# TEST REPORT

| | |
|---|---|
| Product Name: | RGB3DScanner |
| FCC ID: | 2AY3F-RGB3D |
| Trademark: | N/A |
| Model Number: | RGB3DScanner |
| Prepared For: | Wuhan Boyahongtuo Technology Co.,Ltd. |
| Address: | Floor 6, Building B, The modern world trade center of Optics Valley, No. 70 of Guanggu Avenue, Hongshan District, Wuhan, Hubei, China. |
| Manufacturer: | Wuhan Boyahongtuo Technology Co.,Ltd. |
| Address: | Floor 6, Building B, The modern world trade center of Optics Valley, No. 70 of Guanggu Avenue, Hongshan District, Wuhan, Hubei, China. |
| Prepared By: | Shenzhen CTB Testing Technology Co., Ltd. |
| Address: | Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen, China |
| Sample Received Date: | Feb. 20, 2021 |
| Sample tested Date: | Feb. 21, 2021 to Feb. 24, 2021 |
| Issue Date: | Feb. 24, 2021 |
| Report No.: | CTB210222014RFX |
| Test Standards | FCC Part15.247<br>ANSI C63.10:2013 |
| Test Results | PASS |
| Remark: | This is Bluetooth radio test report. |

| Compiled by: | Reviewed by: | Approved by: |
|---|---|---|
| Arron Liu | Bin Mei | Rita Xiao / Director |

The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. Without written approval of Shenzhen CTB Testing Technology Co., Ltd. this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client.

# TABLE OF CONTENT

Test Report Declaration Page

**1. VERSION ..... 4**

**2. TEST SUMMARY ..... 5**

**3. MEASUREMENT UNCERTAINTY ..... 6**

**4. PRODUCT INFORMATION AND TEST SETUP ..... 7**

4.1 Product Information ..... 7

4.2 Test Setup Configuration ..... 7

4.3 Support Equipment ..... 7

4.4 Channel List ..... 8

4.5 Test Mode ..... 8

4.6 Test Environment ..... 8

**5. TEST FACILITY AND TEST INSTRUMENT USED ..... 9**

5.1 Test Facility ..... 9

5.2 Test Instrument Used ..... 9

**6. AC POWER LINE CONDUCTED EMISSION ..... 11**

6.1 Block Diagram Of Test Setup ..... 11

6.2 Limit ..... 11

6.3 Test procedure ..... 11

6.4 Test Result ..... 13

**7. RADIATED SPURIOUS EMISSION ..... 15**

7.1 Block Diagram Of Test Setup ..... 15

7.2 Limit ..... 15

7.3 Test procedure ..... 16

7.4 Test Result ..... 17

**8. BAND EDGE AND RF COUNDUCTED SPURIOUS EMISSIONS ..... 24**

8.1 Block Diagram Of Test Setup ..... 24

8.2 Limit ..... 24

8.3 Test procedure ..... 24

8.4 Test Result ..... 25

**9. COUDUCTED OUTPUT POWER ..... 27**

9.1 Block Diagram Of Test Setup ..... 27

9.2 Limit ..... 27

9.3 Test procedure ..... 27
9.4 Test Result ..... 28
**10. 6DB OCCUPIED BANDWIDTH ..... 30**
10.1 Block Diagram Of Test Setup ..... 30
10.2 Limit ..... 30
10.3 Test procedure ..... 30
10.4 Test Result ..... 30
**11. POWER SPECTRAL DENSITY ..... 32**
11.1 Block Diagram Of Test Setup ..... 32
11.2 Limit ..... 32
11.3 Test procedure ..... 32
11.4 Test Result ..... 32
**12. ANTENNA REQUIREMENT ..... 34**
**13. EUT PHOTOGRAPHS ..... 35**
**14. EUT TEST SETUP PHOTOGRAPHS ..... 36**

*(Note: N/A means not applicable)*

# 1. VERSION

| Report No. | Issue Date | Description | Approved |
|---|---|---|---|
| CTB210222014RFX | Feb. 24, 2021 | Original | Valid |

# 2. TEST SUMMARY

The Product has been tested according to the following specifications:

| Test Item | Test Requirement | Test method | Result |
|---|---|---|---|
| **AC Power Line Conducted Emission** | 47 CFR Part 15 Subpart C Section 15.207 | ANSI C63.10-2013 | PASS |
| **Radiated Spurious emissions** | 47 CFR Part 15 Subpart C Section 15.205/15.209 | ANSI C63.10-2013 | PASS |
| **Band edge and RF Conducted Spurious Emissions** | 47 CFR Part 15 Subpart C Section 15.247(d)/15.205(a) | ANSI C63.10-2013 | PASS |
| **Conducted Peak Output Power** | 47 CFR Part 15 Subpart C Section 15.247 (b)(3) | ANSI C63.10-2013 | PASS |
| **Bandwidth** | 47 CFR Part 15 Subpart C Section 15.247 (a)(2) | ANSI C63.10-2013 | PASS |
| **Power Spectral Density** | 47 CFR Part 15Subpart C Section 15.247 (e) | ANSI C63.10-2013/ KDB 558074 D01v04 | PASS |
| **Antenna Requirement** | 47 CFR Part 15 Subpart C Section 15.203/15.247 (c) | ANSI C63.10-2013 | PASS |

Remark:
Test according to ANSI C63.4-2014 & ANSI C63.10-2013.

# 3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

| Item | Uncertainty |
|---|---|
| Occupancy bandwidth | 54.3kHz |
| Conducted output power Above 1G | 0.9dB |
| Conducted output power below 1G | 0.9dB |
| Power Spectral Density , Conduction | 0.9dB |
| Conduction spurious emissions | 2.0dB |
| Out of band emission | 2.0dB |
| 3m camber Radiated spurious emission(30MHz-1GHz) | 4.6dB |
| 3m chamber Radiated spurious emission(1GHz-18GHz) | 5.1dB |
| 3m chamber Radiated spurious emission(18GHz-40GHz) | 3.4dB |
| humidity uncertainty | 5.5% |
| Temperature uncertainty | 0.63℃ |
| frequency | 1×10-7 |
| Conducted Emission (150KHz-30MHz) | 3.2 dB |
| Radiated Emission(30MHz ~ 1000MHz) | 4.8 dB |
| Radiated Emission(1GHz ~6GHz) | 4.9 dB |

# 4. PRODUCT INFORMATION AND TEST SETUP

## 4.1 Product Information

| | |
|---|---|
| Model(s): | RGB3DScanner |
| Model Description: | N/A |
| Bluetooth Version: | Bluetooth 5.0 |
| Hardware Version: | V1.0 |
| Software Version: | V1.0 |

| | |
|---|---|
| Operation Frequency: | Bluetooth: 2402-2480MHz |
| Max. RF output power: | Bluetooth: 0.601dBm |
| Type of Modulation: | Bluetooth: GFSK |
| Antenna installation: | PCB Antenna |
| Antenna Gain: | Bluetooth: 1dBi |
| Ratings: | DC12V 4A for battery<br>DC 5V charging from adapter |

## 4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

## 4.3 Support Equipment

| Item | Equipment | Mfr/Brand | Model/Type No. | Series No. | Note |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

***Notes:***

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

## 4.4 Channel List

| CH No. | Frequency (MHz) | CH No. | Frequency (MHz) | CH No. | Frequency (MHz) | CH No. | Frequency (MHz) |
|---|---|---|---|---|---|---|---|
| 0 | 2402 | 1 | 2404 | 2 | 2406 | 3 | 2408 |
| 4 | 2410 | 5 | 2412 | 6 | 2414 | 7 | 2416 |
| 8 | 2418 | 9 | 2420 | 10 | 2422 | 11 | 2424 |
| 12 | 2426 | 13 | 2428 | 14 | 2430 | 15 | 2432 |
| 16 | 2434 | 17 | 2436 | 18 | 2438 | 19 | 2440 |
| 20 | 2442 | 21 | 2444 | 22 | 2446 | 23 | 2448 |
| 24 | 2450 | 25 | 2452 | 26 | 2454 | 27 | 2456 |
| 28 | 2458 | 29 | 2460 | 30 | 2462 | 31 | 2464 |
| 32 | 2466 | 33 | 2468 | 34 | 2470 | 35 | 2472 |
| 36 | 2474 | 37 | 2476 | 38 | 2478 | 39 | 2480 |

