | 1000.0 | 9.000 | L1 | 20.3 |
| 1.110000 | 41.77 | --- | 56.00 | 14.23 | 1000.0 | 9.000 | L1 | 20.3 |
| 1.122000 | --- | 29.47 | 46.00 | 16.53 | 1000.0 | 9.000 | L1 | 20.3 |
| 1.122000 | 40.48 | --- | 56.00 | 15.52 | 1000.0 | 9.000 | L1 | 20.3 |
| 6.902000 | --- | 25.47 | 50.00 | 24.53 | 1000.0 | 9.000 | L1 | 20.0 |
| 6.902000 | 31.74 | --- | 60.00 | 28.26 | 1000.0 | 9.000 | L1 | 20.0 |
| 6.986000 | --- | 31.41 | 50.00 | 18.59 | 1000.0 | 9.000 | L1 | 20.0 |
| 6.986000 | 35.33 | --- | 60.00 | 24.67 | 1000.0 | 9.000 | L1 | 20.0 |

### Neutral Line




**Final_Result**

| Frequency (MHz) | QuasiPeak (dBµV) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.798000 | --- | 21.91 | 46.00 | 24.09 | 1000.0 | 9.000 | N | 20.2 |
| 0.798000 | 37.65 | --- | 56.00 | 18.35 | 1000.0 | 9.000 | N | 20.2 |
| 0.814000 | --- | 28.83 | 46.00 | 17.17 | 1000.0 | 9.000 | N | 20.2 |
| 0.814000 | 38.81 | --- | 56.00 | 17.19 | 1000.0 | 9.000 | N | 20.2 |
| 1.106000 | --- | 32.92 | 46.00 | 13.08 | 1000.0 | 9.000 | N | 20.3 |
| 1.106000 | 43.12 | --- | 56.00 | 12.88 | 1000.0 | 9.000 | N | 20.3 |
| 5.822000 | --- | 24.98 | 50.00 | 25.02 | 1000.0 | 9.000 | N | 20.0 |
| 5.822000 | 32.22 | --- | 60.00 | 27.78 | 1000.0 | 9.000 | N | 20.0 |
| 6.982000 | --- | 30.44 | 50.00 | 19.56 | 1000.0 | 9.000 | N | 20.0 |
| 6.982000 | 33.85 | --- | 60.00 | 26.15 | 1000.0 | 9.000 | N | 20.0 |

## Appendix A. Measurement equipment

| Equipment | Manufacturer | Model | Serial No. | Calibration interval | Calibration due. |
|---|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSV40 | 101002 | 1 year | 2021.07.02 |
| 8360B Series Swept Signal Generator | HP | 83630B | 3844A00786 | 1 year | 2022.01.15 |
| DC POWER Supply | AGILENT | 6632B | MY43004114 | 1 year | 2021.06.22 |
| Power Meter | Anritsu | ML2495A | 1438001 | 1 year | 2022.01.14 |
| Pulse Power Sensor | Anritsu | MA2411B | 1339205 | 1 year | 2022.01.14 |
| Loop Antenna | Schwarzbeck | FMZB1513 | 225 | 2 years | 2021.02.15 |
| Trilog-broadband antenna | SCHWARZBECK | VULB 9163 | 715 | 2 years | 2022.12.08 |
| Horn Antenna | A.H | SAS-571 | 414 | 2 years | 2021.02.11 |
| Horn Antenna | SCHWARZBECK | BBHA9170 | BBHA 9170550 | 2 years | 2021.02.19 |
| Preamplifier | R&S | SCU01 | 100603 | 1 year | 2021.11.25 |
| Preamplifier | AGILENT | 8449B | 3008A01742 | 1 year | 2021.12.29 |
| EMI Test Receiver | R&S | ESU26 | 100551 | 1 year | 2021.04.01 |
| EMI TEST RECEIVER | R & S | ESR3 | 101781 | 1 year | 2021.12.29 |

### Peripheral devices

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