# FCC RADIO TEST REPORT

## FCC ID:2AT7Z-GHUB001

**Product:** Gravio Hub
**Trade Name:** Gravio
**Model Name:** GHUB001
**Serial Model:** N/A
**Report No.:** UNIA19072001-4FR-01

### Prepared for

Asteria Technology Pte. Ltd.

160 ROBINSON ROAD, #19-05 SBF CENTER, SINGAPORE Singapore

### Prepared by

Shenzhen United Testing Technology Co., Ltd.

2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China

# TEST RESULTCERTIFICATION

**Applicant's name**.....: Asteria Technology Pte. Ltd.

Address.....: 160 ROBINSON ROAD, #19-05 SBF CENTER, SINGAPORE Singapore

**Manufacture's Name**.....: Asteria Technology Pte. Ltd.

Address.....: 160 ROBINSON ROAD, #19-05 SBF CENTER, SINGAPORE Singapore

**Product description**

Product name.....: Gravio Hub

Trade Mark.....: Gravio

Model and/or type reference .: GHUB001

**Standards**.....: FCC Rules and Regulations Part 15 Subpart C Section 15.249, ANSI C63.10: 2013

This device described above has been tested by Shenzhen United Testing Technology Co., Ltd., and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

This report shall not be reproduced except in full, without the written approval of UNI, this document may be altered or revised by Shenzhen United Testing Technology Co., Ltd., personnel only, and shall be noted in the revision of the document.

**Date of Test**..... :

Date (s) of performance of tests.....: Jul. 20, 2019 ~ Aug. 08 , 2019

Date of Issue.....: Aug. 08 , 2019

Test Result.....: Pass

Prepared by: Kahn yang/Editor

Reviewer: Sherwin Qian/Supervisor

Approved & Authorized Signer: Liuze/Manager

Table of Contents Page


1 . TEST SUMMARY 4

2 . GENERAL INFORMATION 5

2.1 GENERAL DESCRIPTION OF EUT 5

2.2 Carrier Frequency of Channels 6

2.3 Operation of EUT during testing 6

2.4DESCRIPTION OF TEST SETUP 6

2.5MEASUREMENT INSTRUMENTS LIST 7

3 . CONDUCTED EMISSIONS TEST 8

3.1 Conducted Power Line Emission Limit 8

3.2 Test Setup 8

3.3 Test Procedure 8

3.4 Test Result 8

4 RADIATED EMISSION TEST 11

4.1 Radiation Limit 11

4.2 Test Setup 11

4.3 Test Procedure 12

4.4 Test Result 12

5 BAND EDGE 18

5.1 Limits 18

5.2 Test Procedure 18

5.3 Test Result 18

6 OCCUPIED BANDWIDTH MEASUREMENT 20

6.1 Test Setup 20

6.2 Test Procedure 20

6.3 Measurement Equipment Used 20

6.4 Test Result 20

7 ANTENNA REQUIREMENT 22

8 PHOTOGRAPH OF TEST 23

8.1 Radiated Emission 23

8.2Conducted Emission 24

# 1. TEST SUMMARY

## TEST PROCEDURES AND RESULTS

| DESCRIPTION OF TEST | RESULT | STANGARD |
|---|---|---|
| CONDUCTED EMISSIONS TEST | COMPLIANT | FCC Part 15.207 |
| RADIATED EMISSION TEST | COMPLIANT | FCC Part 15.209/15.249 |
| BAND EDGE | COMPLIANT | FCC Part 15.249/15.205 |
| OCCUPIED BANDWIDTH MEASUREMENT | COMPLIANT | FCC Part 15.249 |
| ANTENNA REQUIREMENT | COMPLIANT | FCC Part 15.203 |

## TEST FACILITY

Test Firm : Shenzhen United Testing Technology Co.,Ltd.

Address :2F, Annex Bldg, JiahuangyuanTech Park, #365 Baotian 1 Rd,TiegangCommunity, XixiangStr, Bao'an District, Shenzhen,China

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19.The testing quality system of our laboratory meets with ISO/IEC-17025 requirements, which is approved by CNAS. This approval result is accepted by MRA of APLAC.

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

CNAS-LAB Code: L6494

The EMC Laboratory has been assessed and in compliance with CNAS-CL01 accreditation criteria for testing Laboratories (identical to ISO/IEC 17025:2017 General Requirements) for the Competence of testing Laboratories.

Designation Number: CN1227

Test Firm Registration Number: 674885

The 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.

## MEASUREMENT UNCERTAINTY

Measurement Uncertainty

| | | |
|---|---|---|
| Conducted Emission Expanded Uncertainty | = | 2.23dB, k=2 |
| Radiated emission expanded uncertainty(9kHz-30MHz) | = | 3.08dB, k=2 |
| Radiated emission expanded uncertainty(30MHz-1000MHz) | = | 4.42dB, k=2 |
| Radiated emission expanded uncertainty(Above 1GHz) | = | 4.06dB, k=2 |

# 2. GENERAL INFORMATION

## 2.1 GENERAL DESCRIPTION OF EUT

| | |
|---|---|
| Equipment | Gravio Hub |
| Trade Mark | Gravio |
| Model Name | GHUB001 |
| Serial No. | N/A |
| Model Difference | N/A |
| FCC ID | 2AT7Z-GHUB001 |
| Antenna Type | Ceramics Antenna |
| Antenna Gain | 0.5dBi |
| Frequency Range | 2402~2480MHz |
| Number of Channels | 40CH |
| Modulation Type | GFSK |
| Battery | 3V(The battery only supplies power to the Zigbee module when the battery is powered off.) |
| PowerSource | DC 12V |

## 2.2 Carrier Frequency of Channels

| Channel List | | | | | | | |
|---|---|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 01 | 2402 | 11 | 2422 | 21 | 2442 | 31 | 2462 |
| 02 | 2404 | 12 | 2424 | 22 | 2444 | 32 | 2464 |
| 03 | 2406 | 13 | 2426 | 23 | 2446 | 33 | 2466 |
| 04 | 2408 | 14 | 2428 | 24 | 2448 | 34 | 2468 |
| 05 | 2410 | 15 | 2430 | 25 | 2450 | 35 | 2470 |
| 06 | 2412 | 16 | 2432 | 26 | 2452 | 36 | 2472 |
| 07 | 2414 | 17 | 2434 | 27 | 2454 | 37 | 2474 |
| 08 | 2416 | 18 | 2436 | 28 | 2456 | 38 | 2476 |
| 09 | 2418 | 19 | 2438 | 29 | 2458 | 39 | 2478 |
| 10 | 2420 | 20 | 2440 | 30 | 2460 | 40 | 2480 |

