# TEST REPORT

| | | |
|---|---|---|
| **Product Name** | : | ALPON X4 |
| **Brand Name** | : | Sixfab |
| **Model** | : | SEC1004 |
| **Series Model** | : | N/A |
| **FCC ID** | : | 2BAWK-SEC1004 |
| **Applicant** | : | **Sixfab, Inc.** |
| **Address** | : | 825 Watter's Creek Blvd.,Suite 250, Suite 250, Allen, Texas 75013, USA |
| **Manufacturer** | : | **DENE Teknoloji A.Ş.** |
| **Address** | : | Ikitelli OSB Mah, Bedrettin Dalan Blv, 23/56. Başakşehir. Istanbul. Turkey |
| **Factory** | : | **DENE Teknoloji A.Ş.** |
| **Address** | : | İstanbul İhtisas Serbest Bölgesi Şubesi Yeşilköy SB Mah. C Blok SK. C Blok AP. NO:1/7 Bakırköy/İSTANBUL Turkey |
| **Standard(s)** | : | FCC CFR Title 47 Part 15 Subpart C Section 15.247 |
| **Date of Receipt** | : | Aug.13, 2024 |
| **Date of Test** | : | Aug.13, 2024~ Sept.14, 2024 |
| **Issued Date** | : | Sept.14, 2024 |

**Issued By:** **Guangdong Asia Hongke Test Technology Limited**

B1/F, Building 11, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Tel.: +86 0755-230967639 Fax.: +86 0755-230967639

**Reviewed by:** Leon Yi
Leon.yi

**Approved by:** Sean She
Sean She

## Report Revise Record

| Report Version | Issued Date | Notes |
|---|---|---|
| M1 | Sept.14, 2024 | Initial Release |

# Contents

# 1 TEST SUMMARY

## 1.1 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

ANSI C63.10: 2013: American National Standard for Testing Unlicensed Wireless Devices

KDB558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spreda Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules

## 1.2 Test Summary

| Test Item | Section in CFR 47 | Result |
|---|---|---|
| Maximum Conducted Output Power | §15.247(b) | Pass |
| 20dB Bandwidth | §15.247(a) | Pass |
| Frequency Separation | §15.247(a) | Pass |
| Number Of Hopping Frequency | §15.247(a) | Pass |
| Time Of Occupancy (Dwell Time) | §15.247(a) | Pass |
| Conducted Spurious Emissions and Band Edges Emissions | §15.205, §15.247(d) | Pass |
| Radiated Spurious Emissions | §15.209, §15.247(d) | Pass |
| Emissions at Restricted Band | §15.205 | Pass |
| AC Mains Conducted Emissions | §15.207(a) | Pass |
| Antenna Requirements | §15.203 | Pass |

## 1.3 Test Facility

**Test Laboratory:**
**Guangdong Asia Hongke Test Technology Limited**
B1/F, Building 11, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

The test facility is recognized, certified or accredited by the following organizations:
**FCC-Registration No.: 251906 Designation Number: CN1376**
Guangdong Asia Hongke Test Technology Limited 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.

**IC —Registration No.: 31737 CAB identifier: CN0165**
The 3m Semi-anechoic chamber of Guangdong Asia Hongke Test Technology Limited has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 31737

**A2LA-Lab Cert. No.: 7133.01**
Guangdong Asia Hongke Test Technology Limited has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

## 1.4 Measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16 - 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the Guangdong Asia Hongke Test Technology Limited’s quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.
Hereafter the best measurement capability for Asia Hongke laboratory is reported:

| Test | Measurement Uncertainty | Notes |
|---|---|---|
| Power Line Conducted Emission | 150KHz~30MHz ±1.20 dB | (1) |
| Radiated Emission | 9KHz~30Hz ±3.10dB | (1) |
| Radiated Emission | 9KHz~1GHz ±3.75dB | (1) |
| Radiated Emission | 1GHz~18GHz ±3.88 dB | (1) |
| Radiated Emission | 18GHz-40GHz ±3.88dB | (1) |
| RF power, conducted | 30MHz~6GHz ±0.16dB | (1) |
| RF power density, conducted | ±0.24dB | (1) |
| Spurious emissions, conducted | ±0.21dB | (1) |
| Temperature | ±1℃ | (1) |
| Humidity | ±3% | (1) |
| DC and low frequency voltages | ±1.5% | (1) |
| Time | ±2% | (1) |
| Duty cycle | ±2% | (1) |

The report uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty Multiplied by a coverage factor of k=2 , providing a level of confidence of approximately 95%

# 2 GENGENERAL INFORMATION

## 2.1 Environmental conditions

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

| | |
|---|---|
| Normal Temperature: | 25°C |
| Relative Humidity: | 95 % |
| Air Pressure: | 101 kPa |

## 2.2 General Description of EUT

| | |
|---|---|
| Product Name: | ALPON X4 |
| Model/Type reference: | SEC1004 |
| Serial Model: | N/A |
| Power Supply: | Type 1: USB PD: 12V DC 2.25A, 15V DC 1.8A, 27W Max<br>Type 2: DC Input: 9-30V DC, 27W Max<br>Type 3: IEEE 802.3at Poe+: 48V DC 0.5A 24W |
| Adapter information: | **Adapter 1(USB PD)**<br>Model:HT-PD27W-HD<br>Input: 100-240V~ 50/60Hz 0.6A Max<br>Output: 5.1V⎓5.0A, 9V⎓3.0A, 12V⎓2.25A, 15.0V⎓1.8A 27.0W Max<br>**Adapter 2(DC)**<br>Model:HT36-1202500AX<br>Input: 100-240V~ 50/60Hz 1.0A Max<br>Output: 12V⎓2.5A 30.0W Max<br>**Adapter 3(POE)**<br>Model:GP-H480-050G<br>Input: 100-240V~ 50/60Hz Max 0.75A<br>Output: 48.0V⎓0.5A 24W |
| Hardware Version: | SEC1004-C**XYZABC**<br>SEC1004- X: **RAM** 1: 1GB 2: 2GB 4: 4GB 8: 8GB; Y: **Memory** 8: 8GB 1: 16GB 3: 32GB; Z: **Wi-Fi** N: No Wi-Fi W: Wi-Fi; A: **POE** 0: No POE 1: POE; B: **Antenna Type** Q: Antenna 1 J: Antenna 2 C: Antenna 3; C: **GPS Antenna** 0: None 1: Yes |
| Software Version: | 12 |
| Sample(s) Status: | AiTSZ-240813002-1(Normal sample)<br>AiTSZ-240813002-2(Engineer sample) |
| **Bluetooth :** | |
| Supported type: | Bluetooth BR/EDR |
| Modulation: | GFSK, π/4DQPSK, 8DPSK |
| Operation frequency: | 2402MHz~2480MHz |
| Channel number: | 79 |
| Channel separation: | 1MHz |
| Antenna: | Type / Antenna type / Gain / Manufacturer<br>2JW1102 -C943B / External Dipole Antenna / 4.10dBi / 2J<br>YB0022AA / External Combo antenna / 2.60dBi / QUECTEL<br>YEBT002W1AM / External Dipole / 2.90dBi / QUECTEL |

| | | | | |
|---|---|---|---|---|
| | | Antenna | | |

Note:

1. The above DUT's information was declared by manufacturer. For more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
2. Pre-scan ,we test each combinations of type power supply as well as the antenna type, only the worst combination of POE adapter + 2JW1102-C943B was final test and recorded for BT test.

