# FCC RF Test Report

| | | |
|---|---|---|
| APPLICANT | : | Quectel Wireless Solutions Co., Ltd. |
| EQUIPMENT | : | Smart Module |
| BRAND NAME | : | Quectel |
| MODEL NAME | : | SC668S-NA |
| FCC ID | : | XMR2022SC668SNA |
| STANDARD | : | FCC Part 15 Subpart E §15.407 |
| CLASSIFICATION | : | (NII) Unlicensed National Information Infrastructure |
| TEST DATE(S) | : | Apr. 14, 2023 |

**We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.**

Jason Jia

**Approved by: Jason Jia**

ACCREDITED
Cert #5145.02

***Sporton International Inc. (Kunshan)***
***No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China***

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# REVISION HISTORY

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FR311713B | Rev. 01 | Initial issue of report | Apr. 21, 2023 |
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# SUMMARY OF TEST RESULT

| Report Section | FCC Rule | Description | Limit | Result | Remark |
|---|---|---|---|---|---|
| 2.4 | 15.407(b) | Unwanted Emissions | 15.407(b) & 15.209(a) | Pass | Under limit 6.08 dB at 5350.01 MHz |

| **Declaration of Conformity:** |
|---|
| The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. |
| **Comments and Explanations:** |
| The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification. |

# 1 General Description

## 1.1 Applicant

**Quectel Wireless Solutions Co., Ltd.**
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, 200233,China

## 1.2 Manufacturer

**Quectel Wireless Solutions Co., Ltd.**
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, 200233,China

## 1.3 Product Feature of Equipment Under Test

| Product Feature | |
|---|---|
| **Equipment** | Smart Module |
| **Brand Name** | Quectel |
| **Model Name** | SC668S-NA |
| **FCC ID** | XMR2022SC668SNA |
| **SN** | Radiation: D1C22LT14000064 |
| **HW Version** | R1.0 |
| **SW Version** | SC668SNANAR02A02 |
| **EUT Stage** | Identical Prototype |

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

## 1.4 Modification of EUT

No modifications are made to the EUT during all test items.

## 1.5 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

| | | | |
|---|---|---|---|
| **Test Firm** | Sporton International Inc. (Kunshan) | | |
| **Test Site Location** | No. 1098, Pengxi North Road, Kunshan Economic Development Zone<br>Jiangsu Province 215300 People's Republic of China<br>TEL : +86-512-57900158 | | |
| **Test Site No.** | **Sporton Site No.** | **FCC Designation No.** | **FCC Test Firm Registration No.** |
| | 03CH04-KS | CN1257 | 314309 |

## 1.6 Test Software

| Item | Site | Manufacturer | Name | Version |
|---|---|---|---|---|
| 1. | 03CH04-KS | AUDIX | E3 | 6.2009-8-24al |

## 1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

# 2 Test Configuration of Equipment Under Test

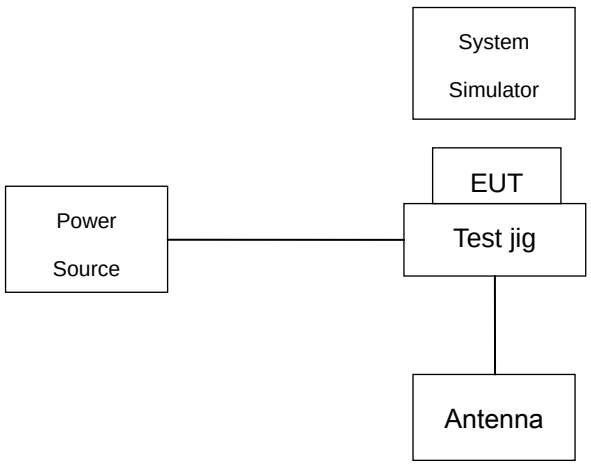
The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.

## 2.1 Test Mode

**Final test modes are considering the modulation and worse data rates as below table.**

| Simultaneous transmission |
|---|
| 802.11ac VHT80 CH58 (5290MHz)+ LTE Band 14 (BW=5M) |

## 2.2 Connection Diagram of Test System




This example is connection diagram of EUT test configurations.

. For detail, please refer to test mode configuration and setup photographs for each test item.

## 2.3 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuous transmit.

## 2.4 Unwanted Emissions Measurement

This section is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement.

### 2.4.1 Limit of Unwanted Emissions

(1) For transmitters operating in the 5150-5250 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of –27dBm/MHz.

For transmitters operating in the 5250-5350 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band must meet all applicable technical requirements for operation in the 5150-5250 MHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5150-5250 MHz band.

For transmitters operating in the 5470-5725 MHz band: all emissions outside of the 5470-5725 MHz band shall not exceed an EIRP of -27 dBm/MHz.

