# FCC TEST REPORT

| | | |
|---|---|---|
| Client Name | : | Guangzhou Hualiang Xinxing Electronic Manufacturing Co., Ltd |
| Address | : | No.5 Industrial Road, Quanxi, Jianggao Town Baiyun District, Guangzhou, China |
| Product Name | : | speaker |
| Date | : | Sept. 16, 2020 |

## Shenzhen Anbotek Compliance Laboratory Limited

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# TEST REPORT

| | | |
|---|---|---|
| Applicant | : | Guangzhou Hualiang Xinxing Electronic Manufacturing Co., Ltd |
| Manufacturer | : | Guangzhou Hualiang Xinxing Electronic Manufacturing Co., Ltd |
| Product Name | : | speaker |
| Model No. | : | KOLAV-F1201, IQ-7112DJBT, AUD-X612, AUD-X622, AUD-X625, LiGE-120F, LiGE-120G, KOLAV-120E, KOLAV-120R, LiGE-1748, KOLAV-F1501, KOLAV-F1202, KOLAV-S1203, KOLAV-M981, KOLAV-120RK, KOLAV-X1202, KOLAV-1757A, AUD-J112, AUD-J115 |
| Trade Mark | : | AiLiANG LiGE FS HomeBoss TopTechAudio YAT FISHER AUDSTER IQ sound iPhoenix PRESTIGE KOLAV 科亮 |
| Rating(s) | : | Input: DC 5V, 1800mA (with DC 3.7V 2400mAh Battery inside) |
| **Test Standard(s)** | **:** | **FCC Part15 Subpart C 2019, Section 15.247** |
| **Test Method(s)** | **:** | **ANSI C63.10: 2013** |

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 | Aug. 28, 2020 |
| Date of Test | Aug. 28~Sept. 14, 2020 |
| Prepared by | Yilia Zhong<br>(Engineer / Yilia Zhong) |
| Reviewer | Bibo Zhang<br>(Supervisor / Bibo Zhang) |
| Approved & Authorized Signer | Kingkong Jin<br>(Manager / Kingkong Jin) |

# 1. General Information

## 1.1. Client Information

| | | |
|---|---|---|
| Applicant | : | Guangzhou Hualiang Xinxing Electronic Manufacturing Co., Ltd |
| Address | : | No.5 Industrial Road, Quanxi, Jianggao Town Baiyun District, Guangzhou, China |
| Manufacturer | : | Guangzhou Hualiang Xinxing Electronic Manufacturing Co., Ltd |
| Address | : | No.5 Industrial Road, Quanxi, Jianggao Town Baiyun District, Guangzhou, China |
| Factory | : | Guangzhou Hualiang Xinxing Electronic Manufacturing Co., Ltd |
| Address | : | No.5 Industrial Road, Quanxi, Jianggao Town Baiyun District, Guangzhou, China |

## 1.2. Description of Device (EUT)

| | | | |
|---|---|---|---|
| Product Name | : | speaker | |
| Model No. | : | KOLAV-F1201, IQ-7112DJBT, AUD-X612, AUD-X622, AUD-X625, LiGE-120F, LiGE-120G, KOLAV-120E, KOLAV-120R, LiGE-1748, KOLAV-F1501, KOLAV-F1202, KOLAV-S1203, KOLAV-M981, KOLAV-120RK, KOLAV-X1202, KOLAV-1757A, AUD-J112, AUD-J115 (Note: All samples are the same except the size and appearance, so we prepare “KOLAV-F1201” for test only.) | |
| Trade Mark | : | AiLiANG LiGE F5 Products HomeBoss TopTechAudio YAT FISHER AUDSTER IQ sound iPhoenix PRESTIGE KOLAV 科亮 | |
| Test Power Supply | : | AC 120V, 60Hz for adapter / AC 240V, 60Hz for adapter<br>DC 3.7V Battery inside | |
| Test Sample No. | : | 1-2-1(Normal Sample), 1-2-2(Engineering Sample) | |
| Product Description | : | Operation Frequency: | 2402~2480MHz |
| | | Transfer Rate: | 1/2 Mbits/s |
| | | Number of Channel: | 79 Channels |
| | | Modulation Type: | GFSK, π/4-DQPSK |
| | | Antenna Type: | PCB Antenna |
| | | Antenna Gain(Peak): | 0 dBi |
| 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

| | | |
|---|---|---|
| Adapter | : | M/N: A2013<br>Input: 100-240V-0.7A 50-60Hz<br>Output: 3.6-5.5V 3A / 6.5-9V 2A / 9-12V 1.5A |

## 1.4. Description of Test Modes

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

TEST MODE:

| | | | |
|---|---|---|---|
| Mode 1 | GFSK | CH00 | TX+ Charging Mode/TX Only |
| Mode 2 | | CH39 | |
| Mode 3 | | CH78 | |
| Mode 4 | π/4-DQPSK | CH00 | |
| Mode 5 | | CH39 | |
| Mode 6 | | CH78 | |

Note:

(1) The measurements are performed at the highest, middle, lowest available channels.

(2)The data rate was set in 1Mbps for radiated emission due to the highest RF output power.


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Hotline 400-003-0500
www.anbotek.com

## 1.5. List of channels

| 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 |
| 05 | 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 built-in battery-powered, fully-charged battery use of the test battery.


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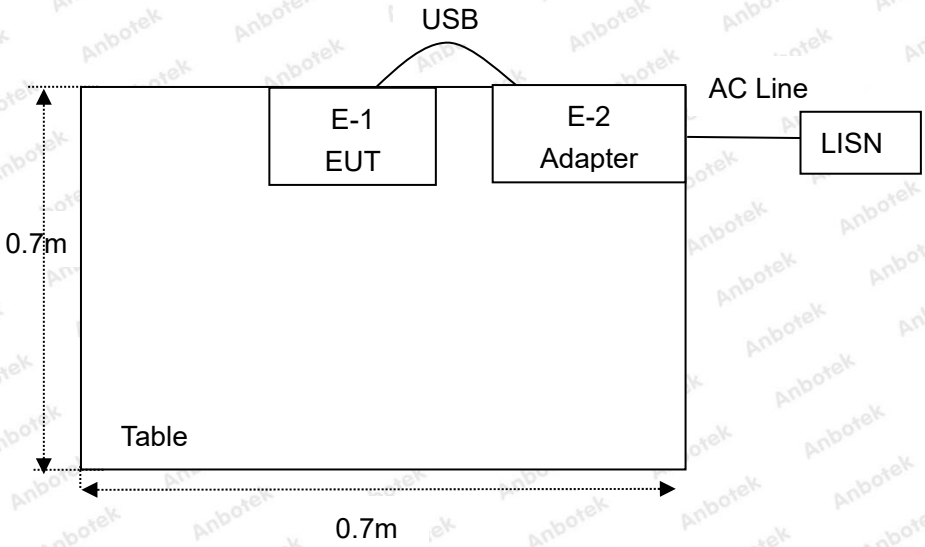
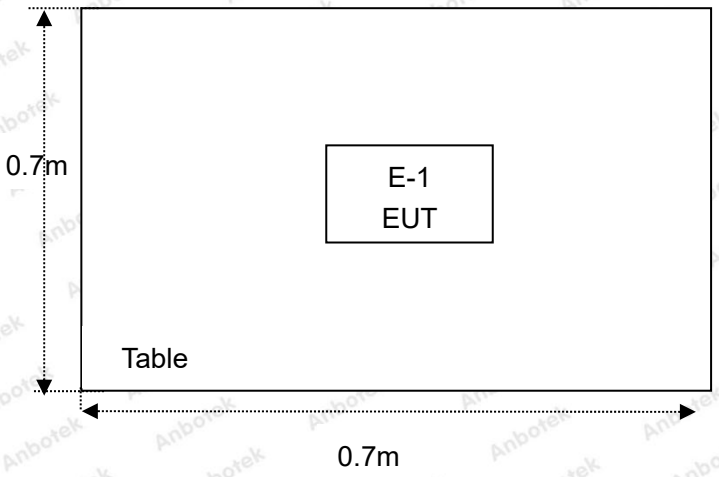
www.anbotek.com

## 1.6. Description Of Test Setup

CE




RE



## 1.7. 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 | Nov. 04, 2019 | 1 Year |
| 2. | EMI Test Receiver | Rohde & Schwarz | ESPI3 | 101604 | Nov. 04, 2019 | 1 Year |
| 3. | RF Switching Unit | Compliance Direction | RSU-M2 | 38303 | Nov. 04, 2019 | 1 Year |
| 4. | MAX Spectrum Analysis | Agilent | N9020A | MY51170037 | Nov. 04, 2019 | 1 Year |
| 5. | Preamplifier | SKET Electronic | BK1G18G30D | KD17503 | Nov. 04, 2019 | 1 Year |
| 6. | Double Ridged Horn Antenna | Instruments corporation | GTH-0118 | 351600 | Nov. 01, 2019 | 1 Year |
| 7. | Bilog Broadband Antenna | Schwarzbeck | VULB9163 | VULB 9163-289 | Nov. 01, 2019 | 1 Year |
| 8. | Loop Antenna | Schwarzbeck | FMZB1519B | 00053 | Nov. 01, 2019 | 1 Year |
| 9. | Horn Antenna | A-INFO | LB-180400-KF | J211060628 | Nov. 01, 2019 | 1 Year |
| 10. | Pre-amplifier | SONOMA | 310N | 186860 | Nov. 04, 2019 | 1 Year |
| 11. | EMI Test Software EZ-EMC | SHURPLE | N/A | N/A | N/A | N/A |
| 12. | RF Test Control System | YIHENG | YH3000 | 2017430 | Nov. 04, 2019 | 1 Year |
| 13. | Power Sensor | DAER | RPR3006W | 15I00041SN045 | Nov. 04, 2019 | 1 Year |
| 14. | Power Sensor | DAER | RPR3006W | 15I00041SN046 | Nov. 04, 2019 | 1 Year |
| 15. | MXA Spectrum Analysis | Agilent | N9020A | MY51170037 | Nov. 04, 2019 | 1 Year |
| 16. | MXG RF Vector Signal Generator | Agilent | N5182A | MY48180656 | Nov. 04, 2019 | 1 Year |
| 17. | Signal Generator | Agilent | E4421B | MY41000743 | Nov. 04, 2019 | 1 Year |
| 18. | DC Power Supply | LW | TPR-6420D | 374470 | Nov. 04, 2019 | 1 Year |
| 19. | Constant Temperature Humidity Chamber | ZHONGJIAN | ZJ-KHWS80B | N/A | Nov. 04, 2019 | 1 Year |

## 1.8. Measurement Uncertainty

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

## 1.9. 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 registed 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, September 27, 2019.

**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, March 07, 2019.

**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) | Hopping Channel Number | PASS |
| 15.247(a)(1) | Dwell Time | PASS |
| 15.247(d) | Band Edge | PASS |
| **Remark:** “N/A” is an abbreviation for Not Applicable. | | |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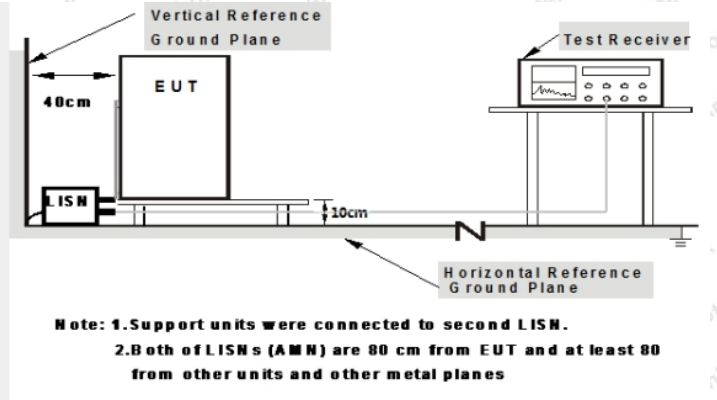
# 3. Conducted Emission Test

## 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 C63.10-2013 on Conducted Emission Measurement.

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

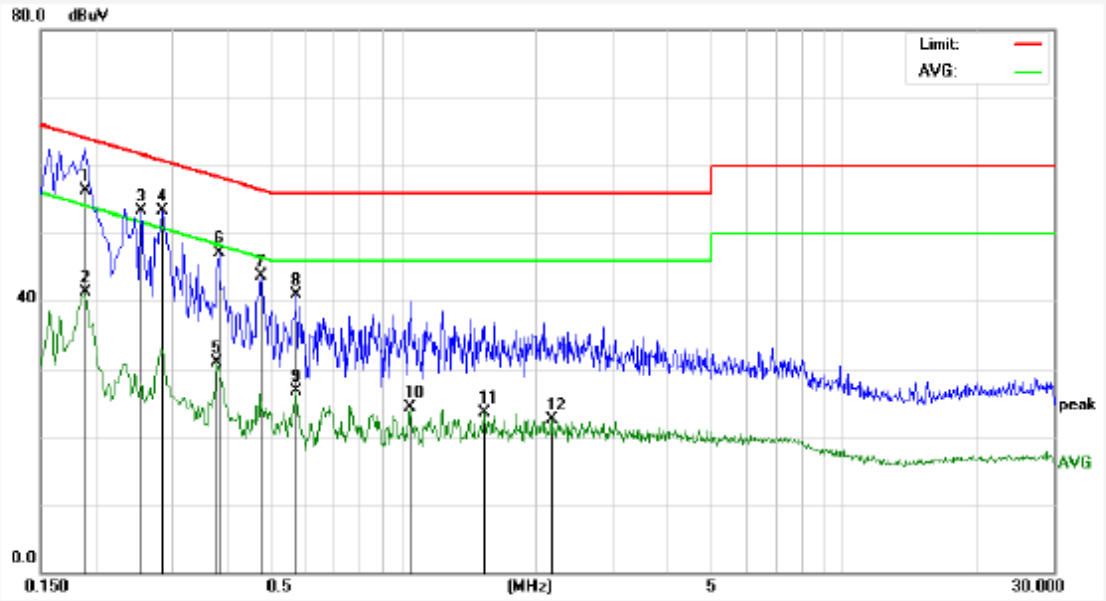
The frequency range from 150kHz to 30MHz is checked.

## 3.4. Test Data

During the test, pre-scan the GFSK, π/4QPSK modulation, and found the GFSK modulation Low channel(TX+Charging Mode) which is the worst case, only the worst case is recorded in the report. Please to see the following pages.

**Conducted Emission Test Data**

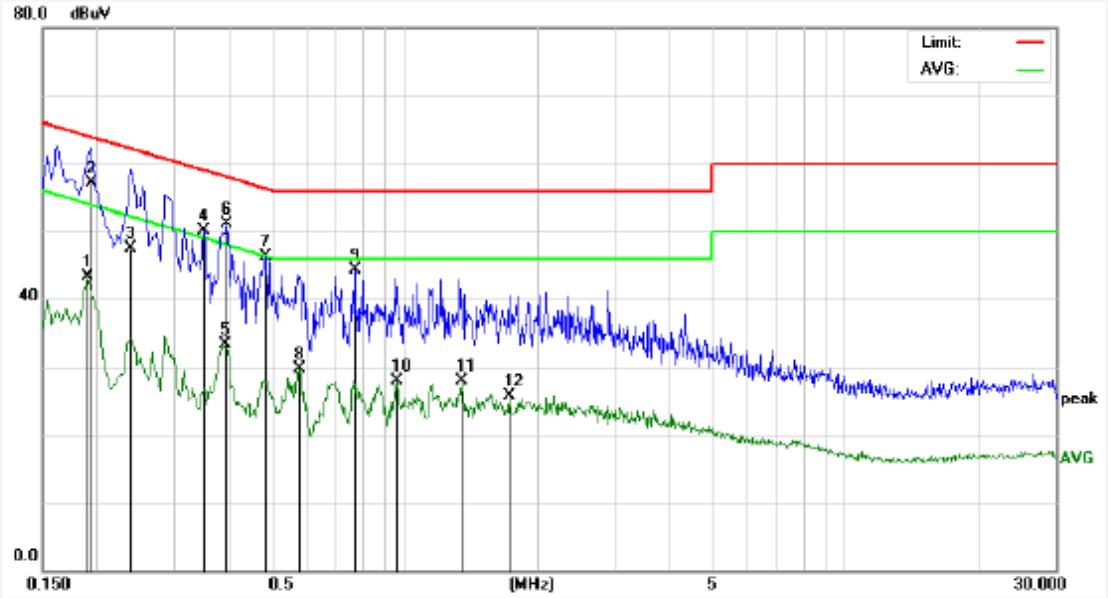
Test Site: 1# Shielded Room
Operating Condition: Mode 1
Test Specification: AC 120V, 60Hz for adapter
Comment: Live Line
Tem.: 25.4℃ Hum.: 54%




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit dBuV | Over Limit (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.1900 | 36.49 | 19.90 | 56.39 | 64.03 | -7.64 | QP | |
| 2 | 0.1900 | 21.46 | 19.90 | 41.36 | 54.03 | -12.67 | AVG | |
| 3 | 0.2540 | 33.37 | 19.89 | 53.26 | 61.62 | -8.36 | QP | |
| 4 | 0.2860 | 33.33 | 19.89 | 53.22 | 60.64 | -7.42 | QP | |
| 5 | 0.3780 | 10.90 | 19.93 | 30.83 | 48.32 | -17.49 | AVG | |
| 6 | 0.3820 | 27.08 | 19.93 | 47.01 | 58.23 | -11.22 | QP | |
| 7 | 0.4780 | 23.73 | 19.97 | 43.70 | 56.37 | -12.67 | QP | |
| 8 | 0.5740 | 20.85 | 20.00 | 40.85 | 56.00 | -15.15 | QP | |
| 9 | 0.5740 | 6.67 | 20.00 | 26.67 | 46.00 | -19.33 | AVG | |
| 10 | 1.0420 | 4.15 | 20.12 | 24.27 | 46.00 | -21.73 | AVG | |
| 11 | 1.5300 | 3.38 | 20.13 | 23.51 | 46.00 | -22.49 | AVG | |
| 12 | 2.1700 | 2.41 | 20.14 | 22.55 | 46.00 | -23.45 | AVG | |

**Conducted Emission Test Data**

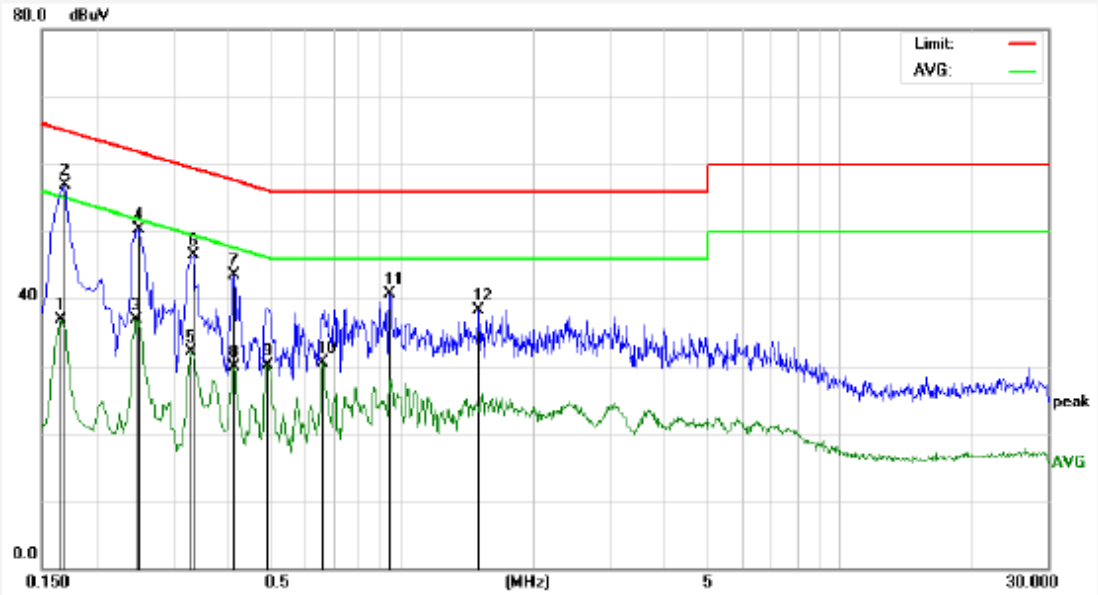
Test Site: 1# Shielded Room
Operating Condition: Mode 1
Test Specification: AC 120V, 60Hz for adapter
Comment: Neutral Line
Tem.: 25.4℃ Hum.: 54%




