# FCC Test Report

| | | |
|---|---|---|
| **Client Name** | : | **Excelsecu Data Technology Co., Ltd.** |
| **Client Address** | : | **Unit 701-708, South 7/F, SDGI Building A, No.2 Kefeng Rd., Nanshan District, Shenzhen, Guangdong, 518057, China** |
| **Product Name** | : | **1D 2D Wireless Barcode Scanner** |
| **Report Date** | : | **Feb. 16, 2023** |

**Shenzhen Anbotek Compliance Laboratory Limited**

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# TEST REPORT

| | | |
|---|---|---|
| Applicant | : | Excelsecu Data Technology Co., Ltd. |
| Manufacturer | : | Excelsecu Data Technology Co., Ltd. |
| Product Name | : | 1D 2D Wireless Barcode Scanner |
| Model No. | : | ESCS-W30 |
| Trade Mark | : | excelsecu |
| Rating(s) | : | Input: 5V⎓ (with DC 3.7V, 2000mAh battery inside) |
| **Test Standard(s)** | **:** | **FCC Part15 Subpart C, Section 15.247** |
| **Test Method(s)** | **:** | **ANSI C63.10: 2020** |

The device described above is tested by Shenzhen Anbotek Compliance Laboratory Limited to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen Anbotek Compliance Laboratory Limited is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the FCC Part 15 Subpart C requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen Anbotek Compliance Laboratory Limited.

| | |
|---|---|
| Date of receipt | Dec. 19, 2022 |
| Date of Test | Dec. 19, 2022 ~ Jan. 16, 2023 |
| Prepared by | Nian xiu Chen<br>(Nianxiu Chen) |
| Approved & Authorized Signer | Kingkong Jin<br>(Kingkong Jin) |

# Revision History

| Report Version | Description | Issued Date |
|---|---|---|
| R00 | Original Issue. | Feb. 16, 2023 |
| | | |
| | | |

# 1. General Information

## 1.1. Client Information

| | | |
|---|---|---|
| Applicant | : | Excelsecu Data Technology Co., Ltd. |
| Address | : | Unit 701-708, South 7/F, SDGI Building A, No.2 Kefeng Rd., Nanshan District, Shenzhen, Guangdong, 518057, China |
| Manufacturer | : | Excelsecu Data Technology Co., Ltd. |
| Address | : | Unit 701-708, South 7/F, SDGI Building A, No.2 Kefeng Rd., Nanshan District, Shenzhen, Guangdong, 518057, China |
| Factory | : | Shenzhen Excelsecu Data Technology Co., Ltd Baoan Branch |
| Address | : | 1st to 3rd Floor, Building 28, Shancheng Industrial Zone, Shixin Community, Langxin Community, Shiyan Street, Baoan District, Shenzhen, P.R.China |

## 1.2. Description of Device (EUT)

| | | |
|---|---|---|
| Product Name | : | 1D 2D Wireless Barcode Scanner |
| Model No. | : | ESCS-W30 |
| Trade Mark | : | excelsecu |
| Test Power Supply | : | AC 120V, 60Hz for adapter/ DC 3.7V battery inside |
| Test Sample No. | : | 1-2-1(Normal Sample), 1-2-2(Engineering Sample) |
| Adapter | : | N/A |
| **RF Specification** | | |
| Operation Mode | : | ☒ BT BDR ☒ BT EDR |
| Operation Frequency | : | 2402~2480MHz |
| Number of Channel | : | 79 Channels |
| Modulation Type | : | GFSK, π/4-DQPSK, 8-DPSK |
| Antenna Type | : | PCB Antenna |
| Antenna Gain(Peak) | : | -0.24 dBi (Provided by customer) |
| **Remark:** 1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual. | | |

## 1.3. Auxiliary Equipment Used During Test

| Description | Rating(s) |
|---|---|
| Adapter | Model: MDY-11-EX<br>Input: 100-240V~50/60Hz, 0.7A<br>Output: 5V⎓3A/ 9V⎓3A/ 12V⎓2.25A/ 20V⎓1.35A/ 11V⎓3A Max |
| Notebook | Manufacturer:HP<br>Model: HP g14<br>Input: 19.5V/3.33A<br>CMIIT ID:5CG50336XJ |

## 1.4. Description of Test Configuration

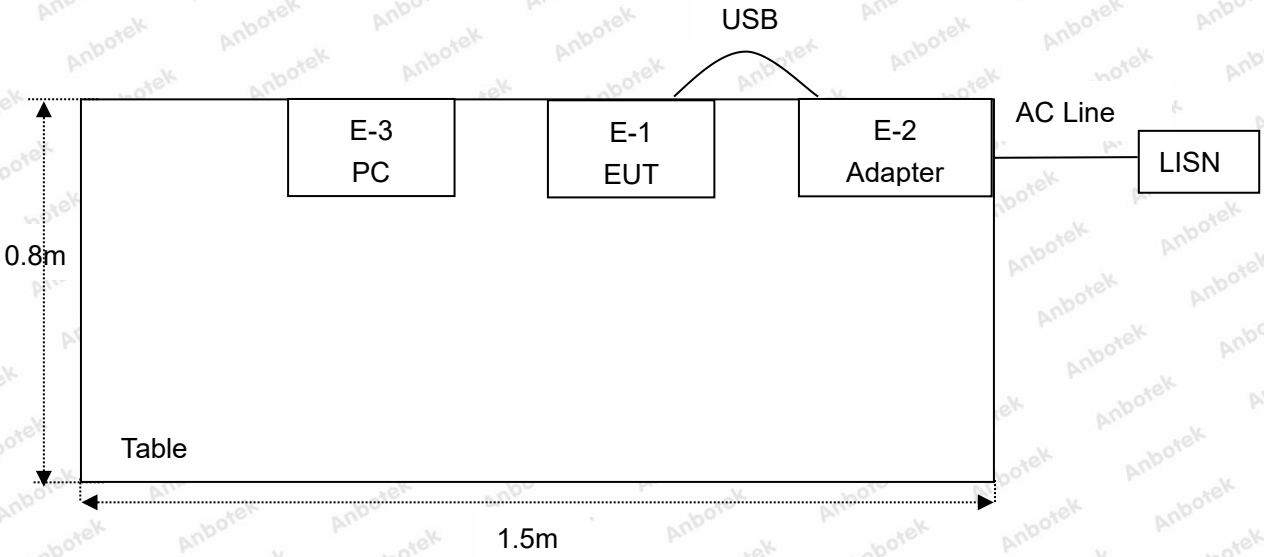
| Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|---|---|---|---|---|---|---|---|---|---|
| **00** | **2402** | 17 | 2419 | 34 | 2436 | 51 | 2453 | 68 | 2470 |
| 01 | 2403 | 18 | 2420 | 35 | 2437 | 52 | 2454 | 69 | 2471 |
| 02 | 2404 | 19 | 2421 | 36 | 2438 | 53 | 2455 | 70 | 2472 |
| 03 | 2405 | 20 | 2422 | 37 | 2439 | 54 | 2456 | 71 | 2473 |
| 04 | 2406 | 21 | 2423 | 38 | 2440 | 55 | 2457 | 72 | 2474 |
| 05 | 2407 | 22 | 2424 | **39** | **2441** | 56 | 2458 | 73 | 2475 |
| 06 | 2408 | 23 | 2425 | 40 | 2442 | 57 | 2459 | 74 | 2476 |
| 07 | 2409 | 24 | 2426 | 41 | 2443 | 58 | 2460 | 75 | 2477 |
| 08 | 2410 | 25 | 2427 | 42 | 2444 | 59 | 2461 | 76 | 2478 |
| 09 | 2411 | 26 | 2428 | 43 | 2445 | 60 | 2462 | 77 | 2479 |
| 10 | 2412 | 27 | 2429 | 44 | 2446 | 61 | 2463 | **78** | **2480** |
| 11 | 2413 | 28 | 2430 | 45 | 2447 | 62 | 2464 | | |
| 12 | 2414 | 29 | 2431 | 46 | 2448 | 63 | 2465 | | |
| 13 | 2415 | 30 | 2432 | 47 | 2449 | 64 | 2466 | | |
| 14 | 2416 | 31 | 2433 | 48 | 2450 | 65 | 2467 | | |
| 15 | 2417 | 32 | 2434 | 49 | 2451 | 66 | 2468 | | |
| 16 | 2418 | 33 | 2435 | 50 | 2452 | 67 | 2469 | | |

