# TEST REPORT

| | | |
|---|---|---|
| **Product** | : | XIAO MG24 |
| **Trade mark** | : | Seeed Studio |
| **Model/Type reference** | : | XIAO MG24, XIAO MG24 Sense |
| **Serial Number** | : | N/A |
| **Report Number** | : | EED32Q82089902 |
| **FCC ID** | : | Z4T-XIAOMG24 |
| **Date of Issue** | : | Jan. 09, 2025 |
| **Test Standards** | : | 47 CFR Part 15 Subpart C |
| **Test result** | : | PASS |

Prepared for:

**Seeed Technology Co., Ltd**
**9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen**

Prepared by:

**Centre Testing International Group Co., Ltd.**
**Hongwei Industrial Zone, Bao'an 70 District,**
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| | | | |
|---|---|---|---|
| Compiled by: | Keven Tan | Reviewed by: | Frazer Li |
| Approved by: | Aaron Ma | Date: | Jan. 09, 2025 |

Check No.: 7826161224

# 1 Content

## 2 Version

| Version No. | Date | Description |
|---|---|---|
| 00 | Jan. 09, 2025 | Original |
| | | |
| | | |

# 3 Test Summary

| Test Item | Test Requirement | Result |
|---|---|---|
| **Antenna Requirement** | 47 CFR Part 15 Subpart C Section 15.203/15.247 (c) | PASS |
| **AC Power Line Conducted Emission** | 47 CFR Part 15 Subpart C Section 15.207 | PASS |
| **DTS Bandwidth** | 47 CFR Part 15 Subpart C Section 15.247 (a)(2) | PASS |
| **Maximum Conducted Output Power** | 47 CFR Part 15 Subpart C Section 15.247 (b)(3) | PASS |
| **Maximum Power Spectral Density** | 47 CFR Part 15 Subpart C Section 15.247 (e) | PASS |
| **Band Edge Measurements** | 47 CFR Part 15 Subpart C Section 15.247(d) | PASS |
| **Conducted Spurious Emissions** | 47 CFR Part 15 Subpart C Section 15.247(d) | PASS |
| **Radiated Spurious Emission & Restricted bands** | 47 CFR Part 15 Subpart C Section 15.205/15.209 | PASS |

Remark:

Model No.: XIAO MG24, XIAO MG24 Sense

Name: XIAO MG24 Model: XIAO MG24

Name: XIAO MG24 Sense Model: XIAO MG24 Sense

Only the model XIAO MG24 was tested.

The difference between XIAO MG24 Sense and XIAO MG24 is that there is a microphone.

Difference description

| | |
|---|---|
| XIAO MG24 | Normal |
| XIAO MG24 Sense | Welded microphone |

# 4 General Information

## 4.1 Client Information

| | |
|---|---|
| Applicant: | Seeed Technology Co., Ltd |
| Address of Applicant: | 9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen |
| Manufacturer: | Seeed Technology Co., Ltd |
| Address of Manufacturer: | 9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen |
| Factory: | Shenzhen Xinxian Technology Co.,Limited |
| Address of Factory: | F5, Building B17, Hengfeng Industrial City,No. 739 Zhoushi Rd, Baoan District, Shenzhen,Guangdong, P.R.C. |

## 4.2 General Description of EUT

| | | |
|---|---|---|
| Product Name: | XIAO MG24 | |
| Model No.: | XIAO MG24, XIAO MG24 Sense | |
| Test Model No.: | XIAO MG24 | |
| Trade mark: | Seeed Studio | |
| Product Type: | ☐ Mobile ☒ Portable ☐ Fixed Location | |
| Operation Frequency: | 2405MHz~2480MHz | |
| Number of Channels: | 16 Channels | |
| Type of Modulation: | O-QPSK | |
| Channel Separation: | 5MHz | |
| Antenna Type: | Ceramic Antenna | |
| Antenna Gain: | 4.97dBi | |
| Power Supply: | Battery: | DC 5V |
| Test Voltage: | DC 5V | |
| Sample Received Date: | Dec. 25, 2024 | |
| Sample tested Date: | Dec. 25, 2024 to Dec. 30, 2024 | |

**EUT channels and frequencies list:**

| Channel | Center Frequency (MHz) | Data Rate |
|---|---|---|
| 1 | 2405 | 250kb/s |
| 2 | 2410 | 250kb/s |
| 3 | 2415 | 250kb/s |
| 4 | 2420 | 250kb/s |
| 5 | 2425 | 250kb/s |
| 6 | 2430 | 250kb/s |
| 7 | 2435 | 250kb/s |
| 8 | 2440 | 250kb/s |
| 9 | 2445 | 250kb/s |
| 10 | 2450 | 250kb/s |
| 11 | 2455 | 250kb/s |
| 12 | 2460 | 250kb/s |
| 13 | 2465 | 250kb/s |
| 14 | 2470 | 250kb/s |
| 15 | 2475 | 250kb/s |
| 16 | 2480 | 250kb/s |

Note:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| Channel | Frequency |
|---|---|
| The lowest channel (CH1) | 2405MHz |
| The middle channel (CH8) | 2440MHz |
| The highest channel (CH16) | 2480MHz |

## 4.3 Test Configuration

| **EUT Test Software Settings:** | |
|---|---|
| Test Software: | NcpCommander.exe |
| EUT Power Grade: | Default (Power level is built-in set parameters and cannot be changed and selected) |

## 4.4 Test Environment

| | |
|---|---|
| **Operating Environment:** | |
| **Radiated Spurious Emissions:** | |
| Temperature: | 22~25.0 °C |
| Humidity: | 50~55 % RH |
| Atmospheric Pressure: | 1010mbar |
| **Conducted Emissions:** | |
| Temperature: | 22~25.0 °C |
| Humidity: | 50~55 % RH |
| Atmospheric Pressure: | 1010mbar |
| **RF Conducted:** | |
| Temperature: | 22~25.0 °C |
| Humidity: | 50~55 % RH |
| Atmospheric Pressure: | 1010mbar |

## 4.5 Description of Support Units

The EUT has been tested with associated equipment below.

1） support equipment

| Description | Manufacturer | Model No. | Certification | Supplied by |
|---|---|---|---|---|
| / | / | / | / | / |

## 4.6 Test Location

All tests were performed at:

Centre Testing International Group Co., Ltd
Building C, Hongwei Industrial Park Block 70, Bao'an District, Shenzhen, China
Telephone: +86 (0) 755 33683668 Fax:+86 (0) 755 33683385
No tests were sub-contracted.
FCC Designation No.: CN1164

## 4.7 Measurement Uncertainty (95% confidence levels, k=2)

| No. | Item | Measurement Uncertainty |
|---|---|---|
| 1 | Radio Frequency | $7.9 \times 10^{-8}$ |
| 2 | RF power, conducted | 0.46dB (30MHz-1GHz) |
| | | 0.55dB (1GHz-40GHz) |
| 3 | Radiated Spurious emission test | 3.3dB (9kHz-30MHz) |
| | | 4.3dB (30MHz-1GHz) |
| | | 4.5dB (1GHz-18GHz) |
| | | 3.4dB (18GHz-40GHz) |
| 4 | Conduction emission | 3.5dB (9kHz to 150kHz) |
| | | 3.1dB (150kHz to 30MHz) |
| 5 | Temperature test | 0.64°C |
| 6 | Humidity test | 3.8% |
| 7 | DC power voltages | 0.026% |

