# RF TEST REPORT

| | |
|---|---|
| **Report No.:** | SET2022-00804 |
| **Product Name:** | Handhold Auto Refractometer |
| **Model No. :** | easyRef |
| **FCC ID:** | 2A422EASYREF |
| **Applicant:** | Shenzhen CERTAINN Technology Co., Ltd. |
| **Address:** | Bldg.2-C,Zone 2, GOTO Digital Technology Park, No.137Bulan Rd., Longgang District, 518112 Shenzhen, P.R.China |
| **Dates of Testing:** | 12/16/2021 - 01/19/2022 |
| **Issued by:** | CCIC Southern Testing Co., Ltd. |
| **Lab Location:** | Electronic Testing Building, No. 43 Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China.<br>**Tel:** 86 755 26627338 **Fax:** 86 755 26627238 |

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# Test Report

| | |
|---|---|
| **Product Name ..... :** | Handhold Auto Refractometer |
| **Trade Name ..... :** | Moptim |
| **Applicant ..... :** | Shenzhen CERTAINN Technology Co., Ltd. |
| **Applicant Address ..... :** | Bldg.2-C,Zone 2, GOTO Digital Technology Park, No.137Bulan Rd., Longgang District, 518112 Shenzhen, P.R.China |
| **Manufacturer ..... :** | Shenzhen CERTAINN Technology Co., Ltd. |
| **Manufacturer Address ..... :** | Bldg.2-C,Zone 2, GOTO Digital Technology Park, No.137Bulan Rd., Longgang District, 518112 Shenzhen, P.R.China |
| **Test Standards ..... :** | 47 CFR Part 15 Subpart C<br>ANSI C63.10-2013<br>IC RSS-Gen(Issue 5, April 2018) Amendment 2 (February 2021)<br>IC RSS-247(Issue 2, Feb. 2017) |
| **Test Result ..... :** | PASS |
| **Tested by ..... :** | Sun 2022.01.21<br>Sun, Test Engineer |
| **Reviewed by ..... :** | Chris You 2022.01.21<br>Chris You, Senior Engineer |
| **Approved by ..... :** | Shuangwen Zhang 2022.01.21<br>Shuangwen Zhang, Manager |

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| Change History | | |
|---|---|---|
| Issue | Date | Reason for change |
| 1.0 | 2022.01.21 | First edition |
| | | |
| | | |

# 1. General Information

## 1.1. EUT Description

| | |
|---|---|
| EUT Type | Handhold Auto Refractometer |
| Hardware Version | V2.1 |
| Software Version | V 1.0 |
| EUT supports Radios application | Bluetooth LE V4.0 |
| Power Supply | Rechargeable Li-ion Battery DC3.8V/3800mAh |
| Frequency Range | 2402MHz~2480MHz |
| Channel Number | 40 |
| Bit Rate of Transmitter | 1Mbps |
| Modulation Type | GFSK |
| Test Control Software | RFTestTool |
| RF setting Level | Default |
| Antenna Type | Internal antenna |
| Antenna Gain | 2.0dBi |

Note 1: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

Note 2: The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

## 1.2. Test Standards and Results

The purpose of the report is to conduct testing according to the following FCC/IC certification standards:

| No. | Identity | Document Title |
|---|---|---|
| 1 | 47 CFR Part 15<br>Subpart C | Radio Frequency Devices |
| 2 | ANSI C63.10-2013 | American National Standard for Testing Unlicensed Wireless Devices |
| 3 | RSS-Gen (Issue 5, April 2018)<br>Amendment2 (February 2021) | General Requirements for Compliance of Radio Apparatus |
| 4 | RSS-247<br>(Issue 2, Feb. 2017) | Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices |

Test detailed items/section required by FCC/IC rules and results are as below:

| No. | Section in CFR 47 | IC Rules | Description | Result |
|---|---|---|---|---|
| 1 | 15.203 | RSS-247, 5.4 | Antenna Requirement | PASS |
| 2 | 15.247(b) | RSS-247, 5.4 | Peak Output Power | PASS |
| 3 | 15.247(a) | RSS-GEN, 6.7<br>RSS-247, 5.2 | 6dB and 99% Occupied Bandwidth | PASS |
| 4 | 15.247(d) | RSS-GEN, 6.13<br>RSS-247, 5.5 | Conducted Band Edges and Spurious Emission | PASS |
| 5 | 15.247(e) | RSS-247, 5.2 | Power spectral density (PSD) | PASS |
| 6 | 15.207 | RSS-GEN, 8.8 | Conducted Emission | PASS |
| 7 | 15.209<br>15.205<br>15.247(d) | RSS-GEN, 8.10<br>RSS-GEN, 6.13<br>RSS-247, 5.5 | Radiated Band Edges and Spurious Emission | PASS |

The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10-2013.

These RF tests were performed according to the method of measurements prescribed in KDB 558074D01 v05r02.

**40 channels are provided for Bluetooth LE**

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|---|---|
| 0 | 2402MHz | 10 | 2422MHz | 20 | 2442MHz | 30 | 2462MHz |
| 1 | 2404MHz | 11 | 2424MHz | 21 | 2444MHz | 31 | 2464MHz |
| 2 | 2406MHz | 12 | 2426MHz | 22 | 2446MHz | 32 | 2466MHz |
| 3 | 2408MHz | 13 | 2428MHz | 23 | 2448MHz | 33 | 2468MHz |
| 4 | 2410MHz | 14 | 2430MHz | 24 | 2450MHz | 34 | 2470MHz |
| 5 | 2412MHz | 15 | 2432MHz | 25 | 2452MHz | 35 | 2472MHz |
| 6 | 2414MHz | 16 | 2434MHz | 26 | 2454MHz | 36 | 2474MHz |
| 7 | 2416MHz | 17 | 2436MHz | 27 | 2456MHz | 37 | 2476MHz |
| 8 | 2418MHz | 18 | 2438MHz | 28 | 2458MHz | 38 | 2478MHz |
| 9 | 2420MHz | 19 | 2440MHz | 29 | 2460MHz | 39 | 2480MHz |
| Note: Channel 0, 19 &20 selected for GFSK. | | | | | | | |

| | Test Items | Modulation | Channel |
|---|---|---|---|
| Bluetooth LE | Peak Conducted Output Power<br>Power Spectral Density<br>6dB and 99% Occupied Bandwidth<br>Conducted and Spurious Emission<br>Radiated and Spurious Emission | GFSK | 0/19/39 |
| | Band Edge | GFSK | 0/39 |

## 1.3. Table for Supporting Units

| No. | Equipment | Brand Name | Model Name | Manufacturer | Serial No. | Note |
|---|---|---|---|---|---|---|
| 1 | Notebook | DELL | PP11L | DELL | H5914A03 | FCC DOC |

## 1.4. Facilities and Accreditations

### 1.4.1. Facilities

**CNAS-Lab Code: L1659**

CCIC-SET is a third party testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L1659.

**FCC-Registration No.: 406086**

CCIC Southern Testing Co., Ltd 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. Designation Number: CN1283, valid time is until April 19th, 2023.

**ISED Registration: 11185A-1**

**CAB identifier: CN0064**

CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A-1 on Aug. 04, 2016, valid time is until Jun. 30th, 2023.

**A2LA Code: 5721.01**

CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025. The accreditation certificate number is 5721.01.

### 1.4.2. Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

| | |
|---|---|
| Temperature ( ℃): | 15 ℃ - 35 ℃ |
| Relative Humidity (%): | 30% -60% |
| Atmospheric Pressure (kPa): | 86KPa-106KPa |

# 2. 47 CFR Part 15C Requirements

## 2.1. Antenna requirement

### 2.1.1. Applicable Standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### 2.1.2. Antenna Information

**Antenna Category:** Internal antenna

An Internal antenna was soldered to the antenna port of EUT via an adaptor cable, can't be removed.

**Antenna General Information:**

| No. | EUT | Ant. Type | Gain(dBi) |
|---|---|---|---|
| 1 | Handhold Auto Refractometer | Internal | 2.0dBi |

### 2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

## 2.2. Peak Output Power

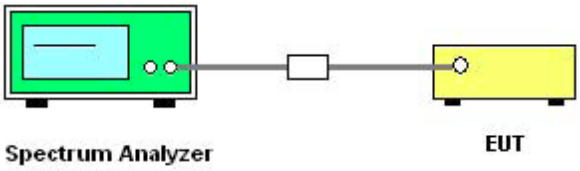
### 2.2.1. Limit of Peak Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

### 2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.2.3. Test Setup




### 2.2.4. Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB 558074D01 v05r02.

2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.

   The path loss was compensated to the results for each measurement.

3. Set to the maximum power setting and enable the EUT transmit continuously.

4. Use the following spectrum analyzer settings: Span≥3RBW; RBW≥DTS bandwidth; VBW≥ 3RBW; Sweep = auto; Detector function = peak; Trace = max hold.