## 2.3 Operation of EUT during testing

Operating Mode
The mode is used: Transmitting mode
Low Channel: 2402MHz
Middle Channel: 2440MHz
High Channel: 2480MHz

## 2.4 DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted testing:

Operation of EUT duringRadiation testing:

Table forauxiliary equipment:

| Equipment Description | Manufacturer | Model | Calibration Due Date |
|---|---|---|---|
| N/A | | | |

## 2.5 MEASUREMENT INSTRUMENTS LIST

| Item | Equipment | Manufacturer | Model No. | Serial No. | Calibrated until |
|---|---|---|---|---|---|
| CONDUCTED EMISSIONS TEST | | | | | |
| 1 | AMN | Schwarzbeck | NNLK8121 | 8121370 | 2019.9.9 |
| 2 | AMN | ETS | 3810/2 | 00020199 | 2019.9.9 |
| 3 | EMI TEST RECEIVER | Rohde&Schwarz | ESCI | 101210 | 2019.9.9 |
| 4 | AAN | TESEQ | T8-Cat6 | 38888 | 2019.9.9 |
| RADIATED EMISSION TEST | | | | | |
| 1 | Horn Antenna | Sunol | DRH-118 | A101415 | 2019.9.29 |
| 2 | BicoNILog Antenna | Sunol | JB1 Antenna | A090215 | 2019.9.29 |
| 3 | PREAMP | HP | 8449B | 3008A00160 | 2019.9.9 |
| 4 | PREAMP | HP | 8447D | 2944A07999 | 2019.9.9 |
| 5 | EMI TEST RECEIVER | Rohde&Schwarz | ESR3 | 101891 | 2019.9.9 |
| 6 | VECTOR Signal Generator | Rohde&Schwarz | SMU200A | 101521 | 2019.9.28 |
| 7 | Signal Generator | Agilent | E4421B | MY4335105 | 2019.9.28 |
| 8 | MXA Signal Analyzer | Agilent | N9020A | MY50510140 | 2019.9.28 |
| 9 | MXA Signal Analyzer | Agilent | N9020A | MY51110104 | 2019.9.9 |
| 10 | ANT Tower&Turn table Controller | Champro | EM 1000 | 60764 | 2019.9.28 |
| 11 | Anechoic Chamber | Taihe Maorui | 9m*6m*6m | 966A0001 | 2019.9.9 |
| 12 | Shielding Room | Taihe Maorui | 6.4m*4m*3m | 643A0001 | 2019.9.9 |
| 13 | RF Power sensor | DARE | RPR3006W | 15I00041SNO88 | 2020.3.14 |
| 14 | RF Power sensor | DARE | RPR3006W | 15I00041SNO89 | 2020.3.14 |
| 15 | RF power divider | Anritsu | K241B | 992289 | 2019.9.28 |
| 16 | Wideband radio communication tester | Rohde&Schwarz | CMW500 | 154987 | 2019.9.28 |
| 17 | Biconical antenna | Schwarzbeck | VHA 9103 | 91032360 | 2019.9.8 |
| 18 | Biconical antenna | Schwarzbeck | VHA 9103 | 91032361 | 2019.9.8 |
| 19 | Broadband Hybrid Antennas | Schwarzbeck | VULB9163 | VULB9163#958 | 2019.9.8 |
| 20 | Horn Antenna | Schwarzbeck | BBHA9120D | 9120D-1680 | 2020.1.12 |
| 21 | Active Receive Loop Antenna | Schwarzbeck | FMZB 1919B | 00023 | 2019.11.02 |
| 22 | Horn Antenna | A-INFOMW | LB-180400-KF | J211060660 | 2020.03.14 |
| 23 | Microwave Broadband Preamplifier | Schwarzbeck | BBV 9721 | 100472 | 2019.10.24 |
| 24 | Active Loop Antenna | Com-Power | AL-130R | 10160009 | 2019.05.10 |
| 25 | Power Meter | KEYSIGHT | N1911A | MY50520168 | 2019.05.10 |
| 26 | Frequency Meter | VICTOR | VC2000 | 997406086 | 2019.05.10 |
| 27 | DC Power Source | HYELEC | HY5020E | 055161818 | 2019.05.10 |

# 3. CONDUCTED EMISSIONS TEST

## 3.1 Conducted Power Line Emission Limit

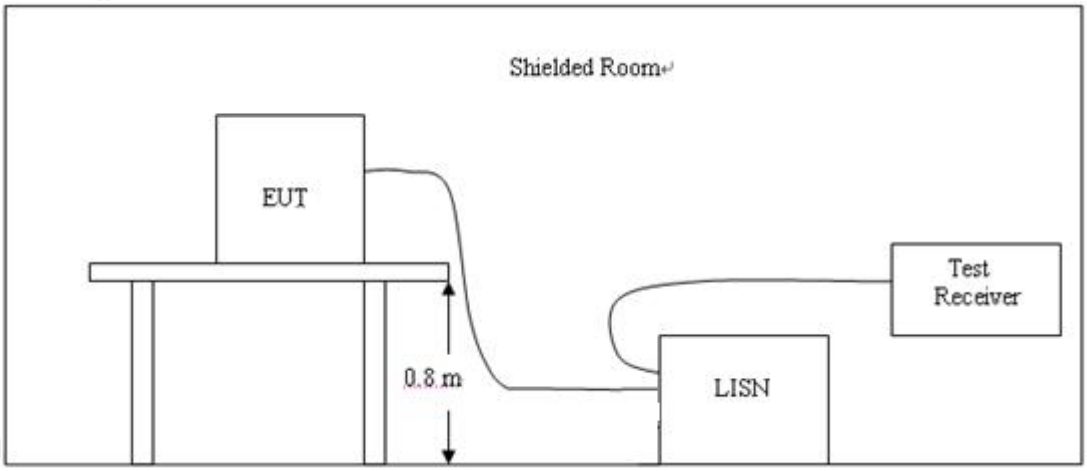
For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following

| Frequency (MHz) | Maximum RF Line Voltage(dBμV) | | | |
|---|---|---|---|---|
| | CLASS A | | CLASS B | |
| | Q.P. | Ave. | Q.P. | Ave. |
| 0.15~0.50 | 79 | 66 | 66~56* | 56~46* |
| 0.50~5.00 | 73 | 60 | 56 | 46 |
| 5.00~30.0 | 73 | 60 | 60 | 50 |

* Decreasing linearly with the logarithm of the frequency

For intentional device, according to §15.207(a) Line Conducted Emission Limit is same as above table.