## 4.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

| Test mode | Low channel | Middle channel | High channel |
|---|---|---|---|
| Transmitting (GFSK) | 2402MHz | 2440MHz | 2480MHz |

## 4.6 Test Environment

| | |
|---|---|
| Humidity(%): | 55 |
| Atmospheric Pressure(kPa): | 101.1 |
| Normal Voltage(DC): | 12.0 |
| Normal Temperature(℃) | 25 |
| Low Temperature(℃) | 0 |
| High Temperature(℃) | 40 |

# 5. TEST FACILITY AND TEST INSTRUMENT USED

## 5.1 Test Facility

All measurement facilities used to collect the measurement data are located at Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

## 5.2 Test Instrument Used

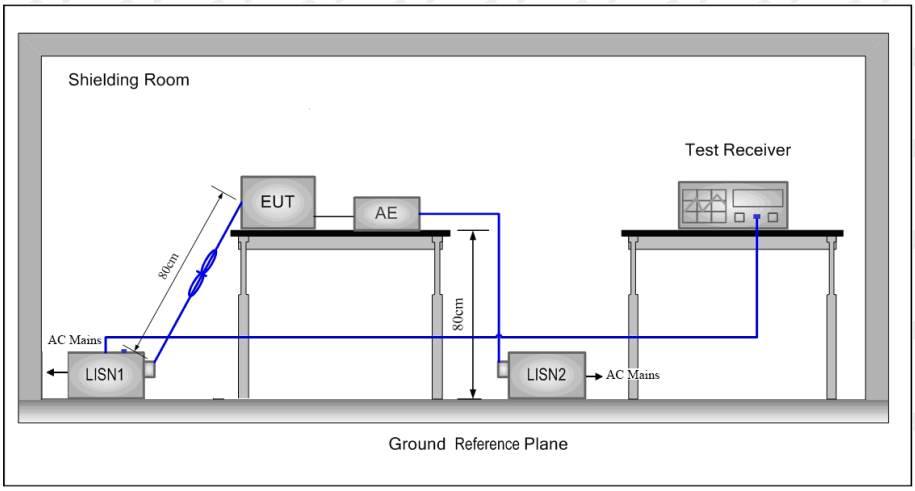
| Item | Equipment | Manufacturer | Type No. | Serial No. | Last calibration | Calibrated until |
|---|---|---|---|---|---|---|
| 1 | Spectrum Analyzer | Agilent | N9020A | MY52090073 | Sep. 28, 2020 | Sep. 28, 2021 |
| 2 | Power Sensor | Agilent | U2021XA | MY56120032 | Sep. 28, 2020 | Sep. 28, 2021 |
| 3 | Power Sensor | Agilent | U2021XA | MY56120034 | Sep. 28, 2020 | Sep. 28, 2021 |
| 4 | Communication test set | R&S | CMW500 | 108058 | Sep. 28, 2020 | Sep. 28, 2021 |
| 5 | Spectrum Analyzer | R&S | FSP40 | 100550 | Sep. 28, 2020 | Sep. 28, 2021 |
| 6 | Signal Generator | Agilent | N5181A | MY49060920 | Sep. 28, 2020 | Sep. 28, 2021 |
| 7 | Signal Generator | Agilent | N5182A | MY47420195 | Sep. 28, 2020 | Sep. 28, 2021 |
| 8 | Communication test set | Agilent | E5515C | MY50102567 | Oct. 10, 2020 | Oct. 10, 2021 |
| 9 | band rejection filter | Shenxiang | MSF2400-2483.5MS-1154 | 20181015001 | Sep. 28, 2020 | Sep. 28, 2021 |
| 10 | band rejection filter | Shenxiang | MSF5150-5850MS-1155 | 20181015001 | Sep. 28, 2020 | Sep. 28, 2021 |
| 11 | band rejection filter | Xingbo | XBLBQ-DZA 120 | 190821-1-1 | Sep. 28, 2020 | Sep. 28, 2021 |
| 12 | BT&WI-FI Automatic test software | Micowave | MTS8310 | Ver. 2.0.0.0 | \ | \ |
| 13 | Rohde & Schwarz SFU Broadcast Test System | R&S | SFU | 101017 | Sep. 28, 2020 | Sep. 28, 2021 |
| 14 | Temperature humidity chamber | Hongjing | TH-80CH | DG-15174 | Sep. 28, 2020 | Sep. 28, 2021 |
| 15 | 234G Automatic test software | Micowave | MTS8200 | Ver. 2.0.0.0 | \ | \ |
| 16 | 966 chamber | C.R.T. | 966 Room | 966 | Nov. 9, 2019 | Nov. 08, 2022 |
| 17 | Receiver | R&S | ESPI | 100362 | Sep. 28, 2020 | Sep. 28, 2021 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 18 | Amplifier | HP | 8447E | 2945A02747 | Sep. 28, 2020 | Sep. 28, 2021 |
| 19 | Amplifier | Agilent | 8449B | 3008A01838 | Sep. 28, 2020 | Sep. 28, 2021 |
| 20 | TRILOG Broadband Antenna | Schwarzbeck | VULB 9168 | 00869 | Nov. 02, 2020 | Nov. 01, 2021 |
| 21 | Horn Antenna | Schwarzbeck | BBHA9120D | 1911 | Nov. 02, 2020 | Nov. 01, 2021 |
| 22 | Software | Fala | EZ-EMC | FA-03A2 RE | \ | \ |
| 23 | 3-Loop Antenna | Daze | ZN30401 | 17014 | Sep. 28, 2020 | Sep. 28, 2021 |
| 24 | loop antenna | ZHINAN | ZN30900A | / | Sep. 28, 2020 | Sep. 28, 2021 |
| 25 | Horn antenna | A/H/System | SAS-574 | 588 | Sep. 28, 2020 | Sep. 28, 2021 |
| 26 | Amplifier | AEROFLEX | / | S/N/ 097 | Sep. 28, 2020 | Sep. 28, 2021 |

| Item | **Conducted emissions Test** | | | | | |
|---|---|---|---|---|---|---|
| 27 | **Equipment** | **Manufacturer** | **Model#** | **Serial#** | **Last Cal.** | **Next Cal.** |
| 28 | AMN | ROHDE&S CHWARZ | ESH3-Z5 | 100318 | Sep. 28, 2020 | Sep. 28, 2021 |
| 29 | Pulse limiter | ROHDE&S CHWARZ | ESH3Z2 | 357881052 | Sep. 28, 2020 | Sep. 28, 2021 |
| 30 | EMI TEST RECEIVER | ROHDE&S CHWARZ | ESCS30 | 834115/006 | Sep. 28, 2020 | Sep. 28, 2021 |
| 31 | Coaxial cable | ZDECL | Z302S | 18091804 | Sep. 28, 2020 | Sep. 28, 2021 |
| 32 | ISN | TESEQ | NTFM8158 | 183 | Sep. 28, 2020 | Sep. 28, 2021 |
| 33 | EMI TEST RECEIVER | ROHDE&S CHWARZ | ESCI | 100428/003 | Sep. 28, 2020 | Sep. 28, 2021 |
| 34 | Software | Fala | EZ-EMC | EMC-CON 3A1.1 | \ | \ |

# 6. AC POWER LINE CONDUCTED EMISSION

## 6.1 Block Diagram Of Test Setup




## 6.2 Limit

| 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

## 6.3 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.

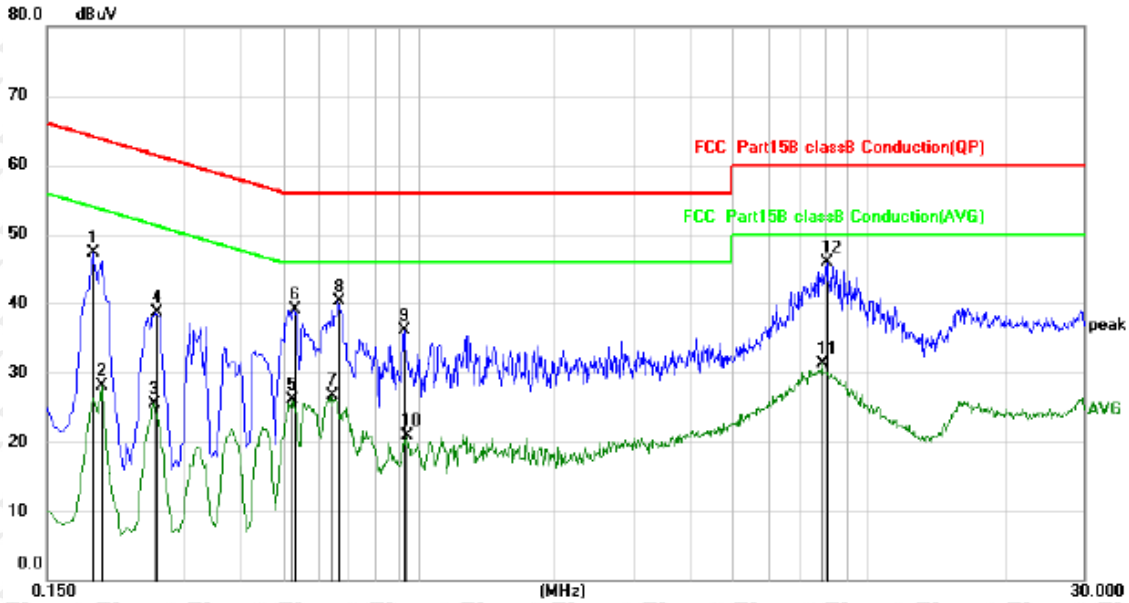
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

6) All modes were tested at AC 120V and 240V, only the worst result of AC 120V 60Hz was reported.

