

# TEST REPORT

Applicant Name : Dragino Technology Co., Limited.  
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LongCheng Street, LongGang District, Shenzhen, China  
Report Number : SZNS220901-39736E-RF-00A  
FCC ID: ZHZWTS

## Test Standard (s)

FCC PART 15.247

## Sample Description

Product Type: WTS  
Model No.: WTS-10  
Multiple Model(s) No.: WTS-11, WTS-12  
Trade Mark: DRAGINO  
Date Received: 2022/09/01  
Report Date: 2022/10/14

|              |       |
|--------------|-------|
| Test Result: | Pass* |
|--------------|-------|

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

## Prepared and Checked By:

*Roger Ling*

Roger Ling  
EMC Engineer

## Approved By:

*Candy Li*

Candy Li  
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".

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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

|                                                                                                                                          |                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product                                                                                                                                  | WTS                                                                                                                                                                                                    |
| Tested Model                                                                                                                             | WTS-10                                                                                                                                                                                                 |
| Multiple Models                                                                                                                          | WTS-11, WTS-12<br>(model difference see product declaration letter of similarity)                                                                                                                      |
| Frequency Range                                                                                                                          | 902.3-914.9MHz                                                                                                                                                                                         |
| Maximum Conducted Peak Output Power                                                                                                      | 3.05dBm                                                                                                                                                                                                |
| Technique                                                                                                                                | Hybrid System                                                                                                                                                                                          |
| Antenna Specification*                                                                                                                   | 2dBi (provide by applicant)                                                                                                                                                                            |
| Voltage Range                                                                                                                            | DC3.6V from battery                                                                                                                                                                                    |
| Sample serial number                                                                                                                     | RF Conducted Test : SZNS220901-39736E-RF-S2<br>Radiated Emission Test :<br>SZNS220901-39736E-RF-S1 (WTS-10),<br>SZNS220901-39736E-RF-S8 (WTS-11), SZNS220901-39736E-RF-S7(WTS-12)<br>(Assigned by ATC) |
| Sample/EUT Status                                                                                                                        | Good condition                                                                                                                                                                                         |
| Note: For radiated emission test (above 1GHz) and conducted test, pre-scan all models, the worst case model WTS-10 was selected to test. |                                                                                                                                                                                                        |

### Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209 and 15.247 rules.

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

## Measurement Uncertainty

| Parameter                    |                 | Uncertainty |
|------------------------------|-----------------|-------------|
| Occupied Channel Bandwidth   |                 | 5%          |
| RF output power, conducted   |                 | 0.73dB      |
| Unwanted Emission, conducted |                 | 1.6dB       |
| AC Line Conducted emission   |                 | 2.72dB      |
| Emissions,<br>Radiated       | 30MHz – 1GHz    | 4.28dB      |
|                              | 1GHz – 18GHz    | 4.98dB      |
|                              | 18GHz – 26.5GHz | 5.06dB      |
| Temperature                  |                 | 1 °C        |
| Humidity                     |                 | 6%          |
| Supply voltages              |                 | 0.4%        |

*Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.*

## Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISED), the Registration Number is 5077A.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in engineering mode.

Channel list:

| Channel | Freq.(MHz) | Channel | Freq.(MHz) | Channel | Freq.(MHz) | Channel | Freq.(MHz) |
|---------|------------|---------|------------|---------|------------|---------|------------|
| 0       | 902.3      | 16      | 905.5      | 32      | 908.7      | 48      | 911.9      |
| 1       | 902.5      | 17      | 905.7      | 33      | 908.9      | 49      | 912.1      |
| 2       | 902.7      | 18      | 905.9      | 34      | 909.1      | 50      | 912.3      |
| 3       | 902.9      | 19      | 906.1      | 35      | 909.3      | 51      | 912.5      |
| 4       | 903.1      | 20      | 906.3      | 36      | 909.5      | 52      | 912.7      |
| 5       | 903.3      | 21      | 906.5      | 37      | 909.7      | 53      | 912.9      |
| 6       | 903.5      | 22      | 906.7      | 38      | 909.9      | 54      | 913.1      |
| 7       | 903.7      | 23      | 906.9      | 39      | 910.1      | 55      | 913.3      |
| 8       | 903.9      | 24      | 907.1      | 40      | 910.3      | 56      | 913.5      |
| 9       | 904.1      | 25      | 907.3      | 41      | 910.5      | 57      | 913.7      |
| 10      | 904.3      | 26      | 907.5      | 42      | 910.7      | 58      | 913.9      |
| 11      | 904.5      | 27      | 907.7      | 43      | 910.9      | 59      | 914.1      |
| 12      | 904.7      | 28      | 907.9      | 44      | 911.1      | 60      | 914.3      |
| 13      | 904.9      | 29      | 908.1      | 45      | 911.3      | 61      | 914.5      |
| 14      | 905.1      | 30      | 908.3      | 46      | 911.5      | 62      | 914.7      |
| 15      | 905.3      | 31      | 908.5      | 47      | 911.7      | 63      | 914.9      |

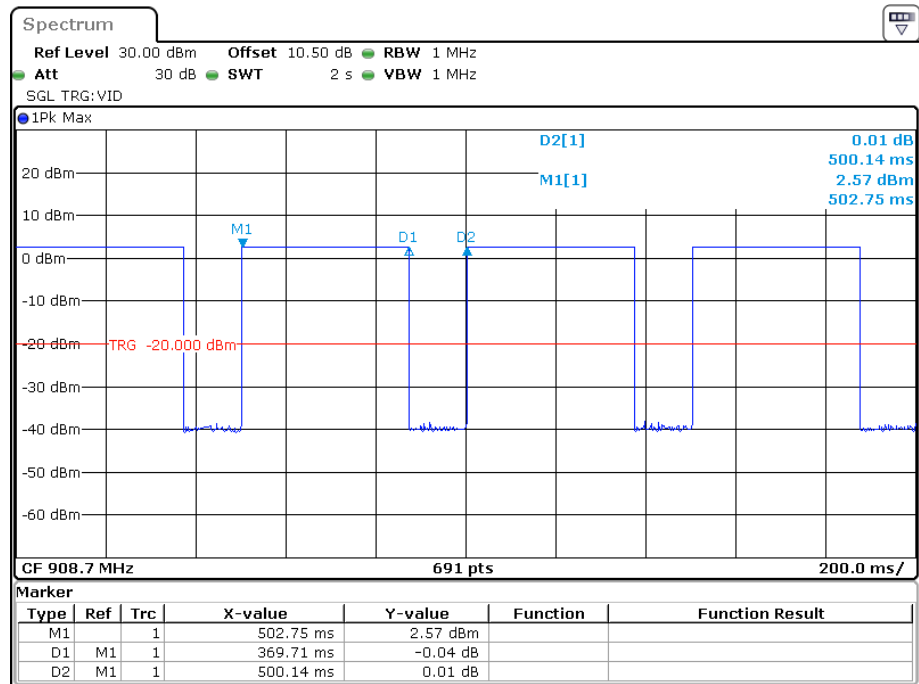
EUT was test with channel 0/32/63

### EUT Exercise Software

“serial\_port\_utility.exe” software was used to the EUT tested and power level is 10. The software and power level was provided by the applicant.

### Duty cycle

| Mode          | T <sub>on</sub><br>(ms) | T <sub>on+off</sub><br>(ms) | Duty Cycle<br>(%) |
|---------------|-------------------------|-----------------------------|-------------------|
| Hybrid System | 369.71                  | 500.14                      | 73.92             |



Date: 14.SEP.2022 15:58:30

## Equipment Modifications

No modification was made to the EUT tested.

## Special Accessories

No special accessory.

## Support Equipment List and Details

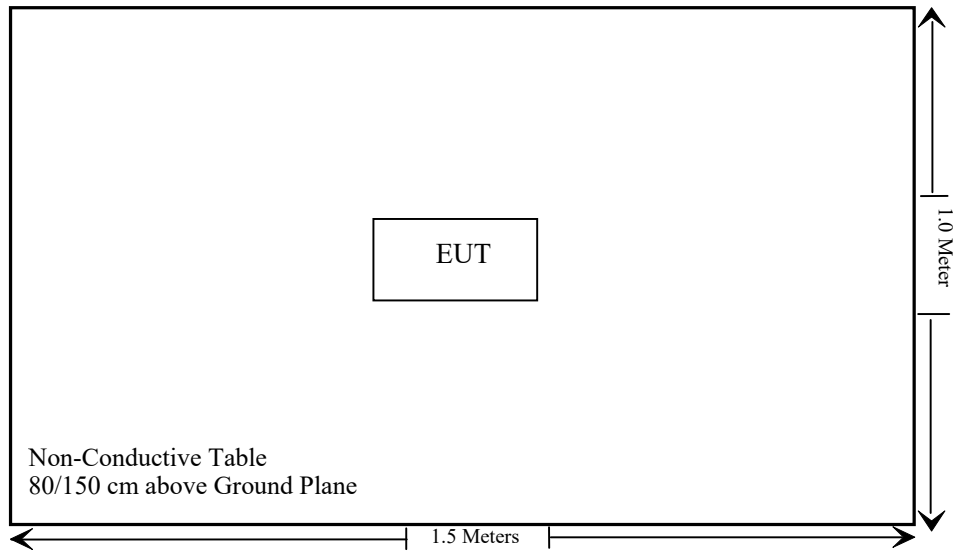
| Manufacturer | Description | Model | Serial Number |
|--------------|-------------|-------|---------------|
| /            | /           | /     | /             |

## External I/O Cable

| Cable Description | Length (m) | From/Port | To |
|-------------------|------------|-----------|----|
| /                 | /          | /         | /  |

## Block Diagram of Test Setup

For radiated emission:





## SUMMARY OF TEST RESULTS

| FCC Rules                     | Description of Test               | Result         |
|-------------------------------|-----------------------------------|----------------|
| §15.247 (i), §2.1091          | Maximum Permissible Exposure(MPE) | Compliant      |
| §15.203                       | Antenna Requirement               | Compliant      |
| §15.207(a)                    | AC Line Conducted Emissions       | Not Applicable |
| §15.205, §15.209 & §15.247(d) | Radiated Emissions                | Compliant      |
| §15.247(a)(1)                 | 20 dB Emission Bandwidth          | Compliant      |
| §15.247(a)(1)(i)              | Channel Separation Test           | Compliant      |
| §15.247(f)                    | Time of Occupancy (Dwell Time)    | Compliant      |
| §15.247(b)(3)                 | Peak Output Power Measurement     | Compliant      |
| §15.247(d)                    | Band edges                        | Compliant      |
| §15.247(f)                    | Power Spectral Density            | Compliant      |

Not Applicable: The EUT is powered by battery only.