## 3.2 Test Setup




## 3.3 Test Procedure

1,The equipment was set up as per the test configuration to simulate typical actual usage per the user'smanual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed onthe ground plane as per ANSI C63.10.

2, Support equipment, if needed, was placed as per ANSI C63.10.

3, All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.

4,If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hzpower through a Line Impedance Stabilization Network (LISN) which supplied power source and wasgrounded 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 EUTusing a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has twomonitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1connected 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.

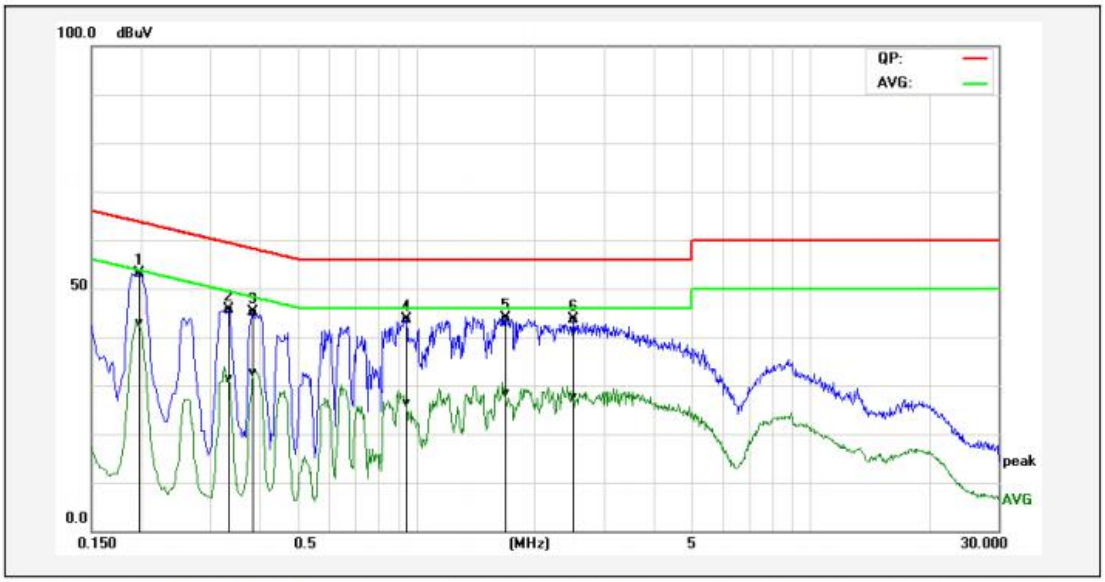
## 3.4 Test Result

Pass

Remark:

1. All modes were tested at AC 120V and 240V, only the worst result of AC 120V was reported.
2. All modes of Low, Middle, and High channel were tested, only the worst result of High Channel was reported as below:

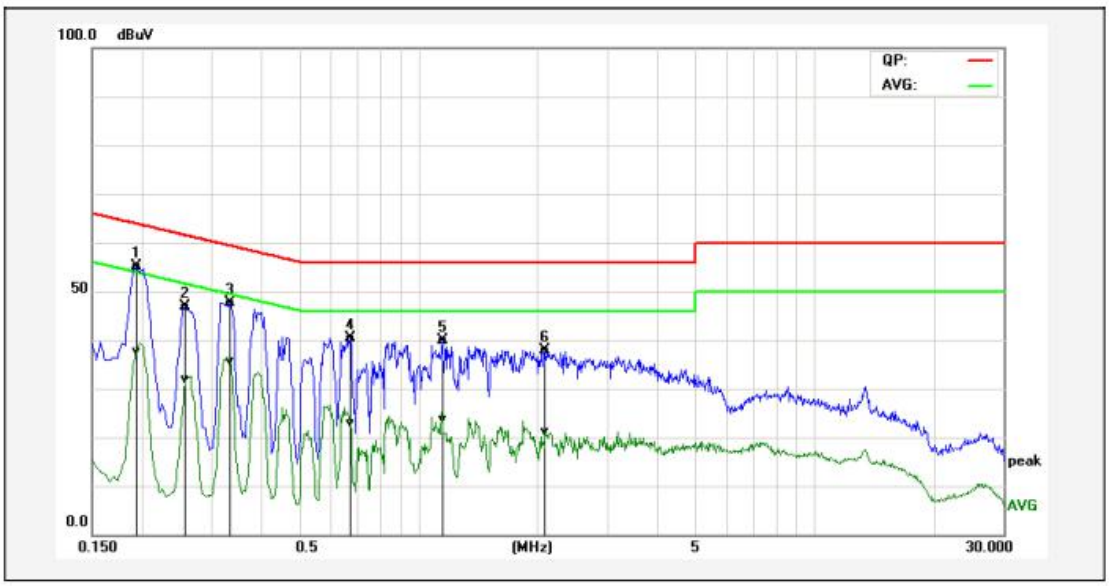
| | | | |
|---|---|---|---|
| Temperature: | 24℃ | Relative Humidity: | 45% |
| Test Date: | Aug. 05, 2019 | Pressure: | 1010hPa |
| Test Voltage: | AC 120V, 60Hz | Phase: | Line |
| Test Mode: | Transmitting mode of GFSK 2480MHz | | |




| No. | Frequency (MHz) | QuasiPeak reading (dBuV) | Average reading (dBuV) | Correction factor (dB) | QuasiPeak result (dBuV) | Average result (dBuV) | QuasiPeak limit (dBuV) | Average limit (dBuV) | QuasiPeak margin (dB) | Average margin (dB) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1* | 0.1980 | 43.51 | 33.22 | 9.73 | 53.24 | 42.95 | 63.69 | 53.69 | -10.45 | -10.74 | Pass |
| 2P | 0.3339 | 35.73 | 21.49 | 9.81 | 45.54 | 31.30 | 59.35 | 49.35 | -13.81 | -18.05 | Pass |
| 3P | 0.3860 | 35.23 | 22.70 | 9.83 | 45.06 | 32.53 | 58.15 | 48.15 | -13.09 | -15.62 | Pass |
| 4P | 0.9460 | 33.74 | 16.51 | 9.85 | 43.59 | 26.36 | 56.00 | 46.00 | -12.41 | -19.64 | Pass |
| 5P | 1.6860 | 33.94 | 18.60 | 9.87 | 43.81 | 28.47 | 56.00 | 46.00 | -12.19 | -17.53 | Pass |
| 6P | 2.5020 | 33.60 | 17.81 | 9.93 | 43.53 | 27.74 | 56.00 | 46.00 | -12.47 | -18.26 | Pass |

