Report No.: HTT202203074F01

# TEST Report

| | |
|---|---|
| **Applicant:** | Dongguan MaiJia Intelligent Technology Co., Ltd. |
| **Address of Applicant:** | Room 202,2F,Building A,No.2 Of ManYuan, Hengtang,Tangxia,Dongguan,China |
| **Manufacturer :** | Dongguan MaiJia Intelligent Technology Co., Ltd. |
| **Address of Manufacturer :** | Room 202,2F,Building A,No.2 Of ManYuan, Hengtang,Tangxia,Dongguan,China |
| **Equipment Under Test (EUT)** | |
| Product Name: | Smart Circuit Breaker |
| Model No.: | ZKG30A |
| Series model: | ZKG30A-B, ZKG60A, ZKG60A-B |
| Trade Mark: | N/A |
| FCC ID: | 2ANJ7-ZKG30A |
| **Applicable standards:** | FCC CFR Title 47 Part 15 Subpart C Section 15.247 |
| **Date of sample receipt:** | Mar.04,2022 |
| **Date of Test:** | Mar.04,2022~Mar.10,2022 |
| **Date of report issued:** | Mar.10,2022 |
| **Test Result :** | PASS * |

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

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

# 1. Version

| Version No. | Date | Description |
|---|---|---|
| *00* | *Mar.10,2022* | *Original* |
| | | |
| | | |
| | | |
| | | |

| | | | |
|---|---|---|---|
| ***Tested/ Prepared By*** | Ervin Xu | ***Date:*** | ***Mar.10,2022*** |
| | ***Project Engineer*** | | |
| ***Check By:*** | Bruce Zhu | ***Date:*** | ***Mar.10,2022*** |
| | ***Reviewer*** | | |
| ***Approved By :*** | Kevin Yang | ***Date:*** | ***Mar.10,2022*** |
| | ***Authorized Signature*** | | |

# 2. Contents

Page


**1. VERSION ..... 2**

**2. CONTENTS ..... 3**

**3. TEST SUMMARY ..... 4**

**4. GENERAL INFORMATION ..... 5**

4.1. GENERAL DESCRIPTION OF EUT ..... 5
4.2. TEST MODE ..... 7
4.3. DESCRIPTION OF SUPPORT UNITS ..... 7
4.4. DEVIATION FROM STANDARDS ..... 7
4.5. ABNORMALITIES FROM STANDARD CONDITIONS ..... 7
4.6. TEST FACILITY ..... 7
4.7. TEST LOCATION ..... 7
4.8. ADDITIONAL INSTRUCTIONS ..... 7

**5. TEST INSTRUMENTS LIST ..... 8**

**6. TEST RESULTS AND MEASUREMENT DATA ..... 9**

6.1. CONDUCTED EMISSIONS ..... 9
6.2. CONDUCTED PEAK OUTPUT POWER ..... 12
6.3. CHANNEL BANDWIDTH ..... 13
6.4. POWER SPECTRAL DENSITY ..... 16
6.5. BAND EDGE ..... 19
*6.5.1. Conducted Emission Method ..... 19*
*6.5.2. Radiated Emission Method ..... 22*
6.6. SPURIOUS EMISSION ..... 24
*6.6.1. Conducted Emission Method ..... 24*
*6.6.2. Radiated Emission Method ..... 29*

**7. TEST SETUP PHOTO ..... 37**

**8. EUT CONSTRUCTIONAL DETAILS ..... 37**

# 3. Test Summary

| Test Item | Section | Result |
|---|---|---|
| Antenna requirement | FCC part 15.203/15.247 (c) | Pass |
| AC Power Line Conducted Emission | FCC part 15.207 | Pass |
| Conducted Peak Output Power | FCC part 15.247 (b)(3) | Pass |
| 6dB Bandwidth | FCC part 15.247 (a)(2) | Pass |
| Power Spectral Density | FCC part 15.247 (e) | Pass |
| Band Edge | FCC part 15.247(d) | Pass |
| Spurious Emission | FCC part 15.205/15.209 | Pass |

*Remark: Test according to ANSI C63.10:2013 and RSS-Gen*

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

**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: | Smart Circuit Breaker |
| Model No.: | ZKG30A |
| Series model: | ZKG30A-B, ZKG60A, ZKG60A-B |
| Test sample(s) ID: | HTT202203074-1(Engineer sample)<br>HTT202203074-2(Normal sample) |
| Channel numbers: | 802.11b/802.11g /802.11n(HT20): 11<br>802.11n(HT40):7 |
| Channel separation: | 5MHz |
| Modulation technology: | 802.11b: Direct Sequence Spread Spectrum (DSSS)<br>802.11g/802.11n(H20)/802.11n(HT40):<br>Orthogonal Frequency Division Multiplexing (OFDM) |
| Antenna Type: | PCB Antenna |
| Antenna gain: | 0 dBi |
| Power supply: | AC 100-240V,50/60Hz |

| Operation Frequency each of channel | | | | | | | |
|---|---|---|---|---|---|---|---|
| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
| 1 | 2412MHz | 4 | 2427MHz | 7 | 2442MHz | 10 | 2457MHz |
| 2 | 2417MHz | 5 | 2432MHz | 8 | 2447MHz | 11 | 2462MHz |
| 3 | 2422MHz | 6 | 2437MHz | 9 | 2452MHz | | |

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:

| **Test channel** | **Frequency (MHz)** | |
|---|---|---|
| | 802.11b/802.11g/802.11n(HT20) | 802.11n(HT40) |
| Lowest channel | 2412MHz | 2422MHz |
| Middle channel | 2437MHz | 2437MHz |
| Highest channel | 2462MHz | 2452MHz |

## 4.2. Test mode

| | |
|---|---|
| Transmitting mode | Keep the EUT in continuously transmitting mode |
| *Remark: During the test, the dutycycle >98%, 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.* | |

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:

Pre-scan all kind of data rate in lowest channel, and found the follow list which it was worst case.

| Mode | 802.11b | 802.11g | 802.11n(HT20) | 802.11n(HT40) |
|---|---|---|---|---|
| Data rate | 1Mbps | 6Mbps | 6.5Mbps | 13Mbps |

## 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 listed 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

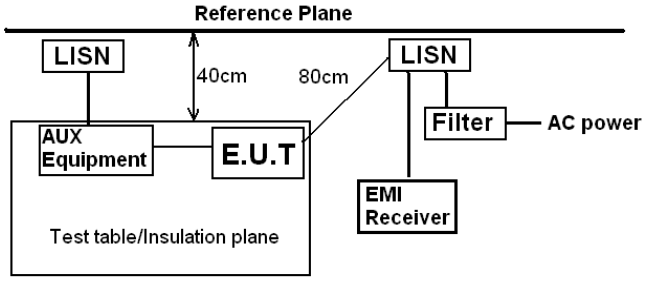
| | |
|---|---|
| Test Software | Special AT test command provided by manufacturer to Keep the EUT in continuously transmitting mode and hopping mode |
| Power level setup | Default |

# 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 2020 | Aug. 09 2024 |
| 2 | Control Room | Shenzhen C.R.T technology co., LTD | 4.8*3.5*3.0 | HTT-E030 | Aug. 10 2020 | Aug. 09 2024 |
| 3 | EMI Test Receiver | Rohde&Schwar | ESCI7 | HTT-E022 | May 21 2021 | May 20 2022 |
| 4 | Spectrum Analyzer | Rohde&Schwar | FSP | HTT-E037 | May 21 2021 | May 20 2022 |
| 5 | Coaxial Cable | ZDecl | ZT26-NJ-NJ-0.6M | HTT-E018 | May 21 2021 | May 20 2022 |
| 6 | Coaxial Cable | ZDecl | ZT26-NJ-SMAJ-2M | HTT-E019 | May 21 2021 | May 20 2022 |
| 7 | Coaxial Cable | ZDecl | ZT26-NJ-SMAJ-0.6M | HTT-E020 | May 21 2021 | May 20 2022 |
| 8 | Coaxial Cable | ZDecl | ZT26-NJ-SMAJ-8.5M | HTT-E021 | May 21 2021 | May 20 2022 |
| 9 | Composite logarithmic antenna | Schwarzbeck | VULB 9168 | HTT-E017 | Aug. 22 2021 | Aug. 21 2022 |
| 10 | Horn Antenna | Schwarzbeck | BBHA9120D | HTT-E016 | Aug. 22 2021 | Aug. 21 2022 |
| 11 | Loop Antenna | Zhinan | ZN30900C | HTT-E039 | Aug. 22 2021 | Aug. 21 2022 |
| 12 | Horn Antenna | Beijing Hangwei Dayang | OBH100400 | HTT-E040 | Aug. 22 2021 | Aug. 21 2022 |
| 13 | low frequency Amplifier | Sonoma Instrument | 310 | HTT-E015 | May 21 2021 | May 20 2022 |
| 14 | high-frequency Amplifier | HP | 8449B | HTT-E014 | May 21 2021 | May 20 2022 |
| 15 | Variable frequency power supply | Shenzhen Anbiao Instrument Co., Ltd | ANB-10VA | HTT-082 | May 21 2021 | May 20 2022 |
| 16 | EMI Test Receiver | Rohde & Schwarz | ESCS30 | HTT-E004 | May 21 2021 | May 20 2022 |
| 17 | Artificial Mains | Rohde & Schwarz | ESH3-Z5 | HTT-E006 | May 21 2021 | May 20 2022 |
| 18 | Artificial Mains | Rohde & Schwarz | ENV-216 | HTT-E038 | May 21 2021 | May 20 2022 |
| 19 | Cable Line | Robinson | Z302S-NJ-BNCJ-1.5M | HTT-E001 | May 21 2021 | May 20 2022 |
| 20 | Attenuator | Robinson | 6810.17A | HTT-E007 | May 21 2021 | May 20 2022 |
| 21 | Variable frequency power supply | Shenzhen Yanghong Electric Co., Ltd | YF-650（5KVA） | HTT-E032 | May 21 2021 | May 20 2022 |
| 22 | Control Room | Shenzhen C.R.T technology co., LTD | 8*4*3.5 | HTT-E029 | May 21 2021 | May 20 2022 |
| 23 | DC power supply | Agilent | E3632A | HTT-E023 | May 21 2021 | May 20 2022 |
| 24 | EMI Test Receiver | Agilent | N9020A | HTT-E024 | May 21 2021 | May 20 2022 |
| 25 | Analog signal generator | Agilent | N5181A | HTT-E025 | May 21 2021 | May 20 2022 |
| 26 | Vector signal generator | Agilent | N5182A | HTT-E026 | May 21 2021 | May 20 2022 |
| 27 | Power sensor | Keysight | U2021XA | HTT-E027 | May 21 2021 | May 20 2022 |
| 28 | Temperature and humidity meter | Shenzhen Anbiao Instrument Co., Ltd | TH10R | HTT-074 | May 21 2021 | May 20 2022 |
| 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

