**Shenzhen Global Test Service Co.,Ltd.**
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

# FCC PART 15 SUBPART C TEST REPORT

## FCC PART 15.247

| | |
|---|---|
| **Report Reference No.....:** | **GTS20200611017-1-8-1** |
| **FCC ID..... :** | **2AVNZ-TYPE-V1** |
| Compiled by<br>( position+printed name+signature)..: | File administrators Jimmy Wang |
| Supervised by<br>( position+printed name+signature)..: | Test Engineer Aaron Tan |
| Approved by<br>( position+printed name+signature)..: | Manager Jason Hu |
| Date of issue.....: | Jun.11, 2020 |

| | |
|---|---|
| **Representative Laboratory Name .:** | **Shenzhen Global Test Service Co.,Ltd.** |
| Address.....: | No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong |

| | |
|---|---|
| **Applicant's name**.....: | **UBUDU SAS** |
| Address .....: | 22 rue Tourlaque 75018 Paris, France |

| | |
|---|---|
| **Test specification** .....**:** | |
| Standard .....: | **FCC Part 15.247** |
| TRF Originator.....: | Shenzhen Global Test Service Co.,Ltd. |

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| | |
|---|---|
| **Test item description .....:** | SDA Tag |
| Trade Mark .....: | UBUDU |
| Manufacturer .....: | UBUDU SAS |
| Model/Type reference.....: | type V1 |
| Listed Models .....: | N/A |
| Modulation Type .....: | GFSK |
| Operation Frequency.....: | From 2402MHz to 2480MHz |
| Rating .....: | DC 3.7V From Battery and DC 5V From external circuit |
| Result.....: | **PASS** |

# TEST REPORT

| Test Report No. : | GTS20200611017-1-8-1 | Jun.11, 2020<br>Date of issue |
|---|---|---|

| | | |
|---|---|---|
| Equipment under Test | : | SDA Tag |
| Model /Type | : | type V1 |
| Listed Models | : | N/A |
| **Applicant** | : | **UBUDU SAS** |
| Address | : | 22 rue Tourlaque 75018 Paris, France |
| **Manufacturer** | : | **UBUDU SAS** |
| Address | : | 22 rue Tourlaque 75018 Paris, France |

| **Test Result**: | **PASS** |
|---|---|

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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# 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 v05r02: Guidance for Compliance Measurements on Digital Transmission Systems (DTS) ,Frequency Hopping Spread Spectrum System(HFSS), and Hybrid System Devices Operating Under §15.247 of The FCC rules.

# 2. SUMMARY

## 2.1. General Remarks

| | | |
|---|---|---|
| Date of receipt of test sample | : | May.28, 2020 |
| | | |
| Testing commenced on | : | May.28, 2020 |
| | | |
| Testing concluded on | : | Jun.11, 2020 |

## 2.2. Product Description

| | |
|---|---|
| Product Name: | SDA Tag |
| Model/Type reference: | type V1 |
| Power supply: | DC 3.7V From Battery and DC 5V From external circuit |
| Adapter information (Auxiliary test suppied by test Lab） | Model: AS5010B<br>Input: 100-240V~, 50/60Hz 0.15A<br>Output:DC5V⎓1000m A |
| Sample ID: | GTS20200611017-1-8-1# |
| **Bluetooth :** | |
| Supported Type: | BLE |
| Modulation: | GFSK |
| Operation frequency: | 2402MHz~2480MHz |
| Channel number: | 40 |
| Channel separation: | 2MHz |
| Antenna type: | Chip antenna |
| Antenna gain: | 0.50dBi |

## 2.3. Equipment Under Test

### Power supply system utilised

| | | | | | |
|---|---|---|---|---|---|
| Power supply voltage | : | ○ | 230V / 50 Hz | ○ | 120V / 60Hz |
| | | ○ | 12 V DC | ○ | 24 V DC |
| | | ● | Other (specified in blank below) | | |

DC 3.7V From Battery and DC 5V From external circuit

## 2.4. Short description of the Equipment under Test (EUT)

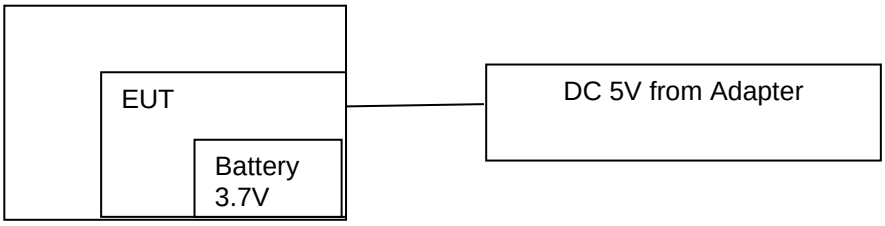
This is a SDA Tag For more details, refer to the user's manual of the EUT.

## 2.5. EUT operation mode

The Applicant provides Nrfgostudio software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 40 channels provided to the EUT. Channel 00/19/39 was selected to test.

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

## 2.6. Block Diagram of Test Setup




## 2.7. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2AVNZ-TYPE-V1** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

## 2.8. EUT configuration

**The following peripheral devices and interface cables were connected during the measurement:**

○ - supplied by the manufacturer

● - Supplied by the lab

| | | | |
|---|---|---|---|
| ○ | ADAPTER | M/N: | |
| | | Manufacturer: | |

## 2.9. Modifications

No modifications were implemented to meet testing criteria.

# 3. TEST ENVIRONMENT

## 3.1. Address of the test laboratory

**Shenzhen Global Test Service Co.,Ltd.**
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

## 3.2. Test Facility

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

### FCC-Registration No.: 165725

Shenzhen Global Test Service Co.,Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

### A2LA-Lab Cert. No.: 4758.01

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

### CNAS-Lab Code: L8169

Shenzhen Global Test Service Co.,Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories. Date of Registration: Dec. 11, 2015. Valid time is until Dec. 10, 2018.

## 3.3. Environmental conditions

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

Radiated Emission:

| | |
|---|---|
| Temperature: | 25 ° C |
| | |
| Humidity: | 45 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

AC Power Conducted Emission

| | |
|---|---|
| Temperature: | 25 ° C |
| | |
| Humidity: | 46 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

Conducted testing：

| | |
|---|---|
| Temperature: | 25 ° C |
| | |
| Humidity: | 44 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

## 3.4. Test Description

| Test Specification clause | Test case | Test Mode | Test Channel | Recorded In Report | | Pass | Fail | NA | NP | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| §15.247(b)(4) | Antenna gain | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | ☒ | ☐ | ☐ | ☐ | complies |
| §15.247(e) | Power spectral density | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | ☒ | ☐ | ☐ | ☐ | complies |
| §15.247(a)(2) | Spectrum bandwidth – 6 dB bandwidth | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | ☒<br>☒ | ☐ | ☐ | ☐ | complies |
| §15.247(b)(1) | Maximum output power | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | ☒<br>☒<br>☒ | ☐ | ☐ | ☐ | complies |
| §15.247(d) | Band edge compliance conducted | GFSK | ☒ Lowest<br>☒ Highest | GFSK | ☒ Lowest<br>☒ Highest | ☒<br>☒ | ☐ | ☐ | ☐ | complies |
| §15.205 | Band edge compliance radiated | GFSK | ☒ Lowest<br>☒ Highest | GFSK | ☒ Lowest<br>☒ Highest | ☒ | ☐ | ☐ | ☐ | complies |
| §15.247(d) | TX spurious emissions conducted | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | ☒<br>☒ | ☐ | ☐ | ☐ | complies |
| §15.247(d) | TX spurious emissions radiated | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | ☒ | ☐ | ☐ | ☐ | complies |
| §15.109 | RX spurious emissions radiated | -/- | -/- | -/- | -/- | ☒ | ☐ | ☐ | ☐ | complies |
| §15.209(a) | TX spurious Emissions radiated < 30 MHz | GFSK | -/- | GFSK | -/- | ☒ | ☐ | ☐ | ☐ | complies |
| §15.107(a)<br>§15.207 | Conducted Emissions < 30 MHz | GFSK | -/- | GFSK | -/- | ☒ | ☐ | ☐ | ☐ | complies |

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed

## 3.5. Statement of the 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 acc. 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 Shenzhen Global Test Service Co.,Ltd. quality system acc. 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 Shenzhen GTS laboratory is reported:

| Test | Range | Measurement Uncertainty | Notes |
|---|---|---|---|
| Radiated Emission | 30~1000MHz | 4.10 dB | (1) |
| Radiated Emission | 1~18GHz | 4.32 dB | (1) |
| Radiated Emission | 18-40GHz | 5.54 dB | (1) |
| Conducted Disturbance | 0.15~30MHz | 3.12 dB | (1) |

