# TEST REPORT

| | |
|---|---|
| **Applicant:** | Shenzhen Yingzhiqi Technology Co.Ltd |
| **Address of Applicant:** | 18A, Ruijun building, No. 108, Shangxing community Central Road, Xinqiao street, Bao'an District, Shenzhen |
| **Manufacturer:** | Shenzhen Yingzhiqi Technology Co.Ltd |
| **Address of Manufacturer:** | 18A, Ruijun building, No. 108, Shangxing community Central Road, Xinqiao street, Bao'an District, Shenzhen |

**Equipment Under Test (EUT)**

| | |
|---|---|
| Product Name: | IRONBEE |
| Model No.: | SK072 |
| Trade Mark: | INKEE |
| **FCC ID:** | **2A2GI-SK072** |
| **Applicable standards:** | FCC CFR Title 47 Part 15 Subpart C Section 15.247 |
| **Date of sample receipt:** | Jun.18,2021 |
| **Date of Test:** | Jun.18,2021- Jun.30,2021 |
| **Date of report issued:** | Jun.30,2021 |
| **Test Result :** | PASS * |

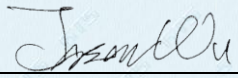
* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

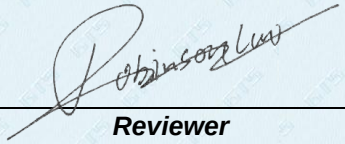
**Robinson Luo**
**Laboratory Manager**

## 2 Version

| Version No. | Date | Description |
|---|---|---|
| *00* | *Jun.30,2021* | *Original* |
| | | |
| | | |
| | | |
| | | |

***Tested/Prepared By:***  ***Date:*** ***Jun.30,2021***

***Project Engineer***

***Check By:***  ***Date:*** ***Jun.30,2021***

***Reviewer***

# 3 Contents

# 4 Test Summary

| Test Item | Section in CFR 47 | Result |
|---|---|---|
| Antenna requirement | 15.203 | Pass |
| AC Power Line Conducted Emission | 15.207 | Pass |
| Conducted Peak Output Power | 15.247 (b)(3) | Pass |
| 6dB Bandwidth | 15.247 (a)(2) | Pass |
| Power Spectral Density | 15.247 (e) | Pass |
| RF Conducted Spurious Emissions & Band Edge | 15.247(d) | Pass |
| Radiated Spurious Emissions | 15.205/15.209(a) | 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 | 30MHz-200MHz | 3.8039dB | (1) |
| Radiated Emission | 200MHz-1GHz | 3.9679dB | (1) |
| Radiated Emission | 1GHz-18GHz | 4.29dB | (1) |
| Radiated Emission | 18GHz-40GHz | 3.30dB | (1) |
| AC Power Line Conducted Emission | 0.15MHz ~ 30MHz | 3.44dB | (1) |
| Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%. | | | |

# 5 General Information

## 5.1 General Description of EUT

| | |
|---|---|
| Product Name: | IRONBEE |
| Model No.: | SK072 |
| Test sample(s) ID: | GTSL202106000231-1(Engineer sample)<br>GTSL202106000231-2(Normal sample) |
| Operation frequency | 2402~2480 MHz |
| Number of Channels | 40 |
| Modulation Type | GFSK |
| Channel separation | 2MHz |
| Antenna Type: | PCB Antenna |
| Antenna Gain: | 0dBi |
| Power Supply: | DC 3.7V Form Battery and DC 5V From External Circuit |
| Adapter Information<br>(Auxiliary test provided by the lab): | Mode: CD122<br>Input: AC100-240V, 50/60Hz, 500mA<br>Output: DC 5V, 2A |

**Channel List:**

| 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** |

Note: The line display in grey were the channel selected for testing

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 | 2440MHz |
| The Highest channel | 2480MHz |

## 5.2 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.* | |

## 5.3 Description of Support Units

None.

## 5.4 Deviation from Standards

None.

## 5.5 Abnormalities from Standard Conditions

None.

## 5.6 Test Facility

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

● **FCC—Registration No.: 381383**

Designation Number: CN5029

Global United Technology Services Co., Ltd., Shenzhen 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 files.

● **IC —Registration No.: 9079A**

CAB identifier: CN0091

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

● **NVLAP (LAB CODE:600179-0)**

Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accred itation Program (NVLAP).

## 5.7 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.
Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102
Tel: 0755-27798480
Fax: 0755-27798960

## 5.8 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 |
| Duty Cycle | The EUT can be set to operate at duty cycle >=98% during the test. |

# 6 Test Instruments list

| Radiated Emission: | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal.Date (mm-dd-yy)** | **Cal.Due date (mm-dd-yy)** |
| 1 | 3m Semi- Anechoic Chamber | ZhongYu Electron | 9.2(L)*6.2(W)* 6.4(H) | GTS250 | July. 02 2020 | July. 01 2025 |
| 2 | Control Room | ZhongYu Electron | 6.2(L)*2.5(W)* 2.4(H) | GTS251 | N/A | N/A |
| 3 | EMI Test Receiver | Rohde & Schwarz | ESU26 | GTS203 | June. 24 2021 | June. 23 2022 |
| 4 | BiConiLog Antenna | SCHWARZBECK MESS-ELEKTRONIK | VULB9163 | GTS214 | June. 24 2021 | June. 23 2022 |
| 5 | Double -ridged waveguide horn | SCHWARZBECK MESS-ELEKTRONIK | BBHA 9120 D | GTS208 | June. 24 2021 | June. 23 2022 |
| 6 | Horn Antenna | ETS-LINDGREN | 3160 | GTS217 | June. 24 2021 | June. 23 2022 |
| 7 | EMI Test Software | AUDIX | E3 | N/A | N/A | N/A |
| 8 | Coaxial Cable | GTS | N/A | GTS213 | June. 24 2021 | June. 23 2022 |
| 9 | Coaxial Cable | GTS | N/A | GTS211 | June. 24 2021 | June. 23 2022 |
| 10 | Coaxial cable | GTS | N/A | GTS210 | June. 24 2021 | June. 23 2022 |
| 11 | Coaxial Cable | GTS | N/A | GTS212 | June. 24 2021 | June. 23 2022 |
| 12 | Amplifier(100kHz-3GHz) | HP | 8347A | GTS204 | June. 24 2021 | June. 23 2022 |
| 13 | Amplifier(2GHz-20GHz) | HP | 84722A | GTS206 | June. 24 2021 | June. 23 2022 |
| 14 | Amplifier (18-26GHz) | Rohde & Schwarz | AFS33-18002 650-30-8P-44 | GTS218 | June. 24 2021 | June. 23 2022 |
| 15 | Band filter | Amindeon | 82346 | GTS219 | June. 24 2021 | June. 23 2022 |
| 16 | Power Meter | Anritsu | ML2495A | GTS540 | June. 24 2021 | June. 23 2022 |
| 17 | Power Sensor | Anritsu | MA2411B | GTS541 | June. 24 2021 | June. 23 2022 |
| 18 | Wideband Radio Communication Tester | Rohde & Schwarz | CMW500 | GTS575 | June. 24 2021 | June. 23 2022 |
| 19 | Splitter | Agilent | 11636B | GTS237 | June. 24 2021 | June. 23 2022 |
| 20 | Loop Antenna | ZHINAN | ZN30900A | GTS534 | June. 24 2021 | June. 23 2022 |
| 21 | Breitband hornantenne | SCHWARZBECK | BBHA 9170 | GTS579 | Oct. 18 2020 | Oct. 17 2021 |
| 22 | Amplifier | TDK | PA-02-02 | GTS574 | Oct. 18 2020 | Oct. 17 2021 |
| 23 | Amplifier | TDK | PA-02-03 | GTS576 | Oct. 18 2020 | Oct. 17 2021 |
| 24 | PSA Series Spectrum Analyzer | Rohde & Schwarz | FSP | GTS578 | June. 24 2021 | June. 23 2022 |