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit dBuV | Over Limit (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.1900 | 23.40 | 19.90 | 43.30 | 54.03 | -10.73 | AVG | |
| 2 | 0.1940 | 37.18 | 19.90 | 57.08 | 63.86 | -6.78 | QP | |
| 3 | 0.2380 | 27.68 | 19.89 | 47.57 | 62.16 | -14.59 | QP | |
| 4 | 0.3500 | 30.27 | 19.91 | 50.18 | 58.96 | -8.78 | QP | |
| 5 | 0.3899 | 13.40 | 19.93 | 33.33 | 48.06 | -14.73 | AVG | |
| 6 | 0.3940 | 31.21 | 19.93 | 51.14 | 57.98 | -6.84 | QP | |
| 7 | 0.4820 | 26.34 | 19.97 | 46.31 | 56.30 | -9.99 | QP | |
| 8 | 0.5780 | 9.80 | 20.00 | 29.80 | 46.00 | -16.20 | AVG | |
| 9 | 0.7700 | 24.27 | 20.06 | 44.33 | 56.00 | -11.67 | QP | |
| 10 | 0.9620 | 7.79 | 20.11 | 27.90 | 46.00 | -18.10 | AVG | |
| 11 | 1.3460 | 7.70 | 20.13 | 27.83 | 46.00 | -18.17 | AVG | |
| 12 | 1.7180 | 5.63 | 20.13 | 25.76 | 46.00 | -20.24 | AVG | |

**Conducted Emission Test Data**

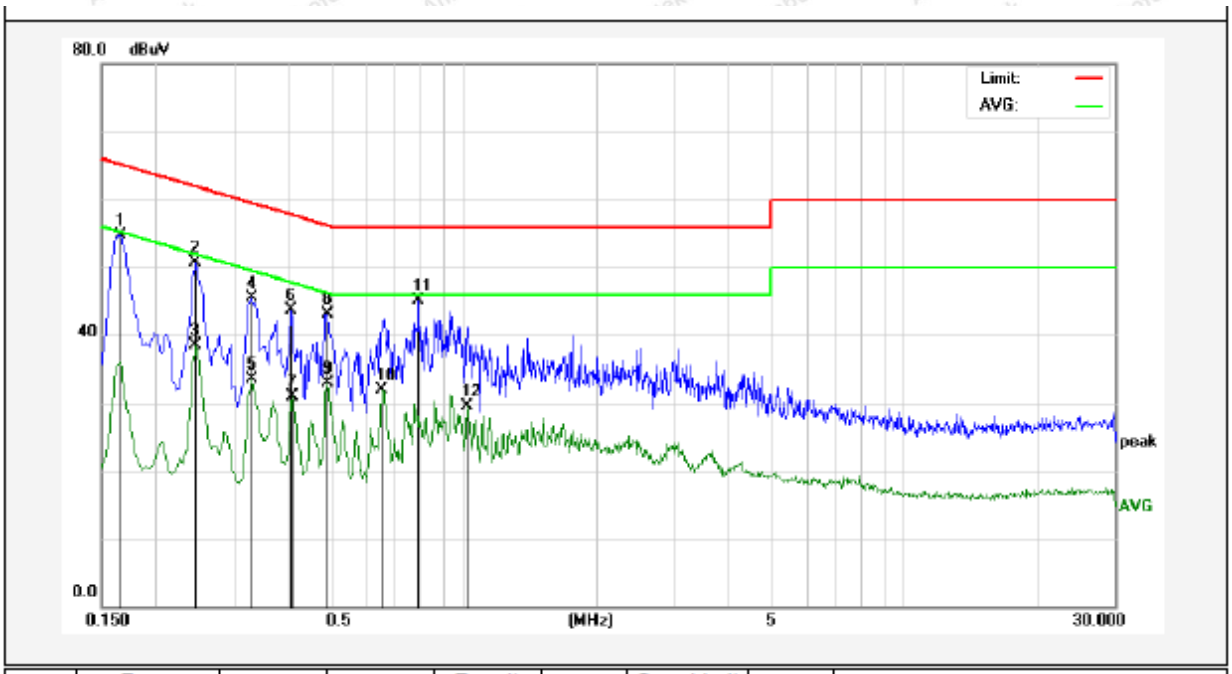
Test Site: 1# Shielded Room
Operating Condition: Mode 1
Test Specification: AC 240V, 60Hz for adapter
Comment: Live Line
Tem.: 25.4℃ Hum.: 54%




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit dBuV | Over Limit (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.1660 | 16.99 | 19.90 | 36.89 | 55.15 | -18.26 | AVG | |
| 2 | 0.1700 | 37.04 | 19.90 | 56.94 | 64.96 | -8.02 | QP | |
| 3 | 0.2460 | 16.99 | 19.89 | 36.88 | 51.89 | -15.01 | AVG | |
| 4 | 0.2500 | 30.40 | 19.89 | 50.29 | 61.75 | -11.46 | QP | |
| 5 | 0.3300 | 12.30 | 19.90 | 32.20 | 49.45 | -17.25 | AVG | |
| 6 | 0.3339 | 26.60 | 19.91 | 46.51 | 59.35 | -12.84 | QP | |
| 7 | 0.4140 | 23.50 | 19.94 | 43.44 | 57.57 | -14.13 | QP | |
| 8 | 0.4140 | 9.91 | 19.94 | 29.85 | 47.57 | -17.72 | AVG | |
| 9 | 0.4940 | 10.09 | 19.98 | 30.07 | 46.10 | -16.03 | AVG | |
| 10 | 0.6580 | 10.53 | 20.03 | 30.56 | 46.00 | -15.44 | AVG | |
| 11 | 0.9420 | 20.63 | 20.10 | 40.73 | 56.00 | -15.27 | QP | |
| 12 | 1.5020 | 18.24 | 20.13 | 38.37 | 56.00 | -17.63 | QP | |

**Conducted Emission Test Data**

Test Site: 1# Shielded Room
Operating Condition: Mode 1
Test Specification: AC 240V, 60Hz for adapter
Comment: Neutral Line
Tem.: 25.4℃ Hum.: 54%




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB) | Result (dBuV) | Limit dBuV | Over Limit (dB) | Detector | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.1660 | 34.84 | 19.90 | 54.74 | 65.15 | -10.41 | QP | |
| 2 | 0.2460 | 30.81 | 19.89 | 50.70 | 61.89 | -11.19 | QP | |
| 3 | 0.2460 | 18.63 | 19.89 | 38.52 | 51.89 | -13.37 | AVG | |
| 4 | 0.3300 | 25.57 | 19.90 | 45.47 | 59.45 | -13.98 | QP | |
| 5 | 0.3300 | 13.52 | 19.90 | 33.42 | 49.45 | -16.03 | AVG | |
| 6 | 0.4060 | 23.83 | 19.94 | 43.77 | 57.73 | -13.96 | QP | |
| 7 | 0.4100 | 10.94 | 19.94 | 30.88 | 47.65 | -16.77 | AVG | |
| 8 | 0.4900 | 23.18 | 19.98 | 43.16 | 56.17 | -13.01 | QP | |
| 9 | 0.4900 | 12.85 | 19.98 | 32.83 | 46.17 | -13.34 | AVG | |
| 10 | 0.6540 | 11.93 | 20.03 | 31.96 | 46.00 | -14.04 | AVG | |
| 11 | 0.7900 | 25.08 | 20.06 | 45.14 | 56.00 | -10.86 | QP | |
| 12 | 1.0140 | 9.34 | 20.12 | 29.46 | 46.00 | -16.54 | AVG | |

# 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

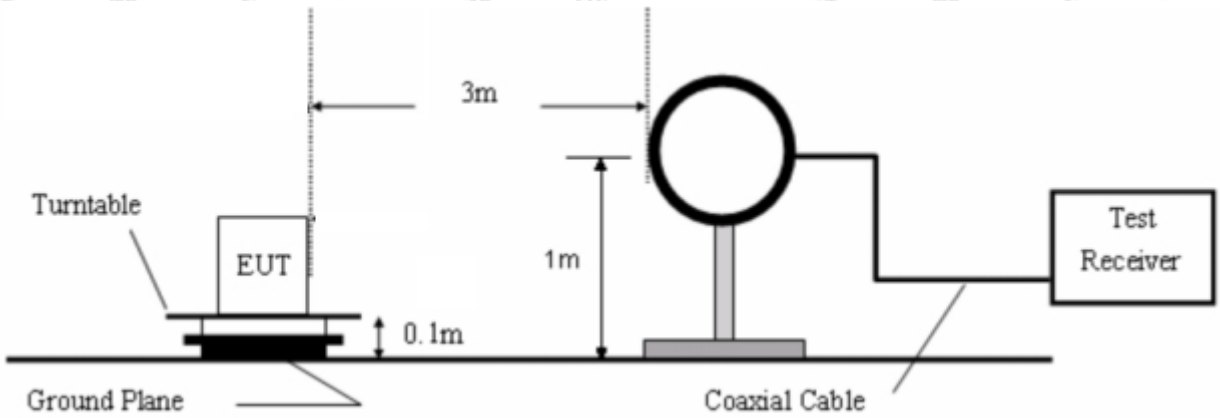



Figure 1. Below 30MHz

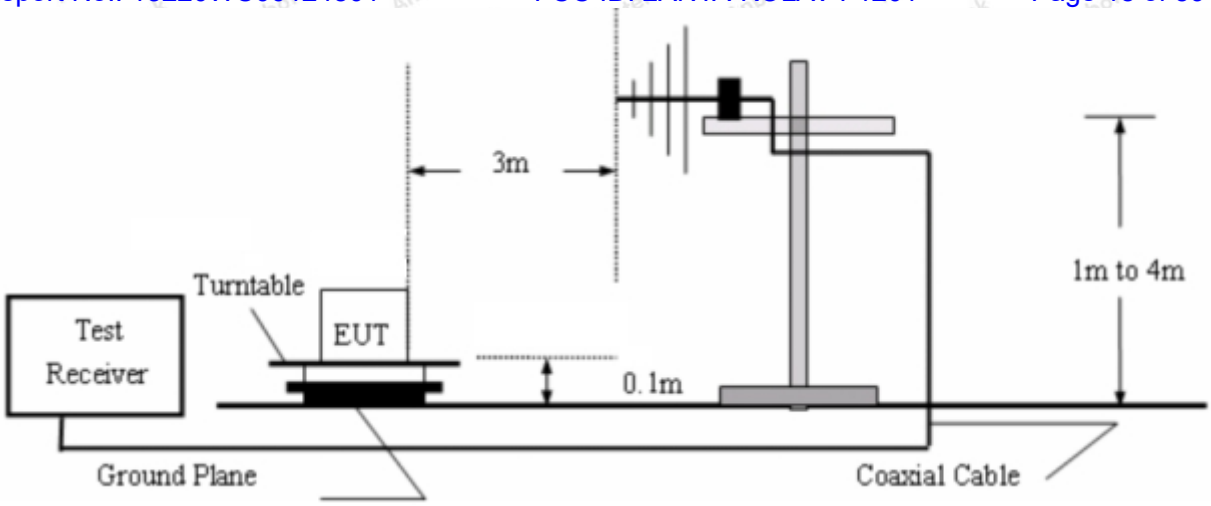



Figure 2. 30MHz to 1GHz

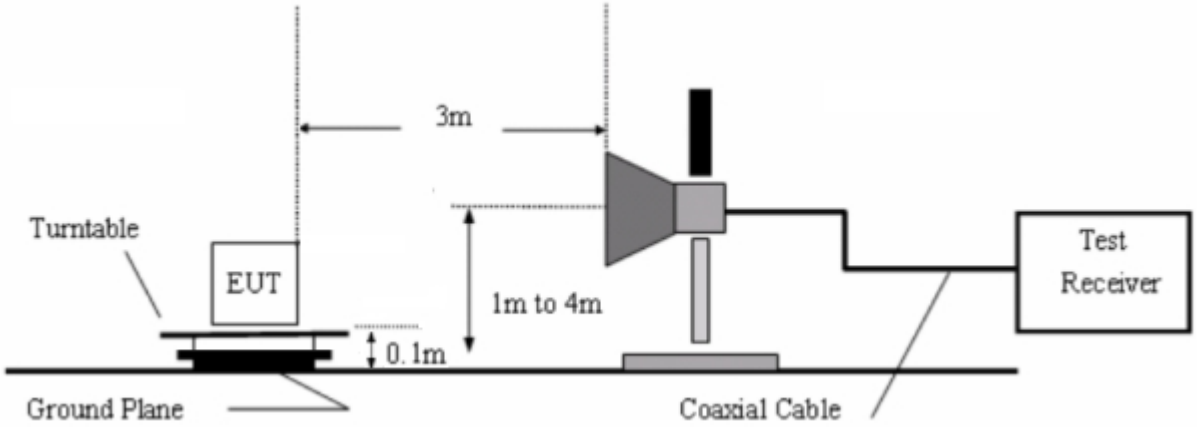



Figure 3. Above 1 GHz

## 4.3. Test Procedure

For below 1GHz: The EUT is placed on a turntable, which is 0.1m above the ground plane.
For above 1GHz: The EUT is placed on a turntable, which is 0.1m 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 = 100kHz, 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.
RBW =1MHz, VBW =10Hz, Detector= Average, Trace mode= Max hold, Sweep- auto couple.

## 4.4. Test Data

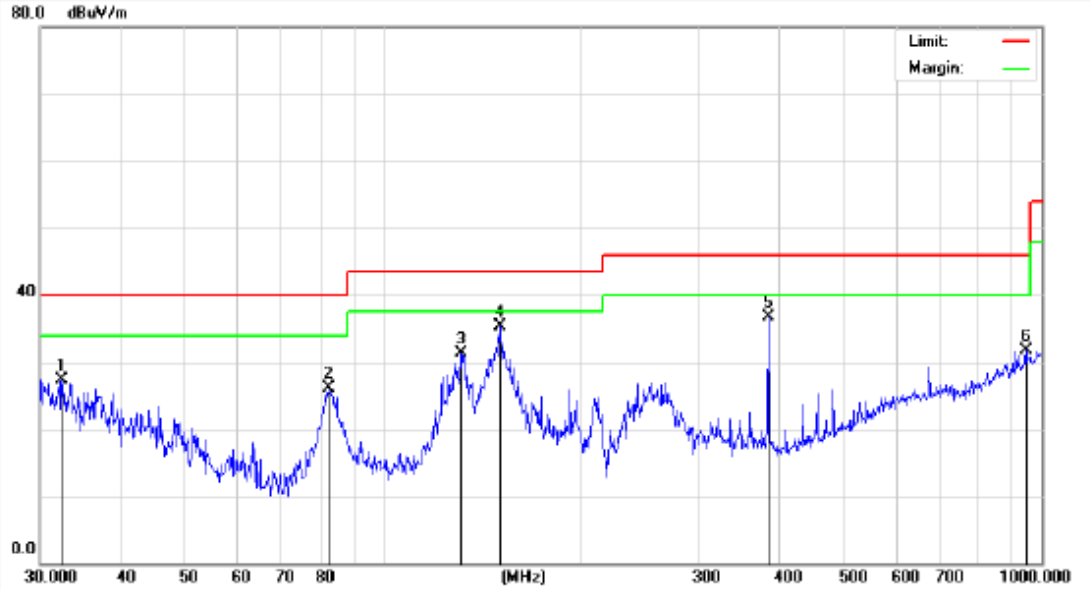
**PASS**

During the test, pre-scan the GFSK, π/4QPSK modulation, and found the GFSK modulation Middle channel(TX only Mode) which is the worst case, only the worst case is recorded in the report

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

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

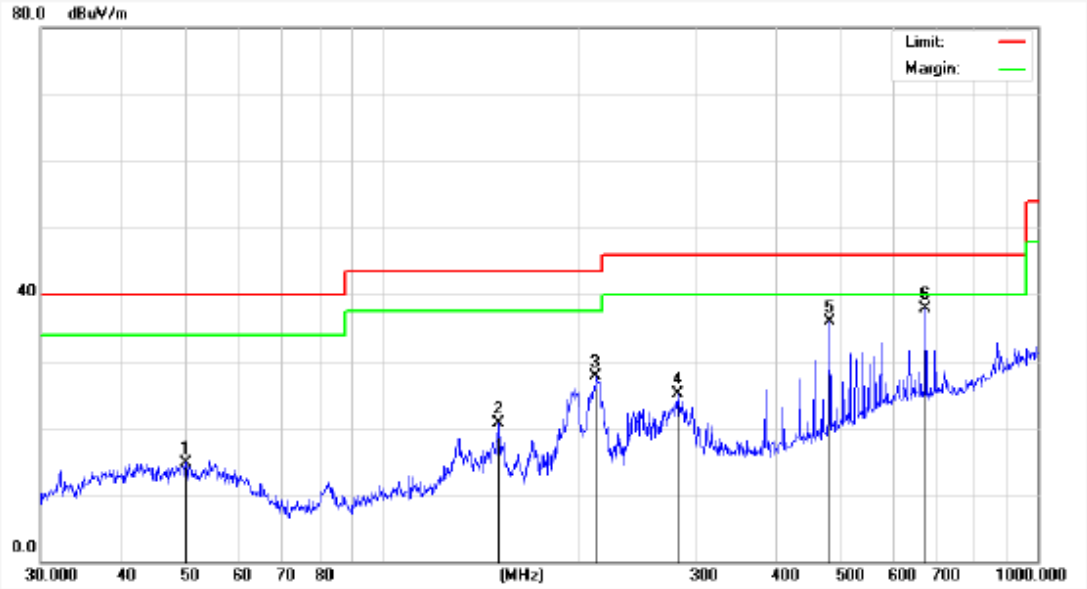
| | |
|---|---|
| Test Mode: | Mode 2 |
| Power Source: | DC 3.7V battery inside |
| Polarization: | Vertical |
| Temp.(℃)/Hum.(%RH): | 24.1℃/52%RH |




| No. | Freq. (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Detector | Height (cm) | degree (deg) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 32.4059 | 44.16 | -16.76 | 27.40 | 40.00 | -12.60 | peak | | | |
| 2 | 82.6482 | 43.30 | -17.23 | 26.07 | 40.00 | -13.93 | peak | | | |
| 3 | 130.8369 | 50.69 | -19.45 | 31.24 | 43.50 | -12.26 | peak | | | |
| 4 | 150.0108 | 55.15 | -19.91 | 35.24 | 43.50 | -8.26 | peak | | | |
| 5 | 383.9318 | 48.23 | -11.51 | 36.72 | 46.00 | -9.28 | peak | | | |
| 6 | 945.4399 | 32.56 | -0.92 | 31.64 | 46.00 | -14.36 | peak | | | |

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

| | |
|---|---|
| Test Mode: | Mode 2 |
| Power Source: | DC 3.7V battery inside |
| Polarization: | Horizontal |
| Temp.(℃)/Hum.(%RH): | 24.1℃/52%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 | 50.0566 | 29.67 | -14.87 | 14.80 | 40.00 | -25.20 | peak | | | |
| 2 | 150.0108 | 41.44 | -20.67 | 20.77 | 43.50 | -22.73 | peak | | | |
| 3 | 211.5265 | 47.33 | -19.63 | 27.70 | 43.50 | -15.80 | peak | | | |
| 4 | 281.9946 | 40.99 | -15.94 | 25.05 | 46.00 | -20.95 | peak | | | |
| 5 | 480.5276 | 46.72 | -10.85 | 35.87 | 46.00 | -10.13 | peak | | | |
| 6 | 672.8444 | 44.32 | -6.44 | 37.88 | 46.00 | -8.12 | peak | | | |

