# Shenzhen HTT Technology Co., Ltd.

Report No.: HTT202307247F01

# TEST Report

| | |
|---|---|
| **Applicant:** | Shenzhen Saibolin Electronic Technology Co., Ltd |
| **Address of Applicant:** | Floor 4, No. 5, Caiyun 1st Road, Longgang District, Shenzhen |
| **Manufacturer :** | Shenzhen Saibolin Electronic Technology Co., Ltd |
| **Address of Manufacturer :** | Floor 4, No. 5, Caiyun 1st Road, Longgang District, Shenzhen |

**Equipment Under Test (EUT)**

| | |
|---|---|
| Product Name: | Karaoke Machine |
| Model No.: | S25 |
| Series model: | S28, S29, S30 |
| Trade Mark: | / |
| FCC ID: | 2BABV-S25 |
| **Applicable standards:** | FCC CFR Title 47 Part 15 Subpart C Section 15.247 |
| **Date of sample receipt:** | Jul.14,2023 |
| **Date of Test:** | Jul.14,2023~Jul.18,2023 |
| **Date of report issued:** | Jul.18,2023 |
| **Test Result :** | PASS * |

* In the configuration tested, the EUT complied with the standards specified above.

# 1. Version

| Version No. | Date | Description |
|---|---|---|
| *00* | *Jul.18,2023* | *Original* |
| | | |
| | | |
| | | |
| | | |

***Tested/ Prepared By*** Heber He ***Date:*** ***Jul.18,2023***

***Project Engineer***

***Check By:*** Bruce Zhu ***Date:*** ***Jul.18,2023***

***Reviewer***

***Approved By :*** Kevin Yang ***Date:*** ***Jul.18,2023***

***Authorized Signature***

# 2. Contents

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# 3. Test Summary

| Test Item | Section in CFR 47 | Result |
|---|---|---|
| Antenna Requirement | 15.203/15.247 (c) | Pass |
| AC Power Line Conducted Emission | 15.207 | Pass |
| Conducted Peak Output Power | 15.247 (b)(1) | Pass |
| 20dB Occupied Bandwidth | 15.247 (a)(1) | Pass |
| Carrier Frequencies Separation | 15.247 (a)(1) | Pass |
| Hopping Channel Number | 15.247 (a)(1)(iii) | Pass |
| Dwell Time | 15.247 (a)(1)(iii) | Pass |
| Radiated Emission | 15.205/15.209 | Pass |
| Band Edge | 15.247(d) | Pass |

*Remarks:*

*1. Pass: The EUT complies with the essential requirements in the standard.*

*2. Test according to ANSI C63.10:2013*

**Measurement Uncertainty**

| Test Item | Frequency Range | Measurement Uncertainty | Notes |
|---|---|---|---|
| Radiated Emission | 30~1000MHz | 3.45 dB | (1) |
| Radiated Emission | 1~6GHz | 3.54 dB | (1) |
| Radiated Emission | 6~40GHz | 5.38 dB | (1) |
| Conducted Disturbance | 0.15~30MHz | 2.66 dB | (1) |
| Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%. | | | |

# 4. General Information

## 4.1. General Description of EUT

| | |
|---|---|
| Product Name: | Karaoke Machine |
| Model No.: | S25 |
| Series model: | S28, S29, S30 |
| Test sample(s) ID: | HTT202307247-1(Engineer sample)<br>HTT202307247-2(Normal sample) |
| Operation Frequency: | 2402MHz~2480MHz |
| Channel numbers: | 79 |
| Channel separation: | 1MHz |
| Modulation type: | GFSK, π/4-DQPSK |
| Antenna Type: | PCB Antenna |
| Antenna gain: | -0.58 dBi |
| Power Supply: | DC 3.7V From Battery and DC 5V From External Circuit |

| Operation Frequency each of channel | | | | | | | |
|---|---|---|---|---|---|---|---|
| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
| 1 | 2402MHz | 21 | 2422MHz | 41 | 2442MHz | 61 | 2462MHz |
| 2 | 2403MHz | 22 | 2423MHz | 42 | 2443MHz | 62 | 2463MHz |
| 3 | 2404MHz | 23 | 2424MHz | 43 | 2444MHz | 63 | 2464MHz |
| 4 | 2405MHz | 24 | 2425MHz | 44 | 2445MHz | 64 | 2465MHz |
| 5 | 2406MHz | 25 | 2426MHz | 45 | 2446MHz | 65 | 2466MHz |
| 6 | 2407MHz | 26 | 2427MHz | 46 | 2447MHz | 66 | 2467MHz |
| 7 | 2408MHz | 27 | 2428MHz | 47 | 2448MHz | 67 | 2468MHz |
| 8 | 2409MHz | 28 | 2429MHz | 48 | 2449MHz | 68 | 2469MHz |
| 9 | 2410MHz | 29 | 2430MHz | 49 | 2450MHz | 69 | 2470MHz |
| 10 | 2411MHz | 30 | 2431MHz | 50 | 2451MHz | 70 | 2471MHz |
| 11 | 2412MHz | 31 | 2432MHz | 51 | 2452MHz | 71 | 2472MHz |
| 12 | 2413MHz | 32 | 2433MHz | 52 | 2453MHz | 72 | 2473MHz |
| 13 | 2414MHz | 33 | 2434MHz | 53 | 2454MHz | 73 | 2474MHz |
| 14 | 2415MHz | 34 | 2435MHz | 54 | 2455MHz | 74 | 2475MHz |
| 15 | 2416MHz | 35 | 2436MHz | 55 | 2456MHz | 75 | 2476MHz |
| 16 | 2417MHz | 36 | 2437MHz | 56 | 2457MHz | 76 | 2477MHz |
| 17 | 2418MHz | 37 | 2438MHz | 57 | 2458MHz | 77 | 2478MHz |
| 18 | 2419MHz | 38 | 2439MHz | 58 | 2459MHz | 78 | 2479MHz |
| 19 | 2420MHz | 39 | 2440MHz | 59 | 2460MHz | 79 | 2480MHz |
| 20 | 2421MHz | 40 | 2441MHz | 60 | 2461MHz | | |

Note:

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

| Channel | Frequency |
|---|---|
| The lowest channel | 2402MHz |
| The middle channel | 2441MHz |
| The Highest channel | 2480MHz |

## 4.2. Test mode

| | |
|---|---|
| Transmitting mode | Keep the EUT in continuously transmitting mode. |
| *Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.* | |

## 4.3. Description of Support Units

None.

## 4.4. Deviation from Standards

None.

## 4.5. Abnormalities from Standard Conditions

None.

## 4.6. Test Facility

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

**FCC-Registration No.: 779513 Designation Number: CN1319**
Shenzhen HTT Technology Co.,Ltd. has been accredited on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

**A2LA-Lab Cert. No.: 6435.01**
Shenzhen HTT Technology Co.,Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

## 4.7. Test Location

All tests were performed at:

Shenzhen HTT Technology Co.,Ltd.
1F, Building B, Huafeng International Robotics Industrial Park, Hangcheng Road,Nanchang Community, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China
Tel: 0755-23595200
Fax: 0755-23595201

## 4.8. Additional Instructions

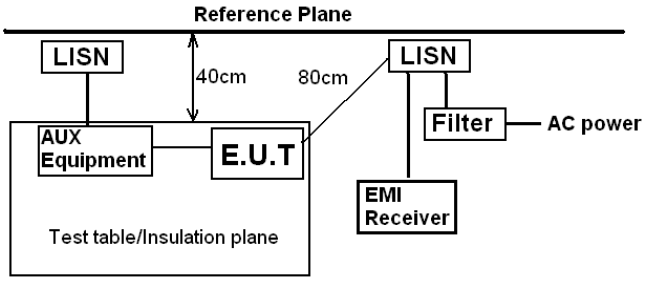
| | |
|---|---|
| Test Software | Special AT test command provided by manufacturer to Keep the EUT in continuously transmitting mode and hopping mode |
| Power level setup | Default |

