

# TEST REPORT

Applicant Name: Astera LED Technology GmbH  
Address: Schatzbogen 60, 81829 Munich, Germany  
Report Number: 2401S69159E-RF-00B  
FCC ID: X55FP7-E26

## Test Standard (s)

FCC PART 15.247

## Sample Description

Product Type: Luna Bulb  
Model No.: FP7-E26  
Multiple Model(s) No.: N/A  
Trade Mark: ASTERA  
Date Received: 2024/04/30  
Issue Date: 2024/07/04

|              |                   |
|--------------|-------------------|
| Test Result: | Pass <sup>▲</sup> |
|--------------|-------------------|

▲ In the configuration tested, the EUT complied with the standards above.

## Prepared and Checked By:

Bruce Lin

Bruce Lin  
RF Engineer

## Approved By:

Nancy Wang

Nancy Wang  
RF Supervisor

Note: The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report. Customer model name, addresses, names, trademarks etc. are included.

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## Bay Area Compliance Laboratories Corp. (Shenzhen)

5F(B-West), 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China

Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

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DOCUMENT REVISION HISTORY

| Revision Number | Report Number      | Description of Revision | Date of Revision |
|-----------------|--------------------|-------------------------|------------------|
| 0               | 2401S69159E-RF-00B | Original Report         | 2024/07/04       |

## GENERAL INFORMATION

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

|                                    |                                                                                                               |
|------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Product                            | Luna Bulb                                                                                                     |
| Tested Model                       | FP7-E26                                                                                                       |
| Multiple Model(s)                  | N/A                                                                                                           |
| Frequency Range                    | 917-922.2 MHz                                                                                                 |
| Transmit Peak Power                | 11.70dBm                                                                                                      |
| Modulation Technique               | GFSK                                                                                                          |
| Antenna Specification <sup>#</sup> | -1.75dBi (provided by the applicant)                                                                          |
| Voltage Range                      | AC 100-120V, 50/60Hz                                                                                          |
| Sample serial number               | 2KSJ-2 for Conducted and Radiated Emissions Test<br>2KSJ-3 for RF Conducted Test (Assigned by BACL, Shenzhen) |
| Sample/EUT Status                  | Good condition                                                                                                |
| Adapter Information                | N/A                                                                                                           |
|                                    |                                                                                                               |

### Objective

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

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.207, 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.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). 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         |                             | 0.72 dB(k=2, 95% level of confidence) |
| AC Power Lines Conducted Emissions | 9kHz-150kHz                 | 3.94dB(k=2, 95% level of confidence)  |
|                                    | 150kHz-30MHz                | 3.84dB(k=2, 95% level of confidence)  |
| Radiated Emissions                 | 9kHz - 30MHz                | 3.30dB(k=2, 95% level of confidence)  |
|                                    | 30MHz~200MHz (Horizontal)   | 4.48dB(k=2, 95% level of confidence)  |
|                                    | 30MHz~200MHz (Vertical)     | 4.55dB(k=2, 95% level of confidence)  |
|                                    | 200MHz~1000MHz (Horizontal) | 4.85dB(k=2, 95% level of confidence)  |
|                                    | 200MHz~1000MHz (Vertical)   | 5.05dB(k=2, 95% level of confidence)  |
|                                    | 1GHz - 6GHz                 | 5.35dB(k=2, 95% level of confidence)  |
|                                    | 6GHz - 18GHz                | 5.44dB(k=2, 95% level of confidence)  |
|                                    | 18GHz - 40GHz               | 5.16dB(k=2, 95% level of confidence)  |
| Temperature                        |                             | ±1°C                                  |
| Humidity                           |                             | ±1%                                   |
| 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 Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 715558, the FCC Designation No. : CN5045.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in an engineering mode.

Frequency range: 917-922.2MHz, Channel spacing: 100 kHz, total channels: 53.

Low Channel: 917MHz (CH0); Middle Channel: 919.6MHz (CH26); High Channel: 922.2MHz (CH52) and Additional channel 921.0MHz (CH40) were selected to test.

### EUT Exercise Software

Software "AsteraApp\_9.96<sup>#</sup>" was used and the power level is default<sup>#</sup>. The power level was provided by the manufacturer.

### Special Accessories

No special accessory.

### Equipment Modifications

No modification was made to the EUT tested.