Remark: Factor = Insertion Loss + Cable Loss, Result=Reading + Factor, Margin=Result – Limit.

| | | | |
|---|---|---|---|
| Temperature: | 24℃ | Relative Humidity: | 45% |
| Test Date: | Aug. 05, 2019 | Pressure: | 1010hPa |
| Test Voltage: | AC 120V, 60Hz | Phase: | Neutral |
| Test Mode: | Transmitting mode of GFSK 2480MHz | | |




| No. | Frequency (MHz) | QuasiPeak reading (dBuV) | Average reading (dBuV) | Correction factor (dB) | QuasiPeak result (dBuV) | Average result (dBuV) | QuasiPeak limit (dBuV) | Average limit (dBuV) | QuasiPeak margin (dB) | Average margin (dB) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1* | 0.1940 | 45.38 | 27.87 | 9.72 | 55.10 | 37.59 | 63.86 | 53.86 | -8.76 | -16.27 | Pass |
| 2P | 0.2580 | 37.19 | 22.09 | 9.79 | 46.98 | 31.88 | 61.49 | 51.50 | -14.51 | -19.62 | Pass |
| 3P | 0.3339 | 37.92 | 25.79 | 9.81 | 47.73 | 35.60 | 59.35 | 49.35 | -11.62 | -13.75 | Pass |
| 4P | 0.6740 | 30.64 | 12.99 | 9.81 | 40.45 | 22.80 | 56.00 | 46.00 | -15.55 | -23.20 | Pass |
| 5P | 1.1500 | 29.91 | 13.79 | 9.85 | 39.76 | 23.64 | 56.00 | 46.00 | -16.24 | -22.36 | Pass |
| 6P | 2.0980 | 27.92 | 11.21 | 9.89 | 37.81 | 21.10 | 56.00 | 46.00 | -18.19 | -24.90 | Pass |

Remark: Factor = Insertion Loss + Cable Loss, Result=Reading + Factor, Margin=Result – Limit.

# 4 RADIATED EMISSION TEST

## 4.1 Radiation Limit

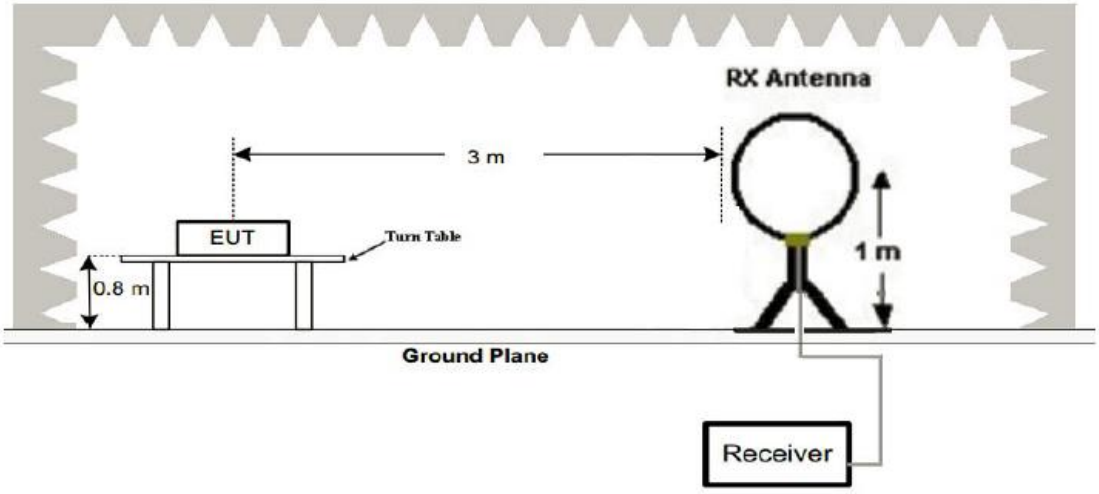
For unintentional device, according to § 15.109(a), except for Class A digital devices, the field strength ofradiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the followingvalues：

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m) | Radiated (μV/m) |
|---|---|---|---|
| 30-88 | 3 | 40 | 100 |
| 88-216 | 3 | 43.5 | 150 |
| 216-960 | 3 | 46 | 200 |
| Above 960 | 3 | 54 | 500 |

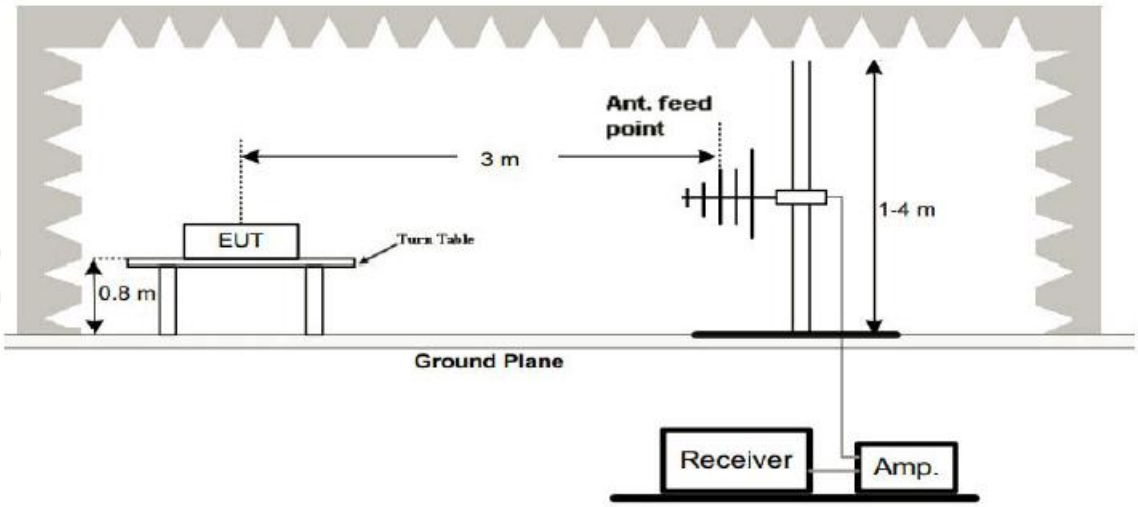
For intentional device, according to § 15.209(a), the general requirement of field strength of radiatedemissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