## 5. Test Instruments list

| Item | Test Equipment | Manufacturer | Model No. | Inventory No. | Cal.Date (mm-dd-yy) | Cal.Due date (mm-dd-yy) |
|---|---|---|---|---|---|---|
| 1 | 3m Semi- Anechoic Chamber | Shenzhen C.R.T technology co., LTD | 9*6*6 | HTT-E028 | Aug. 10 2021 | Aug. 09 2024 |
| 2 | Control Room | Shenzhen C.R.T technology co., LTD | 4.8*3.5*3.0 | HTT-E030 | Aug. 10 2021 | Aug. 09 2024 |
| 3 | EMI Test Receiver | Rohde&Schwar | ESCI7 | HTT-E022 | Apr. 26 2023 | Apr. 25 2024 |
| 4 | Spectrum Analyzer | Rohde&Schwar | FSP | HTT-E037 | Apr. 26 2023 | Apr. 25 2024 |
| 5 | Coaxial Cable | ZDecl | ZT26-NJ-NJ-0.6M | HTT-E018 | Apr. 26 2023 | Apr. 25 2024 |
| 6 | Coaxial Cable | ZDecl | ZT26-NJ-SMAJ-2M | HTT-E019 | Apr. 26 2023 | Apr. 25 2024 |
| 7 | Coaxial Cable | ZDecl | ZT26-NJ-SMAJ-0.6M | HTT-E020 | Apr. 26 2023 | Apr. 25 2024 |
| 8 | Coaxial Cable | ZDecl | ZT26-NJ-SMAJ-8.5M | HTT-E021 | Apr. 26 2023 | Apr. 25 2024 |
| 9 | Composite logarithmic antenna | Schwarzbeck | VULB 9168 | HTT-E017 | May. 21 2023 | May. 20 2024 |
| 10 | Horn Antenna | Schwarzbeck | BBHA9120D | HTT-E016 | May. 20 2023 | May. 19 2024 |
| 11 | Loop Antenna | Zhinan | ZN30900C | HTT-E039 | Apr. 26 2023 | Apr. 25 2024 |
| 12 | Horn Antenna | Beijing Hangwei Dayang | OBH100400 | HTT-E040 | Apr. 26 2023 | Apr. 25 2024 |
| 13 | low frequency Amplifier | Sonoma Instrument | 310 | HTT-E015 | Apr. 26 2023 | Apr. 25 2024 |
| 14 | high-frequency Amplifier | HP | 8449B | HTT-E014 | Apr. 26 2023 | Apr. 25 2024 |
| 15 | Variable frequency power supply | Shenzhen Anbiao Instrument Co., Ltd | ANB-10VA | HTT-082 | Apr. 26 2023 | Apr. 25 2024 |
| 16 | EMI Test Receiver | Rohde & Schwarz | ESCS30 | HTT-E004 | Apr. 26 2023 | Apr. 25 2024 |
| 17 | Artificial Mains | Rohde & Schwarz | ESH3-Z5 | HTT-E006 | May. 23 2023 | May. 22 2024 |
| 18 | Artificial Mains | Rohde & Schwarz | ENV-216 | HTT-E038 | May. 23 2023 | May. 22 2024 |
| 19 | Cable Line | Robinson | Z302S-NJ-BNCJ-1.5M | HTT-E001 | Apr. 26 2023 | Apr. 25 2024 |
| 20 | Attenuator | Robinson | 6810.17A | HTT-E007 | Apr. 26 2023 | Apr. 25 2024 |
| 21 | Variable frequency power supply | Shenzhen Yanghong Electric Co., Ltd | YF-650（5KVA） | HTT-E032 | Apr. 26 2023 | Apr. 25 2024 |
| 22 | Control Room | Shenzhen C.R.T technology co., LTD | 8*4*3.5 | HTT-E029 | Aug. 10 2021 | Aug. 09 2024 |
| 23 | DC power supply | Agilent | E3632A | HTT-E023 | Apr. 26 2023 | Apr. 25 2024 |
| 24 | EMI Test Receiver | Agilent | N9020A | HTT-E024 | Apr. 26 2023 | Apr. 25 2024 |
| 25 | Analog signal generator | Agilent | N5181A | HTT-E025 | Apr. 26 2023 | Apr. 25 2024 |
| 26 | Vector signal generator | Agilent | N5182A | HTT-E026 | Apr. 26 2023 | Apr. 25 2024 |
| 27 | Power sensor | Keysight | U2021XA | HTT-E027 | Apr. 26 2023 | Apr. 25 2024 |
| 28 | Temperature and humidity meter | Shenzhen Anbiao Instrument Co., Ltd | TH10R | HTT-074 | Apr. 28 2023 | Apr. 27 2024 |
| 29 | Radiated Emission Test Software | Farad | EZ-EMC | N/A | N/A | N/A |
| 30 | Conducted Emission Test Software | Farad | EZ-EMC | N/A | N/A | N/A |
| 31 | RF Test Software | panshanrf | TST | N/A | N/A | N/A |

# 6. Test results and Measurement Data

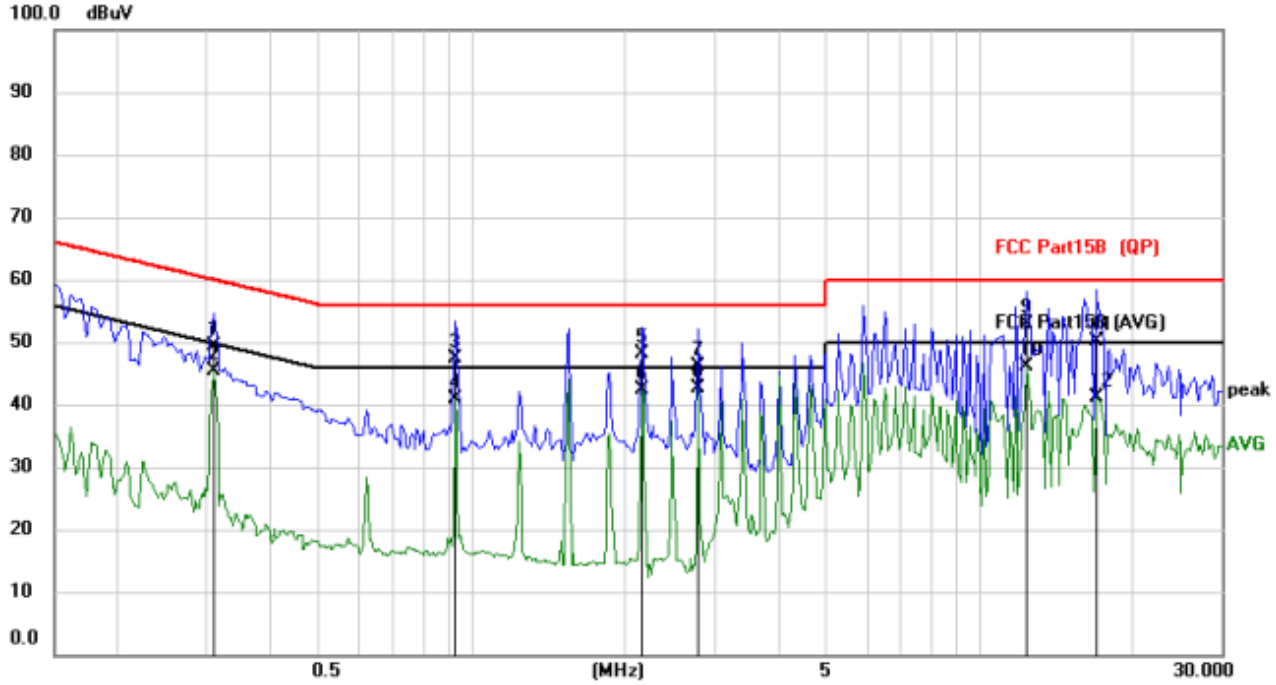
## 6.1. Conducted Emissions

| | |
|---|---|
| Test Requirement: | FCC Part15 C Section 15.207 |
| Test Method: | ANSI C63.10:2013 |
| Test Frequency Range: | 150KHz to 30MHz |
| Class / Severity: | Class B |
| Receiver setup: | RBW=9KHz, VBW=30KHz, Sweep time=auto |
| Limit: | Frequency range (MHz) / Limit (dBuV): Quasi-peak / Average<br>0.15-0.5: 66 to 56* / 56 to 46*<br>0.5-5: 56 / 46<br>5-30: 60 / 50<br>* Decreases with the logarithm of the frequency. |
| Test setup: |  <br>*Remark:*<br>*E.U.T: Equipment Under Test*<br>*LISN: Line Impedence Stabilization Network*<br>*Test table height=0.8m* |
| Test procedure: | 1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment.<br>2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs).<br>3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement. |
| Test Instruments: | Refer to section 6.0 for details |
| Test mode: | Refer to section 5.2 for details |
| Test environment: | Temp.: 25 °C / Humid.: 52% / Press.: 1012mbar |
| Test voltage: | AC 120V, 60Hz |
| Test results: | Pass |

Remark: Both high and low voltages have been tested to show only the worst low voltage test data.

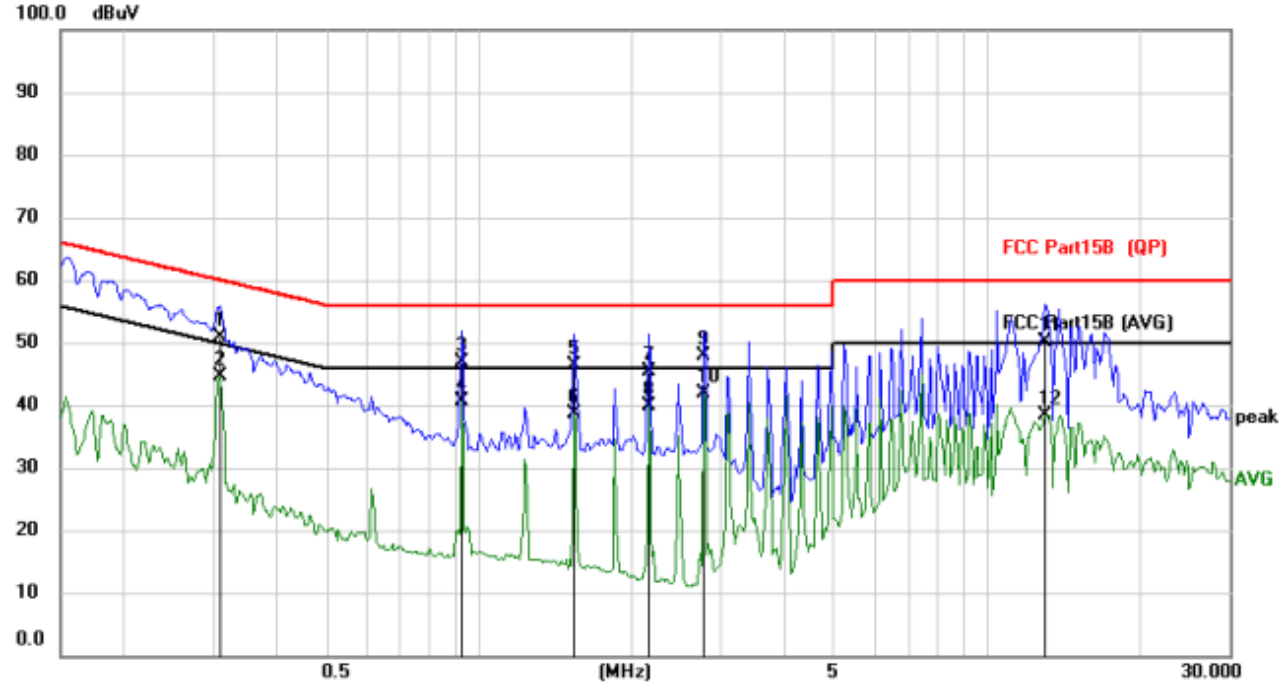
**Measurement data:**

**Line:**




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.3100 | 39.06 | 10.41 | 49.47 | 59.97 | -10.50 | QP |
| 2 | | 0.3100 | 34.87 | 10.41 | 45.28 | 49.97 | -4.69 | AVG |
| 3 | | 0.9261 | 36.44 | 10.86 | 47.30 | 56.00 | -8.70 | QP |
| 4 | | 0.9261 | 30.00 | 10.86 | 40.86 | 46.00 | -5.14 | AVG |
| 5 | | 2.1662 | 37.42 | 10.83 | 48.25 | 56.00 | -7.75 | QP |
| 6 | | 2.1662 | 31.56 | 10.83 | 42.39 | 46.00 | -3.61 | AVG |
| 7 | | 2.7863 | 35.25 | 10.84 | 46.09 | 56.00 | -9.91 | QP |
| 8 | * | 2.7863 | 31.70 | 10.84 | 42.54 | 46.00 | -3.46 | AVG |
| 9 | | 12.3795 | 41.12 | 11.78 | 52.90 | 60.00 | -7.10 | QP |
| 10 | | 12.3795 | 34.39 | 11.78 | 46.17 | 50.00 | -3.83 | AVG |
| 11 | | 17.0088 | 37.96 | 12.22 | 50.18 | 60.00 | -9.82 | QP |
| 12 | | 17.0088 | 29.01 | 12.22 | 41.23 | 50.00 | -8.77 | AVG |