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

| Test Mode: CH00 | | | | | Test channel: Lowest | | | |
|---|---|---|---|---|---|---|---|---|
| Peak Value | | | | | | | | |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4804.00 | 36.48 | 34.04 | 6.58 | 34.09 | 43.01 | 74.00 | -30.99 | V |
| 7206.00 | 31.28 | 37.11 | 7.73 | 34.50 | 41.62 | 74.00 | -32.38 | V |
| 9608.00 | 30.98 | 39.31 | 9.23 | 34.79 | 44.73 | 74.00 | -29.27 | V |
| 12010.00 | * | | | | | 74.00 | | V |
| 14412.00 | * | | | | | 74.00 | | V |
| 4804.00 | 40.60 | 34.04 | 6.58 | 34.09 | 47.13 | 74.00 | -26.87 | H |
| 7206.00 | 32.97 | 37.11 | 7.73 | 34.50 | 43.31 | 74.00 | -30.69 | H |
| 9608.00 | 30.33 | 39.31 | 9.23 | 34.79 | 44.08 | 74.00 | -29.92 | H |
| 12010.00 | * | | | | | 74.00 | | H |
| 14412.00 | * | | | | | 74.00 | | H |
| Average Value | | | | | | | | |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4804.00 | 25.45 | 34.04 | 6.58 | 34.09 | 31.98 | 54.00 | -22.02 | V |
| 7206.00 | 20.06 | 37.11 | 7.73 | 34.50 | 30.40 | 54.00 | -23.60 | V |
| 9608.00 | 19.19 | 39.31 | 9.23 | 34.79 | 32.94 | 54.00 | -21.06 | V |
| 12010.00 | * | | | | | 54.00 | | V |
| 14412.00 | * | | | | | 54.00 | | V |
| 4804.00 | 29.59 | 34.04 | 6.58 | 34.09 | 36.12 | 54.00 | -17.88 | H |
| 7206.00 | 22.18 | 37.11 | 7.73 | 34.50 | 32.52 | 54.00 | -21.48 | H |
| 9608.00 | 18.85 | 39.31 | 9.23 | 34.79 | 32.60 | 54.00 | -21.40 | H |
| 12010.00 | * | | | | | 54.00 | | H |
| 14412.00 | * | | | | | 54.00 | | H |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Hotline 400-003-0500
www.anbotek.com

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

| Test Mode: CH39 | | | | | Test channel: Middle | | | |
|---|---|---|---|---|---|---|---|---|
| Peak Value | | | | | | | | |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4882.00 | 37.87 | 34.38 | 6.69 | 34.09 | 44.85 | 74.00 | -29.15 | V |
| 7323.00 | 32.20 | 37.22 | 7.78 | 34.53 | 42.67 | 74.00 | -31.33 | V |
| 9764.00 | 31.80 | 39.46 | 9.35 | 34.80 | 45.81 | 74.00 | -28.19 | V |
| 12205.00 | * | | | | | 74.00 | | V |
| 14646.00 | * | | | | | 74.00 | | V |
| 4882.00 | 42.27 | 34.38 | 6.69 | 34.09 | 49.25 | 74.00 | -24.75 | H |
| 7323.00 | 34.01 | 37.22 | 7.78 | 34.53 | 44.48 | 74.00 | -29.52 | H |
| 9764.00 | 31.28 | 39.46 | 9.35 | 34.80 | 45.29 | 74.00 | -28.71 | H |
| 12205.00 | * | | | | | 74.00 | | H |
| 14646.00 | * | | | | | 74.00 | | H |
| Average Value | | | | | | | | |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4882.00 | 26.59 | 34.38 | 6.69 | 34.09 | 33.57 | 54.00 | -20.43 | V |
| 7323.00 | 20.84 | 37.22 | 7.78 | 34.53 | 31.31 | 54.00 | -22.69 | V |
| 9764.00 | 19.88 | 39.46 | 9.35 | 34.80 | 33.89 | 54.00 | -20.11 | V |
| 12205.00 | * | | | | | 54.00 | | V |
| 14646.00 | * | | | | | 54.00 | | V |
| 4882.00 | 30.88 | 34.38 | 6.69 | 34.09 | 37.86 | 54.00 | -16.14 | H |
| 7323.00 | 23.05 | 37.22 | 7.78 | 34.53 | 33.52 | 54.00 | -20.48 | H |
| 9764.00 | 19.66 | 39.46 | 9.35 | 34.80 | 33.67 | 54.00 | -20.33 | H |
| 12205.00 | * | | | | | 54.00 | | H |
| 14646.00 | * | | | | | 54.00 | | H |


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

| Test Mode: CH78 | | | | | Test channel: Highest | | | |
|---|---|---|---|---|---|---|---|---|
| Peak Value | | | | | | | | |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4960.00 | 37.35 | 34.72 | 6.79 | 34.09 | 44.77 | 74.00 | -29.23 | V |
| 7440.00 | 31.86 | 37.34 | 7.82 | 34.57 | 42.45 | 74.00 | -31.55 | V |
| 9920.00 | 31.49 | 39.62 | 9.46 | 34.81 | 45.76 | 74.00 | -28.24 | V |
| 12400.00 | * | | | | | 74.00 | | V |
| 14880.00 | * | | | | | 74.00 | | V |
| 4960.00 | 41.64 | 34.72 | 6.79 | 34.09 | 49.06 | 74.00 | -24.94 | H |
| 7440.00 | 33.62 | 37.34 | 7.82 | 34.57 | 44.21 | 74.00 | -29.79 | H |
| 9920.00 | 30.92 | 39.62 | 9.46 | 34.81 | 45.19 | 74.00 | -28.81 | H |
| 12400.00 | * | | | | | 74.00 | | H |
| 14880.00 | * | | | | | 74.00 | | H |
| Average Value | | | | | | | | |
| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Level (dBuV/m) | Limit (dBuV/m) | Over Limit (dB) | Pol. |
| 4960.00 | 26.24 | 34.72 | 6.79 | 34.09 | 33.66 | 54.00 | -20.34 | V |
| 7440.00 | 20.60 | 37.34 | 7.82 | 34.57 | 31.19 | 54.00 | -22.81 | V |
| 9920.00 | 19.67 | 39.62 | 9.46 | 34.81 | 33.94 | 54.00 | -20.06 | V |
| 12400.00 | * | | | | | 54.00 | | V |
| 14880.00 | * | | | | | 54.00 | | V |
| 4960.00 | 30.49 | 34.72 | 6.79 | 34.09 | 37.91 | 54.00 | -16.09 | H |
| 7440.00 | 22.78 | 37.34 | 7.82 | 34.57 | 33.37 | 54.00 | -20.63 | H |
| 9920.00 | 19.41 | 39.62 | 9.46 | 34.81 | 33.68 | 54.00 | -20.32 | H |
| 12400.00 | * | | | | | 54.00 | | H |
| 14880.00 | * | | | | | 54.00 | | H |

Remark:

1. During the test, pre-scan the GFSK, π/4QPSK modulation, and found the GFSK modulation is worse case, the report only record this mode.
2. Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
3. "*" means the test results were attenuated more than 20dB below the permissible limits, so the results don't record in the report.


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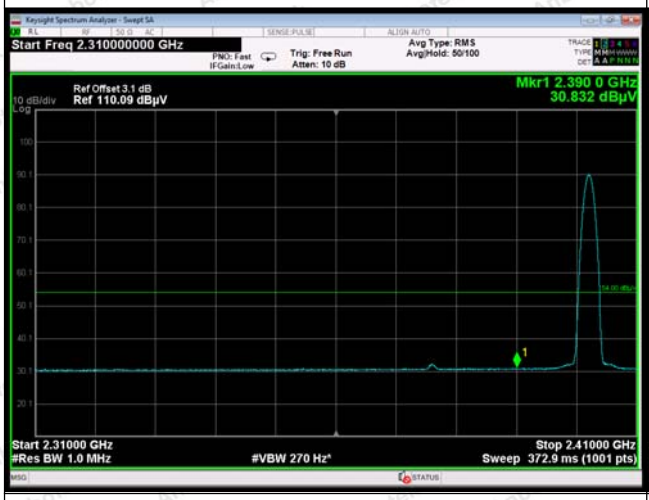
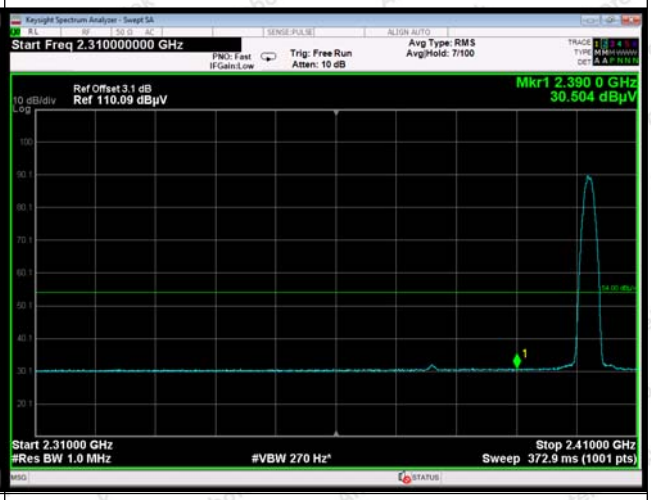
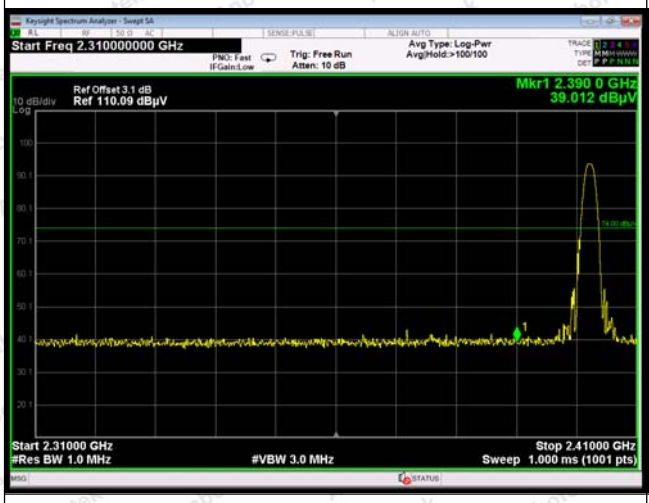
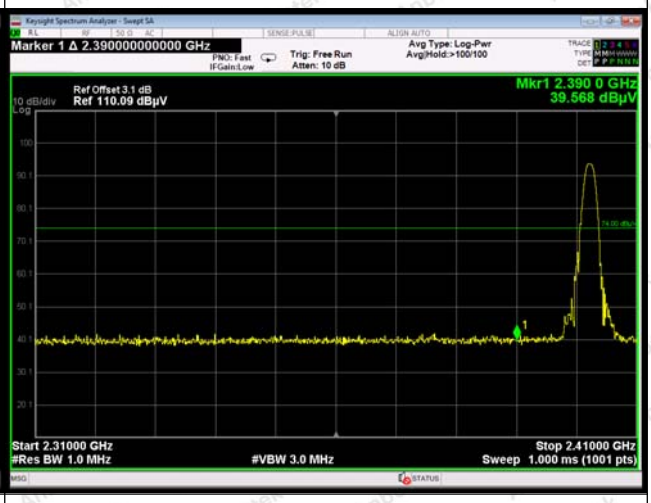
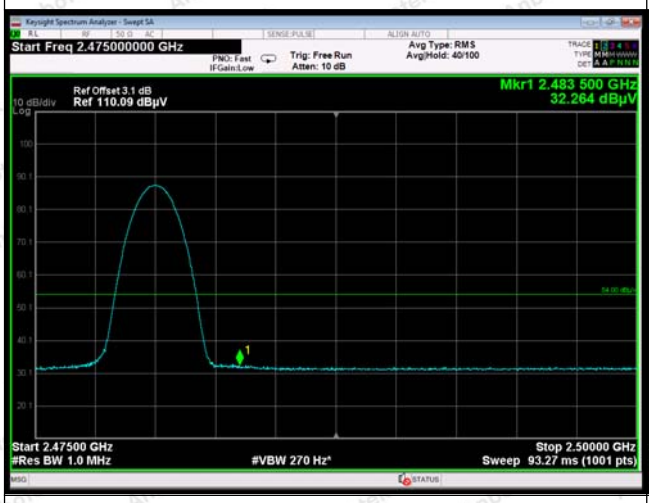
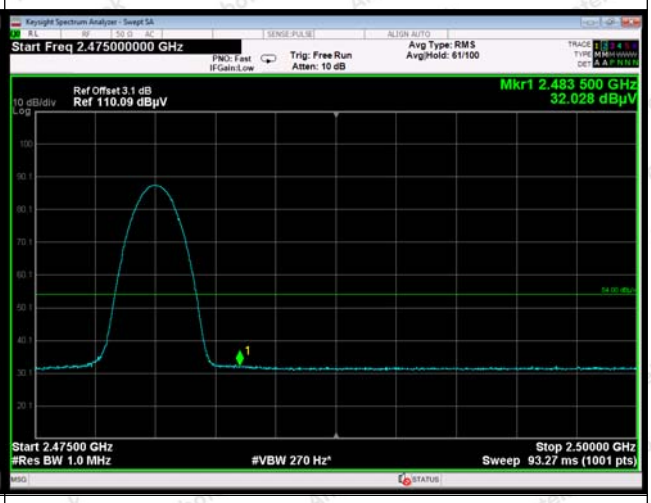
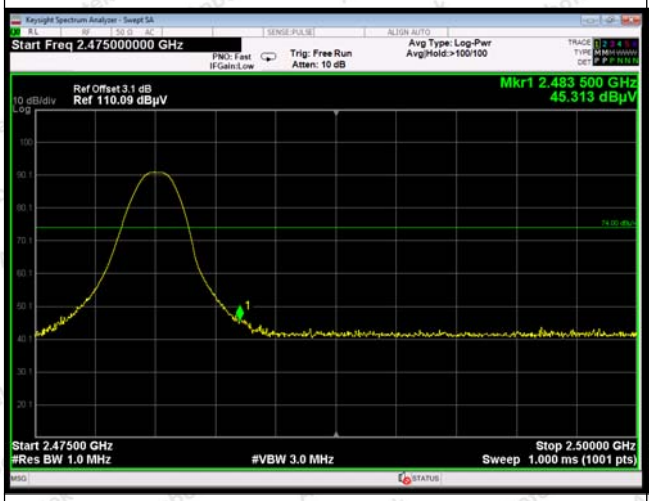
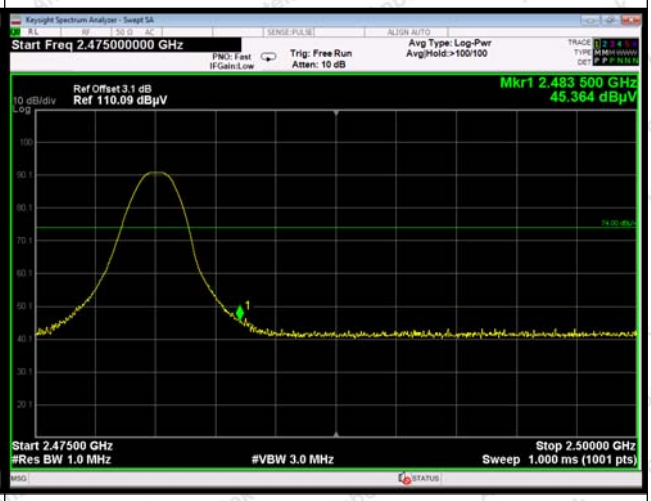
**Radiated Band Edge:**

| Test Mode: CH00 | Test channel: Lowest |
|---|---|
|   |   |
| Average Value(Vertical) | Average Value(Horizontal) |
|   |   |
| Peak Value(Vertical) | Peak Value(Horizontal) |

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

Remark:

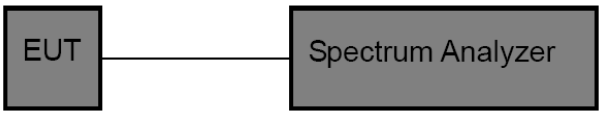
1. During the test, pre-scan the GFSK, π/4QPSK modulation, and found the GFSK modulation is worse case, the report only record this mode.
2. Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

# 5. Maximum Peak Output Power Test

## 5.1. Test Standard and Limit

| | |
|---|---|
| Test Standard | FCC Part15 C Section 15.247 (b)(3) |
| Test Limit | 125mW |

## 5.2. Test Setup



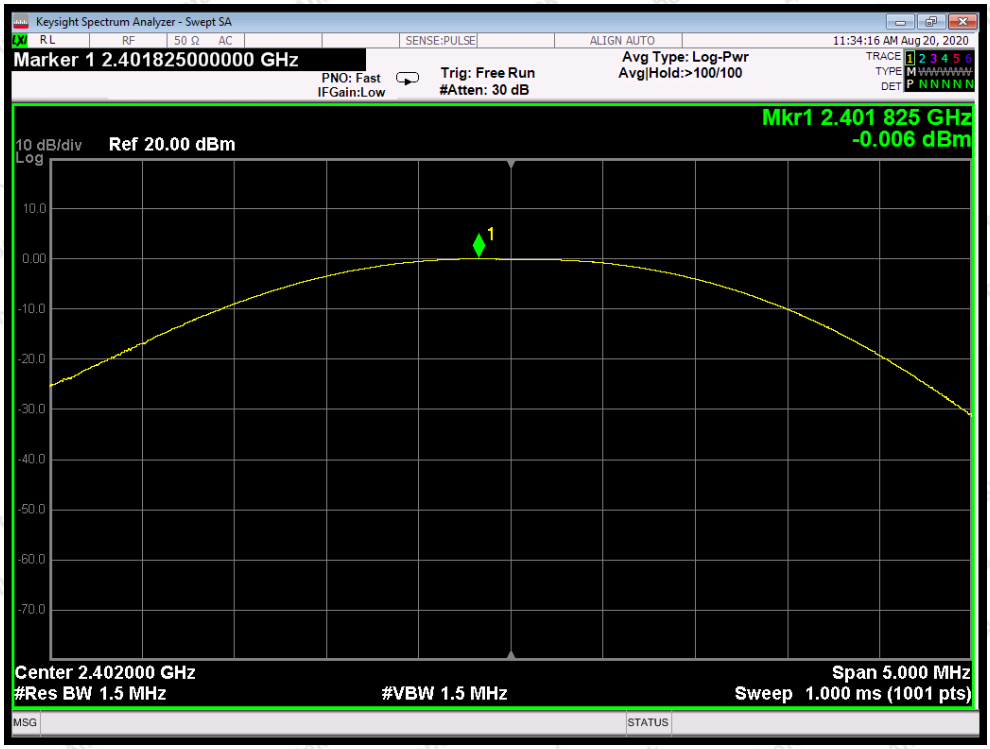

## 5.3. Test Procedure

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

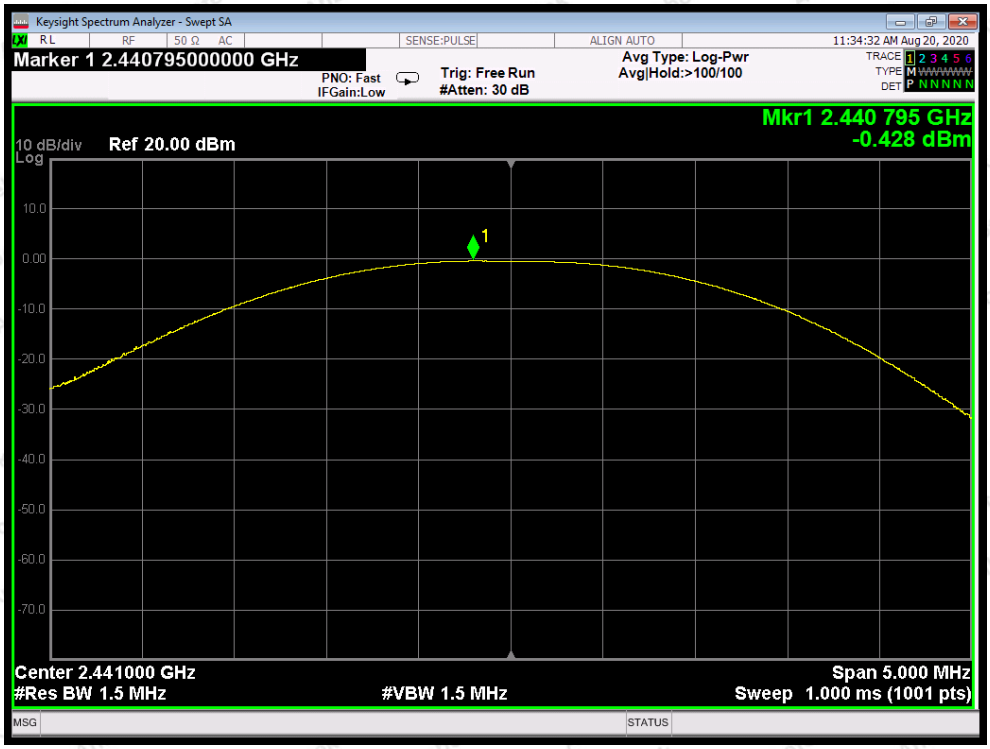
## 5.4. Test Data

| | | | | | |
|---|---|---|---|---|---|
| Test Item | : | Max. peak output power | Test Mode | : | CH Low ~ CH High |
| Test Voltage | : | DC 3.7V Battery inside | Temperature | : | 21.7℃ |
| Test Result | : | PASS | Humidity | : | 52%RH |