### Support Equipment List and Details

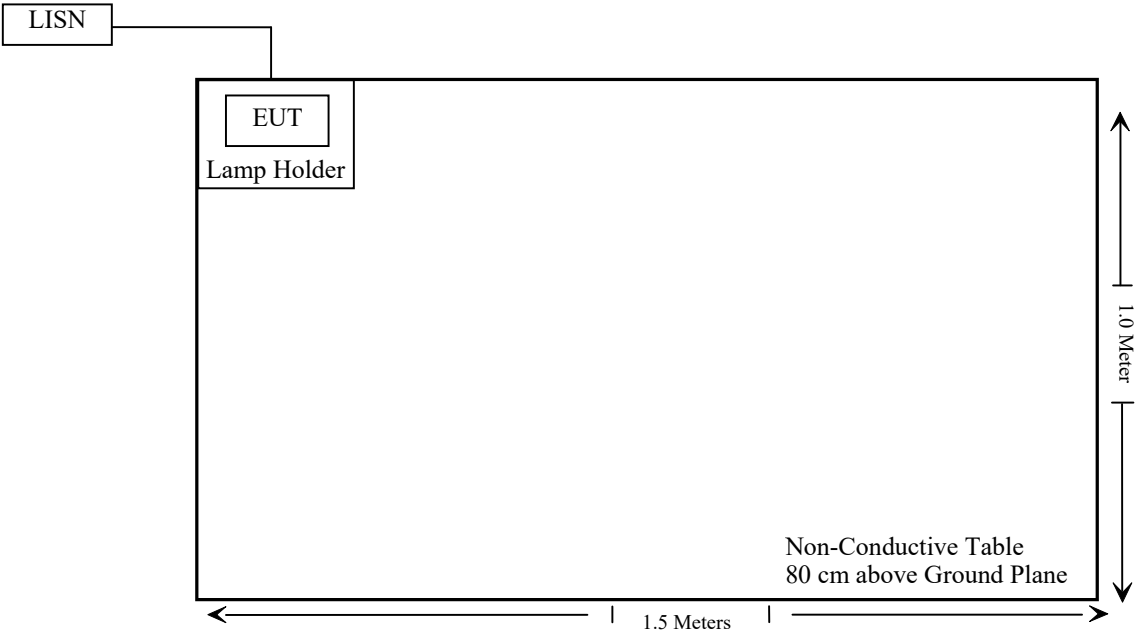
| Manufacturer | Description | Model   | Serial Number |
|--------------|-------------|---------|---------------|
| Unknown      | Lamp Holder | Unknown | Unknown       |

### External I/O Cable

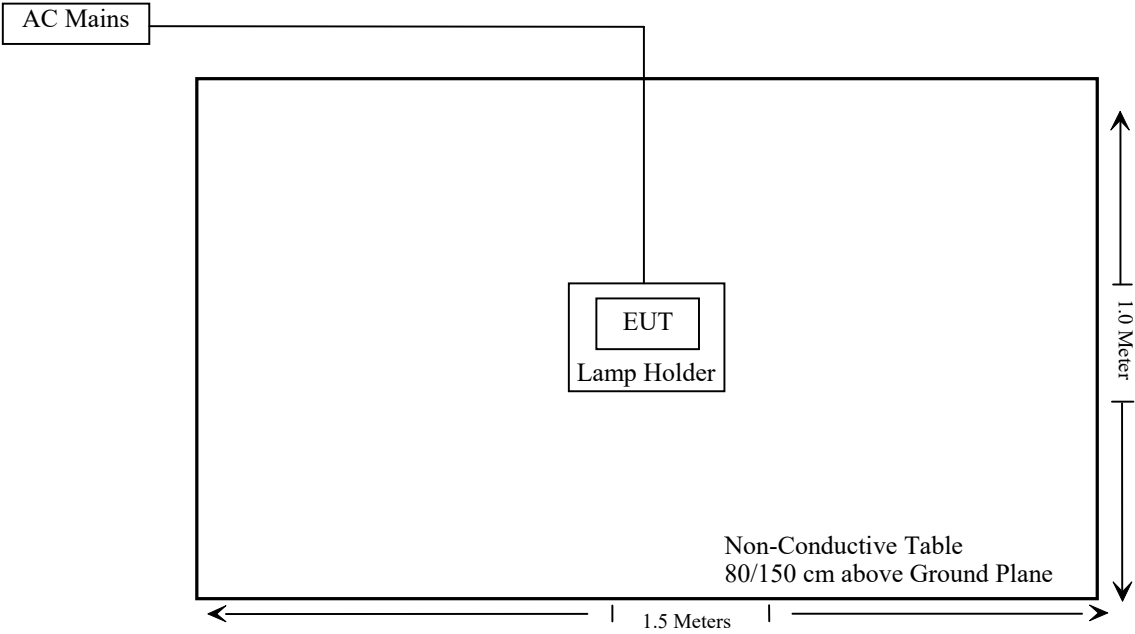
| Cable Description                   | Length (m) | From Port   | To            |
|-------------------------------------|------------|-------------|---------------|
| Un-shielding Un-Detachable AC Cable | 1.2        | Lamp Holder | LISN/AC Mains |

Block Diagram of Test Setup

For Conducted Emissions:



For Radiated Emissions:



**SUMMARY OF TEST RESULTS**

| Rules                            | Description of Test            | Result    |
|----------------------------------|--------------------------------|-----------|
| §1.1307 ,§2.1091                 | MPE-Based Exemption            | Compliant |
| FCC §15.203                      | Antenna Requirement            | Compliant |
| FCC §15.207(a)                   | AC Line Conducted Emissions    | Compliant |
| FCC §15.205, §15.209, §15.247(d) | Radiated Spurious emissions    | Compliant |
| FCC §15.247(a)(1)(i)             | 20dB Bandwidth                 | Compliant |
| FCC §15.247(a)(1)                | Channel Separation             | Compliant |
| FCC §15.247(a)(1)(i)             | Time of Occupancy (Dwell Time) | Compliant |
| FCC §15.247(a)(1)(i)             | Number of hopping Frequency    | Compliant |
| FCC §15.247(b)(2)                | Maximum Conducted Output Power | Compliant |
| FCC §15.247(d)                   | Band edges                     | Compliant |