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

## 3.6. Equipments Used during the Test

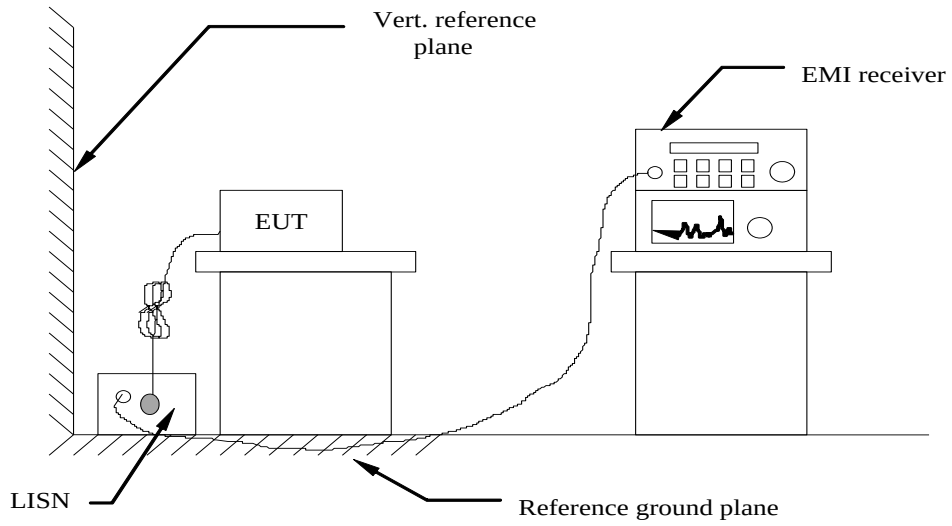
| Test Equipment | Manufacturer | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| LISN | R&S | ENV216 | 3560.6550.08 | 2019/09/20 | 2020/09/19 |
| LISN | R&S | ESH2-Z5 | 893606/008 | 2019/09/20 | 2020/09/19 |
| EMI Test Receiver | R&S | ESPI3 | 101841-cd | 2019/09/20 | 2020/09/19 |
| EMI Test Receiver | R&S | ESCI7 | 101102 | 2019/09/20 | 2020/09/19 |
| Spectrum Analyzer | Agilent | N9020A | MY48010425 | 2019/09/20 | 2020/09/19 |
| Spectrum Analyzer | R&S | FSV40 | 100019 | 2019/09/20 | 2020/09/19 |
| Vector Signal generator | Agilent | N5181A | MY49060502 | 2019/09/20 | 2020/09/19 |
| Signal generator | Agilent | E4421B | 3610AO1069 | 2019/09/20 | 2020/09/19 |
| Climate Chamber | ESPEC | EL-10KA | A20120523 | 2019/09/20 | 2020/09/19 |
| Controller | EM Electronics | Controller EM 1000 | N/A | N/A | N/A |
| Horn Antenna | Schwarzbeck | BBHA 9120D | 01622 | 2019/09/23 | 2020/09/22 |
| Active Loop Antenna | Beijing Da Ze Technology Co.,Ltd. | ZN30900C | 15006 | 2019/10/12 | 2020/10/11 |
| Bilog Antenna | Schwarzbeck | VULB9163 | 000976 | 2020/05/26 | 2021/05/25 |
| Broadband Horn Antenna | SCHWARZBECK | BBHA 9170 | 791 | 2019/09/20 | 2020/09/19 |
| Amplifier | Schwarzbeck | BBV 9743 | #202 | 2019/09/20 | 2020/09/19 |
| Amplifier | Schwarzbeck | BBV9179 | 9719-025 | 2019/09/20 | 2020/09/19 |
| Amplifier | EMCI | EMC051845B | 980355 | 2019/09/20 | 2020/09/19 |
| Temperature/Humidity Meter | Gangxing | CTH-608 | 02 | 2019/09/20 | 2020/09/19 |
| High-Pass Filter | K&L | 9SH10-2700/X12750-O/O | KL142031 | 2019/09/20 | 2020/09/19 |
| High-Pass Filter | K&L | 41H10-1375/U12750-O/O | KL142032 | 2019/09/20 | 2020/09/19 |
| RF Cable(below 1GHz) | HUBER+SUHNER | RG214 | RE01 | 2019/09/20 | 2020/09/19 |
| RF Cable(above 1GHz) | HUBER+SUHNER | RG214 | RE02 | 2019/09/20 | 2020/09/19 |
| Data acquisition card | Agilent | U2531A | TW53323507 | 2019/09/20 | 2020/09/19 |
| Power Sensor | Agilent | U2021XA | MY5365004 | 2019/09/20 | 2020/09/19 |
| Test Control Unit | Tonscend | JS0806-1 | 178060067 | 2019/06/20 | 2020/06/19 |
| Automated filter bank | Tonscend | JS0806-F | 19F8060177 | 2019/06/20 | 2020/06/19 |
| EMI Test Software | Tonscend | JS1120-1 | Ver 2.6.8.0518 | / | / |
| EMI Test Software | Tonscend | JS1120-3 | Ver 2.5.77.0418 | / | / |
| EMI Test Software | Tonscend | JS32-CE | Ver 2.5 | / | / |
| EMI Test Software | Tonscend | JS32-RE | Ver 2.5.1.8 | / | / |

Note: 1. The Cal.Interval was one year.

# 4. TEST CONDITIONS AND RESULTS

## 4.1. AC Power Conducted Emission

**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 EUT received DC5V power, 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.

**AC Power Conducted Emission Limit**

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

| 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. | | |

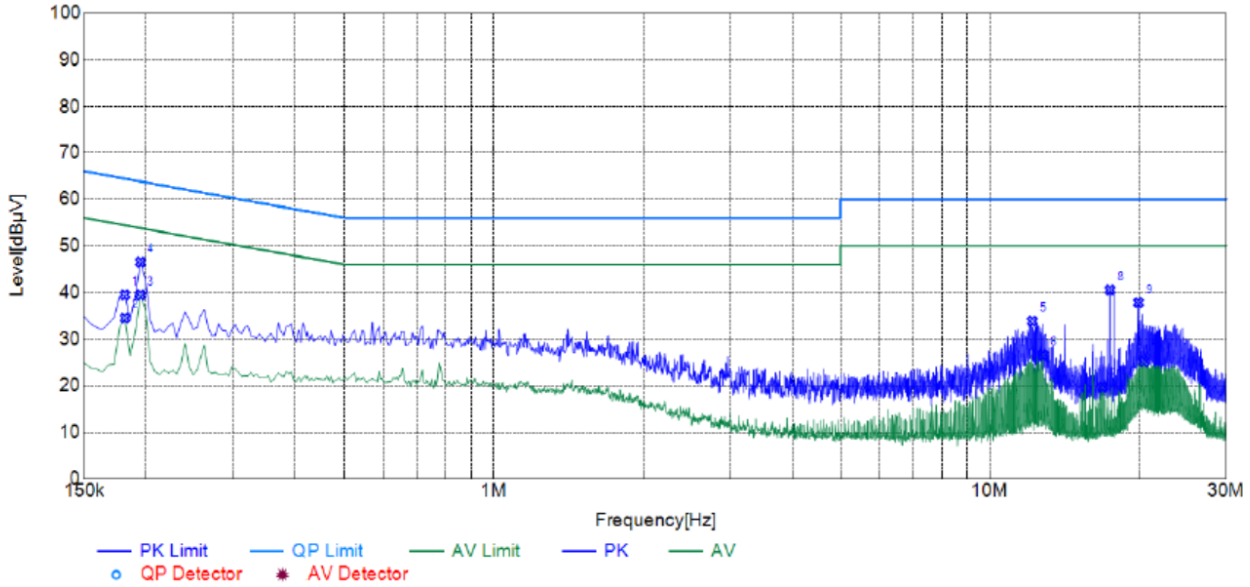
**TEST RESULTS**

Remark:

1. GFSK modes were test at Low, Middle, and High channel; only the worst result of GFSK Middle Channel was reported as below:

2. 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
3. Remark: Result=Reading value+Factor,and Margin=Limit- Result

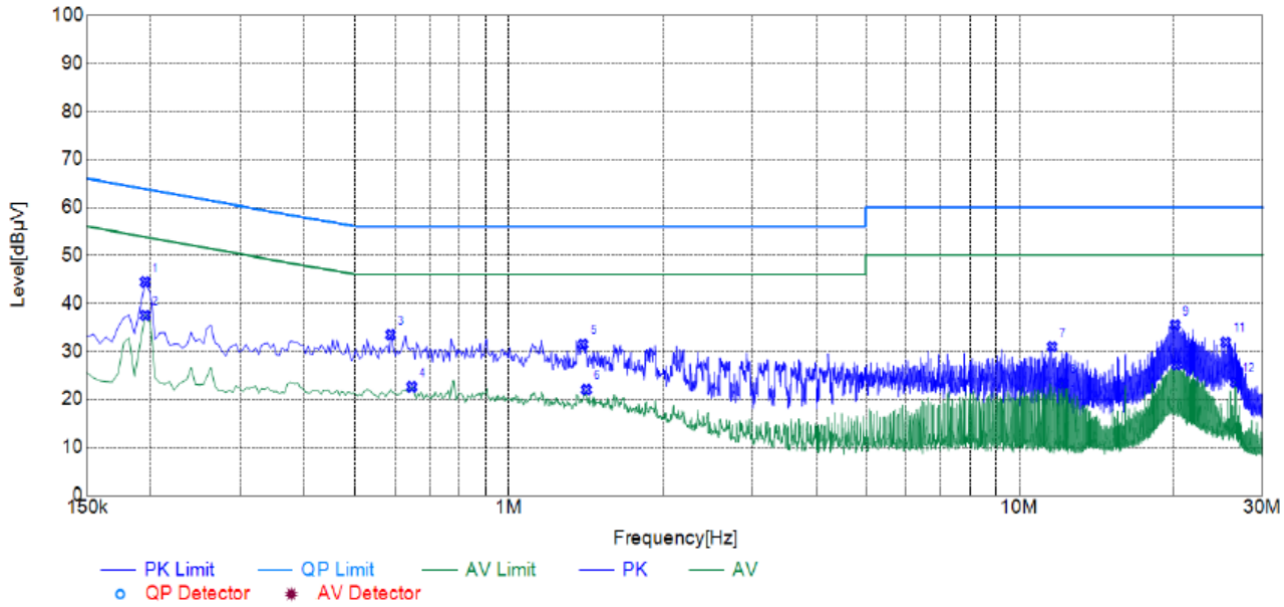
| Power supply: | DC 5V From Adapter | Polarization | L |
|---|---|---|---|