**Neutral:**

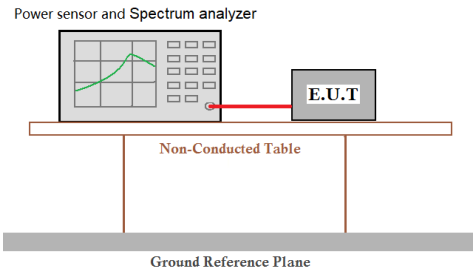



| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.3100 | 40.58 | 10.25 | 50.83 | 59.97 | -9.14 | QP |
| 2 | | 0.3100 | 34.48 | 10.25 | 44.73 | 49.97 | -5.24 | AVG |
| 3 | | 0.9261 | 36.14 | 10.76 | 46.90 | 56.00 | -9.10 | QP |
| 4 | | 0.9261 | 29.89 | 10.76 | 40.65 | 46.00 | -5.35 | AVG |
| 5 | | 1.5423 | 35.54 | 10.81 | 46.35 | 56.00 | -9.65 | QP |
| 6 | | 1.5423 | 27.94 | 10.81 | 38.75 | 46.00 | -7.25 | AVG |
| 7 | | 2.1585 | 34.56 | 10.83 | 45.39 | 56.00 | -10.61 | QP |
| 8 | | 2.1585 | 29.17 | 10.83 | 40.00 | 46.00 | -6.00 | AVG |
| 9 | | 2.7785 | 36.94 | 10.84 | 47.78 | 56.00 | -8.22 | QP |
| 10 | * | 2.7785 | 31.03 | 10.84 | 41.87 | 46.00 | -4.13 | AVG |
| 11 | | 13.0347 | 38.25 | 11.92 | 50.17 | 60.00 | -9.83 | QP |
| 12 | | 13.0347 | 26.55 | 11.92 | 38.47 | 50.00 | -11.53 | AVG |

*Notes:*

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level =Receiver Read level + LISN Factor + Cable Los

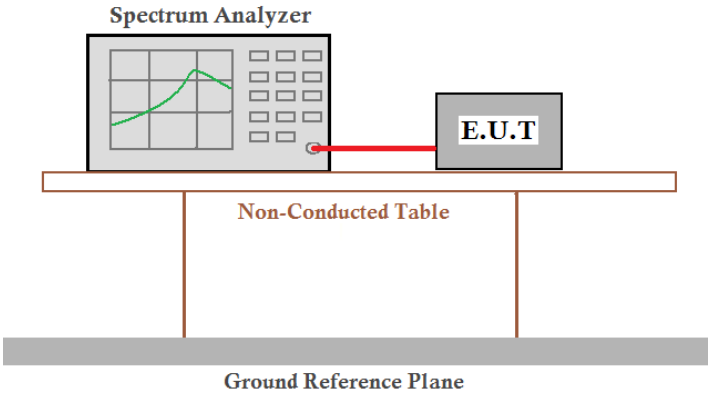
## 6.2. Conducted Peak Output Power

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (b)(3) | | | | | |
| Test Method: | ANSI C63.10:2013 | | | | | |
| Limit: | 30dBm(for GFSK),20.97dBm(for EDR) | | | | | |
| Test setup: |  | | | | | |
| Test Instruments: | Refer to section 6.0 for details | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | |
| Test results: | Pass | | | | | |
| Test environment: | Temp.: | 25 °C | Humid.: | 52% | Press.: | 1012mbar |

**Measurement Data**

| Mode | Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| GFSK | Lowest | 0.62 | 30.00 | Pass |
| | Middle | 2.05 | | |
| | Highest | 3.36 | | |
| π/4-DQPSK | Lowest | 1.40 | 20.97 | Pass |
| | Middle | 2.63 | | |
| | Highest | 3.84 | | |

## 6.3. 20dB Emission Bandwidth

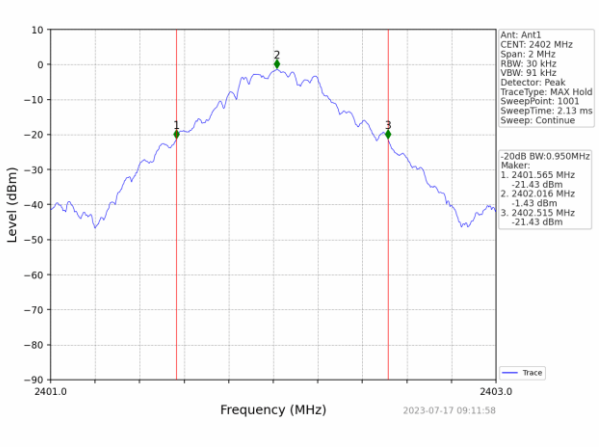
| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(2) | | | | | |
| Test Method: | ANSI C63.10:2013 | | | | | |
| Limit: | N/A | | | | | |
| Test setup: |  | | | | | |
| Test Instruments: | Refer to section 6.0 for details | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | |
| Test results: | Pass | | | | | |
| Test environment: | Temp.: | 25 °C | Humid.: | 52% | Press.: | 1012mbar |

**Measurement Data**

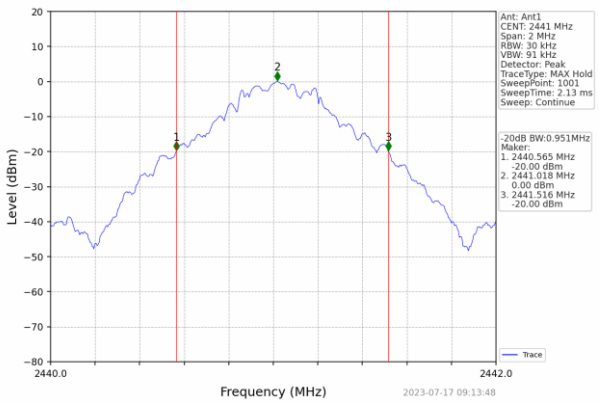
| Mode | Test channel | 20dB Emission Bandwidth (MHz) | Result |
|---|---|---|---|
| GFSK | Lowest | 0.950 | Pass |
| | Middle | 0.951 | |
| | Highest | 0.960 | |
| π/4-DQPSK | Lowest | 1.315 | Pass |
| | Middle | 1.304 | |
| | Highest | 1.321 | |

**Test plot as follows:**

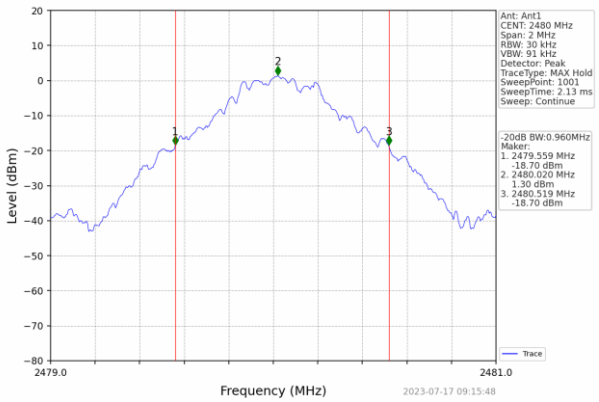
| Test mode: | GFSK mode |
|---|---|




Lowest channel

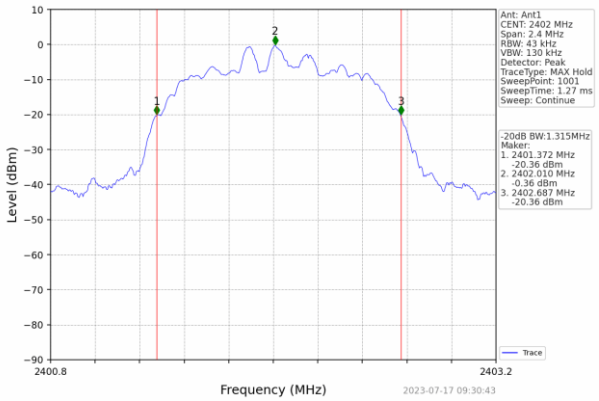



Middle channel

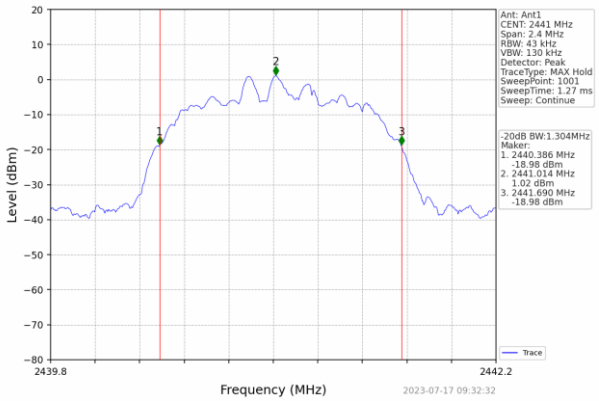



Highest channel

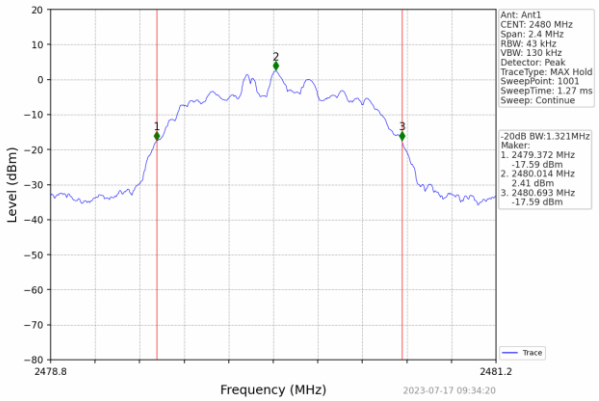
| Test mode: | π/4-DQPSK mode |
|---|---|