Note:

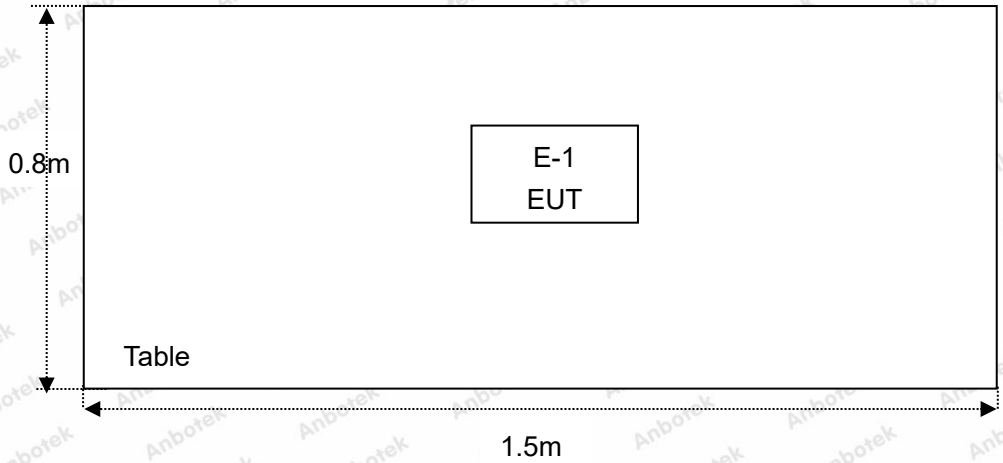
1. The engineering test program was provided and the EUT was programmed to be in continuously transmitting mode.
2. EUT was tested with channel 0, 39 and 78.

## 1.5. Description Of Test Setup

CE




RE



## 1.6. Test Equipment List

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | L.I.S.N. Artificial Mains Network | Rohde & Schwarz | ENV216 | 100055 | Oct. 23, 2022 | 1 Year |
| 2. | Three Phase V-type Artificial Power Network | CYBERTEK | EM5040DT | E215040DT001 | Jul. 05, 2022 | 1 Year |
| 3. | EMI Test Receiver | Rohde & Schwarz | ESCI | 100627 | Oct. 13, 2022 | 1 Year |
| 4. | EMI Test Receiver | Rohde & Schwarz | ESR26 | 101481 | Oct. 23, 2022 | 1 Year |
| 5. | RF Switching Unit | Compliance Direction | RSU-M2 | 38303 | Oct. 22, 2022 | 1 Year |
| 6. | MXA Spectrum Analysis | Agilent | N9020A | MY51170037 | Oct. 13, 2022 | 1 Year |
| 7. | EMI Preamplifier | SKET Electronic | LNPA-0118G-45 | SKET-PA-002 | Oct. 13, 2022 | 1 Year |
| 8. | Double Ridged Horn Antenna | SCHWARZBECK | BBHA 9120D | 02555 | Oct. 16, 2022 | 3 Year |
| 9. | Bilog Broadband Antenna | Schwarzbeck | VULB9163 | VULB 9163-289 | Oct. 23, 2022 | 1 Year |
| 10. | Loop Antenna | Schwarzbeck | FMZB1519B | 00053 | Oct. 23, 2022 | 1 Year |
| 11. | Horn Antenna | A-INFO | LB-180400-KF | J211060628 | Oct. 23, 2022 | 1 Year |
| 12. | Pre-amplifier | SONOMA | 310N | 186860 | Oct. 23, 2022 | 1 Year |
| 13. | EMI Test Software EZ-EMC | SHURPLE | N/A | N/A | N/A | N/A |
| 14. | MXA Spectrum Analysis | KEYSIGHT | N9020A | MY53280032 | Oct. 13, 2022 | 1 Year |
| 15. | MXG RF Vector Signal Generator | Agilent | N5182A | MY48180656 | Oct. 13, 2022 | 1 Year |
| 16. | Signal Generator | Agilent | E4421B | MY41000743 | Oct. 13, 2022 | 1 Year |
| 17. | DC Power Supply | IVYTECH | IV3605 | 1804D360510 | Oct. 22, 2022 | 1 Year |
| 18. | Constant Temperature Humidity Chamber | ZHONGJIAN | ZJ-KHWS80B | N/A | Oct. 19, 2022 | 1 Year |

## 1.7. Measurement Uncertainty

| | | |
|---|---|---|
| Radiation Uncertainty | : | Ur = 3.9 dB (Horizontal) |
| | | Ur = 3.8 dB (Vertical) |
| Conduction Uncertainty | : | Uc = 3.4 dB |

## 1.8. Description of Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

**FCC-Registration No.: 184111**

Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No. 184111.

**ISED-Registration No.: 8058A**

Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (ISED) Innovation, Science and Economic Development Canada. The acceptance letter from the ISED is maintained in our files. Registration 8058A.

**Test Location**

Shenzhen Anbotek Compliance Laboratory Limited.
1/F, Building D, Sogood Science and Technology Park, Sanwei community, Hangcheng Street, Bao'an District, Shenzhen, Guangdong, China.518102

## 2. Summary of Test Results

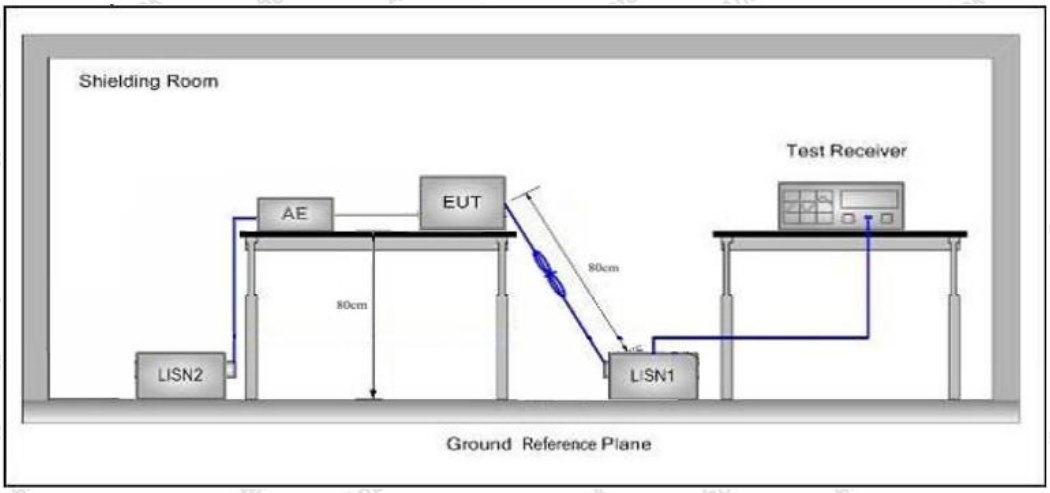
| Standard Section | Test Item | Result |
|---|---|---|
| 15.203/15.247(c) | Antenna Requirement | PASS |
| 15.207 | Conducted Emission | PASS |
| 15.205/15.209 | Spurious Emission | PASS |
| 15.247(b)(1) | Conducted Peak Output Power | PASS |
| 15.247(a)(1) | 20dB Occupied Bandwidth | PASS |
| 15.247(a)(1) | Carrier Frequencies Separation | PASS |
| 15.247(a)(1)(iii) | Number of Hopping Channel | PASS |
| 15.247(a)(1)(iii) | Dwell Time | PASS |
| 15.247(d) | Band Edge | PASS |
| **Remark:** “N/A” is an abbreviation for Not Applicable. | | |

# 3. Conducted Emission Test

## 3.1. Test Standard and Limit

| Test Standard | FCC Part15 Section 15.207 | | |
|---|---|---|---|
| Test Limit | Frequency | Maximum RF Line Voltage (dBuV) | |
| | | Quasi-peak Level | Average Level |
| | 150kHz~500kHz | 66 ~ 56 * | 56 ~ 46 * |
| | 500kHz~5MHz | 56 | 46 |
| | 5MHz~30MHz | 60 | 50 |
| **Remark:** (1) *Decreasing linearly with logarithm of the frequency.<br>(2) The lower limit shall apply at the transition frequency. | | | |

## 3.2. Test Setup




## 3.3. Test Procedure

The EUT system is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC line are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to FCC ANSI C63.10: 2020 on Conducted Emission Measurement.