**TEST EQUIPMENT LIST**

| Manufacturer                                    | Description                 | Model             | Serial Number   | Calibration Date | Calibration Due Date |
|-------------------------------------------------|-----------------------------|-------------------|-----------------|------------------|----------------------|
| <b>Radiated Emission Test</b>                   |                             |                   |                 |                  |                      |
| Rohde& Schwarz                                  | Test Receiver               | ESR               | 102725          | 2021/12/13       | 2022/12/12           |
| Rohde&Schwarz                                   | Spectrum Analyzer           | FSV40             | 101949          | 2021/12/13       | 2022/12/12           |
| SONOMA INSTRUMENT                               | Amplifier                   | 310 N             | 186131          | 2021/11/09       | 2022/11/08           |
| A.H. Systems, inc.                              | Preamplifier                | PAM-0118P         | 135             | 2021/11/09       | 2022/11/08           |
| Schwarzbeck                                     | Bilog Antenna               | VULB9163          | 9163-323        | 2021/07/06       | 2024/07/05           |
| Schwarzbeck                                     | Horn Antenna                | BBHA9120D         | 9120D-1067      | 2020/01/05       | 2023/01/04           |
| Radiated Emission Test Software: e3 19821b (V9) |                             |                   |                 |                  |                      |
| Unknown                                         | RF Coaxial Cable            | No.10             | N050            | 2021/12/14       | 2022/12/13           |
| Unknown                                         | RF Coaxial Cable            | No.11             | N1000           | 2021/12/14       | 2022/12/13           |
| Unknown                                         | RF Coaxial Cable            | No.12             | N040            | 2021/12/14       | 2022/12/13           |
| Unknown                                         | RF Coaxial Cable            | No.13             | N300            | 2021/12/14       | 2022/12/13           |
| Unknown                                         | RF Coaxial Cable            | No.14             | N800            | 2021/12/14       | 2022/12/13           |
| CD                                              | High Pass Filter            | HPM-1.2/18G-60    | 110             | 2021/12/14       | 2022/12/13           |
| <b>RF Conducted Test</b>                        |                             |                   |                 |                  |                      |
| Rohde & Schwarz                                 | Open Switch and ControlUnit | OSP120 + OSP-B157 | 101244 + 100866 | 2021/12/13       | 2022/12/12           |
| Rohde&Schwarz                                   | Spectrum Analyzer           | FSV-40            | 101948          | 2021/12/13       | 2022/12/12           |
| WEINSCHL                                        | 10dB Attenuator             | 5324              | AU 3842         | 2021/12/14       | 2022/12/13           |
| Unknown                                         | RF Coaxial Cable            | No.31             | RF-01           | Each time        |                      |

\* **Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

## FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

| RF Source frequency (MHz) | Threshold ERP (watts) |
|---------------------------|-----------------------|
| 0.3-1.34                  | $1,920 R^2$ .         |
| 1.34-30                   | $3,450 R^2/f^2$ .     |
| 30-300                    | $3.83 R^2$ .          |
| 300-1,500                 | $0.0128 R^2 f$ .      |
| 1,500-100,000             | $19.2 R^2$ .          |

R is the minimum separation distance in meters

f = frequency in MHz

### Result

| Mode          | Frequency (MHz) | Tune up conducted power | Antenna Gain |       | ERP   |        | Evaluation Distance (m) | ERP Limit (W) |
|---------------|-----------------|-------------------------|--------------|-------|-------|--------|-------------------------|---------------|
|               |                 | (dBm)                   | (dBi)        | (dBd) | (dBm) | (W)    |                         |               |
| Hybrid System | 902.3-914.9     | 3.5                     | 2.0          | -0.15 | 3.35  | 0.0022 | 0.2                     | 0.462         |

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.

2. 0dBd=2.15dBi

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

**Result: Compliant.**

## **FCC §15.203 - ANTENNA REQUIREMENT**

---

### **Applicable Standard**

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
  - b. Antenna must use a unique type of connector to attach to the EUT.
- Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### **Antenna Connector Construction**

The EUT has one internal antenna, which was permanently attached, and the maximum antenna gain is 2.0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

**Result:** Compliance.

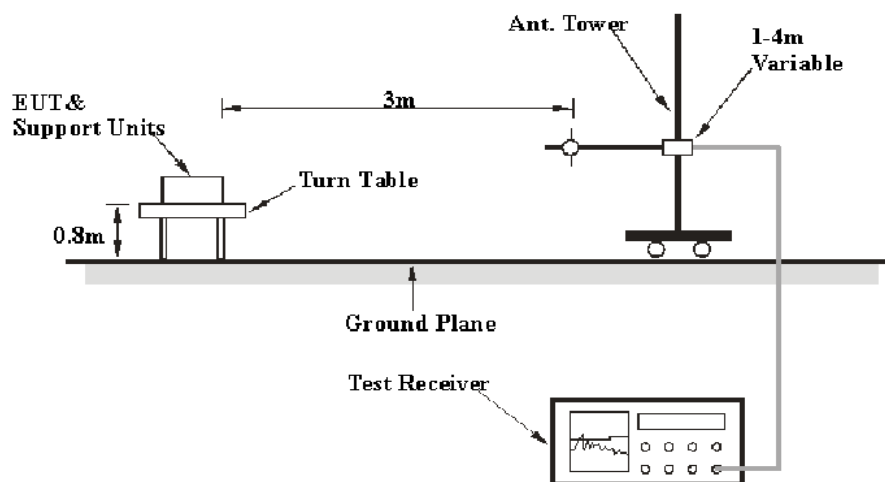
## FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

### Applicable Standard

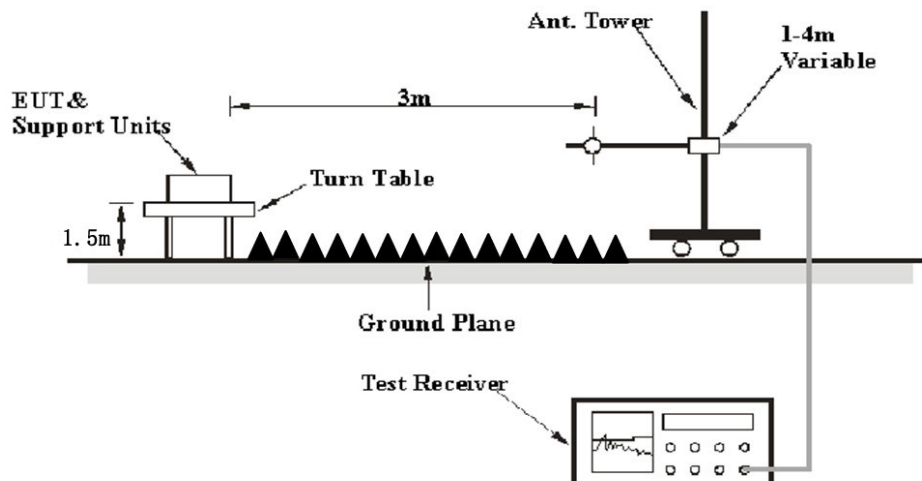
FCC §15.247 (d); §15.209; §15.205;

### EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

## EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 10 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

| Frequency Range   | RBW     | Video B/W | IF B/W  | Measurements |
|-------------------|---------|-----------|---------|--------------|
| 30 MHz – 1000 MHz | 100 kHz | 300 kHz   | 120 kHz | QP           |
| Above 1 GHz       | 1MHz    | 3 MHz     | /       | PK           |
|                   | 1MHz    | 10 Hz     | /       | Ave.         |

## Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

## Corrected Factor & Margin Calculation

The Corrected Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

$$\text{Corrected Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Over Limit or Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a over limit/margin of -7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\begin{aligned} \text{Over Limit/Margin} &= \text{Level/Corrected Amplitude} - \text{Limit} \\ \text{Level/Corrected Amplitude} &= \text{Read Level} + \text{Corrected Factor} \end{aligned}$$

## Test Data

### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 25~27.2°C |
| Relative Humidity: | 54~60%    |
| ATM Pressure:      | 101.0 kPa |

*The testing was performed by Level Li on 2022-09-23 for below 1G and on 2022-09-11 for above 1G.*