(2) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table,

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009 – 0.490 | 2400/F(kHz) | 300 |
| 0.490 – 1.705 | 24000/F(kHz) | 30 |
| 1.705 – 30.0 | 30 | 30 |
| 30 – 88 | 100 | 3 |
| 88 – 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

| EIRP (dBm) | Field Strength at 3m (dBμV/m) |
|---|---|
| - 27 | 68.3 |

**Note:** The following formula is used to convert the EIRP to field strength.

$$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$$

where

EIRP is the equivalent isotropically radiated power, in dBm

$E_{Meas}$ is the field strength of the emission at the measurement distance, in dBμV/m

$d_{Meas}$ is the measurement distance, in m

(3) ANSI C63.10-2013 clause 12.7.3 note 97

As specified by regulatory requirements, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit. However, an out-of-band emission that complies with both the average and peak general regulatory limits is not required to satisfy the peak emission limit.

### 2.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 2.4.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement.

   (1) Procedure for Unwanted Emissions Measurements Below 1000MHz

   - RBW = 120 kHz
   - VBW = 300 kHz
   - Detector = Peak
   - Trace mode = max hold

   (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep time = auto
   - Trace mode = max hold

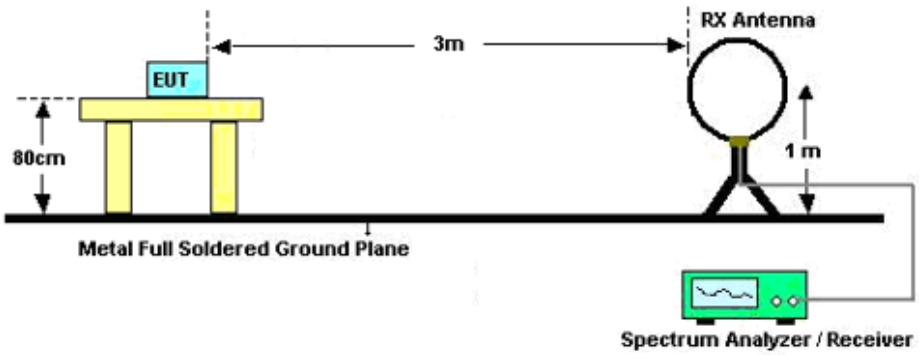
   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

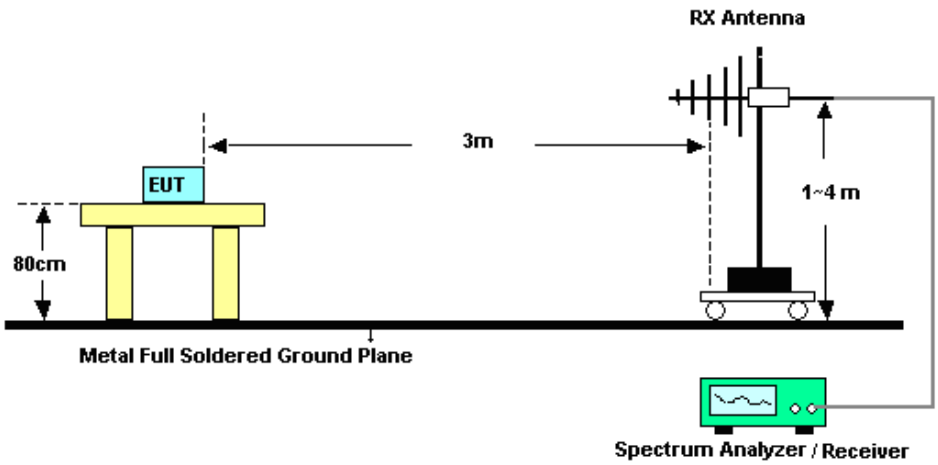
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

### 2.4.4 Test Setup

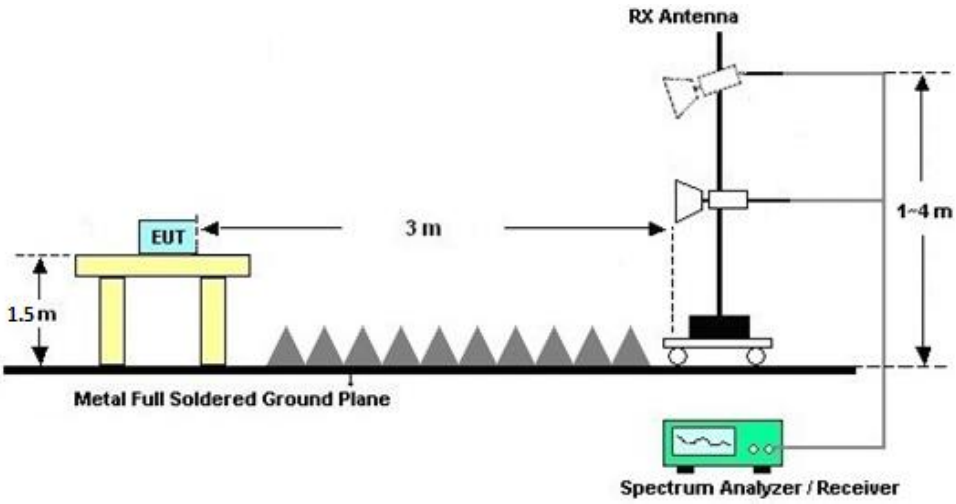
**For radiated emissions below 30MHz**




**For radiated emissions from 30MHz to 1GHz**



**For radiated emissions above 1GHz**




## 2.4.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

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

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

## 2.4.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A.

## 2.4.7 Duty Cycle

Please refer to Appendix B.