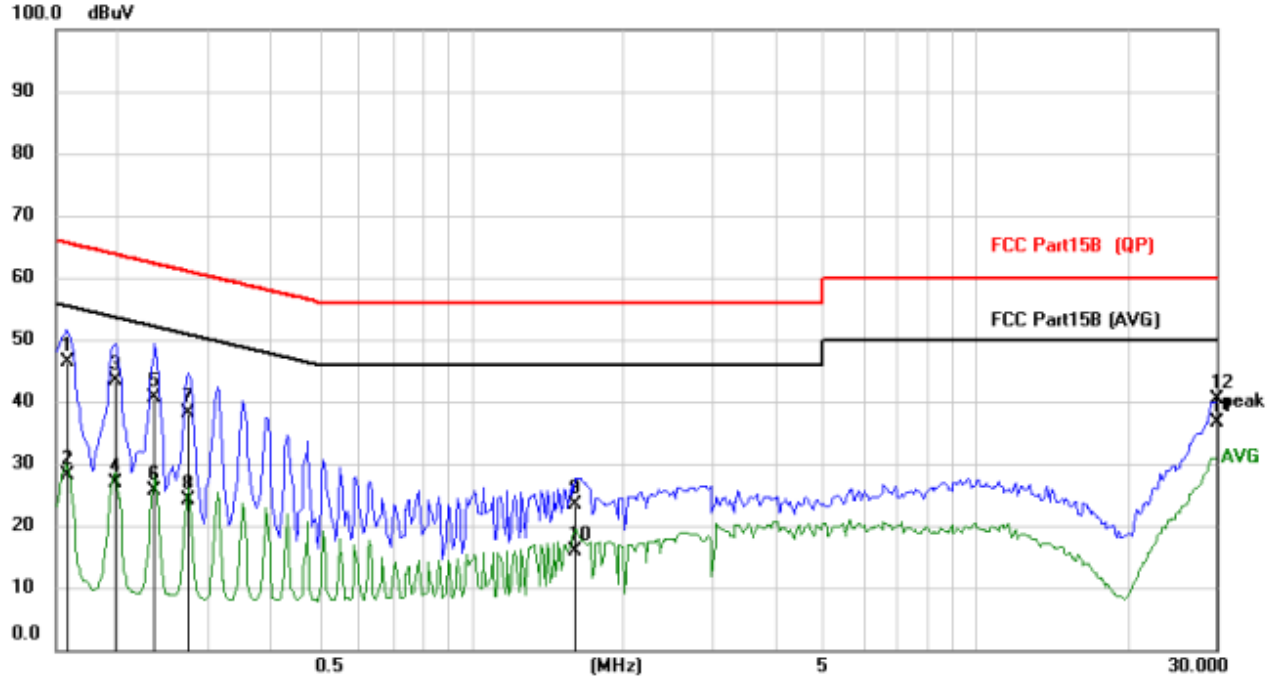
## 6.1. Conducted Emissions

| | |
|---|---|
| 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.

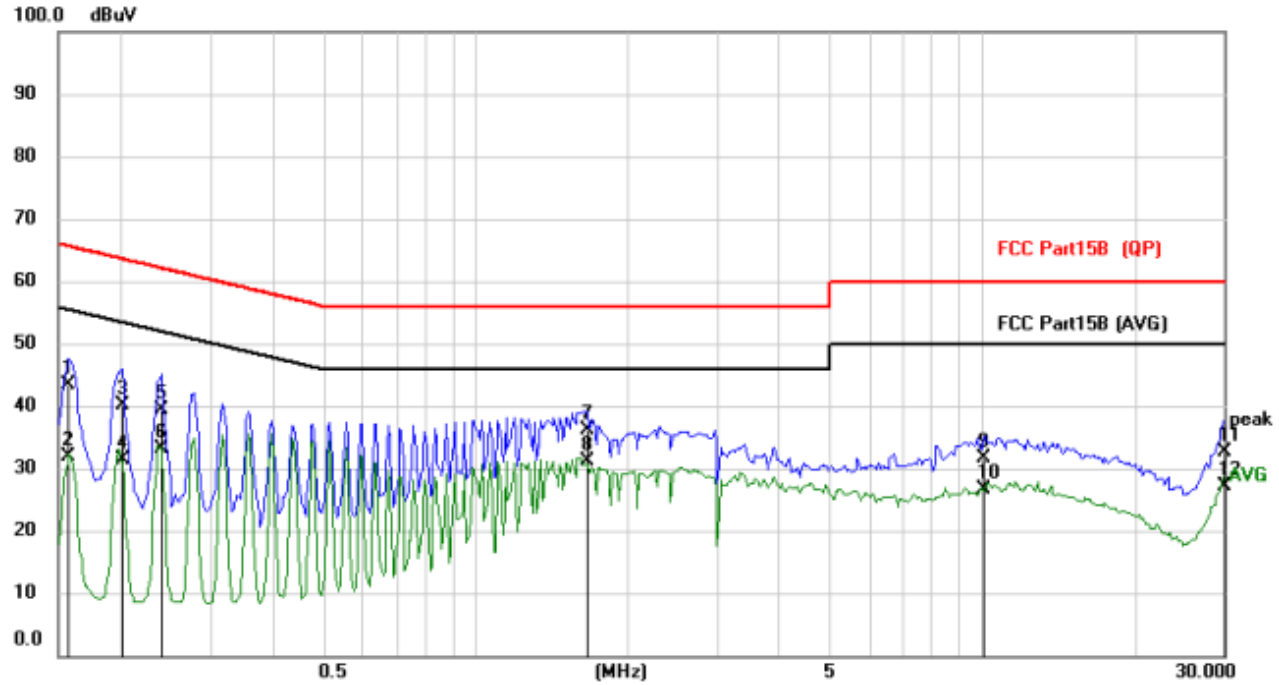
**Measurement data:**

**Line:**




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.1582 | 35.96 | 10.38 | 46.34 | 65.56 | -19.22 | QP |
| 2 | | 0.1582 | 17.66 | 10.38 | 28.04 | 55.56 | -27.52 | AVG |
| 3 | | 0.1968 | 33.05 | 10.39 | 43.44 | 63.74 | -20.30 | QP |
| 4 | | 0.1968 | 16.54 | 10.39 | 26.93 | 53.74 | -26.81 | AVG |
| 5 | | 0.2358 | 30.35 | 10.40 | 40.75 | 62.24 | -21.49 | QP |
| 6 | | 0.2358 | 15.14 | 10.40 | 25.54 | 52.24 | -26.70 | AVG |
| 7 | | 0.2748 | 27.68 | 10.40 | 38.08 | 60.97 | -22.89 | QP |
| 8 | | 0.2748 | 13.67 | 10.40 | 24.07 | 50.97 | -26.90 | AVG |
| 9 | | 1.6086 | 12.60 | 10.85 | 23.45 | 56.00 | -32.55 | QP |
| 10 | | 1.6086 | 5.04 | 10.85 | 15.89 | 46.00 | -30.11 | AVG |
| 11 | | 30.0000 | 23.95 | 12.80 | 36.75 | 60.00 | -23.25 | QP |
| 12 | * | 30.0000 | 27.62 | 12.80 | 40.42 | 50.00 | -9.58 | AVG |

**Neutral:**

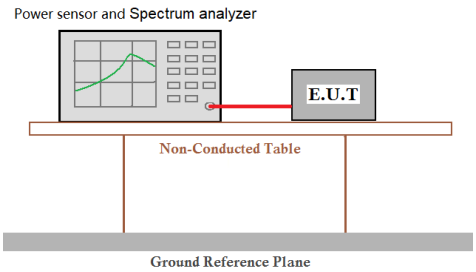



| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.1578 | 33.14 | 10.26 | 43.40 | 65.58 | -22.18 | QP |
| 2 | | 0.1578 | 21.73 | 10.26 | 31.99 | 55.58 | -23.59 | AVG |
| 3 | | 0.2007 | 29.89 | 10.20 | 40.09 | 63.58 | -23.49 | QP |
| 4 | | 0.2007 | 21.09 | 10.20 | 31.29 | 53.58 | -22.29 | AVG |
| 5 | | 0.2397 | 29.26 | 10.22 | 39.48 | 62.11 | -22.63 | QP |
| 6 | | 0.2397 | 22.81 | 10.22 | 33.03 | 52.11 | -19.08 | AVG |
| 7 | | 1.6632 | 25.34 | 10.81 | 36.15 | 56.00 | -19.85 | QP |
| 8 | * | 1.6632 | 20.34 | 10.81 | 31.15 | 46.00 | -14.85 | AVG |
| 9 | | 10.1214 | 20.08 | 11.51 | 31.59 | 60.00 | -28.41 | QP |
| 10 | | 10.1214 | 15.01 | 11.51 | 26.52 | 50.00 | -23.48 | AVG |
| 11 | | 29.9802 | 19.99 | 12.70 | 32.69 | 60.00 | -27.31 | QP |
| 12 | | 29.9802 | 14.47 | 12.70 | 27.17 | 50.00 | -22.83 | 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

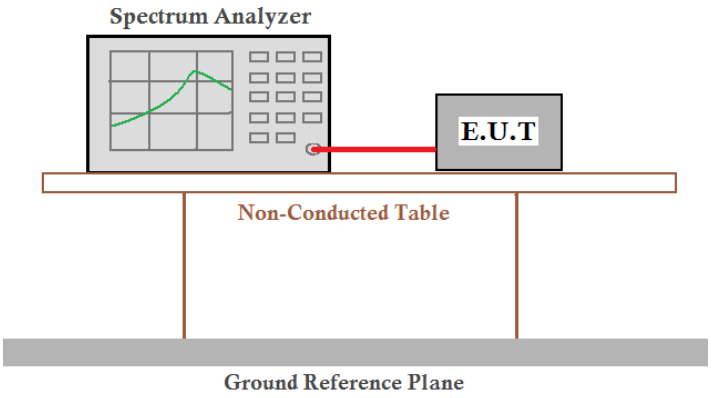
## 6.2. Conducted Peak Output Power

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (b)(3) | | | | | |
| Test Method: | 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 CH | Peak Output Power (dBm) | | | | Limit(dBm) | Result |
|---|---|---|---|---|---|---|
| | 802.11b | 802.11g | 802.11n(HT20) | 802.11n(HT40) | | |
| Lowest | 15.02 | 13.80 | 13.68 | 13.75 | 30.00 | Pass |
| Middle | 14.74 | 13.65 | 13.62 | 13.67 | | |
| Highest | 14.48 | 13.37 | 13.20 | 13.57 | | |

## 6.3. Channel Bandwidth

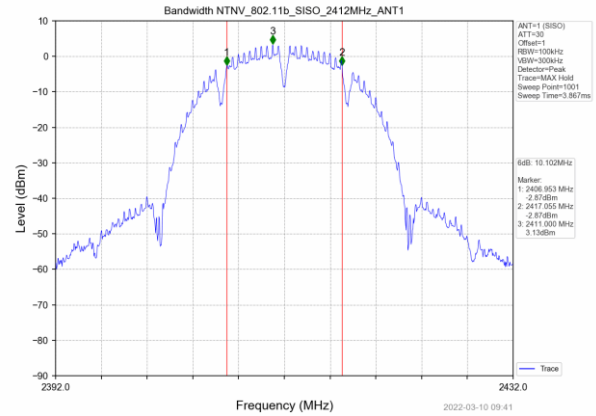
| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(2) | | | | | |
| Test Method: | KDB558074 D01 15.247 Meas Guidance v05r02 | | | | | |
| Limit: | >500KHz | | | | | |
| Test setup: |  | | | | | |
| Test Instruments: | Refer to section 6.0 for details | | | | | |
| Test mode: | Refer to section 5.2 for details | | | | | |
| Test results: | Pass | | | | | |
| Test environment: | Temp.: | 25 °C | Humid.: | 52% | Press.: | 1012mbar |