Suspected List

| NO. | Frequency [MHz] | Reading [dBµV] | Factor [dB] | Result [dBµV] | Limit [dBµV] | Margin [dB] | Detector | Line | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.1815 | 29.41 | 10.06 | 39.47 | 64.42 | 24.95 | Qp | L1 | PASS |
| 2 | 0.1815 | 24.45 | 10.06 | 34.51 | 54.42 | 19.91 | AV | L1 | PASS |
| 3 | 0.1950 | 29.40 | 10.06 | 39.46 | 53.82 | 14.36 | AV | L1 | PASS |
| 4 | 0.1950 | 36.47 | 10.06 | 46.53 | 63.82 | 17.29 | Qp | L1 | PASS |
| 5 | 12.1965 | 22.95 | 10.86 | 33.81 | 60.00 | 26.19 | Qp | L1 | PASS |
| 6 | 12.8085 | 15.64 | 10.89 | 26.53 | 50.00 | 23.47 | AV | L1 | PASS |
| 7 | 16.8990 | 8.55 | 11.22 | 19.77 | 50.00 | 30.23 | AV | L1 | PASS |
| 8 | 17.4975 | 29.26 | 11.28 | 40.54 | 60.00 | 19.46 | Qp | L1 | PASS |
| 9 | 19.9635 | 26.28 | 11.50 | 37.78 | 60.00 | 22.22 | Qp | L1 | PASS |
| 10 | 20.4630 | 13.74 | 11.52 | 25.26 | 50.00 | 24.74 | AV | L1 | PASS |

| Power supply: | DC 5V From Adapter | Polarization | N |
|---|---|---|---|



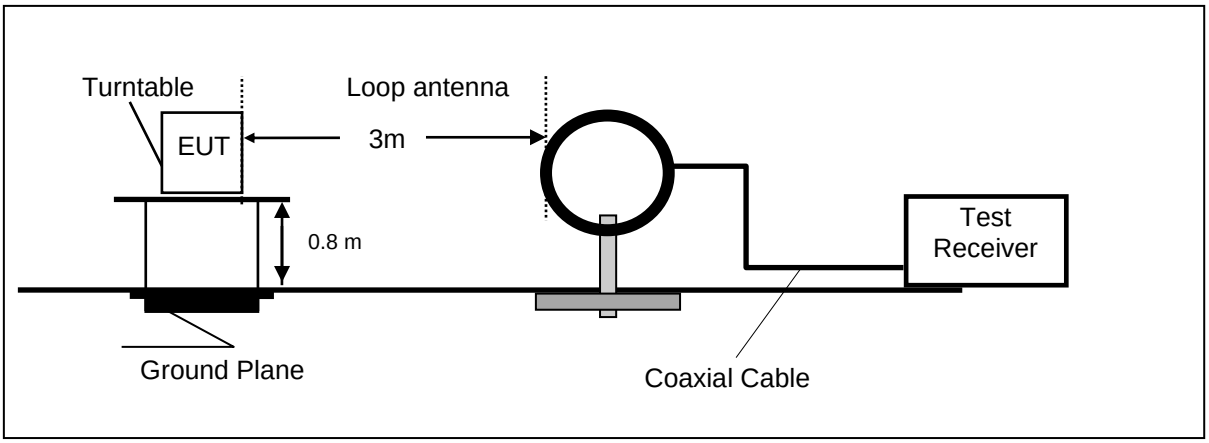

## Suspected List

| NO. | Frequency [MHz] | Reading [dBµV] | Factor [dB] | Result [dBµV] | Limit [dBµV] | Margin [dB] | Detector | Line | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.1950 | 34.37 | 10.06 | 44.43 | 63.82 | 19.39 | Qp | N | PASS |
| 2 | 0.1950 | 27.46 | 10.06 | 37.52 | 53.82 | 16.30 | AV | N | PASS |
| 3 | 0.5865 | 23.37 | 10.06 | 33.43 | 56.00 | 22.57 | Qp | N | PASS |
| 4 | 0.6450 | 12.53 | 10.06 | 22.59 | 46.00 | 23.41 | AV | N | PASS |
| 5 | 1.3965 | 21.40 | 10.10 | 31.50 | 56.00 | 24.50 | Qp | N | PASS |
| 6 | 1.4190 | 11.91 | 10.10 | 22.01 | 46.00 | 23.99 | AV | N | PASS |
| 7 | 11.6025 | 20.12 | 10.82 | 30.94 | 60.00 | 29.06 | Qp | N | PASS |
| 8 | 12.1875 | 12.52 | 10.85 | 23.37 | 50.00 | 26.63 | AV | N | PASS |
| 9 | 20.2065 | 24.05 | 11.41 | 35.46 | 60.00 | 24.54 | Qp | N | PASS |
| 10 | 20.3325 | 15.78 | 11.42 | 27.20 | 50.00 | 22.80 | AV | N | PASS |
| 11 | 25.3815 | 20.25 | 11.64 | 31.89 | 60.00 | 28.11 | Qp | N | PASS |
| 12 | 26.4885 | 11.89 | 11.68 | 23.57 | 50.00 | 26.43 | AV | N | PASS |

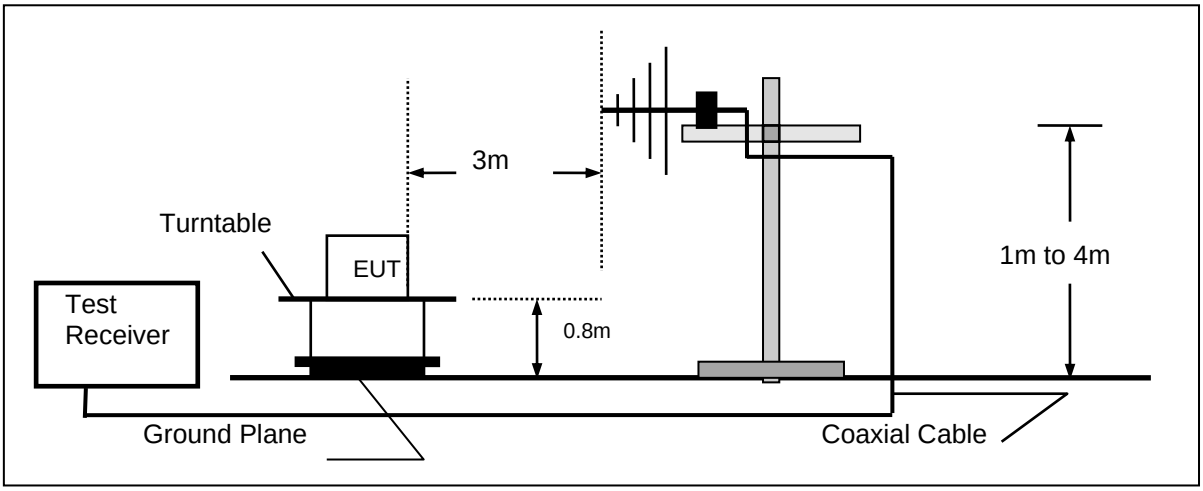
## 4.2. Radiated Emission

**TEST CONFIGURATION**

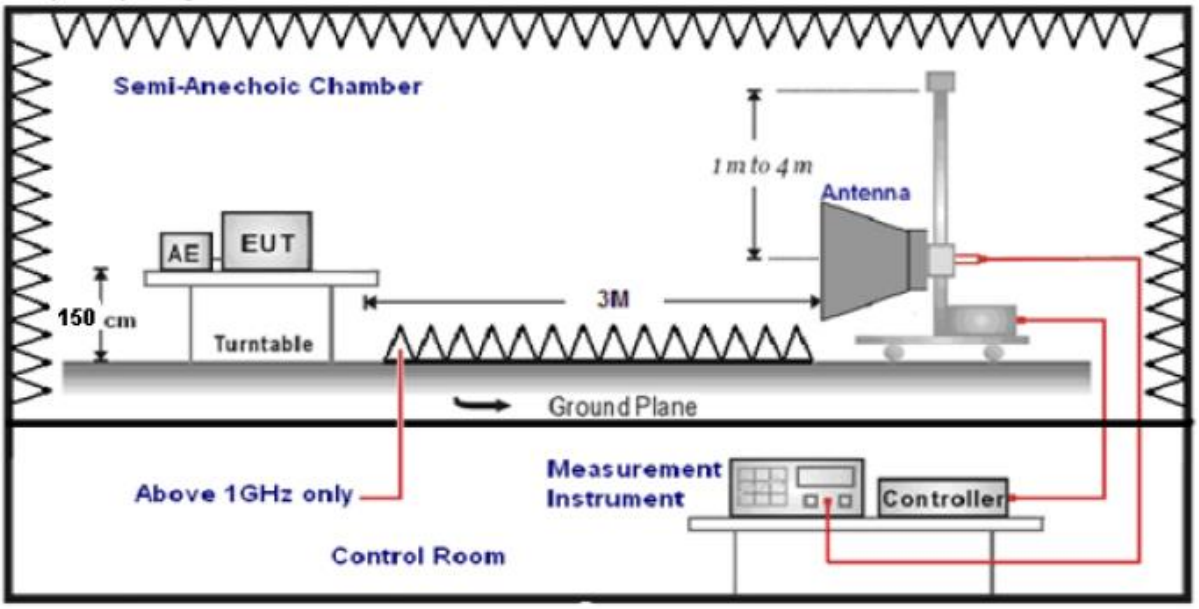
Frequency range 9 KHz – 30MHz




Frequency range 30MHz – 1000MHz




Frequency range above 1GHz-25GHz



**TEST PROCEDURE**

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
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. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz.so 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 | Ultra-Broadband Antenna | 3 |
| 1GHz-18GHz | Double Ridged 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 |