## 2.4.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix A.

# 3 List of Measuring Equipment

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|---|---|---|---|---|---|---|---|---|
| EMI Test Receiver | Keysight | N9038A | MY56400004 | 3Hz~8.5GHz;Max 30dBm | Oct. 13, 2022 | Apr. 14, 2023 | Oct. 12, 2023 | Radiation (03CH04-KS) |
| EXA Spectrum Analyzer | Keysight | N9010B | MY57471079 | 10Hz-44G,MAX 30dB | Oct. 12, 2022 | Apr. 14, 2023 | May 23, 2023 | Radiation (03CH04-KS) |
| Loop Antenna | R&S | HFH2-Z2 | 100321 | 9kHz~30MHz | Oct. 16, 2022 | Apr. 14, 2023 | Oct. 15, 2023 | Radiation (03CH04-KS) |
| Bilog Antenna | TeseQ | CBL6111D | 49922 | 30MHz-1GHz | May 24, 2022 | Apr. 14, 2023 | May 23, 2023 | Radiation (03CH04-KS) |
| Horn Antenna | Schwarzbeck | BBHA9120D | 1284 | 1GHz~18GHz | Oct. 16, 2022 | Apr. 14, 2023 | Oct. 15, 2023 | Radiation (03CH04-KS) |
| SHF-EHF Horn | Com-power | AH-840 | 101070 | 18GHz~40GHz | Jan. 08, 2023 | Apr. 14, 2023 | Jan. 07, 2024 | Radiation (03CH04-KS) |
| Amplifier | SONOMA | 310N | 187289 | 9KHz-1GHz | May 24, 2022 | Apr. 14, 2023 | May 23, 2023 | Radiation (03CH04-KS) |
| Amplifier | MITEQ | EM18G40GGA | 060728 | 18~40GHz | Jan. 05, 2023 | Apr. 14, 2023 | Jan. 04, 2024 | Radiation (03CH04-KS) |
| high gain Amplifier | EM | EM01G18GA | 060840 | 1Ghz-18Ghz | Oct. 12, 2022 | Apr. 14, 2023 | Oct. 11, 2023 | Radiation (03CH04-KS) |
| Amplifier | Agilent | 8449B | 3008A02370 | 1Ghz-18Ghz | Oct. 12, 2022 | Apr. 14, 2023 | Oct. 11, 2023 | Radiation (03CH04-KS) |
| AC Power Source | Chroma | 61601 | F104090004 | N/A | NCR | Apr. 14, 2023 | NCR | Radiation (03CH04-KS) |
| Turn Table | ChamPro | EM 1000-T | 060762-T | 0~360 degree | NCR | Apr. 14, 2023 | NCR | Radiation (03CH04-KS) |
| Antenna Mast | ChamPro | EM 1000-A | 060762-A | 1 m~4 m | NCR | Apr. 14, 2023 | NCR | Radiation (03CH04-KS) |