| Conducted Emission | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal.Date (mm-dd-yy)** | **Cal.Due date (mm-dd-yy)** |
| 1 | Shielding Room | ZhongYu Electron | 7.3(L)x3.1(W)x2.9(H) | GTS252 | May.15 2019 | May.14 2022 |
| 2 | EMI Test Receiver | R&S | ESCI 7 | GTS552 | June. 24 2021 | June. 23 2022 |
| 3 | Coaxial Switch | ANRITSU CORP | MP59B | GTS225 | June. 24 2021 | June. 23 2022 |
| 4 | ENV216 2-L-V-NETZNACHB.DE | ROHDE&SCHWARZ | ENV216 | GTS226 | June. 24 2021 | June. 23 2022 |
| 5 | Coaxial Cable | GTS | N/A | GTS227 | N/A | N/A |
| 6 | EMI Test Software | AUDIX | E3 | N/A | N/A | N/A |
| 7 | Thermo meter | KTJ | TA328 | GTS233 | June. 24 2021 | June. 23 2022 |
| 8 | Absorbing clamp | Elektronik-Feinmechanik | MDS21 | GTS229 | June. 24 2021 | June. 23 2022 |
| 9 | ISN | SCHWARZBECK | NTFM 8158 | GTS565 | June. 24 2021 | June. 23 2022 |
| 10 | High voltage probe | SCHWARZBECK | TK9420 | GTS537 | July. 10 2020 | July. 09 2021 |

| RF Conducted Test: | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Serial No.** | **Cal.Date (mm-dd-yy)** | **Cal.Due date (mm-dd-yy)** |
| 1 | MXA Signal Analyzer | Agilent | N9020A | GTS566 | June. 24 2021 | June. 23 2022 |
| 2 | EMI Test Receiver | R&S | ESCI 7 | GTS552 | June. 24 2021 | June. 23 2022 |
| 3 | Spectrum Analyzer | Agilent | E4440A | GTS533 | June. 24 2021 | June. 23 2022 |
| 4 | MXG vector Signal Generator | Agilent | N5182A | GTS567 | June. 24 2021 | June. 23 2022 |
| 5 | ESG Analog Signal Generator | Agilent | E4428C | GTS568 | June. 24 2021 | June. 23 2022 |
| 6 | USB RF Power Sensor | DARE | RPR3006W | GTS569 | June. 24 2021 | June. 23 2022 |
| 7 | RF Switch Box | Shongyi | RFSW3003328 | GTS571 | June. 24 2021 | June. 23 2022 |
| 8 | Programmable Constant Temp & Humi Test Chamber | WEWON | WHTH-150L-40-880 | GTS572 | June. 24 2021 | June. 23 2022 |

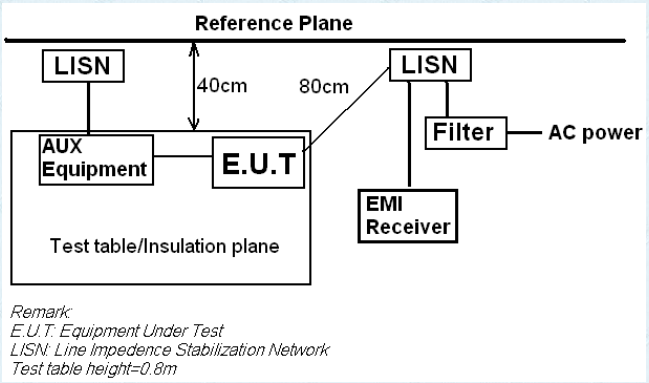
| General used equipment: | | | | | | |
|---|---|---|---|---|---|---|
| **Item** | **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal.Date (mm-dd-yy)** | **Cal.Due date (mm-dd-yy)** |
| 1 | Humidity/ Temperature Indicator | KTJ | TA328 | GTS243 | June. 24 2021 | June. 23 2022 |
| 2 | Barometer | ChangChun | DYM3 | GTS255 | June. 24 2021 | June. 23 2022 |

# 7 Test results and Measurement Data

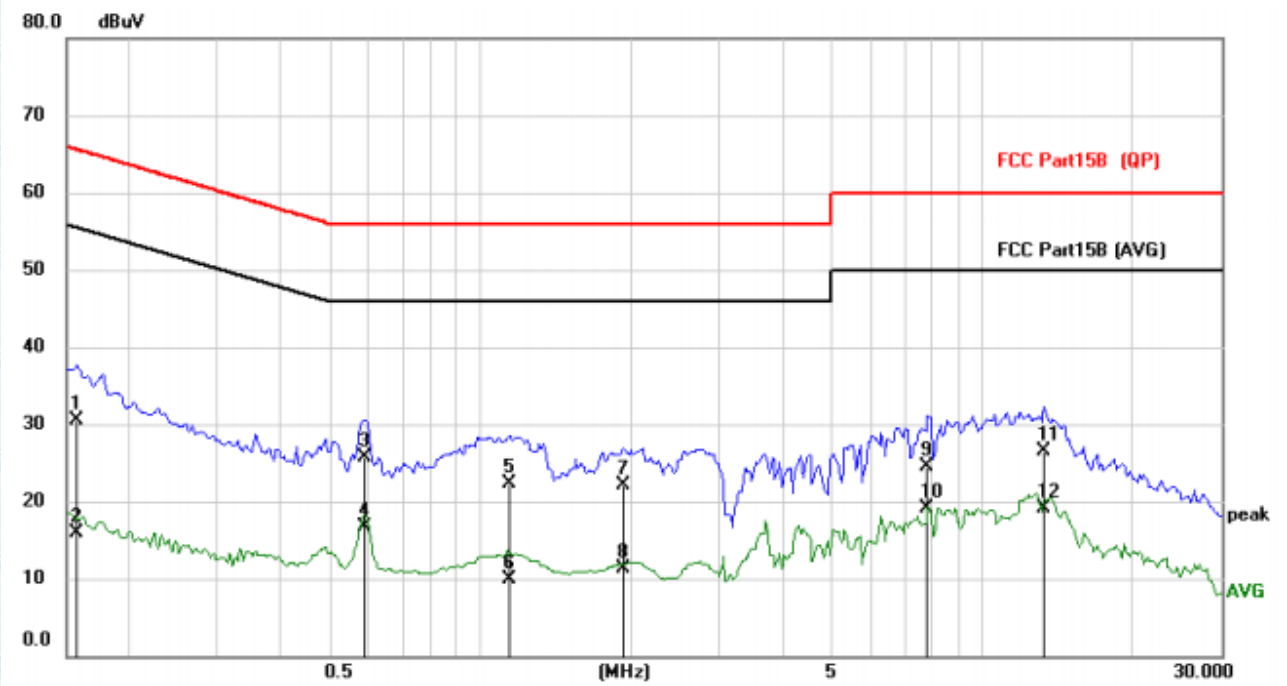
## 7.1 Antenna requirement

| | |
|---|---|
| **Standard requirement:** | FCC Part15 C Section 15.203 |
| **15.203 requirement:**<br>An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.<br>**15.247(c) (1)(i) requirement:**<br>(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. | |
| **E.U.T Antenna:** | |
| *The antenna is* PCB Antenna*, the best case gain of the is 0dBi, reference to the appendix II for details* | |