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

**FS = RA + AF + CL - AG**

| | |
|---|---|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude | AG = Amplifier Gain |
| AF = Antenna Factor | |

Transd=AF +CL-AG

**RADIATION LIMIT**

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

| 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 |

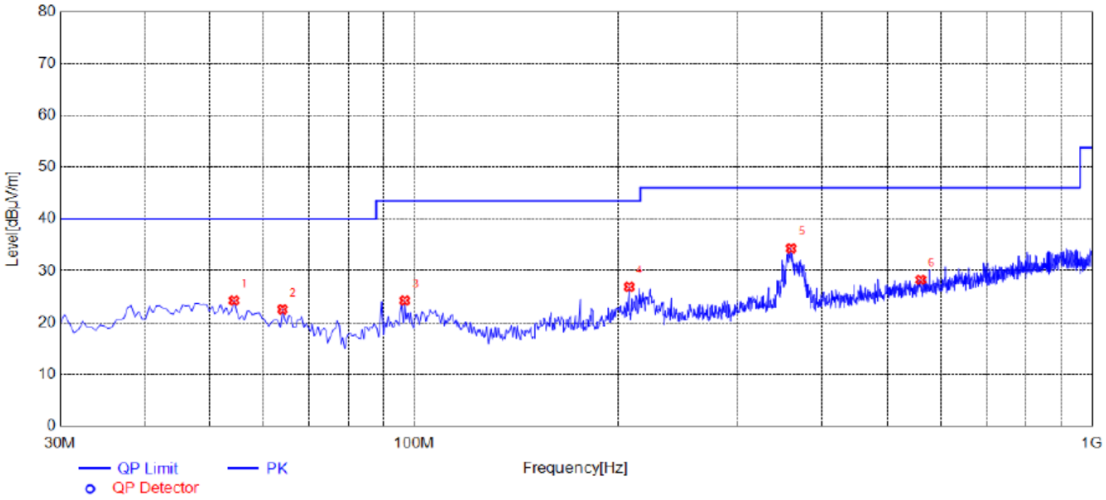
**TEST RESULTS**

Remark:
1. We measured Radiated Emission at GFSK mode from 9 KHz to 25GHz and recorded worst case at GFSK mode.
2. For below 1GHz testing recorded worst at GFSK middle channel
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.
4. Remark: Result=Reading value+Factor,and Margin=Limit- Result

**For 30MHz-1GHz**

**For 30MHz-1GHz**

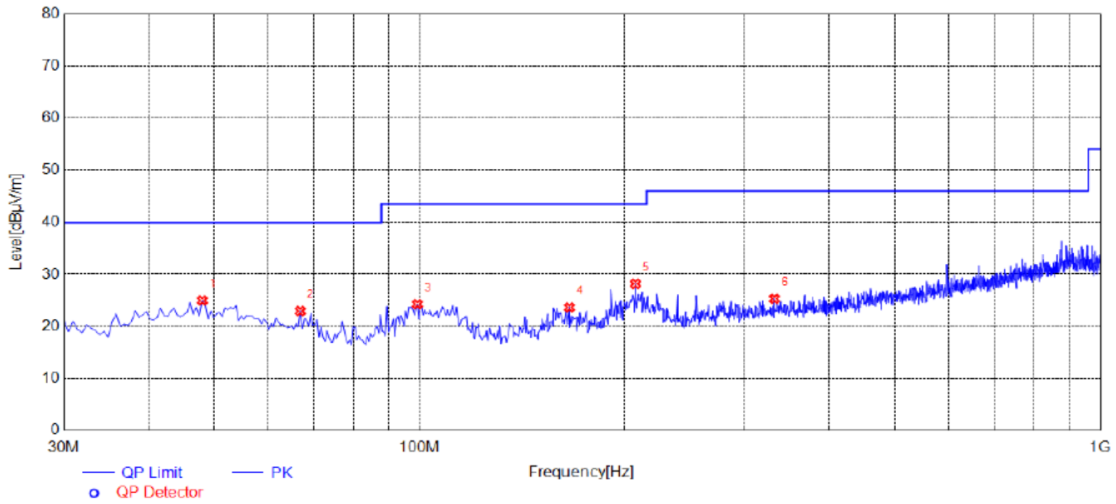
Horizontal




Suspected List

| NO. | Frequency [MHz] | Reading [dBμV/m] | Factor [dB] | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Detector | Polarity | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 54.2500 | 31.15 | -6.91 | 24.24 | 40.00 | 15.76 | 100 | 150 | PK | Horizonta | PASS |
| 2 | 63.9500 | 31.39 | -8.85 | 22.54 | 40.00 | 17.46 | 100 | 20 | PK | Horizonta | PASS |
| 3 | 96.9300 | 33.23 | -9.00 | 24.23 | 43.50 | 19.27 | 100 | 110 | PK | Horizonta | PASS |
| 4 | 207.9950 | 36.32 | -9.42 | 26.90 | 43.50 | 16.60 | 100 | 140 | PK | Horizonta | PASS |
| 5 | 360.7700 | 40.33 | -6.02 | 34.31 | 46.00 | 11.69 | 100 | 20 | PK | Horizonta | PASS |
| 6 | 560.5900 | 31.04 | -2.79 | 28.25 | 46.00 | 17.75 | 100 | 160 | PK | Horizonta | PASS |

Vertical




Suspected List

| NO. | Frequency [MHz] | Reading [dBμV/m] | Factor [dB] | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Detector | Polarity | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 47.9450 | 31.46 | -6.49 | 24.97 | 40.00 | 15.03 | 100 | 90 | PK | Vertical | PASS |
| 2 | 66.8600 | 32.39 | -9.44 | 22.95 | 40.00 | 17.05 | 100 | 80 | PK | Vertical | PASS |
| 3 | 99.3550 | 32.77 | -8.51 | 24.26 | 43.50 | 19.24 | 100 | 40 | PK | Vertical | PASS |
| 4 | 166.2850 | 35.07 | -11.43 | 23.64 | 43.50 | 19.86 | 100 | 20 | PK | Vertical | PASS |
| 5 | 207.9950 | 37.61 | -9.42 | 28.19 | 43.50 | 15.31 | 100 | 120 | PK | Vertical | PASS |
| 6 | 333.1250 | 31.73 | -6.44 | 25.29 | 46.00 | 20.71 | 100 | 150 | PK | Vertical | PASS |

**For 1GHz to 25GHz**

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

| Frequency(MHz): | | | 2402 | | Polarity: | | HORIZONTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4804.00 | 57.95 | PK | 74 | 16.05 | 56.05 | 31.42 | 6.98 | 36.5 | 1.9 |
| 4804.00 | 43.08 | AV | 54 | 10.92 | 41.18 | 31.42 | 6.98 | 36.5 | 1.9 |
| 7206.00 | 54.99 | PK | 74 | 19.01 | 44.39 | 37.03 | 8.87 | 35.3 | 10.6 |
| 7206.00 | 43.37 | AV | 54 | 10.63 | 32.77 | 37.03 | 8.87 | 35.3 | 10.6 |

| Frequency(MHz): | | | 2402 | | Polarity: | | VERTICAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4804.00 | 58.32 | PK | 74 | 15.68 | 56.42 | 31.42 | 6.98 | 36.5 | 1.9 |
| 4804.00 | 43.93 | AV | 54 | 10.07 | 42.03 | 31.42 | 6.98 | 36.5 | 1.9 |
| 7206.00 | 55.97 | PK | 74 | 18.03 | 45.37 | 37.03 | 8.87 | 35.3 | 10.6 |
| 7206.00 | 43.39 | AV | 54 | 10.61 | 32.79 | 37.03 | 8.87 | 35.3 | 10.6 |

| Frequency(MHz): | | | 2440 | | Polarity: | | HORIZONTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4880.00 | 58.14 | PK | 74 | 15.86 | 56.08 | 30.98 | 7.58 | 36.5 | 2.06 |
| 4880.00 | 43.43 | AV | 54 | 10.57 | 41.37 | 30.98 | 7.58 | 36.5 | 2.06 |
| 7320.00 | 56.11 | PK | 74 | 17.89 | 45.19 | 37.66 | 8.56 | 35.3 | 10.92 |
| 7320.00 | 42.74 | AV | 54 | 11.26 | 31.82 | 37.66 | 8.56 | 35.3 | 10.92 |

| Frequency(MHz): | | | 2440 | | Polarity: | | VERTICAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4880.00 | 59.07 | PK | 74 | 14.93 | 57.01 | 30.98 | 7.58 | 36.5 | 2.06 |
| 4880.00 | 42.92 | AV | 54 | 11.08 | 40.86 | 30.98 | 7.58 | 36.5 | 2.06 |
| 7320.00 | 56.89 | PK | 74 | 17.11 | 45.97 | 37.66 | 8.56 | 35.3 | 10.92 |
| 7320.00 | 43.47 | AV | 54 | 10.53 | 32.55 | 37.66 | 8.56 | 35.3 | 10.92 |

| Frequency(MHz): | | | 2480 | | Polarity: | | HORIZONTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4960.00 | 59.89 | PK | 74 | 14.11 | 56.82 | 31.47 | 7.8 | 36.2 | 3.07 |
| 4960.00 | 42.14 | AV | 54 | 11.86 | 39.07 | 31.47 | 7.8 | 36.2 | 3.07 |
| 7440.00 | 57.92 | PK | 74 | 16.08 | 46.18 | 38.32 | 8.72 | 35.3 | 11.74 |
| 7440.00 | 42.85 | PK | 54 | 11.15 | 31.11 | 38.32 | 8.72 | 35.3 | 11.74 |