7) If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.

## 6.4 Test Result

Test Specification: Neutral

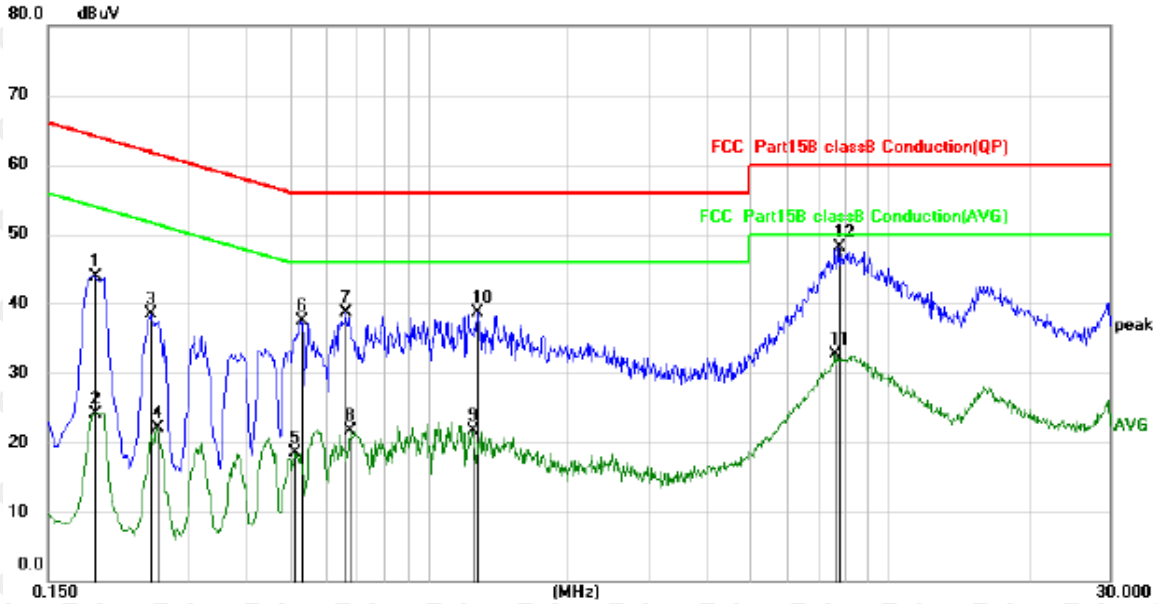



| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Margin | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.1900 | 37.02 | 10.22 | 47.24 | 64.04 | -16.80 | QP |
| 2 | | 0.1980 | 17.87 | 10.22 | 28.09 | 53.69 | -25.60 | AVG |
| 3 | | 0.2580 | 15.40 | 10.18 | 25.58 | 51.50 | -25.92 | AVG |
| 4 | | 0.2620 | 28.49 | 10.18 | 38.67 | 61.37 | -22.70 | QP |
| 5 | | 0.5260 | 16.13 | 10.06 | 26.19 | 46.00 | -19.81 | AVG |
| 6 | | 0.5299 | 29.01 | 10.06 | 39.07 | 56.00 | -16.93 | QP |
| 7 | | 0.6419 | 16.62 | 10.08 | 26.70 | 46.00 | -19.30 | AVG |
| 8 | | 0.6660 | 30.29 | 10.08 | 40.37 | 56.00 | -15.63 | QP |
| 9 | | 0.9300 | 25.84 | 10.20 | 36.04 | 56.00 | -19.96 | QP |
| 10 | | 0.9420 | 10.64 | 10.21 | 20.85 | 46.00 | -25.15 | AVG |
| 11 | | 7.9220 | 20.88 | 10.48 | 31.36 | 50.00 | -18.64 | AVG |
| 12 | * | 8.0700 | 35.36 | 10.48 | 45.84 | 60.00 | -14.16 | QP |

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit

Test Specification: Line




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Margin | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.1900 | 33.85 | 10.11 | 43.96 | 64.04 | -20.08 | QP |
| 2 | | 0.1900 | 14.06 | 10.11 | 24.17 | 54.04 | -29.87 | AVG |
| 3 | | 0.2500 | 28.33 | 10.13 | 38.46 | 61.76 | -23.30 | QP |
| 4 | | 0.2580 | 12.05 | 10.14 | 22.19 | 51.50 | -29.31 | AVG |
| 5 | | 0.5140 | 8.20 | 10.23 | 18.43 | 46.00 | -27.57 | AVG |
| 6 | | 0.5299 | 27.25 | 10.23 | 37.48 | 56.00 | -18.52 | QP |
| 7 | | 0.6620 | 28.38 | 10.24 | 38.62 | 56.00 | -17.38 | QP |
| 8 | | 0.6780 | 11.50 | 10.24 | 21.74 | 46.00 | -24.26 | AVG |
| 9 | | 1.2460 | 11.59 | 10.15 | 21.74 | 46.00 | -24.26 | AVG |
| 10 | | 1.2780 | 28.60 | 10.15 | 38.75 | 56.00 | -17.25 | QP |
| 11 | | 7.6420 | 22.07 | 10.57 | 32.64 | 50.00 | -17.36 | AVG |
| 12 | * | 7.7940 | 37.57 | 10.57 | 48.14 | 60.00 | -11.86 | QP |

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit

# 7. RADIATED SPURIOUS EMISSION

## 7.1 Block Diagram Of Test Setup

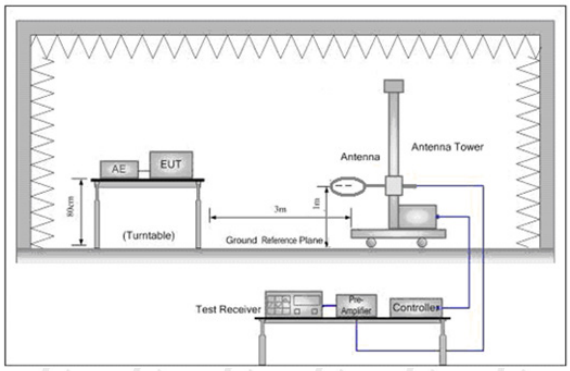



Figure 1. Below 30MHz

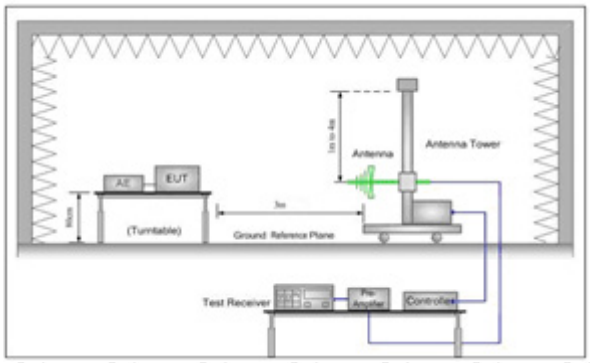



Figure 2. 30MHz to 1GHz

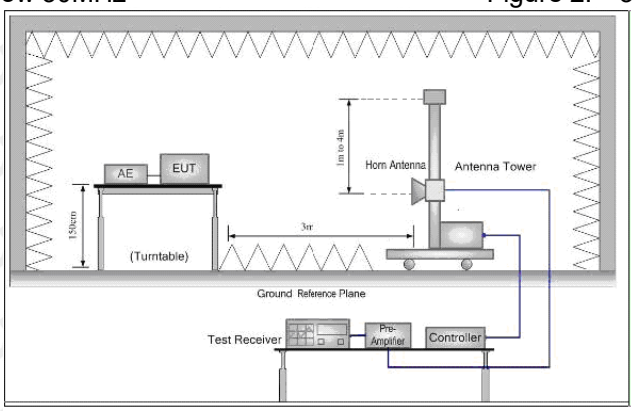



Figure 3. Above 1GHz

## 7.2 Limit

Spurious Emissions:

| Frequency | Field strength (microvolt/meter) | Limit (dBμV/m ) | Remark | Measurement distance (m) |
|---|---|---|---|---|
| 0.009MHz-0.490MHz | 2400/F(kHz) | - | - | 300 |
| 0.490MHz-1.705MHz | 24000/F(kHz) | - | - | 30 |
| 1.705MHz-30MHz | 30 | - | - | 30 |
| 30MHz-88MHz | 100 | 40.0 | Quasi-peak | 3 |
| 88MHz-216MHz | 150 | 43.5 | Quasi-peak | 3 |
| 216MHz-960MHz | 200 | 46.0 | Quasi-peak | 3 |
| 960MHz-1GHz | 500 | 54.0 | Quasi-peak | 3 |
| Above 1GHz | 500 | 54.0 | Average | 3 |

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.

## 7.3 Test procedure

**Below 1GHz test procedure as below:**

a.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.

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.

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.

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 rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.

e.The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

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.

**Above 1GHz test procedure as below:**

g.Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter( Above 18GHz the distance is 1 meter and table is 1.5 meter).

h.Test the EUT in the lowest channel ,the middle channel ,the Highest channel

j.Repeat above procedures until all frequencies measured was complete.

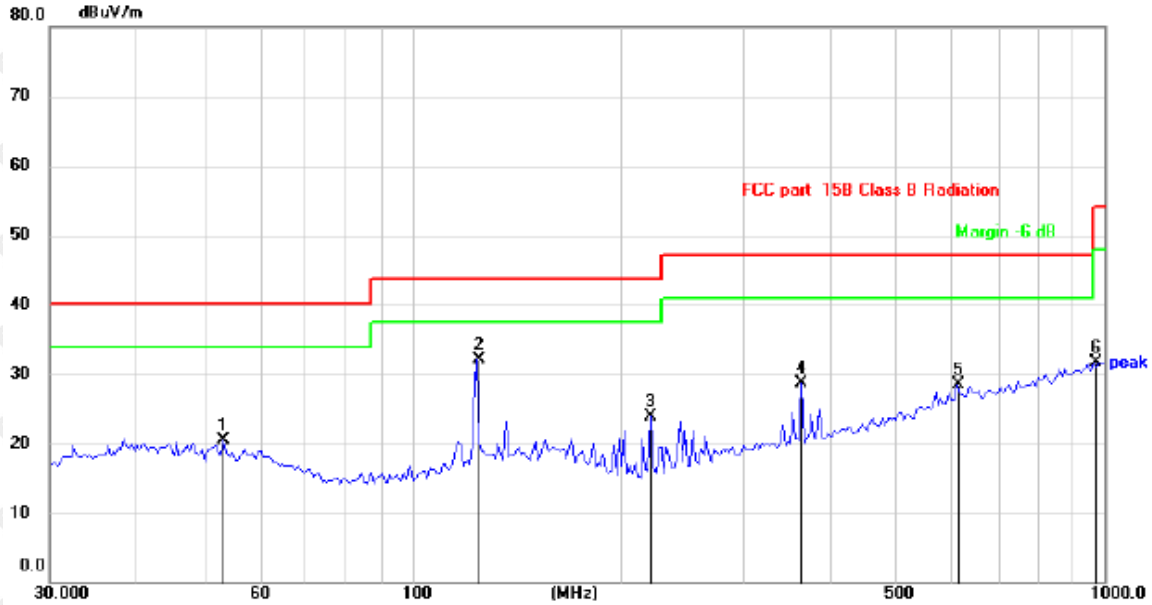
j. Full battery is usedduring test

Receiver set:

| Frequency | Detector | RBW | VBW | Remark |
|---|---|---|---|---|
| 0.009MHz-0.090MHz | Peak | 10kHz | 30KHz | Peak |
| 0.009MHz-0.090MHz | Average | 10kHz | 30KHz | Average |
| 0.090MHz-0.110MHz | Quasi-peak | 10kHz | 30KHz | Quasi-peak |
| 0.110MHz-0.490MHz | Peak | 10kHz | 30KHz | Peak |
| 0.110MHz-0.490MHz | Average | 10kHz | 30KHz | Average |
| 0.490MHz -30MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| 30MHz-1GHz | Quasi-peak | 120 kHz | 300KHz | Quasi-peak |
| Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | Peak | 1MHz | 10Hz | Average |

## 7.4 Test Result

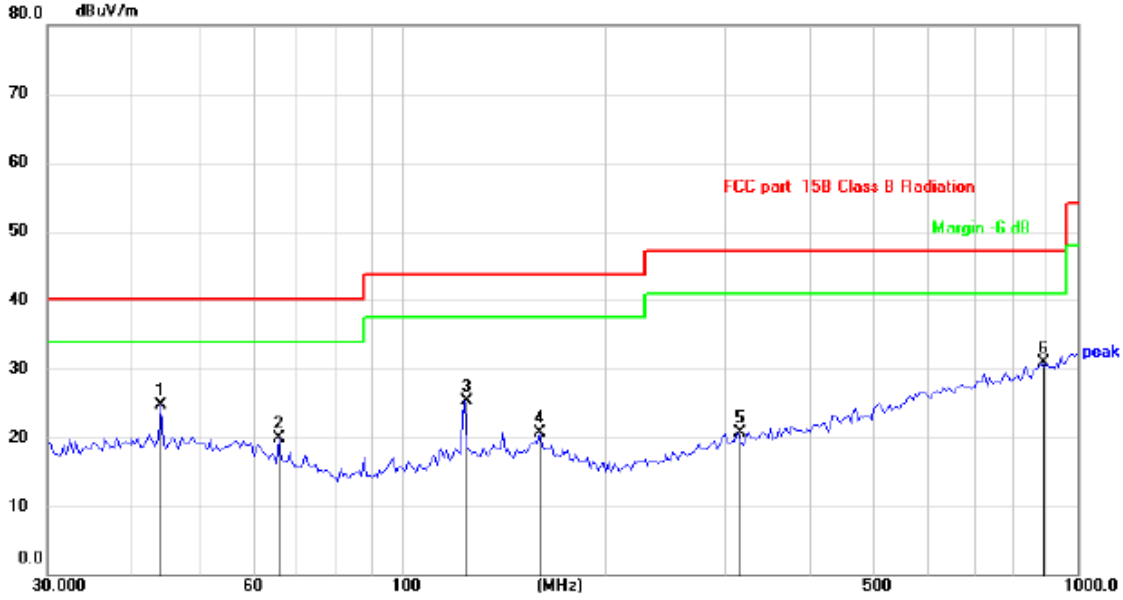
Below 1GHz Test Results:
Antenna polarity: H




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dB/m | dB | Detector |
| 1 | | 53.5052 | 28.12 | -7.62 | 20.50 | 40.00 | -19.50 | QP |
| 2 | * | 124.1330 | 40.81 | -8.78 | 32.03 | 43.50 | -11.47 | QP |
| 3 | | 221.3921 | 34.15 | -10.20 | 23.95 | 43.50 | -19.55 | QP |
| 4 | | 364.8987 | 34.66 | -6.04 | 28.62 | 47.00 | -18.38 | QP |
| 5 | | 612.0642 | 28.46 | -0.02 | 28.44 | 47.00 | -18.56 | QP |
| 6 | | 965.5421 | 27.27 | 4.39 | 31.66 | 54.00 | -22.34 | QP |

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement – Limit

Antenna polarity: V




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dB/m | dB | Detector |
| 1 | * | 44.1202 | 31.76 | -7.06 | 24.70 | 40.00 | -15.30 | QP |
| 2 | | 66.0342 | 29.22 | -9.29 | 19.93 | 40.00 | -20.07 | QP |
| 3 | | 124.1330 | 34.03 | -8.78 | 25.25 | 43.50 | -18.25 | QP |
| 4 | | 160.0648 | 27.92 | -7.19 | 20.73 | 43.50 | -22.77 | QP |
| 5 | | 314.3765 | 27.80 | -7.10 | 20.70 | 47.00 | -26.30 | QP |
| 6 | | 884.5029 | 27.44 | 3.55 | 30.99 | 47.00 | -16.01 | QP |