## 7.2 Conducted Emissions

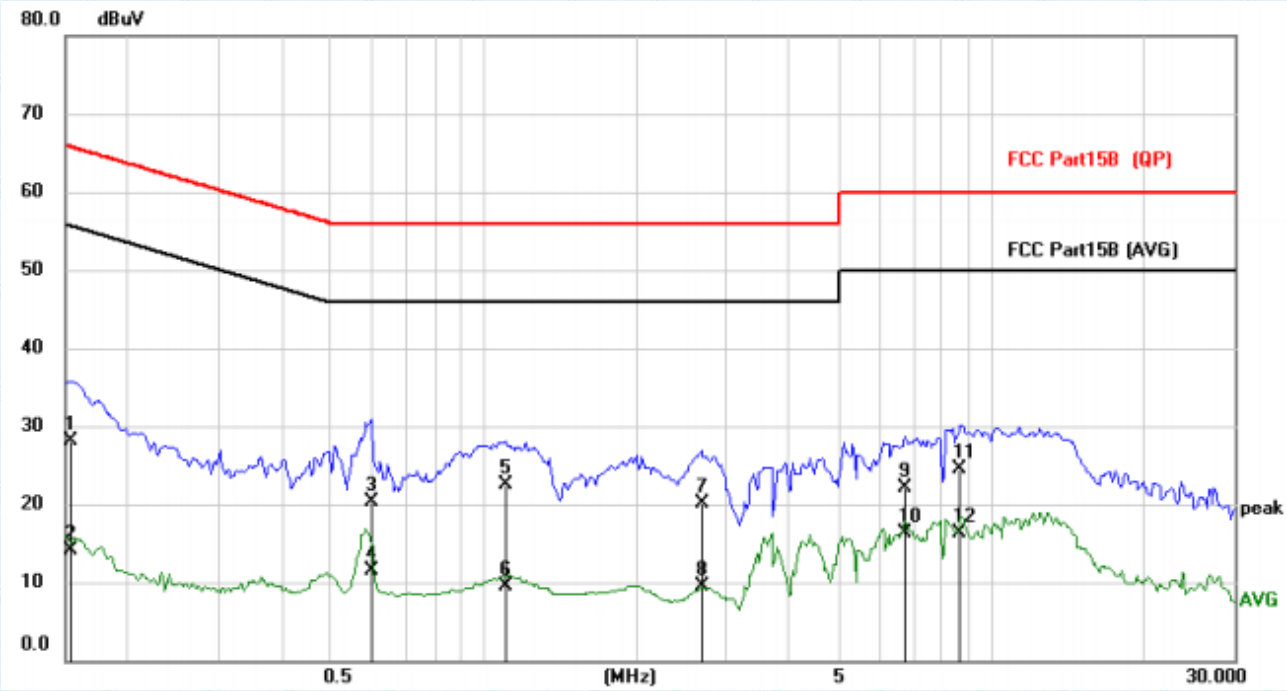
| | |
|---|---|
| Test Requirement: | FCC Part15 C Section 15.207 |
| Test Method: | ANSI C63.10:2013 |
| Test Frequency Range: | 150KHz to 30MHz |
| Class / Severity: | Class B |
| Receiver setup: | RBW=9KHz, VBW=30KHz, Sweep time=auto |
| Limit: | Frequency range (MHz) / Limit (dBuV): Quasi-peak / 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 C63.10:2009 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 |

**Measurement data**
**Line:**




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.1578 | 19.66 | 10.93 | 30.59 | 65.58 | -34.99 | QP |
| 2 | | 0.1578 | 5.04 | 10.93 | 15.97 | 55.58 | -39.61 | AVG |
| 3 | | 0.5907 | 14.73 | 10.92 | 25.65 | 56.00 | -30.35 | QP |
| 4 | * | 0.5907 | 5.80 | 10.92 | 16.72 | 46.00 | -29.28 | AVG |
| 5 | | 1.1445 | 11.36 | 10.92 | 22.28 | 56.00 | -33.72 | QP |
| 6 | | 1.1445 | -1.05 | 10.92 | 9.87 | 46.00 | -36.13 | AVG |
| 7 | | 1.9323 | 11.20 | 10.96 | 22.16 | 56.00 | -33.84 | QP |
| 8 | | 1.9323 | 0.38 | 10.96 | 11.34 | 46.00 | -34.66 | AVG |
| 9 | | 7.7970 | 13.34 | 11.24 | 24.58 | 60.00 | -35.42 | QP |
| 10 | | 7.7970 | 7.89 | 11.24 | 19.13 | 50.00 | -30.87 | AVG |
| 11 | | 13.2765 | 15.01 | 11.42 | 26.43 | 60.00 | -33.57 | QP |
| 12 | | 13.2765 | 7.59 | 11.42 | 19.01 | 50.00 | -30.99 | AVG |

**Neutral:**

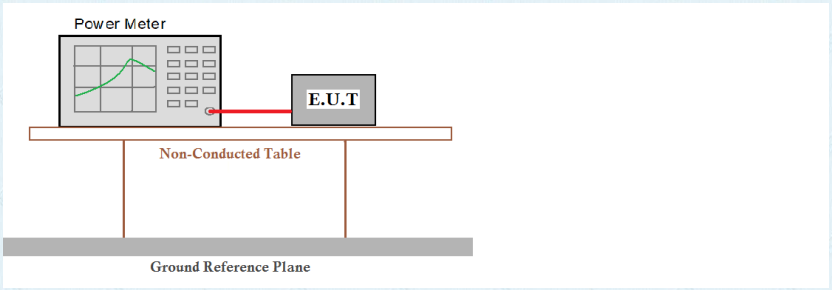



| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.1539 | 17.13 | 10.92 | 28.05 | 65.79 | -37.74 | QP |
| 2 | | 0.1539 | 3.11 | 10.92 | 14.03 | 55.79 | -41.76 | AVG |
| 3 | | 0.6023 | 9.33 | 10.92 | 20.25 | 56.00 | -35.75 | QP |
| 4 | | 0.6023 | 0.55 | 10.92 | 11.47 | 46.00 | -34.53 | AVG |
| 5 | * | 1.1055 | 11.60 | 10.92 | 22.52 | 56.00 | -33.48 | QP |
| 6 | | 1.1055 | -1.42 | 10.92 | 9.50 | 46.00 | -36.50 | AVG |
| 7 | | 2.6810 | 9.16 | 11.00 | 20.16 | 56.00 | -35.84 | QP |
| 8 | | 2.6810 | -1.53 | 11.00 | 9.47 | 46.00 | -36.53 | AVG |
| 9 | | 6.7440 | 10.97 | 11.19 | 22.16 | 60.00 | -37.84 | QP |
| 10 | | 6.7440 | 5.03 | 11.19 | 16.22 | 50.00 | -33.78 | AVG |
| 11 | | 8.6784 | 13.20 | 11.29 | 24.49 | 60.00 | -35.51 | QP |
| 12 | | 8.6784 | 4.92 | 11.29 | 16.21 | 50.00 | -33.79 | 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 Loss*
4. *If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.*