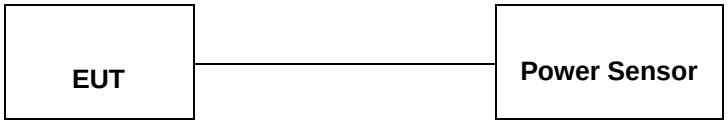
| Frequency(MHz): | | | 2480 | | Polarity: | | VERTICAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4960.00 | 60.95 | PK | 74 | 13.05 | 57.88 | 31.47 | 7.8 | 36.2 | 3.07 |
| 4960.00 | 42.49 | AV | 54 | 11.51 | 39.42 | 31.47 | 7.8 | 36.2 | 3.07 |
| 7440.00 | 57.59 | PK | 74 | 16.41 | 45.85 | 38.32 | 8.72 | 35.3 | 11.74 |
| 7440.00 | 43.3 | PK | 54 | 10.7 | 31.56 | 38.32 | 8.72 | 35.3 | 11.74 |

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

## 4.3. Maximum Peak Output Power

**TEST CONFIGURATION**




**TEST PROCEDURE**

According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power,9.1.2.
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

**LIMIT**

The Maximum Peak Output Power Measurement is 30dBm.

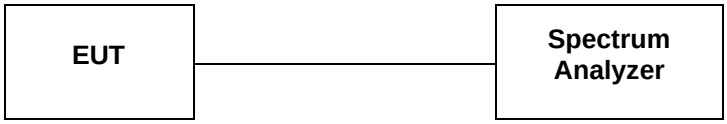
**TEST RESULTS**

| Type | Channel | Output power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| GFSK | 00 | -1.189 | 30 | Pass |
| | 19 | -0.625 | | |
| | 39 | -1.147 | | |

Note: 1.The test results including the cable lose.

## 4.4. Power Spectral Density

**TEST CONFIGURATION**




**TEST PROCEDURE**

1.Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2.Set the RBW =3 kHz.
3.Set the VBW =10 KHz.
4.Set the span to 1.5 times the DTS channel bandwidth.
5.Detector = peak.
6.Sweep time = auto couple.
7.Trace mode = max hold.
8.Allow trace to fully stabilize.
9.Use the peak marker function to determine the maximum power level.
10.If measured value exceeds limit,reduce RBW(no less than 3 kHz)and repeat.
11.The resulting peak PSD level must be  8 dBm.

**LIMIT**

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

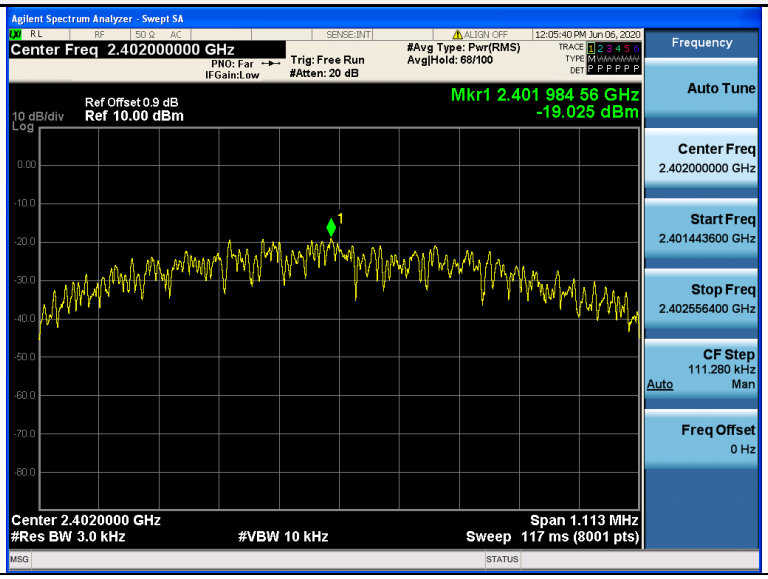
**TEST RESULTS**

| Type | Channel | Power Spectral Density (dBm/3KHz) | Limit (dBm/3KHz) | Result |
|---|---|---|---|---|
| GFSK | 00 | -19.025 | 8 | Pass |
| | 19 | -18.346 | | |
| | 39 | -18.849 | | |

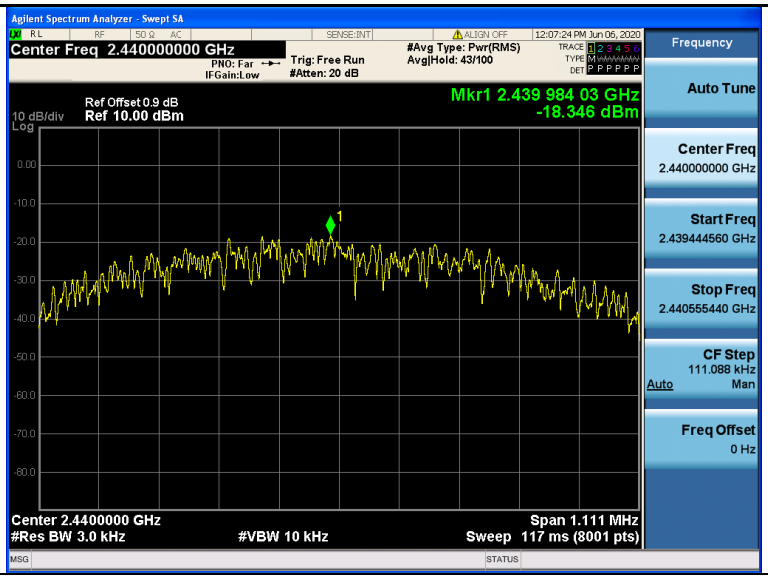
Note:  1.The test results including the cable lose.

Test plot as follows:

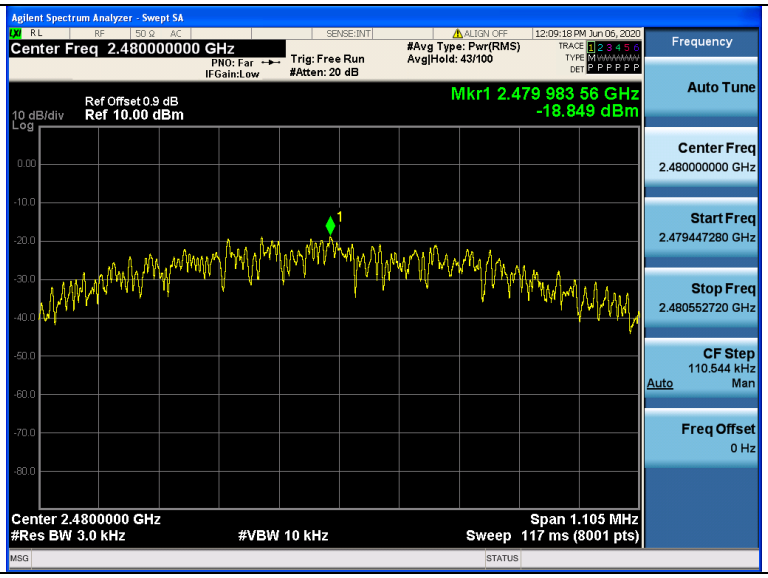
*BLE*




*CH00*



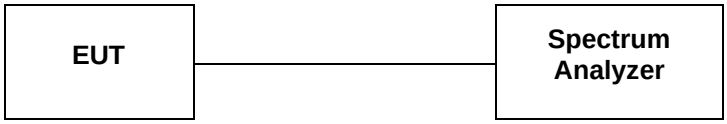

*CH19*




*CH39*

## 4.5. 6dB Bandwidth

**TEST CONFIGURATION**




**TEST PROCEDURE**

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=100 KHz and VBW=300KHz.
The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.
According to KDB558074 D01 V03 for one of the following procedures may be used to determine the modulated DTS device signal bandwidth.
1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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**

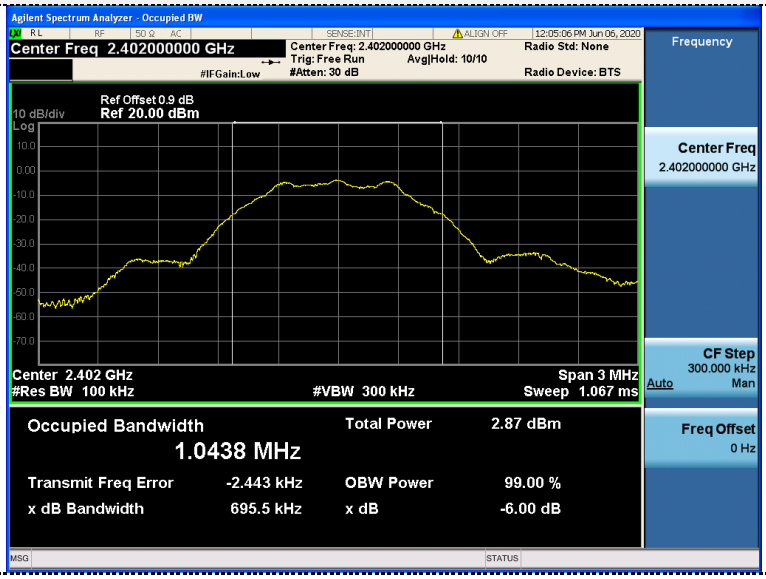
For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