The bandwidth of test receiver (ESCI) set at 9kHz.

The frequency range from 150kHz to 30MHz is checked.

## 3.4. Test Data

**PASS**

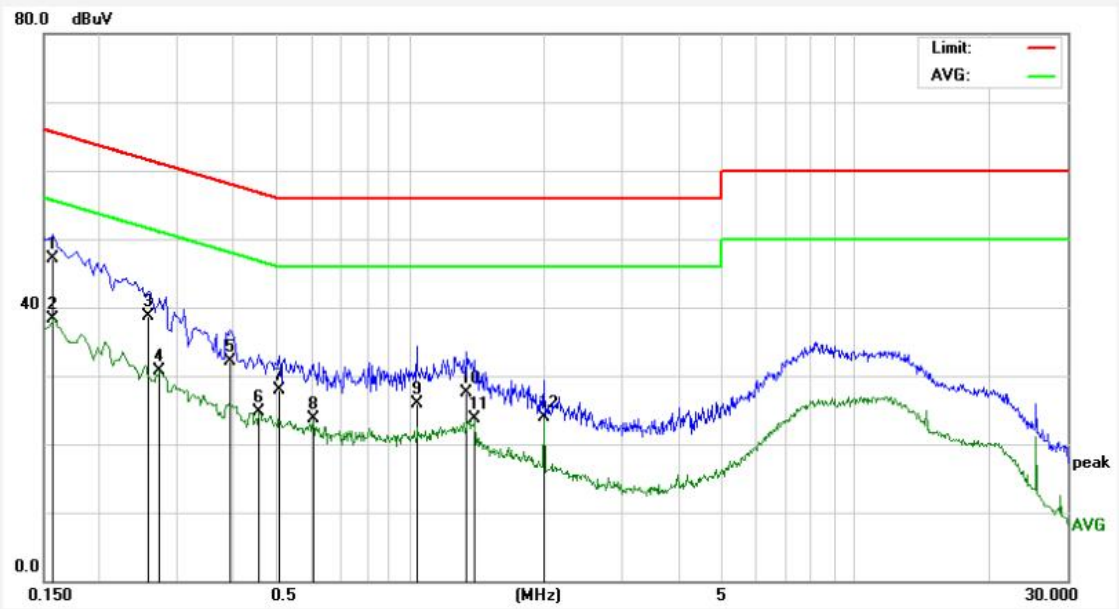
During the test, pre-scan all modes, only the worst case is recorded in the report.

AC conducted emission pre-test at both at AC 120V/60Hz and AC 240V/60Hz modes, recorded worst case AC 120V/60Hz.

Please to see the following pages.

**Conducted Emission Test Data**

| | |
|---|---|
| Test Site: | 1# Shielded Room |
| Operating Condition: | π/4-DQPSK (2402MHz) |
| Test Specification: | AC 120V, 60Hz for adapter |
| Comment: | Live Line |
| Temp.(℃)/Hum.(%RH): | 22.4℃/47%RH |

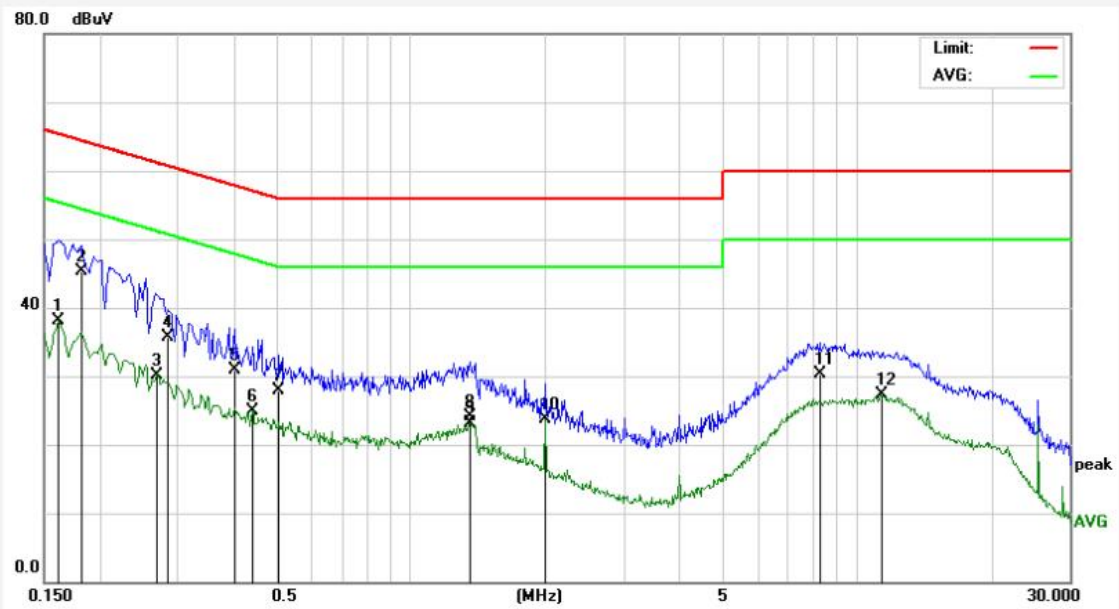



| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit (dBuV) | Over Limit (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.1580 | 37.23 | 9.83 | 47.06 | 65.56 | -18.50 | QP | |
| 2 | 0.1580 | 28.51 | 9.83 | 38.34 | 55.56 | -17.22 | AVG | |
| 3 | 0.2580 | 28.91 | 9.83 | 38.74 | 61.49 | -22.75 | QP | |
| 4 | 0.2740 | 20.86 | 9.83 | 30.69 | 50.99 | -20.30 | AVG | |
| 5 | 0.3940 | 22.28 | 9.81 | 32.09 | 57.98 | -25.89 | QP | |
| 6 | 0.4580 | 14.83 | 9.83 | 24.66 | 46.73 | -22.07 | AVG | |
| 7 | 0.5100 | 18.15 | 9.85 | 28.00 | 56.00 | -28.00 | QP | |
| 8 | 0.6060 | 13.81 | 9.86 | 23.67 | 46.00 | -22.33 | AVG | |
| 9 | 1.0339 | 16.08 | 9.85 | 25.93 | 56.00 | -30.07 | QP | |
| 10 | 1.3380 | 17.67 | 9.84 | 27.51 | 56.00 | -28.49 | QP | |
| 11 | 1.3980 | 13.86 | 9.84 | 23.70 | 46.00 | -22.30 | AVG | |
| 12 | 2.0020 | 14.04 | 9.83 | 23.87 | 46.00 | -22.13 | AVG | |

Note: Result = Reading + Factor Over Limit = Result - Limit

**Conducted Emission Test Data**

| | |
|---|---|
| Test Site: | 1# Shielded Room |
| Operating Condition: | π/4-DQPSK (2402MHz) |
| Test Specification: | AC 120V, 60Hz for adapter |
| Comment: | Neutral Line |
| Temp.(℃)/Hum.(%RH): | 22.4℃/47%RH |