5. Set to the maximum power setting and enable the EUT transmit continuously.

6. Measure the conducted output power and record the results in the test report.

### 2.2.5. Test Result

Please refer to Appendix A for detail

## 2.3. 6dB and 99% Occupied Bandwidth

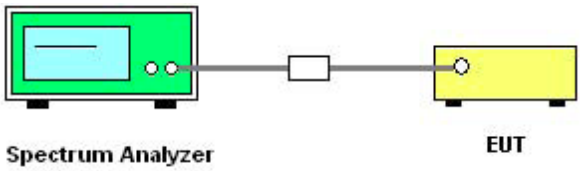
### 2.3.1. Limit of 6dB Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

### 2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.3.3. Test Setup




### 2.3.4. Test Procedures

1. The testing follows FCC KDB 558074D01 v05r02.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz.
5. Measure and record the results in the test report.
6. For %99 Occupy bandwidth measurement, Make the measurement with the spectrum analyzer’s resolution bandwidth (RBW) = 30 kHz. Set the Video bandwidth (VBW) = 100 kHz
7. Measure and record the results in the test report.

### 2.3.5. Test Results of 6dB and 99% Bandwidth

Please refer to Appendix A for detail

## 2.4. Conducted Band Edges and Spurious Emissions

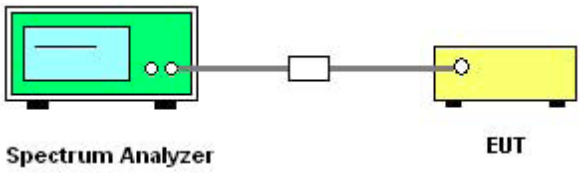
### 2.4.1. Limit of Conducted Band Edges and Spurious Emissions

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

### 2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.4.3. Test Setup




### 2.4.4. Test Procedure

1. The testing follows FCC KDB 558074D01 v05r02.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

### 2.4.5. Test Results of Conducted Band Edges

Please refer to Appendix A for detail

## 2.5. Power spectral density (PSD)

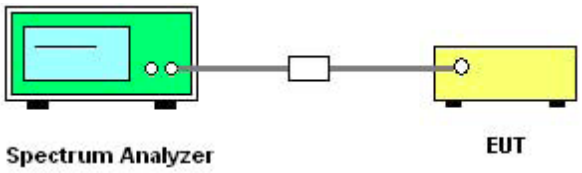
### 2.5.1. Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

### 2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.5.3. Test Setup




### 2.5.4. Test Procedures

1. The testing follows Measurement Procedure 10.2 Method PKPSD of FCC KDB 558074D01 v05r02.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

### 2.5.5. Test Results of Power spectral density

Please refer to Appendix A for detail

## 2.6. Radiated Band Edge and Spurious Emission

### 2.6.1. Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Note: Wireless charger configuration was evaluated.

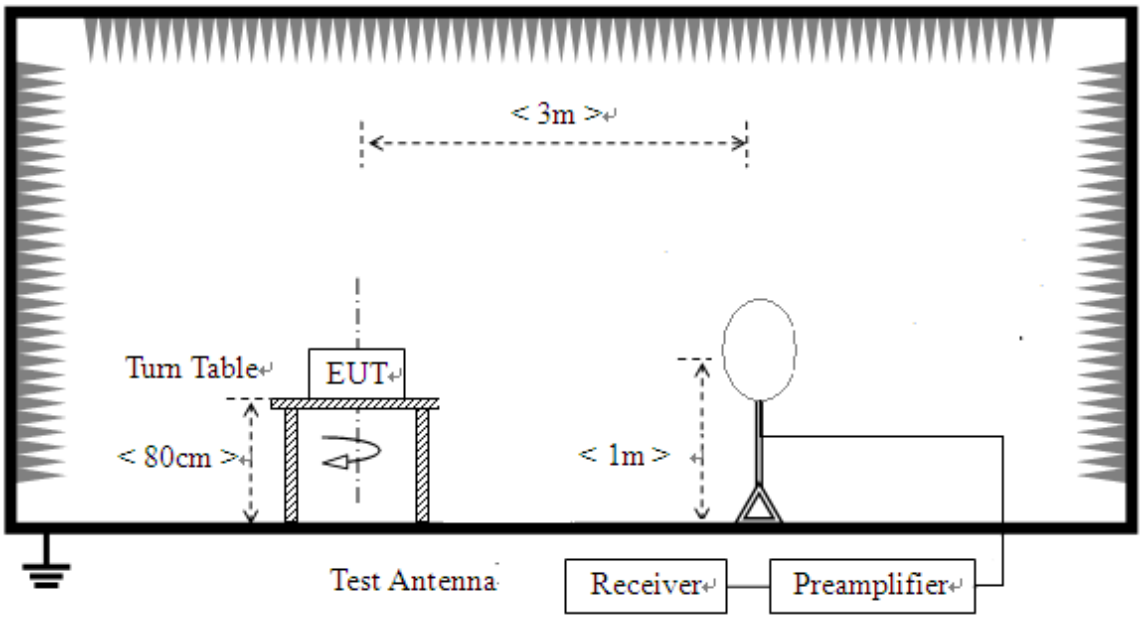
| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|---|---|---|
| 0.009 - 0.490 | 2400/F(kHz) | 300 |
| 0.490 - 1.705 | 24000/F(kHz) | 30 |
| 1.705 - 30.0 | 30 | 30 |
| 30 - 88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

### 2.6.2. Measuring Instruments

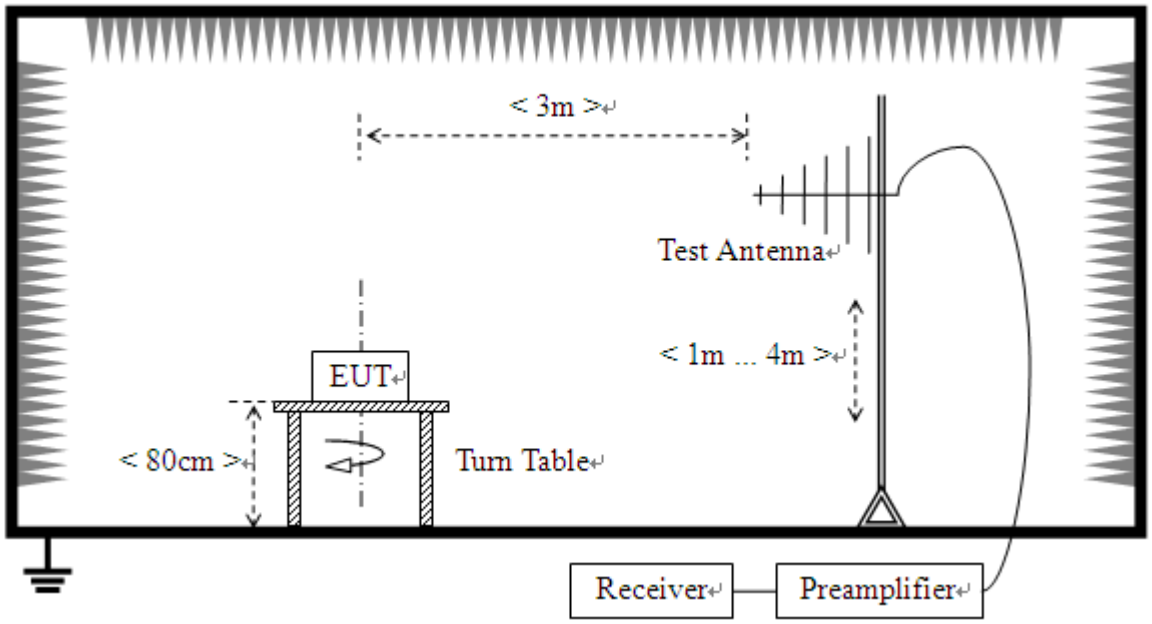
The measuring equipment is listed in the section 3 of this test report.

### 2.6.3. Test Setup

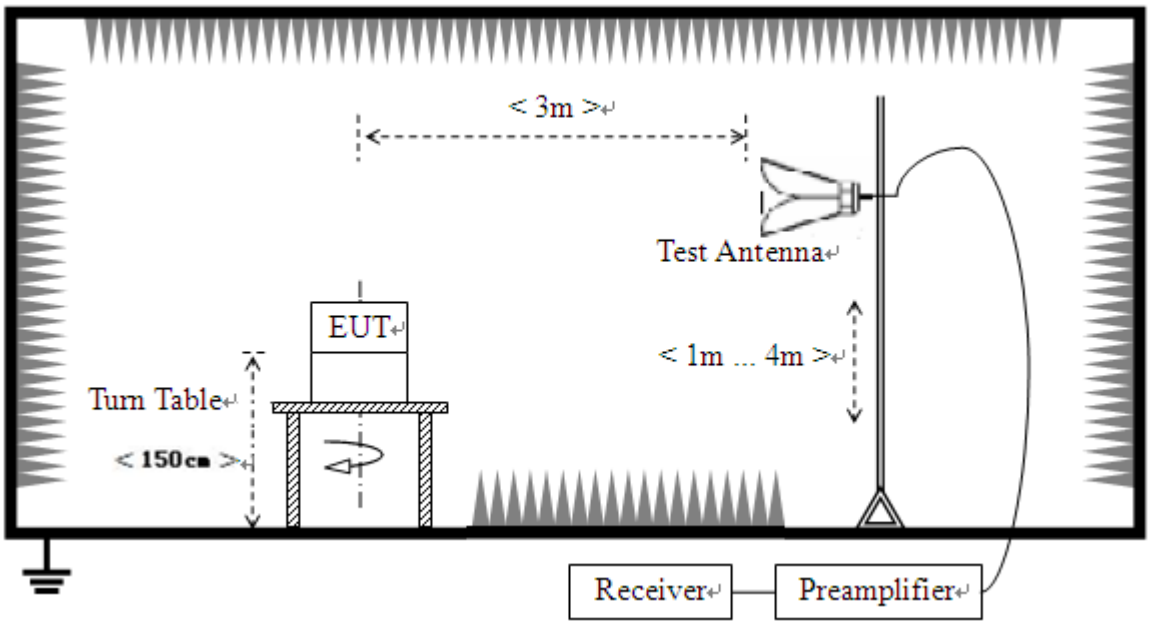
**For radiated emissions from 9 KHz to 30 MHz**