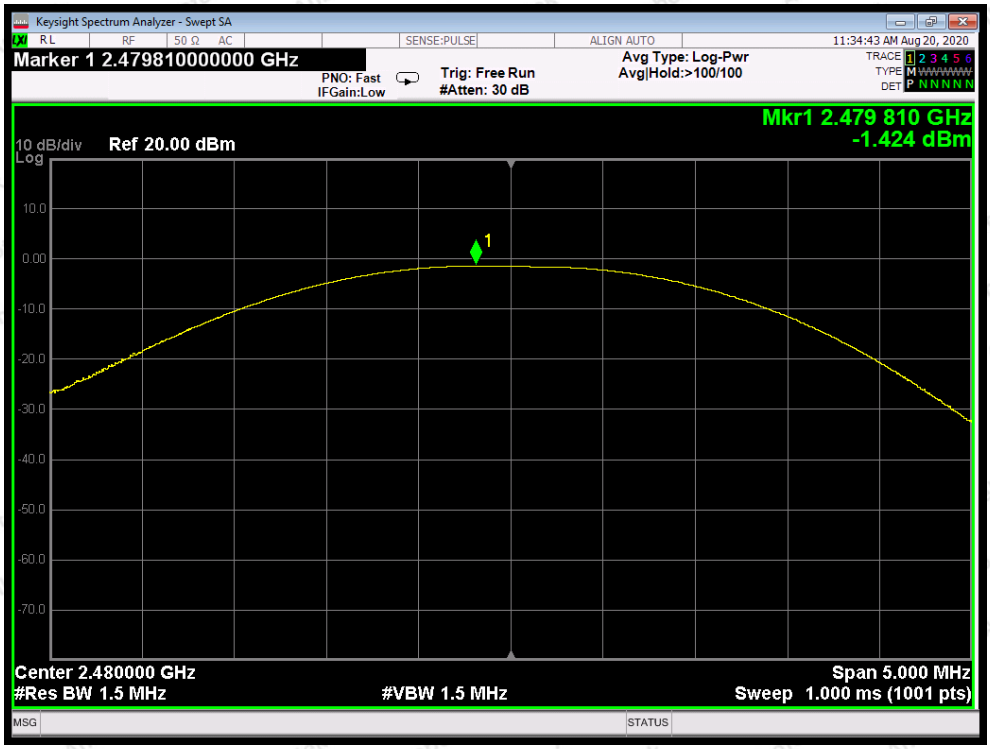
| Channel Frequency (MHz) | Peak Power output (dBm) | Limit (dBm) | Results | Modulation |
|---|---|---|---|---|
| 2402 | -0.006 | 20.96 | PASS | BDR |
| 2441 | -0.428 | 20.96 | PASS | BDR |
| 2480 | -1.424 | 20.96 | PASS | BDR |
| 2402 | 0.525 | 20.96 | PASS | EDR |
| 2441 | 0.131 | 20.96 | PASS | EDR |
| 2480 | -0.894 | 20.96 | PASS | EDR |
| | | | | |



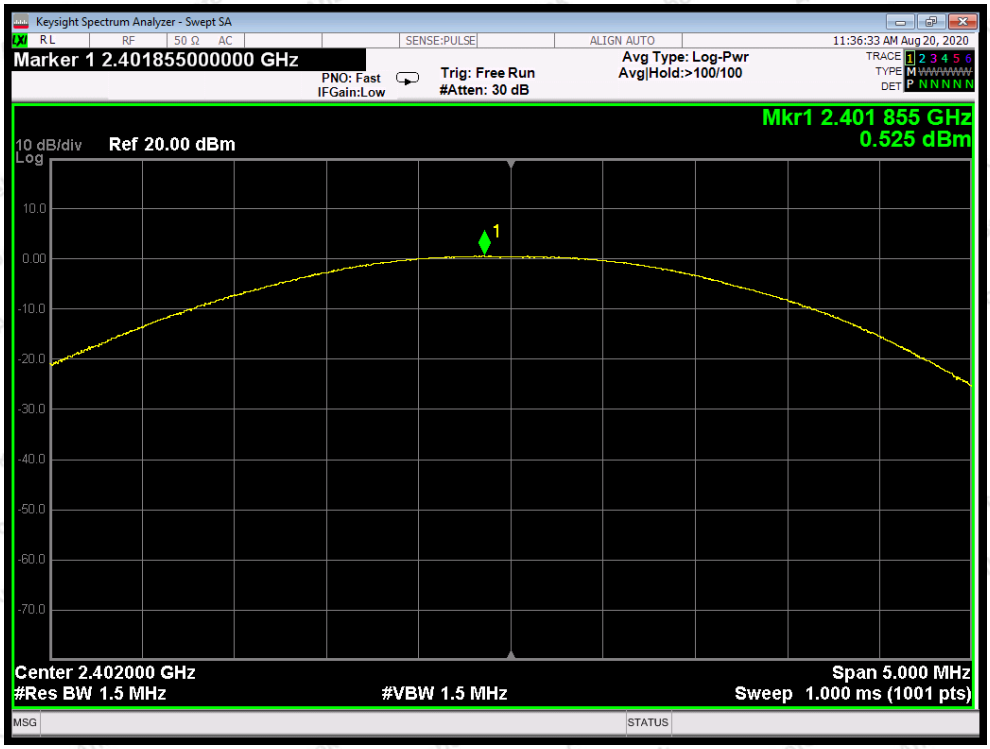

Test Mode: BDR---Low



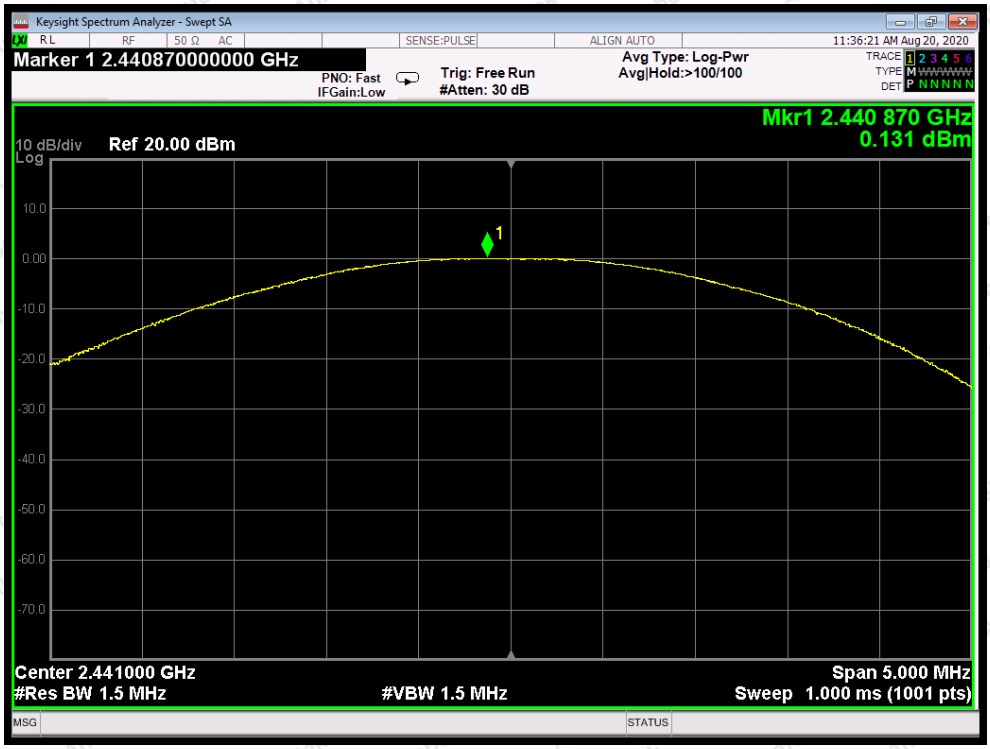

Test Mode: BDR---Middle



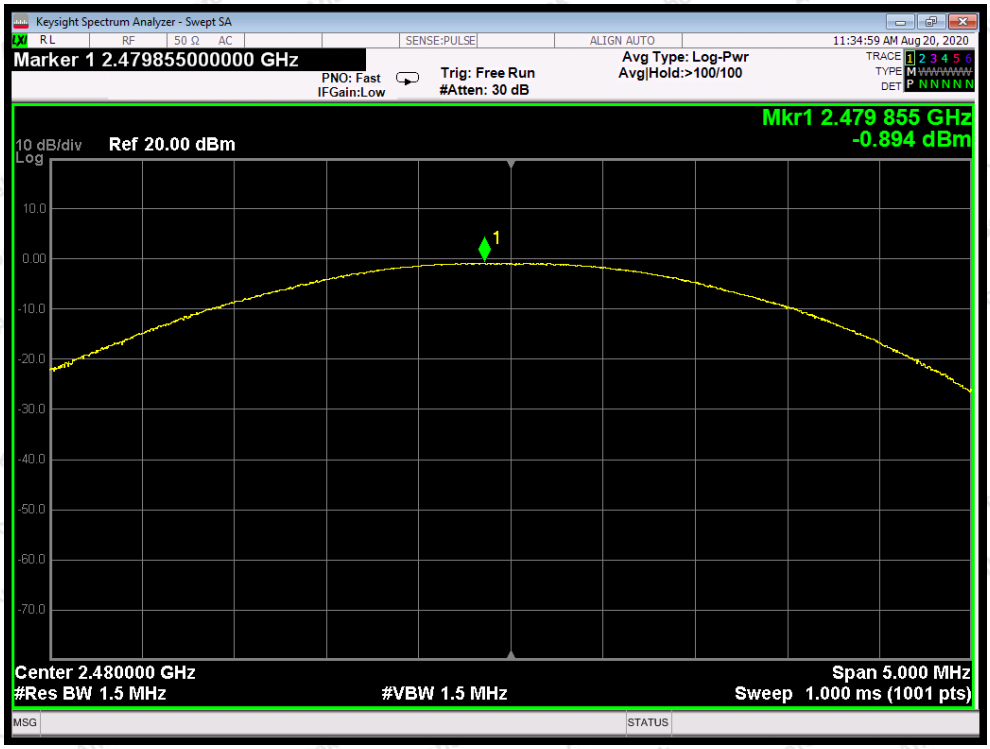

Test Mode: BDR---High




Test Mode: EDR---Low




Test Mode: EDR---Middle



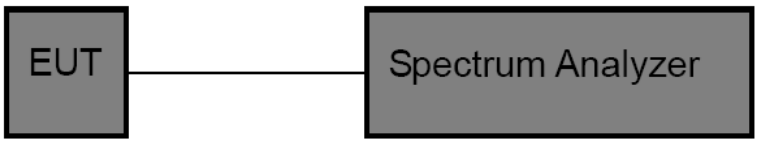

Test Mode: EDR---High

# 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

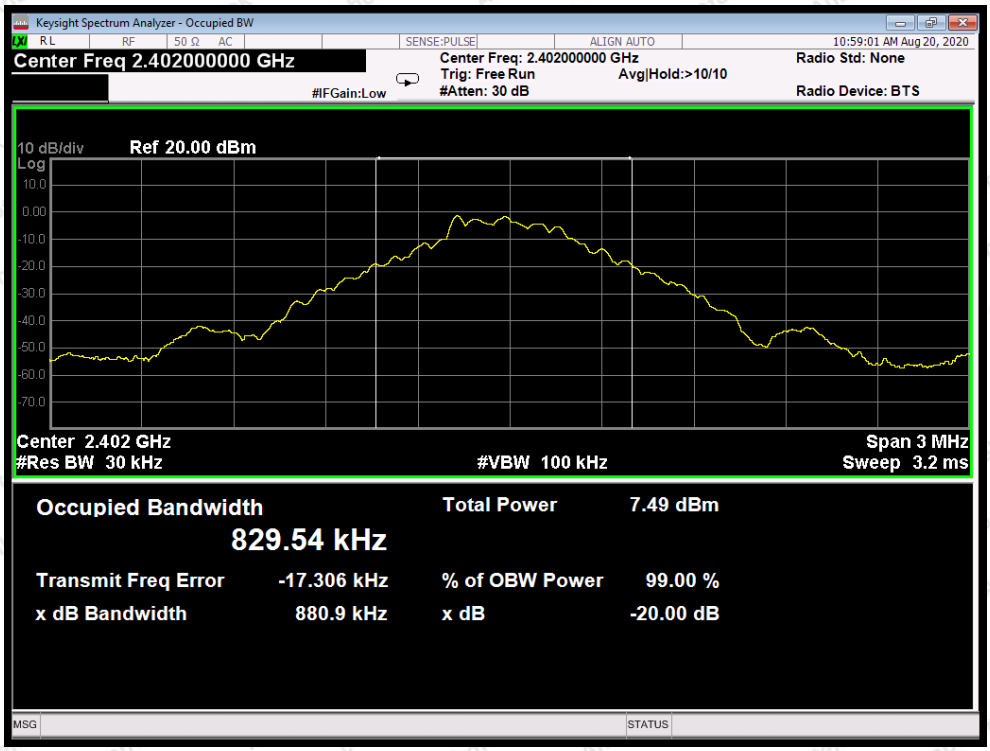
Using the following spectrum analyzer settings:

1. Span= approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel.
2. Set the RBW = 30 kHz.
3. Set the VBW = 100 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

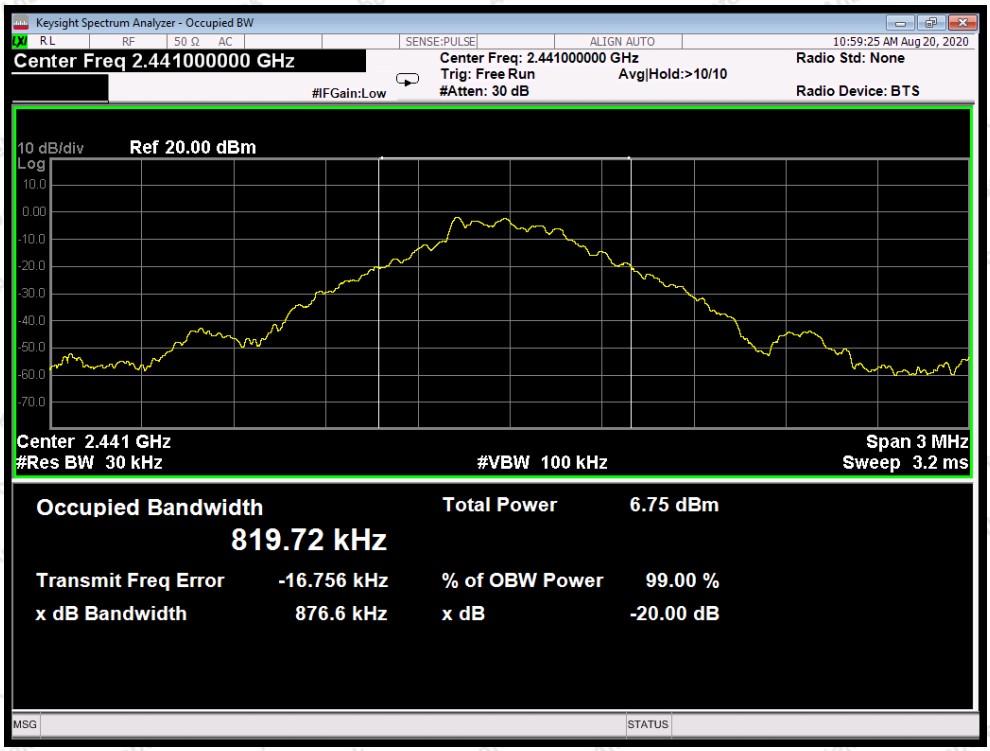
## 6.4. Test Data

| | | | | | |
|---|---|---|---|---|---|
| Test Item | : | 20dB BW | Test Mode | : | CH Low ~ CH High |
| Test Voltage | : | DC 3.7V Battery inside | Temperature | : | 21.7℃ |
| Test Result | : | PASS | Humidity | : | 52%RH |

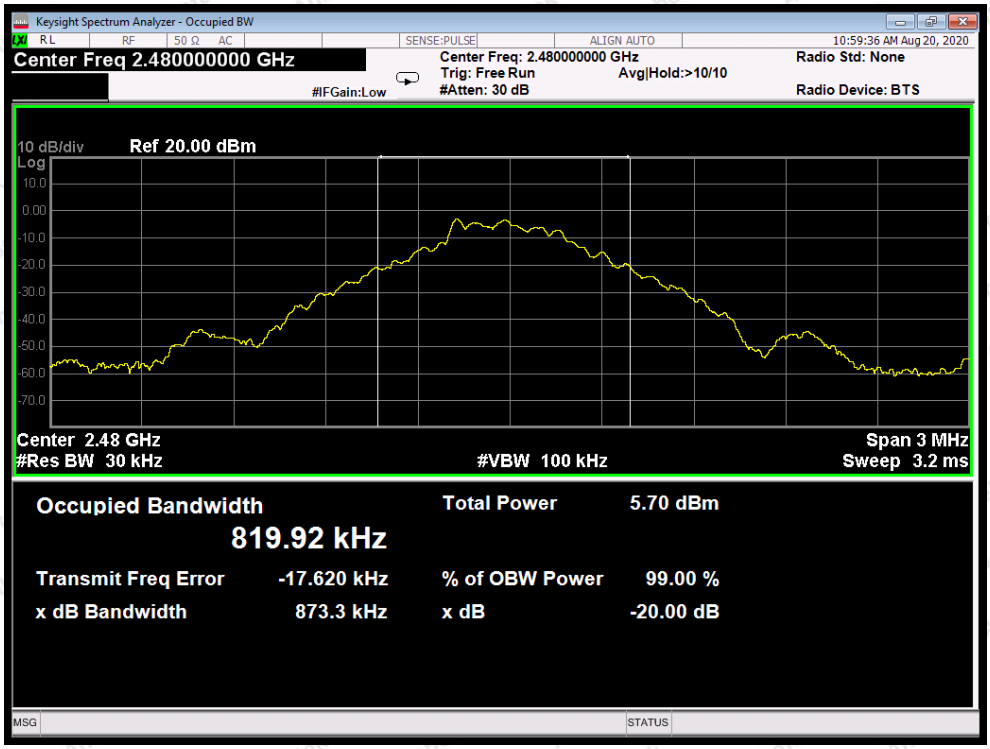
| Channel | Frequency(MHz) | 20dB Down BW(kHz) | Modulation Mode |
|---|---|---|---|
| Low | 2402 | 880.9 | BDR |
| Middle | 2441 | 876.6 | BDR |
| High | 2480 | 873.3 | BDR |
| Low | 2402 | 1235 | EDR |
| Middle | 2441 | 1259 | EDR |
| High | 2480 | 1236 | EDR |
| | | | |