**TEST RESULTS**

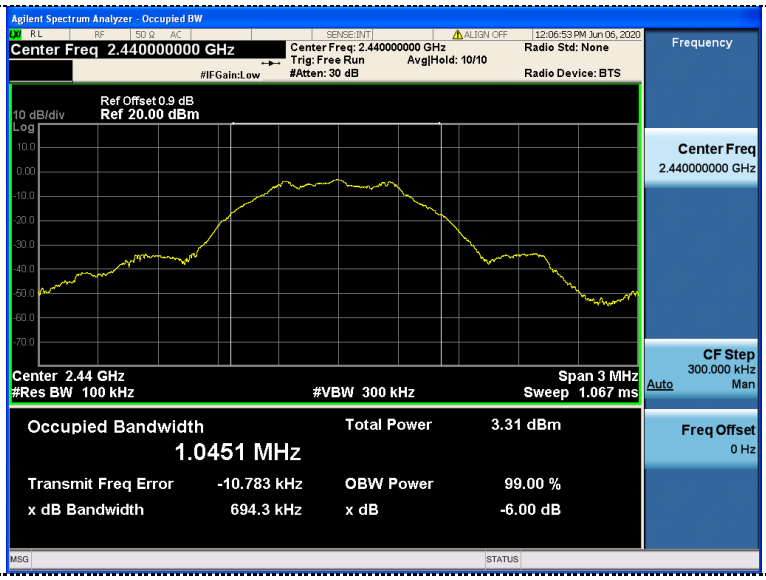
| Type | Channel | 6dB Bandwidth (MHz) | Limit (KHz) | Result |
|---|---|---|---|---|
| GFSK | 00 | 0.6955 | ≥500 | Pass |
| | 19 | 0.6943 | | |
| | 39 | 0.6909 | | |

Test plot as follows:

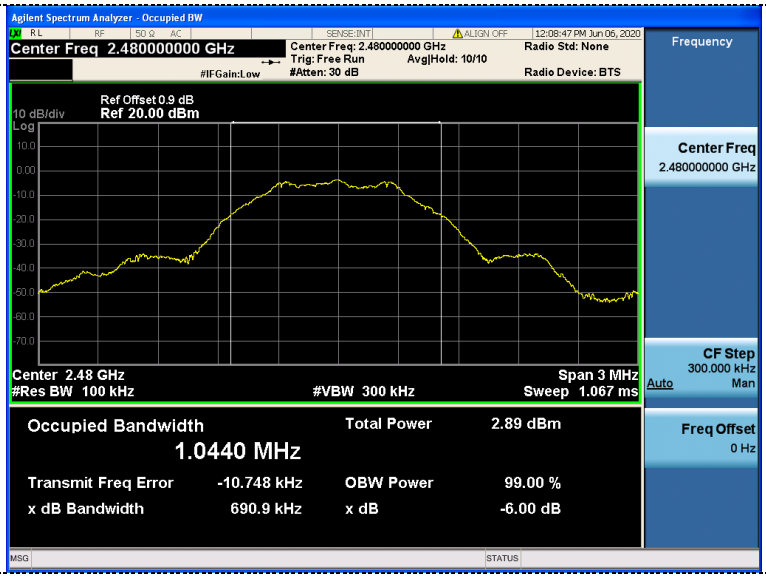
*BLE*




*CH00*




*CH19*



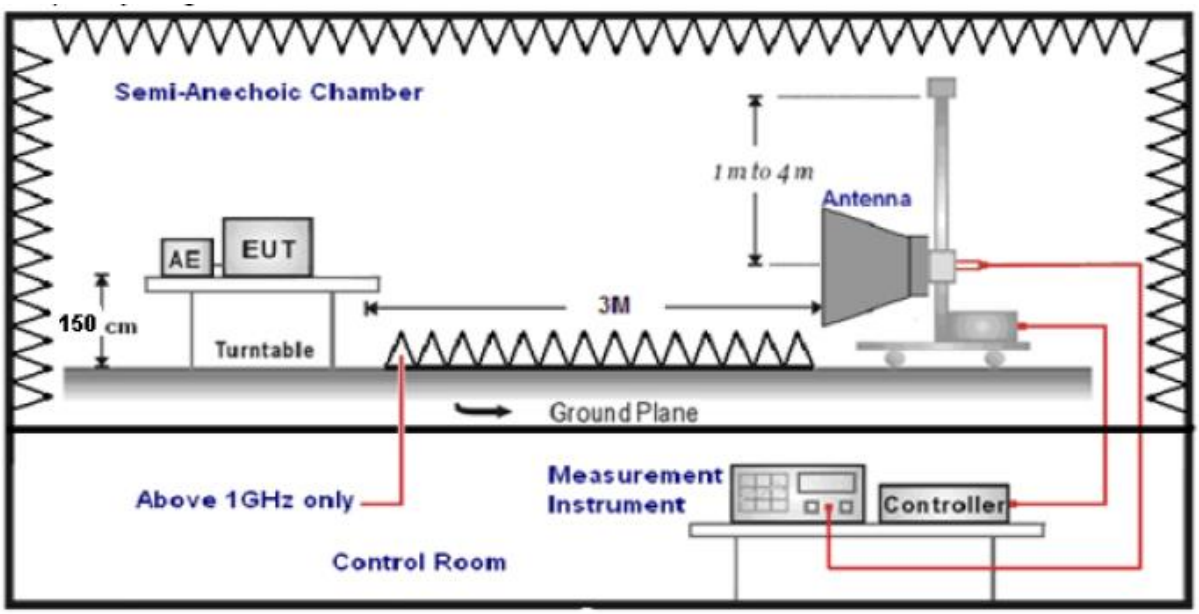

*CH39*

## 4.6. Band Edge Compliance of RF Emission

**TEST REQUIREMENT**

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 conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies 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. 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) (see §15.205(c)).

**TEST CONFIGURATION**




**TEST PROCEDURE**

1. The EUT was placed on a 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. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting | Detector |
|---|---|---|
| 1GHz-40GHz | Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto<br>Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto | Peak |

**LIMIT**

Below -20dB of the highest emission level in operating band.
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)

**TEST RESULTS**

***Results of Band Edges Test (Radiated)***

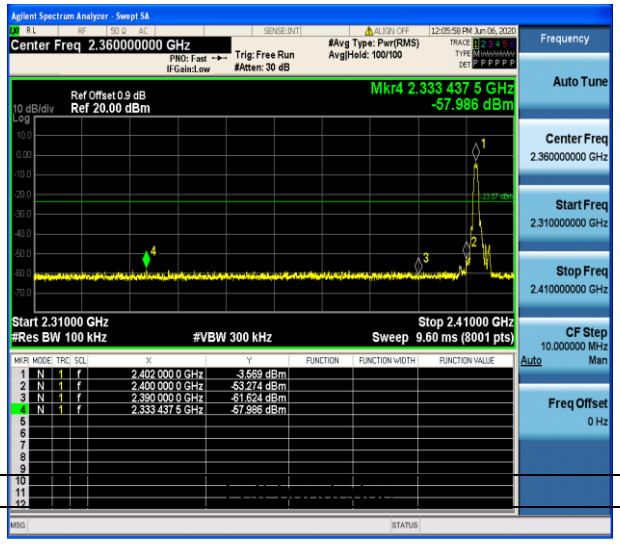
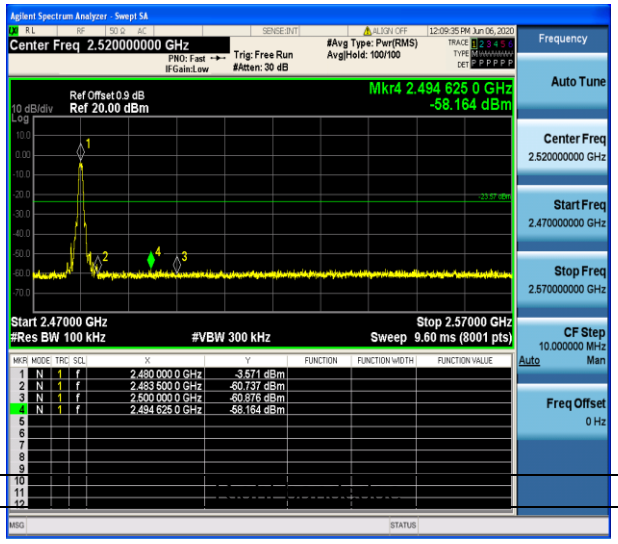
**GFSK**

| **Frequency(MHz):** | | | **2402** | | **Polarity:** | | **HORIZONTAL** | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2390.00 | 57.76 | PK | 74 | 16.24 | 63.17 | 27.49 | 3.32 | 36.22 | -5.41 |
| 2390.00 | 45.34 | AV | 54 | 8.66 | 50.75 | 27.49 | 3.32 | 36.22 | -5.41 |
| **Frequency(MHz):** | | | **2402** | | **Polarity:** | | **VERTICAL** | | |
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2390.00 | 57.64 | PK | 74 | 16.36 | 63.05 | 27.49 | 3.32 | 36.22 | -5.41 |
| 2390.00 | 42.97 | AV | 54 | 11.03 | 48.38 | 27.49 | 3.32 | 36.22 | -5.41 |
| **Frequency(MHz):** | | | **2480** | | **Polarity:** | | **HORIZONTAL** | | |
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2483.50 | 54.76 | PK | 74 | 19.24 | 60.27 | 27.45 | 3.38 | 36.34 | -5.51 |
| 2483.50 | 44.67 | AV | 54 | 9.33 | 50.18 | 27.45 | 3.38 | 36.34 | -5.51 |
| **Frequency(MHz):** | | | **2480** | | **Polarity:** | | **VERTICAL** | | |
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2483.50 | 58.28 | PK | 74 | 15.72 | 63.79 | 27.45 | 3.38 | 36.34 | -5.51 |
| 2483.50 | 42.31 | AV | 54 | 11.69 | 47.82 | 27.45 | 3.38 | 36.34 | -5.51 |

REMARKS:

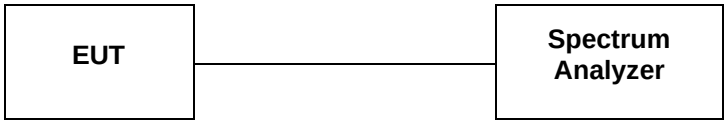
1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.