**For radiated emissions from 30MHz to 1GHz**




**For radiated emissions above 1GHz**



### 2.6.4. Test Procedures

1. The EUT was placed on a turntable 0.8m below 1GHz and 1.5m above 1GHz above ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported.
   Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE:

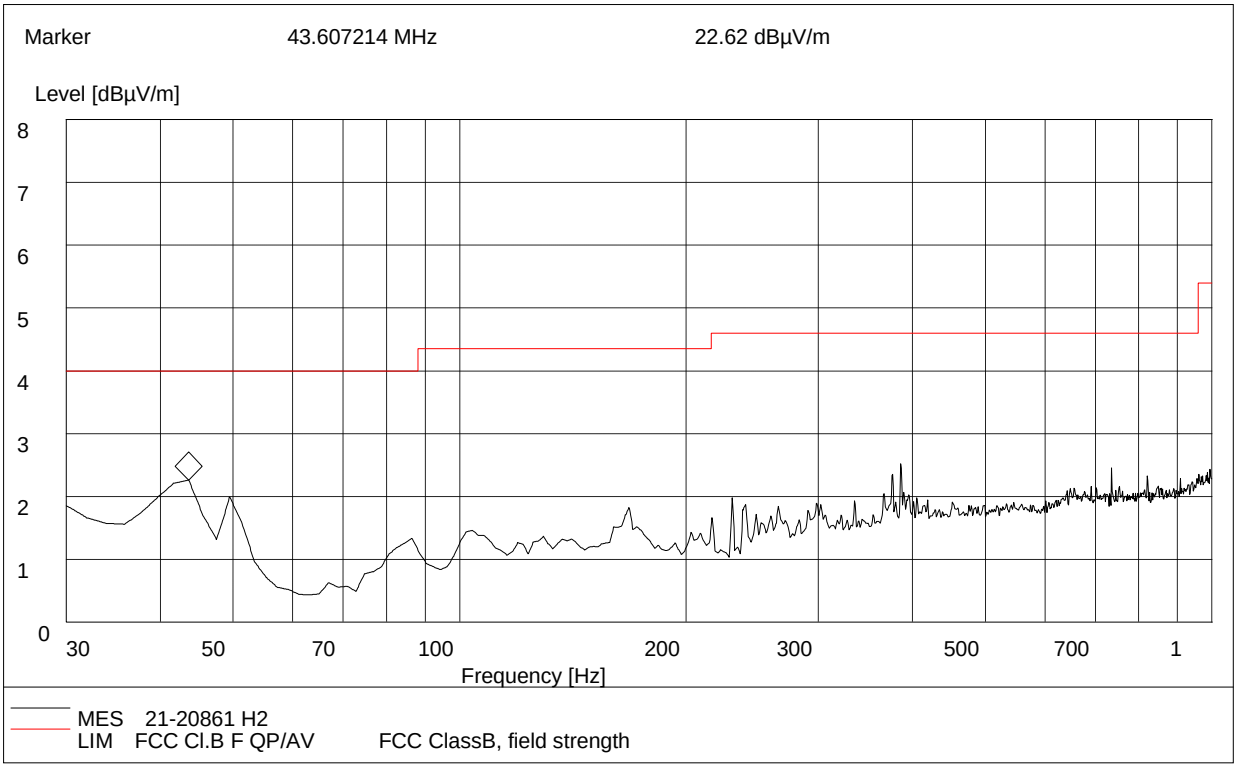
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 10Hz(Duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions (2MHz Bandwidth CH39) are reported for 30MHz-1GHz.

## 2.6.5. Test Results of Radiated Band Edge and Spurious Emission

**For 9KHz to 30MHz**

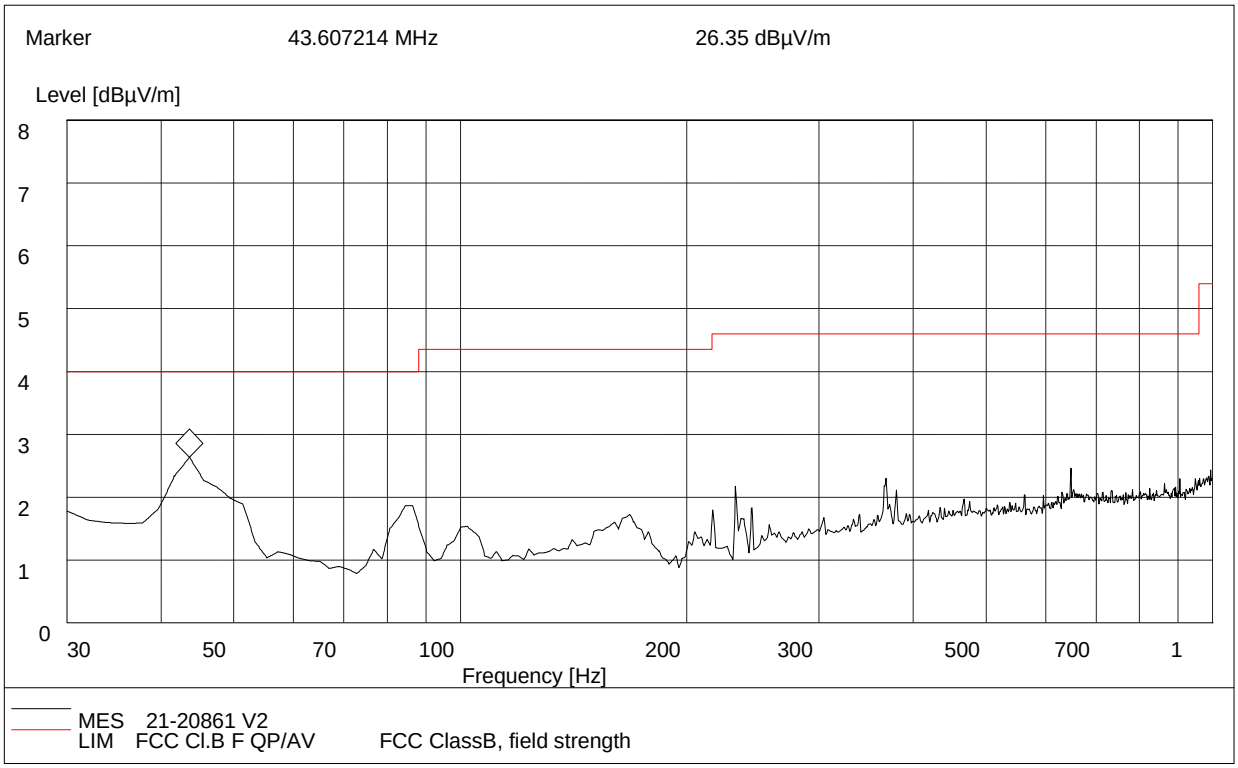
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

**For 30MHz to 1000 MHz**




**Plot A: 30MHz to 1GHz, Antenna Horizontal**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Measurement Bandwidth (kHz) | Corr. Factor (dB/m) | Antenna height (cm) | Limit (dBµV/m) | Margin | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|
| 42.360000 | 21.28 | 120.000 | 14.00 | 100.0 | 40.0 | 18.72 | Horizontal | Pass |
| 49.230000 | 18.30 | 120.000 | 8.50 | 100.0 | 40.0 | 21.70 | Horizontal | Pass |
| 101.280000 | 14.32 | 120.000 | 10.90 | 100.0 | 43.5 | 29.18 | Horizontal | Pass |
| 168.020000 | 18.23 | 120.000 | 11.90 | 100.0 | 43.5 | 25.27 | Horizontal | Pass |
| 230.280000 | 19.28 | 120.000 | 11.70 | 100.0 | 46.0 | 26.72 | Horizontal | Pass |
| 385.260000 | 24.29 | 120.000 | 16.90 | 100.0 | 46.0 | 21.71 | Horizontal | Pass |