## 2.3 Description of Test Modes and Test Frequency

There are 79 channels provided to the EUT and Channel 00/39/78 were selected to test.

**Operation Frequency List:**

| Channel | Frequency (MHz) |
|---|---|
| 00 | 2402 |
| 01 | 2403 |
| ⋮ | ⋮ |
| 38 | 2440 |
| 39 | 2441 |
| 40 | 2442 |
| ⋮ | ⋮ |
| 77 | 2479 |
| 78 | 2480 |

Note: The line display in grey were the channel selected for testing

Exploratory testing was performed under each mode combination test channel; only the final measurement of the worst combination was made and recorded in this report.

| Test case | Exploratory measurement | | | Final measurement Recorded In Report | | |
|---|---|---|---|---|---|---|
| | Mode | Date rate | Channel | Mode | Date rate | Channel |
| Frequency Separation | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK<br>8DPSK | DH5<br>2DH5<br>3DH5 | ☒ Middle |
| Number Of Hopping Frequency | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Full | GFSK<br>Π/4DQPSK<br>8DPSK | DH5<br>2DH5<br>3DH5 | ☒ Full |
| Time of Occupancy (dwell time) | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Middle |
| 20dB bandwidth | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK<br>8DPSK | DH5<br>2DH5<br>3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest |
| Maximum Conducted Output Power | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK<br>8DPSK | DH5<br>2DH5<br>3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest |
| Conducted Band edge | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Highest | GFSK<br>Π/4DQPSK<br>8DPSK | DH5<br>2DH5<br>3DH5 | ☒ Lowest<br>☒ Highest |
| Radiated Band edge | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Highest | GFSK | DH5 | ☒ Lowest<br>☒ Highest |
| Conducted Spurious Emissions | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK<br>8DPSK | DH5<br>2DH5<br>3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest |
| Radiated Spurious Emissions Above 1GHz | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest |
| Radiated Spurious Emissions | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | DH5 | ☒ Middle |

| | | | | | | |
|---|---|---|---|---|---|---|
| Below 1GHz | | | | | | |
| Conducted Emissions 9KHz-30 MHz | GFSK<br>Π/4DQPSK<br>8DPSK | DH1/DH3/DH5<br>2DH1/2DH3/2DH5<br>3DH1/3DH3/3DH5 | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | DH5 | ☒ Middle |

**Power setting during the test:**

During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.
Power Parameters:

| Test Software Version | CMD command | | |
|---|---|---|---|
| Frequency | 2402MHz | 2441MHz | 2480MHz |
| BR/EDR | Default | Default | Default |

## 2.4 Special Accessories

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

| Description | Manufacturer | Model | Serial No. | Provided by | Other |
|---|---|---|---|---|---|
| / | / | / | / | / | / |
| / | / | / | / | / | / |

## 2.5 Equipment List for the Test

| No | Test Equipment | Manufacturer | Model No | Serial No | Pre.Cal. Date | New Cal. Date | Cal. Due Date |
|---|---|---|---|---|---|---|---|
| 1 | Spectrum Analyzer | R&S | FSV40 | 101470 | 2023.09.08 | 2024.09.07 | 2025.09.06 |
| 2 | Spectrum Analyzer | Keysight | N9020A | MY51280643 | 2023.09.08 | 2024.09.07 | 2025.09.06 |
| 3 | EMI Measuring Receiver | R&S | ESR | 101660 | 2023.09.08 | 2024.09.07 | 2025.09.06 |
| 4 | Low Noise Pre-Amplifier | HP | HP8447E | 1937A01855 | 2023.09.08 | 2024.09.07 | 2025.09.06 |
| 5 | Low Noise Pre-Amplifier | Tsj | MLA-0120-A02-34 | 2648A04738 | 2023.09.08 | 2024.09.07 | 2025.09.06 |
| 6 | Passive Loop | ETS | 6512 | 00165355 | 2022.09.04 | 2024.09.03 | 2026.09.06 |
| 7 | TRILOG Super Broadband test Antenna | SCHWARZBECK | VULB9160 | 9160-3206 | 2021.08.29 | 2024.08.28 | 2027.08.27 |
| 8 | Broadband Horn Antenna | SCHWARZBECK | BBHA9120D | 452 | 2021.08.29 | 2024.08.28 | 2027.08.27 |
| 9 | SHF-EHF Horn Antenna 15-40GHz | SCHWARZBECK | BBHA9170 | BBHA9170367d | 2021.08.29 | 2024.08.28 | 2027.08.27 |
| 10 | EMI Measuring Receiver | R&S | ESR | 101160 | 2023.09.13 | 2024.09.12 | 2025.09.11 |
| 11 | LISN | SCHWARZBECK | NNLK 8129 | 8130179 | 2023.10.29 | 2024.10.28 | 2025.10.27 |
| 12 | Pulse Limiter | R&S | ESH3-Z2 | 102789 | 2023.09.13 | 2024.09.12 | 2025.09.11 |
| 13 | Pro.Temp&Humi.chamber | MENTEK | MHP-150-1C | MAA08112501 | 2023.09.08 | 2024.09.07 | 2025.09.06 |
| 14 | RF Automatic Test system | MW | MW100-RFCB | 21033016 | 2023.09.08 | 2024.09.07 | 2025.09.06 |
| 15 | Signal Generator | Agilent | N5182A | MY50143009 | 2023.09.08 | 2024.09.07 | 2025.09.06 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16 | Wideband Radio communication tester | R&S | CMW500 | 1201.0002K50 | 2023.09.08 | 2024.09.07 | 2025.09.06 |
| 17 | RF Automatic Test system | MW | MW100-RFCB | 21033016 | 2023.09.08 | 2024.09.07 | 2025.09.06 |
| 18 | DC power supply | ZHAOXIN | RXN-305D-2 | 28070002559 | N/A | N/A | N/A |
| 19 | RE Software | EZ | EZ-EMC_RE | Ver.AIT-03A | N/A | N/A | N/A |
| 20 | CE Software | EZ | EZ-EMC_CE | Ver.AIT-03A | N/A | N/A | N/A |
| 21 | RF Software | MW | MTS 8310 | 2.0.0.0 | N/A | N/A | N/A |
| 22 | temporary antenna connector(Note) | NTS | R001 | N/A | N/A | N/A | N/A |
| Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list. | | | | | | | |