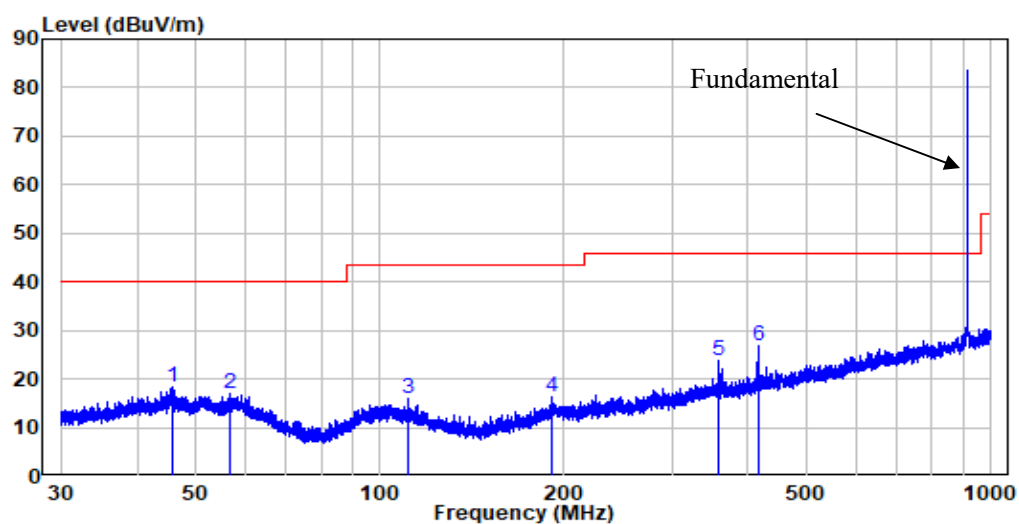
*EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case of orientation was recorded)*

**30MHz - 1GHz:** (worst case is Middle channel)

Note: When the test result of peak was less than the limit of QP more than 6dB, just peak value were recorded.

For Model: WTS-10

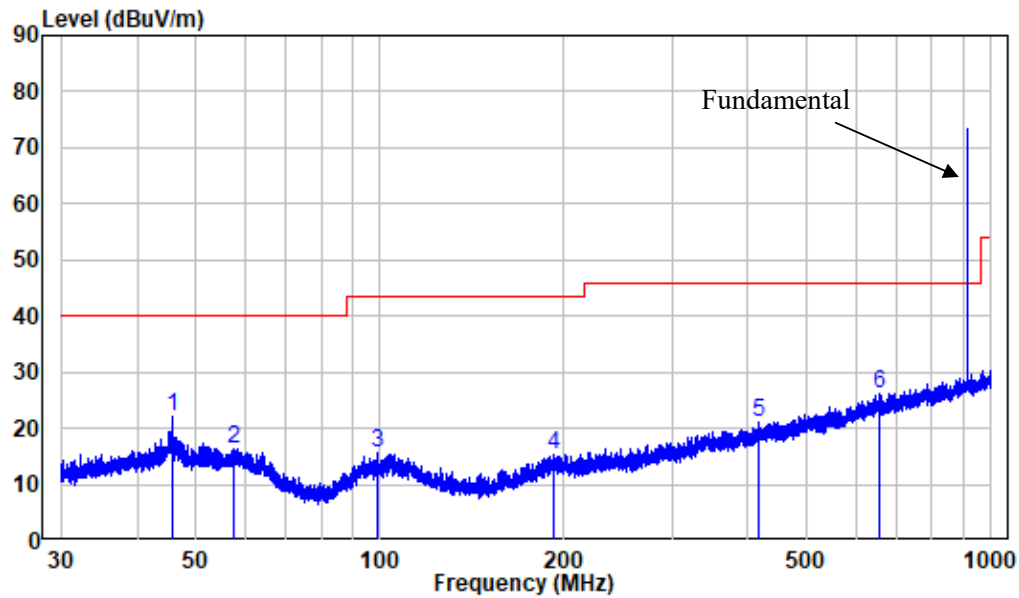
Horizontal



Site : chamber  
Condition: 3m HORIZONTAL  
Job No. : SZNS220901-39736E-RF  
Test Mode: Hybrid system

|   | Freq    | Factor | Read Level | Level  | Limit  | Over   | Remark |
|---|---------|--------|------------|--------|--------|--------|--------|
|   | MHz     | dB/m   | dBuV       | dBuV/m | dBuV/m | dB     |        |
| 1 | 45.755  | -9.98  | 28.35      | 18.37  | 40.00  | -21.63 | Peak   |
| 2 | 56.692  | -10.09 | 27.11      | 17.02  | 40.00  | -22.98 | Peak   |
| 3 | 111.103 | -12.12 | 27.94      | 15.82  | 43.50  | -27.68 | Peak   |
| 4 | 191.158 | -11.39 | 27.55      | 16.16  | 43.50  | -27.34 | Peak   |
| 5 | 357.772 | -7.59  | 31.24      | 23.65  | 46.00  | -22.35 | Peak   |
| 6 | 417.458 | -6.18  | 32.94      | 26.76  | 46.00  | -19.24 | Peak   |

## Vertical



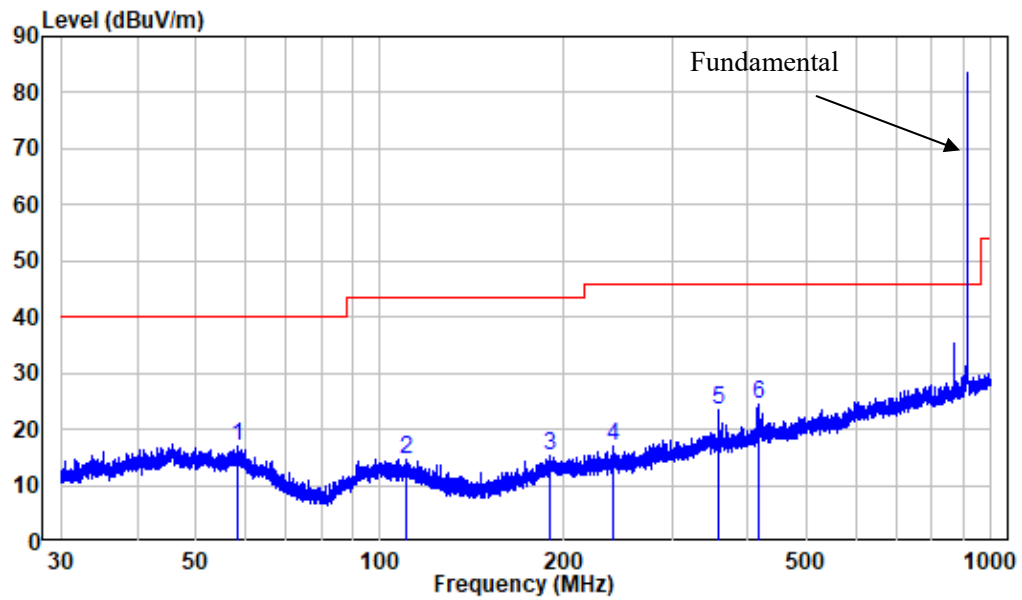
Site : chamber  
 Condition: 3m VERTICAL  
 Job No. : SZNS220901-39736E-RF  
 Test Mode: Hybrid system

|   | Freq    | Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|---|---------|--------|------------|--------|------------|------------|--------|
|   | MHz     | dB/m   | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1 | 45.795  | -9.98  | 31.90      | 21.92  | 40.00      | -18.08     | Peak   |
| 2 | 57.443  | -9.99  | 26.33      | 16.34  | 40.00      | -23.66     | Peak   |
| 3 | 99.049  | -12.02 | 27.57      | 15.55  | 43.50      | -27.95     | Peak   |
| 4 | 192.841 | -11.27 | 26.51      | 15.24  | 43.50      | -28.26     | Peak   |
| 5 | 417.275 | -6.18  | 27.24      | 21.06  | 46.00      | -24.94     | Peak   |
| 6 | 655.667 | -1.59  | 27.86      | 26.27  | 46.00      | -19.73     | Peak   |



For Model: WTS-11

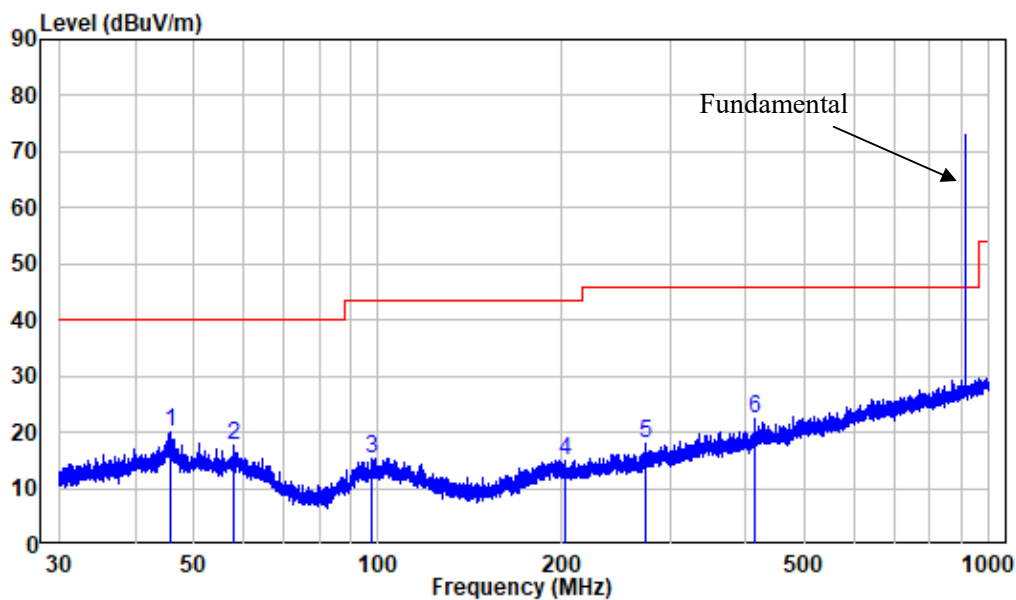
Horizontal



Site : chamber  
Condition: 3m HORIZONTAL  
Job No. : SZNS220901-39736E-RF  
Test Mode: Hybrid system

|   | Freq    | Factor | Read Level | Level  | Limit  | Over Limit | Remark |
|---|---------|--------|------------|--------|--------|------------|--------|
|   | MHz     | dB/m   | dBuV       | dBuV/m | dBuV/m | dB         |        |
| 1 | 58.459  | -10.07 | 26.96      | 16.89  | 40.00  | -23.11     | Peak   |
| 2 | 110.327 | -12.01 | 26.78      | 14.77  | 43.50  | -28.73     | Peak   |
| 3 | 190.155 | -11.56 | 26.96      | 15.40  | 43.50  | -28.10     | Peak   |
| 4 | 240.830 | -10.85 | 27.97      | 17.12  | 46.00  | -28.88     | Peak   |
| 5 | 357.615 | -7.58  | 31.04      | 23.46  | 46.00  | -22.54     | Peak   |
| 6 | 417.458 | -6.18  | 30.67      | 24.49  | 46.00  | -21.51     | Peak   |