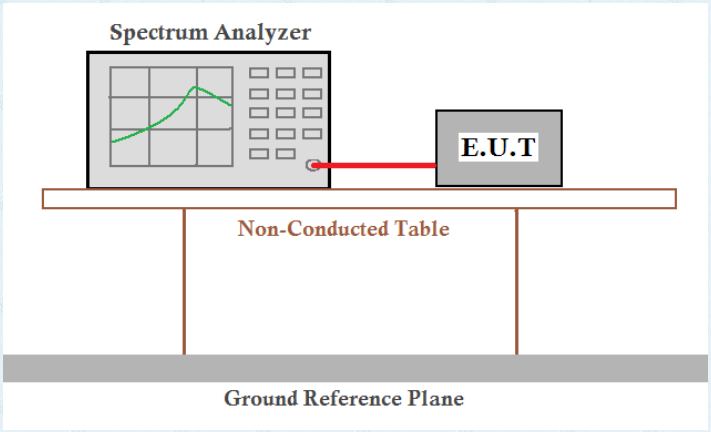
## 7.3 Conducted Output Power

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (b)(3) | | | | | |
| Test Method: | ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 | | | | | |
| Limit: | 30dBm | | | | | |
| 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**

| Test channel | Peak Output Power (dBm) | Limit(dBm) | Result |
|---|---|---|---|
| Lowest | 5.41 | 30.00 | Pass |
| Middle | 6.06 | | |
| Highest | 6.33 | | |

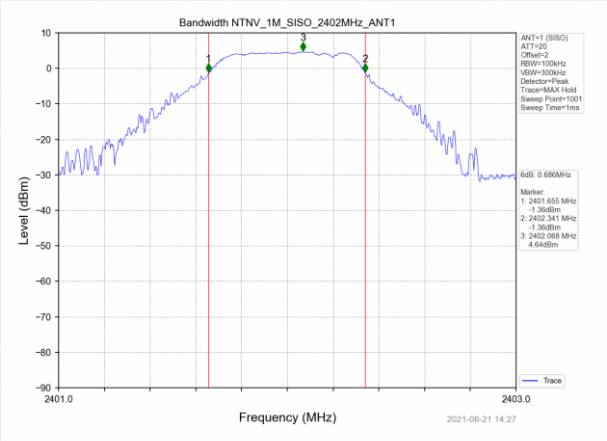
## 7.4 Channel Bandwidth

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(2) | | | | | |
| Test Method: | ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 | | | | | |
| Limit: | >500KHz | | | | | |
| 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 |

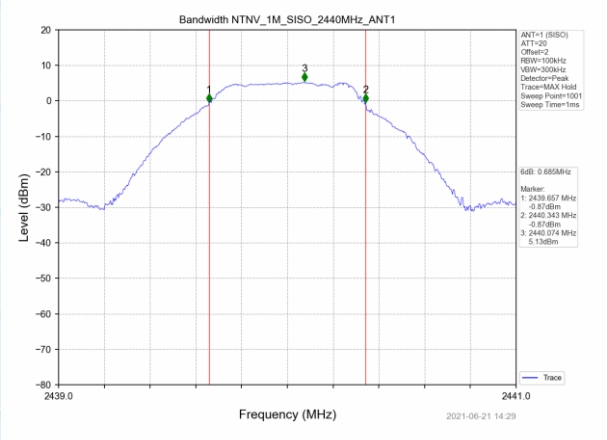
**Measurement Data**

| Test channel | Channel Bandwidth (MHz) | Limit(KHz) | Result |
|---|---|---|---|
| Lowest | 0.686 | >500 | Pass |
| Middle | 0.685 | | |
| Highest | 0.715 | | |

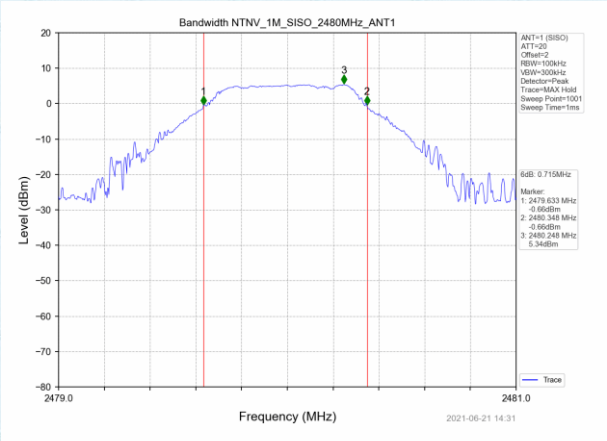
**Test plot as follows:**




Lowest channel

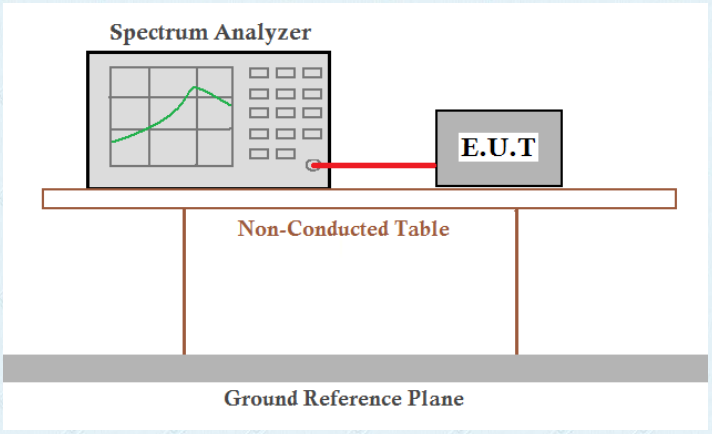



Middle channel




Highest channel

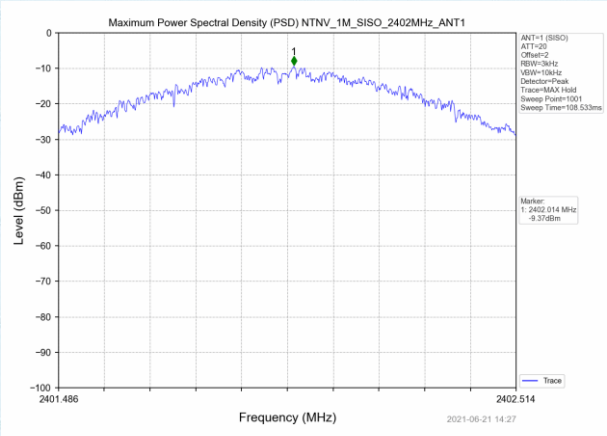
## 7.5 Power Spectral Density

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (e) | | | | | |
| Test Method: | ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 | | | | | |
| Limit: | 8dBm/3kHz | | | | | |
| 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 |