# 3 TEST CONDITIONS AND RESULTS

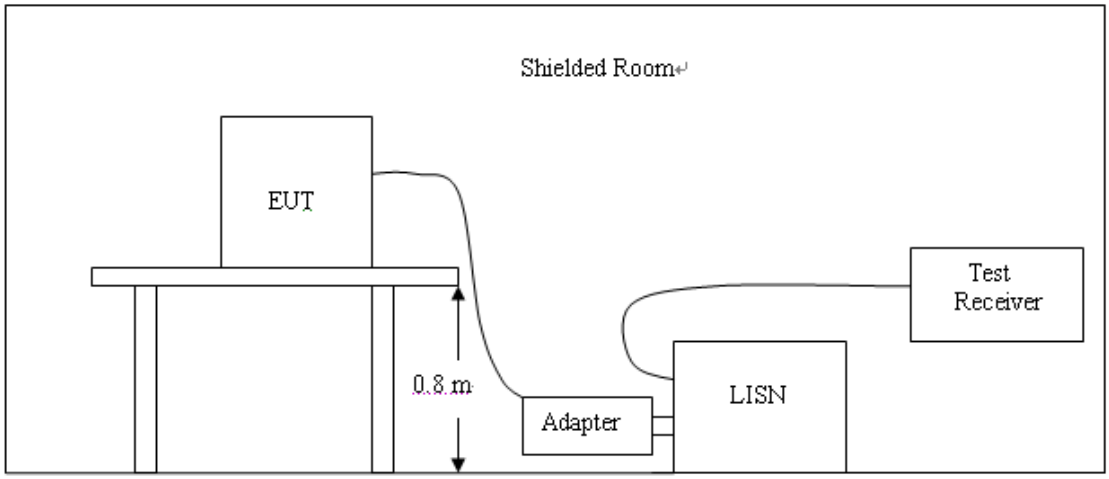
## 3.1 Conducted Emissions Test

**LIMIT**

| Frequency range (MHz) | Limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

**TEST CONFIGURATION**



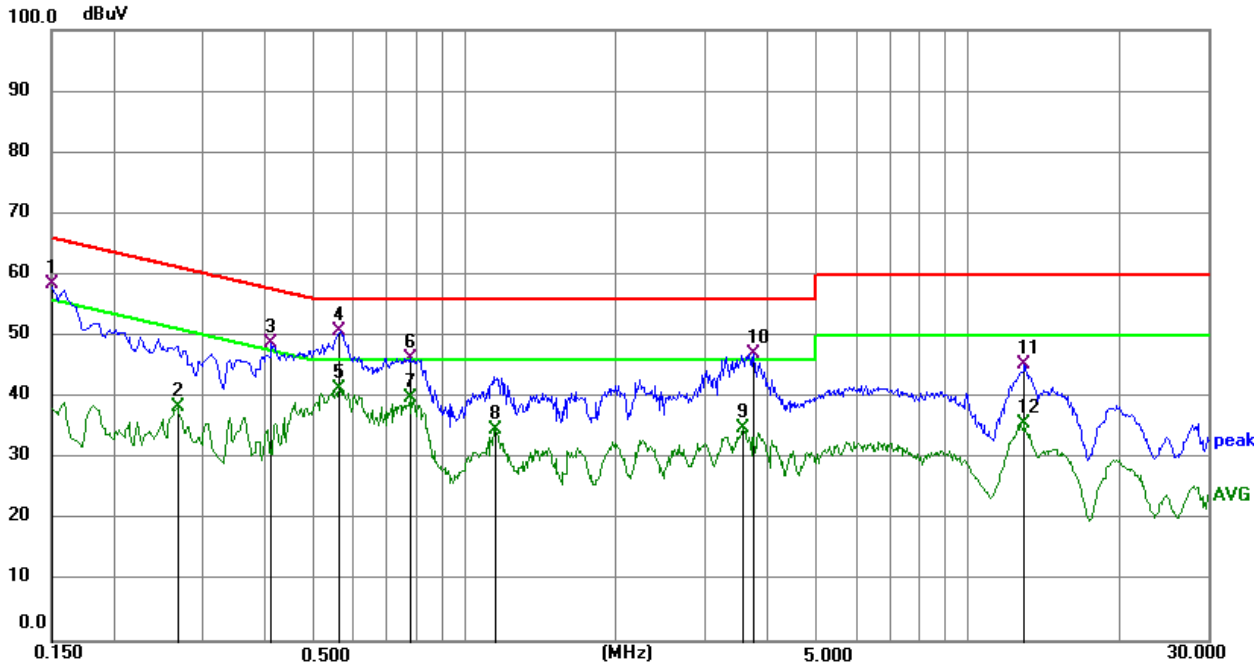

**TEST PROCEDURE**

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. The adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

## TEST RESULTS

Remark: Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:

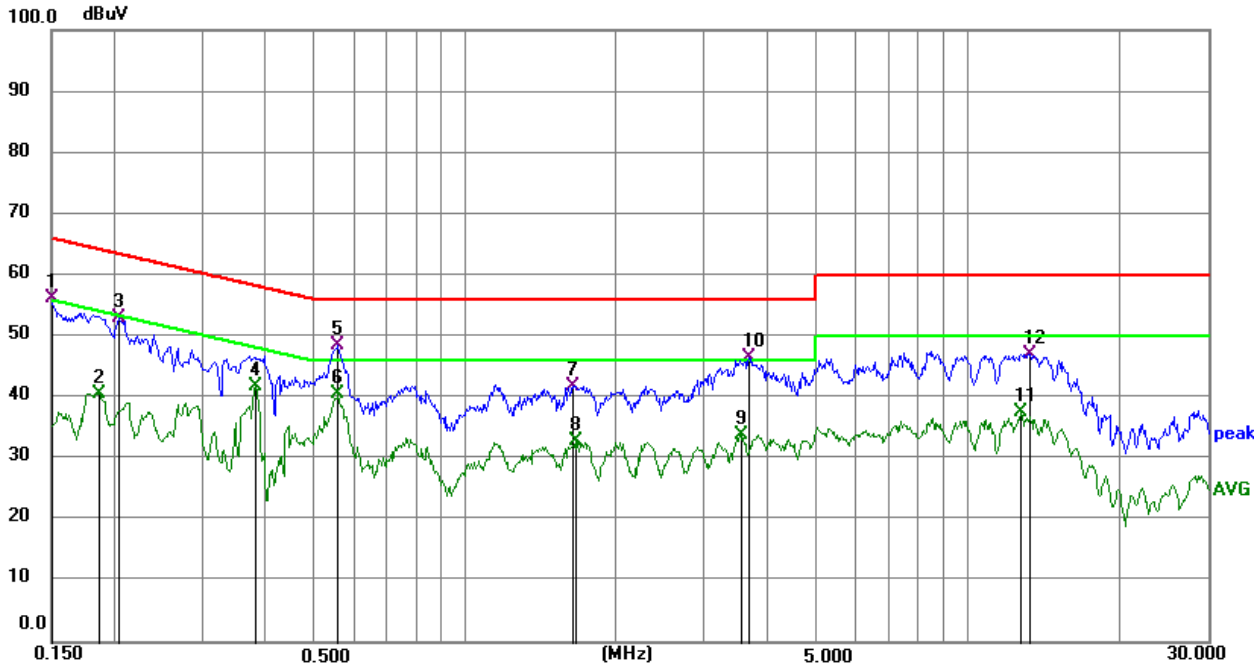
| Test Mode | BT | Line: | L |
|---|---|---|---|