NCR: No Calibration Required

# 4 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

**Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.0dB** |

**Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.0dB** |

**Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.0dB** |

**---------- THE END ----------**

# Appendix A. Radiated Spurious Emission Test Data

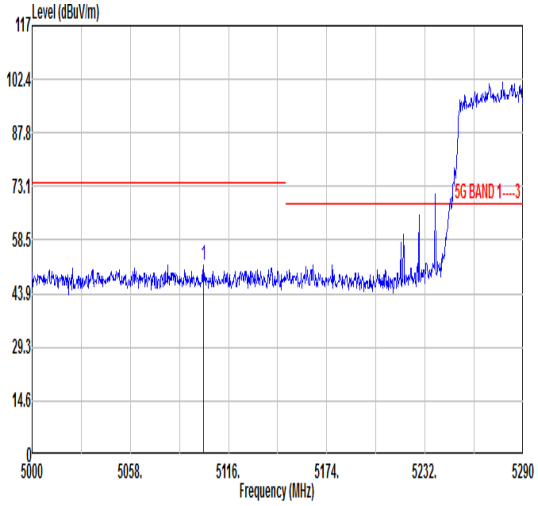
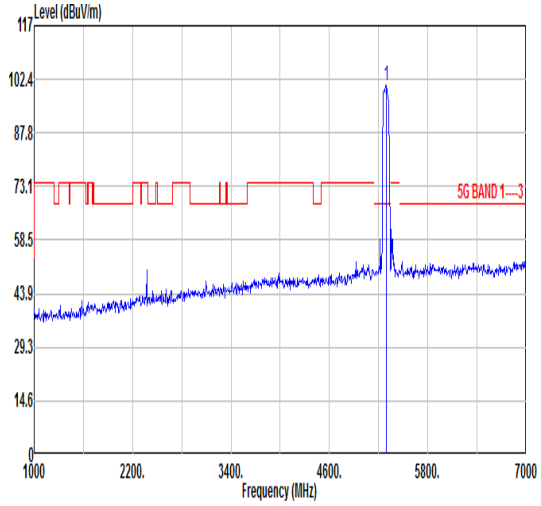
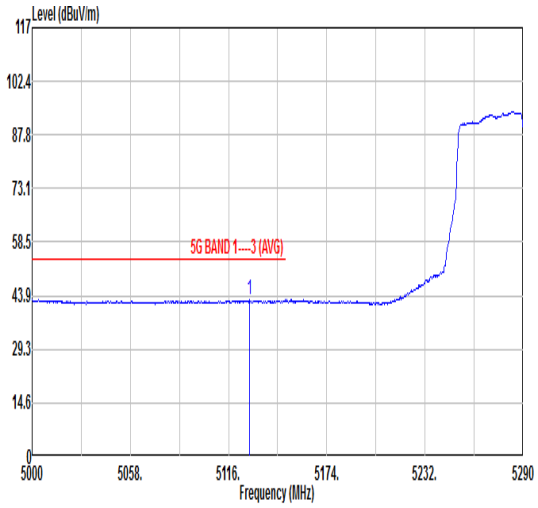
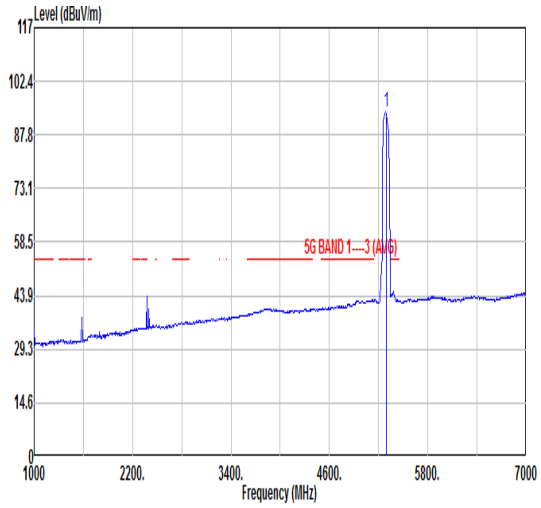
| Test Engineer : | Carry Xu | Relative Humidity : | 41 ~ 42 % |
|---|---|---|---|
| | | Temperature : | 22 ~ 23 ℃ |

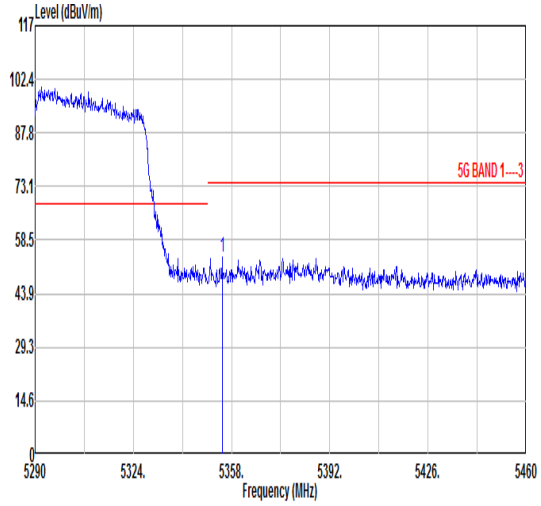
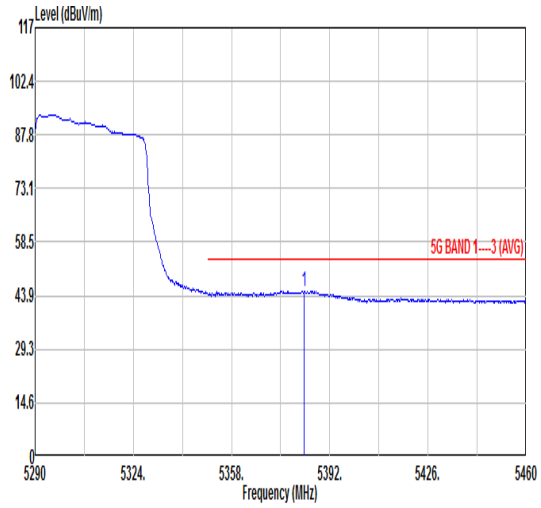
# Radiated Spurious Emission Test Modes