# 5 Equipment List

| RF test system | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. Date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| Spectrum Analyzer | Keysight | N9010A | MY54510339 | 12-14-2023 | 12-13-2024 |
| Signal Generator | Keysight | N5182B | MY53051549 | 11-30-2024 | 11-29-2025 |
| DC Power | Keysight | E3642A | MY56376072 | 11-30-2024 | 11-29-2025 |
| Communication test set | R&S | CMW500 | 169004 | 03-08-2024 | 03-07-2025 |
| RF control unit(power unit) | JS Tonscend | JS0806-2 | 22G8060592 | 07-22-2024 | 07-21-2025 |
| Wi-Fi 7GHz Band Extendder | JS Tonscend | TS-WF7U2 | 2206200002 | 05-31-2024 | 05-30-2025 |
| High-low temperature test chamber | Dong Guang Qin Zhuo | LK-80GA | QZ20150611879 | 11-30-2024 | 11-29-2025 |
| Temperature/ Humidity Indicator | biaozhi | HM10 | 1804186 | 05-29-2024 | 05-28-2025 |
| BT&WI-FI Automatic test software | JS Tonscend | JS1120-3 | V3.3.20 | --- | --- |
| Spectrum Analyzer | R&S | FSV3044 | 101509 | 01-17-2024 | 01-16-2025 |

| Conducted disturbance Test | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| Receiver | R&S | ESCI | 100435 | 04-18-2024 | 04-17-2025 |
| Temperature/ Humidity Indicator | Defu | TH128 | / | 04-25-2024 | 04-24-2025 |
| LISN | R&S | ENV216 | 100098 | 09-19-2024 | 09-18-2025 |
| Barometer | changchun | DYM3 | 1188 | --- | --- |
| Test software | Fara | EZ-EMC | EMC-CON 3A1.1 | --- | --- |

| | | | | | |
|---|---|---|---|---|---|
| Capacitive voltage probe | Schwarzbeck | CVP 9222C | 00124 | 06-18-2024 | 06-17-2025 |
| ISN | TESEQ | ISN T800 | 30297 | 12/05/2024 | 12/04/2025 |

| 3M Semi-anechoic Chamber (2)- Radiated disturbance Test | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| 3M Chamber & Accessory Equipment | TDK | SAC-3 | --- | 05/22/2022 | 05/21/2025 |
| Receiver | R&S | ESCI7 | 100938-003 | 09/07/2024 | 09/06/2025 |
| Spectrum Analyzer | R&S | FSV40 | 101200 | 07/18/2024 | 07/17/2025 |
| TRILOG Broadband Antenna | schwarzbeck | VULB 9163 | 9163-618 | 05/22/2022 | 05/21/2025 |
| Loop Antenna | Schwarzbeck | FMZB 1519B | 1519B-076 | 04/16/2024 | 04/15/2025 |
| Microwave Preamplifier | Tonscend | EMC051845SE | 980380 | 12/05/2024 | 12/04/2025 |
| Horn Antenna | A.H.SYSTEMS | SAS-574 | 374 | 07/02/2023 | 07/01/2026 |
| Horn Antenna | ETS-LINGREN | BBHA 9120D | 9120D-1869 | 04/16/2024 | 04/15/2025 |
| Preamplifier | Agilent | 11909A | 12-1 | 03/22/2024 | 03/21/2025 |
| Preamplifier | CD | PAP-1840-60 | 6041.6042 | 06/19/2024 | 06/18/2025 |
| Test software | Fara | EZ-EMC | EMEC-3A1-Pre | --- | --- |
| Cable line | Fulai(7M) | SF106 | 5219/6A | 05/22/2022 | 05/21/2025 |
| Cable line | Fulai(6M) | SF106 | 5220/6A | 05/22/2022 | 05/21/2025 |
| Cable line | Fulai(3M) | SF106 | 5216/6A | 05/22/2022 | 05/21/2025 |
| Cable line | Fulai(3M) | SF106 | 5217/6A | 05/22/2022 | 05/21/2025 |

| 3M full-anechoic Chamber | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. Date (mm-dd-yyyy)** | **Cal. Due date (mm-dd-yyyy)** |
| Fully Anechoic Chamber | TDK | FAC-3 | --- | 01-09-2024 | 01-08-2027 |
| Receiver | Keysight | N9038A | MY57290136 | 01-09-2024 | 01-08-2025 |
| Spectrum Analyzer | Keysight | N9020B | MY57111112 | 01-29-2024 | 01-28-2025 |
| Spectrum Analyzer | Keysight | N9030B | MY57140871 | 01-23-2024 | 01-22-2025 |
| TRILOG Broadband Antenna | Schwarzbeck | VULB 9163 | 9163-1148 | 04-28-2024 | 04-27-2025 |
| Horn Antenna | Schwarzbeck | BBHA 9170 | 9170-832 | 04-16-2024 | 04-15-2025 |
| Horn Antenna | ETS-LINDGREN | 3117 | 57407 | 07-03-2024 | 07-02-2025 |
| Preamplifier | EMCI | EMC001330 | 980563 | 03-08-2024 | 03-07-2025 |
| Preamplifier | Tonscend | TAP-011858 | AP21B806112 | 07-18-2024 | 07-17-2025 |
| Preamplifier | Tonscend | EMC051845SE | 980380 | 12-05-2024 | 12-04-2025 |
| Temperature/ Humidity Indicator | biaozhi | GM1360 | EE1186631 | 04-07-2024 | 04-06-2025 |
| RSE Automatic test software | JS Tonscend | JS36-RSE | V4.0.0.0 | --- | --- |
| Cable line | Times | SFT205-NMSM-2.50M | 394812-0001 | 01-09-2024 | 01-08-2027 |
| Cable line | Times | SFT205-NMSM-2.50M | 394812-0002 | 01-09-2024 | 01-08-2027 |
| Cable line | Times | SFT205-NMSM-2.50M | 394812-0003 | 01-09-2024 | 01-08-2027 |
| Cable line | Times | SFT205-NMSM-2.50M | 393495-0001 | 01-09-2024 | 01-08-2027 |
| Cable line | Times | EMC104-NMNM-1000 | SN160710 | 01-09-2024 | 01-08-2027 |
| Cable line | Times | SFT205-NMSM-3.00M | 394813-0001 | 01-09-2024 | 01-08-2027 |
| Cable line | Times | SFT205-NMNM-1.50M | 381964-0001 | 01-09-2024 | 01-08-2027 |
| Cable line | Times | SFT205-NMSM-7.00M | 394815-0001 | 01-09-2024 | 01-08-2027 |
| Cable line | Times | HF160-KMKM-3.00M | 393493-0001 | 01-09-2024 | 01-08-2027 |

# 6 Test results and Measurement Data

## 6.1 Antenna Requirement

| | |
|---|---|
| **Standard requirement:** | 47 CFR Part 15C Section 15.203 /247(c) |
| 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>15.247(b) (4) requirement:<br>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. | |
| **EUT Antenna:** | Please see Internal photos |
| The antenna is Ceramic antenna. The best case gain of the antenna is 4.97dBi. | |

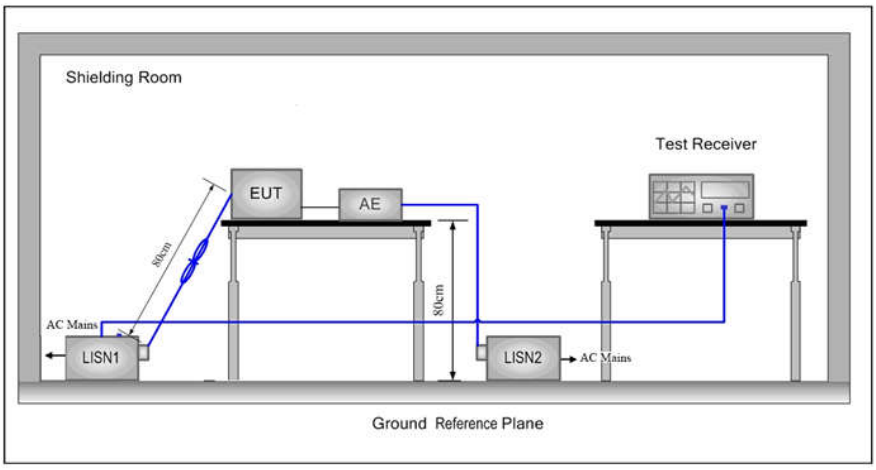
## 6.2 Conducted Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.207 |
| Test Method: | ANSI C63.10: 2013 |
| Test Frequency Range: | 150kHz to 30MHz |
| Receiver setup: | RBW=9 kHz, VBW=30 kHz, Sweep time=auto |
| 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 Setup:




Test Procedure:

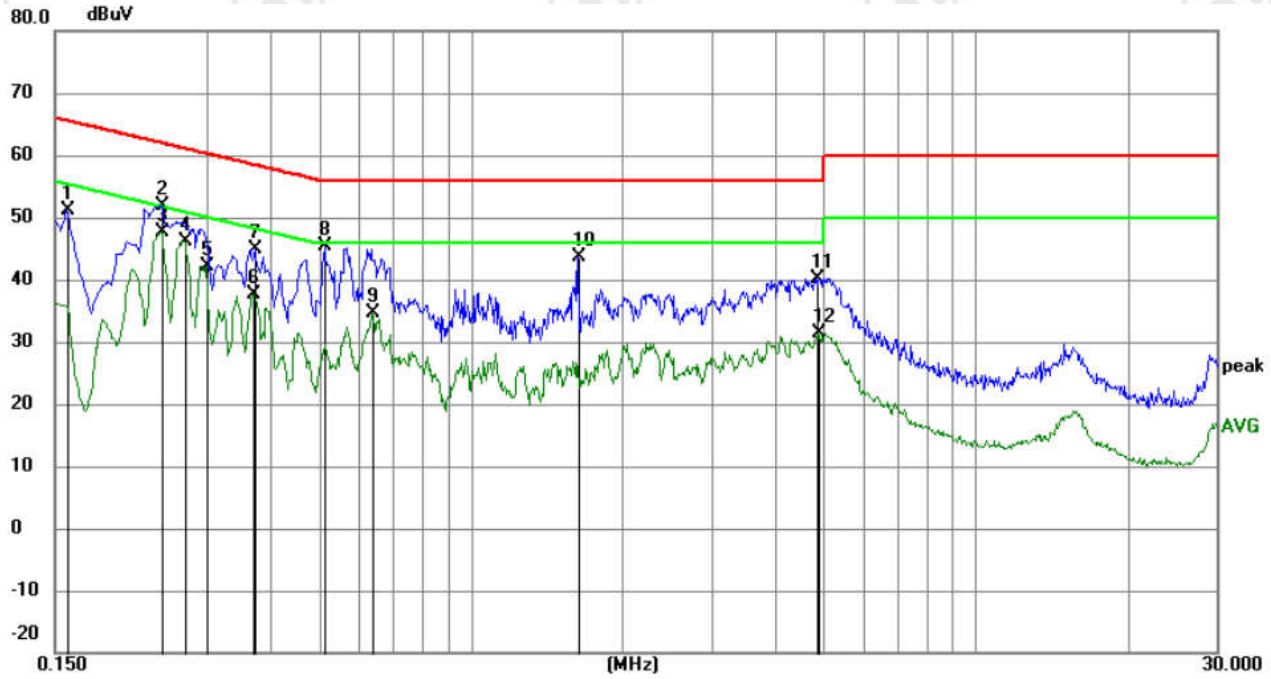
1) The mains terminal disturbance voltage test was conducted in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.
4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.

Test Mode: All modes were tested, only the worst case mode a was recorded in the report.

| Test Results: | Pass |
|---|---|

**Measurement Data**

Live line:

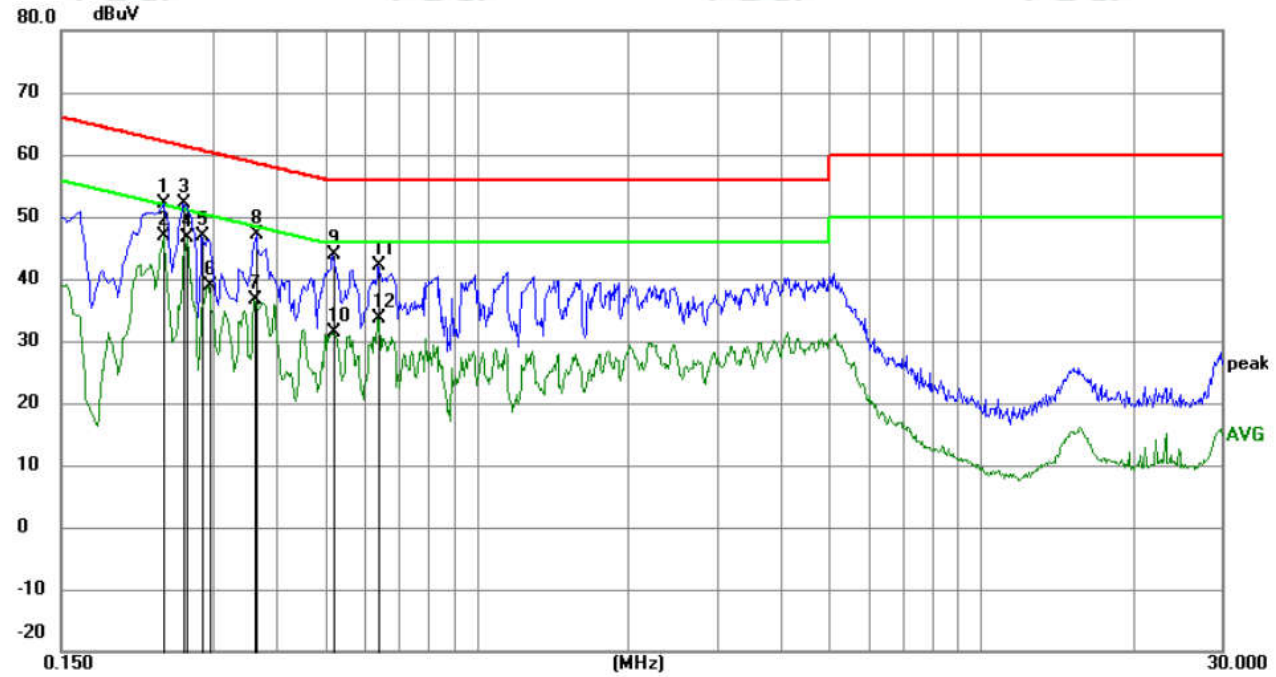



| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Margin | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 0.1590 | 40.89 | 10.27 | 51.16 | 65.52 | -14.36 | QP | |
| 2 | | 0.2445 | 41.73 | 10.17 | 51.90 | 61.94 | -10.04 | QP | |
| 3 | * | 0.2445 | 37.49 | 10.17 | 47.66 | 51.94 | -4.28 | AVG | |
| 4 | | 0.2714 | 36.06 | 10.15 | 46.21 | 51.07 | -4.86 | AVG | |
| 5 | | 0.2987 | 31.89 | 10.13 | 42.02 | 50.28 | -8.26 | AVG | |
| 6 | | 0.3704 | 27.51 | 10.10 | 37.61 | 48.49 | -10.88 | AVG | |
| 7 | | 0.3750 | 34.68 | 10.10 | 44.78 | 58.39 | -13.61 | QP | |
| 8 | | 0.5144 | 35.22 | 10.08 | 45.30 | 56.00 | -10.70 | QP | |
| 9 | | 0.6405 | 24.40 | 10.11 | 34.51 | 46.00 | -11.49 | AVG | |
| 10 | | 1.6350 | 33.40 | 10.17 | 43.57 | 56.00 | -12.43 | QP | |
| 11 | | 4.8480 | 30.02 | 10.07 | 40.09 | 56.00 | -15.91 | QP | |
| 12 | | 4.8885 | 21.40 | 10.06 | 31.46 | 46.00 | -14.54 | AVG | |