### 4.6.2 For Conducted Bandedge Measurement

| BLE GFSK | |
|---|---|
|  |  |

## 4.7. Spurious RF Conducted Emission

**TEST CONFIGURATION**



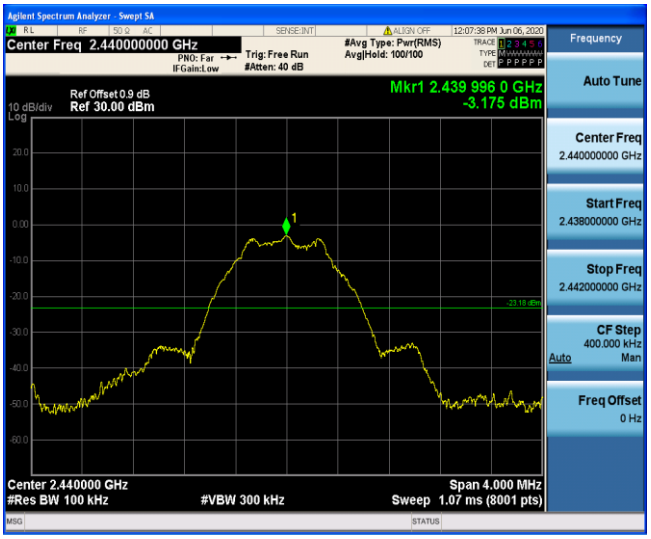
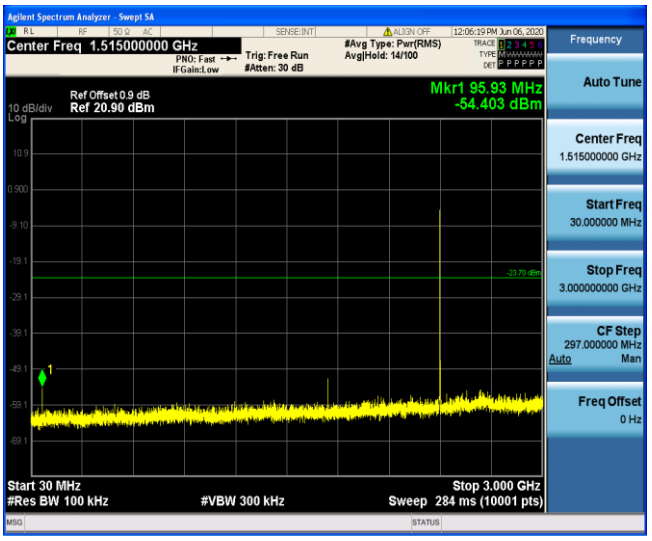
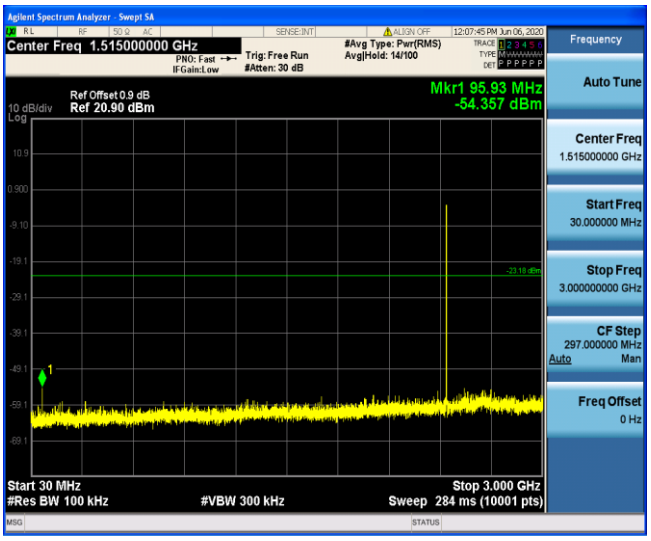
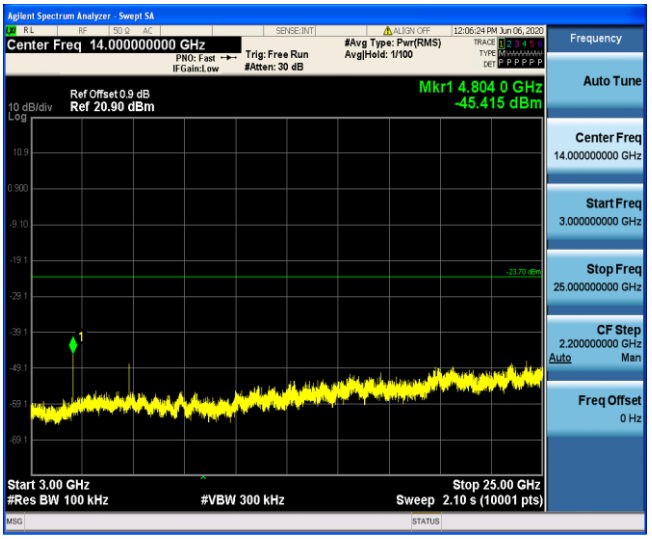
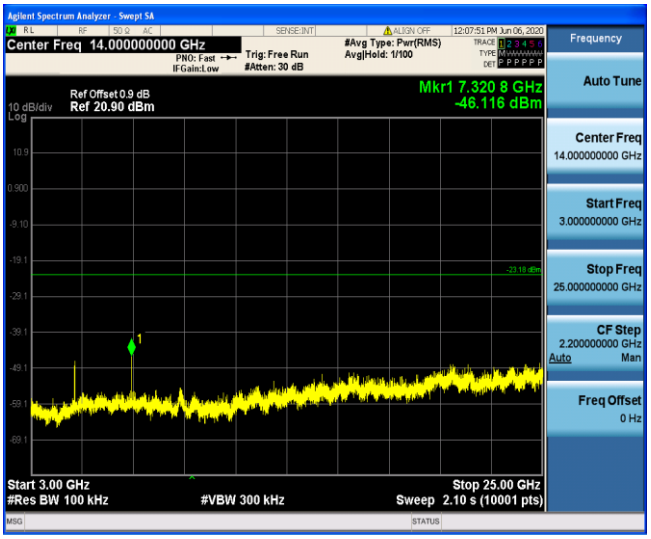

**TEST PROCEDURE**

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300KHz to measure the peak field strength , and mwasure frequeny range from 9KHz to 25GHz.

**LIMIT**

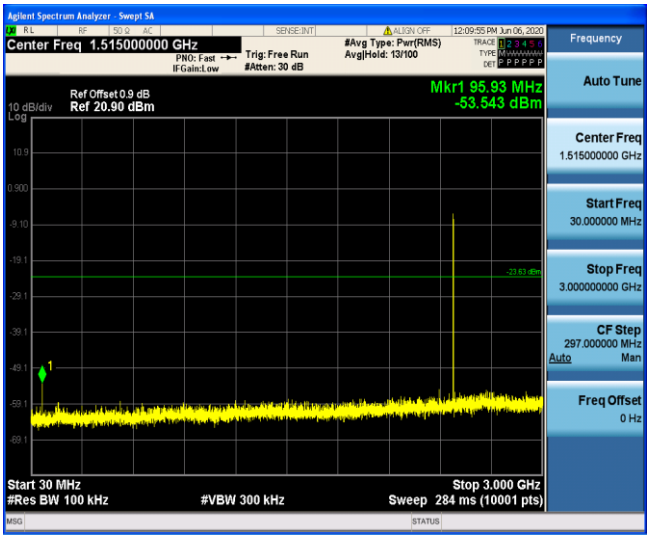
1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

**TEST RESULTS**

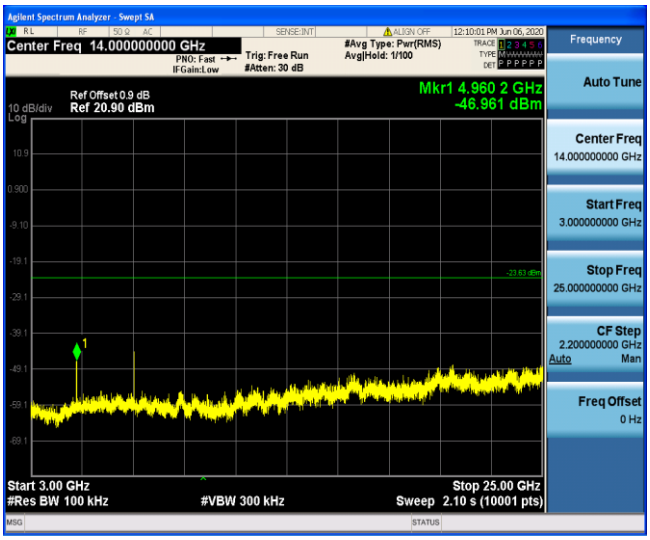
| CH00 | CH19 |
|---|---|
| |   |
| Reference | Reference |
|   |   |
| 30MHz-3GHz | 30MHz-3GHz |
|   |   |
| 3GHz-25GHz | 3GHz-25GHz |

***CH39***

Reference




30MHz-3GHz




3GHz-25GHz

## 4.8. Antenna Requirement

of the antenna exceeds 6dBi.