## Vertical

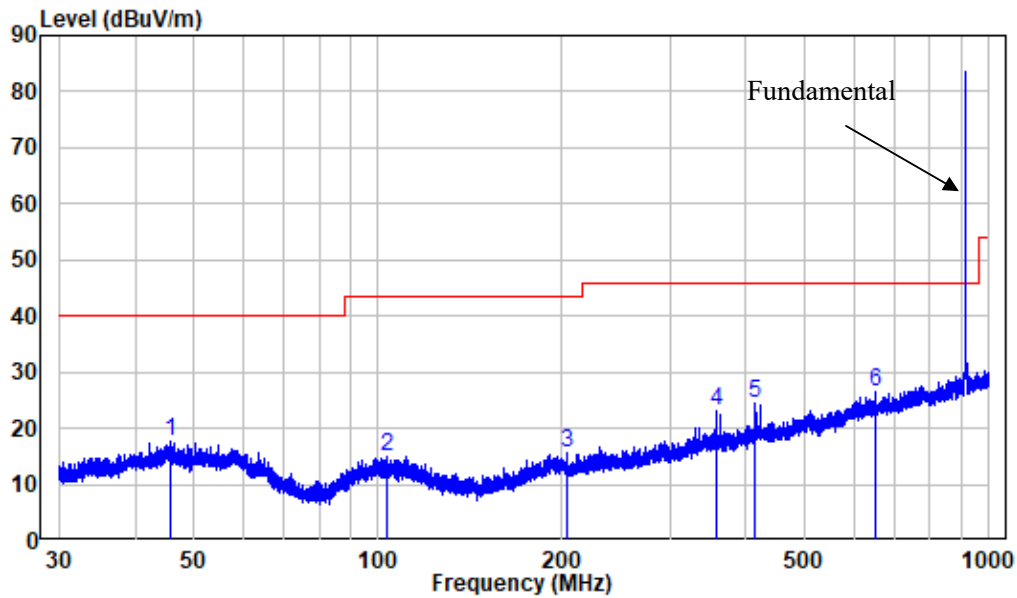


Site : chamber  
 Condition: 3m VERTICAL  
 Job No. : SZNS220901-39736E-RF  
 Test Mode: Hybrid system

|   | Freq    | Factor | Read Level | Level  | Limit  | Over Limit | Remark |
|---|---------|--------|------------|--------|--------|------------|--------|
|   | MHz     | dB/m   | dBuV       | dBuV/m | dBuV/m | dB         |        |
| 1 | 45.715  | -9.98  | 30.17      | 20.19  | 40.00  | -19.81     | Peak   |
| 2 | 57.974  | -9.90  | 27.44      | 17.54  | 40.00  | -22.46     | Peak   |
| 3 | 97.541  | -12.26 | 27.71      | 15.45  | 43.50  | -28.05     | Peak   |
| 4 | 202.189 | -11.59 | 26.69      | 15.10  | 43.50  | -28.40     | Peak   |
| 5 | 274.194 | -9.96  | 27.94      | 17.98  | 46.00  | -28.02     | Peak   |
| 6 | 412.366 | -6.28  | 28.71      | 22.43  | 46.00  | -23.57     | Peak   |

For Model: WTS-12

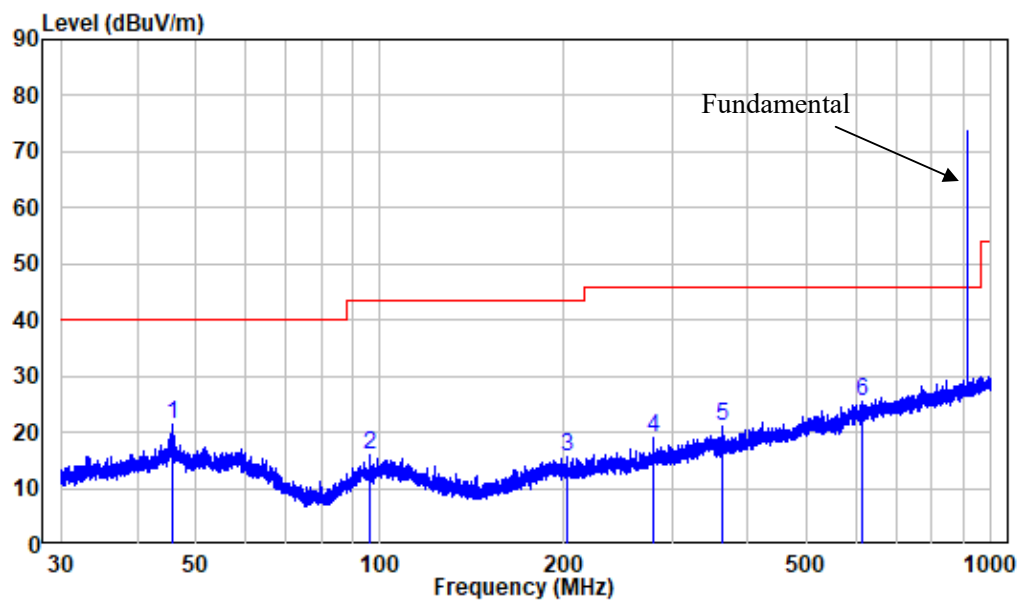
Horizontal



Site : chamber  
Condition: 3m HORIZONTAL  
Job No. : SZNS220901-39736E-RF  
Test Mode: Hybrid system

|   | Freq    | Factor | Read<br>Level | Level  | Limit<br>Line | Over<br>Limit | Remark |
|---|---------|--------|---------------|--------|---------------|---------------|--------|
|   | MHz     | dB/m   | dBuV          | dBuV/m | dBuV/m        | dB            |        |
| 1 | 45.715  | -9.98  | 27.68         | 17.70  | 40.00         | -22.30        | Peak   |
| 2 | 103.624 | -11.71 | 26.71         | 15.00  | 43.50         | -28.50        | Peak   |
| 3 | 203.791 | -11.73 | 27.47         | 15.74  | 43.50         | -27.76        | Peak   |
| 4 | 357.772 | -7.59  | 30.79         | 23.20  | 46.00         | -22.80        | Peak   |
| 5 | 412.366 | -6.28  | 30.65         | 24.37  | 46.00         | -21.63        | Peak   |
| 6 | 650.800 | -1.70  | 28.14         | 26.44  | 46.00         | -19.56        | Peak   |

## Vertical



Site : chamber  
 Condition: 3m VERTICAL  
 Job No. : SZNS220901-39736E-RF  
 Test Mode: Hybrid system

|   | Freq    | Factor | Read Level | Level  | Limit Line | Over Limit | Remark |
|---|---------|--------|------------|--------|------------|------------|--------|
|   | MHz     | dB/m   | dBuV       | dBuV/m | dBuV/m     | dB         |        |
| 1 | 45.715  | -9.98  | 31.27      | 21.29  | 40.00      | -18.71     | Peak   |
| 2 | 96.056  | -12.30 | 28.19      | 15.89  | 43.50      | -27.61     | Peak   |
| 3 | 202.278 | -11.60 | 27.20      | 15.60  | 43.50      | -27.90     | Peak   |
| 4 | 280.638 | -9.57  | 28.64      | 19.07  | 46.00      | -26.93     | Peak   |
| 5 | 362.031 | -7.62  | 28.51      | 20.89  | 46.00      | -25.11     | Peak   |
| 6 | 615.292 | -2.46  | 28.05      | 25.59  | 46.00      | -20.41     | Peak   |