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

Neutral line:

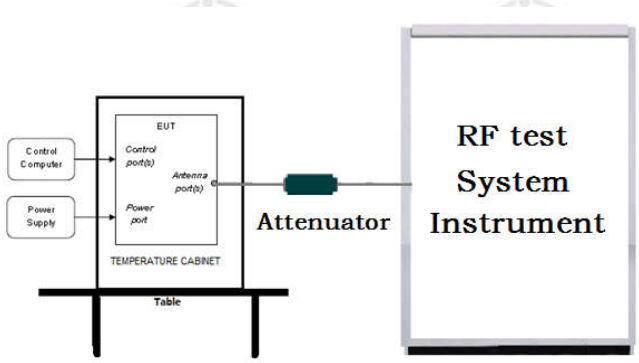



| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Margin | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 0.2400 | 41.84 | 10.18 | 52.02 | 62.10 | -10.08 | QP | |
| 2 | | 0.2400 | 36.60 | 10.18 | 46.78 | 52.10 | -5.32 | AVG | |
| 3 | | 0.2625 | 41.94 | 10.16 | 52.10 | 61.35 | -9.25 | QP | |
| 4 | * | 0.2670 | 36.54 | 10.16 | 46.70 | 51.21 | -4.51 | AVG | |
| 5 | | 0.2850 | 36.85 | 10.14 | 46.99 | 60.67 | -13.68 | QP | |
| 6 | | 0.2940 | 28.78 | 10.13 | 38.91 | 50.41 | -11.50 | AVG | |
| 7 | | 0.3615 | 26.58 | 10.11 | 36.69 | 48.69 | -12.00 | AVG | |
| 8 | | 0.3660 | 37.04 | 10.10 | 47.14 | 58.59 | -11.45 | QP | |
| 9 | | 0.5190 | 33.72 | 10.08 | 43.80 | 56.00 | -12.20 | QP | |
| 10 | | 0.5190 | 21.39 | 10.08 | 31.47 | 46.00 | -14.53 | AVG | |
| 11 | | 0.6405 | 32.12 | 10.11 | 42.23 | 56.00 | -13.77 | QP | |
| 12 | | 0.6405 | 23.43 | 10.11 | 33.54 | 46.00 | -12.46 | AVG | |

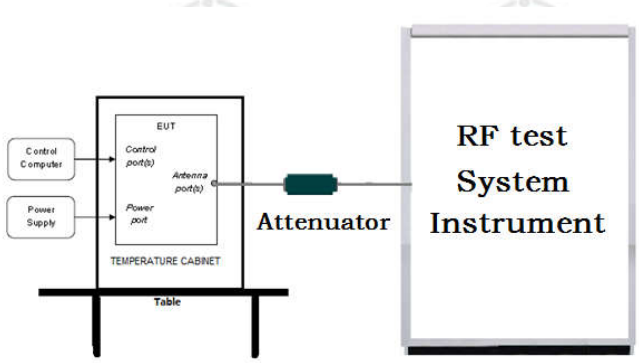
Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

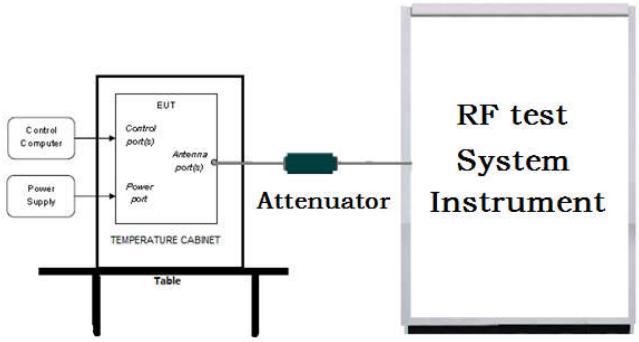
## 6.3 Maximum Conducted Output Power

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (b)(3) |
| Test Method: | ANSI C63.10 2013 |
| Test Setup: |  <br>Remark: Offset=Cable loss+ attenuation factor. |
| Test Procedure: | a) Set the RBW ⩾ DTS bandwidth.<br>b) Set VBW ⩾ 3 × RBW.<br>c) Set span ⩾ 3 x RBW<br>d) Sweep time = auto couple.<br>e) Detector = peak.<br>f) Trace mode = max hold.<br>g) Allow trace to fully stabilize.<br>h) Use peak marker function to determine the peak amplitude level. |
| Limit: | 30dBm |
| Test Mode: | Refer to clause 5.3 |
| Test Results: | Refer to Appendix Zigbee |

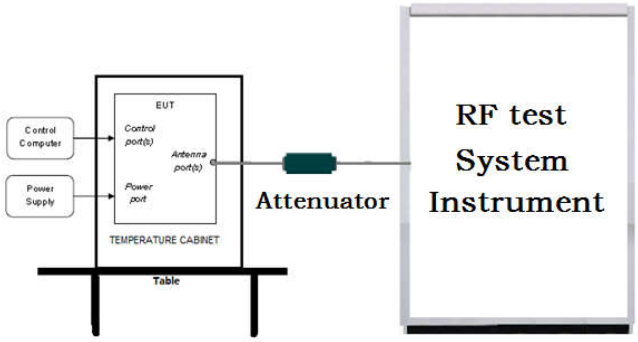
## 6.4 DTS Bandwidth

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(2) |
| Test Method: | ANSI C63.10 2013 |
| Test Setup: |  <br>Remark: Offset=Cable loss+ attenuation factor. |
| Test Procedure: | a) Set RBW = 100 kHz.<br>b) Set the VBW ⩾[3 × RBW].<br>c) Detector = peak.<br>d) Trace mode = max hold.<br>e) Sweep = auto couple.<br>f) Allow the trace to stabilize.<br>g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. |
| Limit: | ≥ 500 kHz |
| Test Mode: | Refer to clause 5.3 |
| Test Results: | Refer to Appendix Zigbee |

## 6.5 Maximum Power Spectral Density

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (e) |
| Test Method: | ANSI C63.10 2013 |
| Test Setup: |  <br>Remark: Offset=Cable loss+ attenuation factor. |
| Test Procedure: | a) Set analyzer center frequency to DTS channel center frequency.<br>b) Set the span to 1.5 times the DTS bandwidth.<br>c) Set the RBW to 3 kHz ⩽ RBW ⩽ 100 kHz.<br>d) Set the VBW ⩾ [3 × RBW].<br>e) Detector = peak.<br>f) Sweep time = auto couple.<br>g) Trace mode = max hold.<br>h) Allow trace to fully stabilize.<br>i) Use the peak marker function to determine the maximum amplitude level within the RBW.<br>j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat. |
| Limit: | ≤8.00dBm/3kHz |
| Test Mode: | Refer to clause 5.3 |
| Test Results: | Refer to Appendix Zigbee |

## 6.6 Band Edge measurements and Conducted Spurious Emission

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (d) |
| Test Method: | ANSI C63.10 2013 |
| Test Setup: |  <br>Remark: Offset=Cable loss+ attenuation factor. |
| Test Procedure: | a) Set RBW =100KHz.<br>b) Set VBW = 300KHz.<br>c) Sweep time = auto couple.<br>d) Detector = peak.<br>e) Trace mode = max hold.<br>f) Allow trace to fully stabilize.<br>g) Use peak marker function to determine the peak amplitude level. |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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 conducted or a radiated measurement. |
| Test Mode: | Refer to clause 5.3 |
| Test Results: | Refer to Appendix Zigbee |