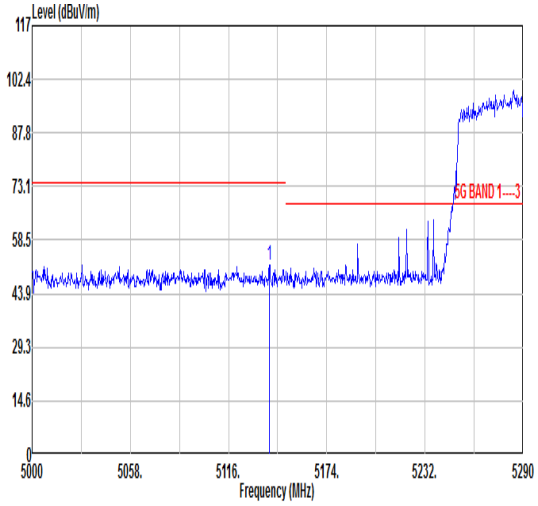
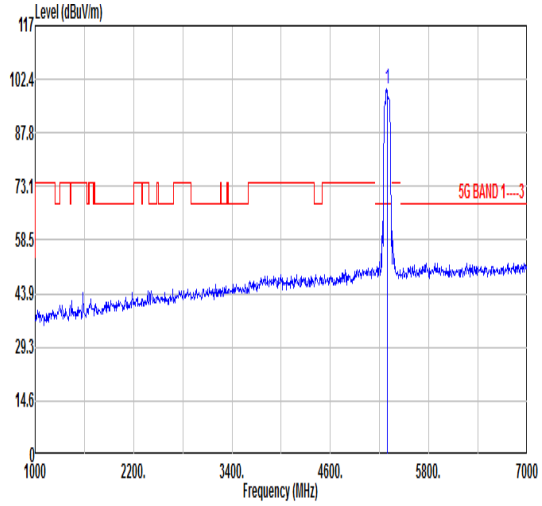
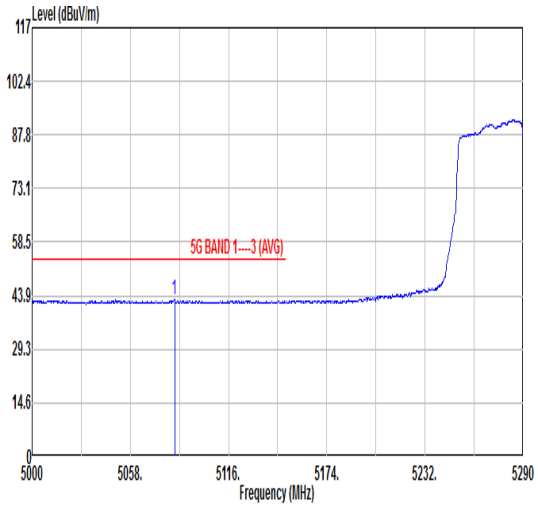
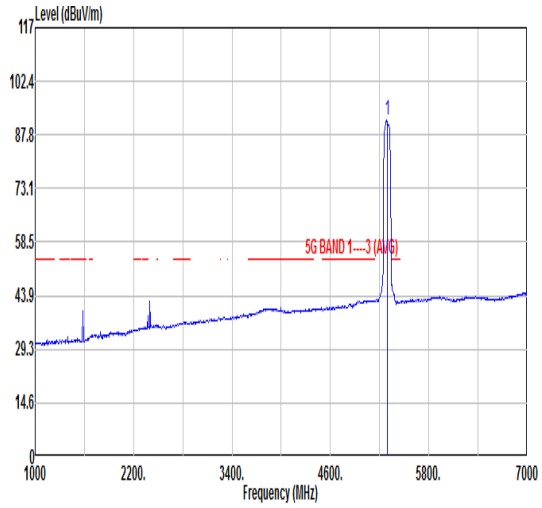
| Mode | Band | Band (GHz) | Antenna | Modulation | Channel | Frequency | Data Rate | RU | Remark |
|---|---|---|---|---|---|---|---|---|---|
| Mode 1 | U-NII-2A | 5.25-5.35 | 4+5 | 802.11ac VHT80 | 58 | 5290 | MCS0 | - | - |
| | LTE Band 14 BW=5M | | | | | | | | |