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement – Limit

Above 1 GHz Test Results:

CH Low (2402MHz)
Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2402 | 108.91 | -5.84 | 103.07 | N/A | N/A | peak |
| 2402 | 94.05 | -5.84 | 88.21 | N/A | N/A | AVG |
| 4804 | 59.20 | -3.64 | 55.56 | 74 | -18.44 | peak |
| 4804 | 49.41 | -3.64 | 45.77 | 54 | -8.23 | AVG |
| 7206 | 58.40 | -0.95 | 57.45 | 74 | -16.55 | peak |
| 7206 | 48.99 | -0.95 | 48.04 | 54 | -5.96 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2402 | 110.62 | -5.84 | 104.78 | N/A | N/A | peak |
| 2402 | 94.69 | -5.84 | 88.85 | N/A | N/A | AVG |
| 4804 | 58.18 | -3.64 | 54.54 | 74 | -19.46 | peak |
| 4804 | 48.54 | -3.64 | 44.90 | 54 | -9.10 | AVG |
| 7206 | 59.29 | -0.95 | 58.34 | 74 | -15.66 | peak |
| 7206 | 49.89 | -0.95 | 48.94 | 54 | -5.06 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

CH Middle (2440MHz)
Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2440 | 106.45 | -5.71 | 100.74 | N/A | N/A | peak |
| 2440 | 92.05 | -5.71 | 86.34 | N/A | N/A | AVG |
| 4880 | 55.70 | -3.51 | 52.19 | 74 | -21.81 | peak |
| 4880 | 45.17 | -3.51 | 41.66 | 54 | -12.34 | AVG |
| 7320 | 56.38 | -0.82 | 55.56 | 74 | -18.44 | peak |
| 7320 | 47.53 | -0.82 | 46.71 | 54 | -7.29 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2440 | 106.27 | -5.71 | 100.56 | N/A | N/A | peak |
| 2440 | 92.45 | -5.71 | 86.74 | N/A | N/A | AVG |
| 4880 | 55.73 | -3.51 | 52.22 | 74.00 | -21.78 | peak |
| 4880 | 45.78 | -3.51 | 42.27 | 54.00 | -11.73 | AVG |
| 7320 | 57.62 | -0.82 | 56.80 | 74.00 | -17.20 | peak |
| 7320 | 46.72 | -0.82 | 45.90 | 54.00 | -8.10 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

CH High (2480MHz)
Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2480 | 107.16 | -5.65 | 101.51 | N/A | N/A | peak |
| 2480 | 91.79 | -5.65 | 86.14 | N/A | N/A | AVG |
| 4960 | 56.15 | -3.43 | 52.72 | 74 | -21.28 | peak |
| 4960 | 45.49 | -3.43 | 42.06 | 54 | -11.94 | AVG |
| 7440 | 56.65 | -0.75 | 55.90 | 74 | -18.10 | peak |
| 7440 | 46.99 | -0.75 | 46.24 | 54 | -7.76 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2480 | 105.99 | -5.65 | 100.34 | N/A | N/A | peak |
| 2480 | 92.27 | -5.65 | 86.62 | N/A | N/A | AVG |
| 4960 | 55.04 | -3.43 | 51.61 | 74 | -22.39 | peak |
| 4960 | 47.48 | -3.43 | 44.05 | 54 | -9.95 | AVG |
| 7440 | 55.38 | -0.75 | 54.63 | 74 | -19.37 | peak |
| 7440 | 46.49 | -0.75 | 45.74 | 54 | -8.26 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Remark:
(1) Measuring frequencies from 1 GHz to the 25 GHz。
(2). All modes of GFSK were test at Low, Middle, and High channel, only the worst result of GFSK Low Channel was reported for below 1GHz test.
(3). For BT above 1GHz test all modes of GFSK were test at Low, Middle, and High channel, only the worst result of GFSK was reported.
(4). 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.
(5). 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.

## Restricted bands around fundamental frequency (Radiated)

Operation Mode: TX CH Low (2402MHz)
Horizontal (Worst case)

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2310 | 55.63 | -5.81 | 49.82 | 74 | -24.18 | peak |
| 2310 | / | -5.81 | / | 54 | / | AVG |
| 2390 | 53.60 | -5.84 | 47.76 | 74 | -26.24 | peak |
| 2390 | / | -5.84 | / | 54 | / | AVG |
| 2400 | 54.41 | -5.84 | 48.57 | 74 | -25.43 | peak |
| 2400 | / | -5.84 | / | 54 | / | AVG |

Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2310 | 54.27 | -5.81 | 48.46 | 74 | -25.54 | peak |
| 2310 | / | -5.81 | / | 54 | / | AVG |
| 2390 | 55.09 | -5.84 | 49.25 | 74 | -24.75 | peak |
| 2390 | / | -5.84 | / | 54 | / | AVG |
| 2400 | 56.84 | -5.84 | 51.00 | 74 | -23.00 | peak |
| 2400 | / | -5.84 | / | 54 | / | AVG |

Operation Mode: TX CH High (2480MHz)
Horizontal (Worst case)

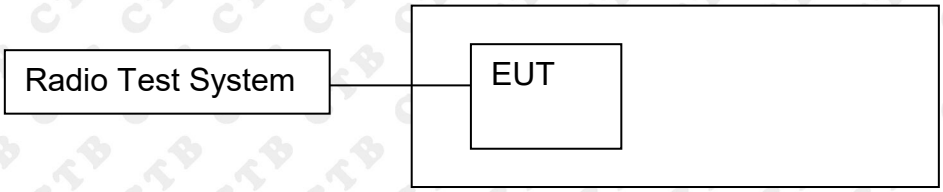
| Frequency (MHz) | Reading Result (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 2483.50 | 54.09 | -5.65 | 48.44 | 74 | -25.56 | peak |
| 2483.50 | / | -5.65 | / | 54 | / | AVG |
| 2500.00 | 54.78 | -5.65 | 49.13 | 74 | -24.87 | peak |
| 2500.00 | / | -5.65 | / | 54 | / | AVG |
| 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 |
|---|---|---|---|---|---|---|
| 2483.50 | 54.81 | -5.65 | 49.16 | 74 | -24.84 | peak |
| 2483.50 | / | -5.65 | / | 54 | / | AVG |
| 2500.00 | 54.30 | -5.65 | 48.65 | 74 | -25.35 | peak |
| 2500.00 | / | -5.65 | / | 54 | / | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |
| Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit. | | | | | | |

# 8. BAND EDGE AND RF COUNDUCTED SPURIOUS EMISSIONS

## 8.1 Block Diagram Of Test Setup



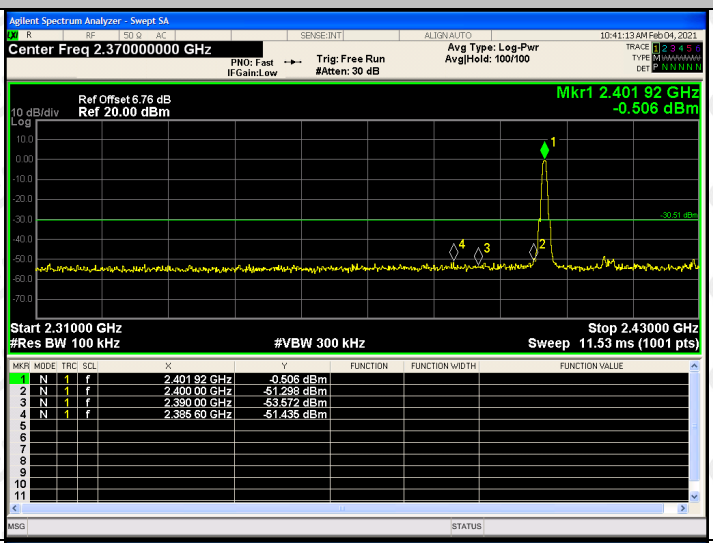
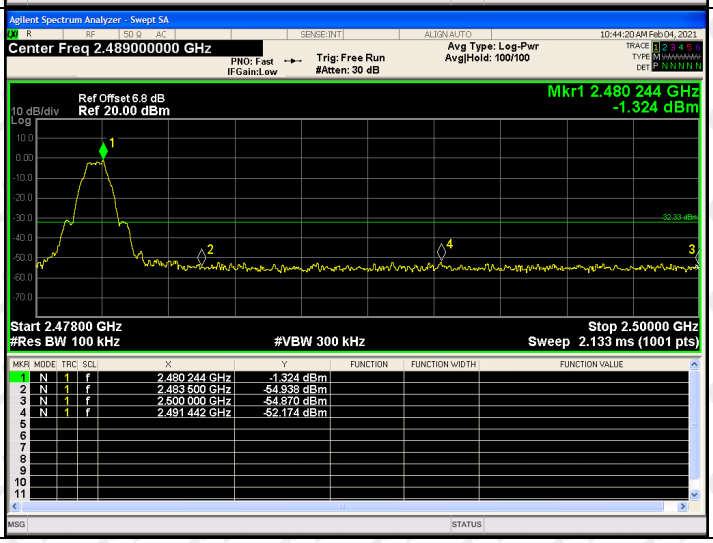