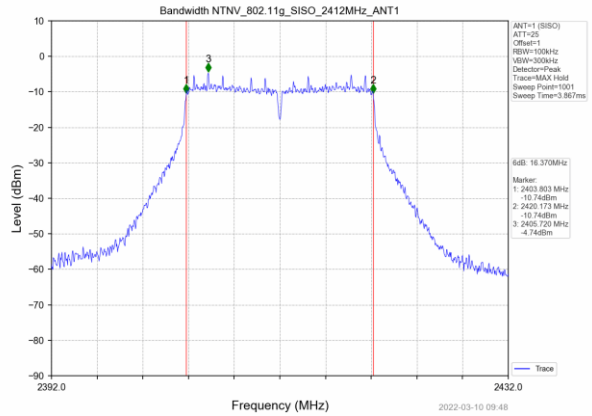
**Measurement Data**

| Test CH | Channel Bandwidth (MHz) | | | | Limit(KHz) | Result |
|---|---|---|---|---|---|---|
| | 802.11b | 802.11g | 802.11n(HT20) | 802.11n(HT40) | | |
| Lowest | 10.102 | 16.370 | 17.372 | 35.759 | >500 | Pass |
| Middle | 10.093 | 16.363 | 17.562 | 36.081 | | |
| Highest | 10.113 | 16.374 | 17.079 | 35.849 | | |

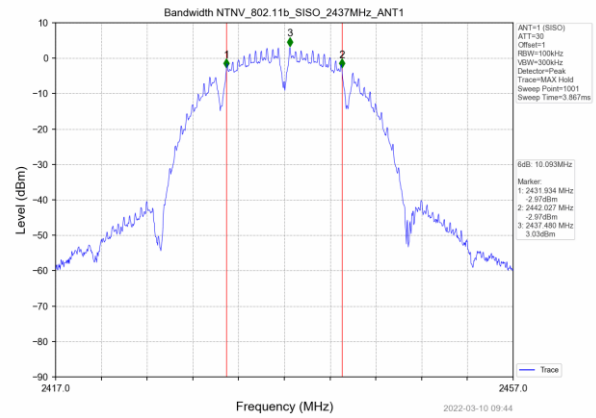
**Test plot as follows:**

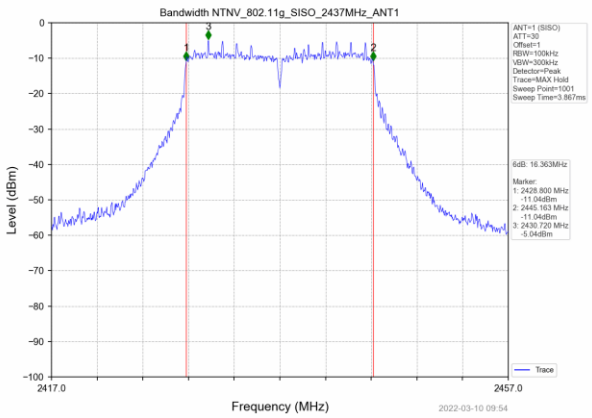
| | | | |
|---|---|---|---|
| 802.11b | | 802.11g | |



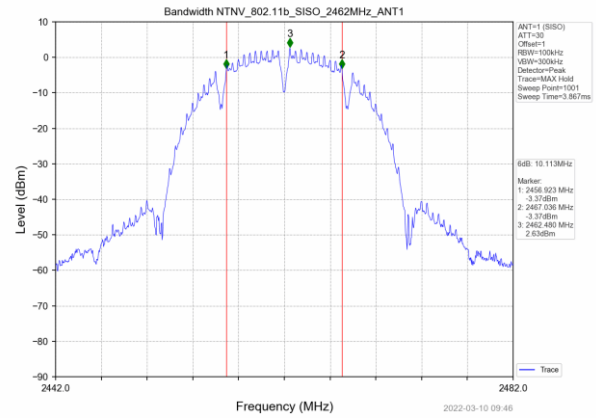



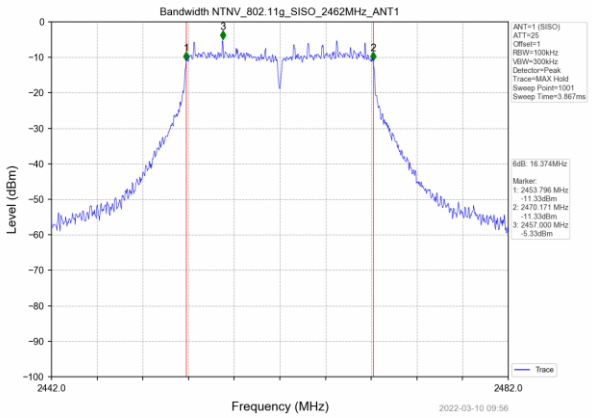

Lowest channel



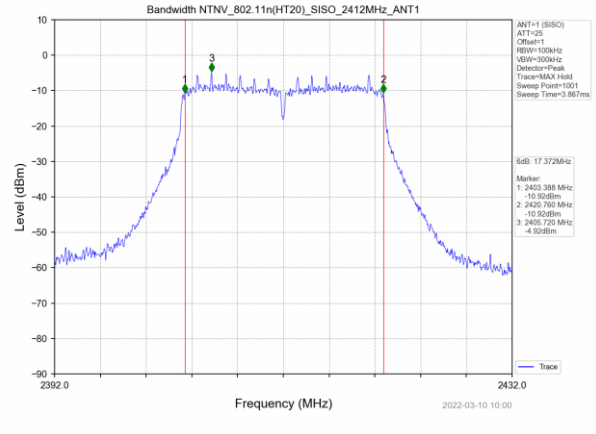

Middle channel

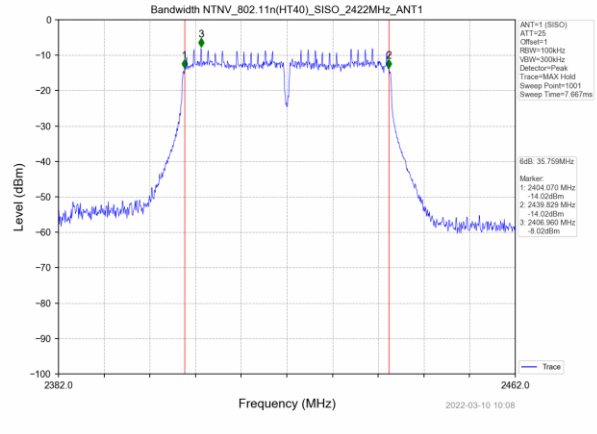


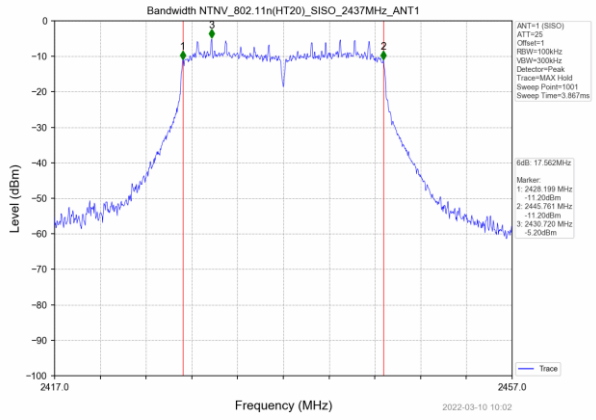

Highest channel

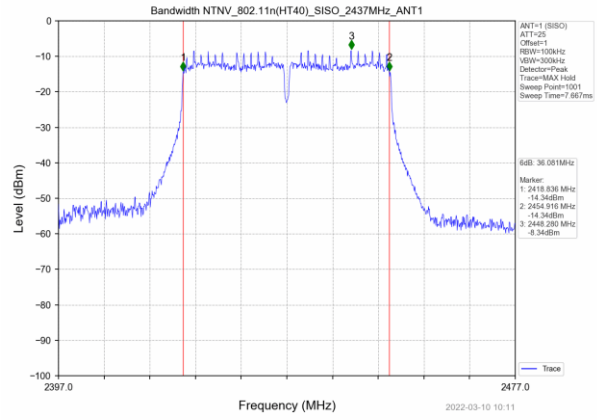
| | | | |
|---|---|---|---|
| 802.11n(HT20) | | 802.11n(HT40) | |



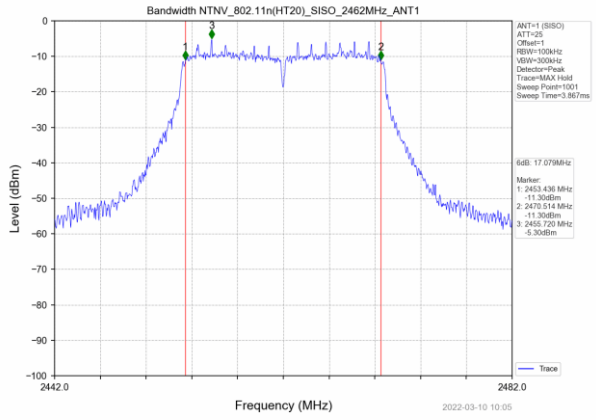



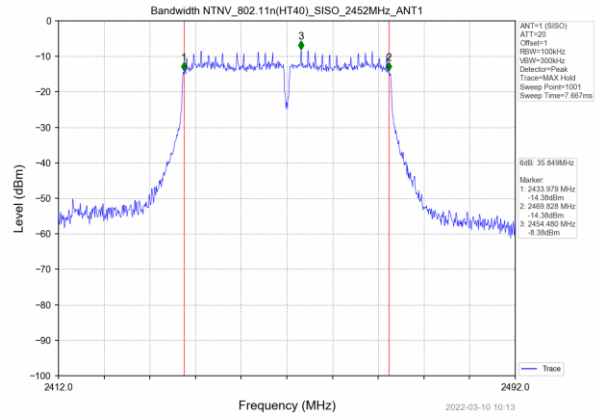

Lowest channel



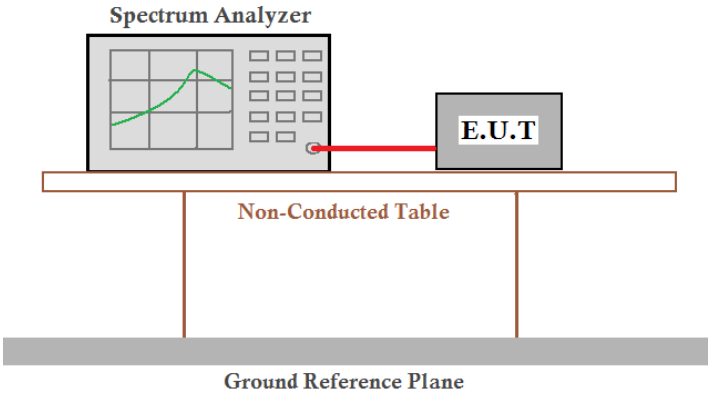

Middle channel




Highest channel

## 6.4. Power Spectral Density

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (e) | | | | | |
| Test Method: | 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 |