**Above 1 GHz:**

| Frequency<br>(MHz)       | Receiver          |        | Turntable<br>Angle<br>Degree | Rx Antenna    |                | Factor<br>(dB/m) | Absolute<br>Level<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
|--------------------------|-------------------|--------|------------------------------|---------------|----------------|------------------|-------------------------------|-------------------|----------------|
|                          | Reading<br>(dBμV) | PK/Ave |                              | Height<br>(m) | Polar<br>(H/V) |                  |                               |                   |                |
| Low Channel(902.3MHz)    |                   |        |                              |               |                |                  |                               |                   |                |
| 1804.6                   | 61.44             | PK     | 169                          | 2.5           | H              | -8.73            | 52.71                         | 74                | -21.29         |
| 1804.6                   | 57.13             | PK     | 56                           | 1.0           | V              | -8.73            | 48.40                         | 74                | -25.60         |
| 2706.9                   | 59.38             | PK     | 314                          | 1.3           | H              | -6.61            | 52.77                         | 74                | -21.23         |
| 2706.9                   | 56.06             | PK     | 2                            | 1.3           | V              | -6.61            | 49.45                         | 74                | -24.55         |
| 3609.2                   | 55.63             | PK     | 354                          | 1.6           | H              | -5.93            | 49.70                         | 74                | -24.30         |
| 3609.2                   | 55.35             | PK     | 139                          | 2.2           | V              | -5.93            | 49.42                         | 74                | -24.58         |
| Middle Channel(908.7MHz) |                   |        |                              |               |                |                  |                               |                   |                |
| 1817.4                   | 60.90             | PK     | 37                           | 1.7           | H              | -8.63            | 52.27                         | 74                | -21.73         |
| 1817.4                   | 58.23             | PK     | 112                          | 1.1           | V              | 8.63             | 49.60                         | 74                | -24.40         |
| 2726.1                   | 59.04             | PK     | 316                          | 2.5           | H              | -6.60            | 52.44                         | 74                | -21.56         |
| 2726.1                   | 56.28             | PK     | 295                          | 1.7           | V              | 6.60             | 49.68                         | 74                | -24.32         |
| 3634.8                   | 56.16             | PK     | 133                          | 1.9           | H              | -5.88            | 50.28                         | 74                | -23.72         |
| 3634.8                   | 56.43             | PK     | 176                          | 1.3           | V              | 5.88             | 50.55                         | 74                | -23.45         |
| High Channel(914.9MHz)   |                   |        |                              |               |                |                  |                               |                   |                |
| 1829.8                   | 60.98             | PK     | 334                          | 1.7           | H              | -8.53            | 52.45                         | 74                | -21.55         |
| 1829.8                   | 56.90             | PK     | 104                          | 1.3           | V              | 8.53             | 48.37                         | 74                | -25.63         |
| 2744.7                   | 59.67             | PK     | 40                           | 1.1           | H              | -6.60            | 53.07                         | 74                | -20.93         |
| 2744.7                   | 56.61             | PK     | 332                          | 1.3           | V              | 6.60             | 50.01                         | 74                | -23.99         |
| 3659.6                   | 55.70             | PK     | 215                          | 1.1           | H              | -5.83            | 49.87                         | 74                | -24.13         |
| 3659.6                   | 55.36             | PK     | 32                           | 1.6           | V              | 5.83             | 49.53                         | 74                | -24.47         |

**Note:**

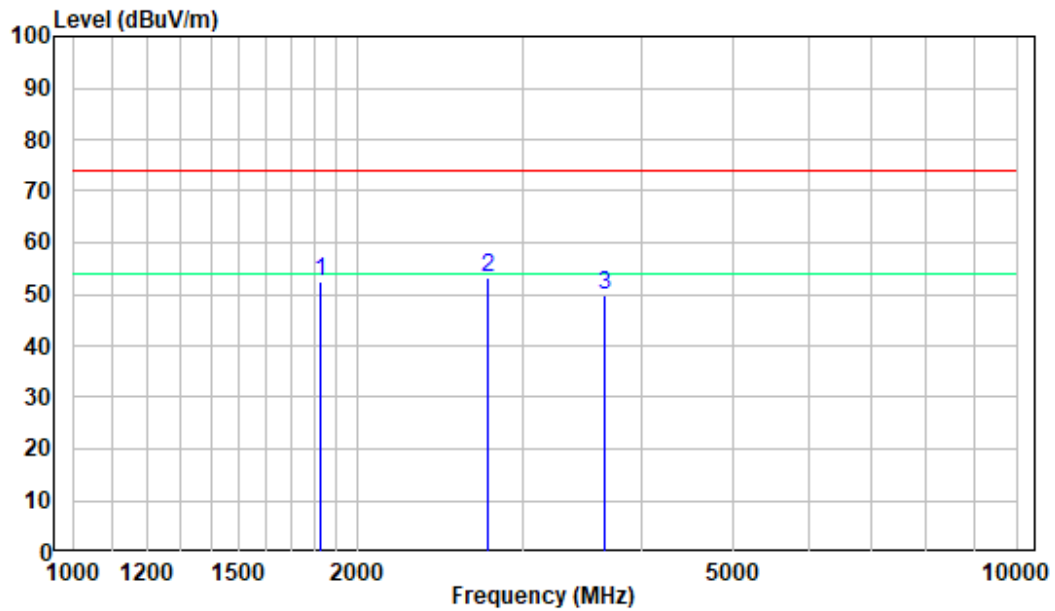
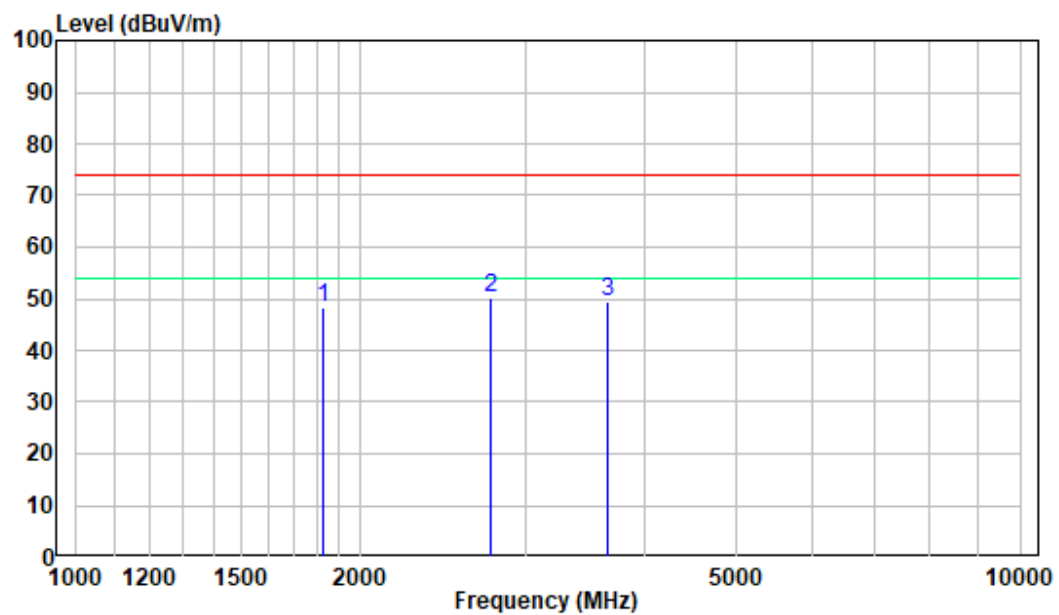
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

Margin = Corrected. Amplitude - Limit

The other spurious emission which is 20dB to the limit was not recorded.

The test result of peak was less than the limit of average, so just peak value were recorded.

**Pre-scan with High channel****Horizontal****Vertical**

**FCC §15.247(a) (1)-CHANNEL SEPARATION TEST****Applicable Standard**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

**Test Procedure**

- c. Set the EUT in transmitting mode, maxhold the channel.
- d. Set the adjacent channel of the EUT and maxhold another trace.
- e. Measure the channel separation.

**Test Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26.8℃     |
| <b>Relative Humidity:</b> | 56 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

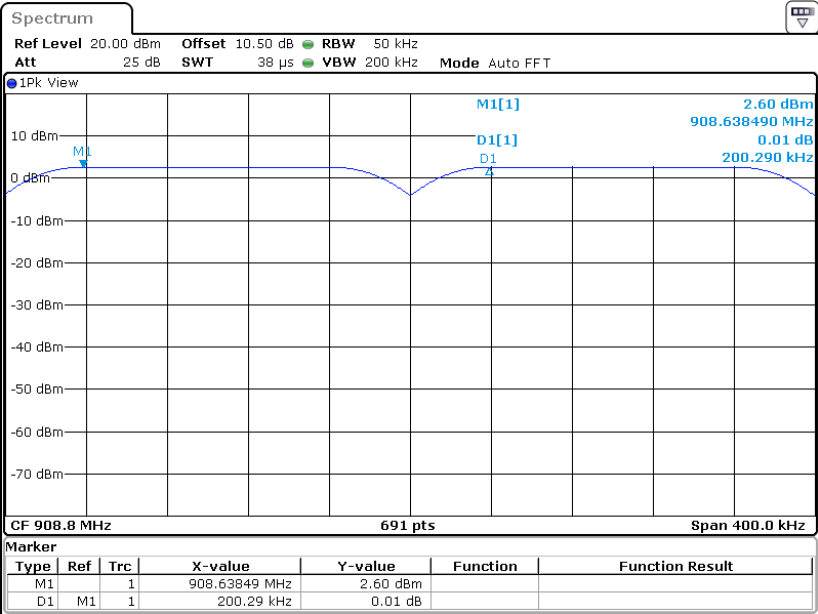
*The testing was performed by Cat Kang on 2022-09-14.*

*EUT operation mode: Transmitting*

*Test Result: Compliance. Please refer to following table and plots*

| <b>Test Mode</b> | <b>Frequency [MHz]</b> | <b>Frequency Separation [MHz]</b> | <b>20dB Bandwidth [MHz]</b> | <b>Verdict</b> |
|------------------|------------------------|-----------------------------------|-----------------------------|----------------|
| Hybrid System    | Hop                    | 0.200                             | 0.144                       | Pass           |

Note: Limit  $\geq$  20 dB bandwidth



Date: 14.SEP.2022 17:12:42



## FCC §15.247(a) (1) (i)– 20 dB EMISSION BANDWIDTH

### Applicable Standard

According to §15.247(a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

### Test Procedure

- f. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- g. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- h. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
- i. Repeat above procedures until all frequencies measured were complete.

### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 26.8℃     |
| Relative Humidity: | 56 %      |
| ATM Pressure:      | 101.0 kPa |

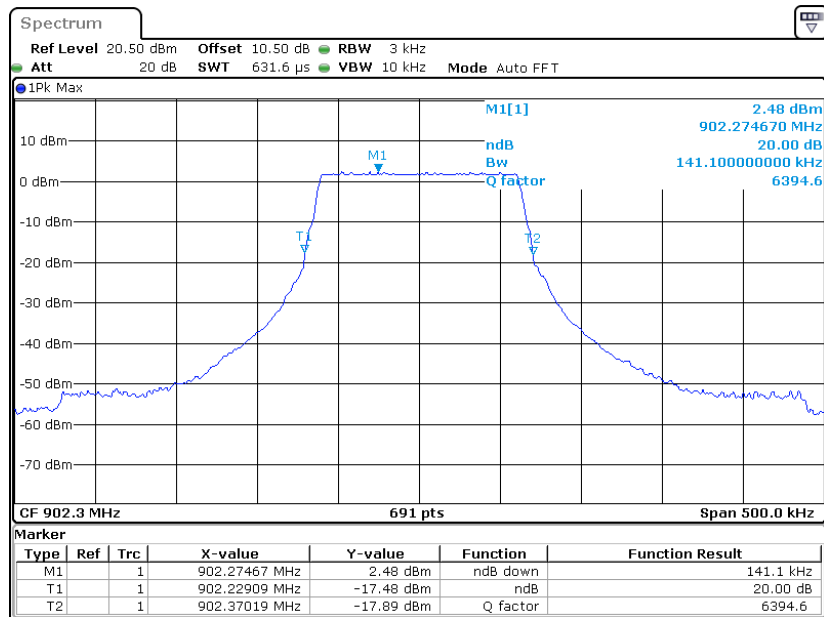
*The testing was performed by Cat Kang on 2022-09-14.*

*EUT operation mode: Transmitting*

*Test Result: Compliance. Please refer to following table and plots.*

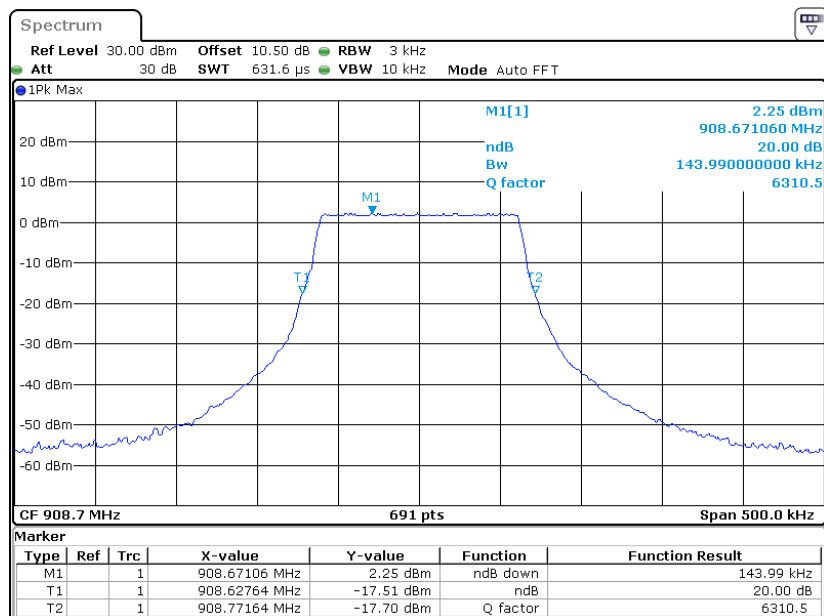
| Mode          | Channel | Frequency (MHz) | 20 dB Emission Bandwidth (MHz) |
|---------------|---------|-----------------|--------------------------------|
| Hybrid System | Low     | 902.3           | 0.141                          |
|               | Middle  | 908.7           | 0.144                          |
|               | High    | 914.9           | 0.144                          |

## Low Channel



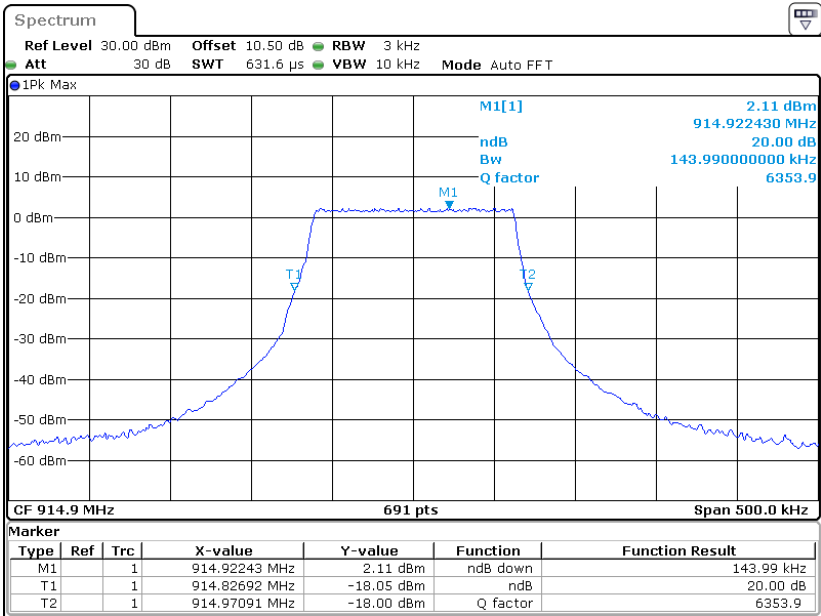
Date: 14.SEP.2022 14:49:02

## Middle Channel



Date: 14.SEP.2022 15:53:45

High Channel



Date: 14.SEP.2022 16:05:33

## **FCC §15.247(f) - TIME OF OCCUPANCY (DWELL TIME)**

### **Applicable Standard**

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### **Test Procedure**

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- a) Span: Zero span, centered on a hopping channel.
- b) RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1 / T$ , where T is the expected dwell time per channel.
- c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- d) Detector function: Peak.
- e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

$$\begin{aligned} & \text{(Number of hops in the period specified in the requirements)} = \\ & \text{(number of hops on spectrum analyzer)} \times (\text{period specified in the requirements} / \text{analyzer sweep time}) \end{aligned}$$

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

**Test Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26.8~28℃  |
| <b>Relative Humidity:</b> | 54~56 %   |
| <b>ATM Pressure:</b>      | 101.0 kPa |

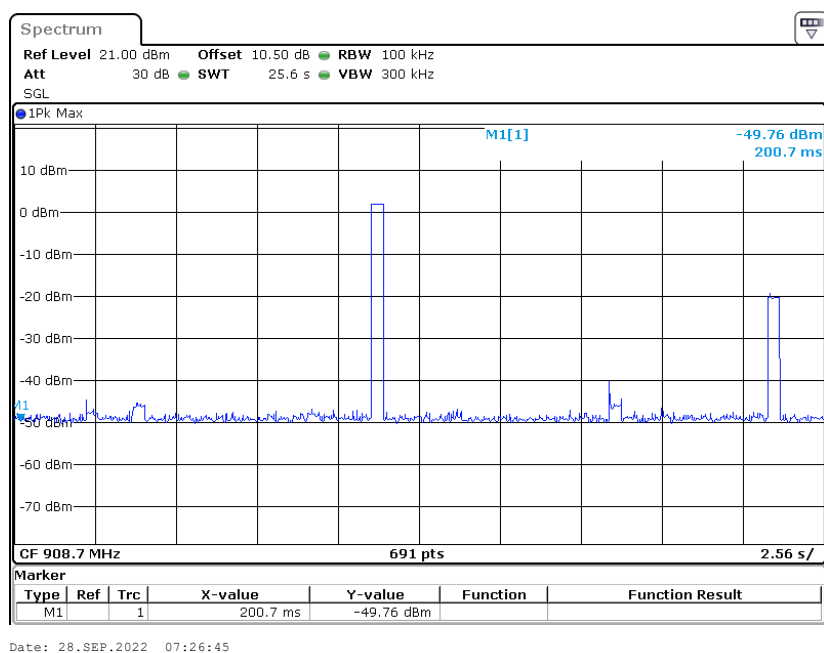
The testing was performed by Cat Kang on 2022-09-14~2022-09-28.

EUT operation mode: Transmitting

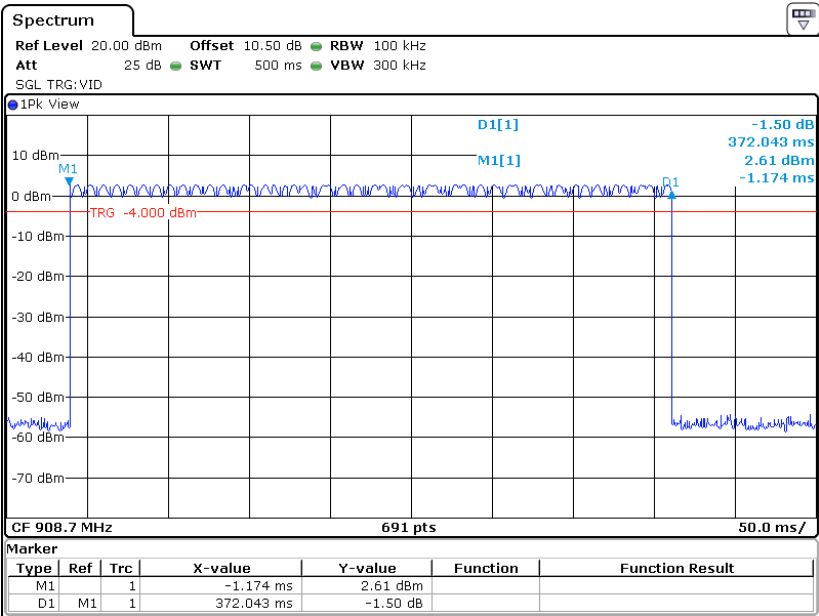
Test Result: Compliance. Please refer to following table and plots.

| Mode    | Pulse Time (ms) | Hopping Number | Period Time (s) | Total of Dwell Time(ms) | Limit (ms) | Result |
|---------|-----------------|----------------|-----------------|-------------------------|------------|--------|
| Hopping | 372.04          | 1              | 25.6            | 372.04                  | 400        | Pass   |

Note: A period time=0.4\*64=25.6(s), Total of Dwell Time= Pluse Time\*Hopping Number

**Hopping Number**

Pulse Time



Date: 14.SEP.2022 17:39:07

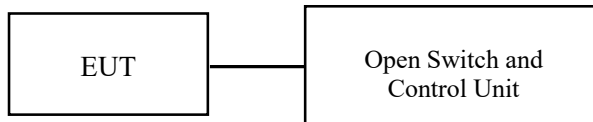
## FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

### Applicable Standard

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

### Test Procedure

- j. Place the EUT on a bench and set it in transmitting mode.
- k. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
- l. Add a correction factor to the display.