**Plot B: 30MHz to 1GHz, Antenna Vertical**

| Frequency (MHz) | QuasiPeak (dB µ V/m) | Measurement Bandwidth (kHz) | Corr. Factor (dBµV/m) | Antenna height (cm) | Limit (dB µ V/m) | Margin | Antenna | Verdict |
|---|---|---|---|---|---|---|---|---|
| 43.060000 | 25.51 | 120.000 | 11.20 | 100.0 | 40.0 | 14.49 | Vertical | Pass |
| 83.640000 | 18.26 | 120.000 | 8.50 | 100.0 | 40.0 | 21.74 | Vertical | Pass |
| 101.280000 | 15.29 | 120.000 | 10.9 | 100.0 | 43.5 | 28.21 | Vertical | Pass |
| 168.000000 | 17.26 | 120.000 | 11.90 | 100.0 | 43.5 | 26.24 | Vertical | Pass |
| 232.060000 | 20.68 | 120.000 | 11.70 | 100.0 | 46.0 | 25.32 | Vertical | Pass |
| 368.250000 | 21.60 | 120.000 | 16.90 | 100.0 | 46.0 | 24.40 | Vertical | Pass |

**For 1GHz to 25GHz**

| GFSK_2402MHz | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emssion Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) | Polarity | Detector |
| 2390.00 | 46.36 | 74.00 | -27.64 | 1.70 | 180 | 45.06 | 1.30 | Horizontal | Peak |
| 2390.00 | 35.88 | 54.00 | -18.12 | 1.70 | 180 | 34.58 | 1.30 | Horizontal | Average |
| 4804.00 | 49.55 | 74.00 | -24.45 | 1.70 | 180 | 43.15 | 6.40 | Horizontal | Peak |
| 4804.00 | 38.37 | 54.00 | -15.63 | 1.70 | 180 | 31.97 | 6.40 | Horizontal | Average |
| 7206.00 | 48.78 | 74.00 | -25.22 | 1.70 | 180 | 39.48 | 9.30 | Horizontal | Peak |
| 7206.00 | 39.09 | 54.00 | -14.91 | 1.70 | 180 | 29.79 | 9.30 | Horizontal | Average |
| 2390.00 | 46.13 | 74.00 | -27.87 | 1.50 | 210 | 44.83 | 1.30 | Vertical | Peak |
| 2390.00 | 35.98 | 54.00 | -18.02 | 1.50 | 210 | 34.68 | 1.30 | Vertical | Average |
| 4804.00 | 48.03 | 74.00 | -25.97 | 1.50 | 210 | 41.63 | 6.40 | Vertical | Peak |
| 4804.00 | 38.39 | 54.00 | -15.61 | 1.50 | 210 | 31.99 | 6.40 | Vertical | Average |
| 7206.00 | 48.22 | 74.00 | -25.78 | 1.50 | 210 | 38.92 | 9.30 | Vertical | Peak |
| 7206.00 | 38.93 | 54.00 | -15.07 | 1.50 | 210 | 29.63 | 9.30 | Vertical | Average |
| **GFSK_2441MHz** | | | | | | | | | |
| Frequency (MHz) | Emssion Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) | Polarity | Detector |
| 4880.00 | 49.34 | 74.00 | -24.66 | 1.70 | 180 | 42.94 | 6.40 | Horizontal | Peak |
| 4880.00 | 37.98 | 54.00 | -16.02 | 1.70 | 180 | 31.58 | 6.40 | Horizontal | Average |
| 7320.00 | 49.08 | 74.00 | -24.92 | 1.70 | 180 | 39.68 | 9.40 | Horizontal | Peak |
| 7320.00 | 39.19 | 54.00 | -14.81 | 1.70 | 180 | 29.79 | 9.40 | Horizontal | Average |
| 4880.00 | 48.30 | 74.00 | -25.70 | 1.50 | 210 | 41.90 | 6.40 | Vertical | Peak |
| 4880.00 | 38.38 | 54.00 | -15.62 | 1.50 | 210 | 31.98 | 6.40 | Vertical | Average |
| 7320.00 | 48.40 | 74.00 | -25.60 | 1.50 | 210 | 39.00 | 9.40 | Vertical | Peak |
| 7320.00 | 38.71 | 54.00 | -15.29 | 1.50 | 210 | 29.31 | 9.40 | Vertical | Average |

*Remark:*

*1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)*

*2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) - Pre-Amplifier Factor(dB)*

*3. Margin value = Emission Level – Limit value*

*4.The emission levels of other frequencies are very lower than the limit and not show in test report.*

| GFSK_2480MHz | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emssion Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV/m) | Correction Factor (dB/m) | Polarity | Detector |
| 2483.50 | 46.06 | 74.00 | -27.94 | 1.70 | 180 | 43.46 | 2.60 | Horizontal | Peak |
| 2483.50 | 36.75 | 54.00 | -17.25 | 1.70 | 180 | 34.15 | 2.60 | Horizontal | Average |
| 4960.00 | 49.35 | 74.00 | -24.65 | 1.70 | 180 | 42.65 | 6.70 | Horizontal | Peak |
| 4960.00 | 38.47 | 54.00 | -15.53 | 1.70 | 180 | 31.77 | 6.70 | Horizontal | Average |
| 7440.00 | 48.84 | 74.00 | -25.16 | 1.70 | 180 | 39.34 | 9.50 | Horizontal | Peak |
| 7440.00 | 38.89 | 54.00 | -15.11 | 1.70 | 180 | 29.39 | 9.50 | Horizontal | Average |
| 2483.50 | 46.83 | 74.00 | -27.17 | 1.50 | 210 | 44.23 | 2.60 | Vertical | Peak |
| 2483.50 | 36.41 | 54.00 | -17.59 | 1.50 | 210 | 33.81 | 2.60 | Vertical | Average |
| 4960.00 | 47.91 | 74.00 | -26.09 | 1.50 | 210 | 41.21 | 6.70 | Vertical | Peak |
| 4960.00 | 38.67 | 54.00 | -15.33 | 1.50 | 210 | 31.97 | 6.70 | Vertical | Average |
| 7440.00 | 48.17 | 74.00 | -25.83 | 1.50 | 210 | 38.67 | 9.50 | Vertical | Peak |
| 7440.00 | 38.76 | 54.00 | -15.24 | 1.50 | 210 | 29.26 | 9.50 | Vertical | Average |

*Remark:*

*1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)*

*2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) - Pre-Amplifier Factor(dB)*

*3. Margin value = Emission Level – Limit value*

*4.The emission levels of other frequencies are very lower than the limit and not show in test report.*

## 2.7. Conducted Emission

### 2.7.1. Limit of Conducted Emission

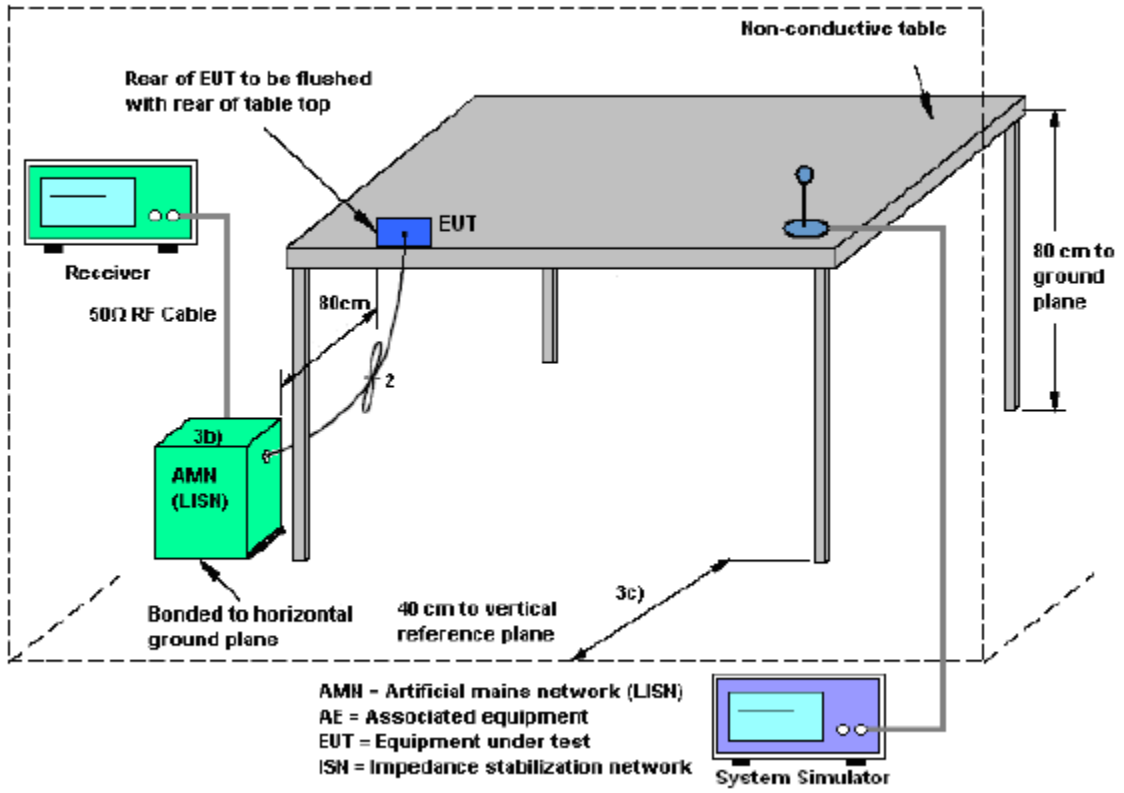
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

| Frequency range (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quai-peak | Average |
| 0.15 - 0.50 | 66 to 56 | 56 to 46 |
| 0.50 - 5 | 56 | 46 |
| 5 - 30 | 60 | 50 |