## 4.2 Test Setup

1. Radiated Emission Test-Up Frequency Below 30MHz




2. Radiated Emission Test-Up Frequency 30MHz~1GHz

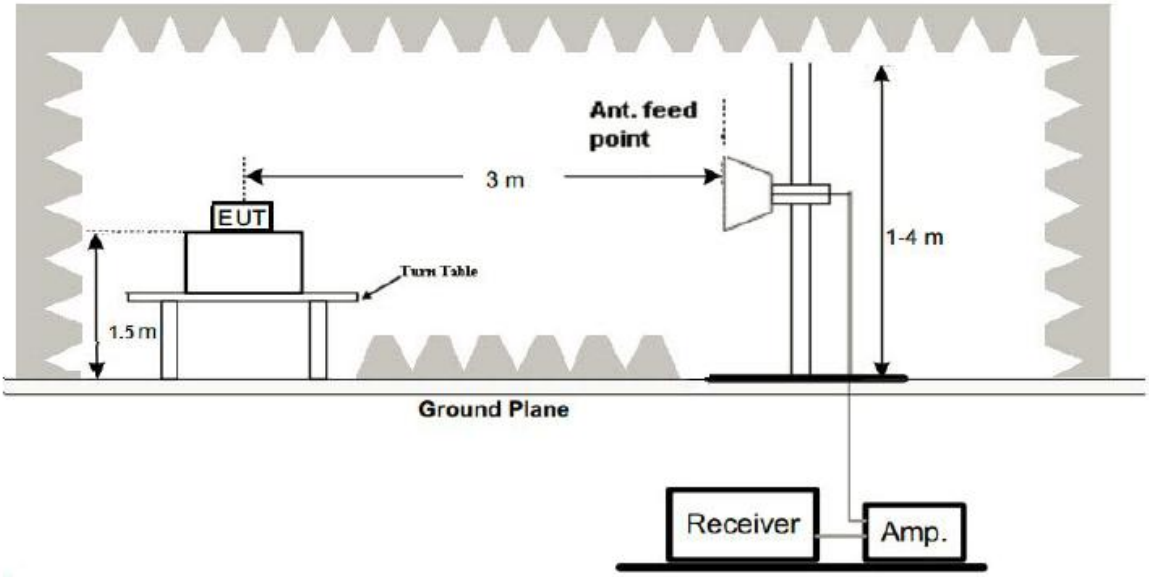


3. Radiated Emission Test-Up Frequency Above 1GHz

For unintentional device, according to § 15.109(a), except for Class A digital devices, the field strength ofradiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the followingvalues：

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m) | Detection method |
|---|---|---|---|
| 2400-2483.5 | 3 | 114 | PK |
| 2400-2483.5 | 3 | 94 | AV |

For intentional device, according to § 15.209(a), the general requirement of field strength of radiatedemissions from intentional radiators at a distance of 3 meters shall not exceed the above table.




## 4.3 Test Procedure

1. Below 1GHz measurement the EUT is placed on turntable which is 0.8m above ground plane. And above 1GHz measurement EUT was placed on low permittivity and low tangent turn table which is 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highestemissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna bothhorizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The test frequency range from 9KHz to25GHz per FCC PART 15.33(a).

Note:

For battery operated equipment, the equipment tests shall be performed using a new battery.

## 4.4 Test Result

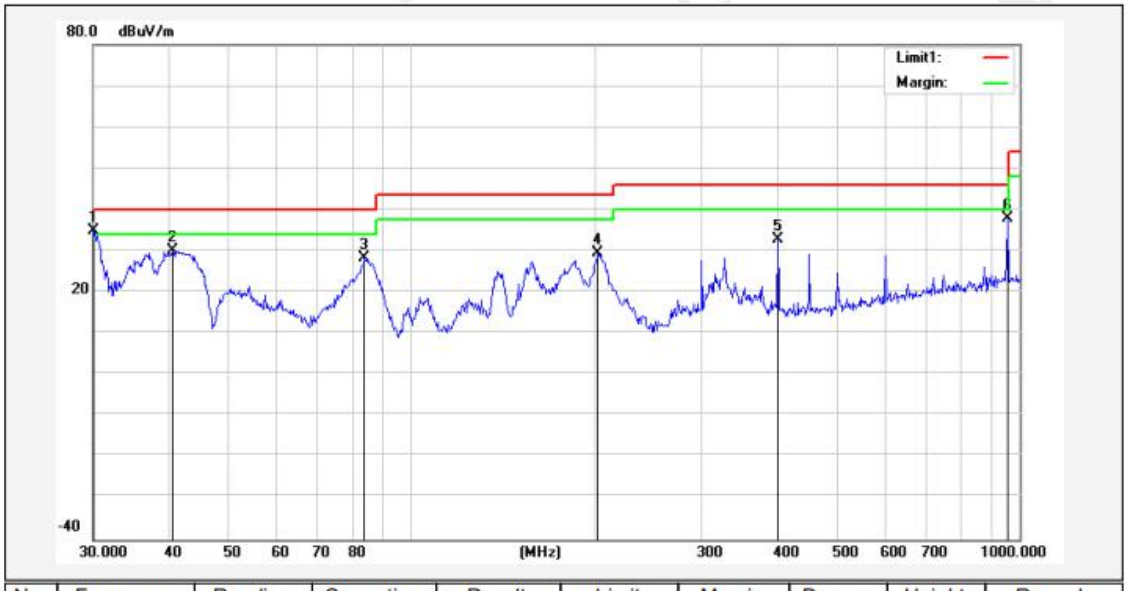
PASS

Remark:

1. All the test modes completed for test. The worst case of Radiated Emissionis High channel, the test data of this mode was reported.
2. By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Z axis” position was the worst, and test data recorded in this report.
3. Radiated emission test from 9KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9KHz to 30MHz and not recorded in this report.