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit (dBuV) | Over Limit (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.1620 | 28.30 | 9.83 | 38.13 | 55.36 | -17.23 | AVG | |
| 2 | 0.1819 | 35.44 | 9.83 | 45.27 | 64.39 | -19.12 | QP | |
| 3 | 0.2700 | 20.37 | 9.83 | 30.20 | 51.12 | -20.92 | AVG | |
| 4 | 0.2860 | 25.84 | 9.83 | 35.67 | 60.64 | -24.97 | QP | |
| 5 | 0.4020 | 21.16 | 9.81 | 30.97 | 57.81 | -26.84 | QP | |
| 6 | 0.4420 | 15.09 | 9.83 | 24.92 | 47.02 | -22.10 | AVG | |
| 7 | 0.5060 | 17.99 | 9.85 | 27.84 | 56.00 | -28.16 | QP | |
| 8 | 1.3540 | 14.33 | 9.84 | 24.17 | 56.00 | -31.83 | QP | |
| 9 | 1.3540 | 13.23 | 9.84 | 23.07 | 46.00 | -22.93 | AVG | |
| 10 | 1.9980 | 13.91 | 9.83 | 23.74 | 46.00 | -22.26 | AVG | |
| 11 | 8.2660 | 20.46 | 9.92 | 30.38 | 60.00 | -29.62 | QP | |
| 12 | 11.2980 | 17.31 | 10.03 | 27.34 | 50.00 | -22.66 | AVG | |

Note: Result = Reading + Factor Over Limit = Result - Limit

# 4. Radiation Spurious Emission and Band Edge

## 4.1. Test Standard and Limit

| Test Standard | FCC Part15 C Section 15.209 and 15.205 | | | | |
|---|---|---|---|---|---|
| Test Limit | Frequency (MHz) | Field strength (microvolt/meter) | Limit (dBuV/m) | Remark | Measurement distance (m) |
| | 0.009MHz~0.490MHz | 2400/F(kHz) | - | - | 300 |
| | 0.490MHz-1.705MHz | 24000/F(kHz) | - | - | 30 |
| | 1.705MHz-30MHz | 30 | - | - | 30 |
| | 30MHz~88MHz | 100 | 40.0 | Quasi-peak | 3 |
| | 88MHz~216MHz | 150 | 43.5 | Quasi-peak | 3 |
| | 216MHz~960MHz | 200 | 46.0 | Quasi-peak | 3 |
| | 960MHz~1000MHz | 500 | 54.0 | Quasi-peak | 3 |
| | Above 1000MHz | 500 | 54.0 | Average | 3 |
| | | - | 74.0 | Peak | 3 |

**Remark:**
(1)The lower limit shall apply at the transition frequency.
(2) 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