### 2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.7.3. Test Setup

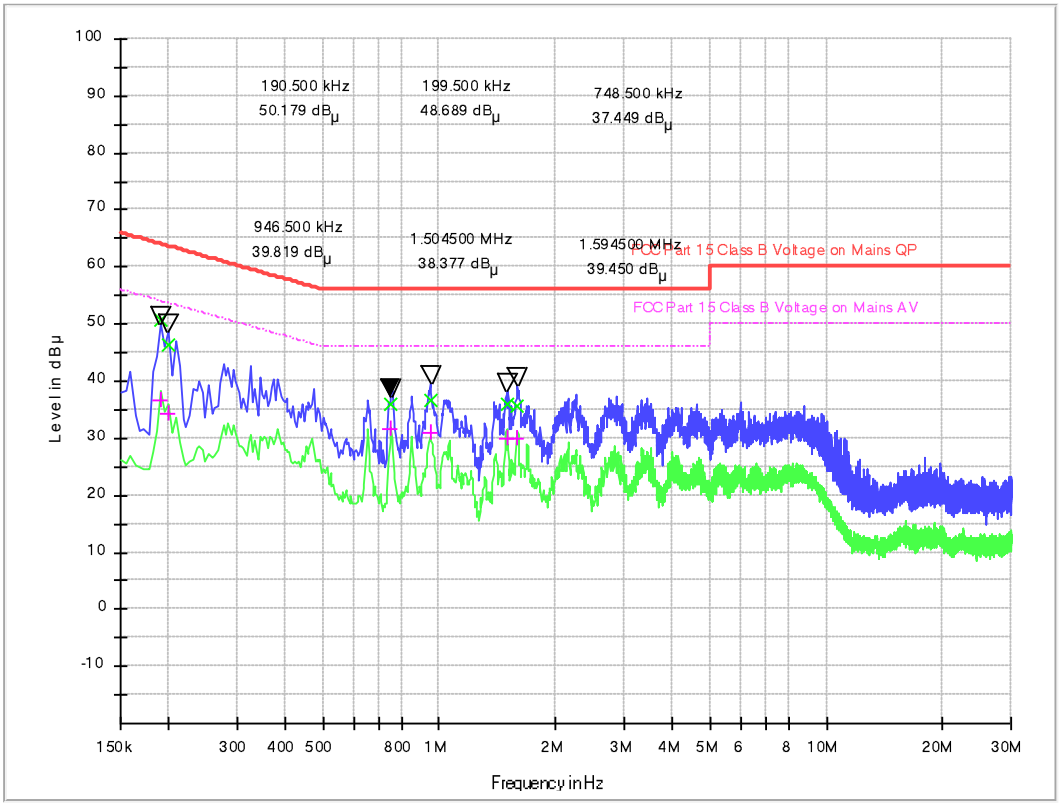


### 2.7.4. Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

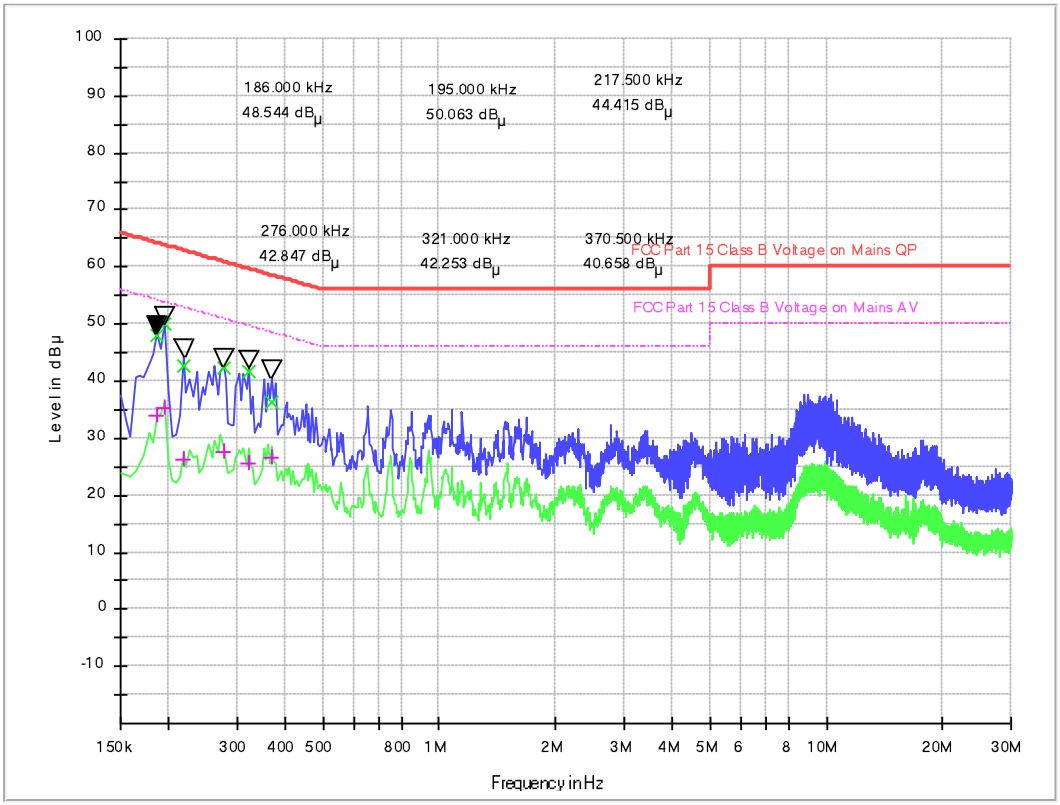
### 2.7.5. Test Result

The EUT configuration of the emission tests is Bluetooth LE Link + USB Cable (Charging from Adapter).




(Plot A: L Phase)

| Frequency (MHz) | QuasiPeak (dB µ V) | CAverage (dB µ V) | Cabel Loss (dB) | Corr. (dB) | Margin - QPK | Limit - QPK | Margin - AV | Limit - AV (dB µ V) |
|---|---|---|---|---|---|---|---|---|
| 0.190500 | 50.68 | 36.52 | 0.2 | 10.2 | 13.33 | 64.0 | 17.49 | 54.0 |
| 0.199500 | 46.50 | 34.45 | 0.2 | 10.2 | 17.13 | 63.6 | 19.18 | 53.6 |
| 0.748500 | 35.84 | 31.78 | 0.2 | 10.2 | 20.16 | 56.0 | 14.22 | 46.0 |
| 0.946500 | 36.64 | 30.80 | 0.2 | 10.2 | 19.36 | 56.0 | 15.20 | 46.0 |
| 1.504500 | 36.05 | 29.92 | 0.2 | 10.2 | 19.95 | 56.0 | 16.08 | 46.0 |
| 1.594500 | 35.76 | 29.93 | 0.2 | 10.2 | 20.24 | 56.0 | 16.07 | 46.0 |




(Plot B: N Phase)

| Frequency (MHz) | QuasiPeak (dB µ V) | CAverage (dB µ V) | Cabel Loss (dB) | Corr. (dB) | Margin - QPK | Limit - QPK | Margin - AV | Limit - AV (dB µ V) |
|---|---|---|---|---|---|---|---|---|
| 0.186000 | 48.02 | 34.08 | 0.2 | 10.2 | 16.19 | 64.2 | 20.13 | 54.2 |
| 0.195000 | 49.92 | 35.43 | 0.2 | 10.2 | 13.90 | 63.8 | 18.39 | 53.8 |
| 0.217500 | 42.72 | 26.30 | 0.2 | 10.2 | 20.19 | 62.9 | 26.61 | 52.9 |
| 0.276000 | 42.44 | 27.64 | 0.2 | 10.2 | 18.50 | 60.9 | 23.30 | 50.9 |
| 0.321000 | 41.61 | 25.53 | 0.2 | 10.2 | 18.07 | 59.7 | 24.15 | 49.7 |
| 0.370500 | 36.41 | 26.71 | 0.2 | 10.2 | 22.08 | 58.5 | 21.78 | 48.5 |