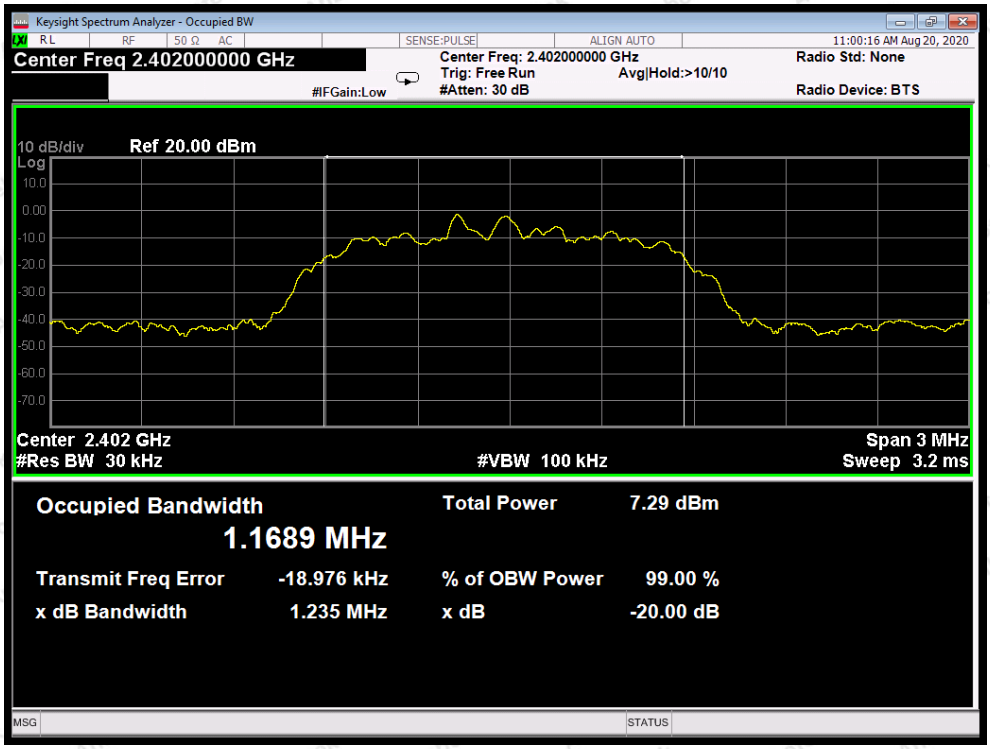

Test Mode: BDR---Low



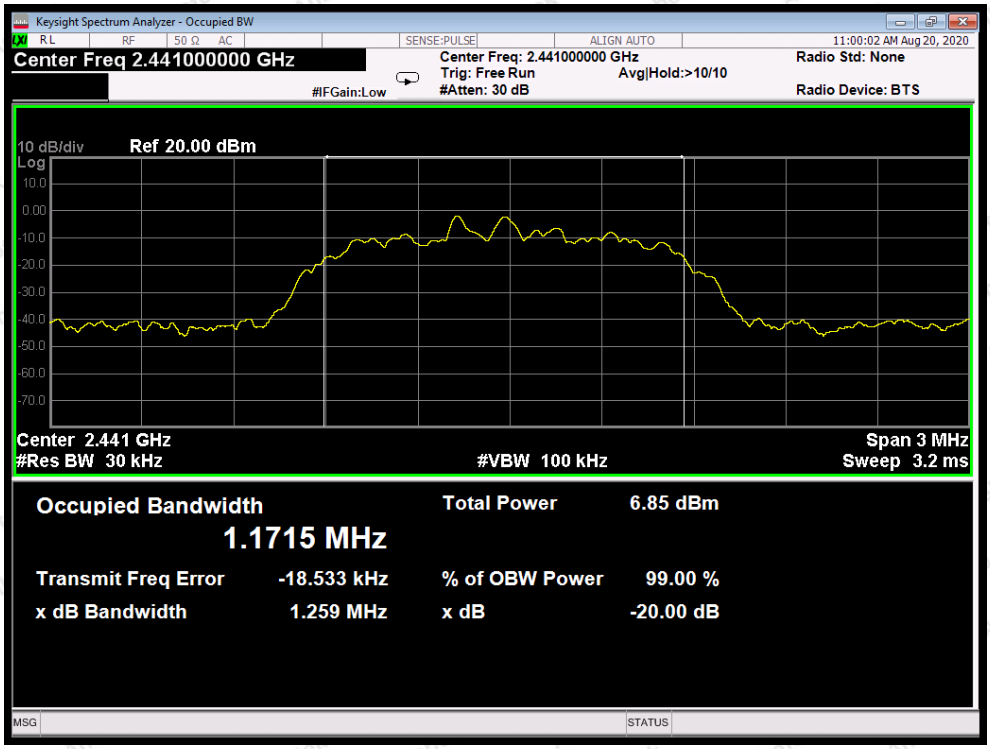

Test Mode: BDR---Middle



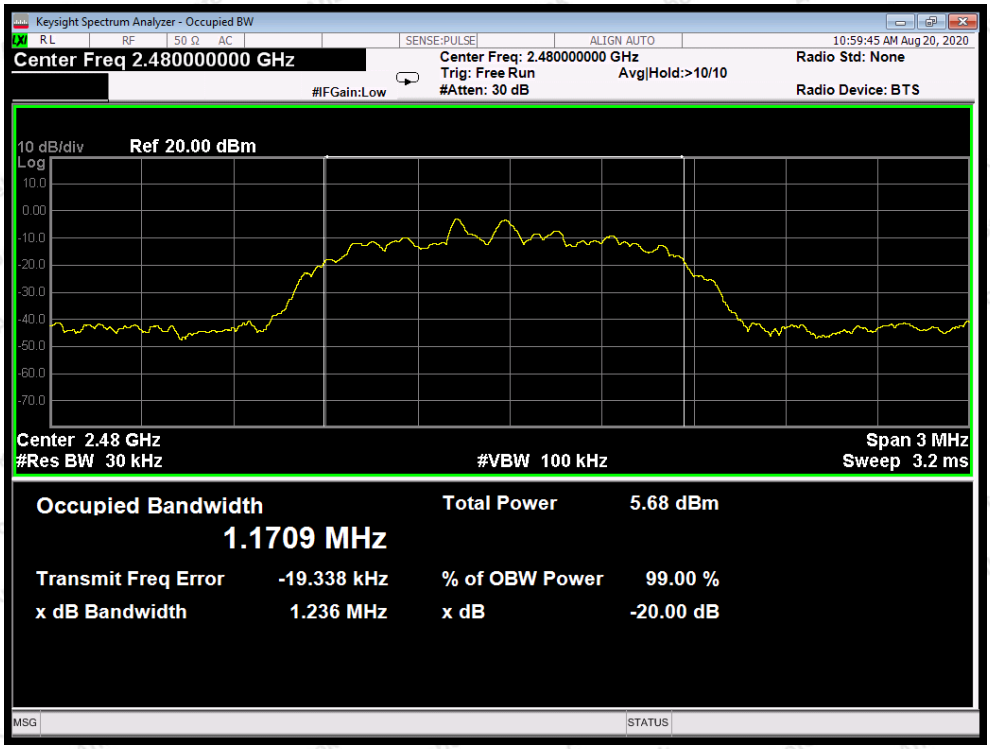

Test Mode: BDR---High




Test Mode: EDR---Low




Test Mode: EDR---Middle



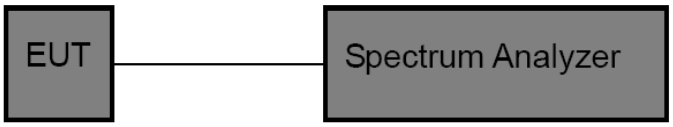

Test Mode: EDR---High

# 7. Carrier Frequency Separation Test

## 7.1. Test Standard and Limit

| | |
|---|---|
| Test Standard | FCC Part15 C Section 15.247 (a)(1) |
| Test Limit | >25KHz or >two-thirds of the 20 dB bandwidth |

## 7.2. Test Setup




## 7.3. Test Procedure

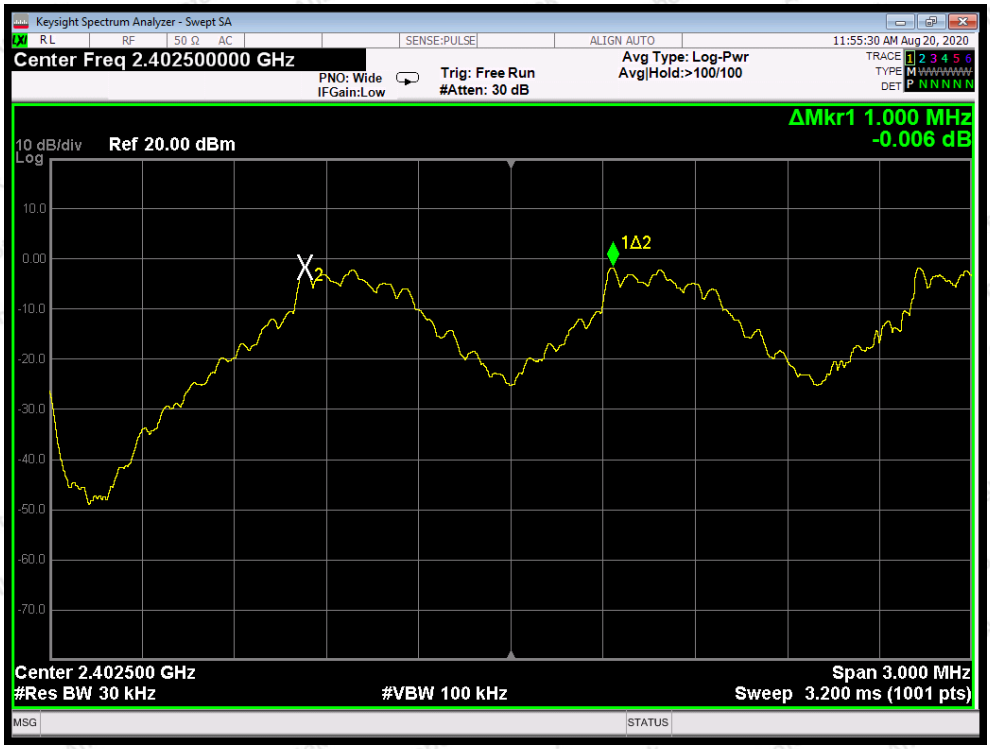
The EUT must have its hopping function enabled. Using the following spectrum analyzer settings:

1. Span= Wide enough to capture the peaks of two adjacent channels
2. Set the RBW = 30 kHz.
3. Set the VBW = 100 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

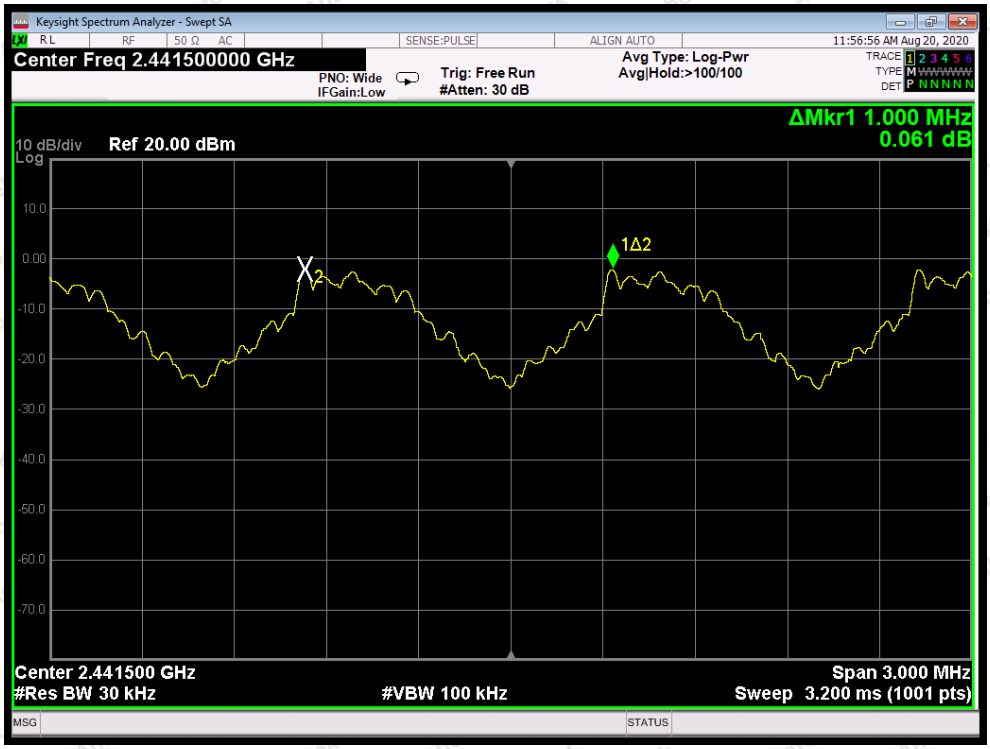
## 7.4. Test Data

| | | | | | |
|---|---|---|---|---|---|
| Test Item | : | Frequency Separation | Test Mode | : | CH Low ~ CH High |
| Test Voltage | : | DC 3.7V Battery inside | Temperature | : | 21.7℃ |
| Test Result | : | PASS | Humidity | : | 52%RH |

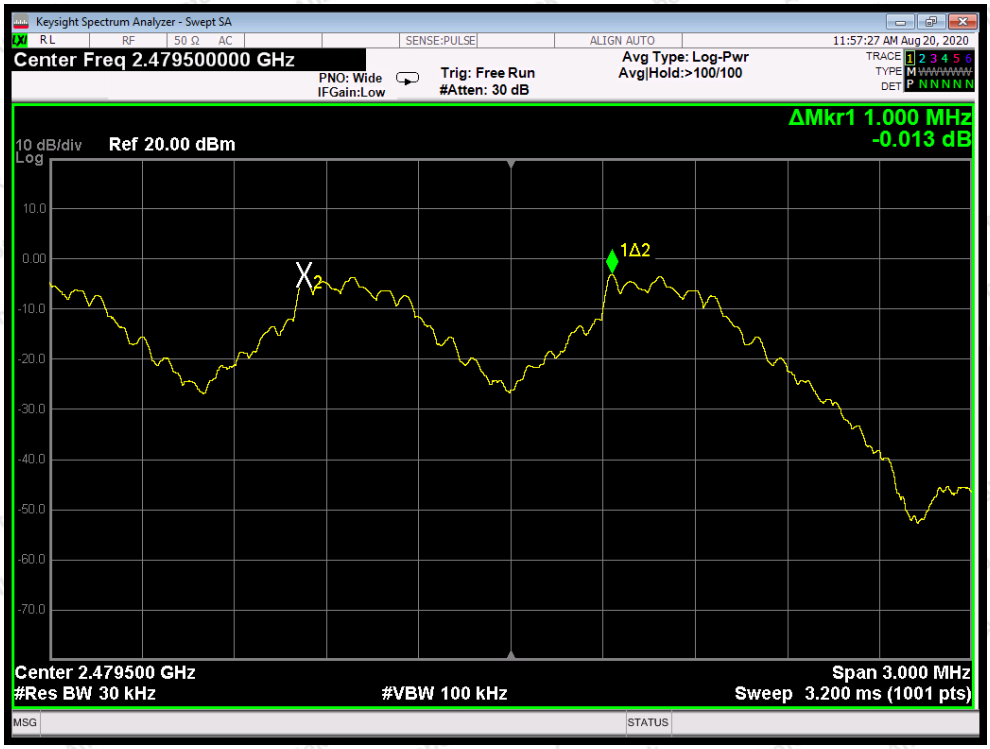
| Channel | Frequency (MHz) | Separation Read Value (kHz) | Limit (kHz) | Modulation Mode |
|---|---|---|---|---|
| Low | 2402 | 1000 | 880.9 | BDR |
| Middle | 2441 | 1000 | 876.6 | BDR |
| High | 2480 | 1000 | 873.3 | BDR |
| Low | 2402 | 1000 | 823.3 | EDR |
| Middle | 2441 | 1000 | 839.3 | EDR |
| High | 2480 | 1000 | 824.0 | EDR |
| Remark: The limit of EDR is 2/3 of 20dB BW. | | | | |