## 4.2. Test Setup

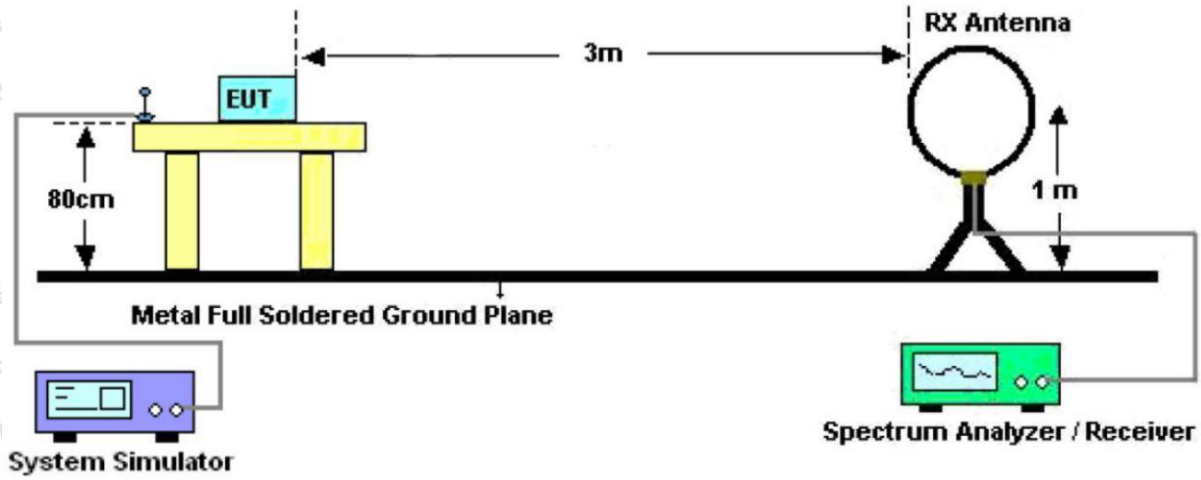



Figure 1. Below 30MHz

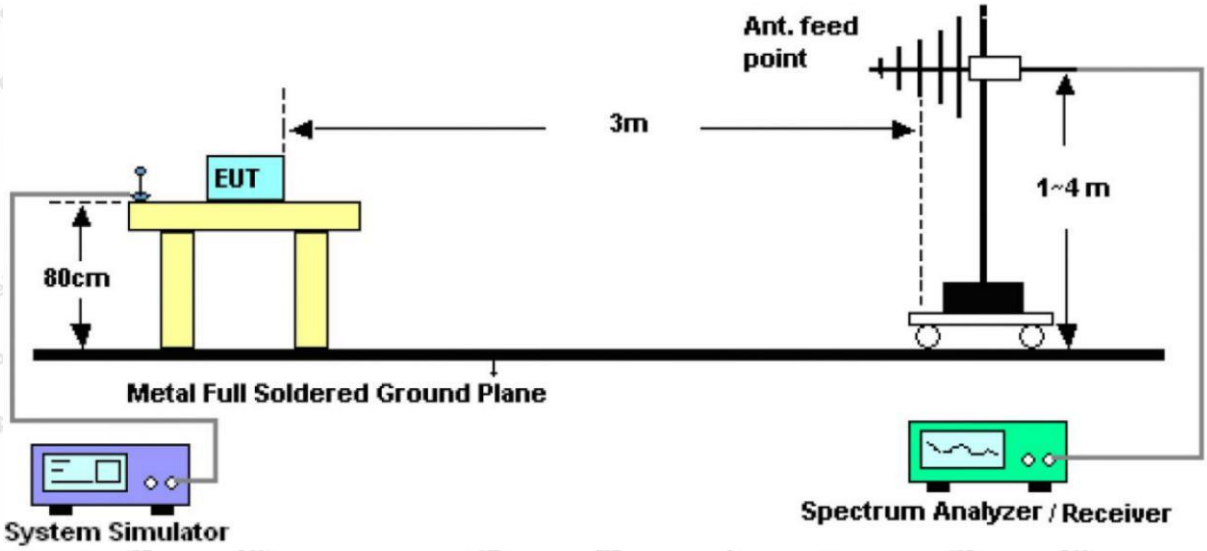



Figure 2. 30MHz to 1GHz

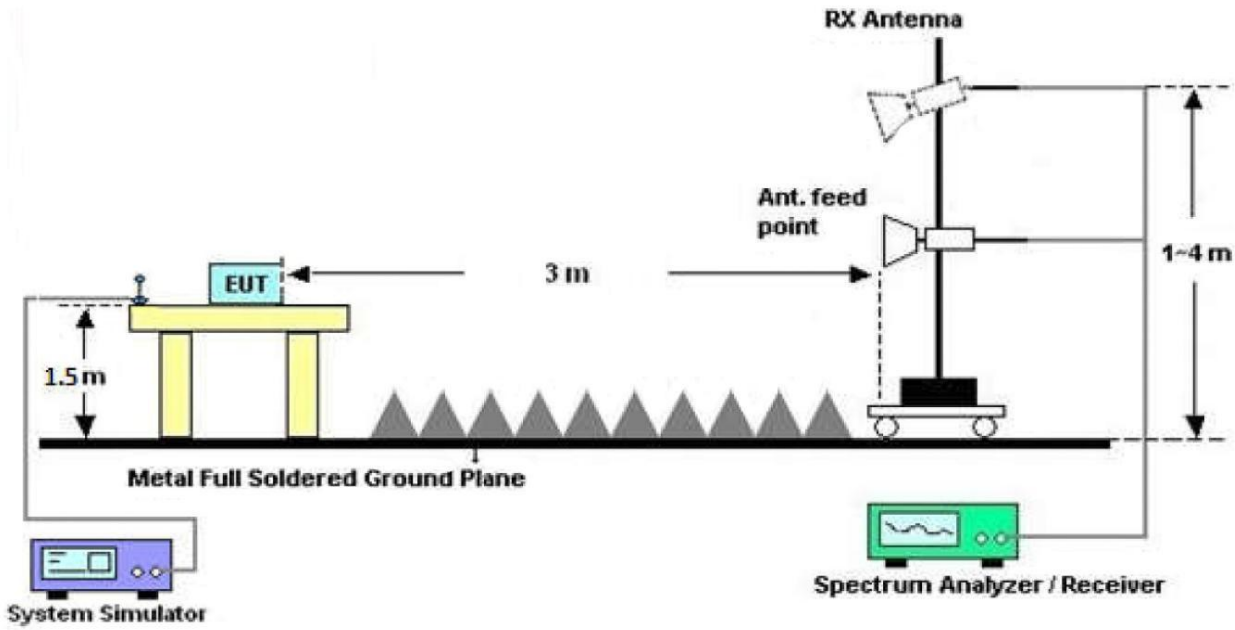



Figure 3. Above 1 GHz

## 4.3. Test Procedure

For below 1GHz: The EUT is placed on a turntable, which is 0.8m above the ground plane.

For above 1GHz: The EUT is placed on a turntable, which is 1.5m above the ground plane.

The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT is set 3 meters away from the receiving antenna which is mounted on a antenna tower. The antenna can be moved up and down from 1 to 4 meters to find out the maximum emission level. Rotated the EUT through three orthogonal axes to determine the maximum emissions, both horizontal and vertical polarization of the antenna are set on test. The EUT is tested in 9*6*6 Chamber. The device is evaluated in xyz orientation.

For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

For 9kHz to 150kHz, Set the spectrum analyzer as:

RBW = 200Hz, VBW =1kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 150kHz to 30MHz, Set the spectrum analyzer as:

RBW = 9KHz, VBW =30kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 30MHz to 1000MHz, Set the spectrum analyzer as:

RBW = 120kHz, VBW =300kHz,Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For above 1GHz,Set the spectrum analyzer as:

RBW =1MHz, VBW =1MHz, Detector= Peak, Trace mode= Max hold, Sweep- auto couple.

For average measurement: use duty cycle correction factor method (DCCF)

Average level = Peak level + DCCF

## 4.4. Test Data

**PASS**

During the test, Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the X-axis is the worst case.

The test results of 9kHz-30MHz was attenuated more than 20dB below the permissible limits, so the results don't record in the report.

During the test, pre-scan all modes, only the worst case is recorded in the report.

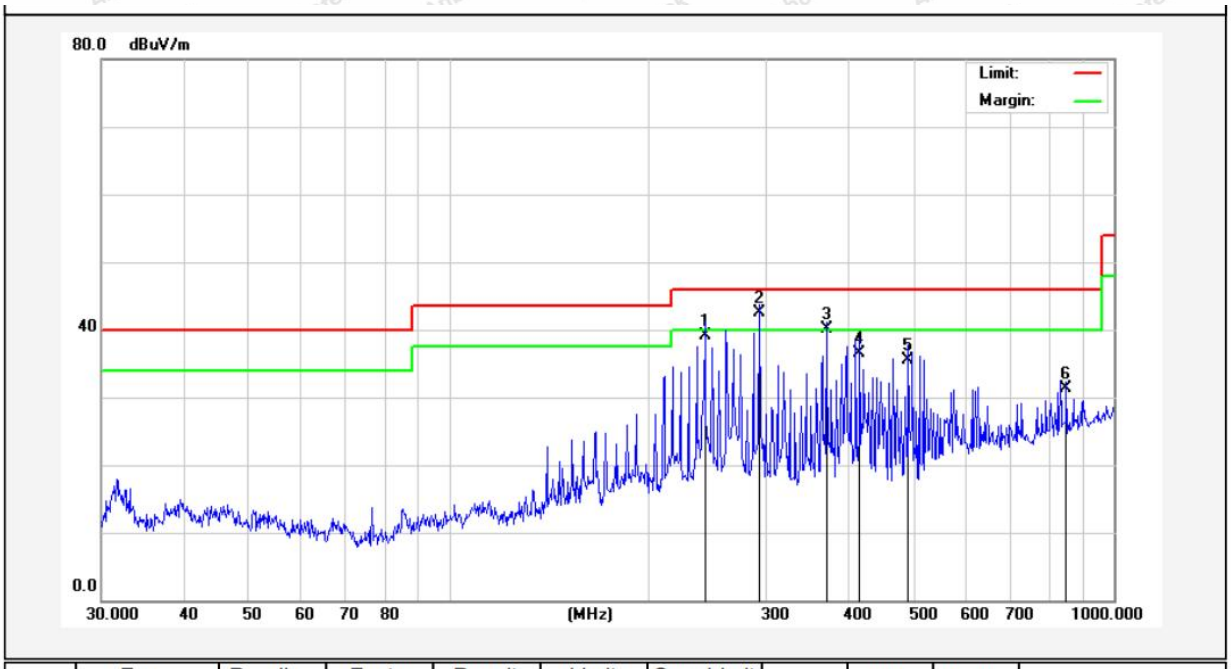
**Test Results (30~1000MHz)**

Test Mode: π/4-DQPSK (2402MHz)

Power Source: DC 3.7V battery inside

Polarization: Horizontal

Temp.(℃)/Hum.(%RH): 23.5℃/50%RH




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | Height (cm) | degree (deg) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 242.5252 | 60.82 | -21.62 | 39.20 | 46.00 | -6.80 | QP | | | |
| 2 | 293.0842 | 60.26 | -17.76 | 42.50 | 46.00 | -3.50 | QP | | | |
| 3 | 369.4045 | 56.13 | -16.06 | 40.07 | 46.00 | -5.93 | QP | | | |
| 4 | 414.7223 | 52.45 | -15.95 | 36.50 | 46.00 | -9.50 | QP | | | |
| 5 | 490.7447 | 49.68 | -14.08 | 35.60 | 46.00 | -10.40 | QP | | | |
| 6 | 848.0562 | 38.82 | -7.52 | 31.30 | 46.00 | -14.70 | QP | | | |

Note: Result = Reading + Factor Over Limit = Result - Limit

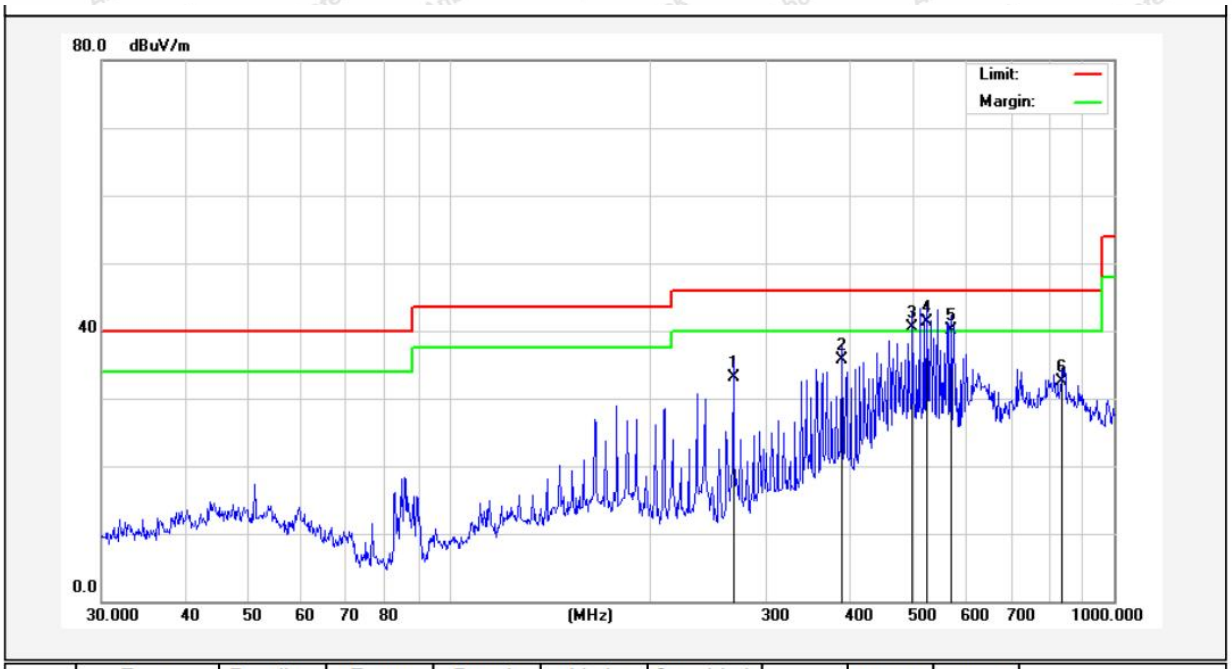
**Test Results (30~1000MHz)**

Test Mode: π/4-DQPSK (2402MHz)