**Test Result: PASS**

Note: Correction factor=Cabel loss+ attenuation factor

attenuation factor=10dB

# 3. List of measuring equipment

| Item | Test Equipment | Manufacturer | Model No. | Serial No. | Cal Date | Due Date |
|---|---|---|---|---|---|---|
| 1 | EMI TEST RECEIVER | KEYSIGHT | N9038A | A141202036 | 2021.04.26 | 2022.04.25 |
| 2 | Power Meter | R&S | NRP-Z31 | 102872 | 2021.04.26 | 2022.04.25 |
| 3 | TURNTABLE | ETS | 2088 | 2149 | N/A | N/A |
| 4 | ANTENNA MAST | ETS | 2075 | 2346 | N/A | N/A |
| 5 | EMI TEST Software | R&S | ESK1 | N/A | N/A | N/A |
| 6 | Horn antenna (18GHz~26.5GHz) | AR | AT4003A | 325306 | 2020.09.16 | 2022.09.15 |
| 7 | Amplifier 30M~1GHz | MILMEGA | 80RF1000-10004 | A140101634 | 2021.01.26 | 2022.01.25 |
| 8 | Amplifier 1G~18GHz | MILMEGA | AS0104R-800/400 | A160302517 | 2021.01.26 | 2022.01.25 |
| 9 | High pass filter | Compliance Direction systems | BSU-6 | 34202 | 2021.11.09 | 2022.11.08 |
| 10 | Horn Antenna | R&S | HF906 | A0304225 | 2019.04.17 | 2022.04.16 |
| 11 | Horn Antenna | R&S | ESIB7 | A0501375 | 2020.06.24 | 2022.06.22 |
| 12 | ULTRA-BROADBAND ANTENNA | SCHWARZ BECK | VULB9160 | A0805560 | 2019.05.24 | 2022.05.23 |
| 13 | Passive Loop Antenna | R&S | HFH2-Z2 | 100047 | 2019.04.26 | 2022.04.25 |
| 14 | Temperature chamber | TABAI | PS-232 | A8708054 | 2021.09.24 | 2022.09.23 |
| 15 | Spectrum Analyzer | KEYSIGHT | N9030A | A160702554 | 2021.04.26 | 2022.04.25 |
| 16 | LISN | ROHDE&SCHWARZ | ENV216 | A140701847 | 2021.08.11 | 2022.08.10 |
| 17 | Test software | ECIT | Eagle | V2.0 | N/A | N/A |

# 4. Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence . The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Emission Measurement (150KHz~30MHz)

| | |
|---|---|
| Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y)) | 2.8dB |

Uncertainty of Radiated Emission Measurement (30MHz~1GHz)

| | |
|---|---|
| Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y)) | 3.91dB |

Uncertainty of Radiated Emission Measurement (1GHz~18GHz)

| | |
|---|---|
| Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y)) | 4.5dB |

Uncertainty of Radiated Emission Measurement (18GHz~40GHz)

| | |
|---|---|
| Measuring Uncertainty for a level of confidence of 95%(U=2Uc(y)) | 4.9dB |

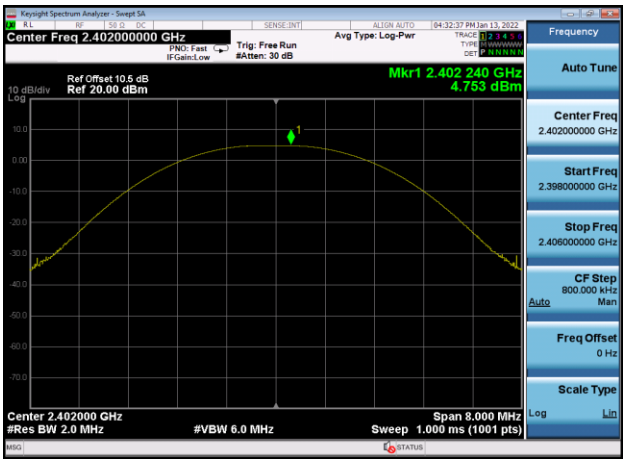
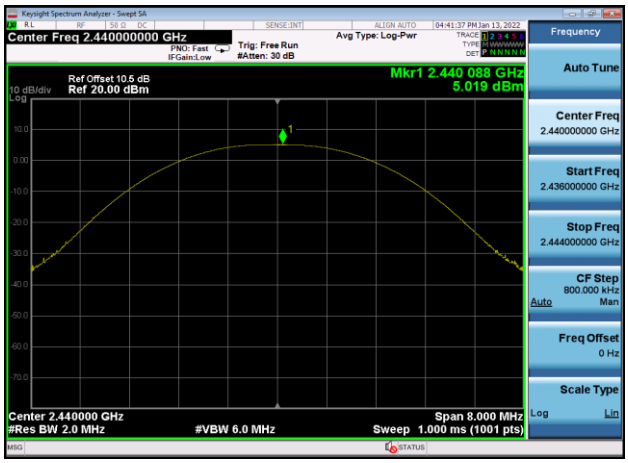
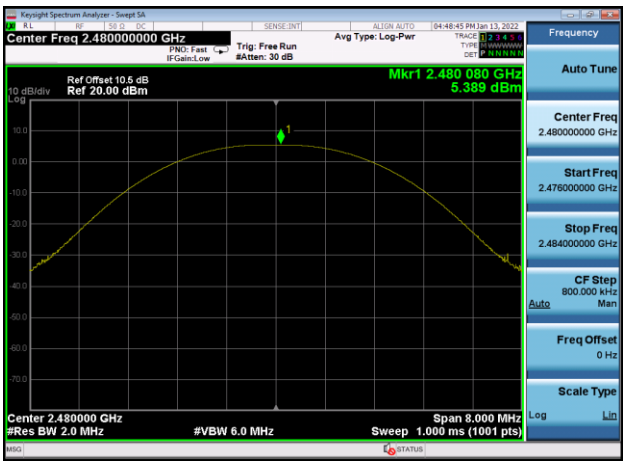
# Appendix A

**Peak Output Power**

**Test Result and Data**

| Test Frequency | Conducted Power(dBm) | Limit (dBm) | EIRP (dBm) | EIRP Limit(dBm) | Result |
|---|---|---|---|---|---|
| 2402 | 4.753 | 30 | 6.753 | 36 | Pass |
| 2440 | 5.019 | | 7.019 | | Pass |
| 2480 | 5.389 | | 7.389 | | Pass |

Note: EIRP=Conducted Power + Antenna gain.

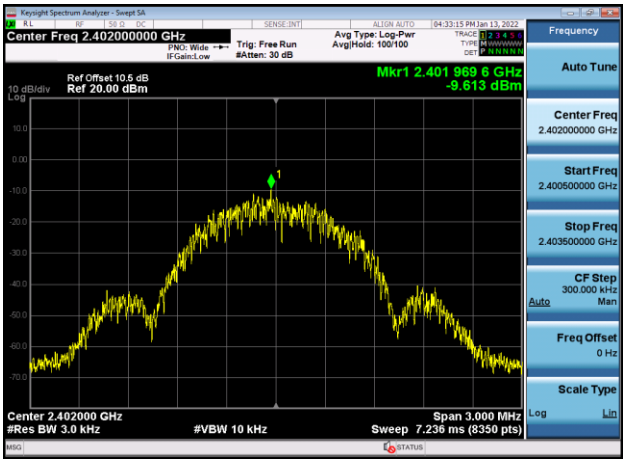
| Output Power：2402MHz | Output Power：2440MHz |
|---|---|
|  |  |
| Output Power：2480MHz | |
|  | |

**Power Spectral Density**

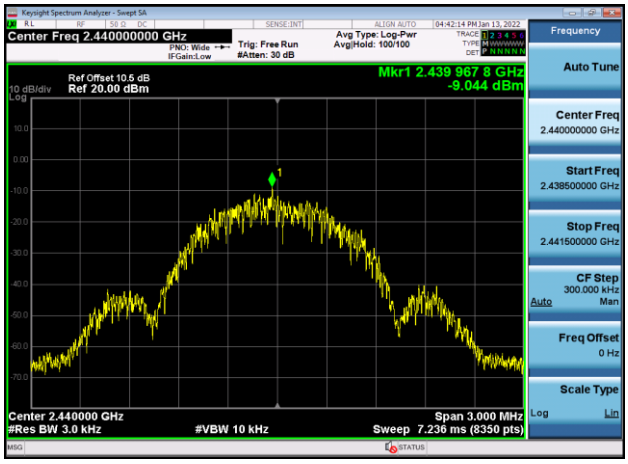
**Test Result and Data**

| Test Frequency | PSD(dBm/3KHz) | Limit(dBm/3KHz) | Result |
|---|---|---|---|
| 2402 | -9.613 | 8 | Pass |
| 2440 | -9.044 | | Pass |
| 2480 | -8.729 | | Pass |