## 8.2 Limit

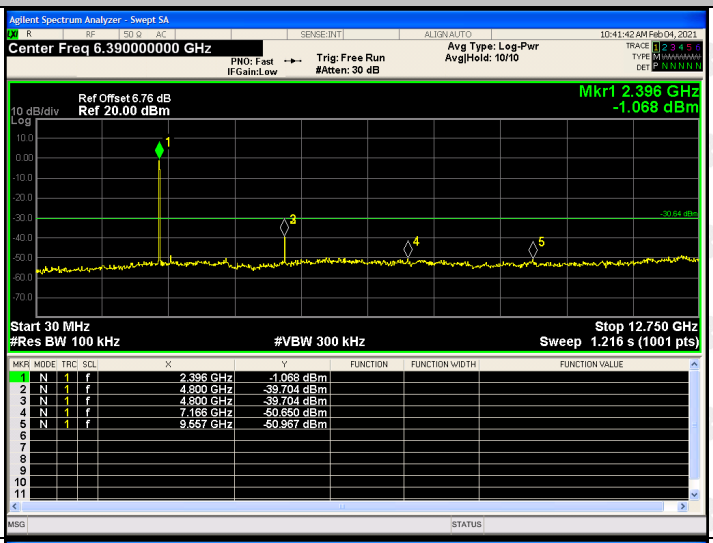
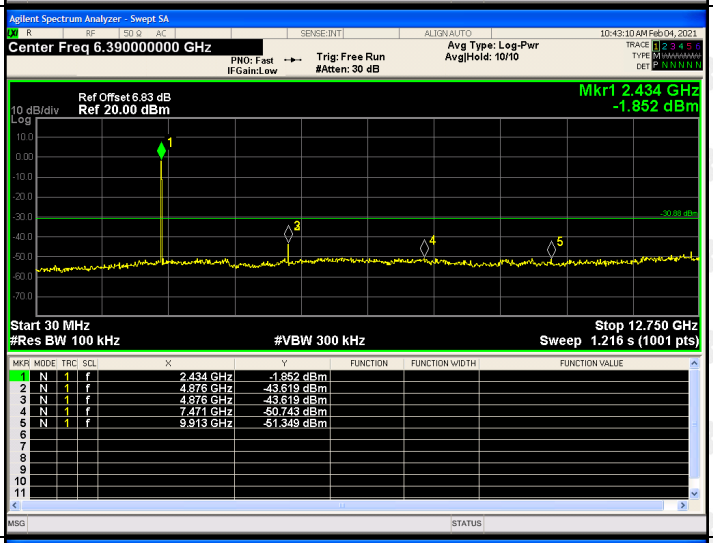
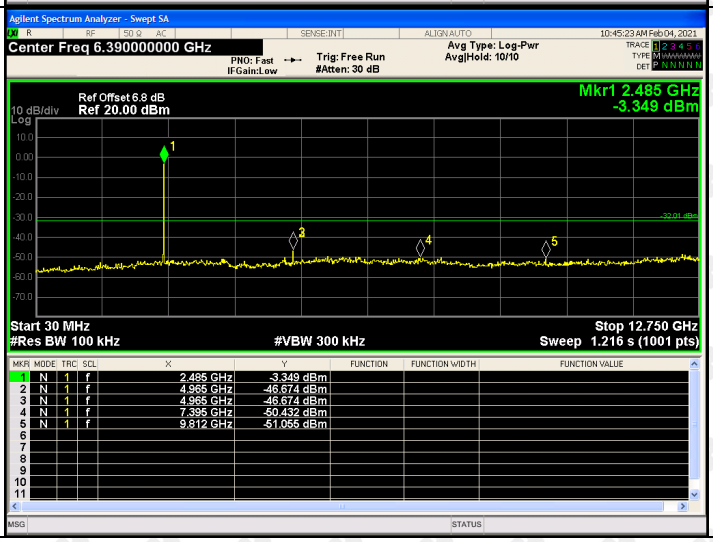
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF 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)).

## 8.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer:
Blow 30MHz:
RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold
Above 30MHz:
RBW = 100KHz, VBW = 300KHz, Sweep = auto
Detector function = peak, Trace = max hold

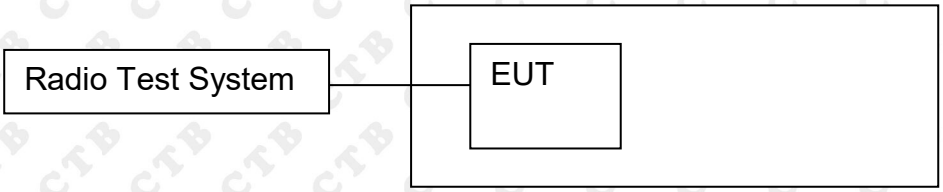
## 8.4 Test Result

| BAND EDGE Graphs | | | |
|---|---|---|---|
| GFSK/LCH | |  | |
| GFSK/HCH | |  | |

| RF Conducted Spurious Emissions Graphs | | |
|---|---|---|
| GFSK/LCH | |  |
| GFSK/MCH | |  |
| GFSK/HCH | |  |

# 9. COUDUCTED OUTPUT POWER

## 9.1 Block Diagram Of Test Setup




## 9.2 Limit

| FCC Part15 (15.247) , Subpart C | | | | |
|---|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247(b)(3) | Output Power | 1 watt or 30dBm | 2400-2483.5 | PASS |

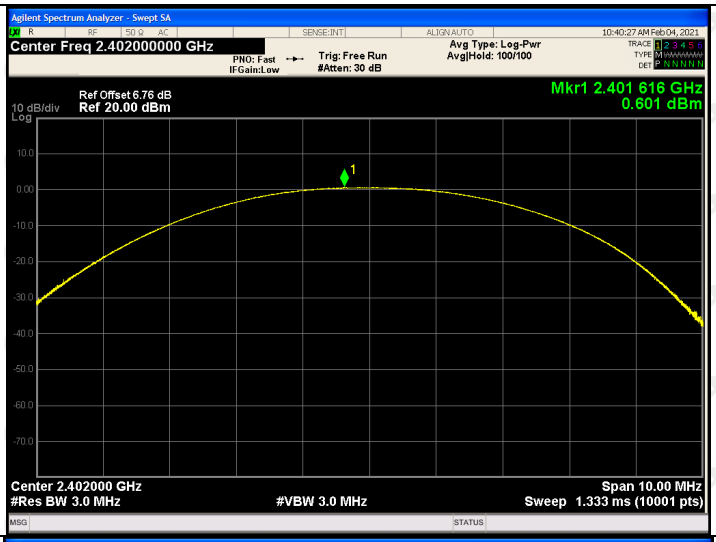
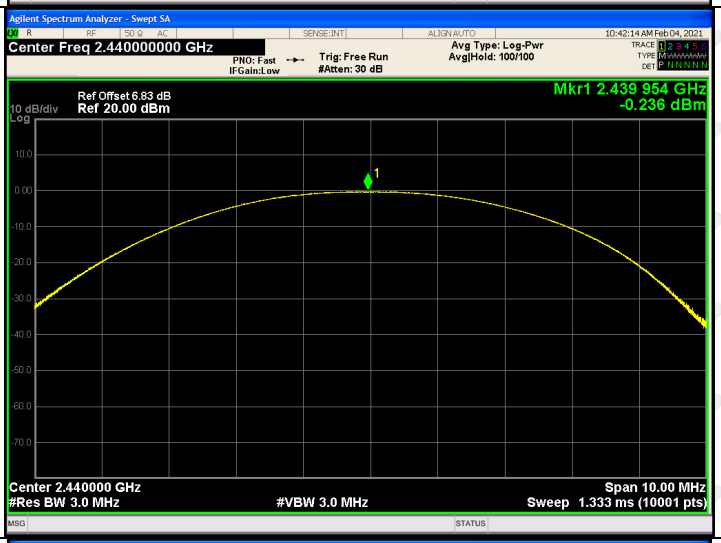
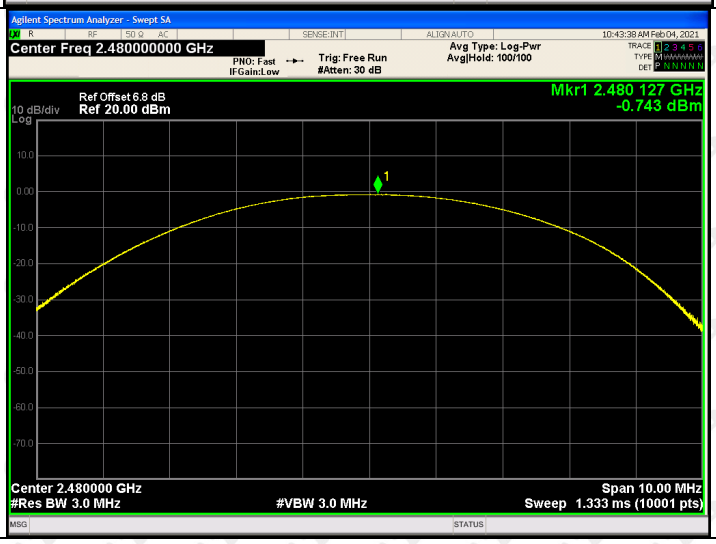
## 9.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Channel power measurement. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