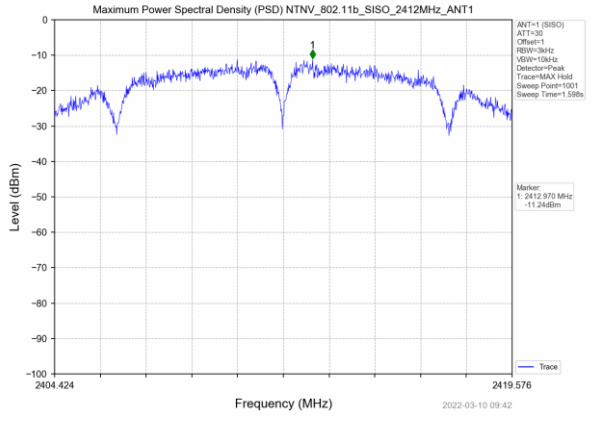
**Measurement Data**

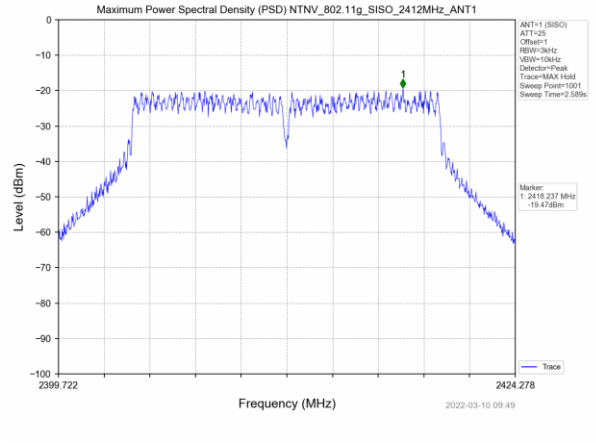
| Test CH | Power Spectral Density (dBm/3kHz) | | | | Limit (dBm/3kHz) | Result |
|---|---|---|---|---|---|---|
| | 802.11b | 802.11g | 802.11n(HT20) | 802.11n(HT40) | | |
| Lowest | -11.24 | -19.47 | -19.65 | -21.52 | 8.00 | Pass |
| Middle | -11.50 | -18.36 | -19.35 | -23.10 | | |
| Highest | -11.66 | -20.15 | -18.40 | -23.23 | | |

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

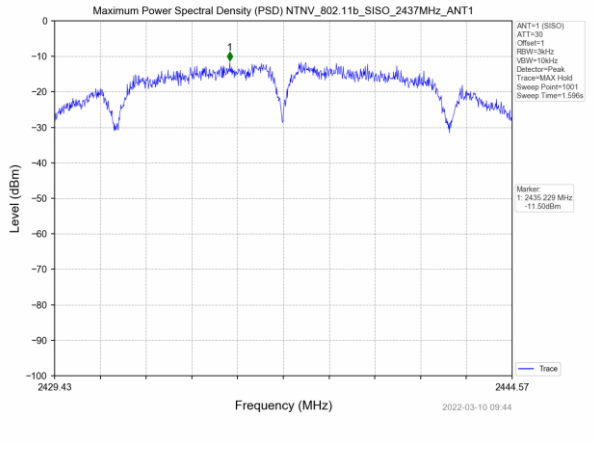
**Test plot as follows:**

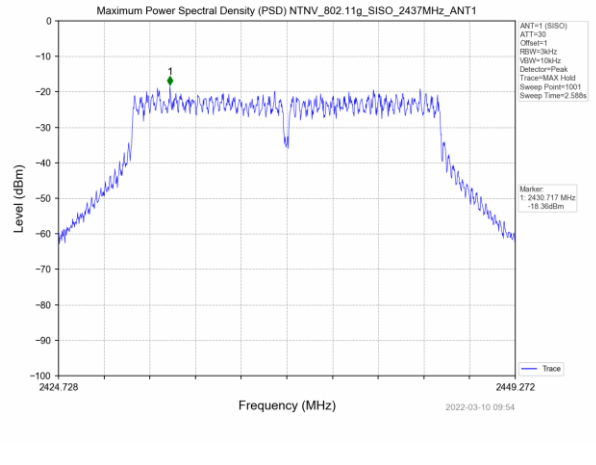
| | | | |
|---|---|---|---|
| 802.11b | | 802.11b | |



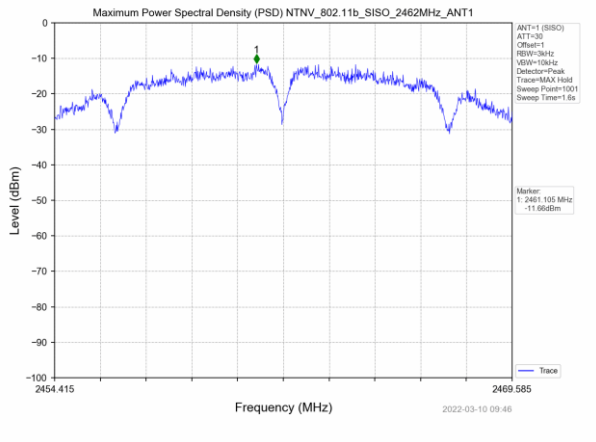



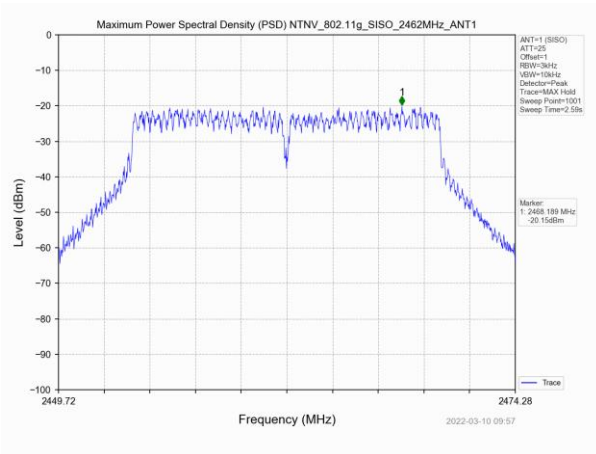

Lowest channel



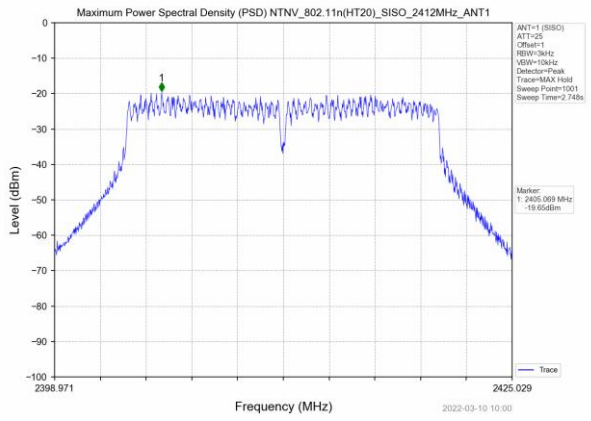

Middle channel

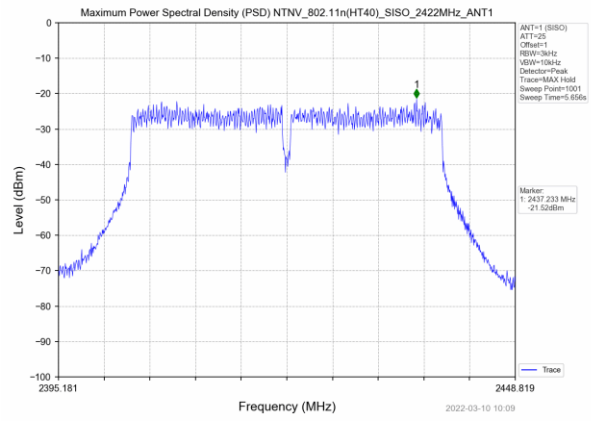


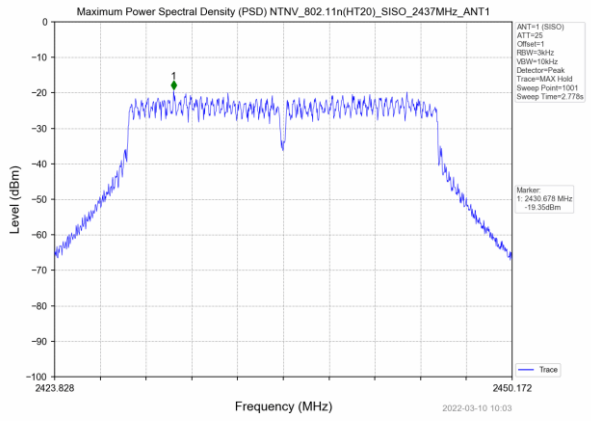

Highest channel

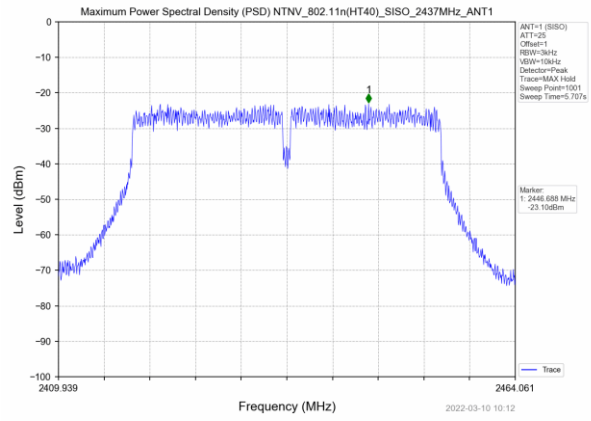
| 802.11n(HT20) | | 802.11n(HT40) | |
|---|---|---|---|