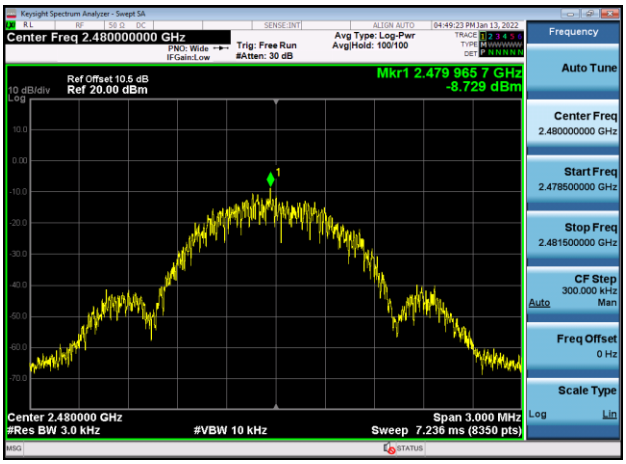
Power spectral density：2402MHz




Power spectral density：2440MHz




Power spectral density：2480MHz



## 6dB and 99% Occupied BandWidth

### Test Result and Data

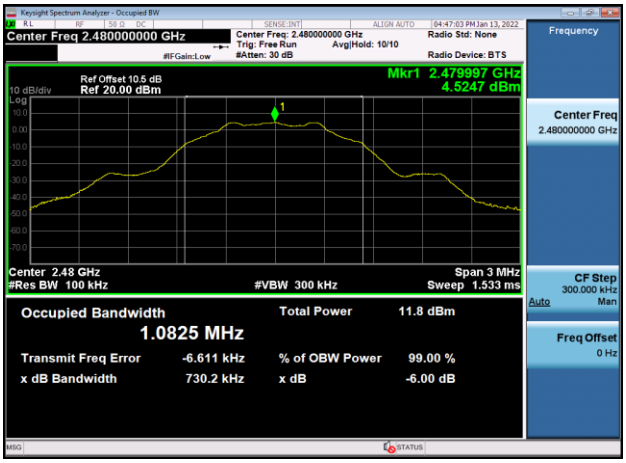
| Test Frequency | 6dB Occupy Bandwidth(KHz) | Min Limit(kHz) | Result |
|---|---|---|---|
| 2402 | 729.617 | 500 | Pass |
| 2440 | 729.410 | | Pass |
| 2480 | 730.157 | | Pass |

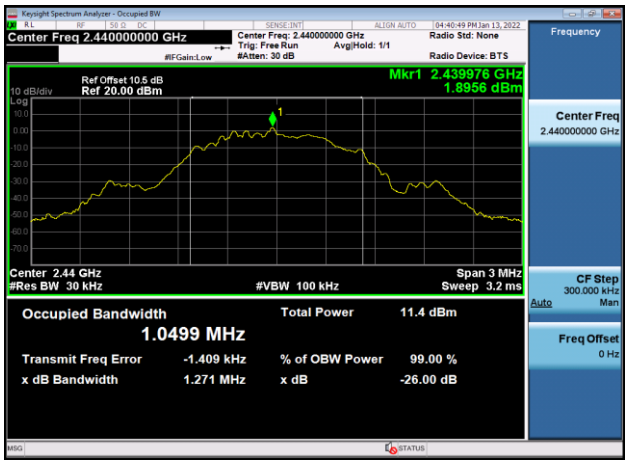
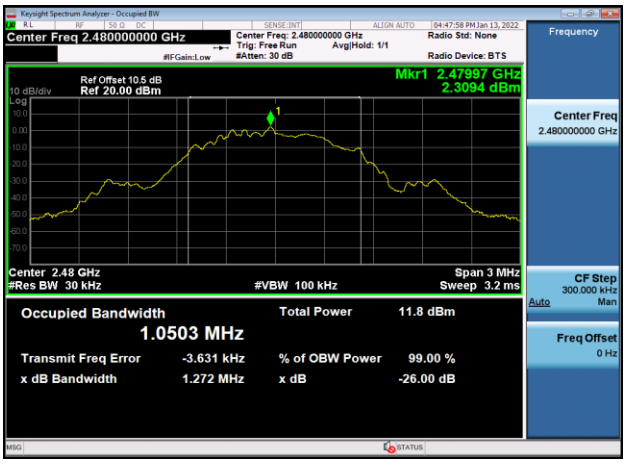
| Test Frequency | 99% Occupy Bandwidth(KHz) | Result |
|---|---|---|
| 2402 | 1.051 | Report only |
| 2440 | 1.050 | |
| 2480 | 1.050 | |

6dB Bandwidth：2402MHz


6dB Bandwidth：2440MHz

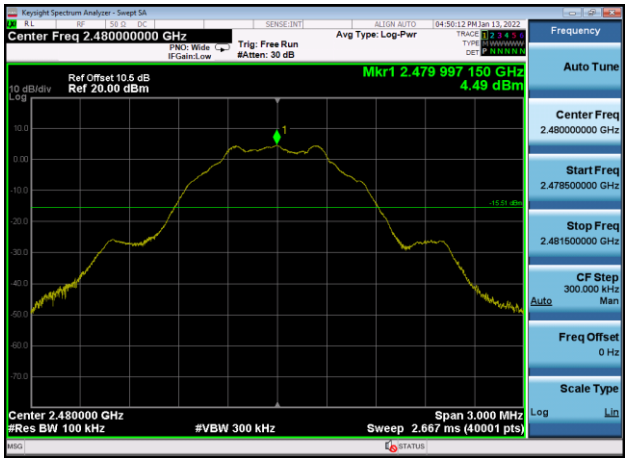
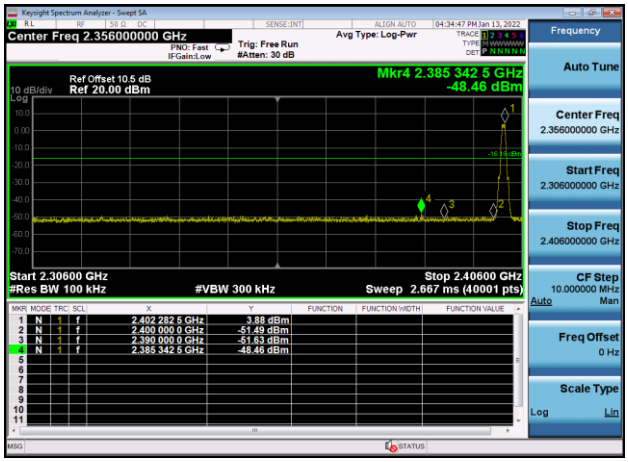
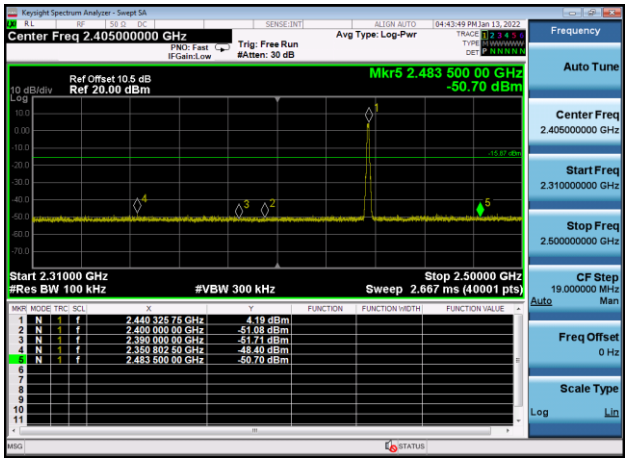
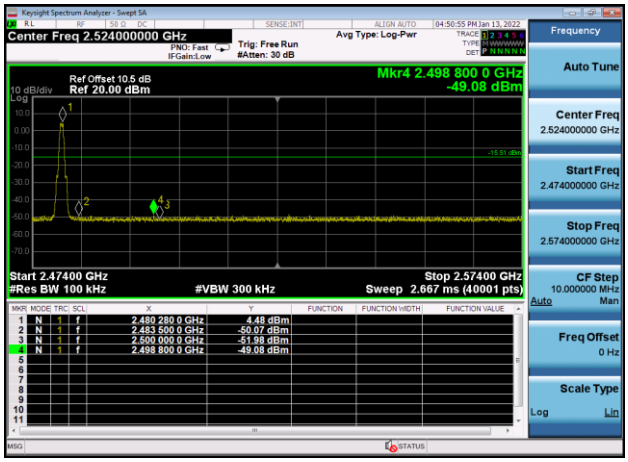