**TEST EQUIPMENT LIST**

| Manufacturer                   | Description                       | Model           | Serial Number          | Calibration Date | Calibration Due Date |
|--------------------------------|-----------------------------------|-----------------|------------------------|------------------|----------------------|
| <b>Conducted Emission Test</b> |                                   |                 |                        |                  |                      |
| Rohde & Schwarz                | EMI Test Receiver                 | ESCI            | 101120                 | 2024/01/16       | 2025/01/15           |
| Rohde & Schwarz                | LISN                              | ENV216          | 101613                 | 2024/01/16       | 2025/01/15           |
| Rohde & Schwarz                | Transient Limiter                 | ESH3Z2          | DE25985                | 2023/08/03       | 2024/08/02           |
| Unknown                        | CE Cable                          | CE Cable        | UF A210B-1-0720-504504 | 2023/08/03       | 2024/08/02           |
| Audix                          | EMI Test software                 | E3              | 191218(V9)             | NCR              | NCR                  |
| <b>Radiated Emission Test</b>  |                                   |                 |                        |                  |                      |
| R&S                            | EMI Test Receiver                 | ESR3            | 102455                 | 2024/01/16       | 2025/01/15           |
| Sonoma instrument              | Pre-amplifier                     | 310 N           | 186238                 | 2023/06/08       | 2024/06/07           |
| Sunol Sciences                 | Broadband Antenna                 | JB1             | A040904-1              | 2023/07/20       | 2026/07/19           |
| BACL                           | Active Loop Antenna               | 1313-1A         | 4031911                | 2024/03/21       | 2025/03/20           |
| Unknown                        | Cable                             | Chamber Cable 1 | F-03-EM236             | 2023/08/03       | 2024/08/02           |
| Unknown                        | Cable                             | Chamber Cable 4 | EC-007                 | 2023/08/03       | 2024/08/02           |
| JD                             | Multiplex Switch Test Control Set | DT7220FSU       | DQ77926                | NCR              | NCR                  |
| Audix                          | EMI Test software                 | E3              | 19821b(V9)             | NCR              | NCR                  |
| Rohde & Schwarz                | Spectrum Analyzer                 | FSV40           | 101605                 | 2024/03/27       | 2025/03/26           |
| COM-POWER                      | Pre-amplifier                     | PA-122          | 181919                 | 2023/06/29       | 2024/06/28           |
| Schwarzbeck                    | Horn Antenna                      | BBHA9120D(1201) | 1143                   | 2023/07/26       | 2026/07/25           |
| Unknown                        | RF Cable                          | KMSE            | 0735                   | 2023/10/08       | 2024/10/07           |
| Unknown                        | RF Cable                          | UFA147          | 219661                 | 2023/10/08       | 2024/10/07           |
| Unknown                        | 1.3G High Pass filter             | 1.3GHz          | 101120                 | 2023/08/03       | 2024/08/02           |
| Audix                          | EMI Test software                 | E3              | 191218(V9)             | NCR              | NCR                  |
| <b>RF Conducted Test</b>       |                                   |                 |                        |                  |                      |
| R&S                            | SPECTRUM ANALYZER                 | FSU26           | 200120                 | 2024/01/08       | 2025/01/07           |
| Unknown                        | 10dB Attenuator                   | Unknown         | F-03-EM122             | 2023/07/04       | 2024/07/03           |
| Unknown                        | 10dB Attenuator                   | Unknown         | F-03-EM122             | 2024/06/27       | 2025/06/26           |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

## FCC §1.1307 (B) & §2.1091- MPE-BASED EXEMPTION

### Applicable Standard

According to 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

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

**Result**

| Mode | Frequency<br>(MHz) | Tune up<br>conducted power <sup>#</sup> | Antenna Gain <sup>#</sup> |       | ERP   |      | Evaluation<br>Distance<br>(m) | ERP<br>Limit<br>(mW) |
|------|--------------------|-----------------------------------------|---------------------------|-------|-------|------|-------------------------------|----------------------|
|      |                    | (dBm)                                   | (dBi)                     | (dBd) | (dBm) | (mW) |                               |                      |
| UHF  | 917-922.2          | 12.0                                    | -1.75                     | -3.90 | 8.10  | 6.46 | 0.2                           | 470                  |
| BLE  | 2402-2480          | -3.0                                    | 0.82                      | -1.33 | -4.33 | 0.37 | 0.2                           | 768                  |

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.  
 2. The BLE and UHF can transmit at same time.  
 3. 0dBd=2.15dBi

Simultaneous transmitting consideration (worst case):

The ratio= $ERP_{UHF}/limit + ERP_{BLE}/limit = 6.46/470 + 0.37/768 = 0.014 < 1.0$ ,  
 so simultaneous exposure is compliant.

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

**Result: Compliant.**

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

---

### **Applicable Standard**

According to FCC § 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 use of a standard antenna jack or electrical connector is prohibited.

Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

### **Antenna Connector Construction**

The EUT has one internal antenna arrangement, which was permanently attached, the antenna gain<sup>#</sup> is -1.75dBi, fulfill the requirement of this section. Please refer to the EUT photos.

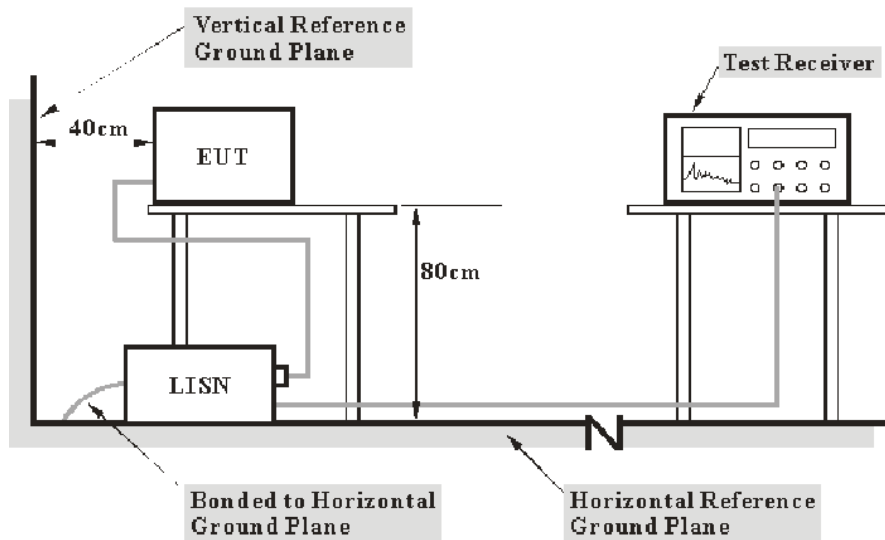
**Result: Compliant**

## FCC §15.207 (a) - AC LINE CONDUCTED EMISSIONS

### Applicable Standard

FCC §15.207(a)

### EUT Setup



Note: 1. Support units were connected to second LISN.  
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

### EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

| Frequency Range  | IF B/W |
|------------------|--------|
| 150 kHz – 30 MHz | 9 kHz  |

### Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

## Factor & Over Limit Calculation

The factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

$$\text{Factor} = \text{LISN VDF} + \text{Cable Loss}$$

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

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

Note: The term "cable loss" refers to the combination of a cable and a 10dB transient limiter (attenuator).

## Test Data

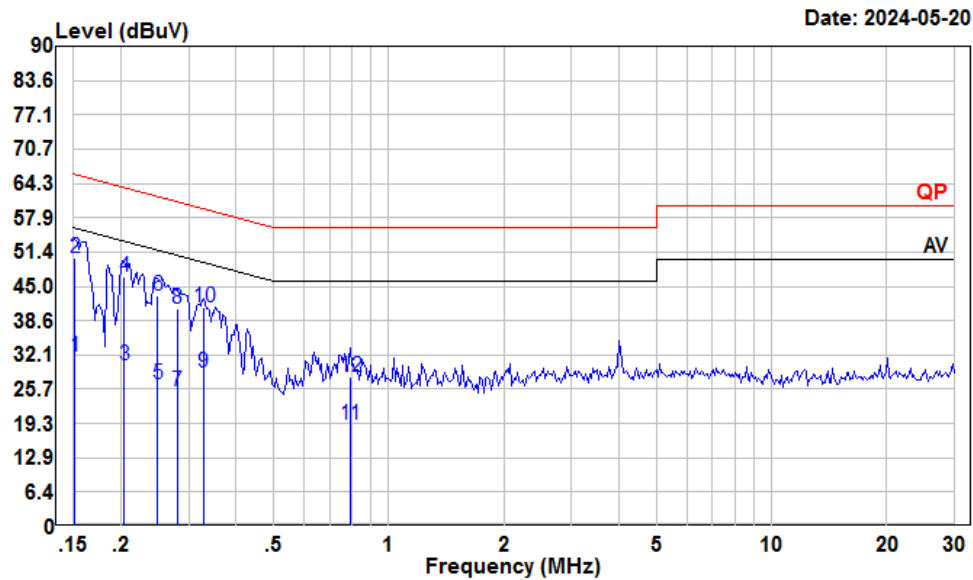
### Environmental Conditions

|                    |         |
|--------------------|---------|
| Temperature:       | 25 °C   |
| Relative Humidity: | 68 %    |
| ATM Pressure:      | 101 kPa |