Test Mode: BDR---Low

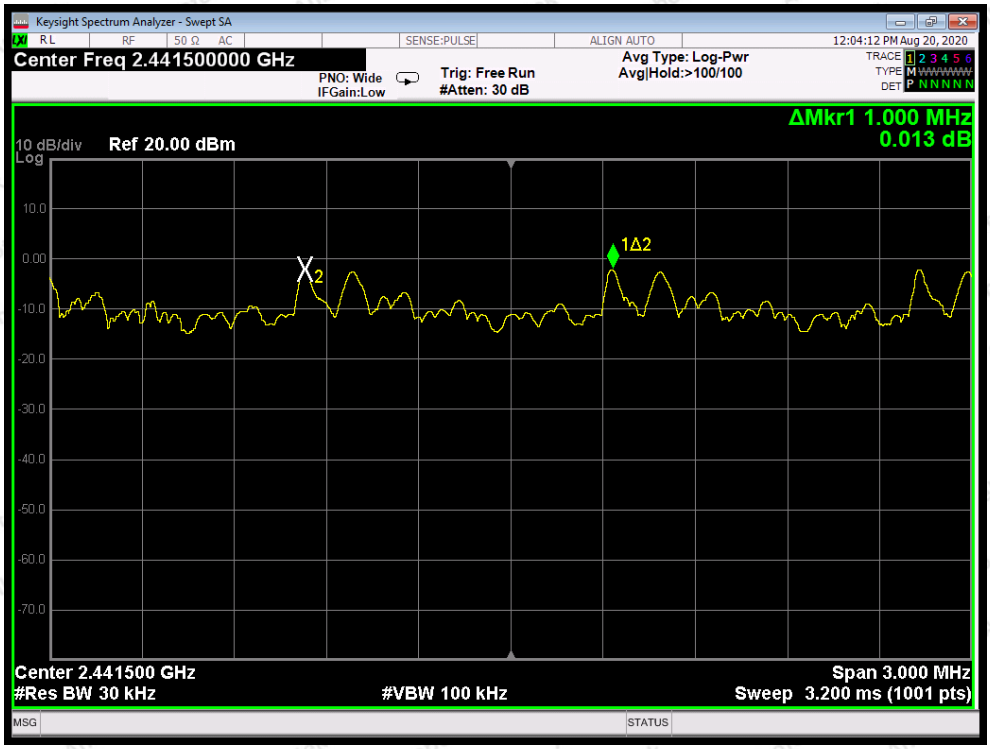



Test Mode: BDR---Middle

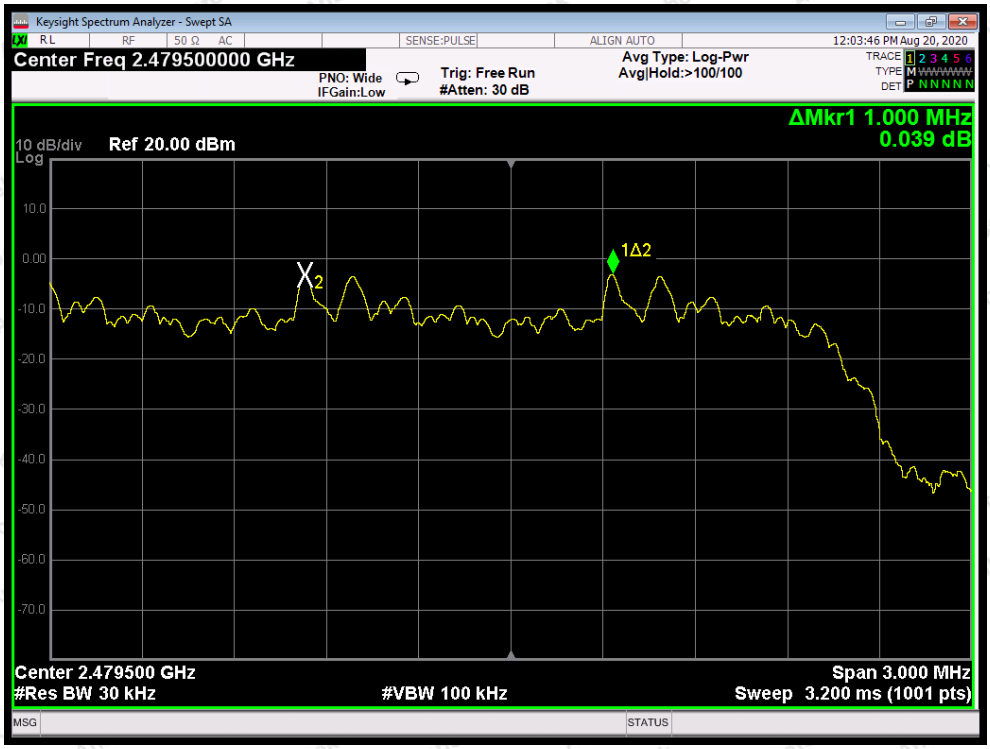



Test Mode: BDR---High

Test Mode: EDR---Low




Test Mode: EDR---Middle



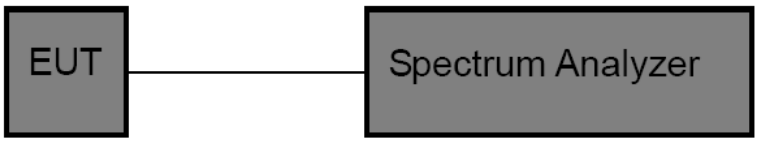

Test Mode: EDR---High

# 8. Number of Hopping Channel Test

## 8.1. Test Standard and Limit

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

## 8.2. Test Setup




## 8.3. Test Procedure

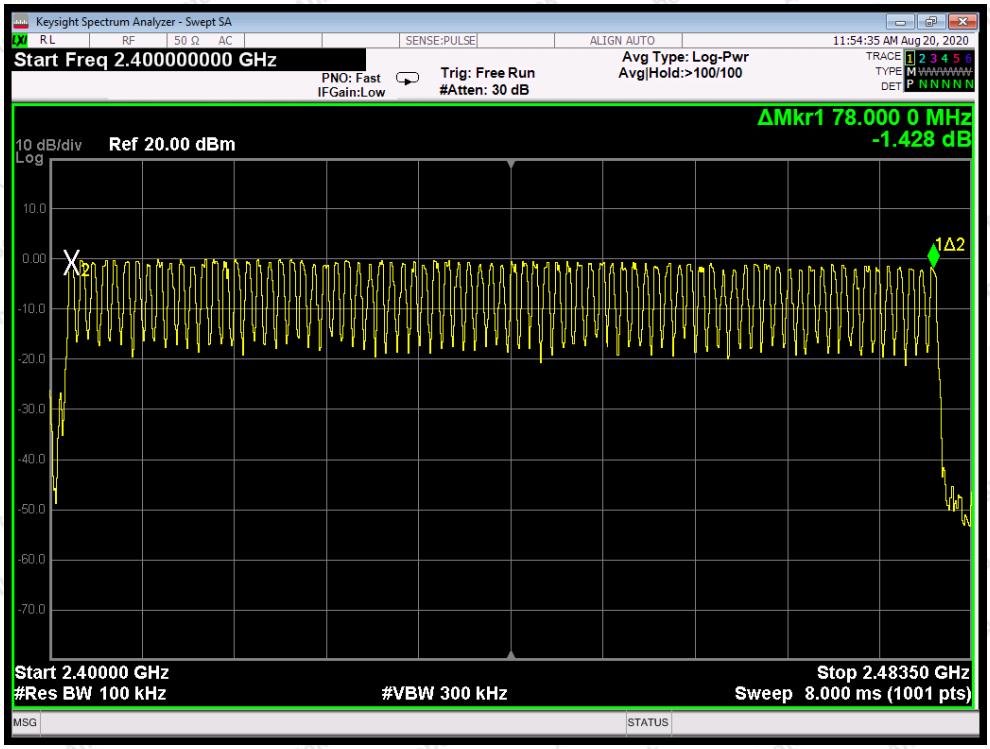
The EUT must have its hopping function enabled. Using the following spectrum analyzer setting:

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

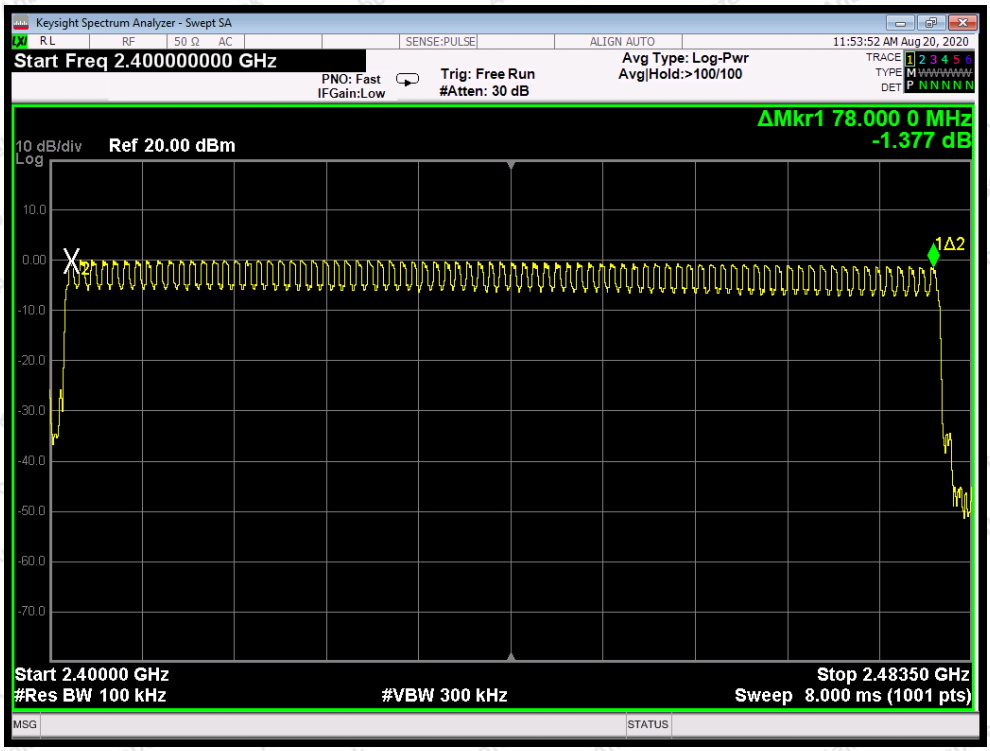
## 8.4. Test Data

| | | | | | |
|---|---|---|---|---|---|
| Test Item | : | Number of Hopping Frequency | Test Mode | : | CH Low ~ CH High |
| Test Voltage | : | DC 3.7V Battery inside | Temperature | : | 21.7℃ |
| Test Result | : | PASS | Humidity | : | 52%RH |

| Hopping Channel Frequency Range | Quantity of Hopping Channel | Quantity of Hopping Channel |
|---|---|---|
| 2402-2480MHz | 79 | ＞15 |
| | | |




BDR Mode



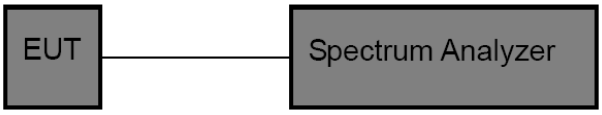

EDR Mode

# 9. Dwell Time Test

## 9.1. Test Standard and Limit

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

## 9.2. Test Setup




## 9.3. Test Procedure

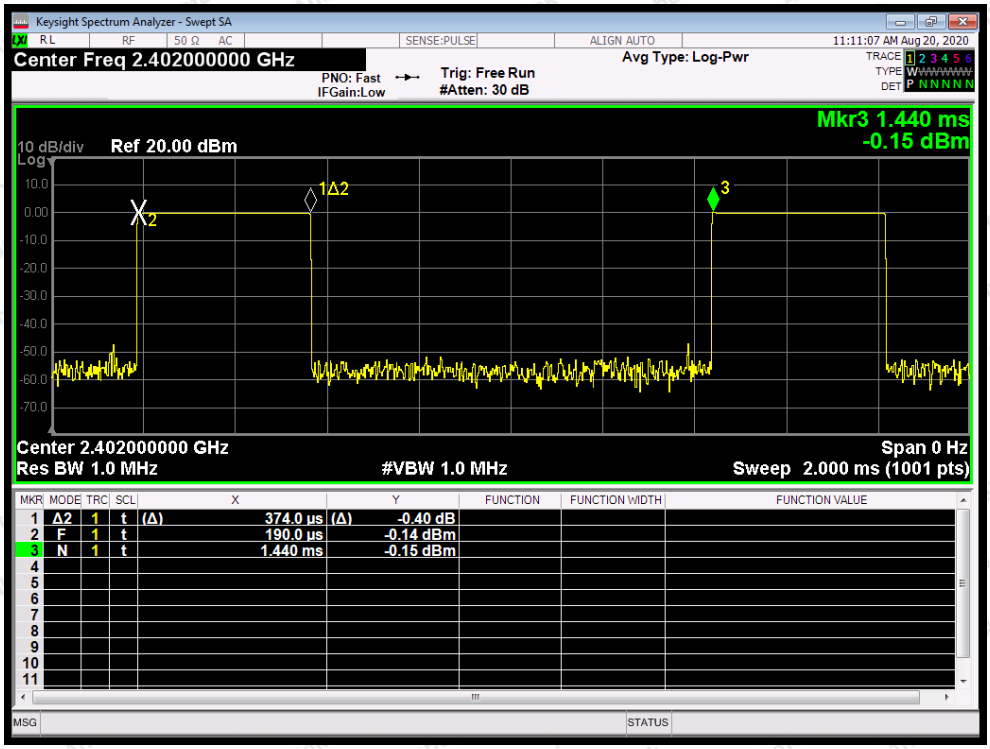
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span= zero span, centered on a hopping channel
2. Set the RBW = 1 MHz.
3. Set the VBW = 1 MHz.
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.

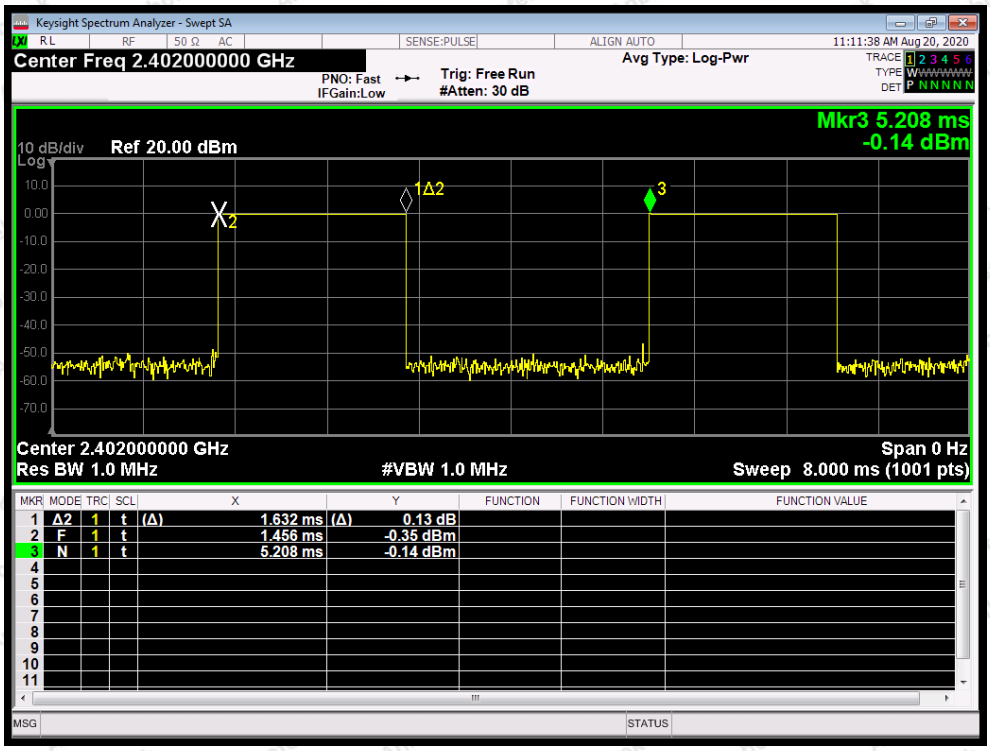
## 9.4. Test Data

| | | | | | |
|---|---|---|---|---|---|
| Test Item | : | Time of Occupancy | Test Mode | : | CH Low ~ CH High |
| Test Voltage | : | DC 3.7V Battery inside | Temperature | : | 21.7℃ |
| Test Result | : | PASS | Humidity | : | 52%RH |

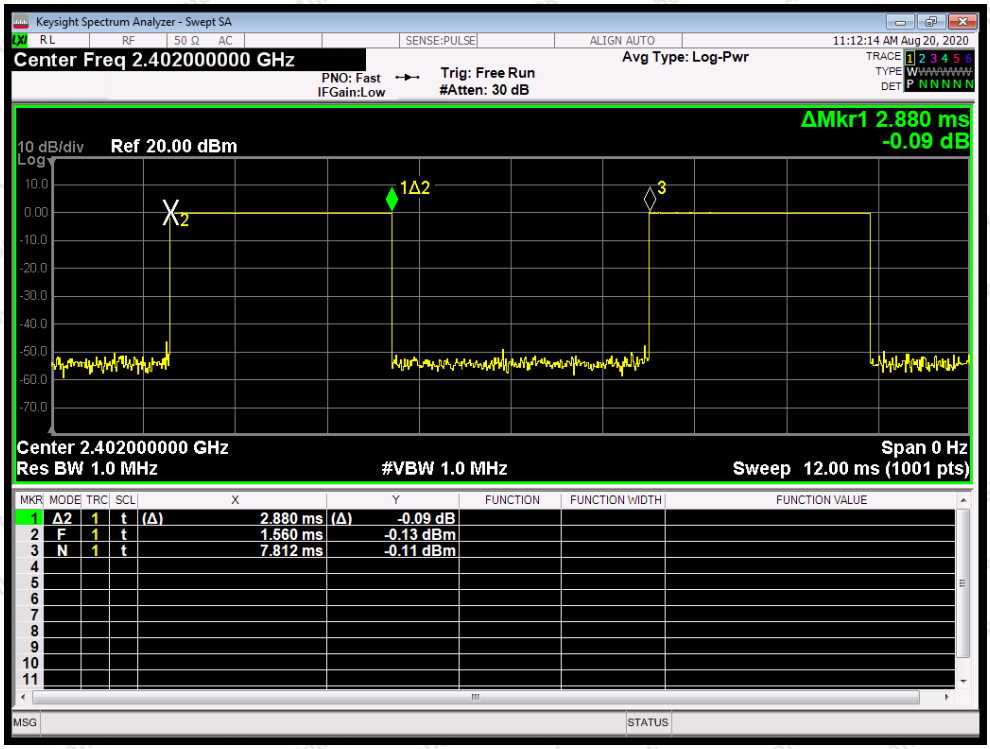
| Package Type | Pulse width (ms) | Time slot length(ms) | Dwell time (ms) | Limit (s) | Modulation |
|---|---|---|---|---|---|
| DH1 | 0.374 | time slot length *1600/2 /79 * 31.6 | 119.68 | 0.4 | BDR |
| DH3 | 1.632 | time slot length *1600/4 /79 * 31.6 | 261.12 | 0.4 | BDR |
| DH5 | 2.880 | time slot length *1600/6 /79 * 31.6 | 307.20 | 0.4 | BDR |
| 2DH1 | 0.384 | time slot length *1600/2 /79 * 31.6 | 122.88 | 0.4 | EDR |
| 2DH3 | 1.632 | time slot length *1600/4 /79 * 31.6 | 261.12 | 0.4 | EDR |
| 2DH5 | 2.892 | time slot length *1600/6 /79 * 31.6 | 308.48 | 0.4 | EDR |