Lowest channel

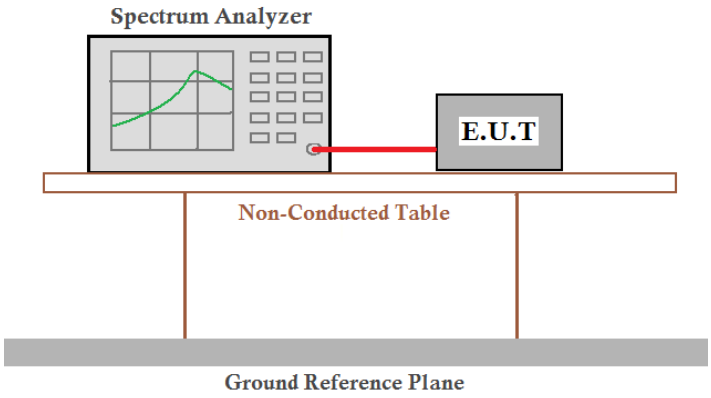



Middle channel




Highest channel

## 6.4. Frequencies Separation

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(1) | | | | | |
| Test Method: | ANSI C63.10:2013 | | | | | |
| Receiver setup: | RBW=100KHz, VBW=300KHz, detector=Peak | | | | | |
| Limit: | GFSK: 20dB bandwidth<br>π/4-DQPSK : 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater) | | | | | |
| Test setup: |  | | | | | |
| Test Instruments: | Refer to section 6.0 for details | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | |
| Test results: | Pass | | | | | |
| Test environment: | Temp.: | 25 °C | Humid.: | 52% | Press.: | 1012mbar |

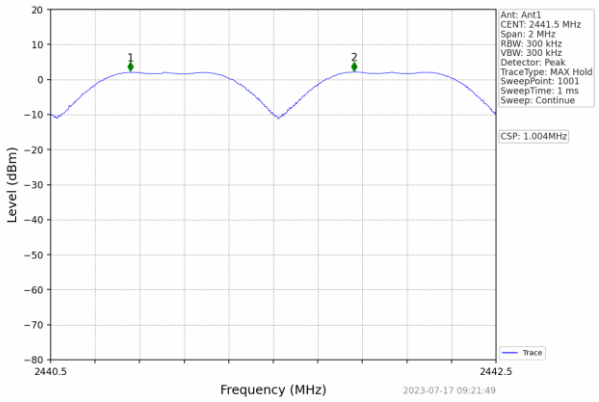
**Measurement Data**

| Mode | Test channel | Frequencies Separation (MHz) | Limit (kHz) | Result |
|---|---|---|---|---|
| GFSK | Middle | 1.004 | 25KHz or 2/3*20dB bandwidth | Pass |
| π/4-DQPSK | Middle | 0.994 | 25KHz or 2/3*20dB bandwidth | Pass |

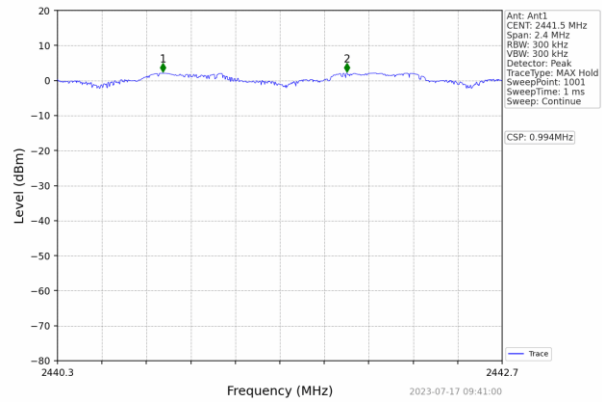
Remark: We have tested all mode at high, middle and low channel, and recorded worst case at middle

**Test plot as follows:**

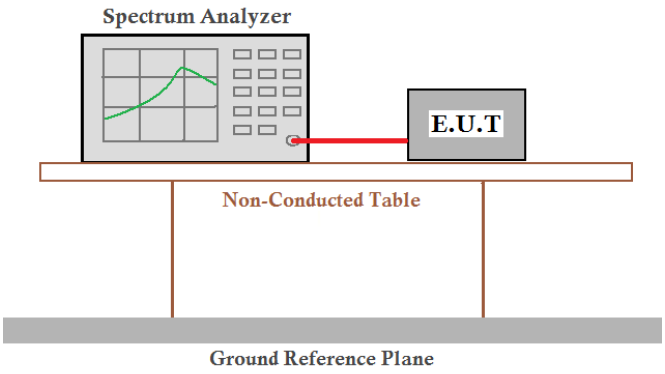
| Modulation mode: | GFSK |
|---|---|




| Test mode: | π/4-DQPSK |
|---|---|



## 6.5. Hopping Channel Number

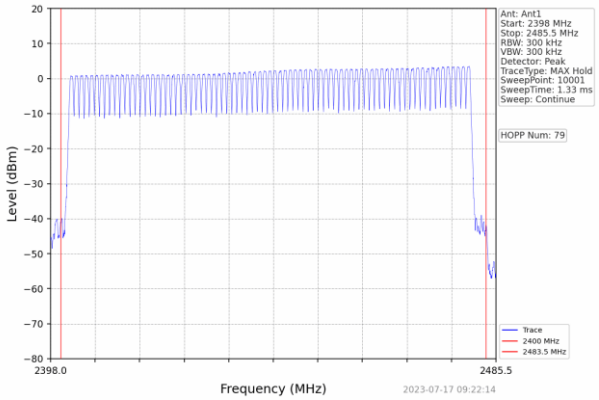
| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(1)(iii) | | | | | |
| Test Method: | ANSI C63.10:2013 | | | | | |
| Receiver setup: | RBW=100kHz, VBW=300kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak | | | | | |
| Limit: | 15 channels | | | | | |
| Test setup: |  | | | | | |
| Test Instruments: | Refer to section 6.0 for details | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | |
| Test results: | Pass | | | | | |
| Test environment: | Temp.: | 25 °C | Humid.: | 52% | Press.: | 1012mbar |

**Measurement Data:**

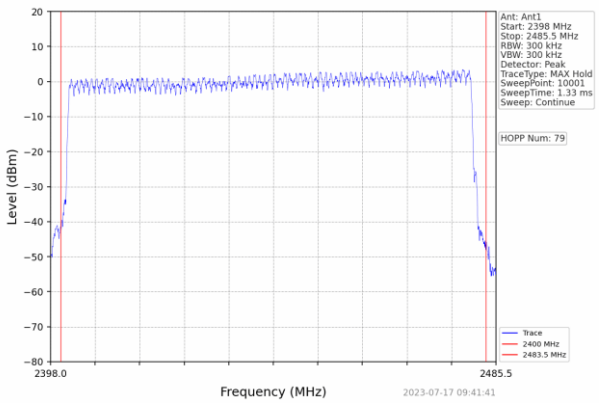
| Mode | Hopping channel numbers | Limit | Result |
|---|---|---|---|
| GFSK | 79 | ≥15 | Pass |
| π/4-DQPSK | 79 | | Pass |

**Test plot as follows:**

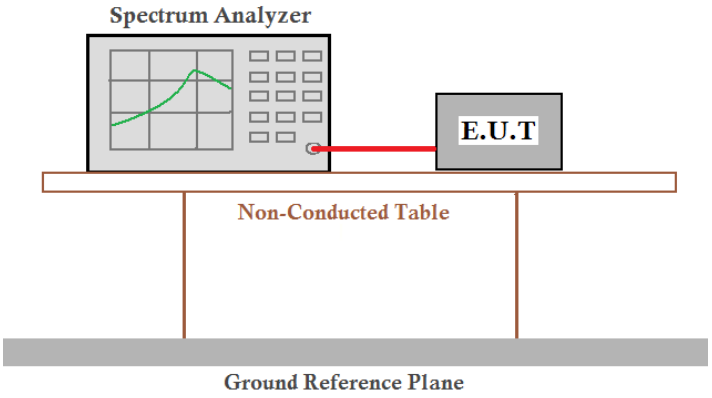
| Test mode: | GFSK |
|---|---|




| Test mode: | π/4-DQPSK |
|---|---|



## 6.6. Dwell Time

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(1)(iii) | | | | | |
| Test Method: | ANSI C63.10:2013 | | | | | |
| Receiver setup: | RBW=1MHz, VBW=1MHz, Span=0Hz, Detector=Peak | | | | | |
| Limit: | 0.4 Second | | | | | |
| Test setup: |  | | | | | |
| Test Instruments: | Refer to section 6.0 for details | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | |
| Test results: | Pass | | | | | |
| Test environment: | Temp.: | 25 °C | Humid.: | 52% | Press.: | 1012mbar |

**Measurement Data**

**GFSK mode:**

| Frequency | Packet | Pulse time (ms) | Dwell time(ms) | Limit(ms) | Result |
|---|---|---|---|---|---|
| Hopping | DH1 | 0.386 | 122.748 | 400 | Pass |
| Hopping | DH3 | 1.644 | 259.752 | 400 | Pass |
| Hopping | DH5 | 2.896 | 318.560 | 400 | Pass |

Note:We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.

Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1

Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3

Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5

**π/4-DQPSK mode:**

| Frequency | Packet | Pulse time (ms) | Dwell time(ms) | Limit(ms) | Result |
|---|---|---|---|---|---|
| Hopping | 2DH1 | 0.396 | 125.532 | 400 | Pass |
| Hopping | 2DH3 | 1.648 | 276.864 | 400 | Pass |
| Hopping | 2DH5 | 2.896 | 309.872 | 400 | Pass |

Note:We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.