Remark: Correct Factor = Insertion loss of LISN + Cable loss + Insertion loss of Pulse Limiter;
Measurement Result = Reading Level +Correct Factor;
Margin = Measurement Result- Limit

| No. | Frequency (MHz) | Reading (dBuV) | Correct (dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0.1500 | 46.67 | 11.84 | 58.51 | 66.00 | -7.49 | QP |
| 2 | 0.2671 | 27.52 | 10.70 | 38.22 | 51.21 | -12.99 | AVG |
| 3 | 0.4102 | 37.98 | 10.69 | 48.67 | 57.64 | -8.97 | QP |
| 4 | 0.5639 | 40.07 | 10.68 | 50.75 | 56.00 | -5.25 | QP |
| 5 | 0.5639 | 30.68 | 10.68 | 41.36 | 46.00 | -4.64 | AVG |
| 6 | 0.7751 | 35.72 | 10.67 | 46.39 | 56.00 | -9.61 | QP |
| 7 | 0.7751 | 29.22 | 10.67 | 39.89 | 46.00 | -6.11 | AVG |
| 8 | 1.1471 | 23.92 | 10.67 | 34.59 | 46.00 | -11.41 | AVG |
| 9 | 3.5653 | 23.87 | 10.98 | 34.85 | 46.00 | -11.15 | AVG |
| 10 | 3.7395 | 36.03 | 11.00 | 47.03 | 56.00 | -8.97 | QP |
| 11 | 12.9198 | 33.93 | 11.35 | 45.28 | 60.00 | -14.72 | QP |
| 12 | 12.9198 | 24.34 | 11.35 | 35.69 | 50.00 | -14.31 | AVG |

| Test Mode | BT | Line: | N |
|---|---|---|---|




Remark: Correct Factor = Insertion loss of LISN + Cable loss + Insertion loss of Pulse Limiter;
Measurement Result = Reading Level +Correct Factor;

Margin = Measurement Result- Limit

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | (dB) | (dBuV) | (dBuV) | (dB) | |
| 1 | 0.1500 | 44.34 | 11.84 | 56.18 | 66.00 | -9.82 | QP |
| 2 | 0.1860 | 29.92 | 10.69 | 40.61 | 54.21 | -13.60 | AVG |
| 3 | 0.2040 | 42.25 | 10.69 | 52.94 | 63.45 | -10.51 | QP |
| 4 | 0.3795 | 31.07 | 10.69 | 41.76 | 48.29 | -6.53 | AVG |
| 5 | 0.5594 | 37.87 | 10.68 | 48.55 | 56.00 | -7.45 | QP |
| 6 | 0.5594 | 29.93 | 10.68 | 40.61 | 46.00 | -5.39 | AVG |
| 7 | 1.6391 | 31.12 | 10.73 | 41.85 | 56.00 | -14.15 | QP |
| 8 | 1.6620 | 22.16 | 10.73 | 32.89 | 46.00 | -13.11 | AVG |
| 9 | 3.5565 | 22.83 | 10.97 | 33.80 | 46.00 | -12.20 | AVG |
| 10 | 3.6780 | 35.48 | 10.98 | 46.46 | 56.00 | -9.54 | QP |
| 11 | 12.7680 | 26.24 | 11.31 | 37.55 | 50.00 | -12.45 | AVG |
| 12 | 13.2855 | 35.74 | 11.34 | 47.08 | 60.00 | -12.92 | QP |

## 3.2 Radiated Emissions and Band Edge

**Limit**

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

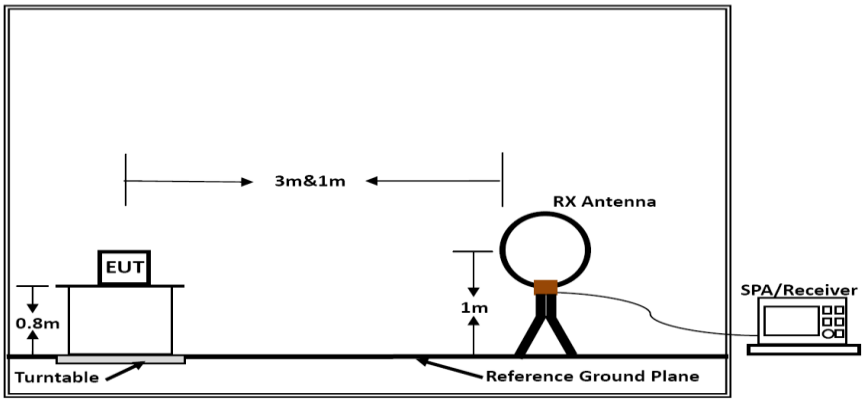
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Radiated emission limits

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m) | Radiated (μV/m) |
|---|---|---|---|
| 0.009-0.49 | 3 | 20log(2400/F(KHz))+40log(300/3) | 2400/F(KHz) |
| 0.49-1.705 | 3 | 20log(24000/F(KHz))+ 40log(30/3) | 24000/F(KHz) |
| 1.705-30 | 3 | 20log(30)+ 40log(30/3) | 30 |
| 30-88 | 3 | 40.0 | 100 |
| 88-216 | 3 | 43.5 | 150 |
| 216-960 | 3 | 46.0 | 200 |
| Above 960 | 3 | 54.0 | 500 |