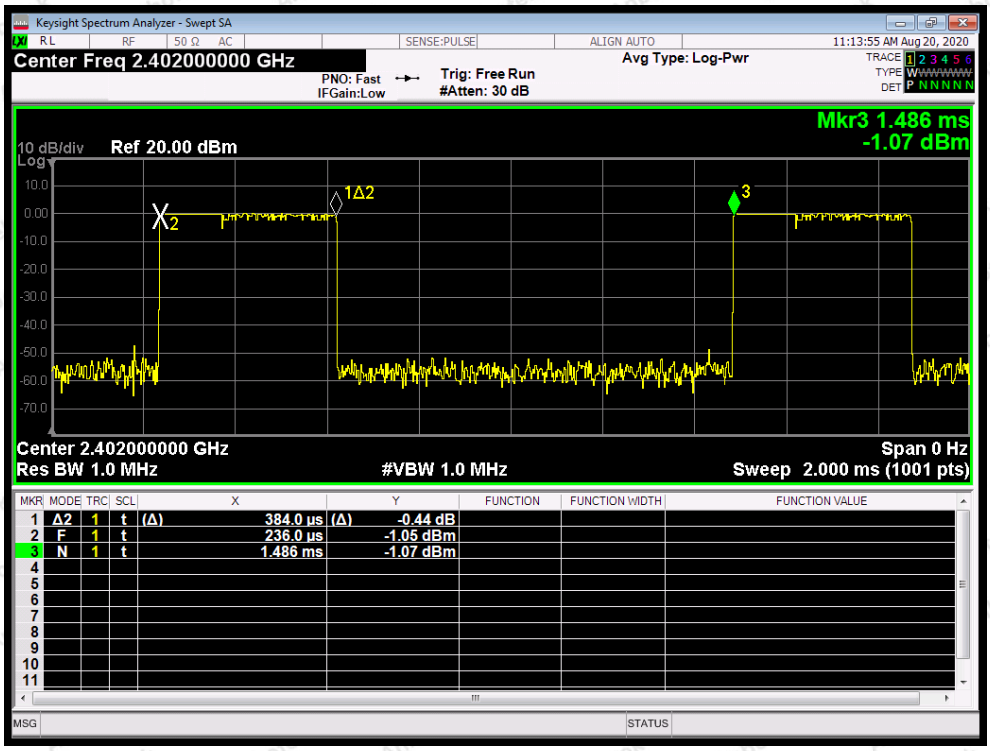

Test Mode: BDR---DH1



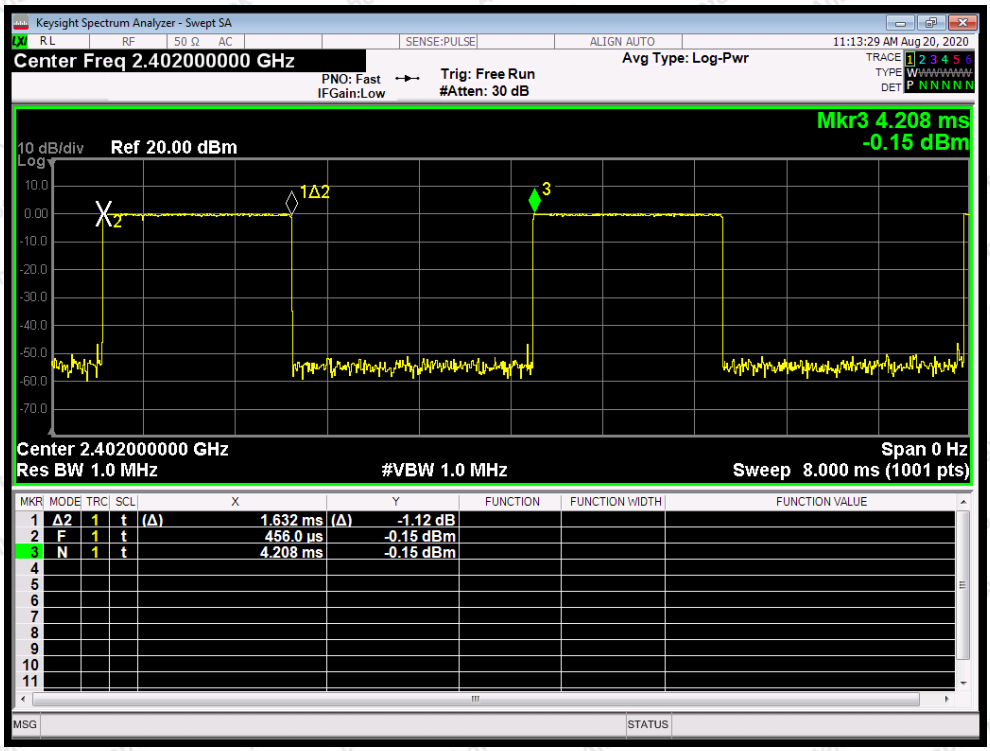

Test Mode: BDR---DH3



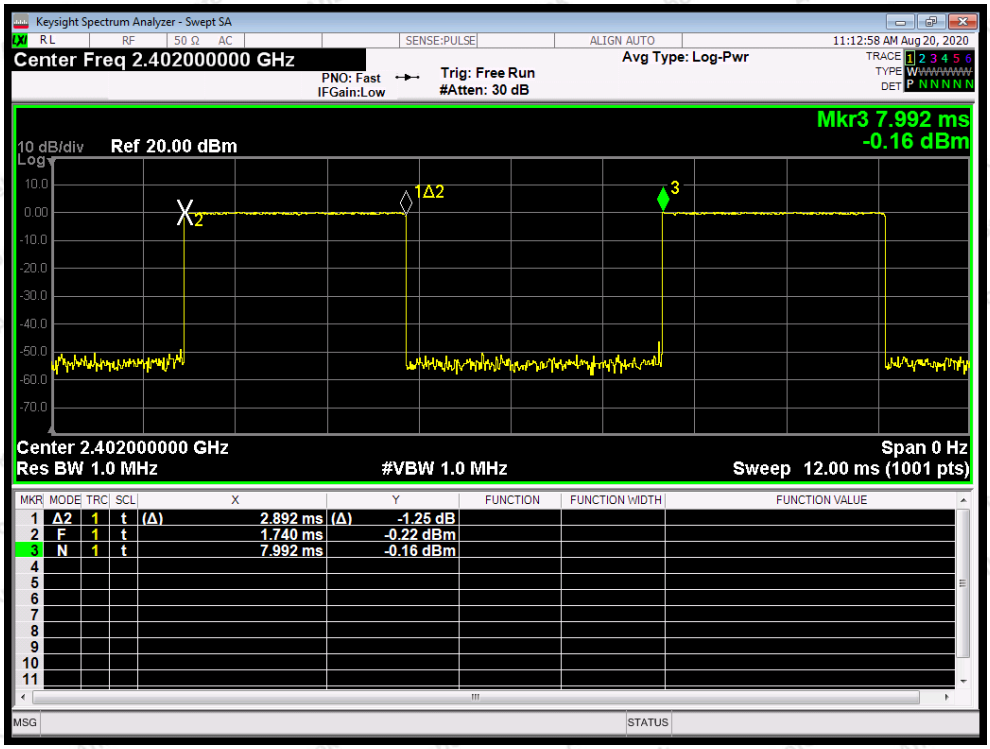

Test Mode: BDR---DH5




Test Mode: EDR---2DH1




Test Mode: EDR---2DH3



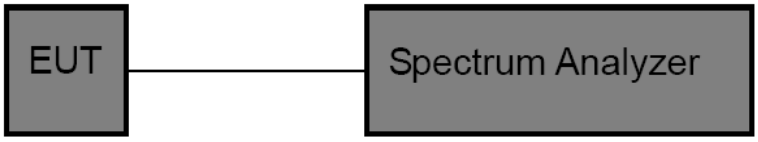

Test Mode: EDR---2DH5

# 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

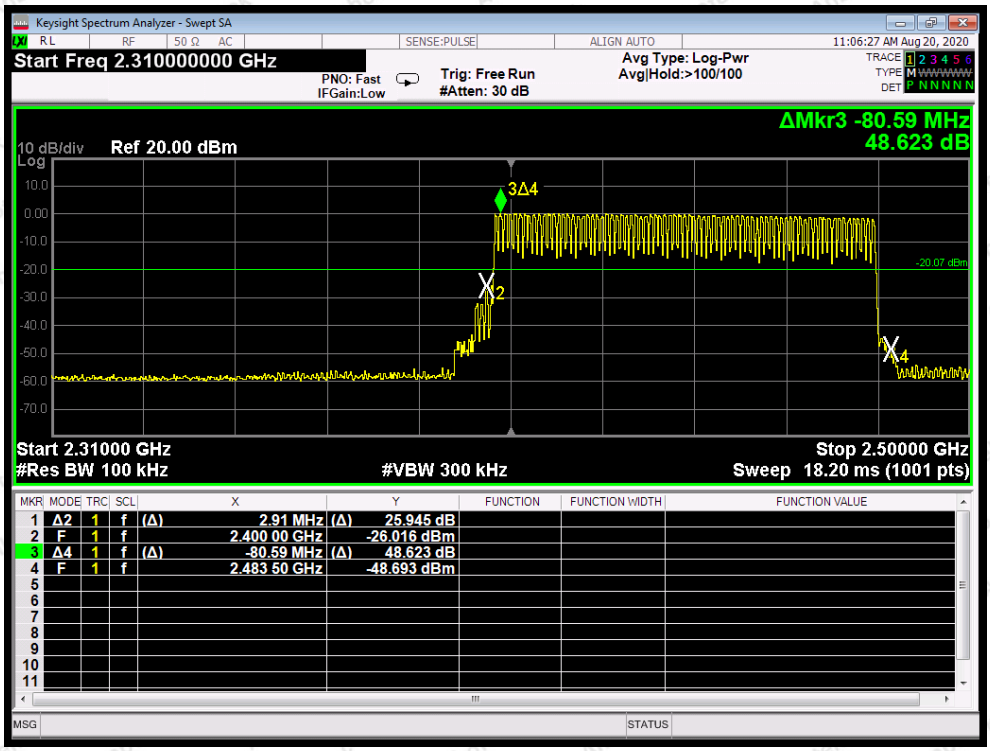
The EUT must have its hopping/Non-hopping function enabled. Using the following spectrum analyzer setting:

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.

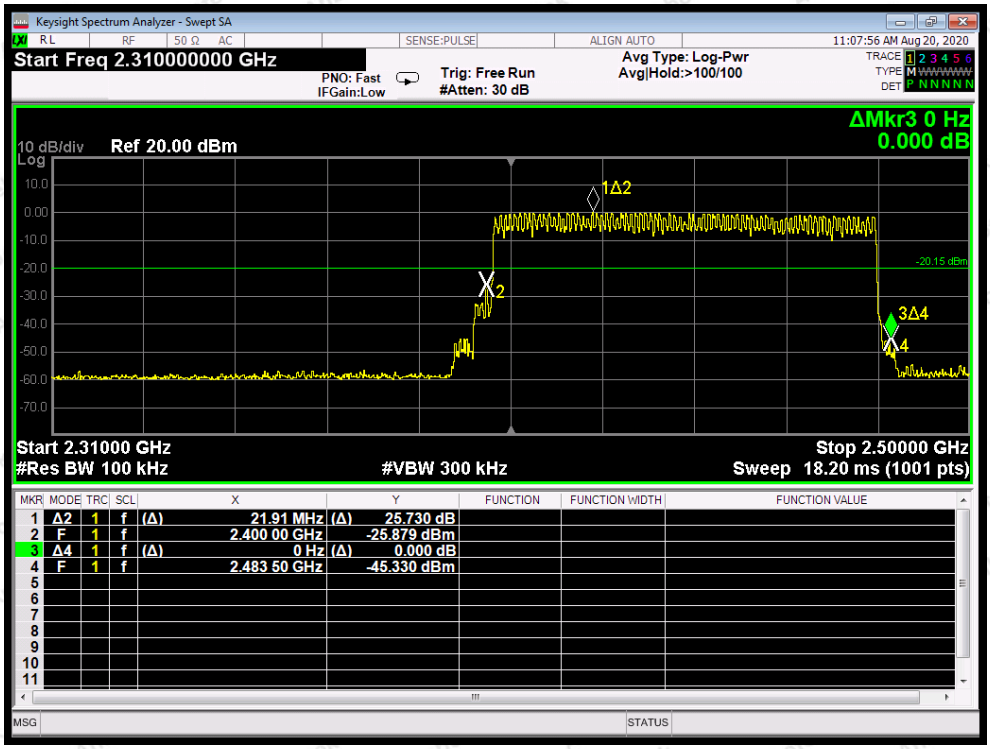
## 10.4. Test Data

| | | | | | |
|---|---|---|---|---|---|
| Test Item | : | Band edge | Test Mode | : | CH Low ~ CH High |
| Test Voltage | : | DC 3.7V Battery inside | Temperature | : | 21.7℃ |
| Test Result | : | PASS | Humidity | : | 52%RH |