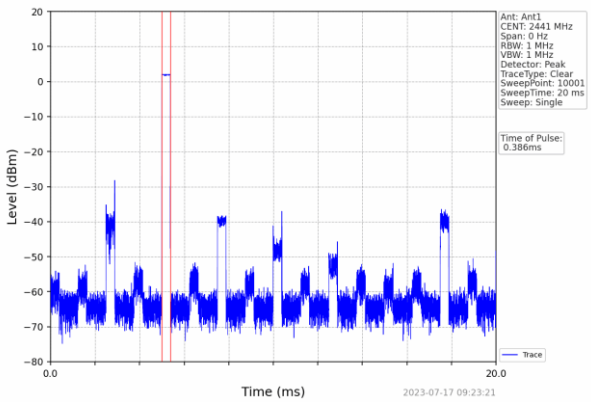
Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1

Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3

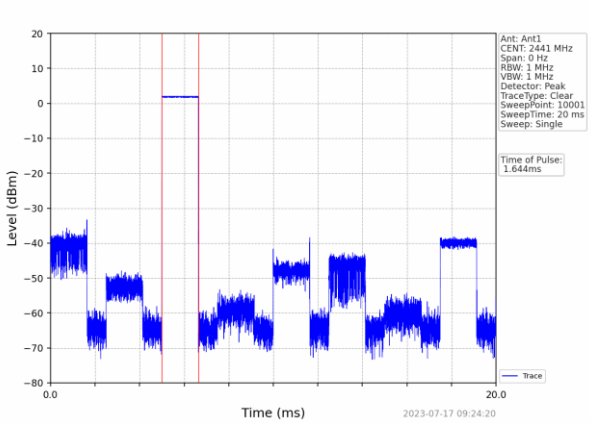
Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5

**Test plot as follows:**

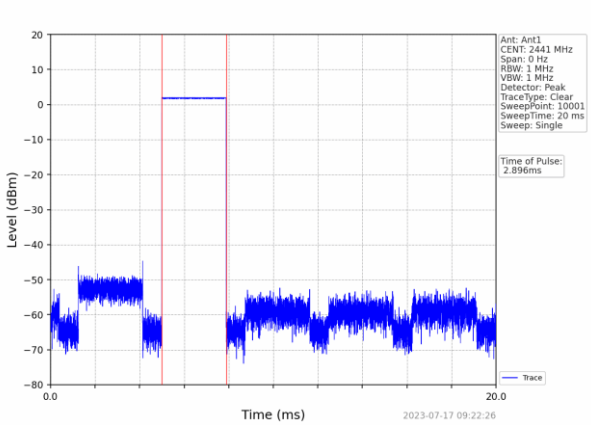
| **GFSK mode** |
|---|




DH1

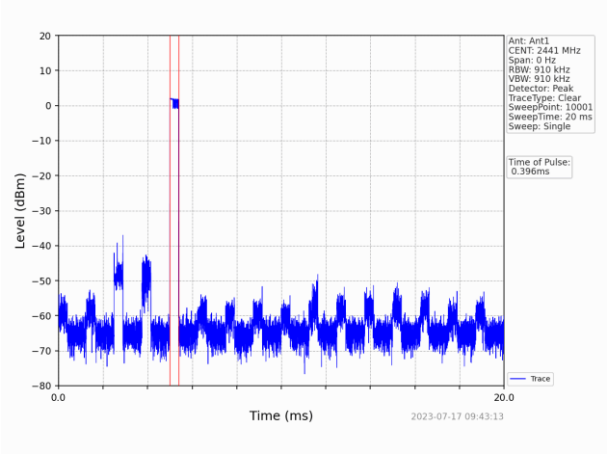



DH3

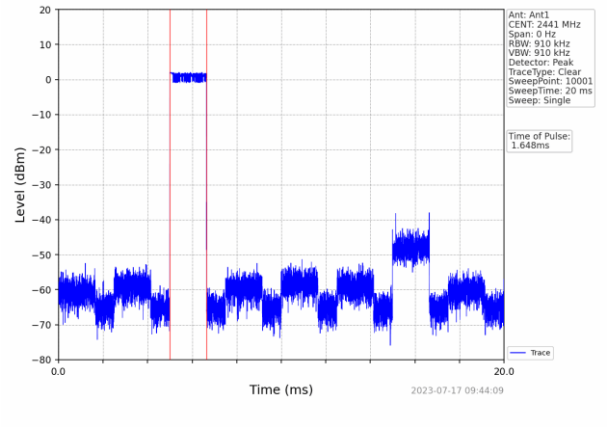



DH5

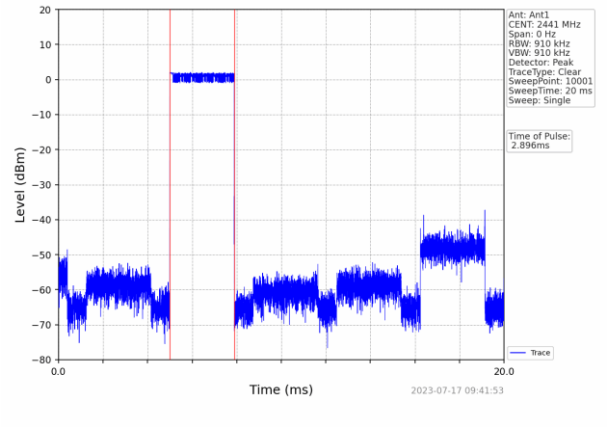
**π/4-DQPSK mode**




2DH1



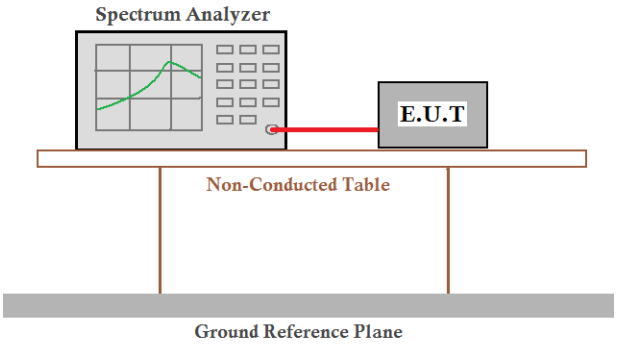

2DH3




2DH5

## 6.7. Band Edge

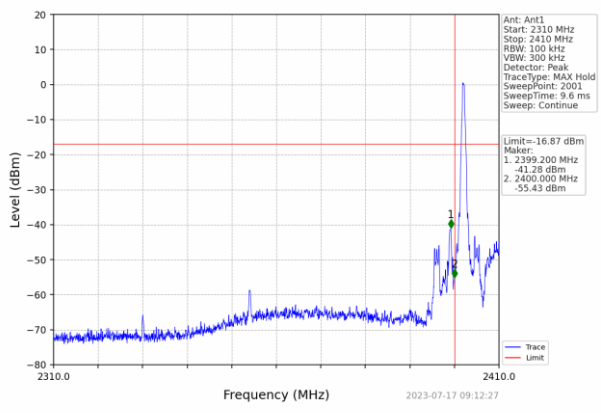
### 6.7.1. Conducted Emission Method

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (d) | | | | | |
| Test Method: | ANSI C63.10:2013 | | | | | |
| Receiver setup: | RBW=100kHz, VBW=300kHz, Detector=Peak | | | | | |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. | | | | | |
| Test setup: |  | | | | | |
| Test Instruments: | Refer to section 6.0 for details | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | |
| Test results: | Pass | | | | | |
| Test environment: | Temp.: | 25 °C | Humid.: | 52% | Press.: | 1012mbar |