*The testing was performed by Macy Shi on 2024-05-20.*

*EUT operation mode: Transmitting (Maximum output power mode, 921.0MHz)*

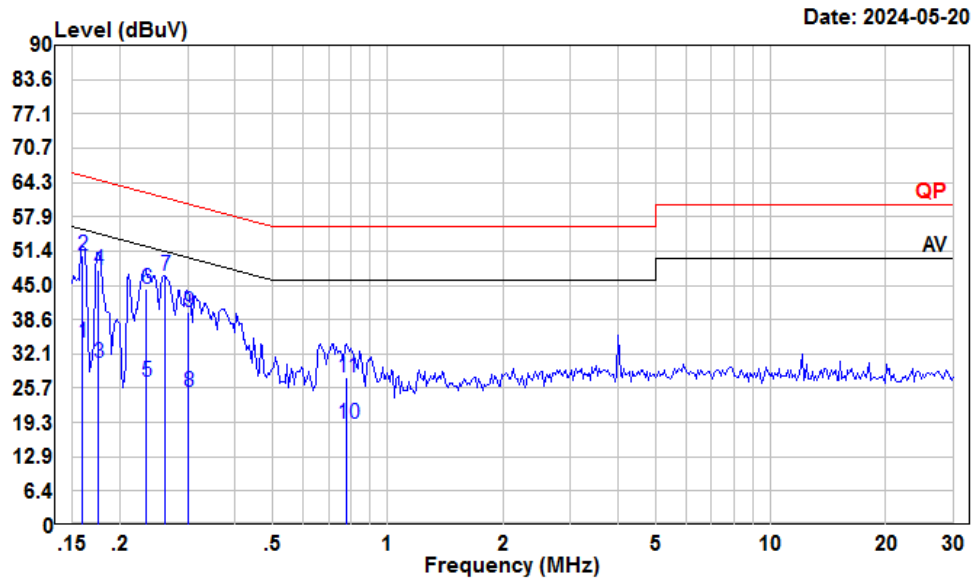
AC 120V/60 Hz, Line



Condition: Line  
Project : 2401S69159E-RF  
Tester : Macy shi  
Note : UHF

|    | Freq | Read Level | LISN Level | LISN Factor | Cable Loss | Limit Line | Over Limit | Remark  |
|----|------|------------|------------|-------------|------------|------------|------------|---------|
|    | MHz  | dBuV       | dBuV       | dB          | dB         | dBuV       | dB         |         |
| 1  | 0.15 | 11.19      | 31.74      | 10.40       | 10.15      | 55.91      | -24.17     | Average |
| 2  | 0.15 | 29.63      | 50.18      | 10.40       | 10.15      | 65.91      | -15.73     | QP      |
| 3  | 0.20 | 9.78       | 30.28      | 10.40       | 10.10      | 53.45      | -23.17     | Average |
| 4  | 0.20 | 26.37      | 46.87      | 10.40       | 10.10      | 63.45      | -16.58     | QP      |
| 5  | 0.25 | 6.10       | 26.66      | 10.35       | 10.21      | 51.78      | -25.12     | Average |
| 6  | 0.25 | 22.60      | 43.16      | 10.35       | 10.21      | 61.78      | -18.62     | QP      |
| 7  | 0.28 | 4.79       | 25.28      | 10.33       | 10.16      | 50.81      | -25.53     | Average |
| 8  | 0.28 | 20.29      | 40.78      | 10.33       | 10.16      | 60.81      | -20.03     | QP      |
| 9  | 0.33 | 8.53       | 28.96      | 10.29       | 10.14      | 49.49      | -20.53     | Average |
| 10 | 0.33 | 20.65      | 41.08      | 10.29       | 10.14      | 59.49      | -18.41     | QP      |
| 11 | 0.79 | -1.56      | 19.08      | 10.47       | 10.17      | 46.00      | -26.92     | Average |
| 12 | 0.79 | 7.48       | 28.12      | 10.47       | 10.17      | 56.00      | -27.88     | QP      |

## AC 120V/60 Hz, Neutral



Condition: Neutral

Project : 2401S69159E-RF

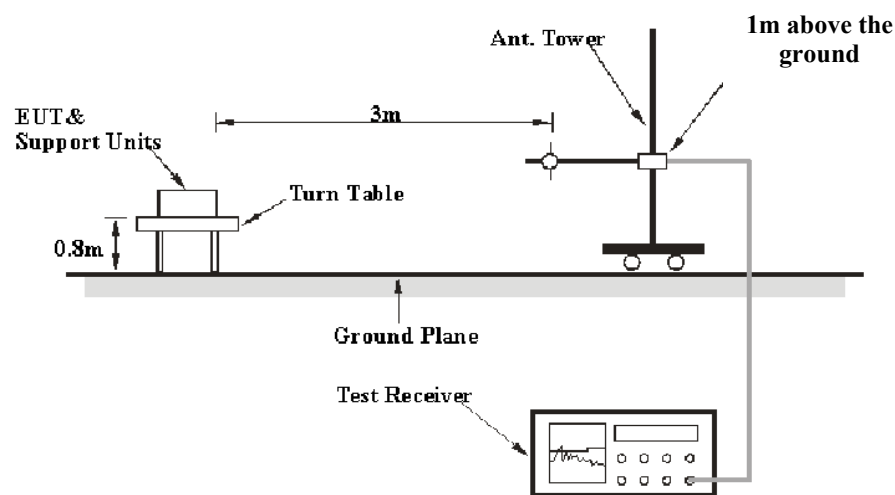
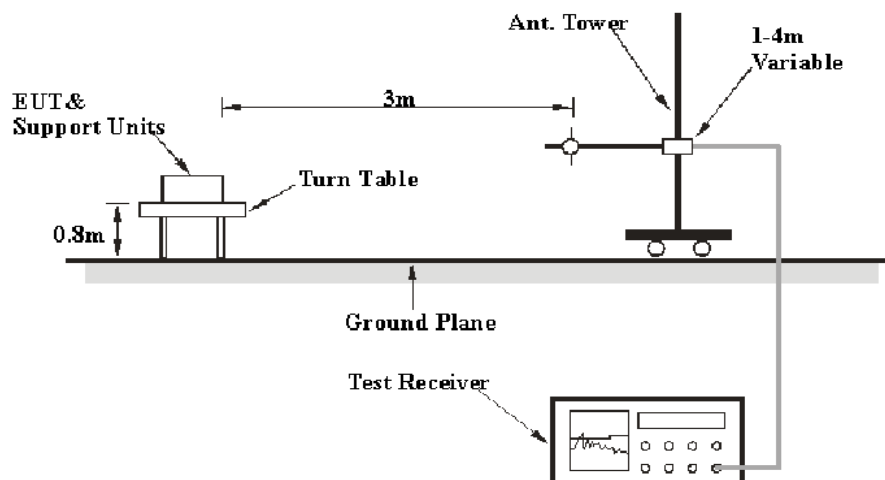
Tester : Macy shi