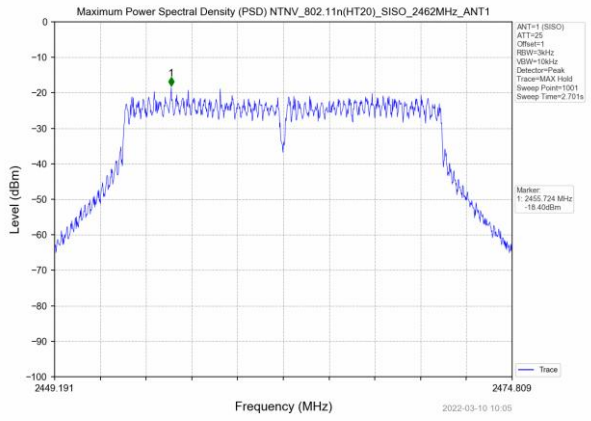



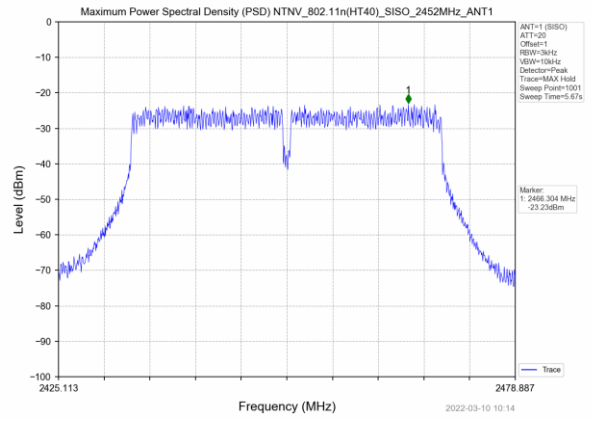

Lowest channel




Middle channel

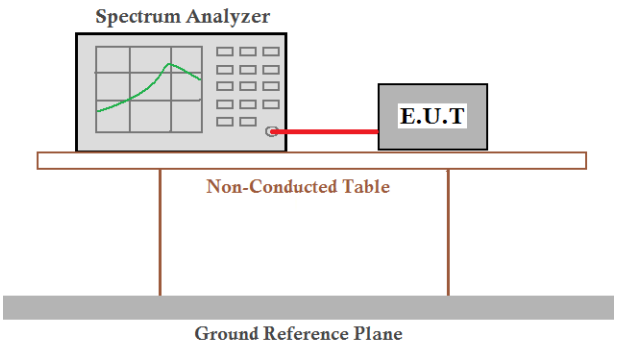



Highest channel

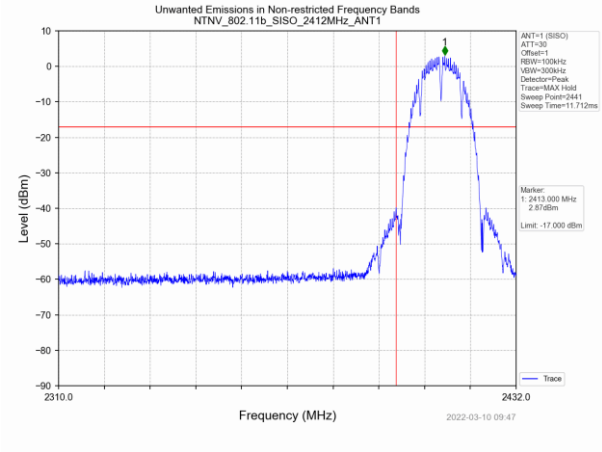
## 6.5. Band Edge

### 6.5.1. Conducted Emission Method

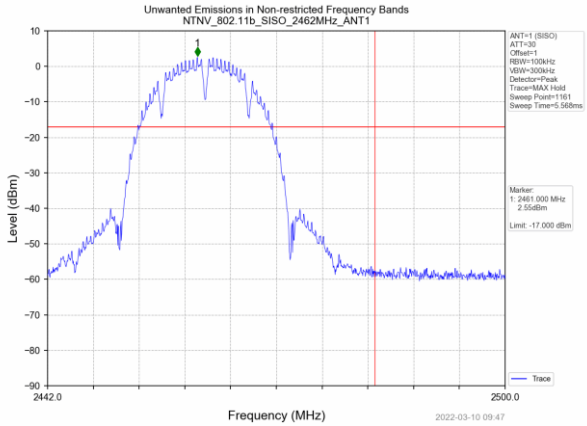
| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (d) | | | | | |
| Test Method: | KDB558074 D01 15.247 Meas Guidance v05r02 | | | | | |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, 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:**

| Test mode: | 802.11b |
|---|---|

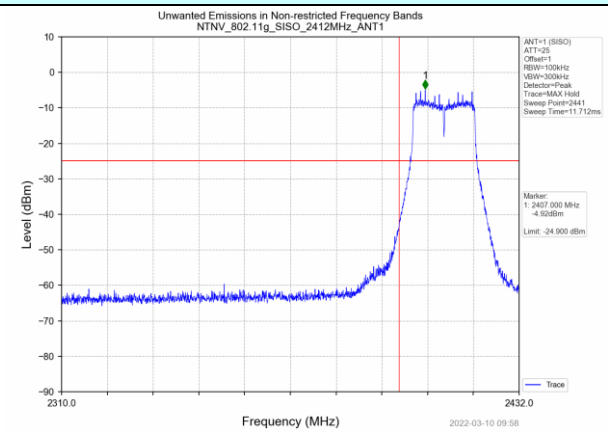



Lowest channel

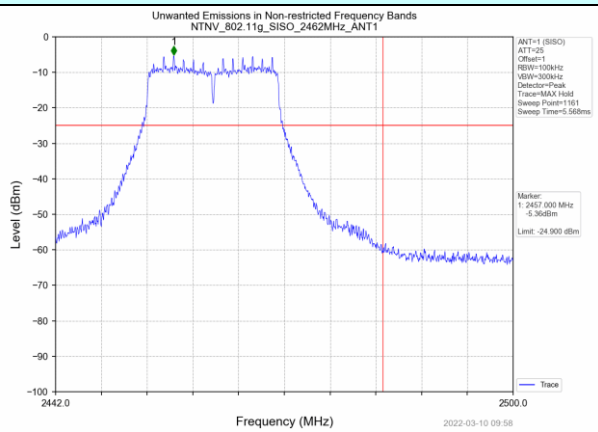



Highest channel

| Test mode: | 802.11g |
|---|---|

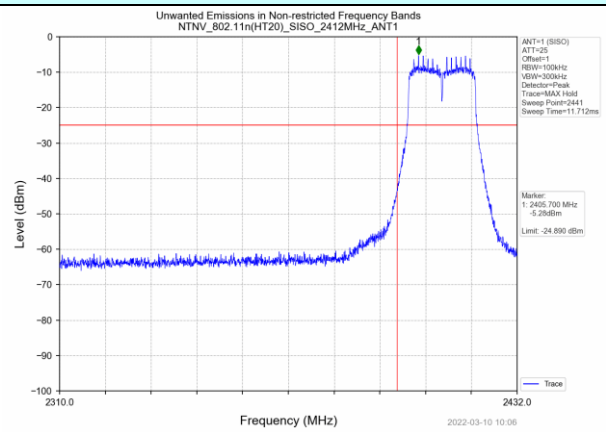



Lowest channel

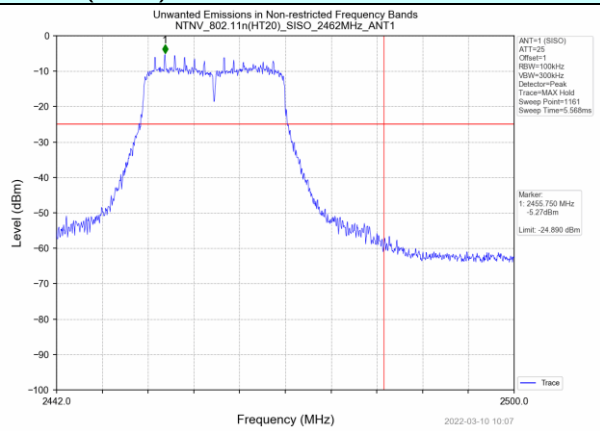



Highest channel

| Test mode: | 802.11n(HT20) |
|---|---|

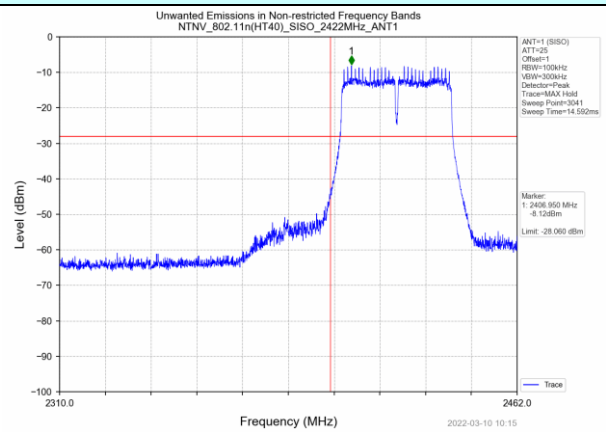



Lowest channel

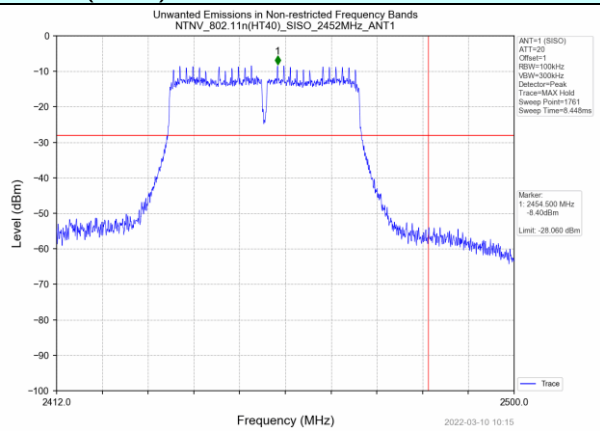



Highest channel

| Test mode: | 802.11n(HT40) |
|---|---|




Lowest channel




Highest channel

### 6.5.2. Radiated Emission Method

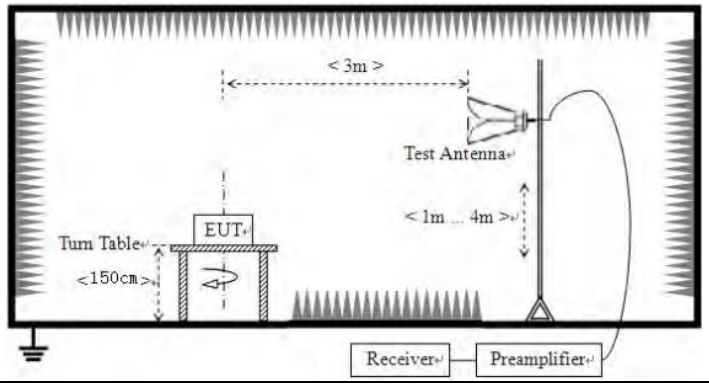
| | |
|---|---|
| Test Requirement: | FCC Part15 C Section 15.209 and 15.205 |
| Test Method: | ANSI C63.10: 2013 |
| Test Frequency Range: | All of the restrict bands were tested, only the worst band's (2310MHz to 2500MHz) data was showed. |
| Test site: | Measurement Distance: 3m |
| Receiver setup: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

| 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: During the test, pre-scan the 802.11b/802.11g/802.11n (H20)/802.11n (H40) modulation, and found the 802.11b modulation which it is worse case.

| Test mode: | 802.11b | Test channel: | Lowest |
|---|---|---|---|

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 | 61.21 | 26.20 | 5.72 | 33.30 | 59.83 | 74.00 | -14.17 | peak |
| 2390 | 45.02 | 26.20 | 5.72 | 33.30 | 43.64 | 54.00 | -10.36 | 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 | 58.88 | 26.20 | 5.72 | 33.30 | 57.50 | 74.00 | -16.50 | peak |
| 2390 | 44.26 | 26.20 | 5.72 | 33.30 | 42.88 | 54.00 | -11.12 | AVG |

| Test mode: | 802.11b | Test channel: | Highest |
|---|---|---|---|

Horizontal (Worst case)