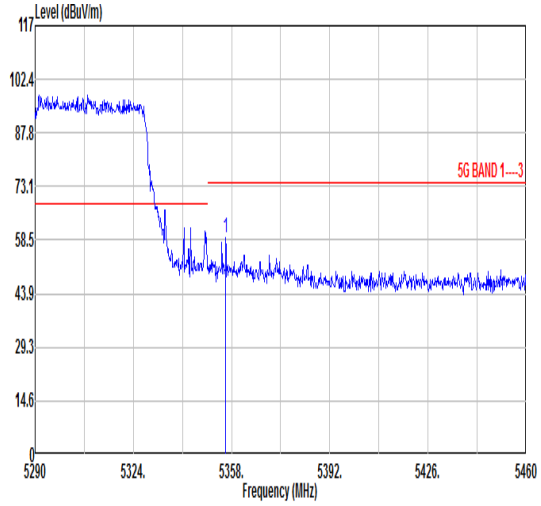
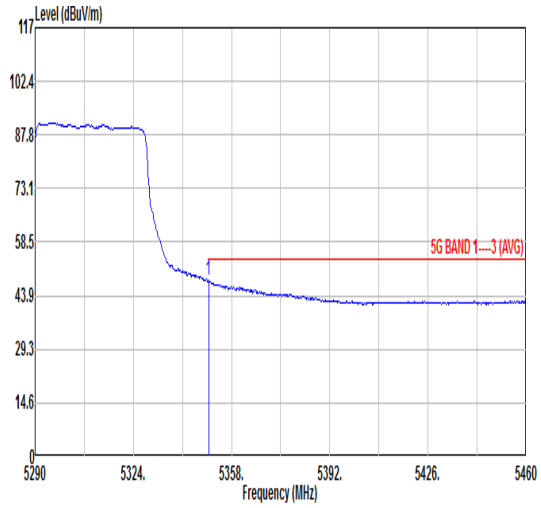
# Summary of each worse mode

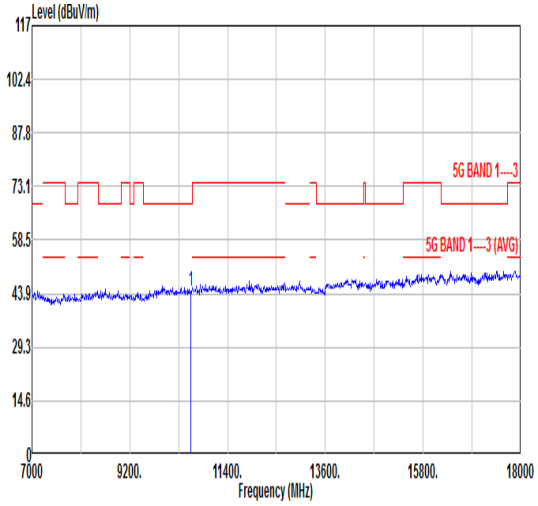
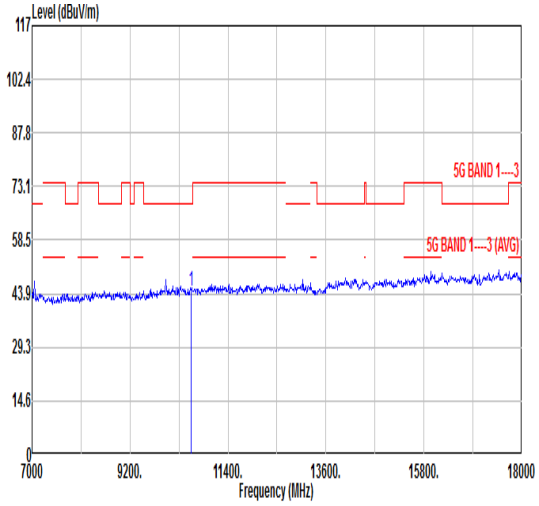
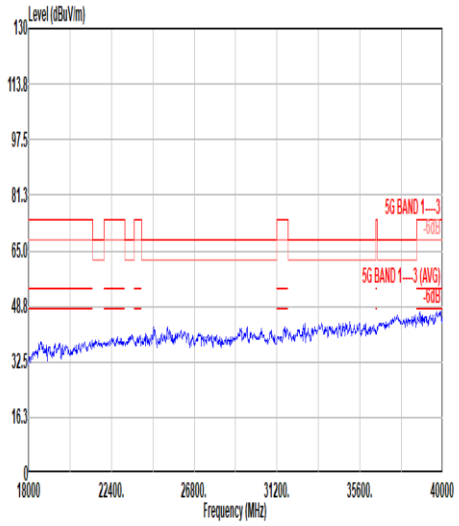
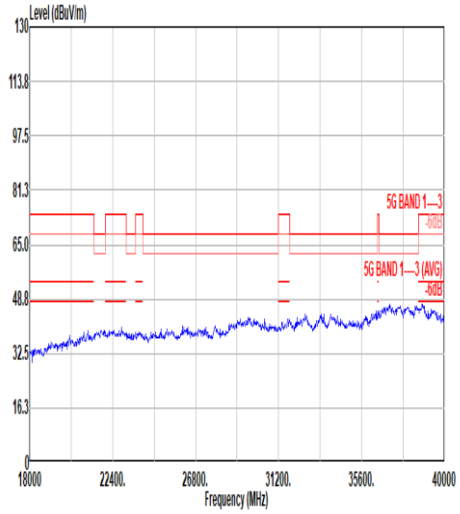
| Mode | Modulation | Ch. | Freq. (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Pol. | Peak Avg. | Result | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 802.11ac VHT80 | 58 | 5350.01 | 47.92 | 54.00 | -6.08 | V | AVERAGE | Pass | Band Edge |
| | 802.11ac VHT80 | 58 | 10580.00 | 44.47 | 68.30 | -23.83 | V | PEAK | Pass | Harmonic |