## 9.4 Test Result

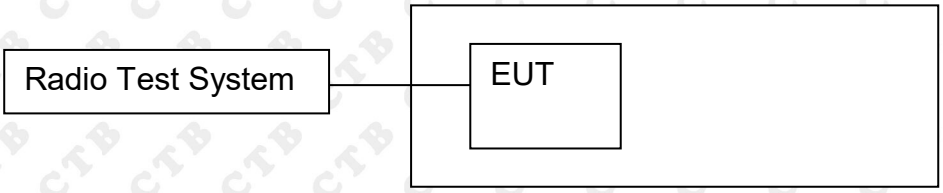
| Mode | Channel. | Maximum Output Power [dBm] | Limit[dBm] | Verdict |
|---|---|---|---|---|
| GFSK | LCH | 0.601 | 30 | PASS |
| | MCH | -0.236 | 30 | PASS |
| | HCH | -0.743 | 30 | PASS |

## Test Graph:

| | | | |
|---|---|---|---|
| GFSK<br>Low channel | |  | |
| GFSK<br>Mid channel | |  | |
| GFSK<br>High channel | |  | |

# 10. 6DB OCCUPIED BANDWIDTH

## 10.1 Block Diagram Of Test Setup




## 10.2 Limit

| FCC Part15 (15.247) , Subpart C | | | | |
|---|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247(a)(2) | Bandwidth | >= 500KHz (6dB bandwidth) | 2400-2483.5 | PASS |

## 10.3 Test procedure

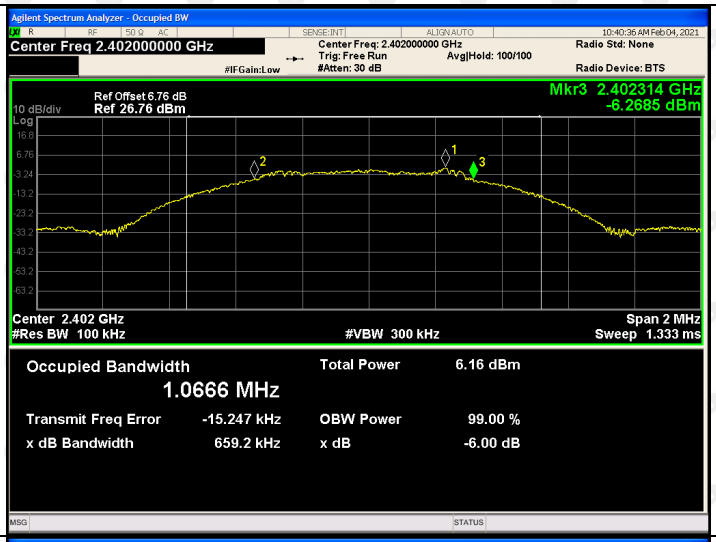
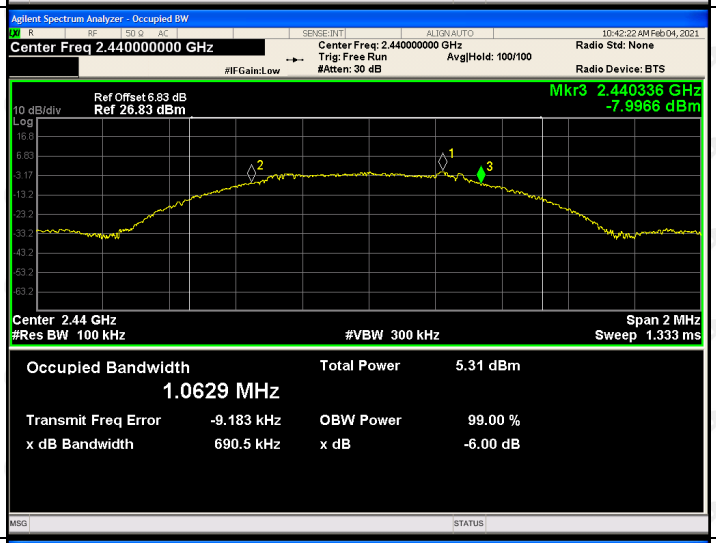
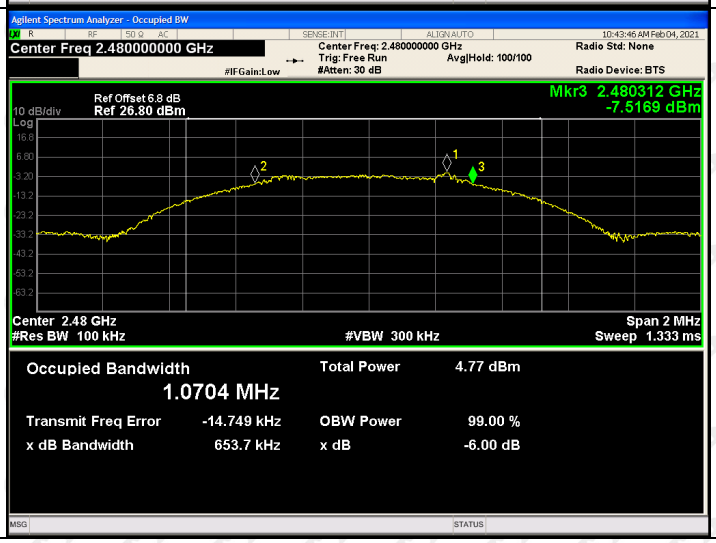
1. Rem1. Set RBW = 30 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

## 10.4 Test Result

| Test Mode | Frequency | 6dB Bandwidth (MHz) | Result |
|---|---|---|---|
| GFSK | Low channel | 0.659 | **PASS** |
| | Mid channel | 0.691 | **PASS** |
| | High channel | 0.654 | **PASS** |

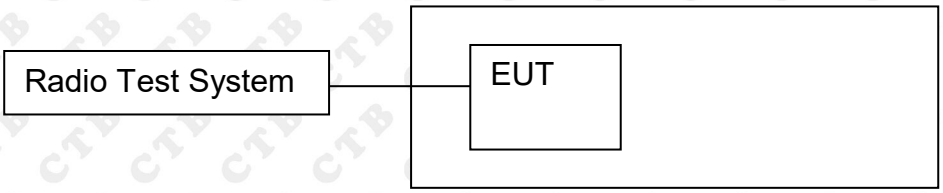
Note: All modes of operation were Pre-scan and the worst-case emissions are reported.