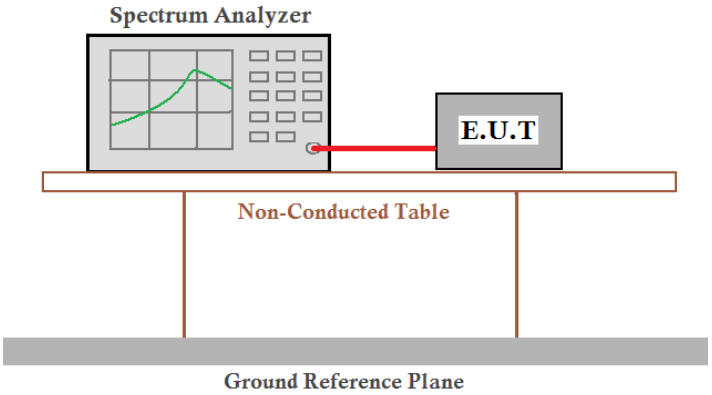
| Frequency | Meter Reading | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBµV) | (dB/m) | (dB) | (dB) | (dBµV/m) | (dBµV/m) | (dB) | |
| 2483.5 | 57.80 | 28.60 | 6.97 | 32.70 | 60.67 | 74.00 | -13.33 | peak |
| 2483.5 | 42.26 | 28.60 | 6.97 | 32.70 | 45.13 | 54.00 | -8.87 | 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 | 55.50 | 28.60 | 6.97 | 32.70 | 58.37 | 74.00 | -15.63 | peak |
| 2483.5 | 42.11 | 28.60 | 6.97 | 32.70 | 44.98 | 54.00 | -9.02 | AVG |

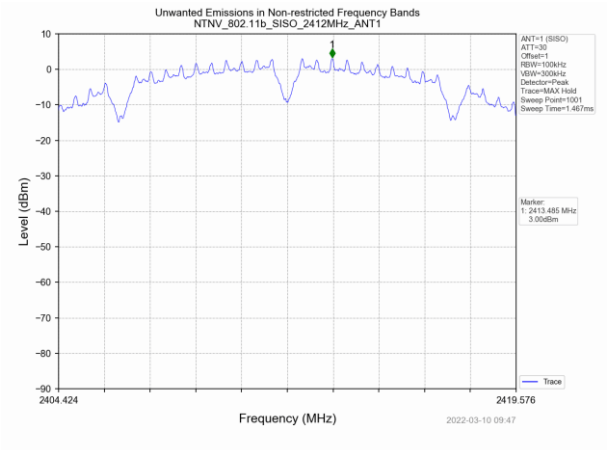
## 6.6. Spurious Emission

### 6.6.1. Conducted Emission Method

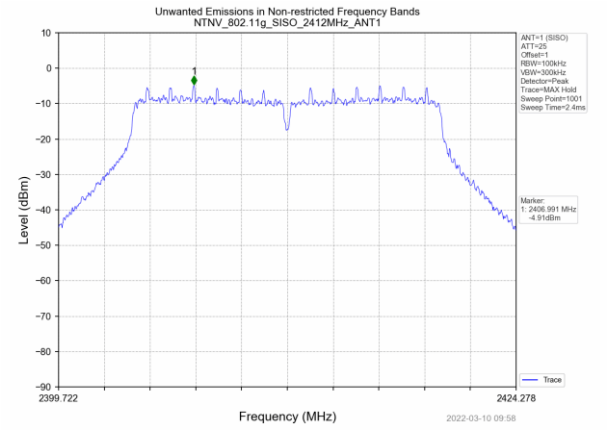
| | | | | | | |
|---|---|---|---|---|---|---|
| Test Requirement: | FCC Part15 C Section 15.247 (d) | | | | | |
| Test Method: | KDB558074 D01 15.247 Meas Guidance v05r02 | | | | | |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, 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 |

**Measurement Data:**

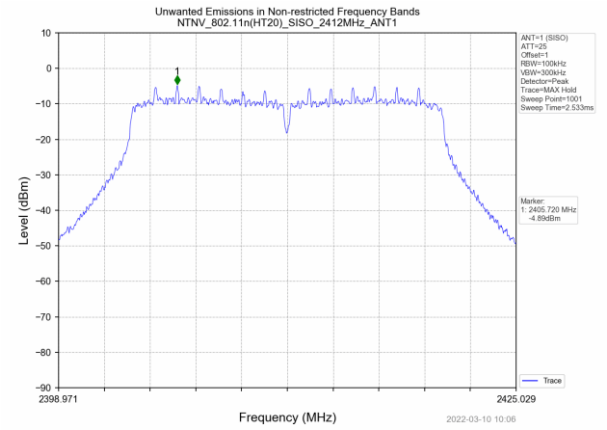
Reference



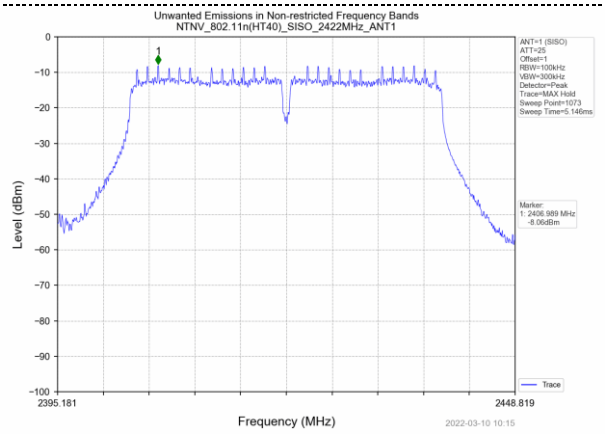

***802.11b***




***802.11g***



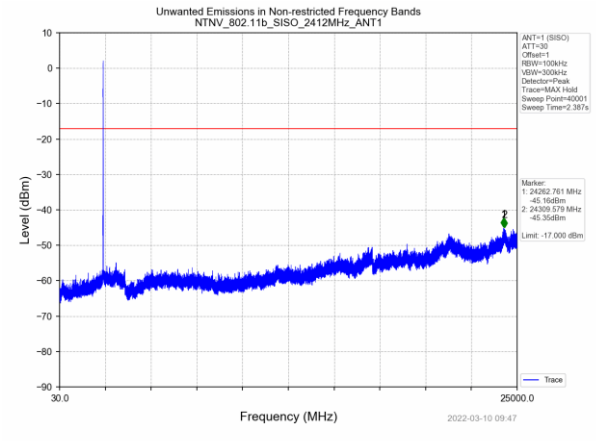

***802.11n(HT20)***

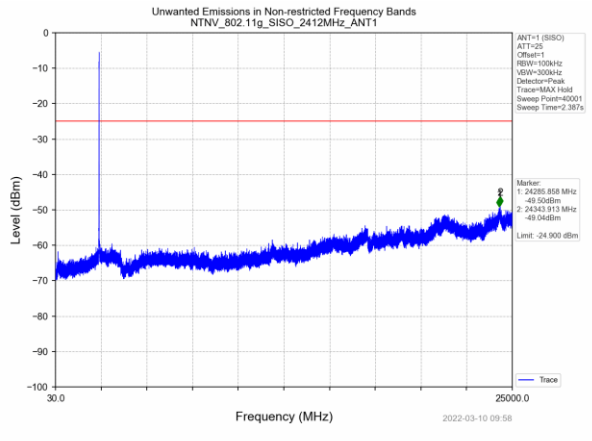

Unwanted Emissions in Non-restricted Frequency Bands
NTNV_802.11n(HT40)_SISO_2422MHz_ANT1
Level (dBm)
Frequency (MHz)
2395.181
2448.819
ANT=1 (SISO)
ATT=26
Offset=1
RBW=100kHz
VBW=300kHz
Detector=Peak
Trace=MAX Hold
Sweep Point=1073
Sweep Time=5.146ms
Marker:
1: 2406.989 MHz
-8.06dBm
Trace
2022-03-10 10:15