Note: the Open Switch and Control Unit has a built-in power sensor.

### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 26.8℃     |
| Relative Humidity: | 56 %      |
| ATM Pressure:      | 101.0 kPa |

The testing was performed by Cat Kang on 2022-09-14.

Test Result: Compliance. Please refer to following table.

EUT operation mode: Transmitting

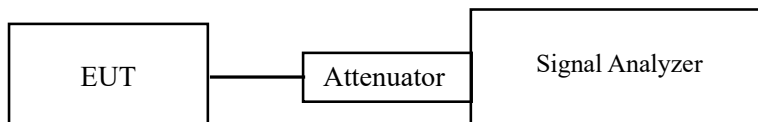
| Test Mode     | Frequency (MHZ) | Max Peak Output Power (dBm) | Limit[dBm] | Verdict |
|---------------|-----------------|-----------------------------|------------|---------|
| Hybrid System | 902.3           | 3.05                        | <=30       | PASS    |
|               | 908.7           | 2.89                        |            | PASS    |
|               | 914.9           | 2.64                        |            | PASS    |

**FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE****Applicable Standard**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

**Test Procedure**

- m. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- n. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- o. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- p. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- q. Repeat above procedures until all measured frequencies were complete.

**Test Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 26.8℃     |
| <b>Relative Humidity:</b> | 56 %      |
| <b>ATM Pressure:</b>      | 101.0 kPa |

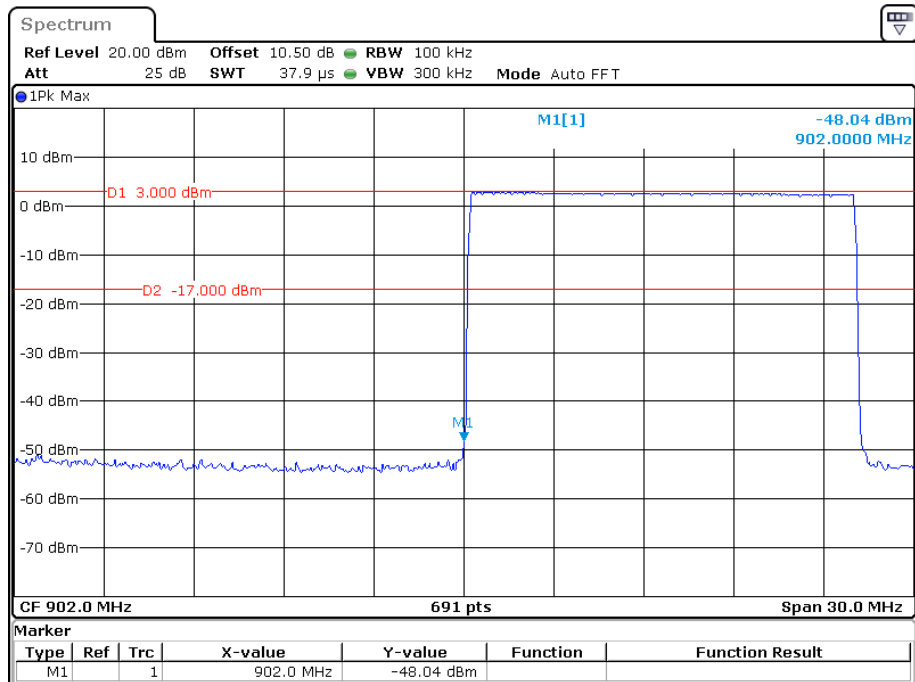
*The testing was performed by Cat Kang on 2022-09-14.*