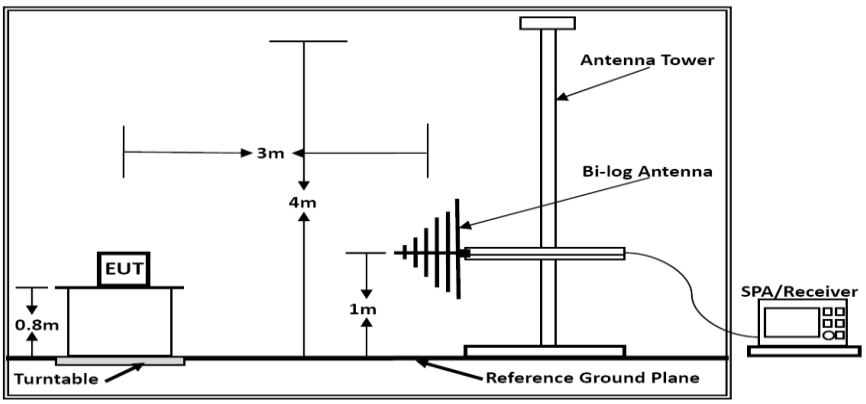
**TEST CONFIGURATION**

(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



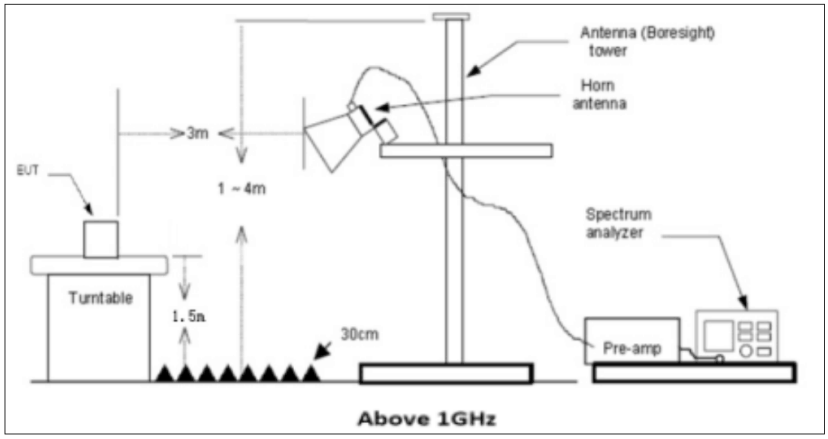

Below 30MHz

(B) Radiated Emission Test Set-Up, Frequency below 1000MHz




Below 1GHz

(C) Radiated Emission Test Set-Up, Frequency above 1000MHz




## Test Procedure

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

| Test Frequency range | Test Antenna Type | Test Distance |
|---|---|---|
| 9KHz-30MHz | Active Loop Antenna | 3 |
| 30MHz-1GHz | Bilog Antenna | 3 |
| 1GHz-18GHz | Horn Antenna | 3 |
| 18GHz-25GHz | Horn Anternna | 1 |

7. Setting test receiver/spectrum as following table states:

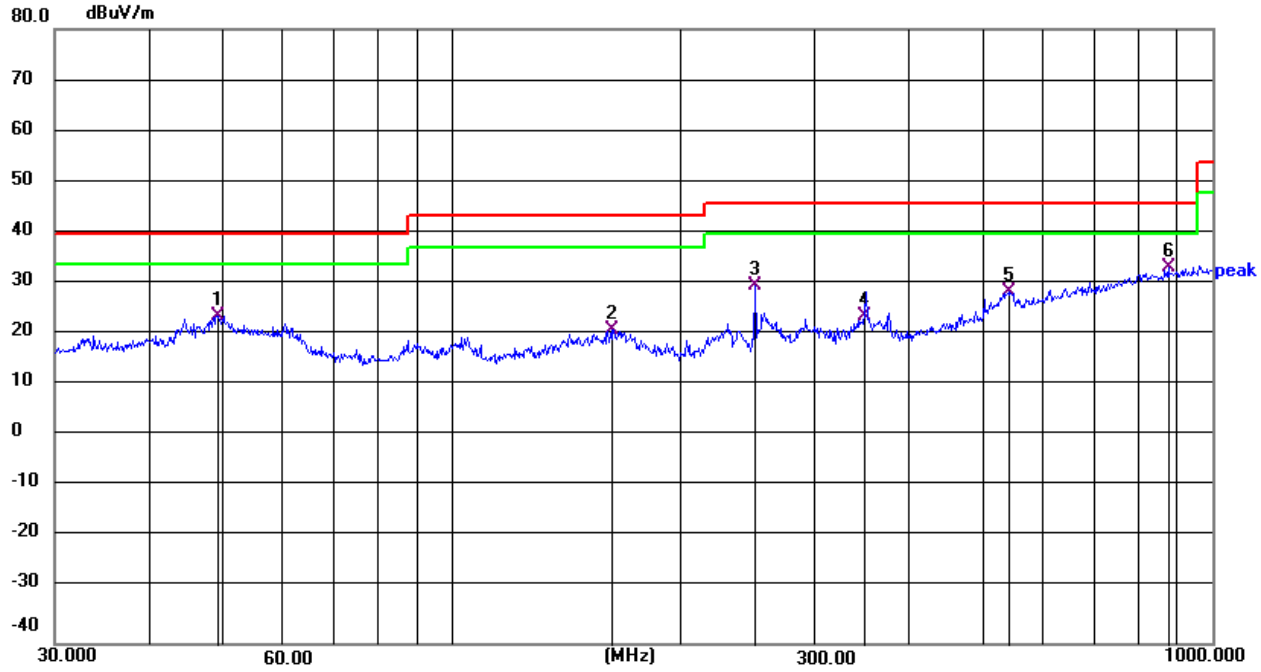
| Test Frequency range | Test Receiver/Spectrum Setting | Detector |
|---|---|---|
| 9KHz-150KHz | RBW=200Hz/VBW=3KHz,Sweep time=Auto | QP |
| 150KHz-30MHz | RBW=9KHz/VBW=100KHz,Sweep time=Auto | QP |
| 30MHz-1GHz | RBW=120KHz/VBW=1000KHz,Sweep time=Auto | QP |
| 1GHz-40GHz | Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto<br>Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto | Peak |

## TEST RESULTS

Remark:
1. All GFSK, π/4 DQPSK and 8DPSK mode were measured from 9 KHz to 25GHz and recorded worst case at GFSK DH5 mode.
2. For below 1GHz testing recorded worst at GFSK DH5 middle channel.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and The emission levels from 9kHz to 30MHz are attenuated 20dB below the limit and not recorded in report.