## 6.7 Radiated Spurious Emission & Restricted bands

<table>
<tr><td>Test Requirement:</td><td>47 CFR Part 15C Section 15.209 and 15.205</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10 2013</td></tr>
<tr><td>Test Site:</td><td>Measurement Distance: 3m (Semi-Anechoic Chamber)</td></tr>
<tr><td>Receiver Setup:</td><td>
<table>
<tr><th>Frequency</th><th>Detector</th><th>RBW</th><th>VBW</th><th>Remark</th></tr>
<tr><td>0.009MHz-0.090MHz</td><td>Peak</td><td>10kHz</td><td>30kHz</td><td>Peak</td></tr>
<tr><td>0.009MHz-0.090MHz</td><td>Average</td><td>10kHz</td><td>30kHz</td><td>Average</td></tr>
<tr><td>0.090MHz-0.110MHz</td><td>Quasi-peak</td><td>10kHz</td><td>30kHz</td><td>Quasi-peak</td></tr>
<tr><td>0.110MHz-0.490MHz</td><td>Peak</td><td>10kHz</td><td>30kHz</td><td>Peak</td></tr>
<tr><td>0.110MHz-0.490MHz</td><td>Average</td><td>10kHz</td><td>30kHz</td><td>Average</td></tr>
<tr><td>0.490MHz -30MHz</td><td>Quasi-peak</td><td>10kHz</td><td>30kHz</td><td>Quasi-peak</td></tr>
<tr><td>30MHz-1GHz</td><td>Quasi-peak</td><td>100 kHz</td><td>300kHz</td><td>Quasi-peak</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>Peak</td><td>1MHz</td><td>3MHz</td><td>Peak</td></tr>
<tr><td>Peak</td><td>1MHz</td><td>10kHz</td><td>Average</td></tr>
</table>
</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><th>Frequency</th><th>Field strength (microvolt/meter)</th><th>Limit (dBuV/m)</th><th>Remark</th><th>Measurement distance (m)</th></tr>
<tr><td>0.009MHz-0.490MHz</td><td>2400/F(kHz)</td><td>-</td><td>-</td><td>300</td></tr>
<tr><td>0.490MHz-1.705MHz</td><td>24000/F(kHz)</td><td>-</td><td>-</td><td>30</td></tr>
<tr><td>1.705MHz-30MHz</td><td>30</td><td>-</td><td>-</td><td>30</td></tr>
<tr><td>30MHz-88MHz</td><td>100</td><td>40.0</td><td>Quasi-peak</td><td>3</td></tr>
<tr><td>88MHz-216MHz</td><td>150</td><td>43.5</td><td>Quasi-peak</td><td>3</td></tr>
<tr><td>216MHz-960MHz</td><td>200</td><td>46.0</td><td>Quasi-peak</td><td>3</td></tr>
<tr><td>960MHz-1GHz</td><td>500</td><td>54.0</td><td>Quasi-peak</td><td>3</td></tr>
<tr><td>Above 1GHz</td><td>500</td><td>54.0</td><td>Average</td><td>3</td></tr>
</table>
Note: 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.
</td></tr>
</table>

| Test Setup: | |
|---|---|

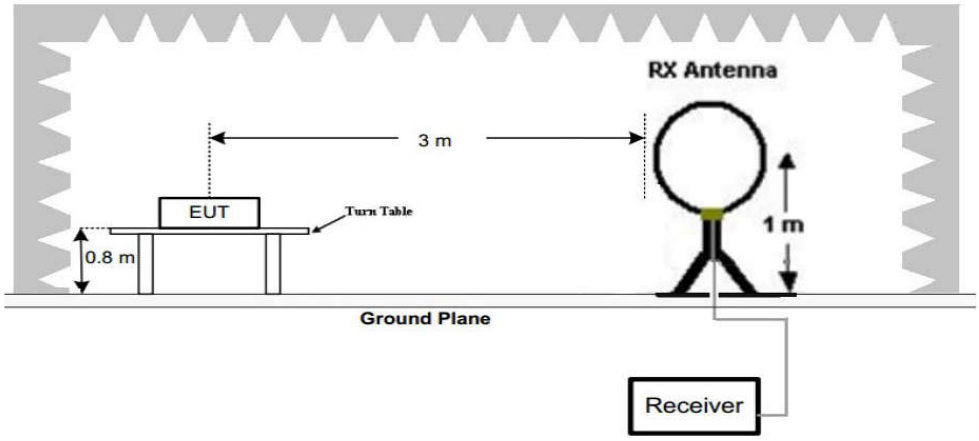



Figure 1. Below 30MHz

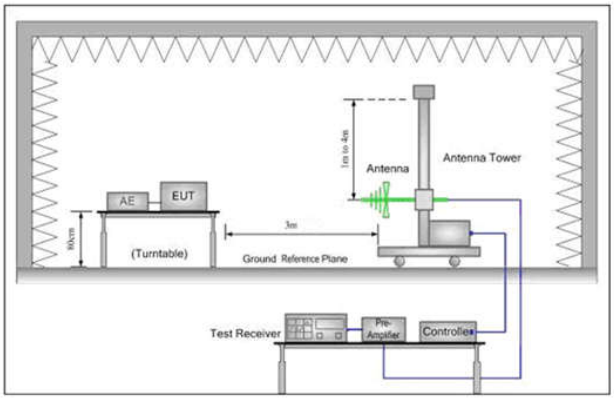



Figure 2. 30MHz to 1GHz

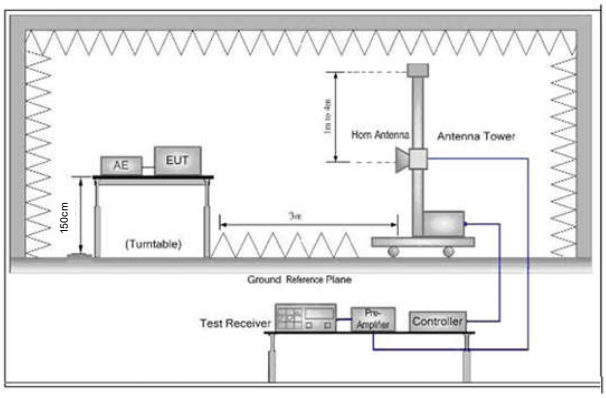



Figure 3. Above 1 GHz

| Test Procedure: | a. 1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.<br>2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.<br>Note: For the radiated emission test above 1GHz:<br>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.<br>b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.<br>c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both |
|---|---|