Power Source: DC 3.7V battery inside

Polarization: Vertical

Temp.(℃)/Hum.(%RH): 23.5℃/50%RH




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | Height (cm) | degree (deg) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 267.5455 | 50.54 | -17.34 | 33.20 | 46.00 | -12.80 | QP | | | |
| 2 | 389.3548 | 50.22 | -14.56 | 35.66 | 46.00 | -10.34 | QP | | | |
| 3 | 497.6764 | 52.89 | -12.29 | 40.60 | 46.00 | -5.40 | QP | | | |
| 4 | 522.7179 | 53.32 | -12.02 | 41.30 | 46.00 | -4.70 | QP | | | |
| 5 | 568.6127 | 51.37 | -11.31 | 40.06 | 46.00 | -5.94 | QP | | | |
| 6 | 836.2441 | 40.19 | -7.70 | 32.49 | 46.00 | -13.51 | QP | | | |

Note: Result = Reading + Factor Over Limit = Result - Limit

**Test Results (1GHz-25GHz)**

| Test Mode: CH00 | | | Test channel: Lowest | | | |
|---|---|---|---|---|---|---|
| **Peak value:** | | | | | | |
| Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
| 4804.00 | 27.89 | 15.27 | 43.16 | 74.00 | -30.84 | Vertical |
| 7206.00 | 28.93 | 18.09 | 47.02 | 74.00 | -26.98 | Vertical |
| 9608.00 | 30.00 | 23.76 | 53.76 | 74.00 | -20.24 | Vertical |
| 12010.00 | * | | | 74.00 | | Vertical |
| 14412.00 | * | | | 74.00 | | Vertical |
| 4804.00 | 28.20 | 15.27 | 43.47 | 74.00 | -30.53 | Horizontal |
| 7206.00 | 29.36 | 18.09 | 47.45 | 74.00 | -26.55 | Horizontal |
| 9608.00 | 28.54 | 23.76 | 52.30 | 74.00 | -21.70 | Horizontal |
| 12010.00 | * | | | 74.00 | | Horizontal |
| 14412.00 | * | | | 74.00 | | Horizontal |
| **Average value:** | | | | | | |
| Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | polarization |
| 4804.00 | 17.27 | 15.27 | 32.54 | 54.00 | -21.46 | Vertical |
| 7206.00 | 17.96 | 18.09 | 36.05 | 54.00 | -17.95 | Vertical |
| 9608.00 | 19.02 | 23.76 | 42.78 | 54.00 | -11.22 | Vertical |
| 12010.00 | * | | | 54.00 | | Vertical |
| 14412.00 | * | | | 54.00 | | Vertical |
| 4804.00 | 16.55 | 15.27 | 31.82 | 54.00 | -22.18 | Horizontal |
| 7206.00 | 18.42 | 18.09 | 36.51 | 54.00 | -17.49 | Horizontal |
| 9608.00 | 17.85 | 23.76 | 41.61 | 54.00 | -12.39 | Horizontal |
| 12010.00 | * | | | 54.00 | | Horizontal |
| 14412.00 | * | | | 54.00 | | Horizontal |

**Test Results (1GHz-25GHz)**

| Test Mode: CH39 | | | Test channel: Middle | | | |
|---|---|---|---|---|---|---|
| **Peak value:** | | | | | | |
| Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
| 4882.00 | 27.91 | 15.42 | 43.33 | 74.00 | -30.67 | Vertical |
| 7323.00 | 28.78 | 18.02 | 46.80 | 74.00 | -27.20 | Vertical |
| 9764.00 | 29.01 | 23.80 | 52.81 | 74.00 | -21.19 | Vertical |
| 12205.00 | * | | | 74.00 | | Vertical |
| 14646.00 | * | | | 74.00 | | Vertical |
| 4882.00 | 27.90 | 15.42 | 43.32 | 74.00 | -30.68 | Horizontal |
| 7323.00 | 29.35 | 18.02 | 47.37 | 74.00 | -26.63 | Horizontal |
| 9764.00 | 28.24 | 23.80 | 52.04 | 74.00 | -21.96 | Horizontal |
| 12205.00 | * | | | 74.00 | | Horizontal |
| 14646.00 | * | | | 74.00 | | Horizontal |
| **Average value:** | | | | | | |
| Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | polarization |
| 4882.00 | 17.00 | 15.42 | 32.42 | 54.00 | -21.58 | Vertical |
| 7323.00 | 18.06 | 18.02 | 36.08 | 54.00 | -17.92 | Vertical |
| 9764.00 | 18.88 | 23.80 | 42.68 | 54.00 | -11.32 | Vertical |
| 12205.00 | * | | | 54.00 | | Vertical |
| 14646.00 | * | | | 54.00 | | Vertical |
| 4882.00 | 16.46 | 15.42 | 31.88 | 54.00 | -22.12 | Horizontal |
| 7323.00 | 17.98 | 18.02 | 36.00 | 54.00 | -18.00 | Horizontal |
| 9764.00 | 18.36 | 23.80 | 42.16 | 54.00 | -11.84 | Horizontal |
| 12205.00 | * | | | 54.00 | | Horizontal |
| 14646.00 | * | | | 54.00 | | Horizontal |

**Test Results (1GHz-25GHz)**

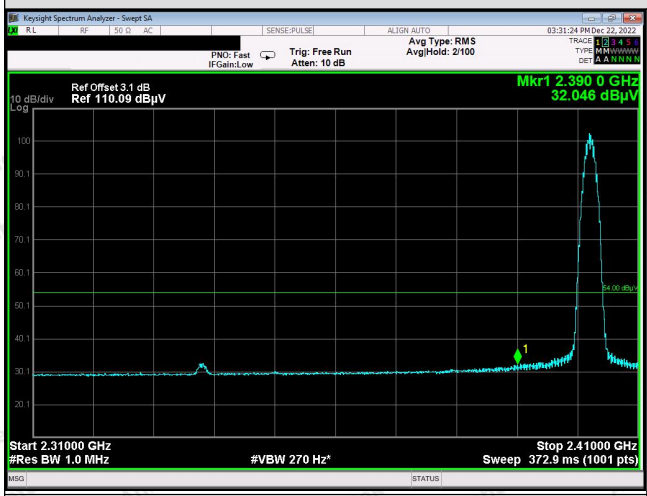
| Test Mode: CH78 | | | Test channel: Highest | | | |
|---|---|---|---|---|---|---|
| **Peak value:** | | | | | | |
| Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
| 4960.00 | 28.18 | 15.58 | 43.76 | 74.00 | -30.24 | Vertical |
| 7440.00 | 28.79 | 17.93 | 46.72 | 74.00 | -27.28 | Vertical |
| 9920.00 | 29.56 | 23.83 | 53.39 | 74.00 | -20.61 | Vertical |
| 12400.00 | * | | | 74.00 | | Vertical |
| 14880.00 | * | | | 74.00 | | Vertical |
| 4960.00 | 27.97 | 15.58 | 43.55 | 74.00 | -30.45 | Horizontal |
| 7440.00 | 29.38 | 17.93 | 47.31 | 74.00 | -26.69 | Horizontal |
| 9920.00 | 28.92 | 23.83 | 52.75 | 74.00 | -21.25 | Horizontal |
| 12400.00 | * | | | 74.00 | | Horizontal |
| 14880.00 | * | | | 74.00 | | Horizontal |
| **Average value:** | | | | | | |
| Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | polarization |
| 4960.00 | 18.12 | 15.58 | 33.70 | 54.00 | -20.30 | Vertical |
| 7440.00 | 19.07 | 17.93 | 37.00 | 54.00 | -17.00 | Vertical |
| 9920.00 | 19.43 | 23.83 | 43.26 | 54.00 | -10.74 | Vertical |
| 12400.00 | * | | | 54.00 | | Vertical |
| 14880.00 | * | | | 54.00 | | Vertical |
| 4960.00 | 17.90 | 15.58 | 33.48 | 54.00 | -20.52 | Horizontal |
| 7440.00 | 19.35 | 17.93 | 37.28 | 54.00 | -16.72 | Horizontal |
| 9920.00 | 18.26 | 23.83 | 42.09 | 54.00 | -11.91 | Horizontal |
| 12400.00 | * | | | 54.00 | | Horizontal |
| 14880.00 | * | | | 54.00 | | Horizontal |