| Mode | 1 | |
|---|---|---|
| | Band Edge - L | |
| | U-NII-2A_5.25-5.35_802.11ac VHT80_CH58_5290MHz | |
| ANT | 4+5 | |
| Pol. | Horizontal | Fundamental |
| Peak |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5101.21 51.56 74.00 -22.44 42.75 34.98 10.63 36.80 0.00 397 271 PEAK |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5290.00 100.67 ------ ------ 91.40 35.18 10.90 36.81 0.00 397 271 PEAK |
| Avg |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5128.18 42.79 54.00 -11.21 33.92 35.01 10.66 36.80 0.00 397 271 AVERAGE |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5290.00 93.86 ------ ------ 84.63 35.16 10.88 36.81 0.00 397 271 AVERAGE |

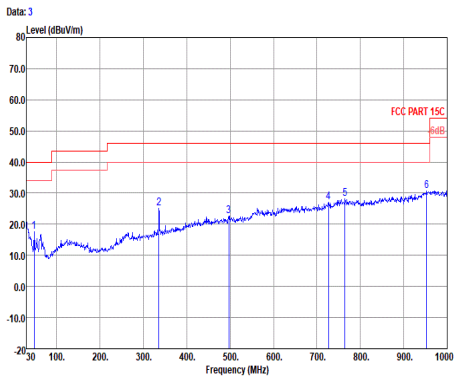
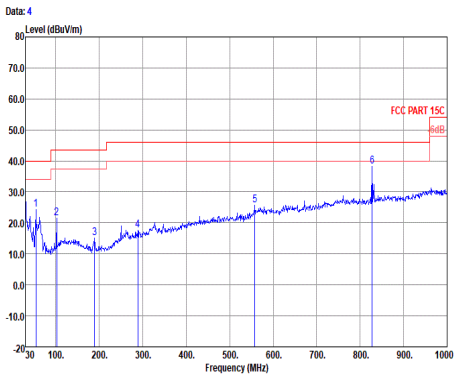
| Mode | 1 | |
|---|---|---|
| | Band Edge - R | |
| | U-NII-2A_5.25-5.35_802.11ac VHT80_CH58_5290MHz | |
| ANT | 4+5 | |
| Pol. | Horizontal | Fundamental |
| Peak |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5354.77 53.80 74.00 -20.20 44.39 35.23 10.99 36.81 0.00 397 271 PEAK | Blank |
| Avg |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5383.16 45.05 54.00 -8.95 35.58 35.25 11.03 36.81 0.00 397 271 AVERAGE | Blank |

| Mode | 1 | |
|---|---|---|
| | Band Edge - L | |
| | U-NII-2A_5.25-5.35_802.11ac VHT80_CH58_5290MHz | |
| ANT | 4+5 | |
| Pol. | Vertical | Fundamental |
| Peak |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5140.07 51.63 74.00 -22.37 42.73 35.02 10.68 36.80 0.00 378 345 PEAK |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5290.00 99.62 ------ ------ 90.39 35.16 10.88 36.81 0.00 378 345 PEAK |
| Avg |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5084.10 42.72 54.00 -11.28 33.95 34.96 10.61 36.80 0.00 378 345 AVERAGE |  <br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5290.00 91.68 ------ ------ 82.45 35.16 10.88 36.81 0.00 378 345 AVERAGE |