Below 1GHz Test Results:

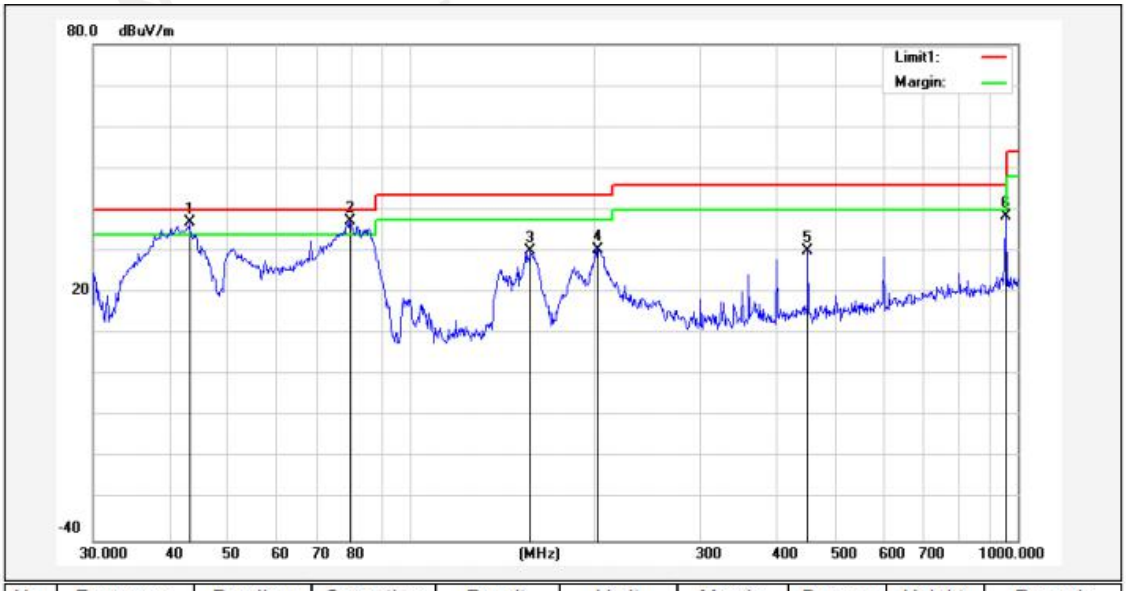
| | | | |
|---|---|---|---|
| Temperature: | 24℃ | Relative Humidity: | 45% |
| Test Date: | Aug. 05, 2019 | Pressure: | 1010hPa |
| Test Voltage: | AC 120V, 60Hz | Polarization: | Horizontal |
| Test Mode: | Transmitting mode of GFSK2480MHz | | |




| No. | Frequency (MHz) | Reading (dBuV) | Correction factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Degree (deg.) | Height (cm) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1* | 30.0000 | 42.03 | -7.13 | 34.90 | 40.00 | -5.10 | | | peak |
| 2 | 40.5591 | 45.76 | -15.83 | 29.93 | 40.00 | -10.07 | | | peak |
| 3 | 83.8156 | 48.85 | -20.61 | 28.24 | 40.00 | -11.76 | | | peak |
| 4 | 202.8104 | 45.59 | -16.08 | 29.51 | 43.50 | -13.99 | | | peak |
| 5 | 400.4320 | 46.20 | -13.57 | 32.63 | 46.00 | -13.37 | | | peak |
| 6 | 955.4381 | 43.49 | -5.77 | 37.72 | 46.00 | -8.28 | | | peak |

Remark: Absolute Level= Reading Level+ Factor, Margin= Absolute Level – Limit
Factor=Ant. Factor + Cable Loss – Pre-amplifier

| | | | |
|---|---|---|---|
| Temperature: | 24℃ | Relative Humidity: | 45% |
| Test Date: | Aug. 05, 2019 | Pressure: | 1010hPa |
| Test Voltage: | AC 120V, 60Hz | Polarization: | Vertical |
| Test Mode: | Transmitting mode of GFSK2480MHz | | |




| No. | Frequency (MHz) | Reading (dBuV) | Correction factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Degree (deg.) | Height (cm) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1! | 43.2017 | 54.81 | -17.88 | 36.93 | 40.00 | -3.07 | | | peak |
| 2* | 79.5207 | 58.52 | -21.36 | 37.16 | 40.00 | -2.84 | | | peak |
| 3 | 157.5588 | 45.98 | -15.86 | 30.12 | 43.50 | -13.38 | | | peak |
| 4 | 203.5228 | 46.62 | -16.27 | 30.35 | 43.50 | -13.15 | | | peak |
| 5 | 451.1350 | 42.86 | -12.72 | 30.14 | 46.00 | -15.86 | | | peak |
| 6 | 955.4381 | 44.28 | -5.77 | 38.51 | 46.00 | -7.49 | | | peak |

Remark: Absolute Level= Reading Level+ Factor, Margin= Absolute Level – Limit
Factor=Ant. Factor + Cable Loss – Pre-amplifier

Remark：
(1) Measuring frequencies from 9 KHz to the 1 GHz, Radiated emission test from 9KHz to 30MHzwas verified, and no any emission was found except system noise floor.
(2) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(3) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.