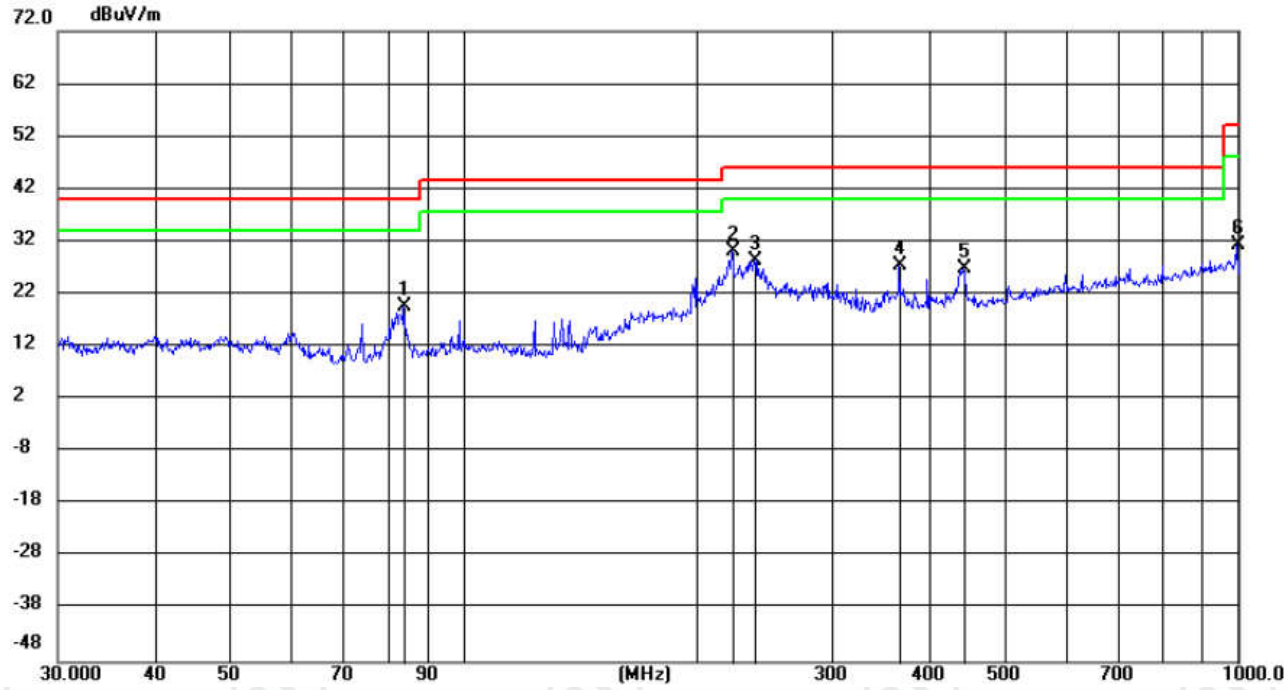
| | |
|---|---|
| | horizontal and vertical polarizations of the antenna are set to make the measurement.<br>d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.<br>e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.<br>f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.<br>g. Test the EUT in the lowest channel (2402MHz),the middle channel (2440MHz),the Highest channel (2480MHz)<br>h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.<br>i. Repeat above procedures until all frequencies measured was complete. |
| Test Mode: | Refer to clause 5.3 |
| Test Results: | Pass |

## Radiated Spurious Emission below 1GHz:

During the test, the Radiates Emission from 30MHz to 1GHz was performed in all modes, only the worst case highest channel of Zigbee was recorded in the report.

Horizontal:

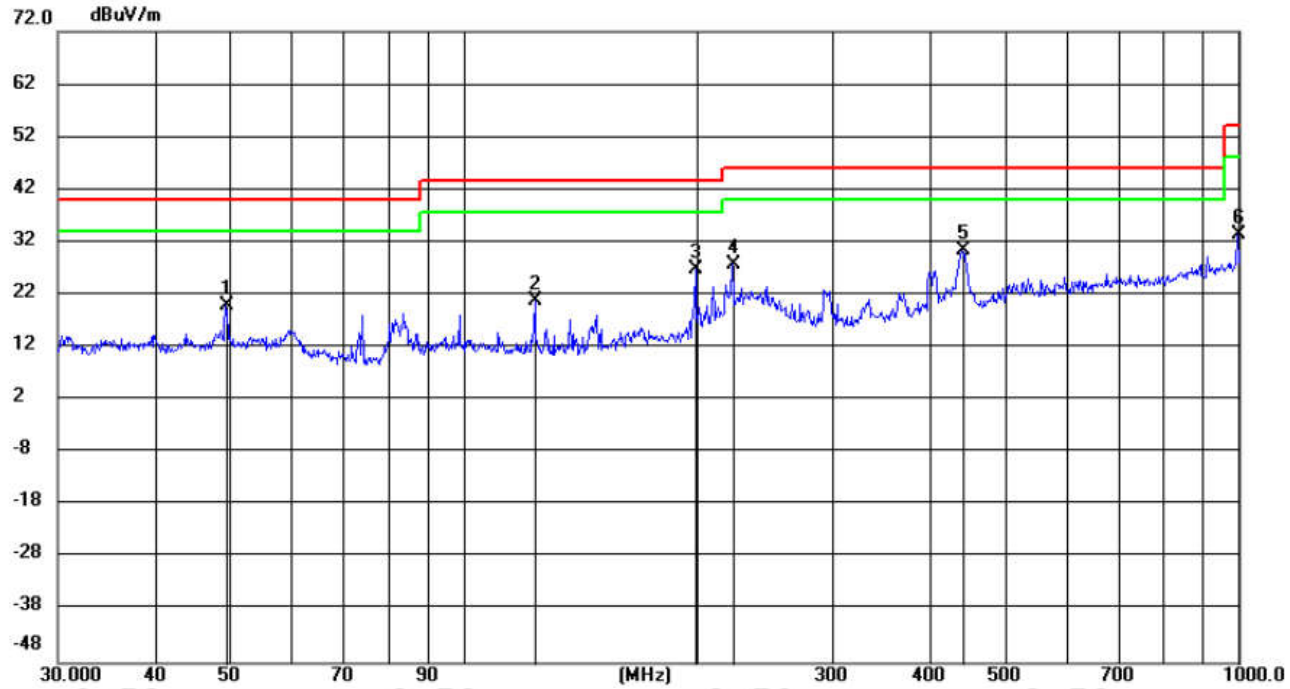
**Test Graph**




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Margin | | Antenna Height | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB/m | dBuV/m | dBuV/m | dB | Detector | cm | degree | Comment |
| 1 | | 83.8890 | 9.38 | 10.14 | 19.52 | 40.00 | -20.48 | QP | 200 | 343 | |
| 2 | * | 222.7939 | 16.87 | 13.24 | 30.11 | 46.00 | -15.89 | QP | 100 | 73 | |
| 3 | | 237.6009 | 14.69 | 13.80 | 28.49 | 46.00 | -17.51 | QP | 200 | 280 | |
| 4 | | 365.9879 | 10.10 | 17.40 | 27.50 | 46.00 | -18.50 | QP | 200 | 165 | |
| 5 | | 442.9058 | 7.93 | 18.81 | 26.74 | 46.00 | -19.26 | QP | 200 | 238 | |
| 6 | | 997.8982 | 4.85 | 26.49 | 31.34 | 54.00 | -22.66 | QP | 200 | 80 | |

Vertical:

**Test Graph**




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Margin | | Antenna Height | Table Degree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB/m | dBuV/m | dBuV/m | dB | Detector | cm | degree | Comment |
| 1 | | 49.5241 | 6.48 | 13.54 | 20.02 | 40.00 | -19.98 | QP | 200 | 331 | |
| 2 | | 123.7418 | 9.80 | 11.00 | 20.80 | 43.50 | -22.70 | QP | 100 | 345 | |
| 3 | | 199.8454 | 14.52 | 12.37 | 26.89 | 43.50 | -16.61 | QP | 200 | 166 | |
| 4 | | 222.7549 | 14.37 | 13.24 | 27.61 | 46.00 | -18.39 | QP | 100 | 112 | |
| 5 | * | 441.6651 | 11.62 | 18.79 | 30.41 | 46.00 | -15.59 | QP | 100 | 186 | |
| 6 | | 997.7233 | 6.95 | 26.49 | 33.44 | 54.00 | -20.56 | QP | 200 | 124 | |