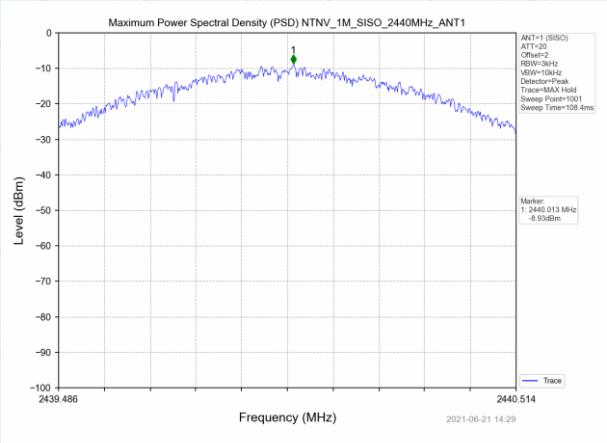
**Measurement Data**

| Test channel | Power Spectral Density (dBm/3kHz) | Limit(dBm/3kHz) | Result |
|---|---|---|---|
| Lowest | -9.37 | 8.00 | Pass |
| Middle | -8.93 | | |
| Highest | -9.05 | | |

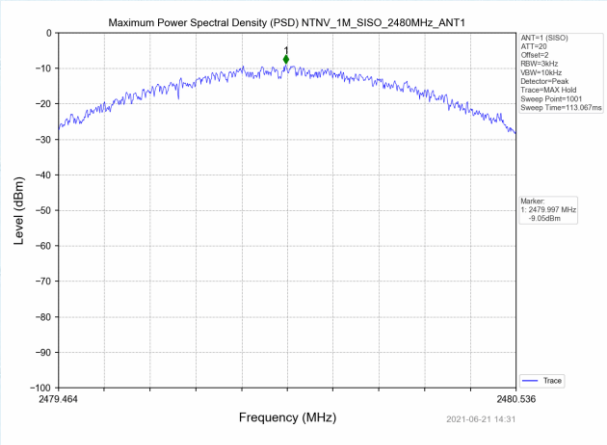
**Test plot as follows:**




Lowest channel



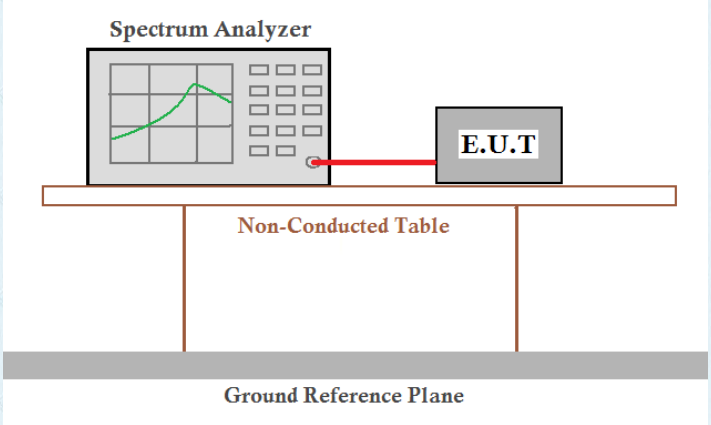

Middle channel



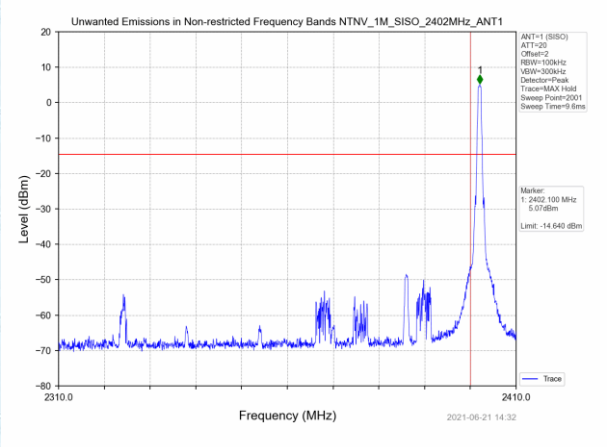

Highest channel

## 7.6 Band edges

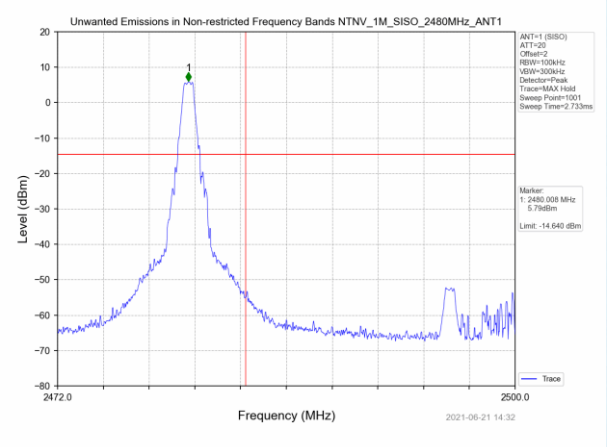
### 7.6.1 Conducted Emission Method

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (d) | | | | | |
| Test Method: | ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 | | | | | |
| 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:**

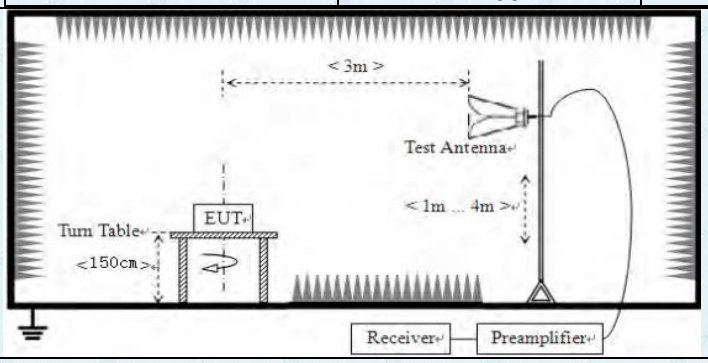



Lowest channel




Highest channel

### 7.6.2 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: Above 1GHz — Detector: Peak, RBW: 1MHz, VBW: 3MHz, Value: Peak; Detector: RMS, RBW: 1MHz, VBW: 3MHz, Value: Average |
| Limit: | Frequency: Above 1GHz — Limit (dBuV/m @3m): 54.00, Value: Average; Limit (dBuV/m @3m): 74.00, Value: Peak |
| 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.<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.<br>7. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report. |
| 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**

Operation Mode: GFSK TX Low channel(2402MHz)

Horizontal (Worst case)