Above 1 GHz Test Results:
CH Low (2402MHz)

Horizontal:

| Frequency (MHz) | Reading Result (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2402 | 107.49 | -5.84 | 101.65 | 114 | -12.35 | PK |
| 2402 | 80.34 | -5.84 | 74.50 | 94 | -19.50 | AV |
| 4804 | 63.35 | -3.64 | 59.71 | 74 | -14.29 | PK |
| 4804 | 50.87 | -3.64 | 47.23 | 54 | -6.77 | AV |
| 7206 | 58.61 | -0.95 | 57.66 | 74 | -16.34 | PK |
| 7206 | 46.62 | -0.95 | 45.67 | 54 | -8.33 | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit | | | | | | |

Vertical:

| Frequency (MHz) | Reading Result (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2402 | 109.21 | -5.84 | 103.37 | 114 | -10.63 | PK |
| 2402 | 81.25 | -5.84 | 75.41 | 94 | -18.59 | AV |
| 4804 | 61.24 | -3.64 | 57.60 | 74 | -16.40 | PK |
| 4804 | 48.99 | -3.64 | 45.35 | 54 | -8.65 | AV |
| 7206 | 56.75 | -0.95 | 55.8 | 74 | -18.2 | PK |
| 7206 | 47.21 | -0.95 | 46.26 | 54 | -7.74 | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit | | | | | | |

CH Middle (2440MHz)

Horizontal:

| Frequency (MHz) | Reading Result (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2440 | 109.35 | -5.71 | 103.64 | 114 | -10.36 | PK |
| 2440 | 81.24 | -5.71 | 75.53 | 94 | -18.47 | AV |
| 4880 | 60.24 | -3.51 | 56.73 | 74 | -17.27 | PK |
| 4880 | 47.92 | -3.51 | 44.41 | 54 | -9.59 | AV |
| 7320 | 57.34 | -0.82 | 56.52 | 74 | -17.48 | PK |
| 7320 | 46.38 | -0.82 | 45.56 | 54 | -8.44 | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit | | | | | | |

Vertical:

| Frequency (MHz) | Reading Result (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2440 | 108.79 | -5.71 | 103.08 | 114 | -10.92 | PK |
| 2440 | 82.21 | -5.71 | 76.50 | 94 | -17.50 | AV |
| 4880 | 61.24 | -3.51 | 57.73 | 74 | -16.27 | PK |
| 4880 | 49.35 | -3.51 | 45.84 | 54 | -8.16 | AV |
| 7320 | 56.88 | -0.82 | 56.06 | 74 | -17.94 | PK |
| 7320 | 46.27 | -0.82 | 45.45 | 54 | -8.55 | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit | | | | | | |

CH High (2480MHz)
Horizontal:

| Frequency (MHz) | Reading Result (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2480 | 108.77 | -5.65 | 103.12 | 114 | -10.88 | PK |
| 2480 | 81.22 | -5.65 | 75.57 | 94 | -18.43 | AV |
| 4960 | 64.35 | -3.43 | 60.92 | 74 | -13.08 | PK |
| 4960 | 50.39 | -3.43 | 46.96 | 54 | -7.04 | AV |
| 7440 | 57.68 | -0.75 | 56.93 | 74 | -17.07 | PK |
| 7440 | 47.35 | -0.75 | 46.60 | 54 | -7.40 | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit | | | | | | |

Vertical:

| Frequency (MHz) | Reading Result (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2480 | 109.31 | -5.65 | 103.66 | 114 | -10.34 | PK |
| 2480 | 82.25 | -5.65 | 76.60 | 94 | -17.40 | AV |
| 4960 | 61.34 | -3.43 | 57.91 | 74 | -16.09 | PK |
| 4960 | 50.39 | -3.43 | 46.96 | 54 | -7.04 | AV |
| 7440 | 56.81 | -0.75 | 56.06 | 74 | -17.94 | PK |
| 7440 | 47.26 | -0.75 | 46.51 | 54 | -7.49 | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit | | | | | | |

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz.
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) Data of measurement within this frequency range shown “--- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.The resolution bandwidth of test receiver/spectrum analyzer is 1MHzand video bandwidth is 3MHz for peak measurement with peak detectorat frequency above 1GHz.The resolution bandwidth of test receiver/spectrum analyzer is 1MHzand video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
(7)All modes of operation were investigated and the worst-case emissionsare reported.

# 5 BAND EDGE

## 5.1 Limits

FCC PART 15.249(d) Emissions radiated outside of the specified frequency bands, except for harmonics,shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emissionlimits in §15.209, whichever is the lesser attenuation.

## 5.2 Test Procedure

The band edge compliance of RF radiated emission should be measured by following the guidance in ANSIC63.10 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT issituated in three orthogonal planes (if appropriate), adjusting the measurement antenna height andpolarization etc. Set RBW to 1MHz and VBM to 3MHz to measure the peak field strength and set RMS detector to measure the average radiated field strength.The conducted RF band edge was measured by using a spectrum analyzer. Set span wide enough to capturethe highest in-band emission and the emission at the band edge. Set RBW to 100 KHz and VBW to 300 KHz,to measure the conducted peak band edge.

## 5.3 Test Result

PASS

Radiated Band Edge Test:

Operation Mode: TX CH Low (2402MHz)

Horizontal:

| Frequency | Reading Result | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2310 | 56.31 | -5.81 | 50.50 | 74 | -23.50 | PK |
| 2310 | / | -5.81 | / | 54 | / | AV |
| 2390 | 56.81 | -5.84 | 50.97 | 74 | -23.03 | PK |
| 2390 | / | -5.84 | / | 54 | / | AV |
| 2400 | 57.84 | -5.84 | 52.00 | 74 | -22.00 | PK |
| 2400 | / | -5.84 | / | 54 | / | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Vertical:

| Frequency | Reading Result | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2310 | 55.29 | -5.81 | 49.48 | 74 | -24.52 | PK |
| 2310 | / | -5.81 | / | 54 | / | AV |
| 2390 | 55.87 | -5.84 | 50.03 | 74 | -23.97 | PK |
| 2390 | / | -5.84 | / | 54 | / | AV |
| 2400 | 57.69 | -5.84 | 51.85 | 74 | -22.15 | PK |
| 2400 | / | -5.84 | / | 54 | / | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Operation Mode: TX CH High (2480MHz)

Horizontal:

| Frequency (MHz) | Reading Result (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2483.5 | 57.61 | -5.65 | 51.96 | 74 | -22.04 | PK |
| 2483.5 | / | -5.65 | / | 54 | / | AV |
| 2500 | 57.06 | -5.72 | 51.34 | 74 | -22.66 | PK |
| 2500 | / | -5.72 | / | 54 | / | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Vertical:

| Frequency (MHz) | Reading Result (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2483.5 | 56.99 | -5.65 | 51.34 | 74 | -22.66 | PK |
| 2483.5 | / | -5.65 | / | 54 | / | AV |
| 2500 | 56.21 | -5.72 | 50.49 | 74 | -23.51 | PK |
| 2500 | / | -5.72 | / | 54 | / | AV |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

# 6 OCCUPIED BANDWIDTH MEASUREMENT

## 6.1 Test Setup

Same asRadiated Emission Measurement

## 6.2 Test Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation.
3. Based on ANSI C63.10 section 6.9.2: RBW=30KHz. VBW=100KHz, Span=3MHz.
4. The useful radiated emission from the EUT was detected by the spectrum analyzer with peak detector.