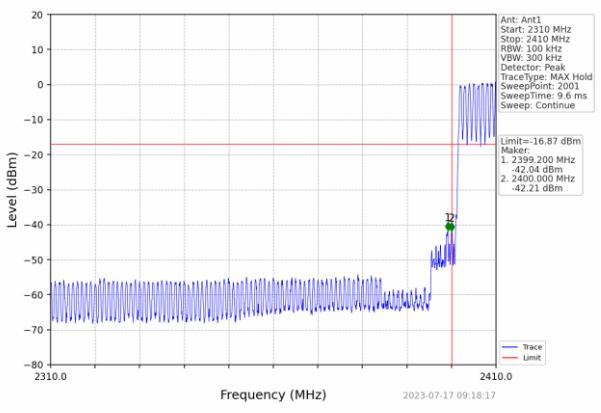
**Test plot as follows:**

**GFSK Mode:**

| Test channel | Lowest channel |
|---|---|

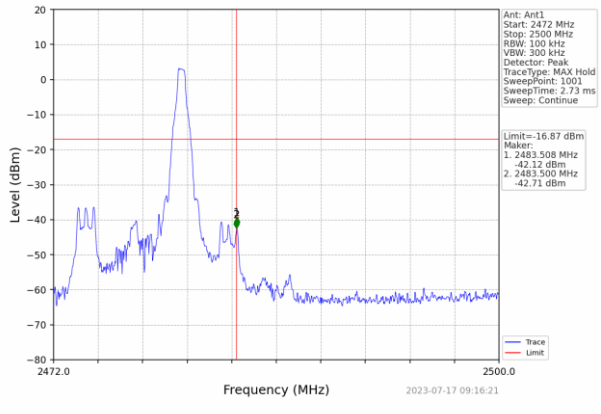



No-hopping mode

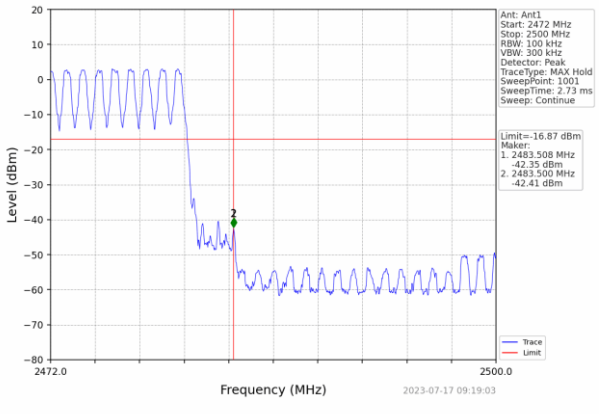



Hopping mode

| Test channel: | Highest channel |
|---|---|



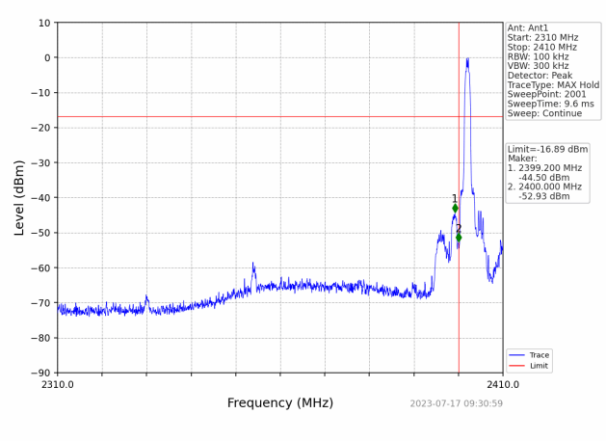

No-hopping mode



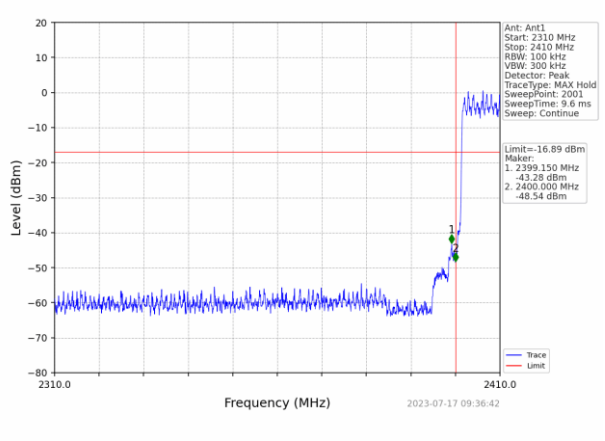

Hopping mode

**π/4-DQPSK Mode:**

| Test channel | Lowest channel |
|---|---|

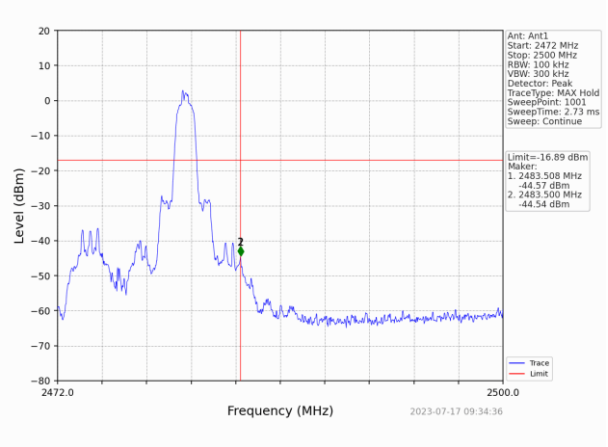



No-hopping mode

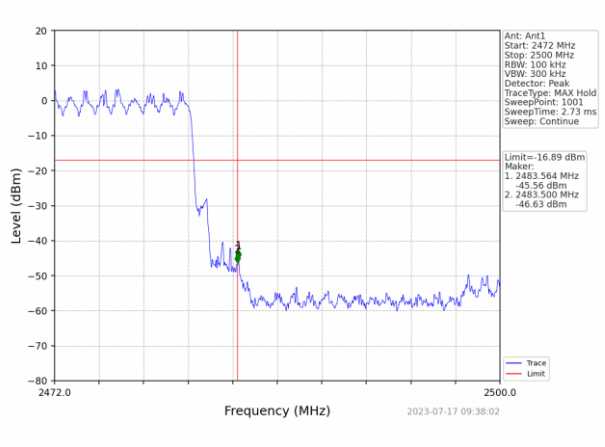



Hopping mode

| Test channel: | Highest channel |
|---|---|




No-hopping mode




Hopping mode

### 6.7.2. Radiated Emission Method

| | |
|---|---|
| Test Requirement: | FCC Part15 C Section 15.209 and 15.205 |
| Test Method: | ANSI C63.10:2013 |
| Test Frequency Range: | All of the restrict bands were tested, only the worst band's (2310MHz to 2500MHz) data was showed. |
| Test site: | Measurement Distance: 3m |

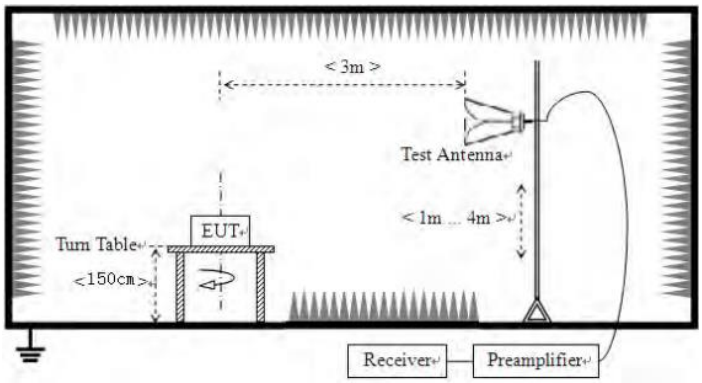
Receiver setup:

| Frequency | Detector | RBW | VBW | Remark |
|---|---|---|---|---|
| Above 1GHz | Peak | 1MHz | 3MHz | Peak Value |
| | Peak | 1MHz | 10Hz | Average Value |

Limit:

| Frequency | Limit (dBuV/m @3m) | Remark |
|---|---|---|
| Above 1GHz | 54.00 | Average Value |
| | 74.00 | Peak Value |

Test setup:




Test Procedure:

1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. 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.
4. 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 and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. 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.

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Instruments: | Refer to section 6.0 for details | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | |
| Test results: | Pass | | | | | |
| Test environment: | Temp.: | 25 °C | Humid.: | 52% | Press.: | 1012mbar |

**Measurement Data**

Remark: GFSK, Pi/4 DQPSK all have been tested, only worse case GFSK is reported.

Operation Mode: GFSK TX Low channel(2402MHz)

Horizontal (Worst case)

| Frequency | Meter Reading | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB/m) | (dB) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2390 | 58.82 | 26.20 | 5.72 | 33.30 | 57.44 | 74.00 | -16.56 | peak |
| 2390 | 45.16 | 26.20 | 5.72 | 33.30 | 43.78 | 54.00 | -10.22 | AVG |

Vertical:

| Frequency | Meter Reading | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB/m) | (dB) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2390 | 59.47 | 26.20 | 5.72 | 33.30 | 58.09 | 74.00 | -15.91 | peak |
| 2390 | 46.05 | 26.20 | 5.72 | 33.30 | 44.67 | 54.00 | -9.33 | AVG |

Operation Mode: GFSK TX High channel (2480MHz)

Horizontal (Worst case)

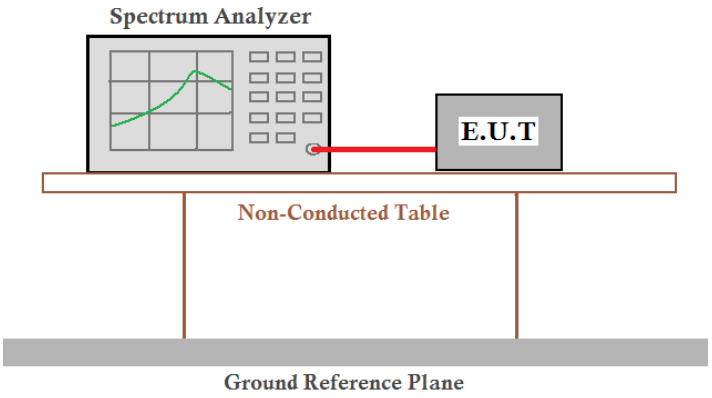
| Frequency | Meter Reading | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB/m) | (dB) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2483.5 | 56.38 | 28.60 | 6.97 | 32.70 | 59.25 | 74.00 | -14.75 | peak |
| 2483.5 | 41.82 | 28.60 | 6.97 | 32.70 | 44.69 | 54.00 | -9.31 | AVG |

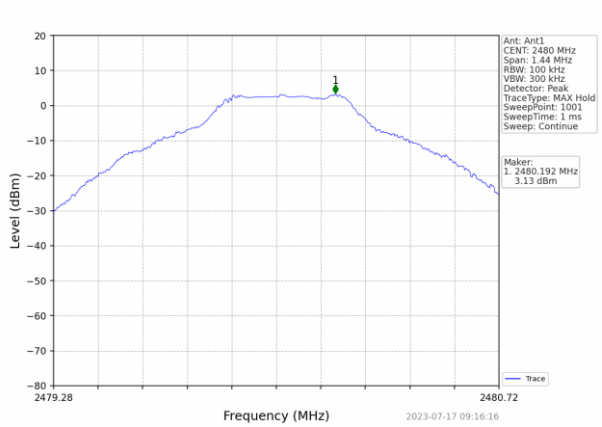
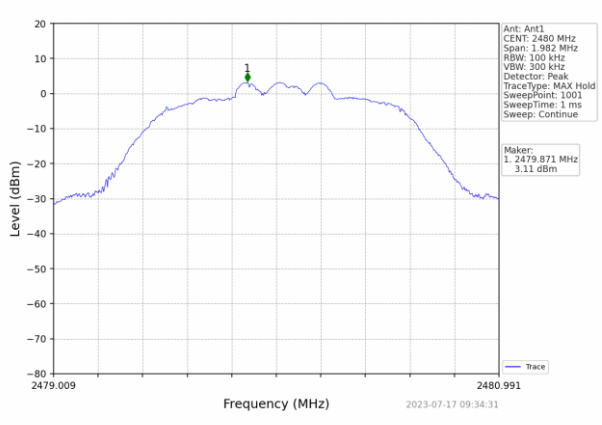
Vertical:

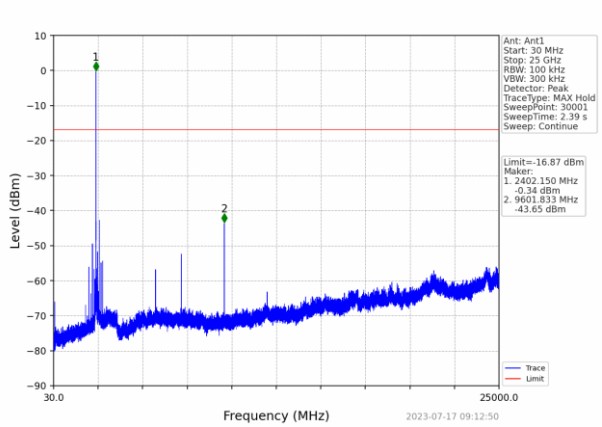
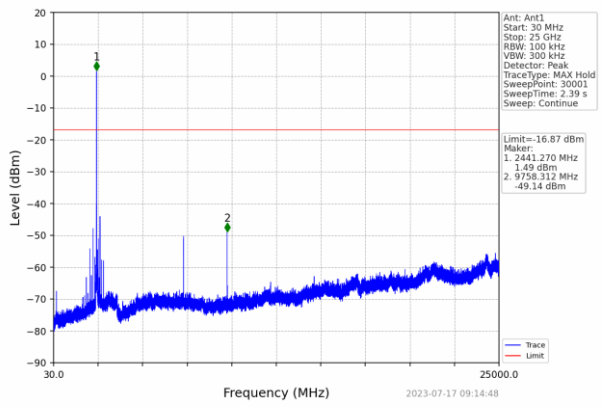
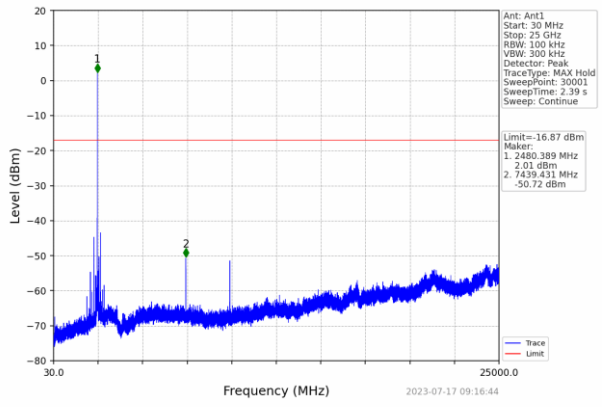
| Frequency | Meter Reading | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB/m) | (dB) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2483.5 | 54.18 | 28.60 | 6.97 | 32.70 | 57.05 | 74.00 | -16.95 | peak |
| 2483.5 | 43.50 | 28.60 | 6.97 | 32.70 | 46.37 | 54.00 | -7.63 | AVG |

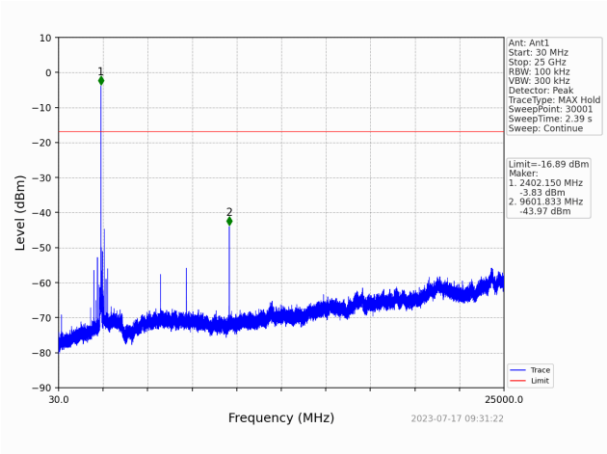
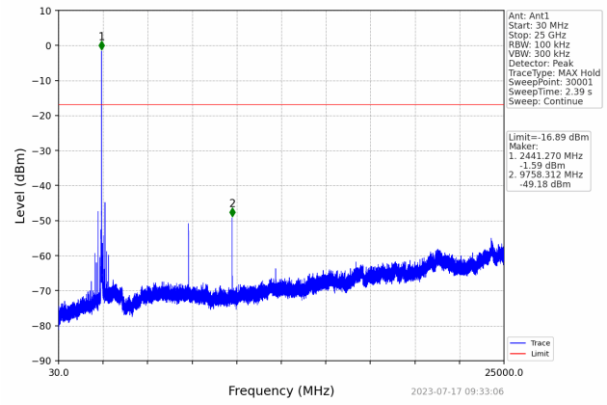
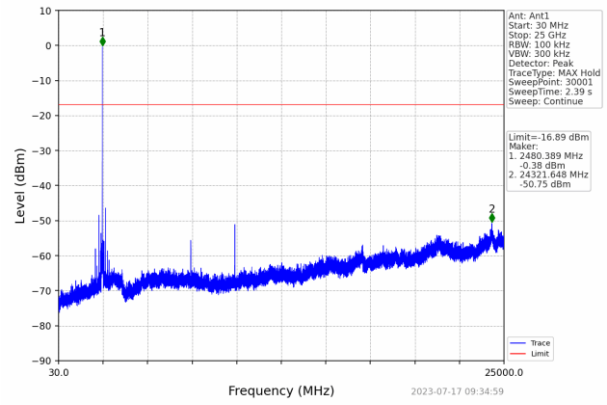
## 6.8. Spurious Emission

### 6.8.1. Conducted Emission Method

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (d) | | | | | |
| Test Method: | ANSI C63.10:2013 | | | | | |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. | | | | | |
| Test setup: |  | | | | | |
| Test Instruments: | Refer to section 6.0 for details | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | |
| Test results: | Pass | | | | | |
| Test environment: | Temp.: | 25 °C | Humid.: | 52% | Press.: | 1012mbar |

| Reference |
| --- |
|  |
| ***GFSK*** |
|  |
| ***π/4DQPSK*** |

| GFSK |
| --- |
|  |
| CH00 |
|  |
| CH39 |
|  |
| CH78 |

| π/4DQPSK |
| --- |
|  |
| **CH00** |
|  |
| **CH39** |
|  |
| **CH78** |

### 6.8.2. Radiated Emission Method

| | |
|---|---|
| Test Requirement: | FCC Part15 C Section 15.209 |
| Test Method: | ANSI C63.10:2013 |
| Test Frequency Range: | 9kHz to 25GHz |
| Test site: | Measurement Distance: 3m |

Receiver setup:

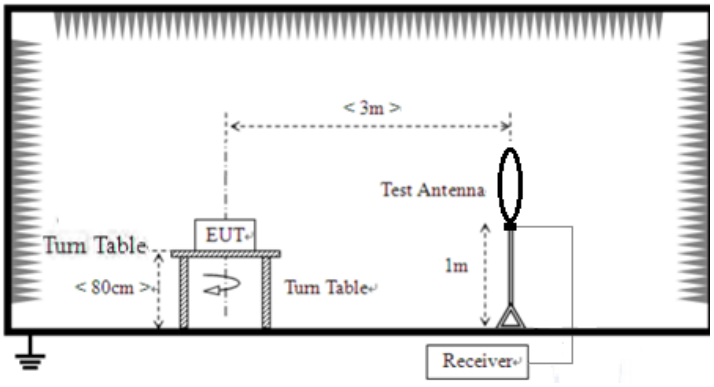
| Frequency | Detector | RBW | VBW | Value |
|---|---|---|---|---|
| 9KHz-150KHz | Quasi-peak | 200Hz | 600Hz | Quasi-peak |
| 150KHz-30MHz | Quasi-peak | 9KHz | 30KHz | Quasi-peak |
| 30MHz-1GHz | Quasi-peak | 120KHz | 300KHz | Quasi-peak |
| Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | Peak | 1MHz | 10Hz | Average |

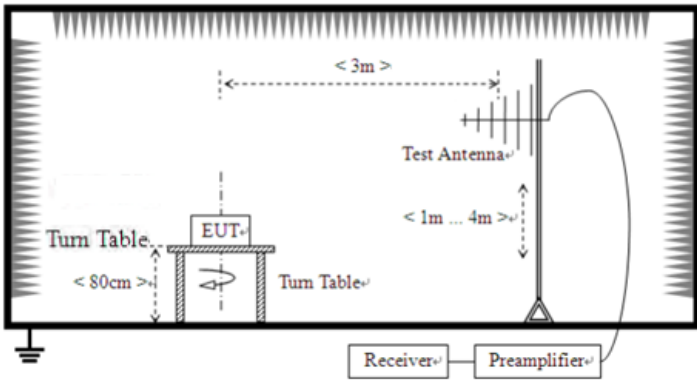
Limit:

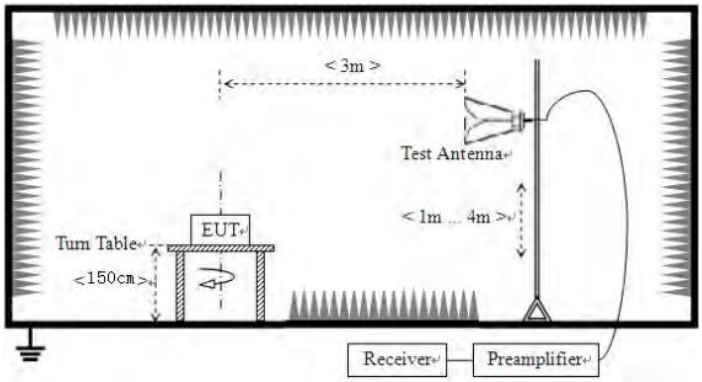
| Frequency | Limit (uV/m) | Value | Measurement Distance |
|---|---|---|---|
| 0.009MHz-0.490MHz | 2400/F(KHz) | QP | 300m |
| 0.490MHz-1.705MHz | 24000/F(KHz) | QP | 30m |
| 1.705MHz-30MHz | 30 | QP | 30m |
| 30MHz-88MHz | 100 | QP | 3m |
| 88MHz-216MHz | 150 | QP | |
| 216MHz-960MHz | 200 | QP | |
| 960MHz-1GHz | 500 | QP | |
| Above 1GHz | 500 | Average | |
| | 5000 | Peak | |

Test setup:

For radiated emissions from 9kHz to 30MHz



<table>
<tr><td></td><td>For radiated emissions from 30MHz to1GHz<br> 

<br>For radiated emissions above 1GHz<br> 
</td></tr>
<tr><td>Test Procedure:</td><td>1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.<br>2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.<br>3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.<br>4. 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 and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.<br>5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.<br>6. 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.</td></tr>
<tr><td>Test Instruments:</td><td colspan="6">Refer to section 6.0 for details</td></tr>
<tr><td>Test mode:</td><td colspan="6">Refer to section 5.2 for details</td></tr>
<tr><td>Test environment:</td><td>Temp.:</td><td>25 °C</td><td>Humid.:</td><td>52%</td><td>Press.:</td><td>1012mbar</td></tr>
</table>

| | |
|---|---|
| Test voltage: | AC 120V, 60Hz |
| Test results: | Pass |

**Measurement data:**

*Remarks:*

1. *During the test, pre-scan the GFSK, π/4-DQPSK modulation, and found the GFSK modulation which it is worse case.*
2. *Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.*