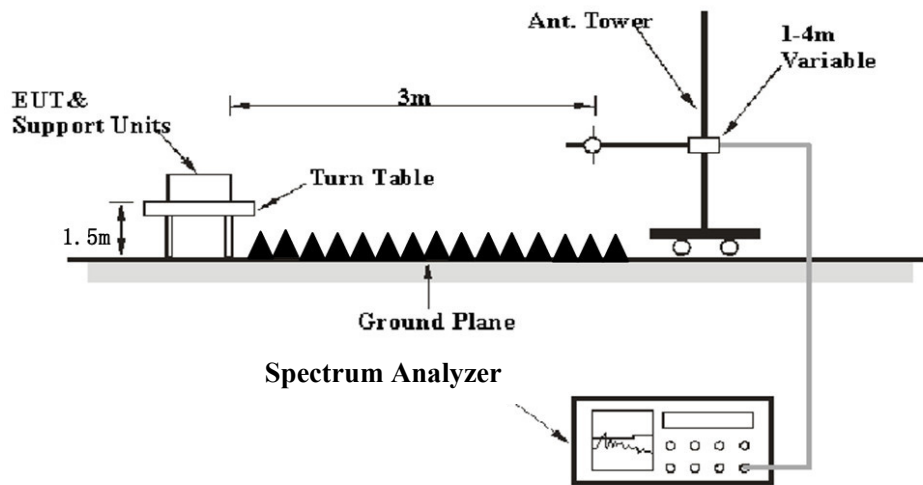
Note : UHF

|    | Freq | Read Level | LISN Level | LISN Factor | Cable Loss | Limit Line | Over Limit | Remark  |
|----|------|------------|------------|-------------|------------|------------|------------|---------|
|    | MHz  | dBuV       | dBuV       | dB          | dB         | dBuV       | dB         |         |
| 1  | 0.16 | 13.92      | 34.36      | 10.29       | 10.15      | 55.47      | -21.11     | Average |
| 2  | 0.16 | 30.10      | 50.54      | 10.29       | 10.15      | 65.47      | -14.93     | QP      |
| 3  | 0.18 | 10.00      | 30.56      | 10.42       | 10.14      | 54.68      | -24.12     | Average |
| 4  | 0.18 | 27.30      | 47.86      | 10.42       | 10.14      | 64.68      | -16.82     | QP      |
| 5  | 0.23 | 6.10       | 26.90      | 10.63       | 10.17      | 52.30      | -25.40     | Average |
| 6  | 0.23 | 23.51      | 44.31      | 10.63       | 10.17      | 62.30      | -17.99     | QP      |
| 7  | 0.26 | 25.85      | 46.70      | 10.66       | 10.19      | 61.34      | -14.64     | Peak    |
| 8  | 0.30 | 4.19       | 25.00      | 10.69       | 10.12      | 50.19      | -25.19     | Average |
| 9  | 0.30 | 19.29      | 40.10      | 10.69       | 10.12      | 60.19      | -20.09     | QP      |
| 10 | 0.78 | -1.69      | 18.93      | 10.44       | 10.18      | 46.00      | -27.07     | Average |
| 11 | 0.78 | 7.03       | 27.65      | 10.44       | 10.18      | 56.00      | -28.35     | QP      |

**FCC §15.205, §15.209 & §15.247(d) - RADIATED EMISSIONS****Applicable Standard**

FCC §15.205; §15.209; §15.247(d)