## 6.3 Measurement Equipment Used

Same asRadiated Emission Measurement

## 6.4 Test Result

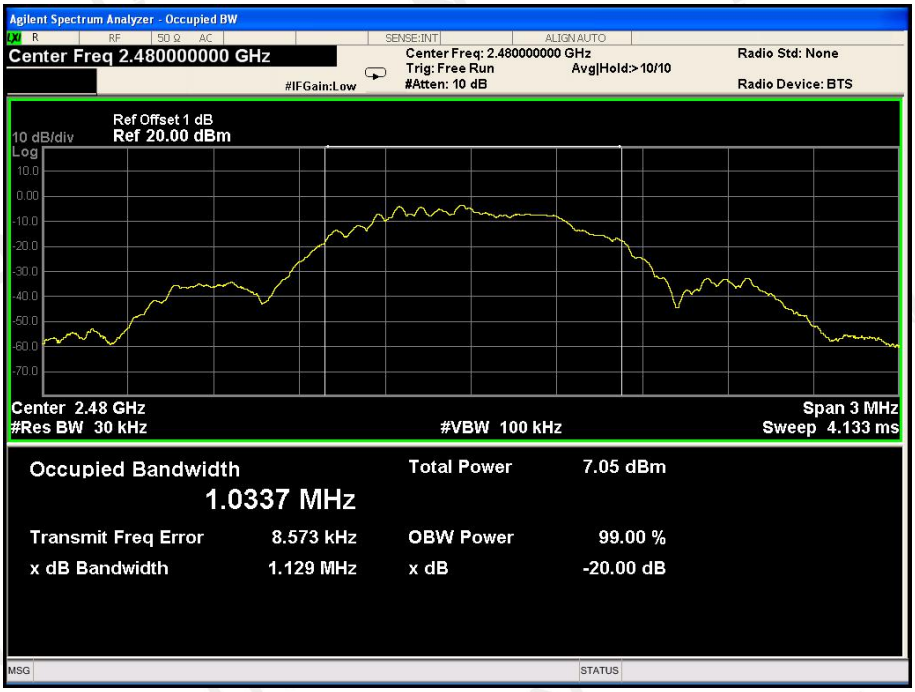
PASS

| Frequency (MHz) | 20dB Bandwidth (MHz) | Result |
|---|---|---|
| 2402 | 1.132 | PASS |
| 2440 | 1.132 | PASS |
| 2480 | 1.129 | PASS |

CH:2402MHz

CH:2440MHz

CH:2480MHz

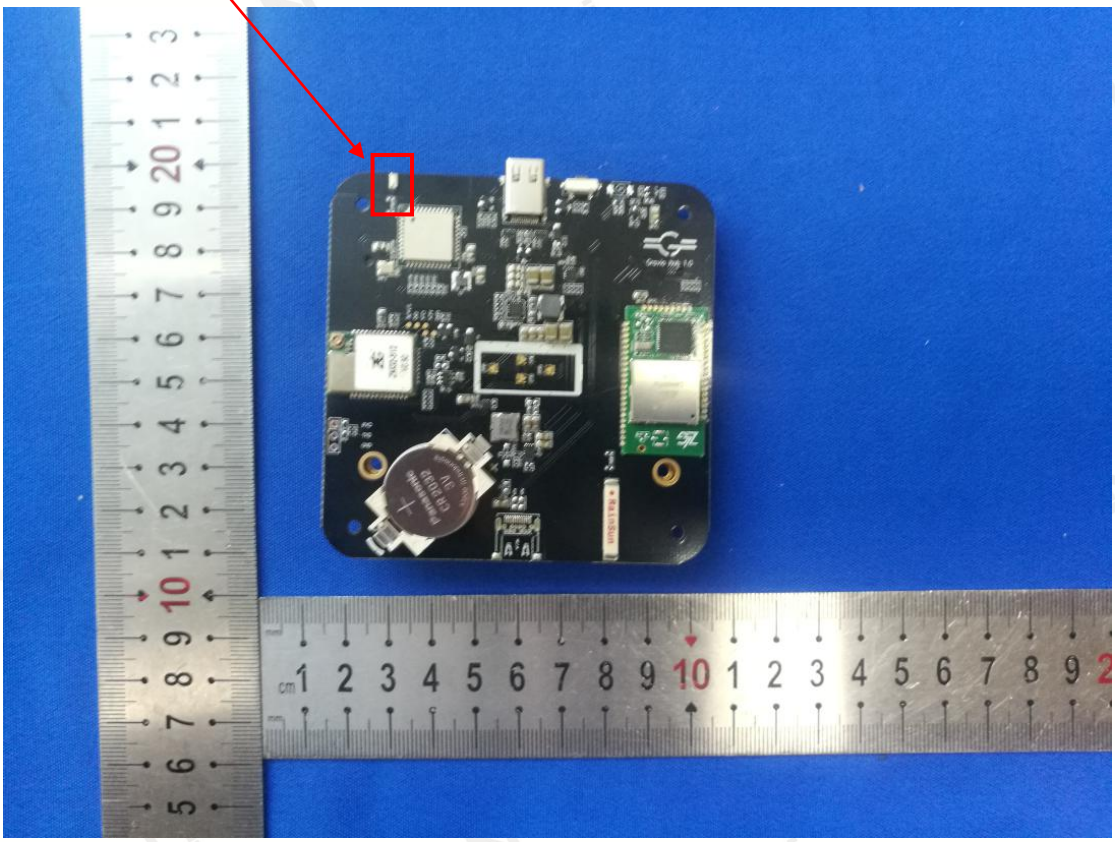


# 7 ANTENNA REQUIREMENT

Standard Applicable:
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed toensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Connected Construction
The antenna used in this product is a Ceramics Antenna, The directional gains of antenna used for transmitting is 0.5dBi.

ANTENNA:



# 8 PHOTOGRAPH OF TEST

## 8.1Radiated Emission

8.2Conducted Emission

***End of Report***