Remark:

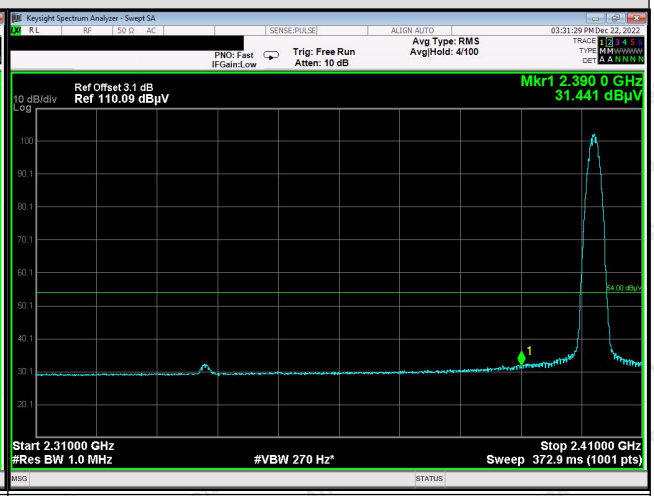
1. During the test, pre-scan the GFSK, π/4QPSK, 8DPSK modulation, and found the π/4QPSK modulation is worse case, the report only record this mode.
2. Result =Reading + Factor
3. "*" means the test results were attenuated more than 20dB below the permissible limits, so the results don't record in the report.

**Radiated Band Edge:**

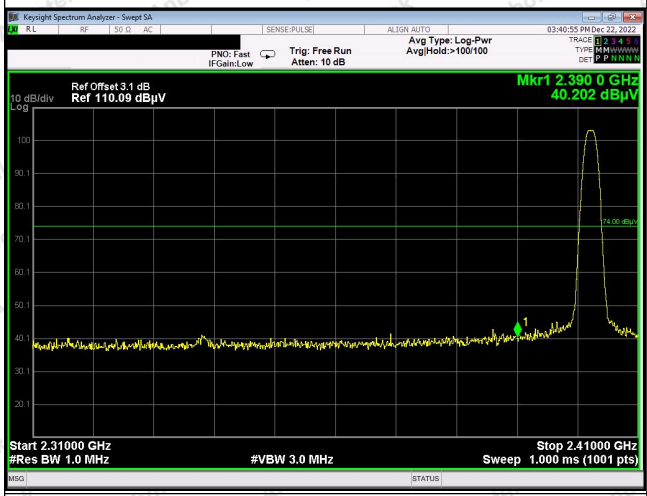
Test Mode: Lowest (CH00)



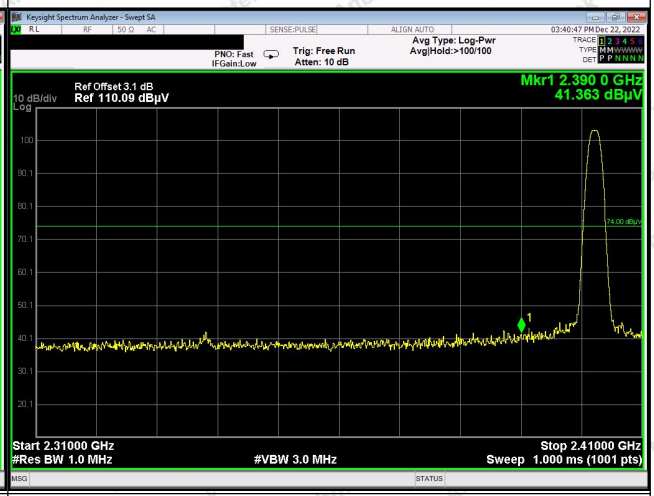

Average Value(Vertical)



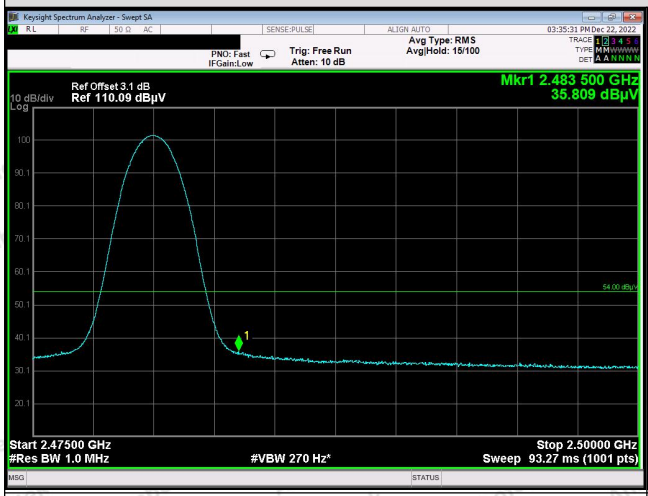
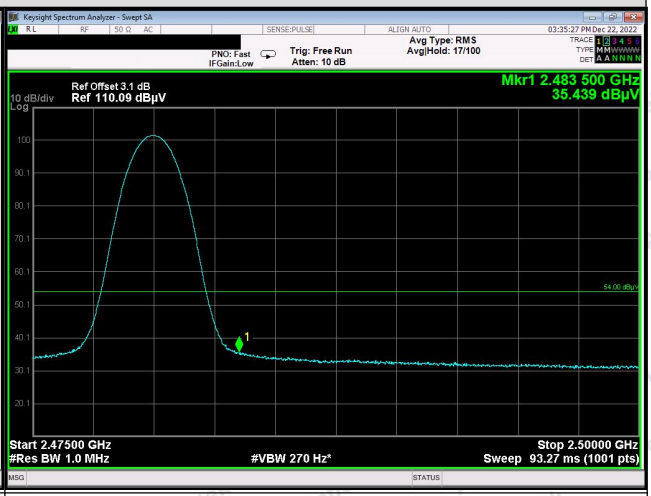
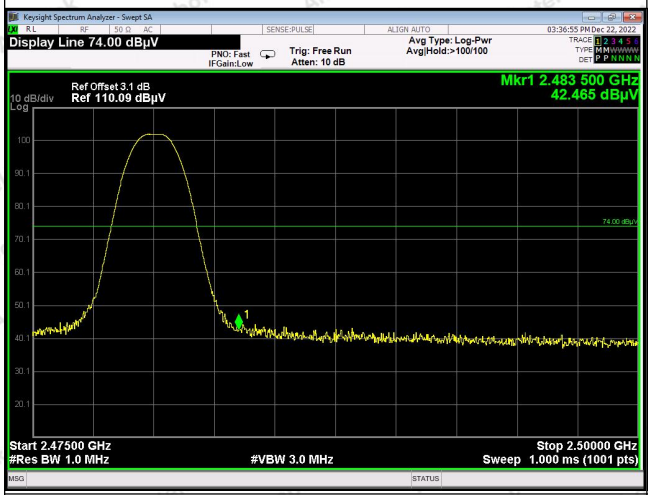
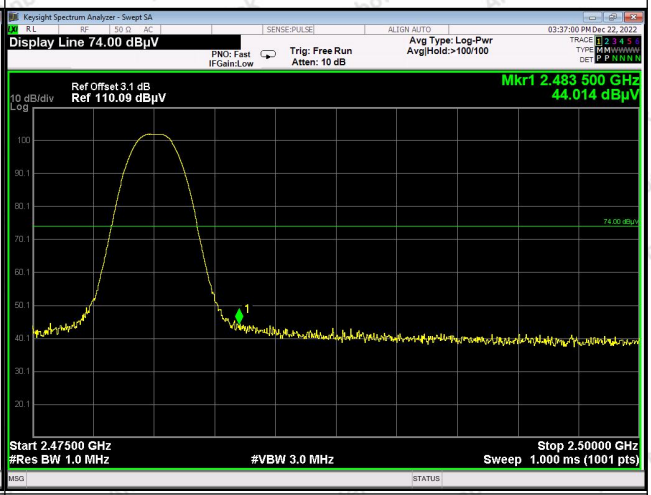