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBµV) | (dB) | (dBµV/m) | (dBµV/m) | (dB) | |
| 2390 | 56.72 | -5.68 | 51.04 | 74.00 | -22.96 | peak |
| 2390 | 47.15 | -5.68 | 41.47 | 54.00 | -12.53 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Vertical:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBµV) | (dB) | (dBµV/m) | (dBµV/m) | (dB) | |
| 2390 | 61.04 | -5.68 | 55.36 | 74.00 | -18.64 | peak |
| 2390 | 44.79 | -5.68 | 39.11 | 54.00 | -14.89 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Operation Mode: GFSK TX High channel (2480MHz)

Horizontal (Worst case)

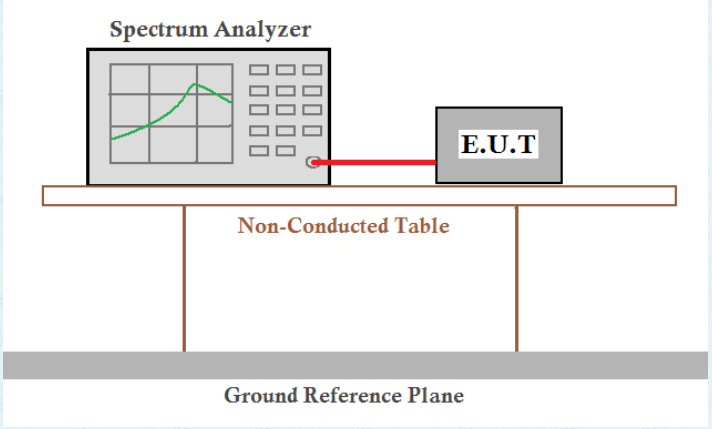
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2483.5 | 58.71 | -5.85 | 52.86 | 74.00 | -21.14 | peak |
| 2483.5 | 45.93 | -5.85 | 40.08 | 54.00 | -13.92 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | |

Vertical:

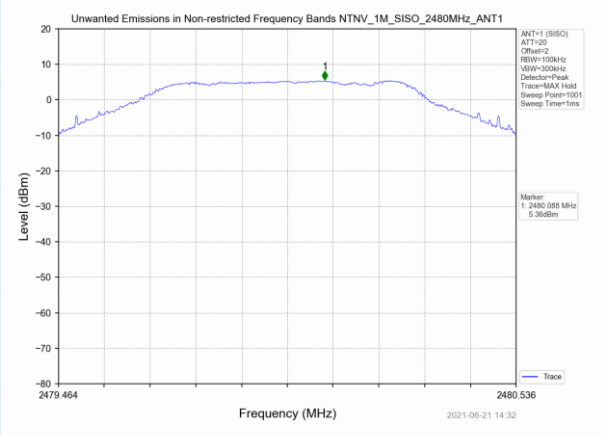
| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2483.5 | 61.77 | -5.85 | 55.92 | 74.00 | -18.08 | peak |
| 2483.5 | 46.08 | -5.85 | 40.23 | 54.00 | -13.77 | AVG |
| Remark: 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. | | | | | | |

## 7.7 Spurious Emission

### 7.7.1 Conducted Emission Method

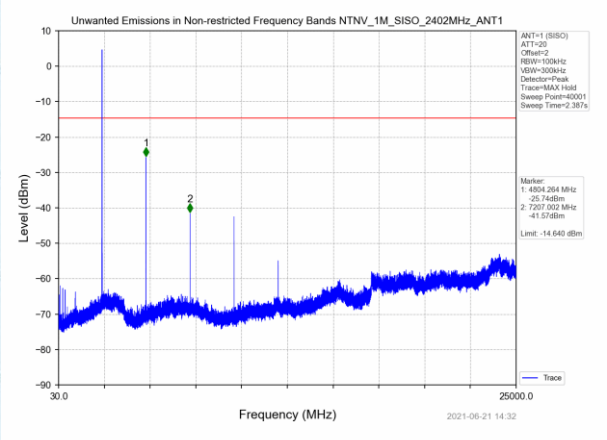
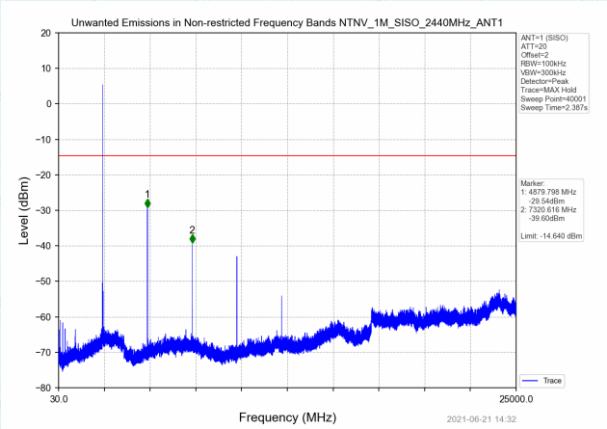
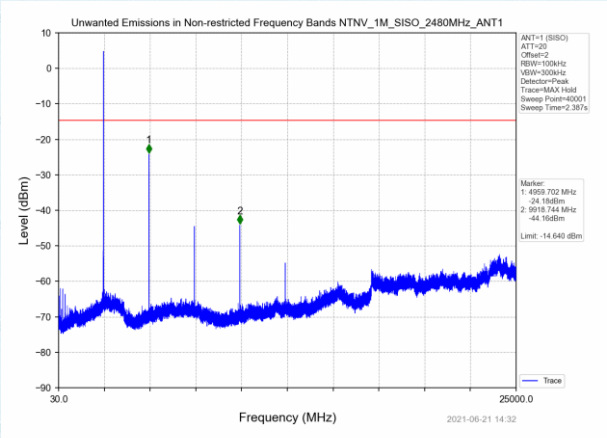
| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (d) | | | | | |
| Test Method: | ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 | | | | | |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional 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 |