Test Graph:

| | | | |
|---|---|---|---|
| GFSK<br>Low channel | |  | |
| GFSK<br>Mid channel | |  | |
| GFSK<br>High channel | |  | |

# 11. POWER SPECTRAL DENSITY

## 11.1 Block Diagram Of Test Setup




## 11.2 Limit

| FCC Part15 (15.247) , Subpart C | | | | |
|---|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247 | Power Spectral Density | 8 dBm (in any 3KHz) | 2400-2483.5 | PASS |

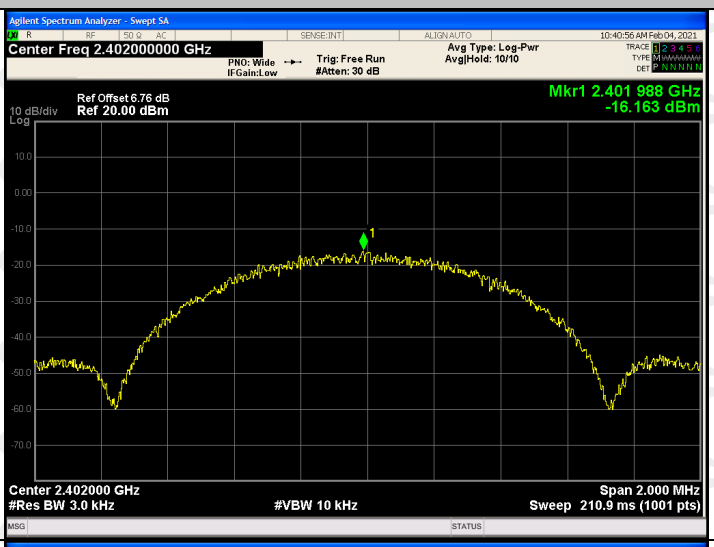
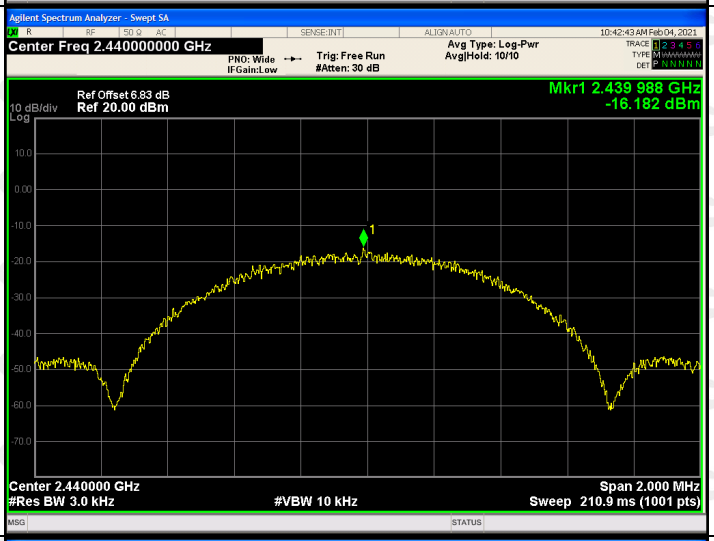
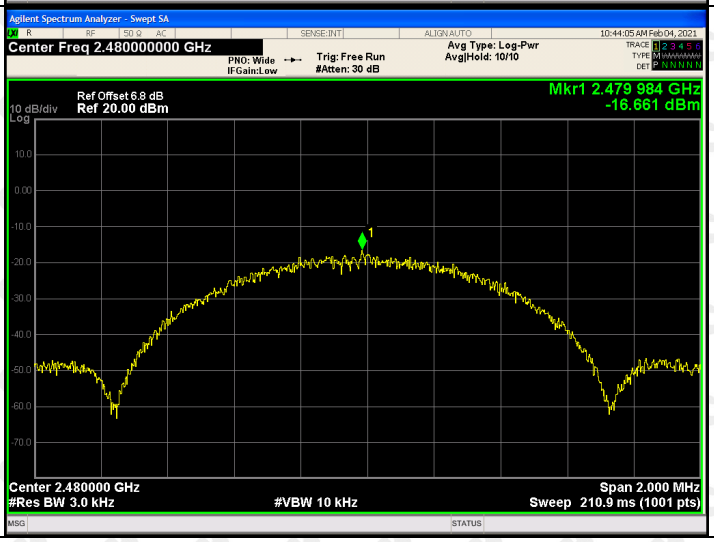
## 11.3 Test procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = RMS.
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 amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

## 11.4 Test Result

| Mode | Channel. | Power Spectral Density (dBm/3KHz) | Limit(dBm/3KHz) | Verdict |
|---|---|---|---|---|
| GFSK | LCH | -16.163 | 8 | PASS |
| GFSK | MCH | -16.182 | 8 | PASS |
| GFSK | HCH | -16.661 | 8 | PASS |

## Test Graph

| Graphs | | | |
|---|---|---|---|
| GFSK/LCH | |  | |
| GFSK/MCH | |  | |
| GFSK/HCH | |  | |

# 12. ANTENNA REQUIREMENT

15.203 requirement:

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.

15.247(b) (4) requirement:

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.

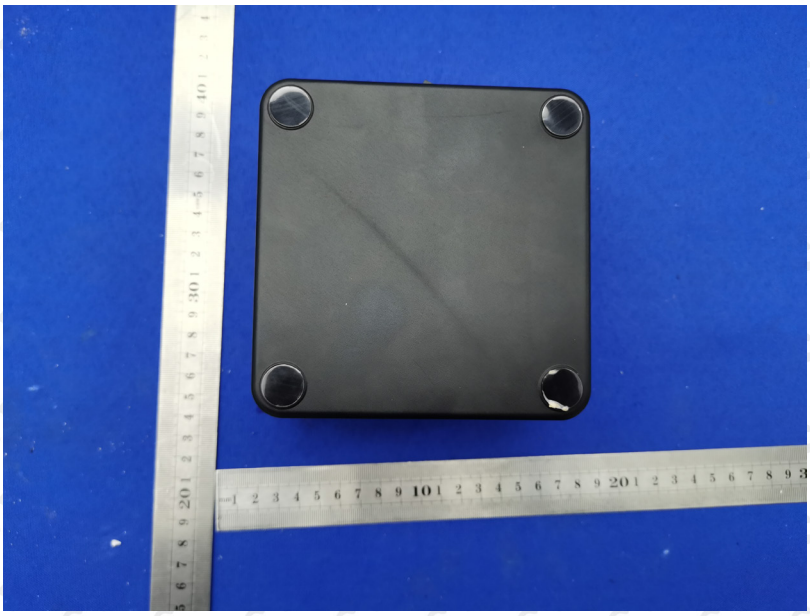
**EUT Antenna:**

The antenna is Internal Antenna. The best case gain of the antenna is 1dBi.

# 13. EUT PHOTOGRAPHS

**EUT Photo 1**

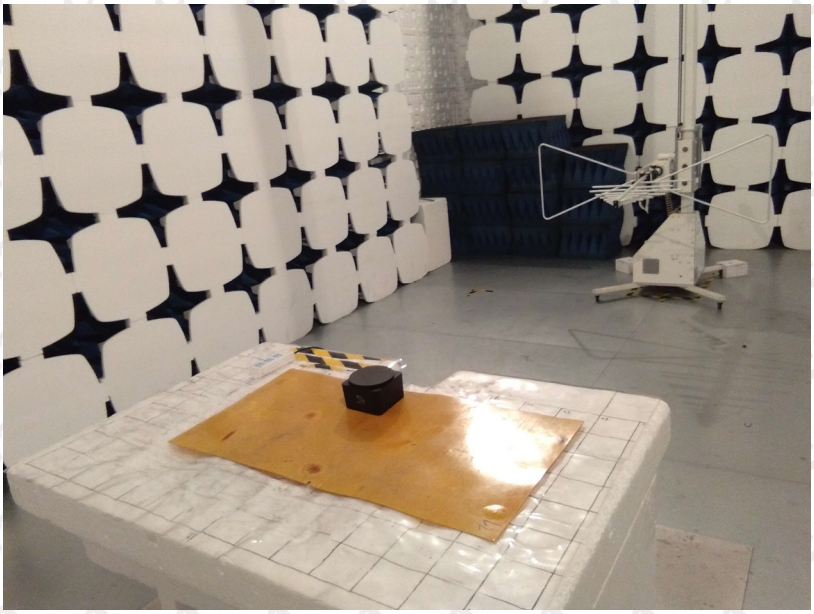
**EUT Photo 2**



# 14. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

Below 1G



Above 1G

Conducted emission

※※※※※ END OF REPORT ※※※※※