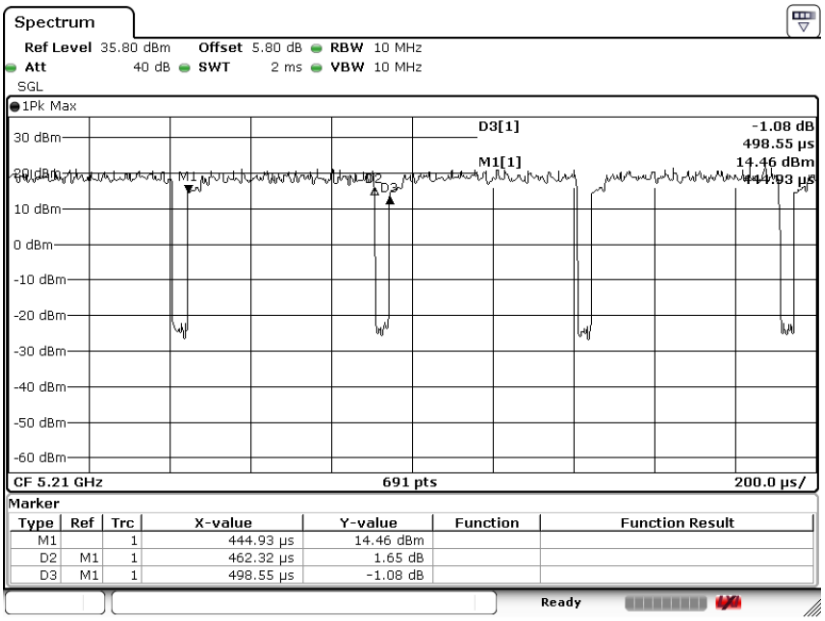
| Mode | 1 | |
|---|---|---|
| | Band Edge - R | |
| | U-NII-2A_5.25-5.35_802.11ac VHT80_CH58_5290MHz | |
| ANT | 4+5 | |
| Pol. | Vertical | Fundamental |
| Peak |  <br>Limit Read Ant Cable Preamp Aux APos TPos<br>Freq Level Line Margin Level Factor Loss Factor Factor Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5355.96 59.11 74.00 -14.89 49.70 35.23 10.99 36.81 0.00 378 345 PEAK | Blank |
| Avg |  <br>Limit Read Ant Cable Preamp Aux APos TPos<br>Freq Level Line Margin Level Factor Loss Factor Factor Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 5350.01 47.92 54.00 -6.08 38.51 35.23 10.99 36.81 0.00 378 345 AVERAGE | Blank |

| Mode | 1 | |
|---|---|---|
| | Harmonic | |
| | U-NII-2A_5.25-5.35_802.11ac VHT80_CH58_5290MHz | |
| ANT | 4+5 | |
| Pol. | Horizontal | Vertical |
| Peak<br>Avg |  <br><br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 10580.00 44.40 68.30 -23.90 52.93 38.39 15.65 62.57 0.00 --- --- PEAK |  <br><br>Freq Level Limit Line Margin Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark<br>MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg<br>1 10580.00 44.47 68.30 -23.83 53.00 38.39 15.65 62.57 0.00 --- --- PEAK |
| Peak |  <br> |  <br> |

| Mode | 30M-1G |
|---|---|
| | Emission below 1GHz |
| | U-NII-2A_5.25-5.35_802.11ac VHT80_CH58_5290MHz |
| ANT | 1 |

| Pol. | Horizontal | Vertical |
|---|---|---|
| Peak<br>Avg |  <br><br>Freq Level Over Limit Limit Line ReadAntenna Level Factor Cable Loss Preamp Factor A/Pos T/Pos Remark Pol/Phas<br>MHz dBuV/m dB dBuV/m dBuV dB/m dB dB cm deg<br>1 48.43 17.73 -22.27 40.00 34.15 15.00 0.98 32.40 --- --- Peak HORIZONT<br>2 335.55 25.03 -20.97 46.00 34.90 19.83 2.70 32.40 --- --- Peak HORIZONT<br>3 496.57 22.62 -23.38 46.00 28.15 23.73 3.14 32.40 --- --- Peak HORIZONT<br>4 726.46 27.10 -18.90 46.00 28.06 27.37 4.02 32.35 --- --- Peak HORIZONT<br>5 764.29 28.13 -17.87 46.00 28.14 28.12 4.11 32.24 --- --- Peak HORIZONT<br>6 962.47 30.80 -15.20 46.00 26.33 30.95 4.59 31.07 --- --- Peak HORIZONT |  <br><br>Freq Level Over Limit Limit Line ReadAntenna Level Factor Cable Loss Preamp Factor A/Pos T/Pos Remark Pol/Phas<br>MHz dBuV/m dB dBuV/m dBuV dB/m dB dB cm deg<br>1 54.25 24.32 -15.68 40.00 43.20 12.50 1.02 32.40 --- --- Peak VERTICAL<br>2 101.78 21.37 -22.13 43.50 36.29 16.00 1.48 32.40 --- --- Peak VERTICAL<br>3 189.08 15.23 -28.27 43.50 31.01 14.60 2.02 32.40 --- --- Peak VERTICAL<br>4 288.99 17.53 -28.47 46.00 28.42 19.06 2.45 32.40 --- --- Peak VERTICAL<br>5 557.68 25.66 -20.34 46.00 28.92 25.88 3.26 32.40 --- --- Peak VERTICAL<br>6 827.34 38.25 -7.75 46.00 38.02 27.98 4.24 31.99 --- --- Peak VERTICAL |

# Appendix B. Duty Cycle Plots

| Band | Duty Cycle(%) | T(ms) | 1/T(kHz) | VBW Setting |
|---|---|---|---|---|
| 802.11ac VHT80 | 92.73 | 0.462 | 2.163 | 2.2khz |

**802.11ac VHT80**