***GFSK***

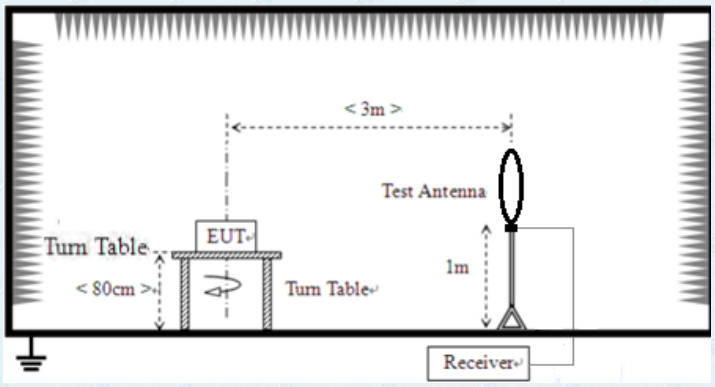


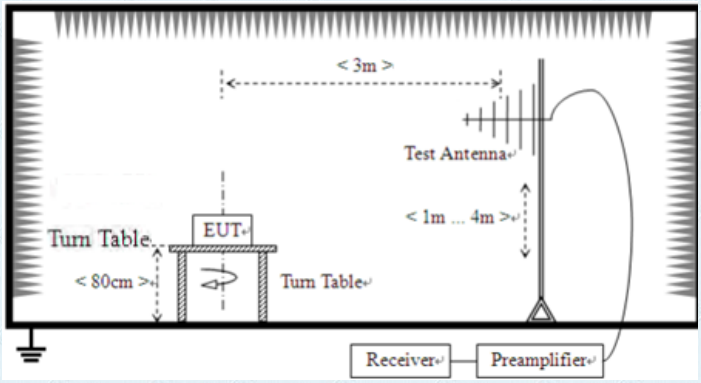
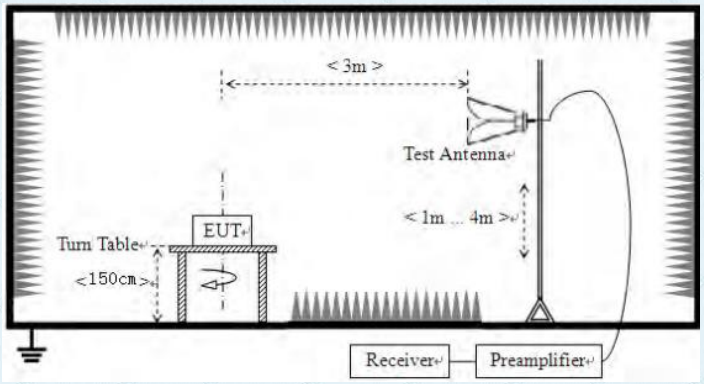

***reference***

**Test plot as follows:**

| ***GFSK*** |
|---|
|  |
| ***Low Channel*** |
|  |
| ***Mid Channel*** |
|  |
| ***High Channel*** |

### 7.7.2 Radiated Emission Method

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.209</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10:2013</td></tr>
<tr><td>Test Frequency Range:</td><td>9kHz to 25GHz</td></tr>
<tr><td>Test site:</td><td>Measurement Distance: 3m</td></tr>
<tr><td>Receiver setup:</td><td>
<table>
<tr><th>Frequency</th><th>Detector</th><th>RBW</th><th>VBW</th><th>Value</th></tr>
<tr><td>9KHz-150KHz</td><td>Quasi-peak</td><td>200Hz</td><td>600Hz</td><td>Quasi-peak</td></tr>
<tr><td>150KHz-30MHz</td><td>Quasi-peak</td><td>9KHz</td><td>30KHz</td><td>Quasi-peak</td></tr>
<tr><td>30MHz-1GHz</td><td>Quasi-peak</td><td>120KHz</td><td>300KHz</td><td>Quasi-peak</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>Peak</td><td>1MHz</td><td>3MHz</td><td>Peak</td></tr>
<tr><td>Peak</td><td>1MHz</td><td>10Hz</td><td>Average</td></tr>
</table>
</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><th>Frequency</th><th>Limit (uV/m)</th><th>Value</th><th>Measurement Distance</th></tr>
<tr><td>0.009MHz-0.490MHz</td><td>2400/F(KHz)</td><td>QP</td><td>300m</td></tr>
<tr><td>0.490MHz-1.705MHz</td><td>24000/F(KHz)</td><td>QP</td><td>30m</td></tr>
<tr><td>1.705MHz-30MHz</td><td>30</td><td>QP</td><td>30m</td></tr>
<tr><td>30MHz-88MHz</td><td>100</td><td>QP</td><td rowspan="7">3m</td></tr>
<tr><td>88MHz-216MHz</td><td>150</td><td>QP</td></tr>
<tr><td>216MHz-960MHz</td><td>200</td><td>QP</td></tr>
<tr><td>960MHz-1GHz</td><td>500</td><td>QP</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>500</td><td>Average</td></tr>
<tr><td>5000</td><td>Peak</td></tr>
</table>
</td></tr>
<tr><td>Test setup:</td><td>For radiated emissions from 9kHz to 30MHz<br> 
</td></tr>
</table>

| | |
|---|---|
| | For radiated emissions from 30MHz to1GHz<br>  <br><br>For radiated emissions above 1GHz<br>  <br> |
| Test Procedure: | 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. |
| 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 | | | | | |

**Measurement data:**

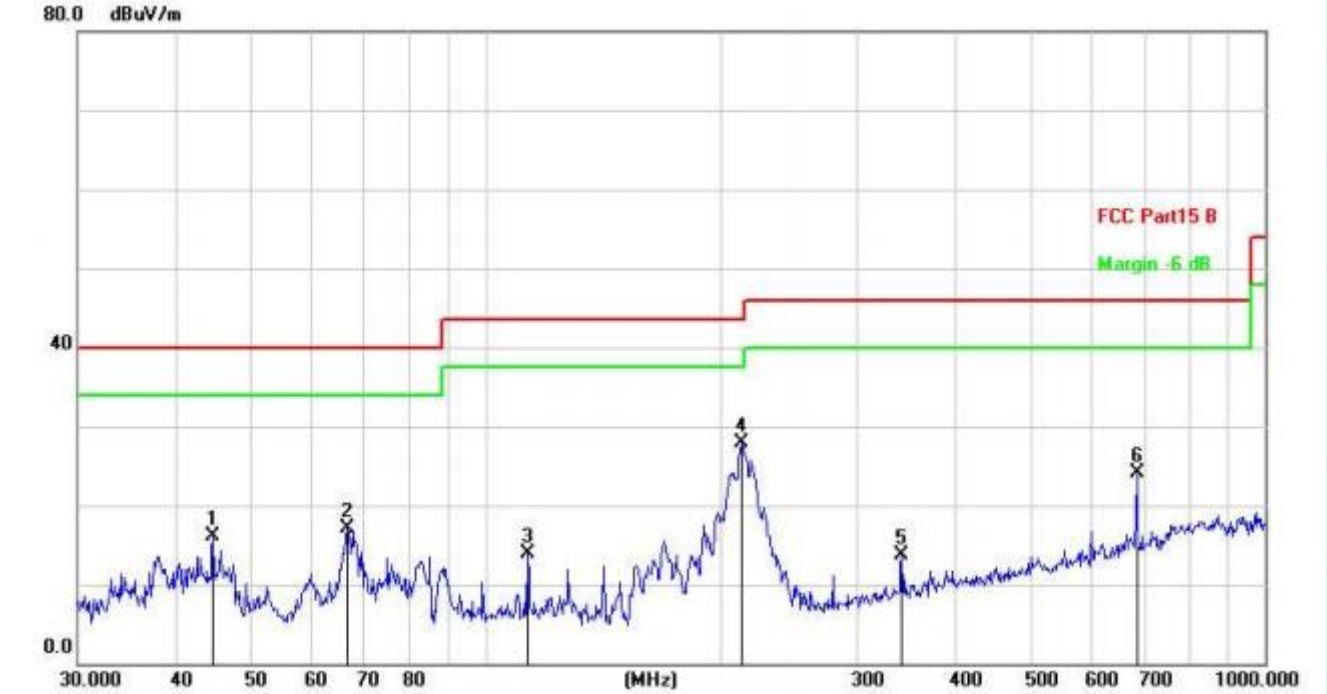
*Remark:*
*Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.*

■ **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.