**For 30MHz-1GHz**

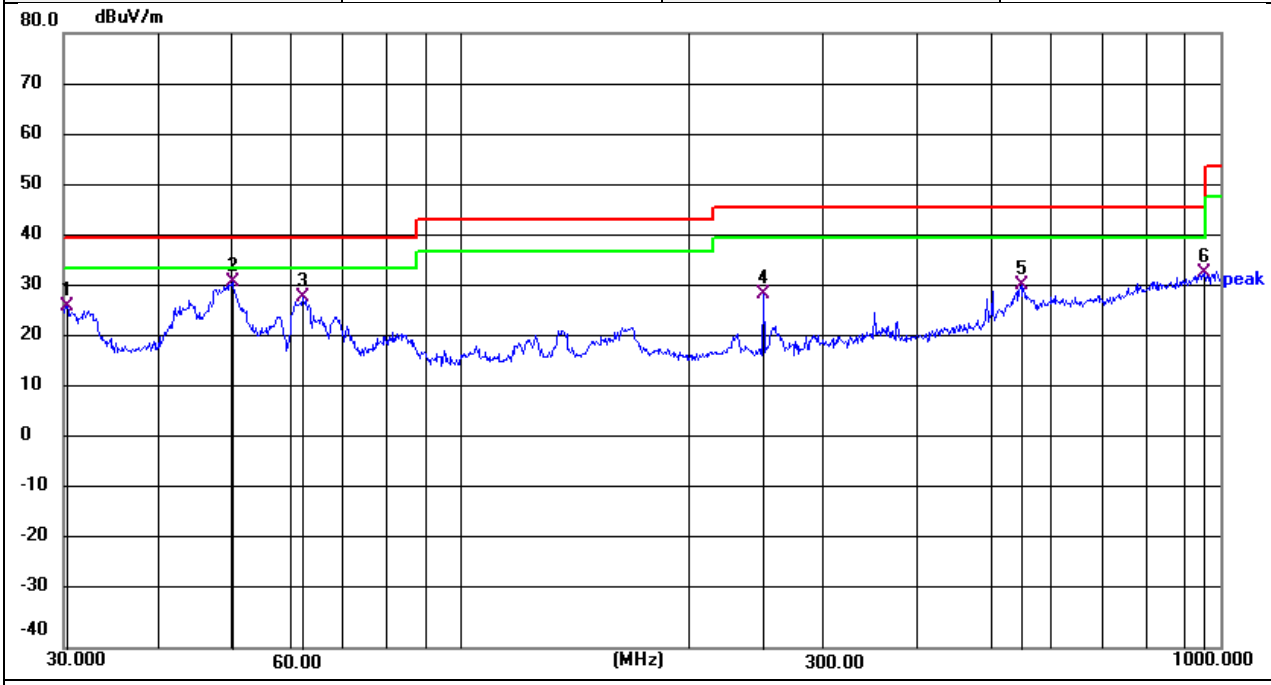
| Test mode: | BT | Polarization: | Horizontal |
|---|---|---|---|




Remark:
Emission Level = Reading + Factor;
Factor = Antenna Factor + Cable Loss – Pre-amplifier;
Margin= Emission Level - Limit.

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Det. |
|---|---|---|---|---|---|---|---|
| 1 | 49.1865 | 40.73 | -16.60 | 24.13 | 40.00 | -15.87 | QP |
| 2 | 162.0413 | 37.93 | -16.59 | 21.34 | 43.50 | -22.16 | QP |
| 3 | 250.3010 | 48.50 | -18.57 | 29.93 | 46.00 | -16.07 | QP |
| 4 | 349.2500 | 39.92 | -15.77 | 24.15 | 46.00 | -21.85 | QP |
| 5 | 539.4773 | 40.15 | -11.49 | 28.66 | 46.00 | -17.34 | QP |
| 6 * | 875.2470 | 38.66 | -5.11 | 33.55 | 46.00 | -12.45 | QP |

| Test mode: | BT | Polarization: | Vertical |
|---|---|---|---|




Remark:
Emission Level = Reading + Factor;
Factor = Antenna Factor + Cable Loss – Pre-amplifier;
Margin= Emission Level - Limit.

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Det. |
|---|---|---|---|---|---|---|---|
| 1 | 30.3170 | 44.22 | -17.55 | 26.67 | 40.00 | -13.33 | QP |
| 2 * | 50.0566 | 47.97 | -16.60 | 31.37 | 40.00 | -8.63 | QP |
| 3 | 61.9950 | 46.19 | -17.58 | 28.61 | 40.00 | -11.39 | QP |
| 4 | 250.3010 | 47.54 | -18.57 | 28.97 | 46.00 | -17.03 | QP |
| 5 | 547.0976 | 42.03 | -11.24 | 30.79 | 46.00 | -15.21 | QP |
| 6 | 952.0937 | 36.83 | -3.51 | 33.32 | 46.00 | -12.68 | QP |

***For 1GHz to 25GHz***

Note:GFSK, Pi/4 DQPSK and 8DPSK all have been tested, only worse case GFSK is reported as bellow:

***GFSK (above 1GHz)***

| **Frequency(MHz):** | | **2402** | | **Polarity:** | **Horizontal** | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4804 | 46.46 | 5.06 | 51.52 | 74 | -22.48 | PEAK |
| 4804 | 36.77 | 5.06 | 41.83 | 54 | -12.17 | AVG |
| 7206 | 44.36 | 7.03 | 51.39 | 74 | -22.61 | PEAK |
| 7206 | 31.20 | 7.03 | 38.23 | 54 | -15.77 | AVG |

| **Frequency(MHz):** | | **2402** | | **Polarity:** | **VERTICAL** | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4804 | 47.33 | 5.06 | 52.39 | 74 | -21.61 | PEAK |
| 4804 | 35.48 | 5.06 | 40.54 | 54 | -13.46 | AVG |
| 7206 | 44.21 | 7.03 | 51.24 | 74 | -22.76 | PEAK |
| 7206 | 31.04 | 7.03 | 38.07 | 54 | -15.93 | AVG |

| **Frequency(MHz):** | | **2441** | | **Polarity:** | **Horizontal** | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4882 | 46.64 | 5.14 | 51.78 | 74 | -22.22 | PEAK |
| 4882 | 36.43 | 5.14 | 41.57 | 54 | -12.43 | AVG |
| 7323 | 43.78 | 7.52 | 51.30 | 74 | -22.70 | PEAK |
| 7323 | 31.07 | 7.52 | 38.59 | 54 | -15.41 | AVG |

| **Frequency(MHz):** | | **2441** | | **Polarity:** | **VERTICAL** | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4882 | 48.20 | 5.14 | 53.34 | 74 | -20.66 | PEAK |
| 4882 | 36.49 | 5.14 | 41.63 | 54 | -12.37 | AVG |
| 7323 | 44.07 | 7.52 | 51.59 | 74 | -22.41 | PEAK |
| 7323 | 29.81 | 7.52 | 37.33 | 54 | -16.67 | AVG |

| Frequency(MHz): | | 2480 | | Polarity: | Horizontal | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4960 | 47.84 | 5.22 | 53.06 | 74 | -20.94 | PEAK |
| 4960 | 34.75 | 5.22 | 39.97 | 54 | -14.03 | AVG |
| 7440 | 43.52 | 8.06 | 51.58 | 74 | -22.42 | PEAK |
| 7440 | 32.68 | 8.06 | 40.74 | 54 | -13.26 | AVG |

| Frequency(MHz): | | 2480 | | Polarity: | VERTICAL | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4960 | 46.14 | 5.22 | 51.36 | 74 | -22.64 | PEAK |
| 4960 | 36.05 | 5.22 | 41.27 | 54 | -12.73 | AVG |
| 7440 | 44.64 | 8.06 | 52.70 | 74 | -21.30 | PEAK |
| 7440 | 30.06 | 8.06 | 38.12 | 54 | -15.88 | AVG |

REMARKS:

1. Emission level (dBuV/m) = Reading (dBuV)+ Factor (dB/m)
2. Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Emission level- Limit value.
4. -- Mean the PK detector measured value is below average limit.
5. Other emission levels are attenuated 20dB below the limit and not recorded in report.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

***Radiation Restricted band***

Note: GFSK, Pi/4 DQPSK and 8DPSK all have been tested, only worse case GFSK is reported as below:

| Frequency(MHz): | | 2402 | | Polarity: | Horizontal | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2385.69 | 40.69 | -5.55 | 35.14 | 74 | -38.86 | peak |
| 2390 | 40.68 | -5.72 | 34.96 | 74 | -39.04 | peak |
| 2400 | 39.85 | -5.61 | 34.24 | 74 | -39.76 | peak |

| Frequency(MHz): | | 2402 | | Polarity: | Vertical | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2387.12 | 41.38 | -5.98 | 35.4 | 74 | -38.6 | peak |
| 2390 | 38.77 | -5.94 | 32.83 | 74 | -41.17 | peak |
| 2400 | 40.7 | -5.65 | 35.05 | 74 | -38.95 | peak |

| Frequency(MHz): | | 2480 | | Polarity: | Horizontal | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2483.5 | 36.07 | -4.67 | 31.4 | 74 | -42.6 | peak |
| 2485.8 | 37.38 | -5.06 | 32.32 | 74 | -41.68 | peak |

| Frequency(MHz): | | 2408 | | Polarity: | Vertical | |
|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
| (MHz) | (dBμV) | (dB/m) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2483.5 | 38.26 | -4.8 | 33.46 | 74 | -40.54 | peak |
| 2485.14 | 38.85 | -4.67 | 34.18 | 74 | -39.82 | peak |

REMARKS:

1. Emission level (dBuV/m) = Reading (dBuV)+ Factor (dB/m)
2. Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Emission level- Limit value.
4. Other emission levels are attenuated 20dB below the limit and not recorded in report.
5. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

## 3.3 Maximum Peak Output Power

**Limit**

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

**Test Procedure**

The transmitter output (antenna port) was connected to the spectrum analyzer. According to ANSI C63.10:2013 Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices; this is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

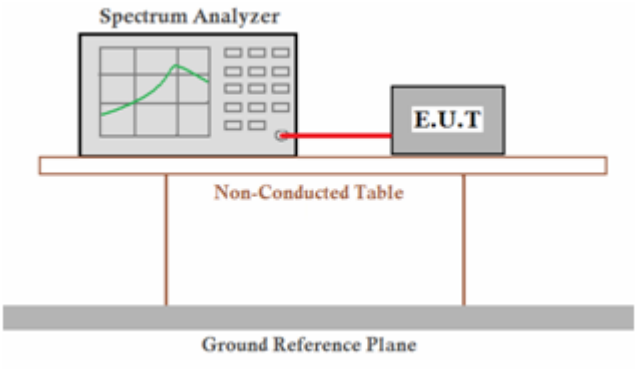
a) Use the following spectrum analyzer settings:
   1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
   2) RBW > 20 dB bandwidth of the emission being measured.
   3) VBW ≥ RBW.
   4) Sweep: Auto.
   5) Detector function: Peak.
   6) Trace: Max hold.

b) Allow trace to stabilize.

c) Use the marker-to-peak function to set the marker to the peak of the emission.

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

**Test Configuration**




**Test Results**

☒ **Pass** ☐ **Not Applicable**

Note:
For test data, please refer to Appendix RF test data for BT.

## 3.4 20dB Bandwidth

**Limit**

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

**Test Procedure**

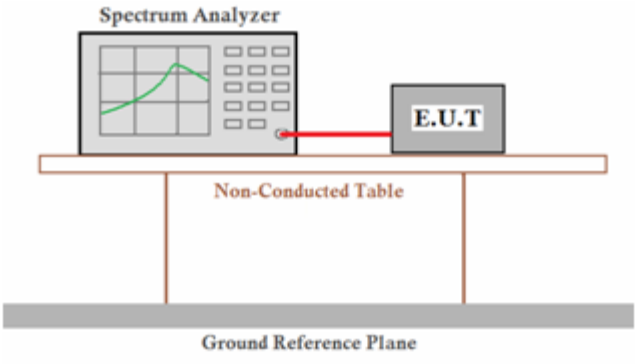
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer. Place the EUT on the table and set it in transmitting mode.

Use the following spectrum analyzer settings:

1) Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel.
2) RBW ≥1% of the 20 dB bandwidth, VBW ≥RBW.
3) Detector function = peak.
4) Trace = max hold.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

**Test Configuration**




**Test Results**

☒ **Pass** ☐ **Not Applicable**

Note:
For test data, please refer to Appendix RF test data for BT.

## 3.5 Occupied Bandwidth

**Limit**

N/A

**Test Procedure**

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

RBW=1% to 5% of the OBW

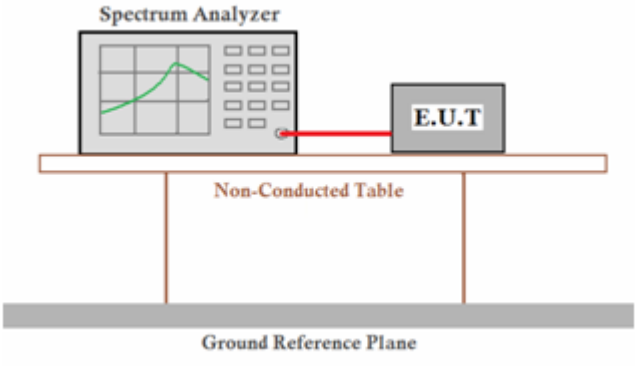
VBW=approximately 3 X RBW

Detector=Peak

Trace Mode: Max Hold

Use the 99% power bandwidth function of the instrument to measure the Occupied Bandwidth and recoded.

**Test Configuration**




**Test Results**

☒ **Pass** ☐ **Not Applicable**

Note:
For test data, please refer to Appendix RF test data for BT.

## 3.6 Frequency Separation

**LIMIT**

According to 15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

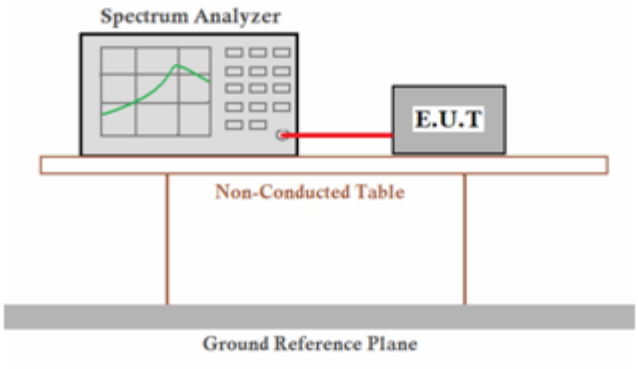
**Test Procedure**

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer. Place the EUT on the table and set it in transmitting mode.