**EUT Setup****9 kHz-30MHz:****30MHz-1GHz:**

**Above 1GHz:**

The radiated emission tests were performed in the 3 meters, 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 EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

| Frequency Range   | RBW                                                           | Video B/W | IF B/W  | Measurement |
|-------------------|---------------------------------------------------------------|-----------|---------|-------------|
| 9 kHz – 150 kHz   | /                                                             | /         | 200 Hz  | QP          |
|                   | 300 Hz                                                        | 1 kHz     | /       | PK          |
| 150 kHz – 30 MHz  | /                                                             | /         | 9 kHz   | QP          |
|                   | 10 kHz                                                        | 30 kHz    | /       | PK          |
| 30 MHz – 1000 MHz | /                                                             | /         | 120 kHz | QP          |
|                   | 100 kHz                                                       | 300 kHz   | /       | PK          |
| Above 1 GHz       | Harmonics & Band Edge                                         |           |         |             |
|                   | 1MHz                                                          | 3 MHz     | /       | PK          |
|                   | Average Emission Level=Peak Emission Level+20*log(Duty cycle) |           |         |             |
|                   | Other Emissions                                               |           |         |             |
|                   | 1MHz                                                          | 3 MHz     | /       | PK          |
|                   | 1MHz                                                          | 10 Hz     | /       | Average     |

For Duty cycle measurement:

Use the duty cycle factor correction factor method per 15.35(c).

Duty cycle=On time/100milliseconds, On time= $N_1 \cdot L_1 + N_2 \cdot L_2 + \dots + N_{n-1} \cdot L_{n-1} + N_n \cdot L_n$ ,

Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulse, etc.

## Test Procedure

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

All final data was recorded in Quasi-peak detection mode except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz, average detection modes for frequency bands 9–90 kHz and 110–490 kHz, peak and average detection modes for frequencies above 1 GHz.

For 9 kHz-30MHz, the report shall list the six emissions with the smallest margin relative to the limit, for each of the three antenna orientations (parallel, perpendicular, and ground-parallel) unless the margin is greater than 20 dB.

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

All emissions under the average limit and under the noise floor have not recorded in the report.

## Factor & Over Limit/Margin Calculation

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

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

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

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

## Test Data

### Environmental Conditions

|                    |            |
|--------------------|------------|
| Temperature:       | 22~25.6 °C |
| Relative Humidity: | 50~54 %    |
| ATM Pressure:      | 101 kPa    |

*The testing was performed by Anson Su on 2024-06-01 for below 1GHz and Dylan Yang from 2024-05-18 to 2024-06-02 for above 1GHz.*

*Test mode: Transmitting*

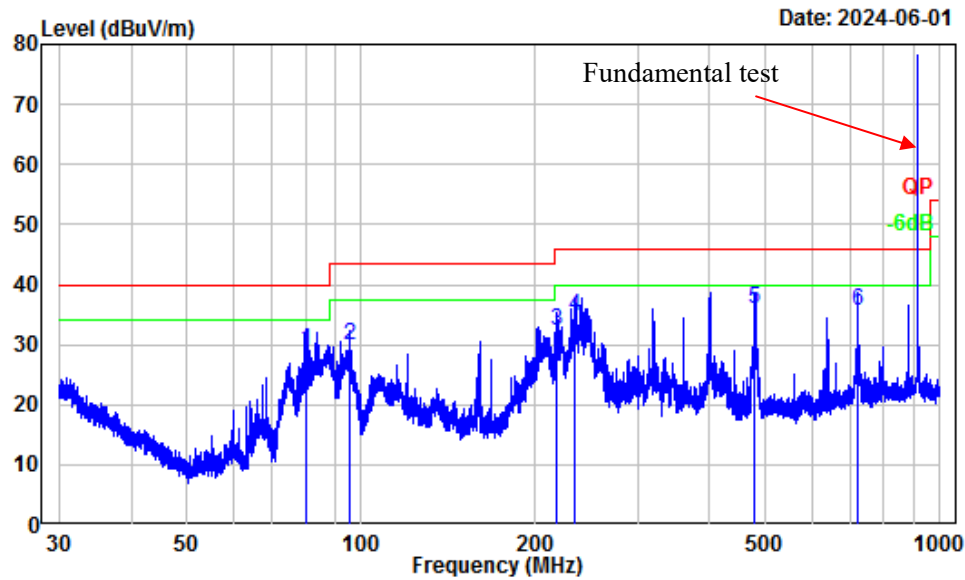
*Note: After pre-scan in the X, Y and Z axes of orientation, the worst case z-axis of orientation were recorded.*

**9 kHz-30MHz:** *(Maximum output power mode, 921.0MHz)*

*The amplitude of spurious emissions attenuated more than 20 dB below the limit was not recorded.*

30MHz-1GHz: (Maximum output power mode, 921.0MHz)