## Radiated Spurious Emission above 1GHz:

| Mode: | | Zigbee GFSK Transmitting | | | | Channel: | | 2405 MHz | |
|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Factor [dB] | Reading [dBμV] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 1154.8103 | 10.25 | 38.08 | 48.33 | 74.00 | 25.67 | Pass | H | PK |
| 2 | 1935.6624 | 16.62 | 35.21 | 51.83 | 74.00 | 22.17 | Pass | H | PK |
| 3 | 4501.1001 | -8.44 | 48.85 | 40.41 | 74.00 | 33.59 | Pass | H | PK |
| 4 | 8293.3529 | -3.02 | 46.67 | 43.65 | 74.00 | 30.35 | Pass | H | PK |
| 5 | 13003.6669 | 8.40 | 43.75 | 52.15 | 74.00 | 21.85 | Pass | H | PK |
| 6 | 15893.8596 | 13.48 | 38.98 | 52.46 | 74.00 | 21.54 | Pass | H | PK |
| 7 | 1388.0259 | 10.51 | 39.13 | 49.64 | 74.00 | 24.36 | Pass | V | PK |
| 8 | 1846.4564 | 15.23 | 37.10 | 52.33 | 74.00 | 21.67 | Pass | V | PK |
| 9 | 4515.101 | -8.99 | 50.53 | 41.54 | 74.00 | 32.46 | Pass | V | PK |
| 10 | 7830.322 | -3.04 | 46.88 | 43.84 | 74.00 | 30.16 | Pass | V | PK |
| 11 | 11270.5514 | 4.64 | 45.96 | 50.60 | 74.00 | 23.40 | Pass | V | PK |
| 12 | 15911.8608 | 12.80 | 39.54 | 52.34 | 74.00 | 21.66 | Pass | V | PK |

| Mode: | | Zigbee GFSK Transmitting | | | | Channel: | | 2440 MHz | |
|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Factor [dB] | Reading [dBμV] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 1397.0931 | 10.60 | 38.50 | 49.10 | 74.00 | 24.90 | Pass | H | PK |
| 2 | 1948.7299 | 17.04 | 35.61 | 52.65 | 74.00 | 21.35 | Pass | H | PK |
| 3 | 4501.1001 | -8.44 | 49.73 | 41.29 | 74.00 | 32.71 | Pass | H | PK |
| 4 | 7758.3172 | -3.18 | 45.99 | 42.81 | 74.00 | 31.19 | Pass | H | PK |
| 5 | 12965.6644 | 7.57 | 43.81 | 51.38 | 74.00 | 22.62 | Pass | H | PK |
| 6 | 16416.8945 | 12.81 | 39.61 | 52.42 | 74.00 | 21.58 | Pass | H | PK |
| 7 | 1137.4758 | 10.00 | 38.29 | 48.29 | 74.00 | 25.71 | Pass | V | PK |
| 8 | 1939.396 | 16.74 | 35.55 | 52.29 | 74.00 | 21.71 | Pass | V | PK |
| 9 | 4302.0868 | -9.82 | 50.60 | 40.78 | 74.00 | 33.22 | Pass | V | PK |
| 10 | 6807.2538 | -4.93 | 47.36 | 42.43 | 74.00 | 31.57 | Pass | V | PK |
| 11 | 11944.5963 | 5.63 | 44.60 | 50.23 | 74.00 | 23.77 | Pass | V | PK |
| 12 | 15885.8591 | 13.18 | 39.23 | 52.41 | 74.00 | 21.59 | Pass | V | PK |

| Mode: | | | Zigbee GFSK Transmitting | | | Channel: | | 2480 MHz | |
|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Factor [dB] | Reading [dBμV] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 1134.409 | 9.89 | 38.58 | 48.47 | 74.00 | 25.53 | Pass | H | PK |
| 2 | 1945.3964 | 16.93 | 35.62 | 52.55 | 74.00 | 21.45 | Pass | H | PK |
| 3 | 4505.1003 | -8.60 | 50.36 | 41.76 | 74.00 | 32.24 | Pass | H | PK |
| 4 | 7342.2895 | -4.30 | 47.29 | 42.99 | 74.00 | 31.01 | Pass | H | PK |
| 5 | 11946.5964 | 5.72 | 44.91 | 50.63 | 74.00 | 23.37 | Pass | H | PK |
| 6 | 15901.8601 | 13.56 | 38.99 | 52.55 | 74.00 | 21.45 | Pass | H | PK |
| 7 | 1126.2751 | 9.63 | 38.55 | 48.18 | 74.00 | 25.82 | Pass | V | PK |
| 8 | 2049.67 | 15.48 | 36.39 | 51.87 | 74.00 | 22.13 | Pass | V | PK |
| 9 | 4868.1245 | -10.04 | 49.93 | 39.89 | 74.00 | 34.11 | Pass | V | PK |
| 10 | 9790.4527 | 3.11 | 44.86 | 47.97 | 74.00 | 26.03 | Pass | V | PK |
| 11 | 12979.6653 | 8.02 | 43.60 | 51.62 | 74.00 | 22.38 | Pass | V | PK |
| 12 | 15894.8597 | 13.52 | 38.47 | 51.99 | 74.00 | 22.01 | Pass | V | PK |

Remark:

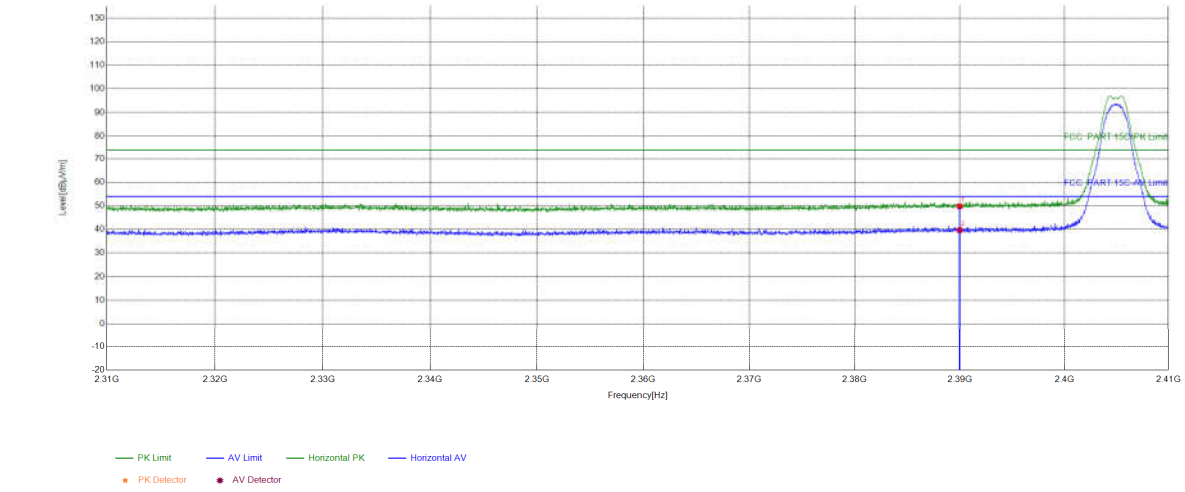
1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
2) Scan from 9kHz to 25GHz, the disturbance above 10GHz and below 30MHz was very low. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

## Restricted bands:

**Test plot as follows:**

| EUT_Name | | Test_Model | |
|---|---|---|---|
| Test_Mode | Zigbee | Test_Frequency | 2405MHz |
| Tset_Engineer | Aiden.wang | Test_Date | 2024/12/24 |
| Remark | 23.5°C56.9%\ | | |