**For Hopping Mode**

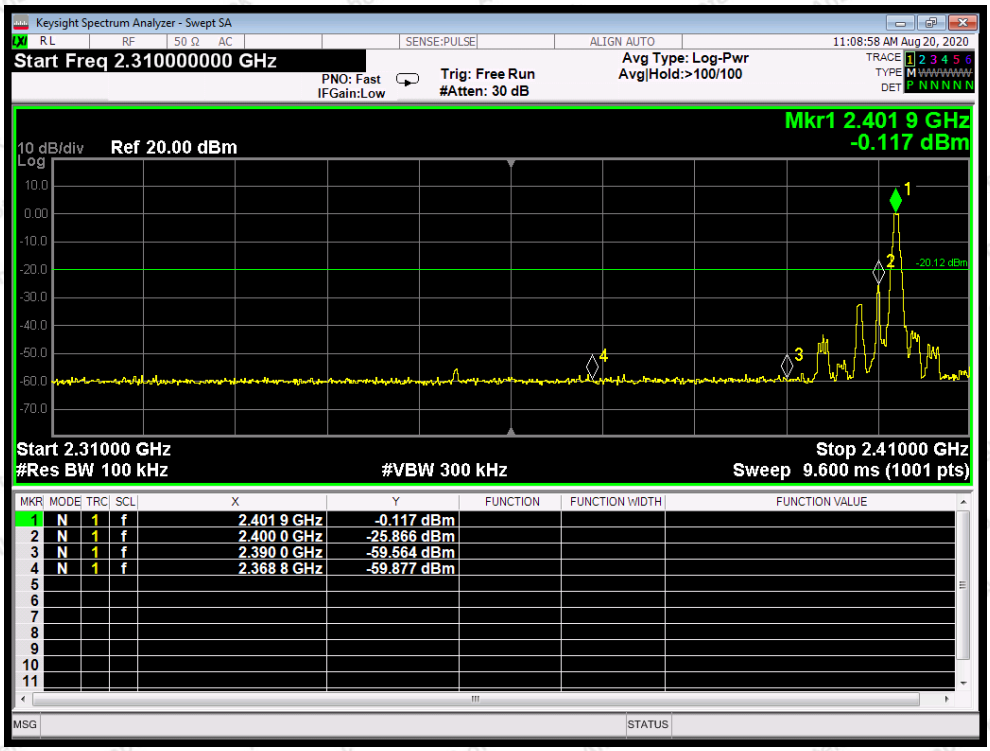



BDR mode

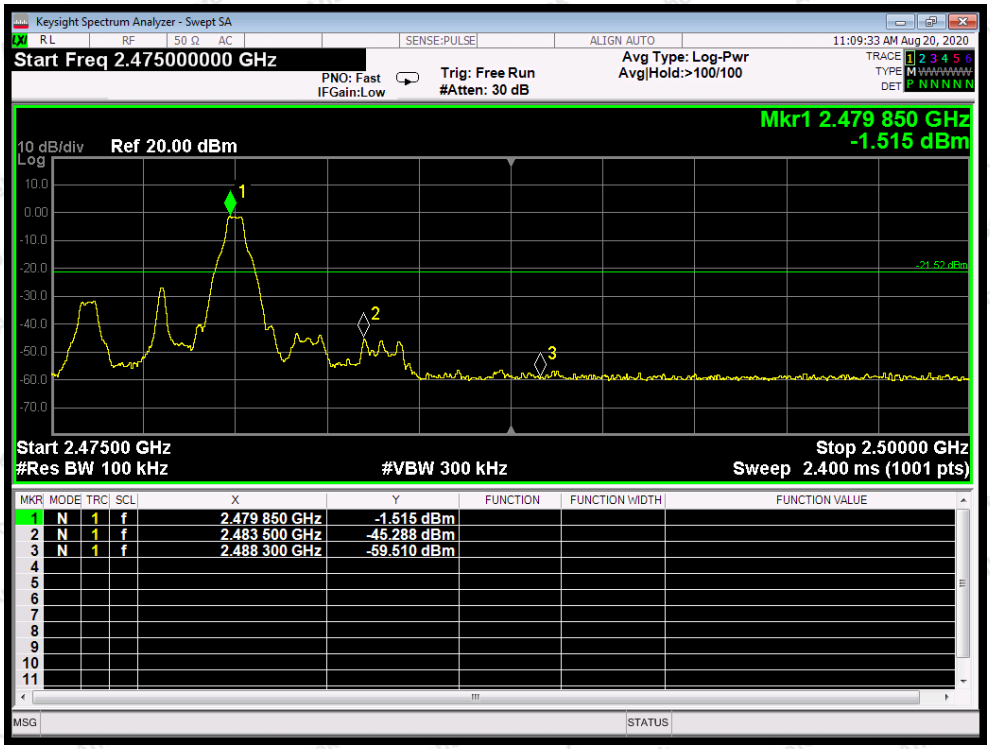



EDR mode

**For Non-Hopping Mode**

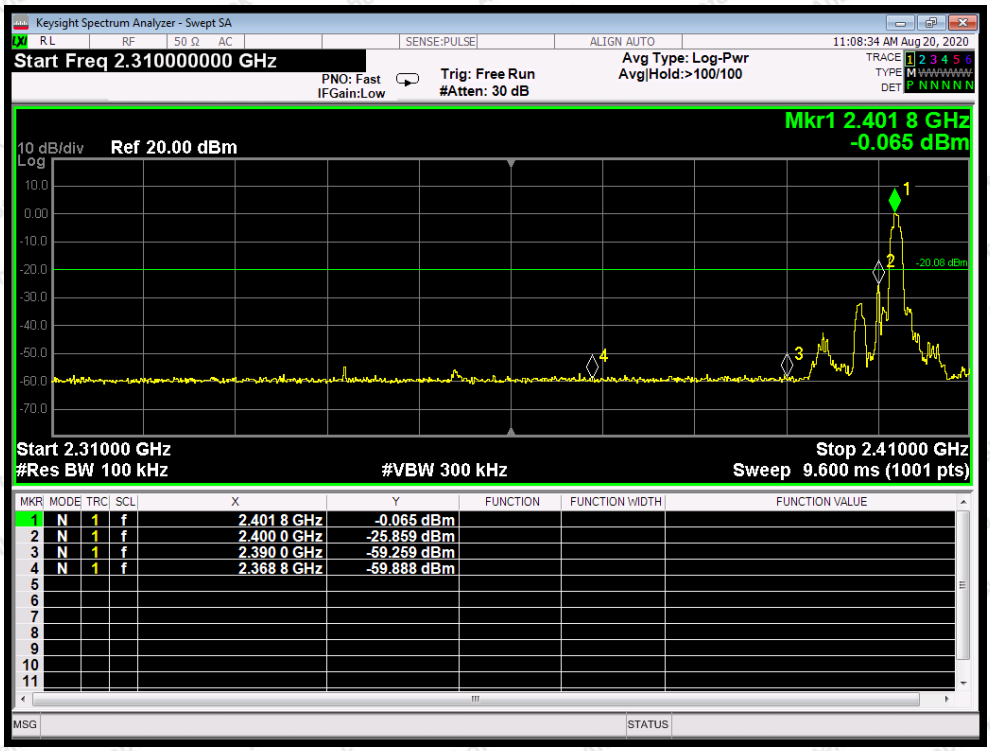



BDR mode -- Lowest

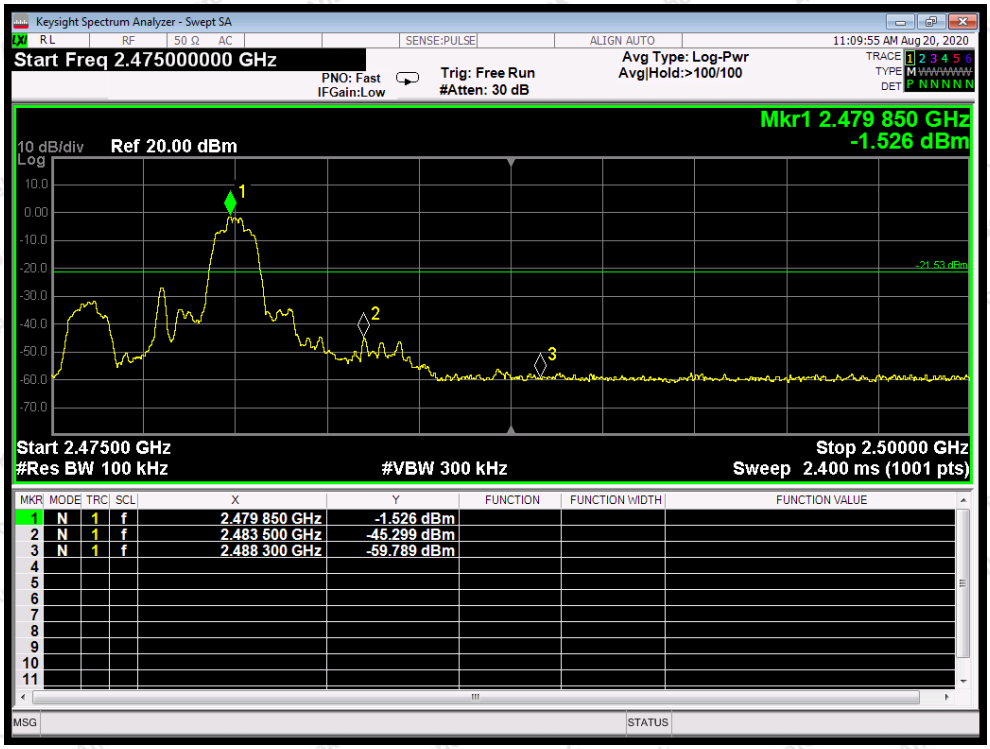



BDR mode -- Highest

**For Non-Hopping Mode**

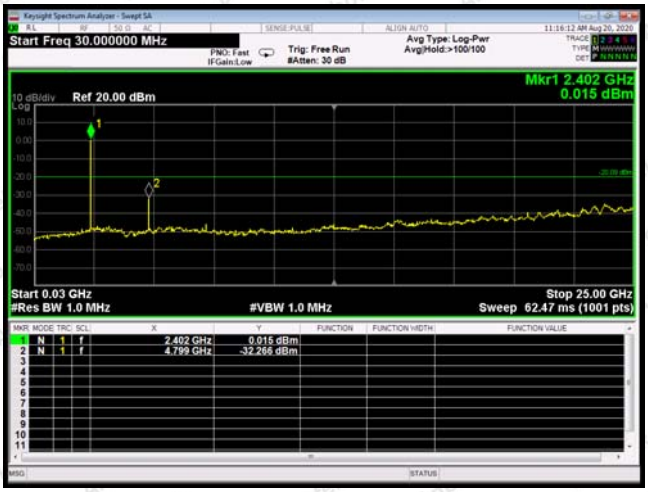



EDR mode -- Lowest

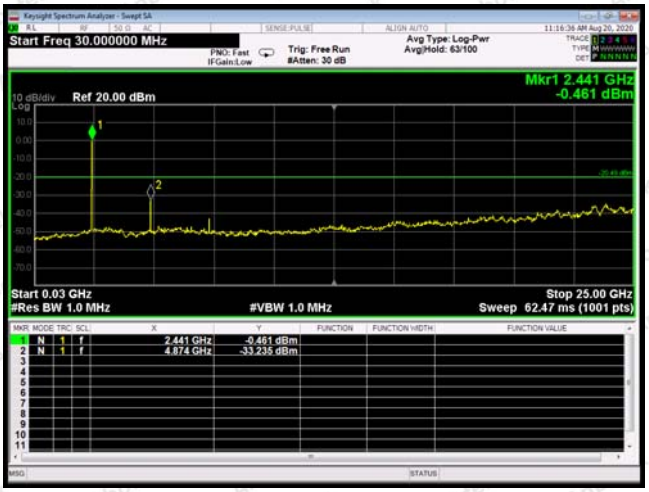



EDR mode -- Highest

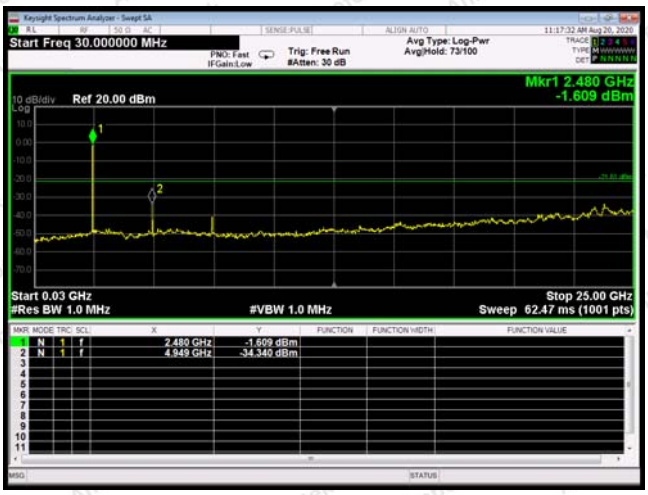
Conducted Emission Method



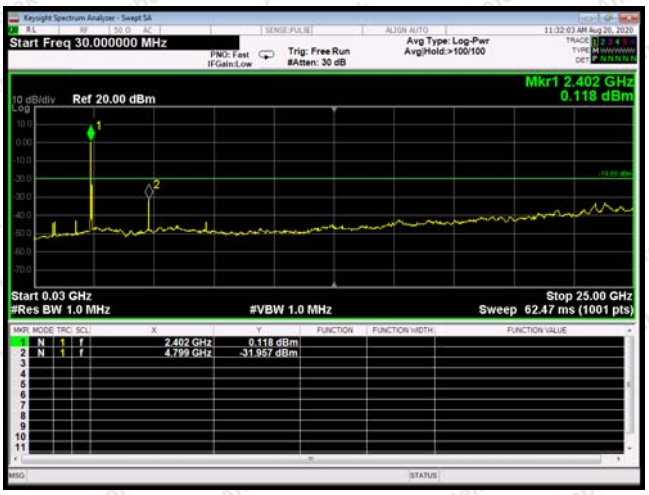

Test Mode: BDR---Low



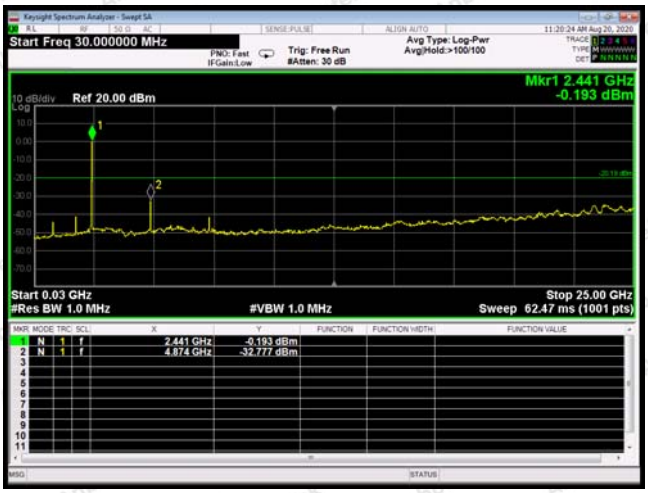

Test Mode: BDR---Mid



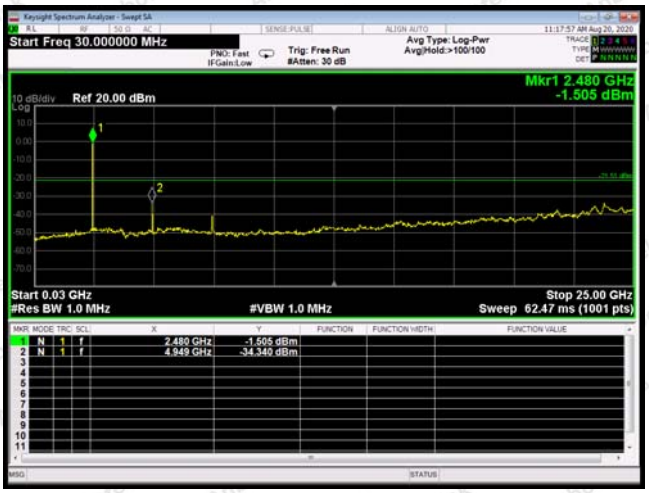

Test Mode: BDR---High




Test Mode: EDR---Low




Test Mode: EDR---Mid




Test Mode: EDR---High

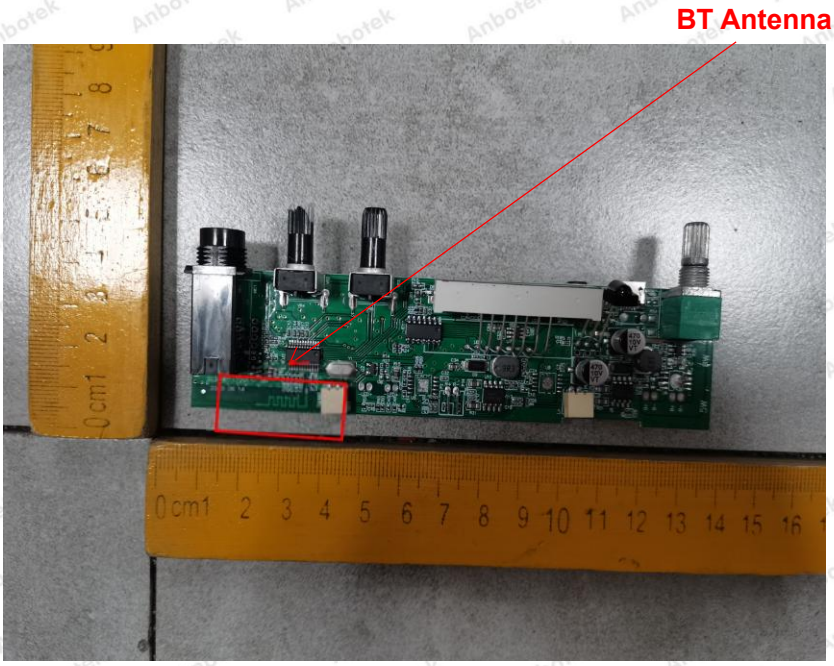
# 11. Antenna Requirement

## 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 |

## 11.2. Antenna Connected Construction

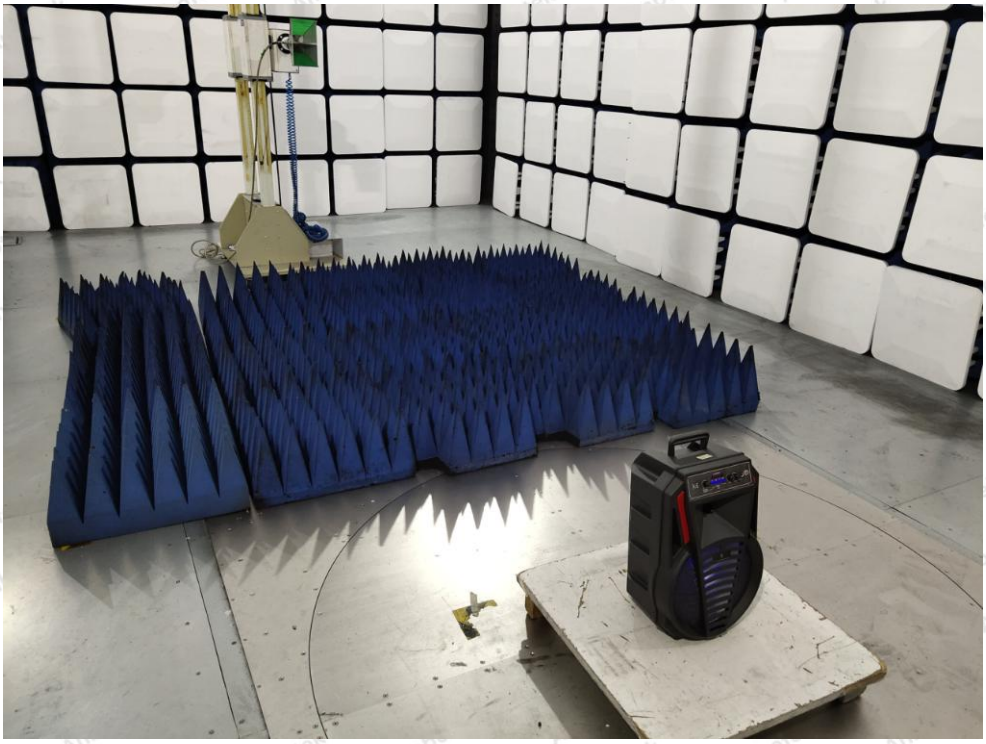
The antenna is PCB Antenna which permanently attached, and the best case gain of the antenna is 0 dBi. It complies with the standard requirement.



# APPENDIX I -- TEST SETUP PHOTOGRAPH

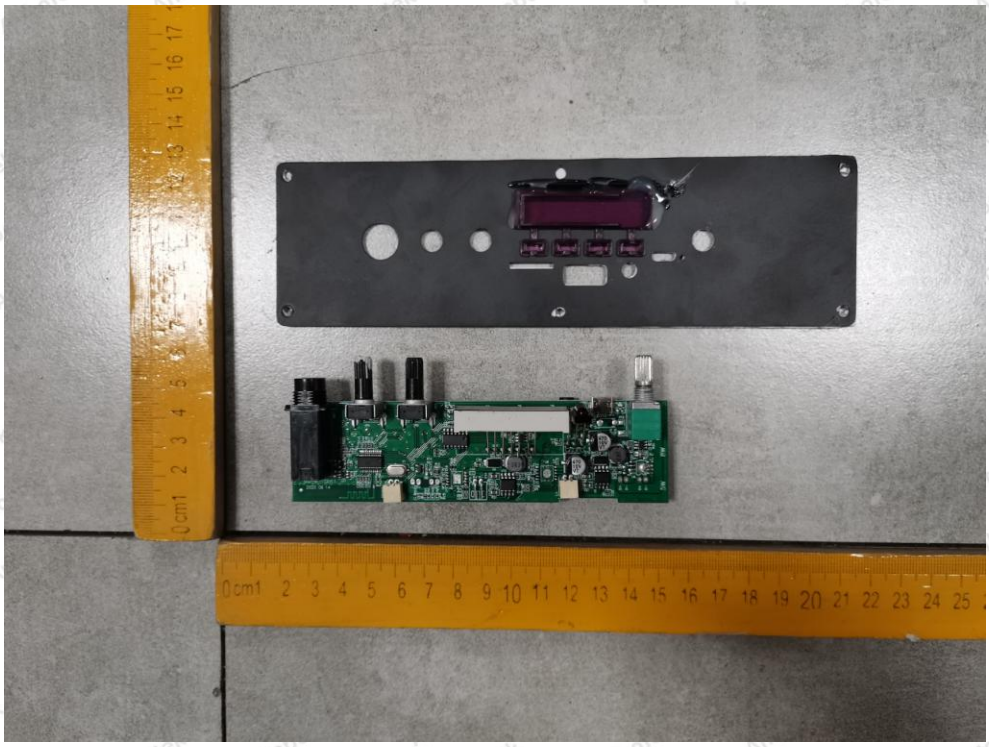
Photo of Conducted Emission Measurement

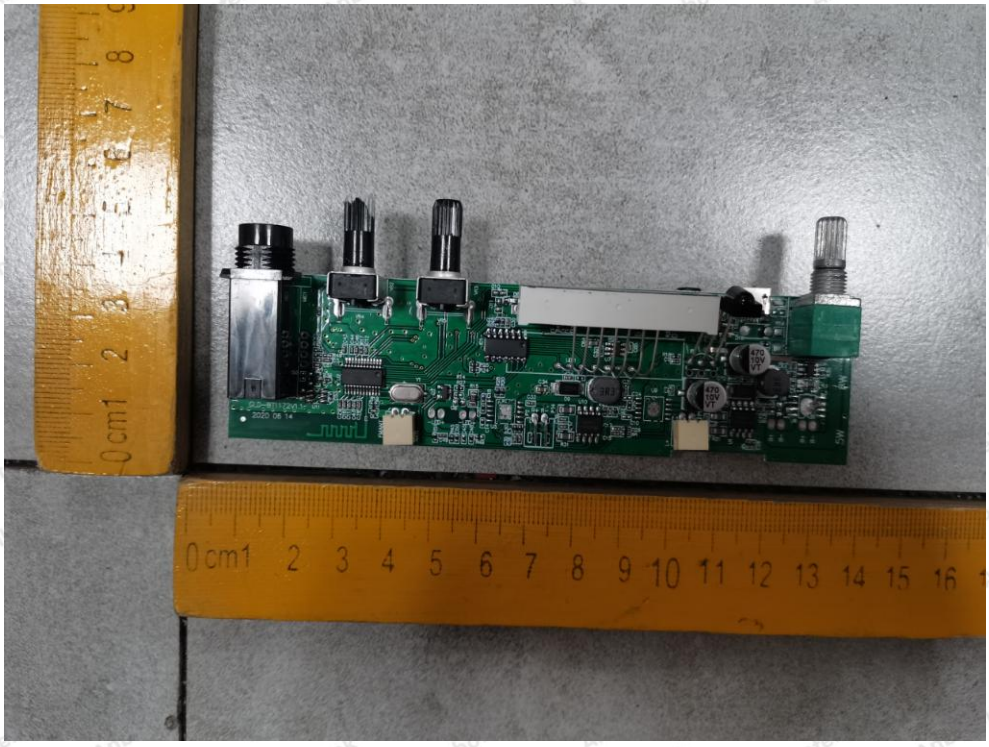
Photo of Radiation Emission Test

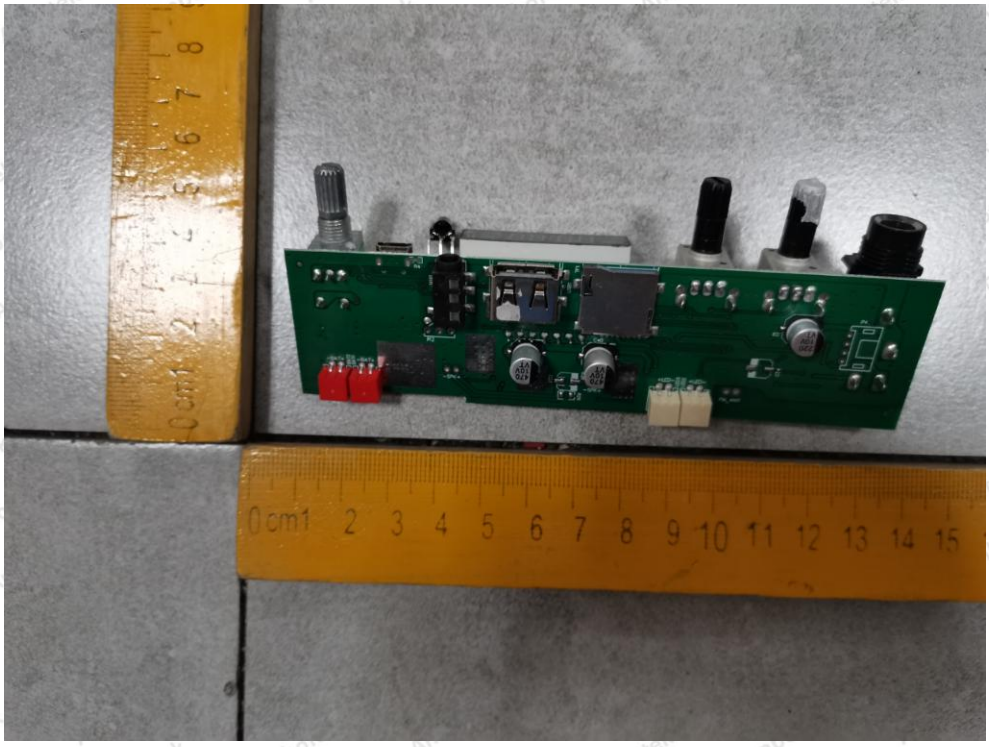


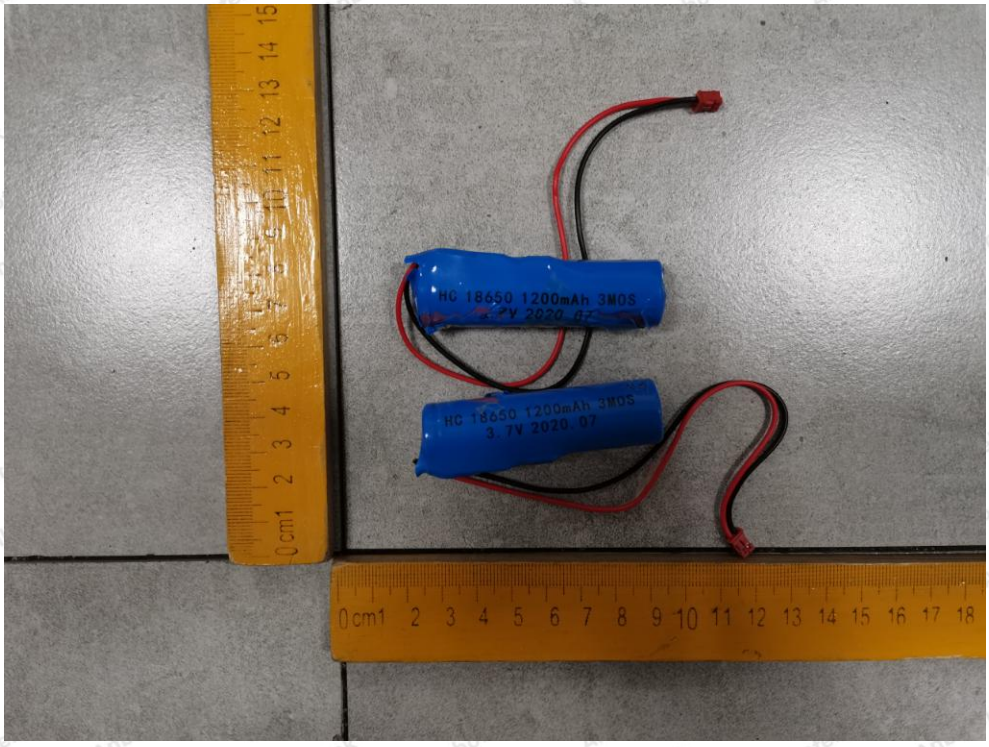
# APPENDIX II -- EXTERNAL PHOTOGRAPH

# APPENDIX III -- INTERNAL PHOTOGRAPH









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