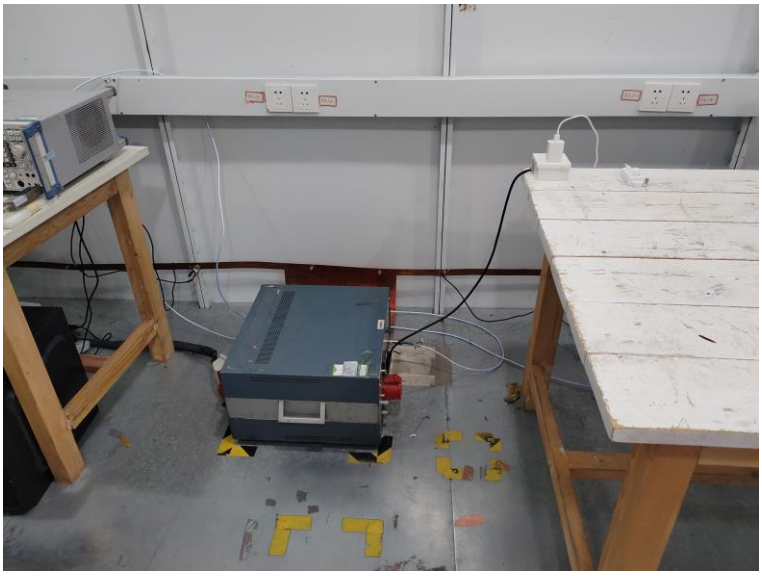
**Refer to statement below for compliance**

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

**Antenna Connected Construction**

The maximum gain of antenna was 0.50dBi.

# 5. Test Setup Photos of the EUT

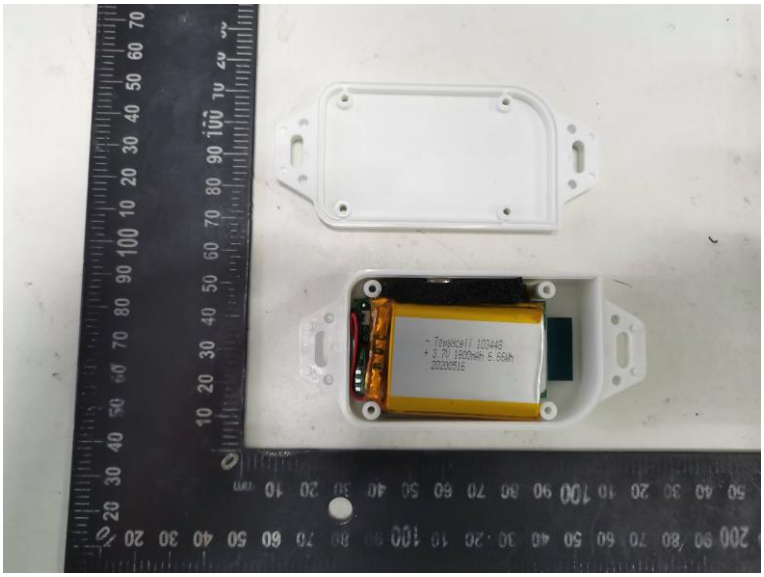


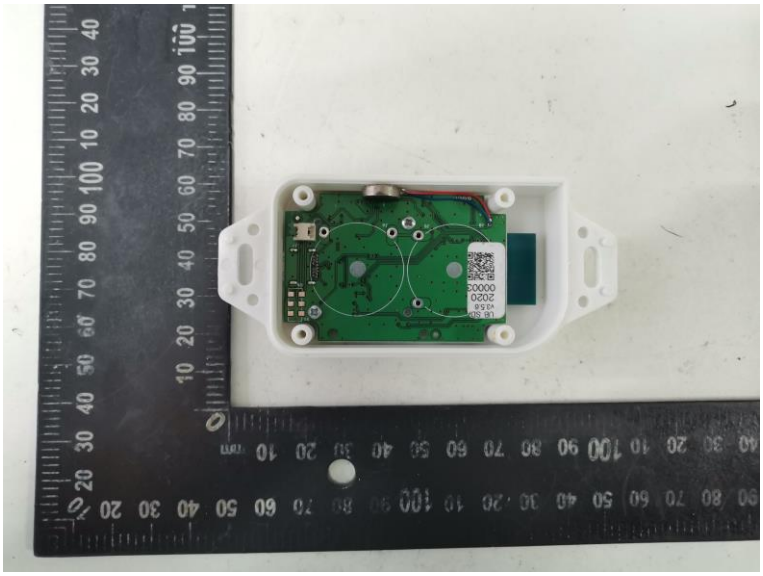
# 6. External and Internal Photos of the EUT

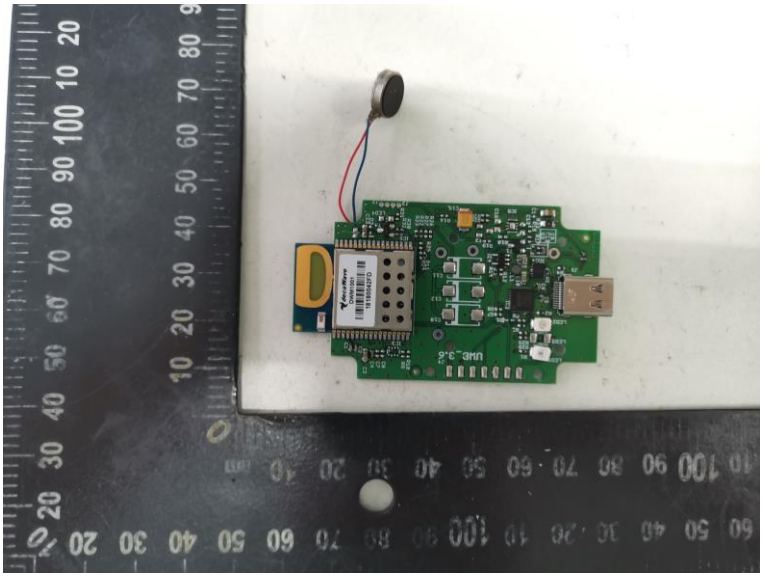
ubudu
SDA Tag

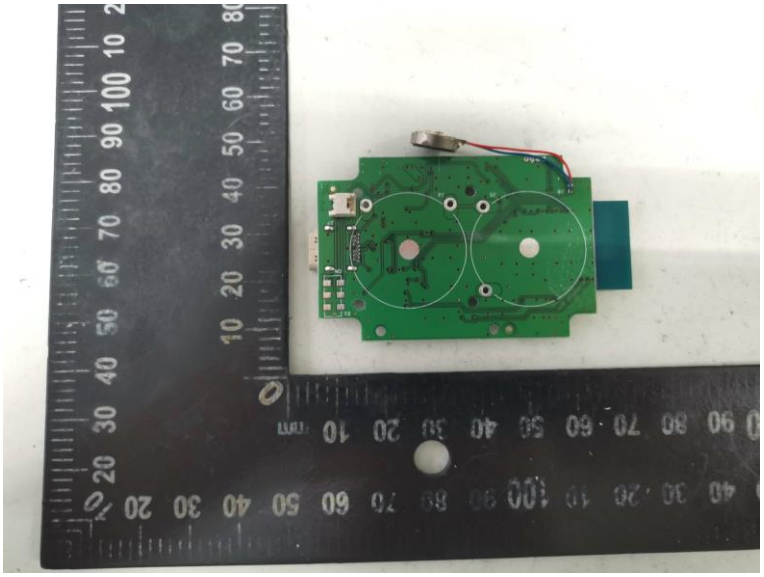
ubudu
SDA Tag

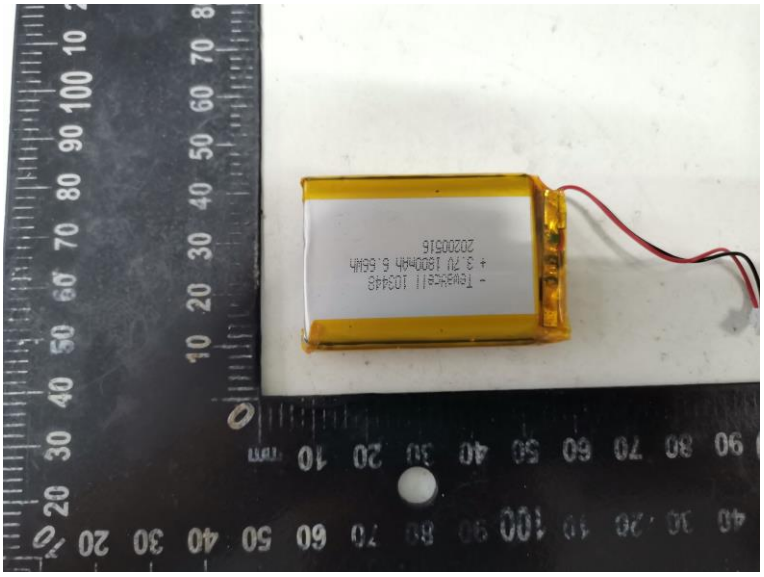
ubudu
SDA Tag











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