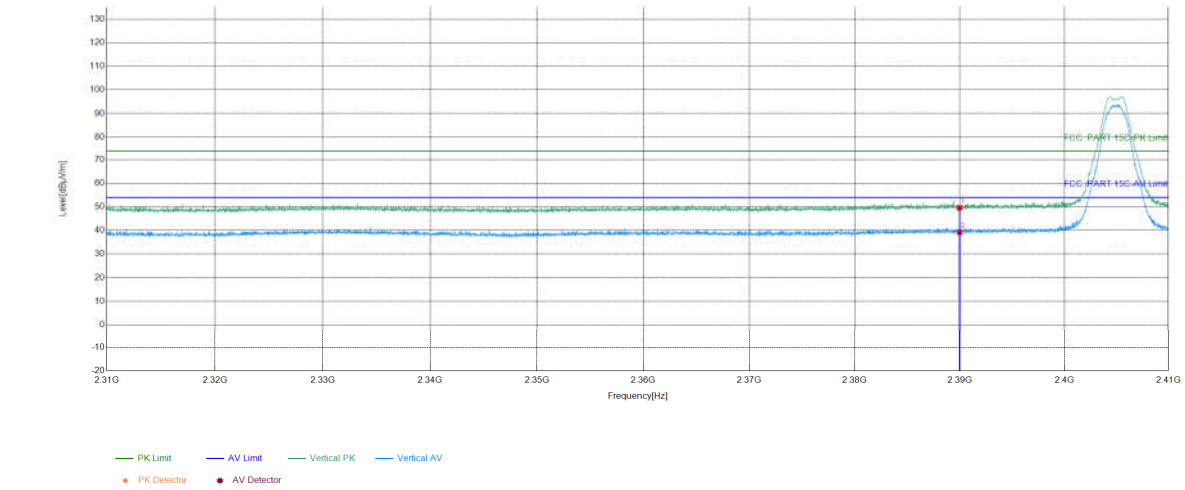
**Test Graph**




| Suspected List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Factor [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 2390 | 15.31 | 34.45 | 49.76 | 74.00 | 24.24 | PASS | Horizontal | PK |
| 2 | 2390 | 15.31 | 24.38 | 39.69 | 54.00 | 14.31 | PASS | Horizontal | AV |

| EUT_Name | | Test_Model | |
|---|---|---|---|
| Test_Mode | Zigbee | Test_Frequency | 2405MHz |
| Tset_Engineer | Aiden.wang | Test_Date | 2024/12/24 |
| Remark | 23.5°C56.9%\ | | |

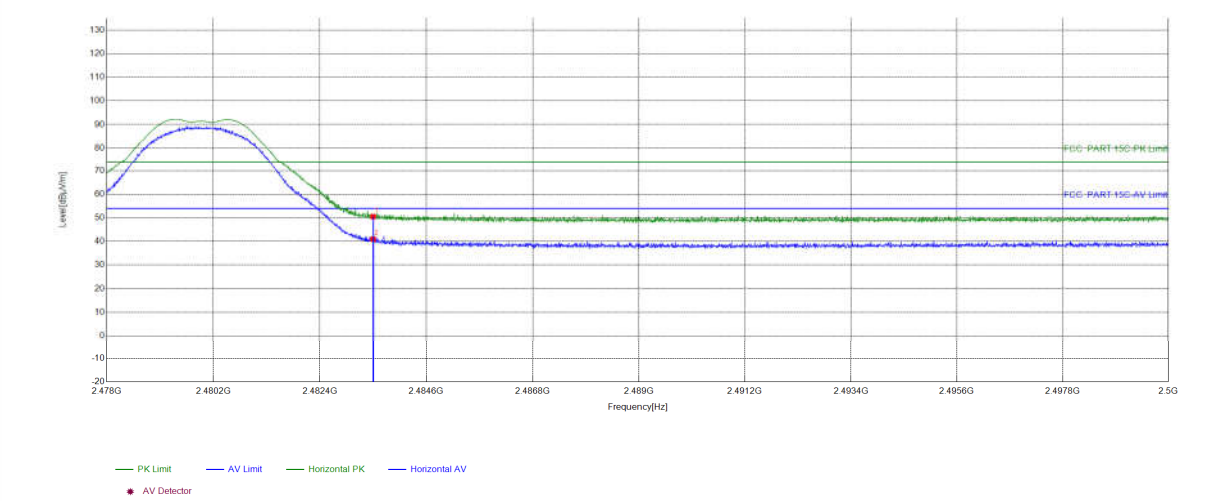
**Test Graph**




| Suspected List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Factor [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 2390 | 15.31 | 34.30 | 49.61 | 74.00 | 24.39 | PASS | Vertical | PK |
| 2 | 2390 | 15.31 | 23.92 | 39.23 | 54.00 | 14.77 | PASS | Vertical | AV |

| EUT_Name | | Test_Model | |
|---|---|---|---|
| Test_Mode | Zigbee | Test_Frequency | 2480MHz |
| Tset_Engineer | Aiden.wang | Test_Date | 2024/12/24 |
| Remark | 23.5°C56.9%\ | | |

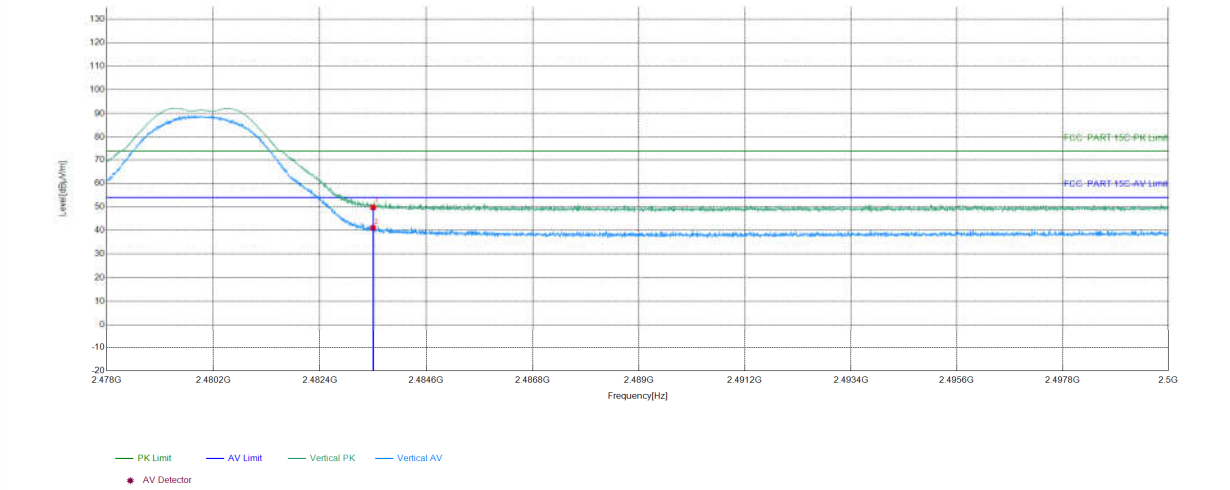
**Test Graph**




| Suspected List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Factor [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 2483.5 | 15.16 | 35.39 | 50.55 | 74.00 | 23.45 | PASS | Horizontal | PK |
| 2 | 2483.5 | 15.16 | 25.82 | 40.98 | 54.00 | 13.02 | PASS | Horizontal | AV |

| EUT_Name | | Test_Model | |
|---|---|---|---|
| Test_Mode | Zigbee | Test_Frequency | 2480MHz |
| Tset_Engineer | Aiden.wang | Test_Date | 2024/12/24 |
| Remark | 23.5°C56.9%\ | | |

**Test Graph**




| Suspected List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO | Freq. [MHz] | Factor [dB] | Reading [dBµV] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Result | Polarity | Remark |
| 1 | 2483.5 | 15.16 | 34.60 | 49.76 | 74.00 | 24.24 | PASS | Vertical | PK |
| 2 | 2483.5 | 15.16 | 25.93 | 41.09 | 54.00 | 12.91 | PASS | Vertical | AV |

Note:
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level =Receiver Reading -Correct Factor

Correct Factor = Preamplifier Factor– Antenna Factor–Cable Factor

# 7 Appendix Zigbee

Refer to Appendix: Zigbee of EED32Q82089902

# 9 PHOTOGRAPHS OF EUT Constructional Details

Refer to Report No.EED32Q82089901 for EUT external and internal photos.

**声明**

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