■ **9kHz~30MHz**

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

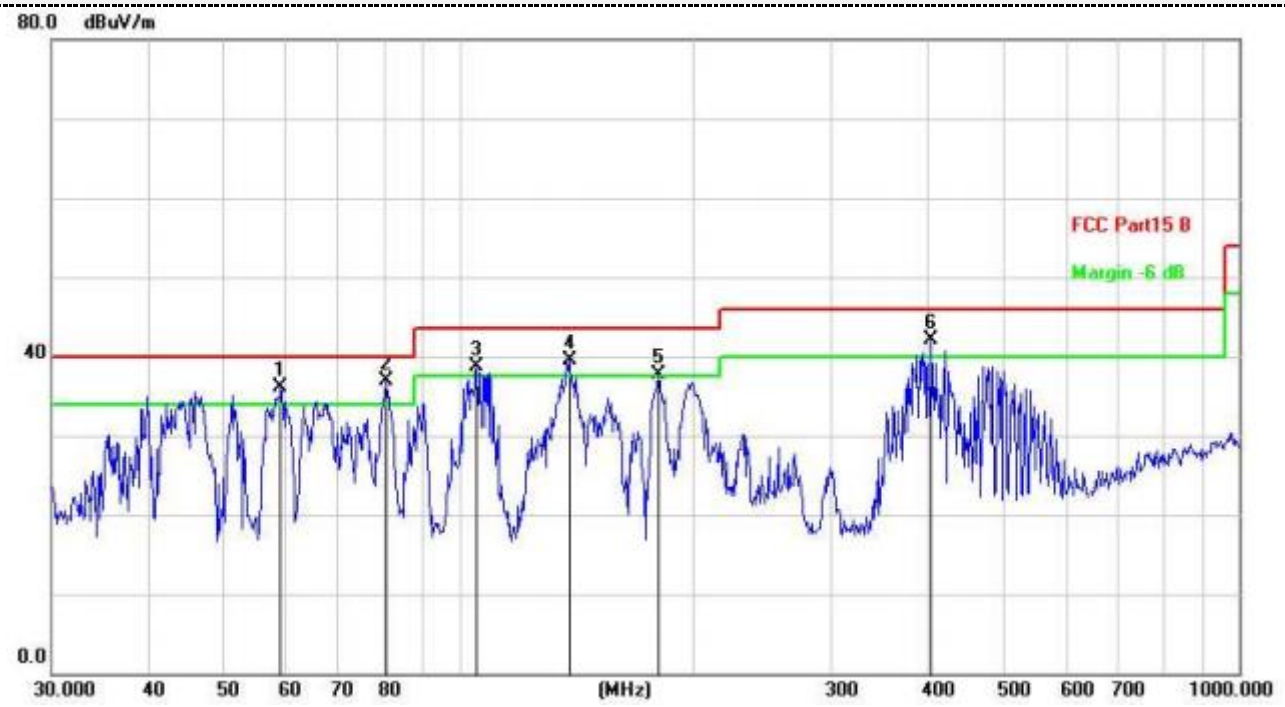
**For 30MHz-1GHz**

Horizontal


| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB/m | dBuV/m | dB/m | dB | Detector |
| 1 | | 79.2425 | 48.05 | -15.11 | 32.94 | 40.00 | -7.06 | QP |
| 2 | | 138.8735 | 47.27 | -11.96 | 35.31 | 43.50 | -8.19 | QP |
| 3 | * | 168.4138 | 50.69 | -10.90 | 39.79 | 43.50 | -3.71 | QP |
| 4 | ! | 200.6879 | 52.33 | -13.39 | 38.94 | 43.50 | -4.56 | QP |
| 5 | | 274.1938 | 47.18 | -11.42 | 35.76 | 46.00 | -10.24 | QP |
| 6 | | 386.6338 | 47.54 | -8.49 | 39.05 | 46.00 | -6.95 | QP |

Final Level =Receiver Read level + Correct Factor

Vertical




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB/m | dBuV/m | dB/m | dB | Detector |
| 1 | ! | 59.0251 | 47.80 | -11.60 | 36.20 | 40.00 | -3.80 | QP |
| 2 | * | 80.6440 | 52.22 | -15.31 | 36.91 | 40.00 | -3.09 | QP |
| 3 | ! | 105.2716 | 53.15 | -14.42 | 38.73 | 43.50 | -4.77 | QP |
| 4 | ! | 138.3873 | 51.46 | -11.99 | 39.47 | 43.50 | -4.03 | QP |
| 5 | ! | 180.0165 | 50.46 | -12.80 | 37.66 | 43.50 | -5.84 | QP |
| 6 | ! | 403.2500 | 50.02 | -7.92 | 42.10 | 46.00 | -3.90 | QP |

Final Level =Receiver Read level + Correct Factor

**For 1GHz to 25GHz**

Remark: For test above 1GHz GFSK,Pi/4 DQPSK were test at Low, Middle, and High channel; only the worst result of GFSK was reported as below:

CH Low (2402MHz)

Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|---|---|
| 4804 | 52.37 | 31.40 | 8.18 | 31.50 | 60.45 | 74.00 | -13.55 | peak |
| 4804 | 37.45 | 31.40 | 8.18 | 31.50 | 45.53 | 54.00 | -8.47 | AVG |
| 7206 | 46.13 | 35.80 | 10.83 | 31.40 | 61.36 | 74.00 | -12.64 | peak |
| 7206 | 28.79 | 35.80 | 10.83 | 31.40 | 44.02 | 54.00 | -9.98 | AVG |
| --- | --- | | | --- | --- | --- | --- | --- |
| --- | --- | | | --- | --- | --- | --- | --- |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | | | |

Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|---|---|
| 4804 | 51.80 | 31.40 | 8.18 | 31.50 | 59.88 | 74.00 | -14.12 | peak |
| 4804 | 36.56 | 31.40 | 8.18 | 31.50 | 44.64 | 54.00 | -9.36 | AVG |
| 7206 | 45.29 | 35.80 | 10.83 | 31.40 | 60.52 | 74.00 | -13.48 | peak |
| 7206 | 29.38 | 35.80 | 10.83 | 31.40 | 44.61 | 54.00 | -9.39 | AVG |
| --- | --- | | | --- | --- | --- | --- | --- |
| --- | --- | | | --- | --- | --- | --- | --- |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | | | |

## CH Middle (2441MHz)

### Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|---|---|
| 4882 | 51.47 | 31.40 | 9.17 | 32.10 | 59.94 | 74.00 | -14.06 | peak |
| 4882 | 38.46 | 31.40 | 9.17 | 32.10 | 46.93 | 54.00 | -7.07 | AVG |
| 7323 | 42.69 | 35.80 | 10.83 | 31.40 | 57.92 | 74.00 | -16.08 | peak |
| 7323 | 28.67 | 35.80 | 10.83 | 31.40 | 43.90 | 54.00 | -10.10 | AVG |
| --- | --- | | | --- | --- | --- | --- | --- |
| --- | --- | | | --- | --- | --- | --- | --- |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | | | |

### Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|---|---|
| 4882 | 52.07 | 31.40 | 9.17 | 32.10 | 60.54 | 74.00 | -13.46 | peak |
| 4882 | 37.14 | 31.40 | 9.17 | 32.10 | 45.61 | 54.00 | -8.39 | AVG |
| 7323 | 43.22 | 35.80 | 10.83 | 31.40 | 58.45 | 74.00 | -15.55 | peak |
| 7323 | 29.61 | 35.80 | 10.83 | 31.40 | 44.84 | 54.00 | -9.16 | AVG |
| --- | --- | | | --- | --- | --- | --- | --- |
| --- | --- | | | --- | --- | --- | --- | --- |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | | | |

CH High (2480MHz)

Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|---|---|
| 4960 | 50.89 | 31.40 | 9.17 | 32.10 | 59.36 | 74.00 | -14.64 | peak |
| 4960 | 38.21 | 31.40 | 9.17 | 32.10 | 46.68 | 54.00 | -7.32 | AVG |
| 7440 | 45.22 | 35.80 | 10.83 | 31.40 | 60.45 | 74.00 | -13.55 | peak |
| 7440 | 29.78 | 35.80 | 10.83 | 31.40 | 45.01 | 54.00 | -8.99 | AVG |
| --- | --- | | | --- | --- | --- | --- | --- |
| --- | --- | | | --- | --- | --- | --- | --- |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | | | |

Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Antenna Factor (dB/m) | Cable Loss (dB) | Preamp Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|---|---|
| 4960 | 51.48 | 31.40 | 9.17 | 32.10 | 59.95 | 74.00 | -14.05 | peak |
| 4960 | 37.46 | 31.40 | 9.17 | 32.10 | 45.93 | 54.00 | -8.07 | AVG |
| 7440 | 44.96 | 35.80 | 10.83 | 31.40 | 60.19 | 74.00 | -13.81 | peak |
| 7440 | 28.53 | 35.80 | 10.83 | 31.40 | 43.76 | 54.00 | -10.24 | AVG |
| --- | --- | | | --- | --- | --- | --- | --- |
| --- | --- | | | --- | --- | --- | --- | --- |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | | | |

Remark：
(1) 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.
(2) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed.

## 6.9. Antenna Requirement

**Standard Applicable**

**For intentional device, according to FCC 47 CFR Section 15.203:**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

**FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1) (I):**

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

**Antenna Connected Construction**

The maximum gain of antenna was -0.58 dBi.

Remark:The antenna gain is provided by the customer , if the data provided by the customer is not accurate, Shenzhen HTT Technology Co.,Ltd. does not assume any responsibility.

# 7. Test Setup Photo

Reference to the **appendix I** for details.

# 8. EUT Constructional Details

Reference to the **appendix II** for details.

------End------