***802.11n(HT40)***

| 802.11b | 802.11g |
|---|---|

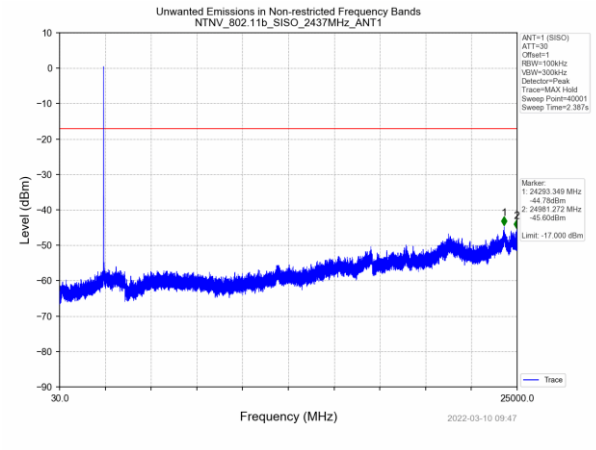
Lowest channel

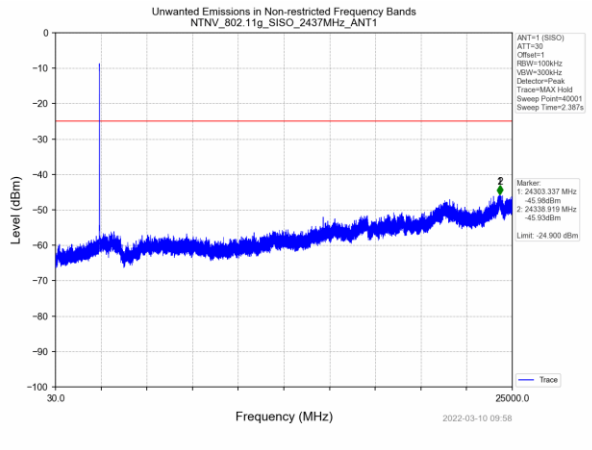



30MHz~25GHz

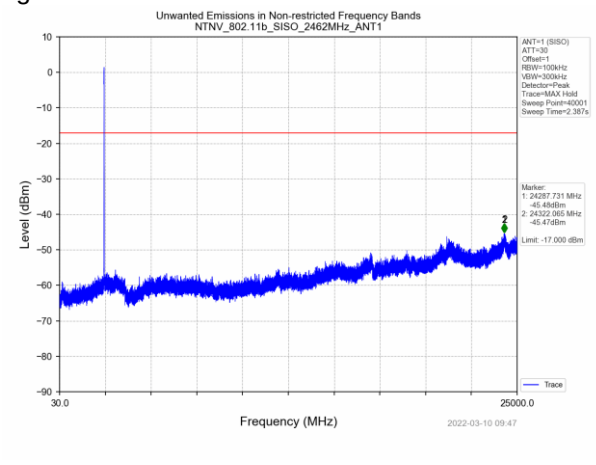
Middle channel

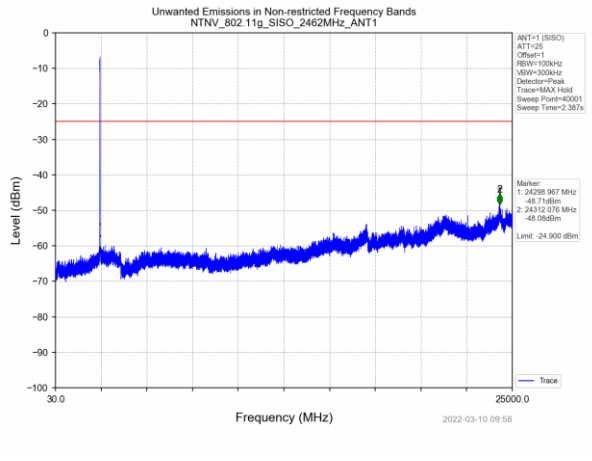



30MHz~25GHz

Highest channel

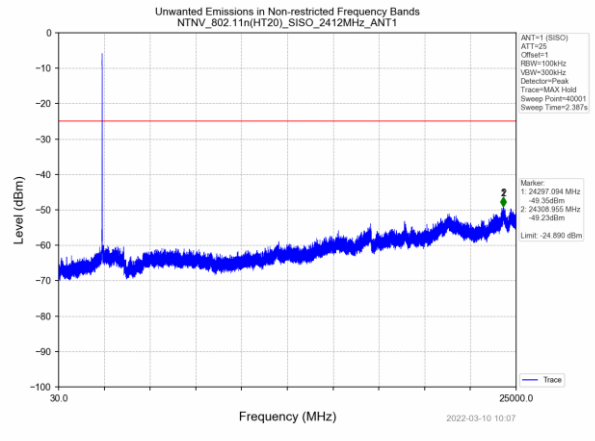


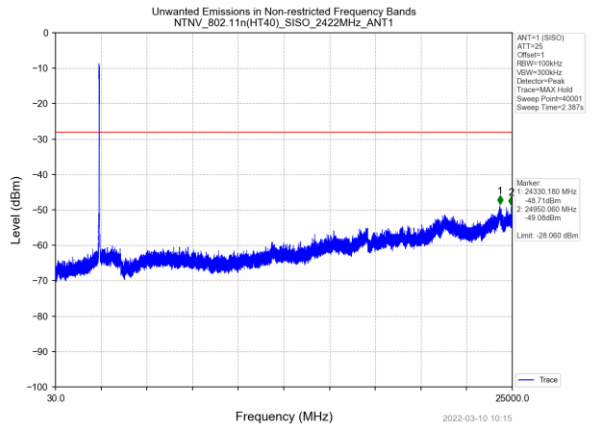




30MHz~25GHz

| 802.11n(HT20) | 802.11n(HT40) |
|---|---|

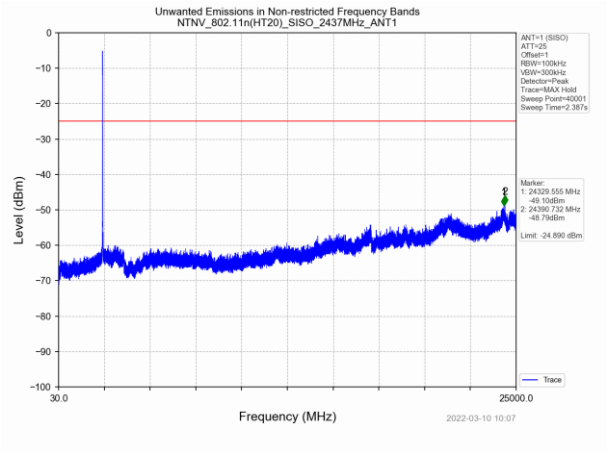
Lowest channel

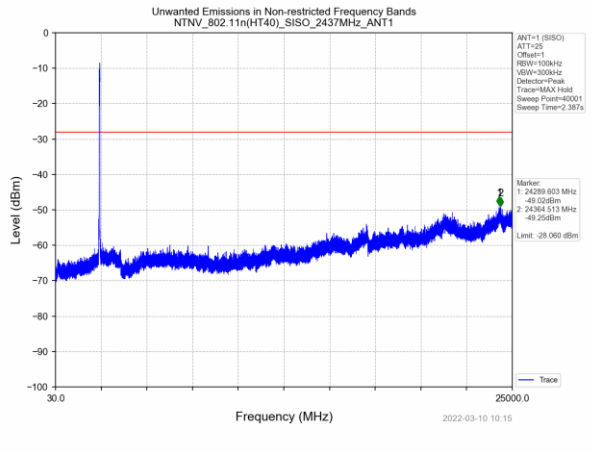



30MHz~25GHz

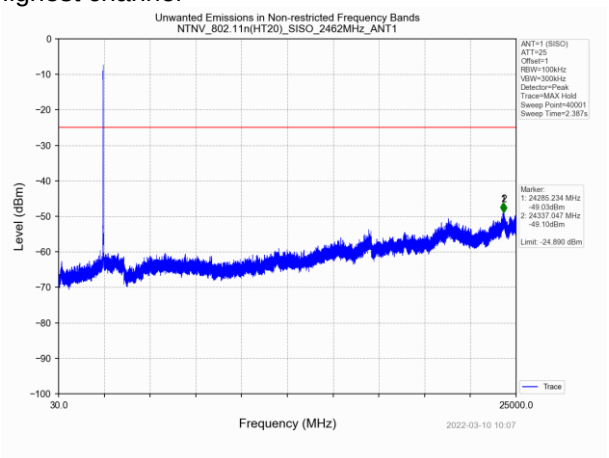
Middle channel

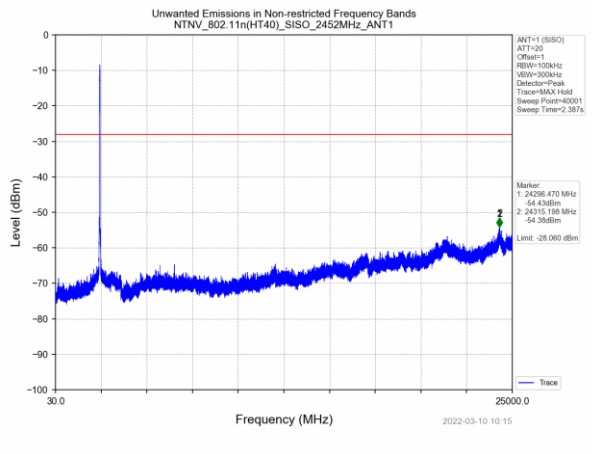



30MHz~25GHz

Highest channel




30MHz~25GHz

### 6.6.2. 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:**

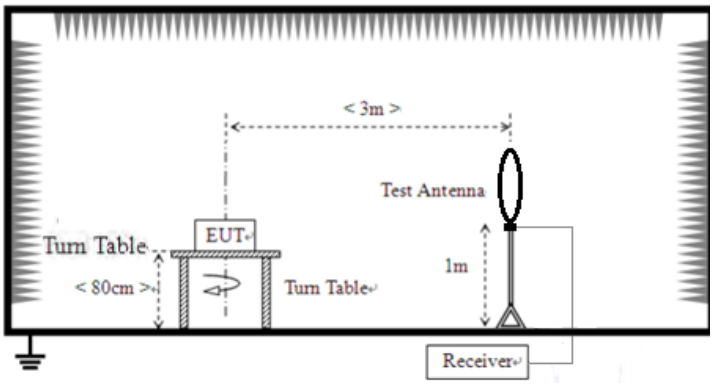
| Frequency | Detector | RBW | VBW | Value |
|---|---|---|---|---|
| 9KHz-150KHz | Quasi-peak | 200Hz | 600Hz | Quasi-peak |
| 150KHz-30MHz | Quasi-peak | 9KHz | 30KHz | Quasi-peak |
| 30MHz-1GHz | Quasi-peak | 120KHz | 300KHz | Quasi-peak |
| Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | Peak | 1MHz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

**Limit:**

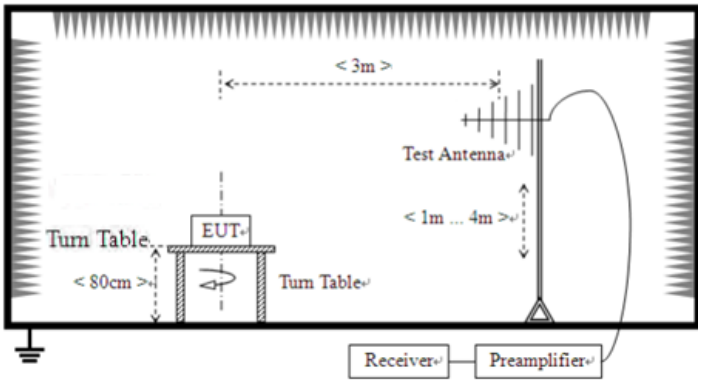
| Frequency | Limit (uV/m) | Value | Measurement Distance |
|---|---|---|---|
| 0.009MHz-0.490MHz | 2400/F(KHz) | QP | 300m |
| 0.490MHz-1.705MHz | 24000/F(KHz) | QP | 30m |
| 1.705MHz-30MHz | 30 | QP | 30m |
| 30MHz-88MHz | 100 | QP | 3m |
| 88MHz-216MHz | 150 | QP | |
| 216MHz-960MHz | 200 | QP | |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

**Test setup:**

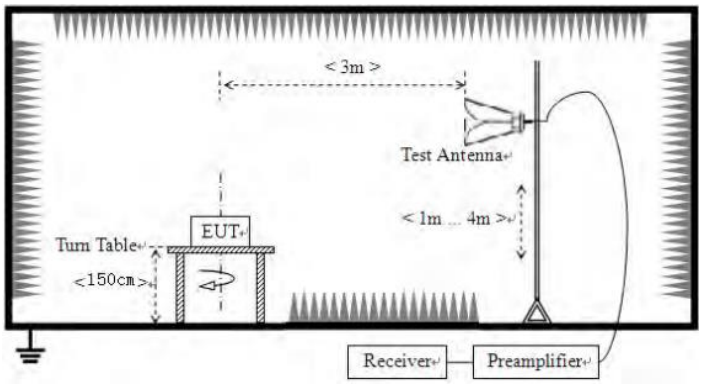
For radiated emissions from 9kHz to 30MHz



For radiated emissions from 30MHz to1GHz




For radiated emissions above 1GHz




| | | | | | | |
|---|---|---|---|---|---|---|
| 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 |

*Remarks:*
*1.Only the worst case Main Antenna test data.*
*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.*