6dB Bandwidth：2480MHz

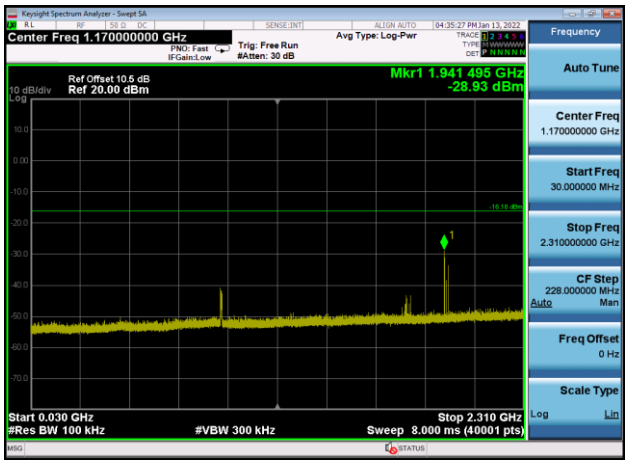
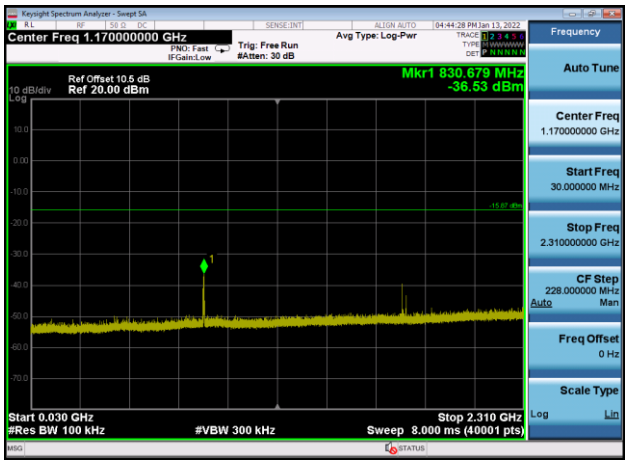
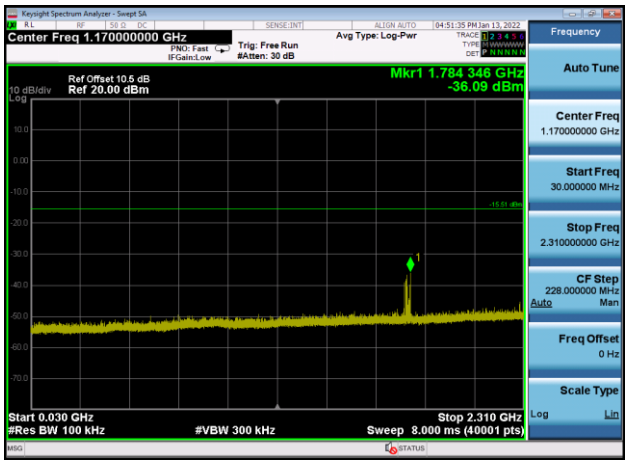
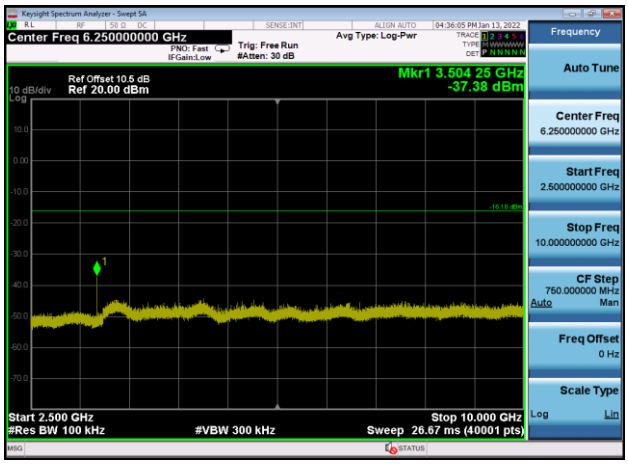
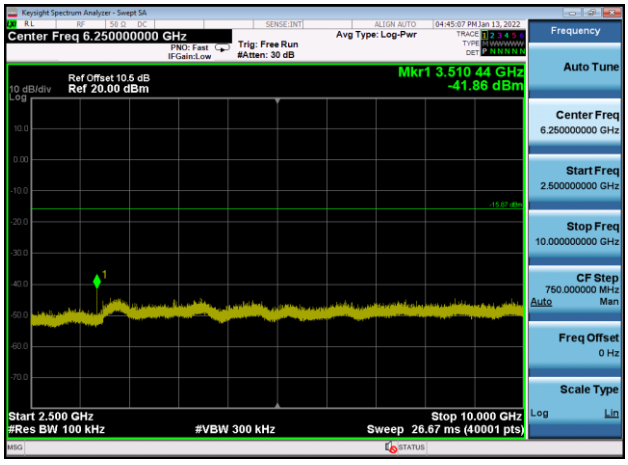
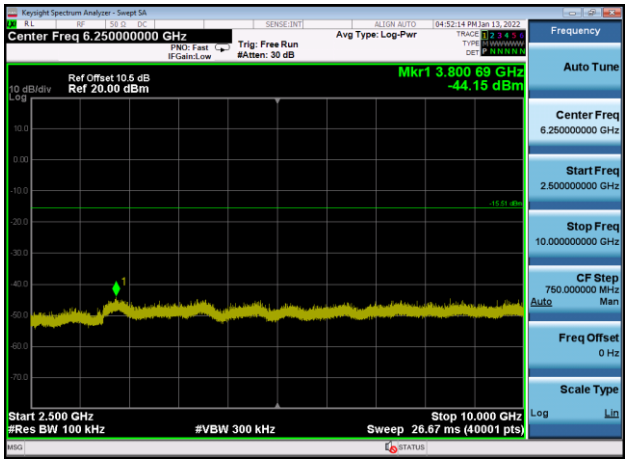


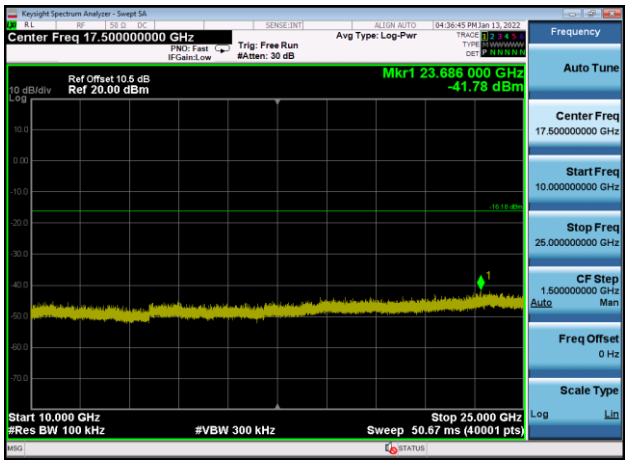
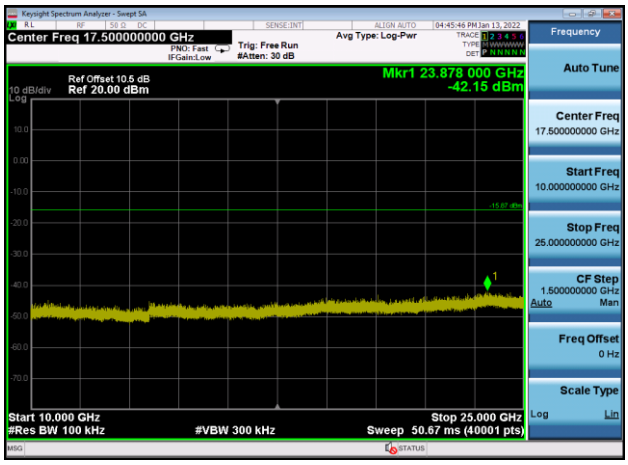
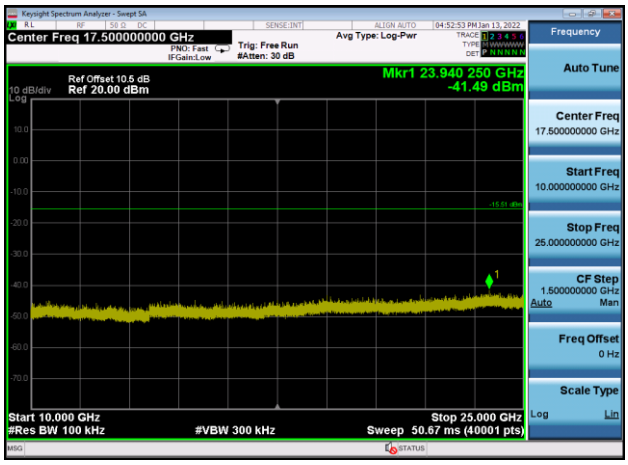
| 99% Bandwidth：2402MHz | 99% Bandwidth：2440MHz |
|---|---|
|  |  |
| **99% Bandwidth：2480MHz** | |
|  | |

## Conducted Band Edges and Spurious Emissions

### Test Result and Data

| | |
|---|---|
| ,Plot ,1Transmitter Spurious Emission ： 2402,Referecy Level | ,Plot ,1Transmitter Spurious Emission ： 2440,Referecy Level |
|  |  |
| ,Plot ,1Transmitter Spurious Emission ： 2480,Referecy Level | ,Plot ,2Conducted Emission：2402 ,Band Edge |
|  |  |
| ,Plot ,2Conducted Emission：2440 ,Band Edge | ,Plot ,2Conducted Emission：2480 ,Band Edge |
|  |  |

| | |
|---|---|
| ,Plot ,3Transmitter Spurious Emission<br>：2402,30MHz~2310MHz | ,Plot ,3Transmitter Spurious Emission<br>：2440,30MHz~2310MHz |
|  |  |
| ,Plot ,3Transmitter Spurious Emission<br>：2480,30MHz~2310MHz | ,Plot ,4Transmitter Spurious Emission<br>：2402,2500MHz~10000MHz |
|  |  |
| ,Plot ,4Transmitter Spurious Emission<br>：2440,2500MHz~10000MHz | ,Plot ,4Transmitter Spurious Emission<br>：2480,2500MHz~10000MHz |
|  |  |

| ,Plot ,5Transmitter Spurious Emission<br>： 2402,10000MHz~25000MHz | ,Plot ,5Transmitter Spurious Emission<br>： 2440,10000MHz~25000MHz |
|---|---|
|  |  |
| ,Plot ,5Transmitter Spurious Emission<br>： 2480,10000MHz~25000MHz | |
|  | |

** END OF REPORT **