■ **Below 1GHz**

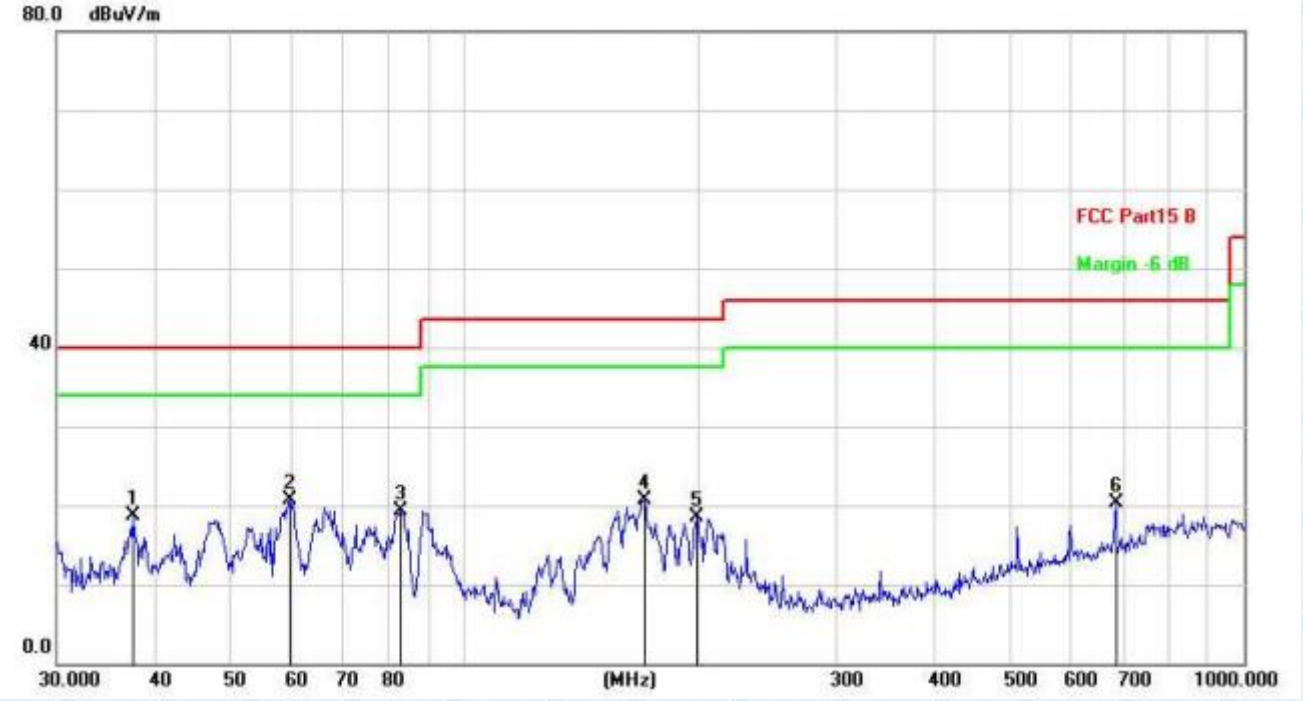
■ Horizontal




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dB/m | dB | Detector |
| 1 | | 44.7433 | 34.03 | -17.89 | 16.14 | 40.00 | -23.86 | QP |
| 2 | | 66.4989 | 36.55 | -19.52 | 17.03 | 40.00 | -22.97 | QP |
| 3 | | 113.3162 | 33.99 | -20.11 | 13.88 | 43.50 | -29.62 | QP |
| 4 | * | 213.0150 | 47.53 | -19.67 | 27.86 | 43.50 | -15.64 | QP |
| 5 | | 341.9786 | 31.70 | -17.93 | 13.77 | 46.00 | -32.23 | QP |
| 6 | | 684.7454 | 36.24 | -12.07 | 24.17 | 46.00 | -21.83 | QP |

Final Level =Receiver Read level + Correct Factor

Vertical




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dB/m | dB | Detector |
| 1 | | 37.6798 | 36.75 | -18.12 | 18.63 | 40.00 | -21.37 | QP |
| 2 | * | 59.6493 | 39.36 | -18.74 | 20.62 | 40.00 | -19.38 | QP |
| 3 | | 82.9385 | 40.21 | -20.96 | 19.25 | 40.00 | -20.75 | QP |
| 4 | | 170.1948 | 37.06 | -16.33 | 20.73 | 43.50 | -22.77 | QP |
| 5 | | 198.5880 | 38.71 | -20.15 | 18.56 | 43.50 | -24.94 | QP |
| 6 | | 684.7454 | 32.45 | -12.07 | 20.38 | 46.00 | -25.62 | QP |

Final Level =Receiver Read level + Correct Factor

■ **Above 1GHz**

CH Low (2402MHz)

Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 4804 | 61.72 | -3.61 | 58.11 | 74.00 | -15.89 | peak |
| 4804 | 45.83 | -3.61 | 42.22 | 54.00 | -11.78 | AVG |
| 7206 | 55.58 | -0.85 | 54.73 | 74.00 | -19.27 | peak |
| 7206 | 44.71 | -0.85 | 43.86 | 54.00 | -10.14 | 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 |
|---|---|---|---|---|---|---|
| 4804 | 61.38 | -3.61 | 57.77 | 74.00 | -16.23 | peak |
| 4804 | 45.79 | -3.61 | 42.18 | 54.00 | -11.82 | AVG |
| 7206 | 55.85 | -0.85 | 55.00 | 74.00 | -19.00 | peak |
| 7206 | 42.36 | -0.85 | 41.51 | 54.00 | -12.49 | 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 |
|---|---|---|---|---|---|---|
| 4880 | 63.02 | -3.49 | 59.53 | 74.00 | -14.47 | peak |
| 4880 | 45.72 | -3.49 | 42.23 | 54.00 | -11.77 | AVG |
| 7320 | 57.59 | -0.80 | 56.79 | 74.00 | -17.21 | peak |
| 7320 | 40.34 | -0.80 | 39.54 | 54.00 | -14.46 | 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 |
|---|---|---|---|---|---|---|
| 4880 | 61.35 | -3.49 | 57.86 | 74.00 | -16.14 | peak |
| 4880 | 45.29 | -3.49 | 41.80 | 54.00 | -12.20 | AVG |
| 7320 | 56.72 | -0.80 | 55.92 | 74.00 | -18.08 | peak |
| 7320 | 43.28 | -0.80 | 42.48 | 54.00 | -11.52 | 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 |
|---|---|---|---|---|---|---|
| 4960 | 61.36 | -3.41 | 57.95 | 74.00 | -16.05 | peak |
| 4960 | 46.72 | -3.41 | 43.31 | 54.00 | -10.69 | AVG |
| 7440 | 55.82 | -0.72 | 55.10 | 74.00 | -18.90 | peak |
| 7440 | 44.79 | -0.72 | 44.07 | 54.00 | -9.93 | 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 |
|---|---|---|---|---|---|---|
| 4960 | 62.35 | -3.41 | 58.94 | 74.00 | -15.06 | peak |
| 4960 | 46.29 | -3.41 | 42.88 | 54.00 | -11.12 | AVG |
| 7440 | 56.80 | -0.72 | 56.08 | 74.00 | -17.92 | peak |
| 7440 | 45.11 | -0.72 | 44.39 | 54.00 | -9.61 | 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.

# 8 Test Setup Photo

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

# 9 EUT Constructional Details

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

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