Average Value(Horizontal)




Peak Value(Vertical)




Peak Value(Horizontal)

| Test Mode: Highest (CH78) | |
|---|---|
|   |   |
| Average Value(Vertical) | Average Value(Horizontal) |
|   |   |
| Peak Value(Vertical) | Peak Value(Horizontal) |

Remark:

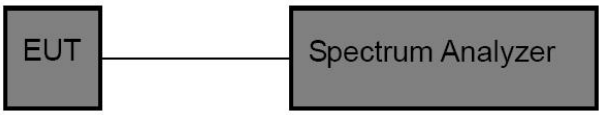
1. During the test, pre-scan the GFSK, π/4QPSK, 8DPSK modulation, and found the π/4QPSK modulation is worse case, the report only record this mode.

# 5. Maximum Peak Output Power Test

## 5.1. Test Standard and Limit

| | |
|---|---|
| Test Standard | FCC Part15 C Section 15.247 (b)(1) |
| Test Limit | For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. |

## 5.2. Test Setup




## 5.3. Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above,
2. Spectrum Setting:
   RBW > the 20 dB bandwidth of the emission being measured
   Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

## 5.4. Test Data

Pass

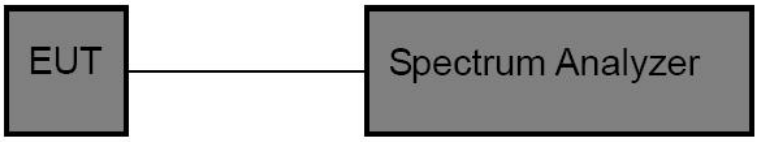
Please refer to Appendix C of the Appendix Test Data.

# 6. 20DB Occupy Bandwidth Test

## 6.1. Test Standard

| | |
|---|---|
| Test Standard | FCC Part15 C Section 15.247 (a)(1) |

## 6.2. Test Setup




## 6.3. Test Procedure

Using the following spectrum analyzer settings:

1. Span= approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel.
2. Set the RBW ≥1% of the 20 dB bandwidth.
3. Set the VBW ≥RBW
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

## 6.4. Test Data

Pass

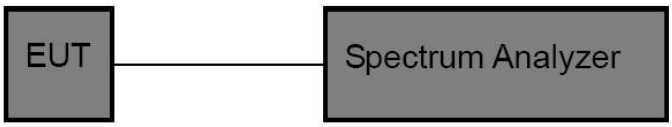
Please refer to Appendix A of the Appendix Test Data.

# 7. Carrier Frequency Separation Test

## 7.1. Test Standard and Limit

| | |
|---|---|
| Test Standard | FCC Part15 C Section 15.247 (a)(1) |
| Test Limit | 2/3 of the 20dB bandwidth base on the transmission power is less than 0.125W. |

## 7.2. Test Setup




## 7.3. Test Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer settings:

1. Span= Wide enough to capture the peaks of two adjacent channels
2. Set the RBW =approximately 30% of the channel spacing.
3. Set the VBW ≥ RBW.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

## 7.4. Test Data

Pass

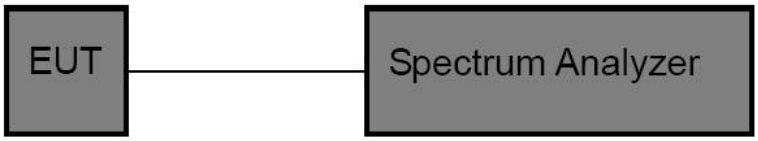
Please refer to Appendix D of the Appendix Test Data.

# 8. Number of Hopping Channel Test

## 8.1. Test Standard and Limit

| | |
|---|---|
| Test Standard | FCC Part15 C Section 15.247 (a)(1)(iii) |
| Test Limit | >15 channels |

## 8.2. Test Setup




## 8.3. Test Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer setting:

1. Span= the frequency band of operation
2. Set the RBW = less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3. Set the VBW ≥ RBW.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

## 8.4. Test Data

Pass

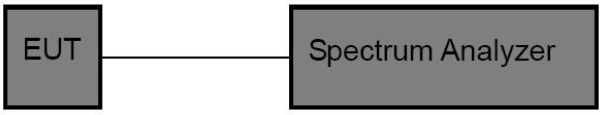
Please refer to Appendix F of the Appendix Test Data.

# 9. Dwell Time Test

## 9.1. Test Standard and Limit

| | |
|---|---|
| Test Standard | FCC Part15 C Section 15.247 (a)(1)(iii) |
| Test Limit | 0.4 s |

## 9.2. Test Setup




## 9.3. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span= zero span, centered on a hopping channel
2. Set the RBW = 1 MHz.
3. Set the VBW ≥ RBW.
4. Sweep time = as necessary to capture the entire dwell time per hopping channel.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

## 9.4. Test Data

Pass

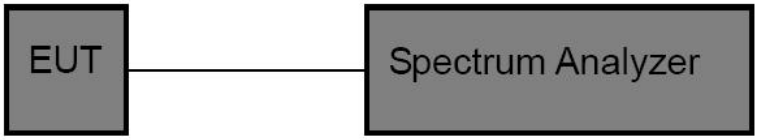
Please refer to Appendix E of the Appendix Test Data.

# 10. 100kHz Bandwidth of Frequency Band Edge Requirement

## 10.1. Test Standard and Limit

| | |
|---|---|
| Test Standard | FCC Part15 C Section 15.247 (d) |
| Test Limit | In any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a). |

## 10.2. Test Setup




## 10.3. Test Procedure

The EUT must have its hopping/Non-hopping function enabled. Using the following spectrum analyzer setting:

1. Set the RBW = 100kHz.
2. Set the VBW = 300kHz.
3. Sweep time = auto couple.
4. Detector function = peak.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.

## 10.4. Test Data

Pass

Please refer to Appendix G & Appendix H of the Appendix Test Data.

# 11. Antenna Requirement

## 11.1. Test Standard and Requirement

| | |
|---|---|
| Test Standard | FCC Part15 Section 15.203 /247(c) |
| Requirement | 1) 15.203 requirement:<br>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, 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.<br>2) 15.247(c) (1)(i) requirement:<br>Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. |

## 11.2. Antenna Connected Construction

The antenna is PCB Antenna which permanently attached, and the best case gain of the antenna is -0.24dBi. It complies with the standard requirement.

# APPENDIX I -- TEST SETUP PHOTOGRAPH

Please refer to separated files Appendix I -- Test Setup Photograph

# APPENDIX II -- EXTERNAL PHOTOGRAPH

Please refer to separated files Appendix II -- External Photograph

# APPENDIX III -- INTERNAL PHOTOGRAPH

Please refer to separated files Appendix III -- Internal Photograph

---------- End of Report ----------