Use the following spectrum analyzer settings:

1) Set center frequency of Spectrum Analyzer = middle of hopping channel.
2) Set the Spectrum Analyzer as RBW = 100 kHz, VBW =300 kHz, Span = wide enough to capture the peaks of two adjacent channels, Sweep = auto.
3) Max hold, mark 2 peaks of hopping channel and record the 2 peaks frequency.

**TEST CONFIGURATION**




**TEST RESULTS**

☒ **Pass** ☐ **Not Applicable**

Note:
For test data, please refer to Appendix RF test data for BT.

## 3.7 Number of hopping frequency

**Limit**

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

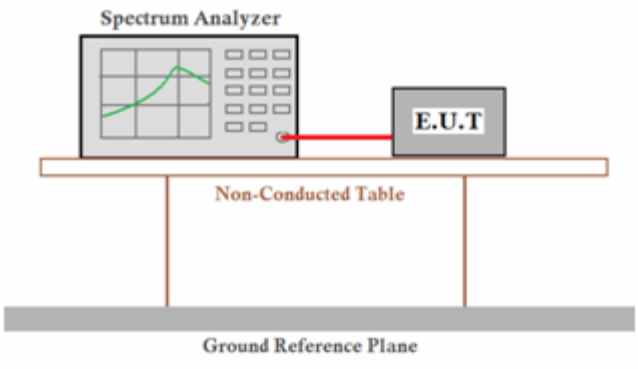
**Test Procedure**

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer. Place the EUT on the table and set it in transmitting mode.

Use the following spectrum analyzer settings:

1) Set Spectrum Analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
2) Set the Spectrum Analyzer as RBW/VBW=100KHz/300KHz.
3) Max hold, view and count how many channel in the band.

**Test Configuration**




**Test Results**

☒ **Pass** ☐ **Not Applicable**

Note:
For test data, please refer to Appendix RF test data for BT.

## 3.8 Time of Occupancy (Dwell Time)

**Limit**

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

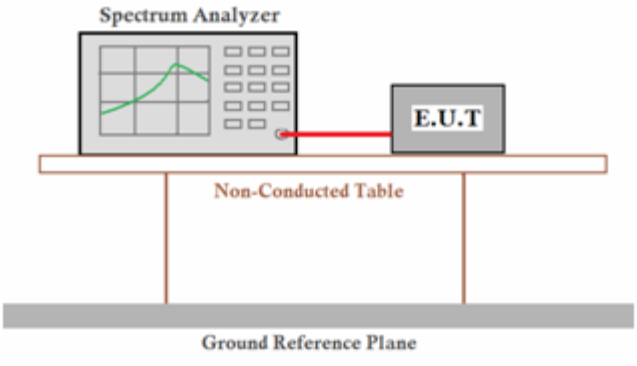
**Test Procedure**

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer. Place the EUT on the table and set it in transmitting mode.

Use the following spectrum analyzer settings:

1) Set center frequency of Spectrum Analyzer = operating frequency.
2) Set the Spectrum Analyzer as RBW=1MHz, VBW=3MHz, Span = 0Hz, Sweep = auto.
3) Repeat above procedures until all frequency measured was complete.

**Test Configuration**




**Test Results**

☒ **Pass** ☐ **Not Applicable**

Note:
For test data, please refer to Appendix RF test data for BT.

## 3.9 Out-of-band Emissions

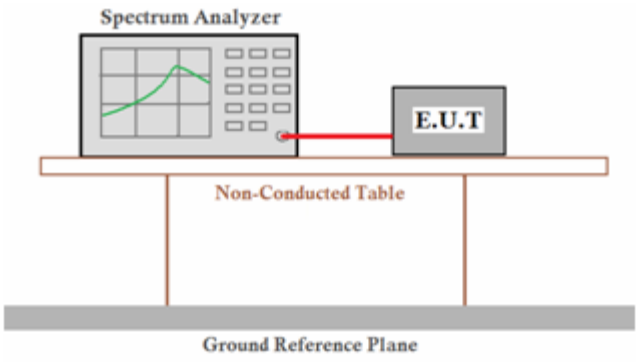
**Limit**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

**Test Procedure**

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector, and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

**Test Configuration**




**Test Results**

☒ **Pass** ☐ **Not Applicable**

Note:
For test data, please refer to Appendix RF test data for BT.

## 3.10 Pseudorandom Frequency Hopping Sequence

**TEST APPLICABLE**

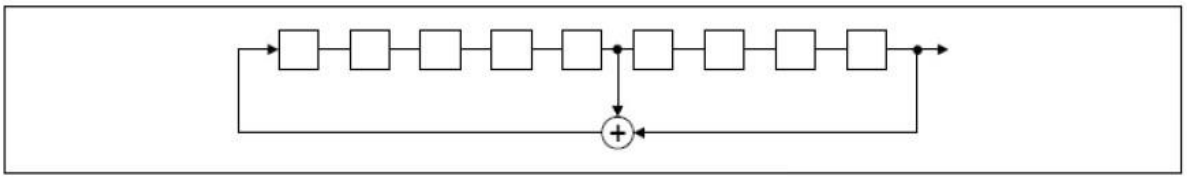
**For 47 CFR Part 15C section 15.247 (a) (1) RSS-247§5.1 requirement:**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

**EUT Pseudorandom Frequency Hopping Sequence Requirement**

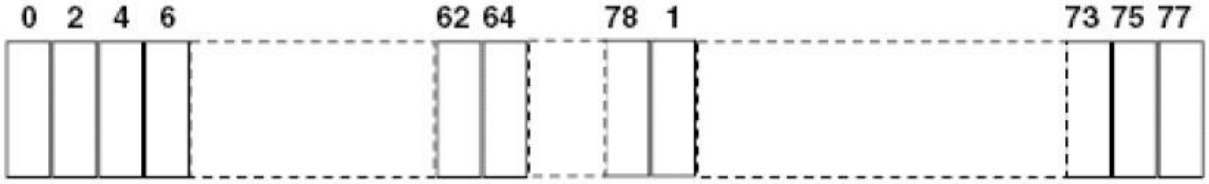
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



*Linear Feedback Shift Register for Generation of the PRBS sequence*

An example of pseudorandom frequency hopping sequence as follows:




Each frequency used equally one the average by each transmitter.

The system receiver has input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

## 3.11 Antenna Requirement

**Standard Applicable**

**For intentional device, according to FCC 47 CFR Section 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, 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

**FCC CFR Title 47 Part 15 Subpart C Section 15.247(b) (4):**
(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**Test Result**

The maximum gain of antenna was 4.10dBi with impedance 50Ω.

# 4 Test Setup Photographs of EUT

Please refer to separated files for Test Setup Photos of the EUT.

# 5 External Photographs of EUT

Please refer to separated files for External Photos of the EUT.

# 6 Internal Photographs of EUT

Please refer to separated files for Internal Photos of the EUT.

********** End of Report **********