**Measurement data:**

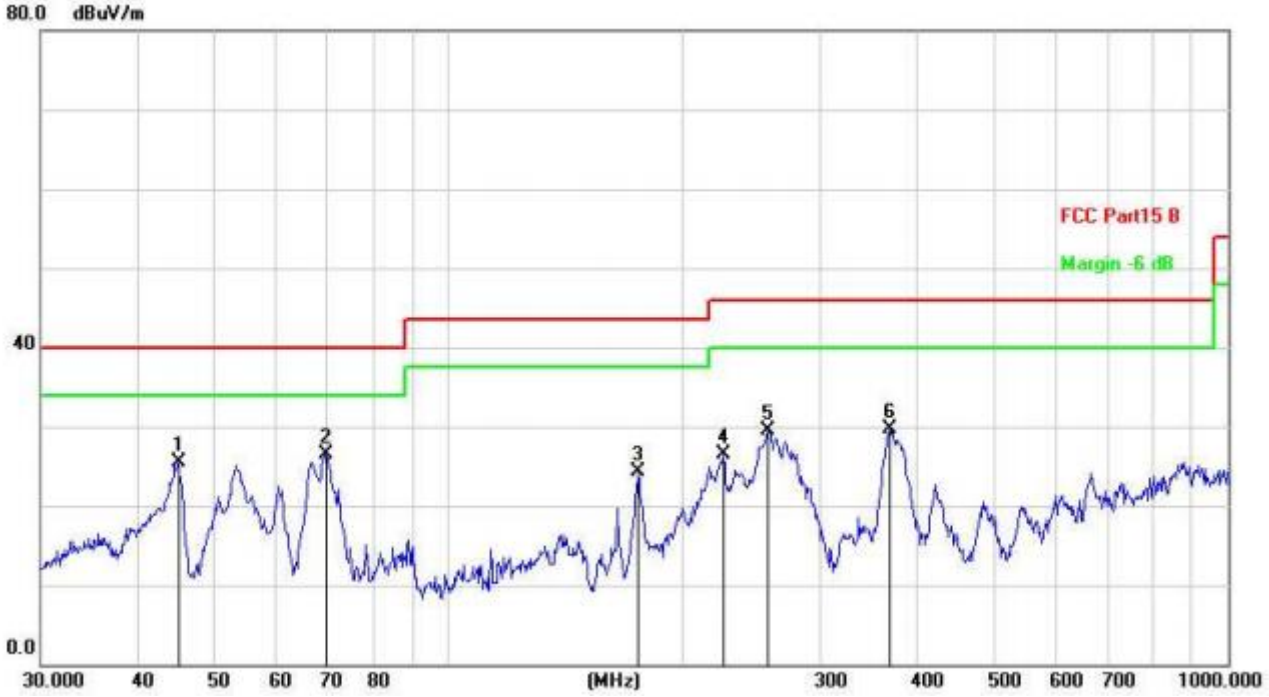
- **9kHz~30MHz**

  The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and according to 15.31(o) & RSS-Gen 6.13, the test result no need to reported.

■ **Below 1GHz**

Pre-scan all test modes, found worst case at 802.11b 2437MHz, and so only show the test result of 802.11b 2437MHz

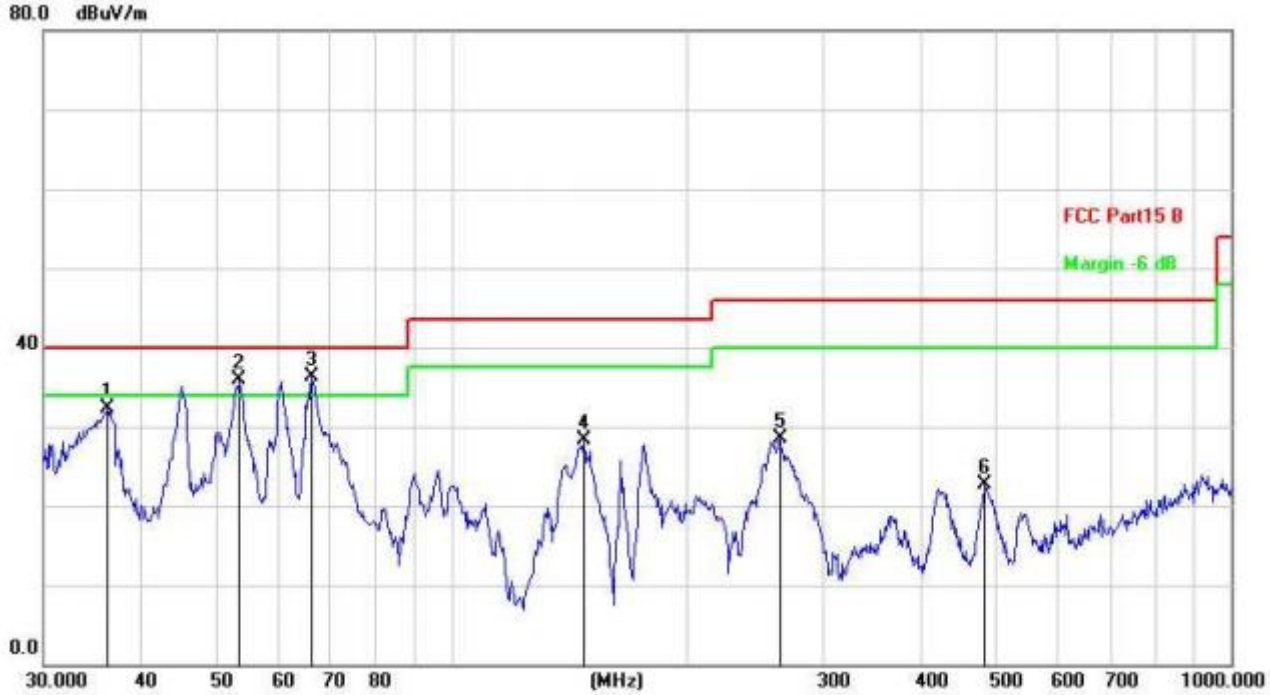
Horizontal




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV/m | dB/m | dB | Detector |
| 1 | | 45.0583 | 42.63 | -17.22 | 25.41 | 40.00 | -14.59 | QP |
| 2 | * | 69.8450 | 46.50 | -19.94 | 26.56 | 40.00 | -13.44 | QP |
| 3 | | 175.0368 | 43.46 | -19.19 | 24.27 | 43.50 | -19.23 | QP |
| 4 | | 225.3080 | 46.03 | -19.57 | 26.46 | 46.00 | -19.54 | QP |
| 5 | | 257.4222 | 48.28 | -18.71 | 29.57 | 46.00 | -16.43 | QP |
| 6 | | 368.1116 | 47.15 | -17.42 | 29.73 | 46.00 | -16.27 | 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 | | 36.2541 | 50.30 | -17.90 | 32.40 | 40.00 | -7.60 | QP |
| 2 | ! | 53.5052 | 53.39 | -17.52 | 35.87 | 40.00 | -4.13 | QP |
| 3 | * | 66.2661 | 55.57 | -19.28 | 36.29 | 40.00 | -3.71 | QP |
| 4 | | 147.9214 | 46.28 | -17.88 | 28.40 | 43.50 | -15.10 | QP |
| 5 | | 263.8190 | 46.79 | -18.37 | 28.42 | 46.00 | -17.58 | QP |
| 6 | | 483.9094 | 36.67 | -14.06 | 22.61 | 46.00 | -23.39 | QP |

Final Level =Receiver Read level + Correct Factor

■ **Above 1-25GHz**

*Note: During the test, pre-scan the 802.11b/802.11g/802.11n (H20)/802.11n (H40) modulation, and found the 802.11b modulation which it is worse case.*

802.11b:Lowest

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 |
|---|---|---|---|---|---|---|---|---|
| 4824 | 51.11 | 31.40 | 8.18 | 31.50 | 59.19 | 74.00 | -14.81 | peak |
| 4824 | 37.15 | 31.40 | 8.18 | 31.50 | 45.23 | 54.00 | -8.77 | AVG |
| 7236 | 45.31 | 35.80 | 10.83 | 31.40 | 60.54 | 74.00 | -13.46 | peak |
| 7236 | 28.15 | 35.80 | 10.83 | 31.40 | 43.38 | 54.00 | -10.62 | 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 |
|---|---|---|---|---|---|---|---|---|
| 4824 | 52.37 | 31.40 | 8.18 | 31.50 | 60.45 | 74.00 | -13.55 | peak |
| 4824 | 35.15 | 31.40 | 8.18 | 31.50 | 43.23 | 54.00 | -10.77 | AVG |
| 7236 | 44.44 | 35.80 | 10.83 | 31.40 | 59.67 | 74.00 | -14.33 | peak |
| 7236 | 27.99 | 35.80 | 10.83 | 31.40 | 43.22 | 54.00 | -10.78 | AVG |
| --- | --- | | | --- | --- | --- | --- | --- |
| --- | --- | | | --- | --- | --- | --- | --- |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | | | |

## 802.11b:Middle

### 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 |
|---|---|---|---|---|---|---|---|---|
| 4874 | 51.30 | 31.40 | 9.17 | 32.10 | 59.77 | 74.00 | -14.23 | peak |
| 4874 | 37.23 | 31.40 | 9.17 | 32.10 | 45.70 | 54.00 | -8.30 | AVG |
| 7311 | 43.78 | 35.80 | 10.83 | 31.40 | 59.01 | 74.00 | -14.99 | peak |
| 7311 | 28.12 | 35.80 | 10.83 | 31.40 | 43.35 | 54.00 | -10.65 | 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 |
|---|---|---|---|---|---|---|---|---|
| 4874 | 51.20 | 31.40 | 9.17 | 32.10 | 59.67 | 74.00 | -14.33 | peak |
| 4874 | 36.12 | 31.40 | 9.17 | 32.10 | 44.59 | 54.00 | -9.41 | AVG |
| 7311 | 44.15 | 35.80 | 10.83 | 31.40 | 59.38 | 74.00 | -14.62 | peak |
| 7311 | 27.85 | 35.80 | 10.83 | 31.40 | 43.08 | 54.00 | -10.92 | AVG |
| --- | --- | | | --- | --- | --- | --- | --- |
| --- | --- | | | --- | --- | --- | --- | --- |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. | | | | | | | | |

802.11b:Highest

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 |
|---|---|---|---|---|---|---|---|---|
| 4924 | 50.05 | 31.40 | 9.17 | 32.10 | 58.52 | 74 | -15.48 | peak |
| 4924 | 35.12 | 31.40 | 9.17 | 32.10 | 43.59 | 54 | -10.41 | AVG |
| 7386 | 43.85 | 35.80 | 10.83 | 31.40 | 59.08 | 74 | -14.92 | peak |
| 7386 | 28.87 | 35.80 | 10.83 | 31.40 | 44.1 | 54 | -9.9 | 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 |
|---|---|---|---|---|---|---|---|---|
| 4924 | 50.88 | 31.40 | 9.17 | 32.10 | 59.35 | 74 | -14.65 | peak |
| 4924 | 35.30 | 31.40 | 9.17 | 32.10 | 43.77 | 54 | -10.23 | AVG |
| 7386 | 43.90 | 35.80 | 10.83 | 31.40 | 59.13 | 74 | -14.87 | peak |
| 7386 | 27.60 | 35.80 | 10.83 | 31.40 | 42.83 | 54 | -11.17 | 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.

# 7. Test Setup Photo

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

# 8. EUT Constructional Details

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

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