*Test Result: Compliance. Please refer to following plots.*

*EUT operation mode: Transmitting*

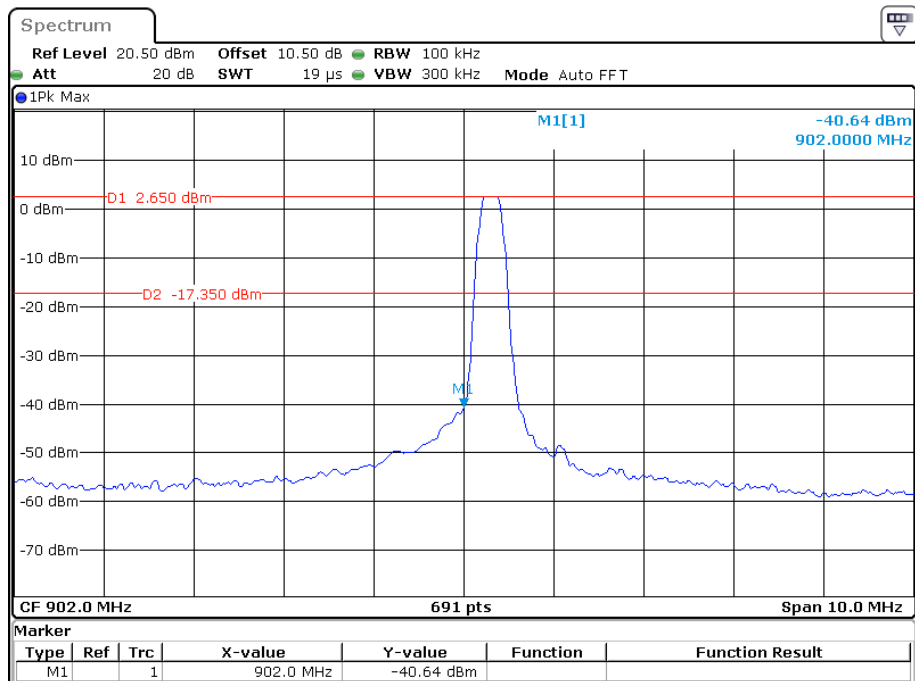


### Left side Hopping



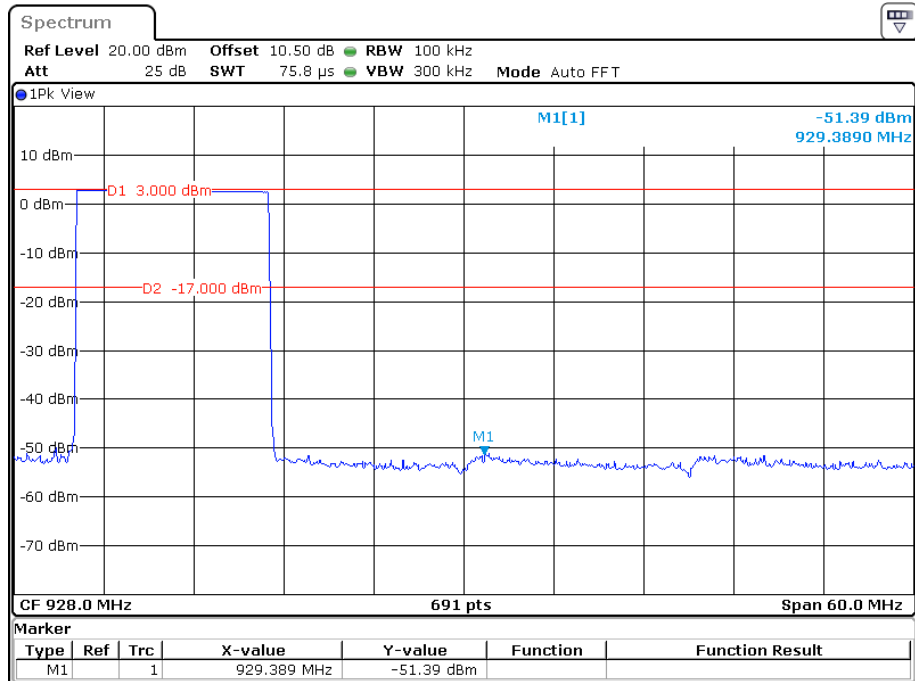
Date: 14.SEP.2022 17:18:37

### Single



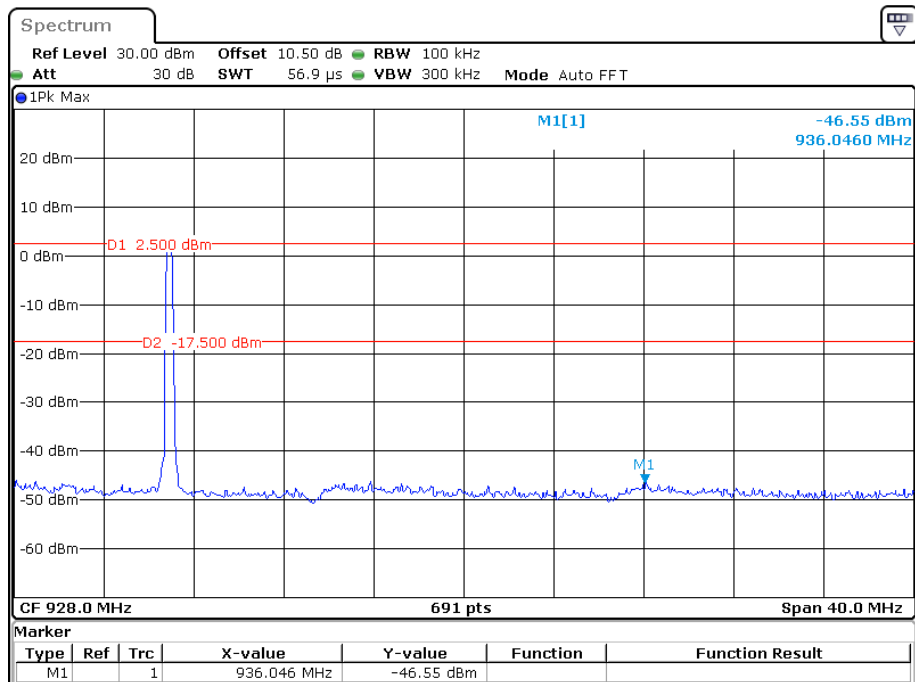
Date: 14.SEP.2022 14:54:44

### Right side Hopping



Date: 14.SEP.2022 17:20:38

### Single



Date: 14.SEP.2022 16:09:28

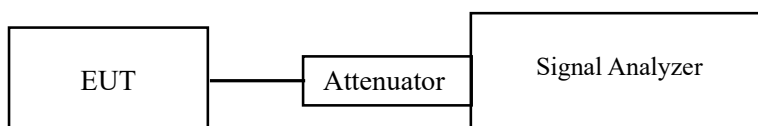
## FCC §15.247(f) - POWER SPECTRAL DENSITY

### Applicable Standard

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### Test Procedure

- r. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
- s. Set the RBW to:  $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$ .
- t. Set the VBW  $\geq 3 \times \text{RBW}$ .
- u. Set the span to 1.5 times the DTS bandwidth.
- v. Detector = peak.
- w. Sweep time = auto couple.
- x. Trace mode = max hold.
- y. Allow trace to fully stabilize.
- z. Use the peak marker function to determine the maximum amplitude level within the RBW.
- aa. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 26.8℃     |
| Relative Humidity: | 56 %      |
| ATM Pressure:      | 101.0 kPa |

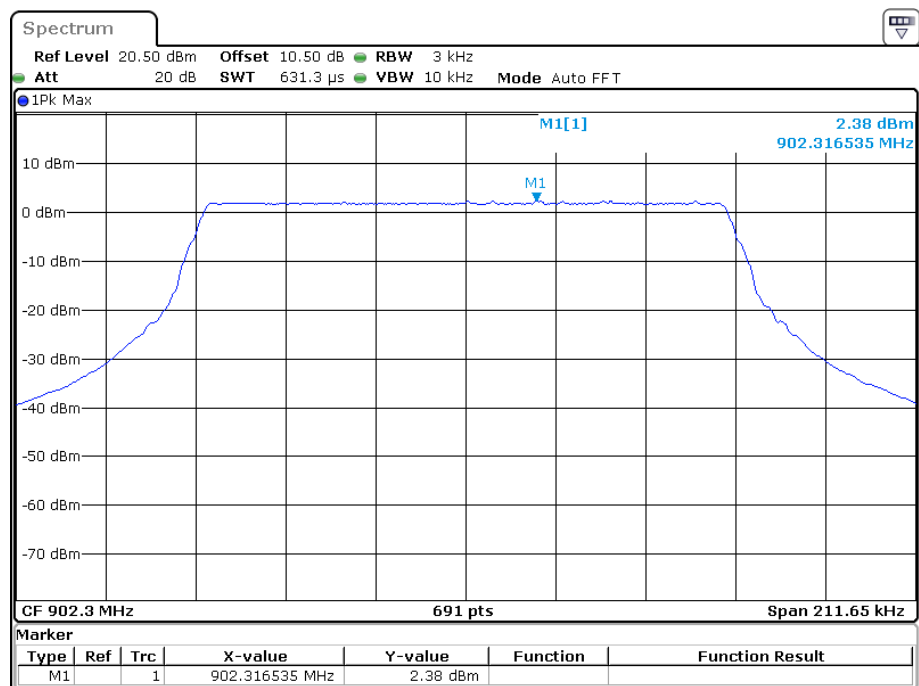
*The testing was performed by Cat Kang on 2022-09-14.*

*EUT operation mode: Transmitting*

**Test Result:** Pass

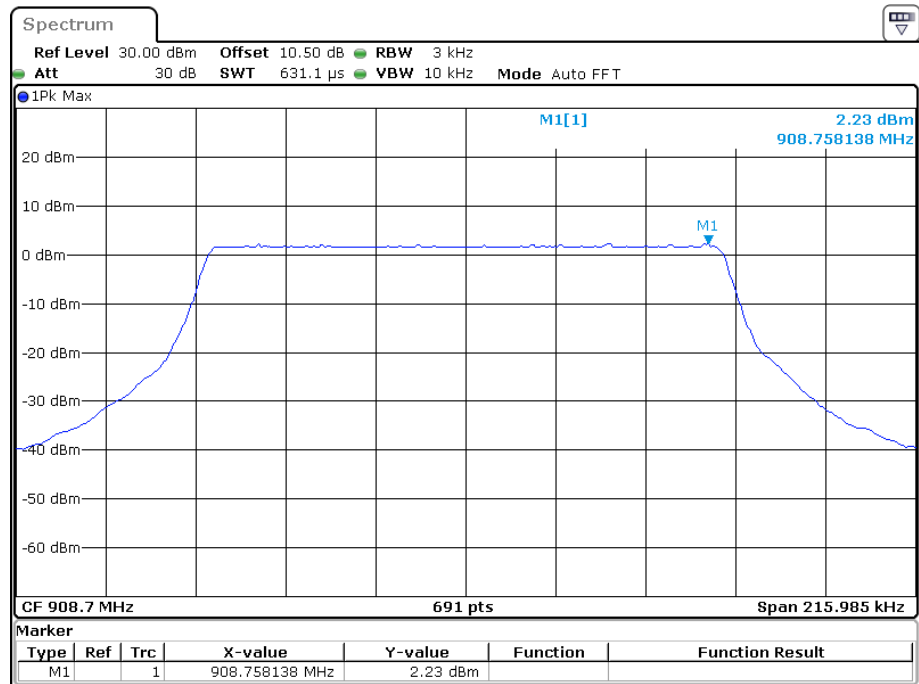
| Test Mode     | Frequency (MHz) | Result[dBm/3kHz] | Limit[dBm/3kHz] | Verdict |
|---------------|-----------------|------------------|-----------------|---------|
| Hybrid System | 902.3           | 2.38             | <=8             | PASS    |
|               | 908.7           | 2.23             |                 | PASS    |
|               | 914.9           | 2.07             |                 | PASS    |

## Power Spectral Density, Low Channel



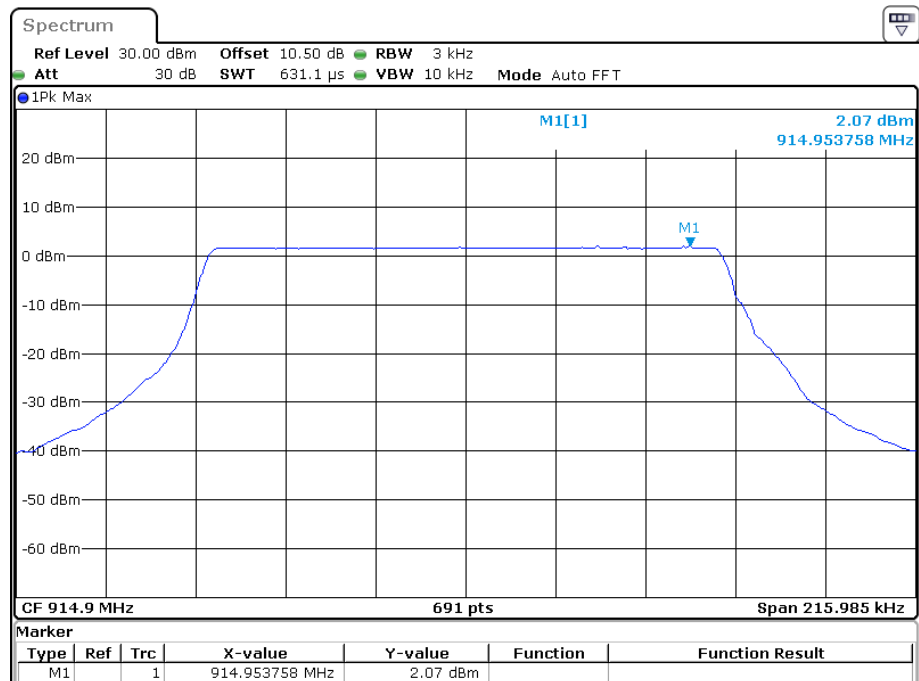
Date: 14.SEP.2022 14:51:24

## Power Spectral Density, Middle Channel



Date: 14.SEP.2022 15:55:17

## Power Spectral Density, High Channel



Date: 14.SEP.2022 16:06:39

\*\*\*\*\* END OF REPORT \*\*\*