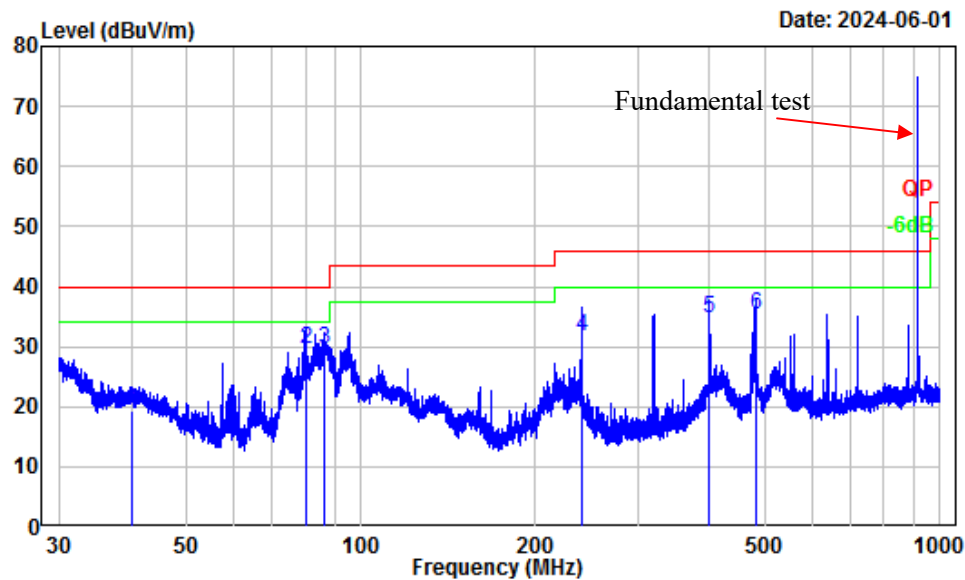
Horizontal



Site : Chamber A  
Condition : 3m Horizontal  
Project Number: 2401S69159E-RF  
Test Mode : UHF  
Tester : Anson Su

| Freq Factor |        | Read Level |        | Limit  | Over  | Remark    |
|-------------|--------|------------|--------|--------|-------|-----------|
| MHz         | dB/m   | dBuV       | dBuV/m | dBuV/m | Limit |           |
| 1           | 80.05  | -18.24     | 47.23  | 28.99  | 40.00 | -11.01 QP |
| 2           | 95.55  | -16.63     | 46.60  | 29.97  | 43.50 | -13.53 QP |
| 3           | 217.93 | -13.85     | 46.13  | 32.28  | 46.00 | -13.72 QP |
| 4           | 234.27 | -14.20     | 48.92  | 34.72  | 46.00 | -11.28 QP |
| 5           | 479.27 | -8.82      | 44.68  | 35.86  | 46.00 | -10.14 QP |
| 6           | 719.51 | -5.93      | 41.49  | 35.56  | 46.00 | -10.44 QP |

Vertical



Site : Chamber A  
Condition : 3m Vertical  
Project Number: 2401S69159E-RF  
Test Mode : UHF  
Tester : Anson Su

|   | Freq   | Factor | Read<br>Level | Level  | Limit<br>Line | Over<br>Limit | Remark |
|---|--------|--------|---------------|--------|---------------|---------------|--------|
|   | MHz    | dB/m   | dBuV          | dBuV/m | dBuV/m        | dB            |        |
| 1 | 40.19  | -13.13 | 32.44         | 19.31  | 40.00         | -20.69        | QP     |
| 2 | 80.01  | -18.74 | 48.19         | 29.45  | 40.00         | -10.55        | QP     |
| 3 | 86.31  | -18.84 | 48.50         | 29.66  | 40.00         | -10.34        | QP     |
| 4 | 239.99 | -14.88 | 46.60         | 31.72  | 46.00         | -14.28        | QP     |
| 5 | 399.91 | -10.80 | 45.53         | 34.73  | 46.00         | -11.27        | QP     |
| 6 | 479.90 | -9.12  | 44.37         | 35.25  | 46.00         | -10.75        | QP     |

**Above 1GHz:**

| Frequency<br>(MHz) | Receiver          |       | Polar<br>(H/V) | Factor<br>(dB/m) | Corrected<br>Amplitude<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
|--------------------|-------------------|-------|----------------|------------------|------------------------------------|-------------------|----------------|
|                    | Reading<br>(dBμV) | PK/AV |                |                  |                                    |                   |                |
| Low Channel        |                   |       |                |                  |                                    |                   |                |
| 2751.00            | 49.96             | PK    | H              | -2.46            | 47.50                              | 74                | -26.50         |
| 2751.00            | 49.47             | PK    | V              | -2.46            | 47.01                              | 74                | -26.99         |
| 3668.00            | 49.87             | PK    | H              | -1.84            | 48.03                              | 74                | -25.97         |
| 3668.00            | 49.82             | PK    | V              | -1.84            | 47.98                              | 74                | -26.02         |
| Middle Channel     |                   |       |                |                  |                                    |                   |                |
| 2758.80            | 50.08             | PK    | H              | -2.46            | 47.62                              | 74                | -26.38         |
| 2758.80            | 49.59             | PK    | V              | -2.46            | 47.13                              | 74                | -26.87         |
| 3678.40            | 49.68             | PK    | H              | -1.84            | 47.84                              | 74                | -26.16         |
| 3678.40            | 49.53             | PK    | V              | -1.84            | 47.69                              | 74                | -26.31         |
| High Channel       |                   |       |                |                  |                                    |                   |                |
| 2766.60            | 50.12             | PK    | H              | -2.46            | 47.66                              | 74                | -26.34         |
| 2766.60            | 48.93             | PK    | V              | -2.46            | 46.47                              | 74                | -27.53         |
| 3688.80            | 49.62             | PK    | H              | -1.74            | 47.88                              | 74                | -26.12         |
| 3688.80            | 48.58             | PK    | V              | -1.74            | 46.84                              | 74                | -27.16         |

**Note:**

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

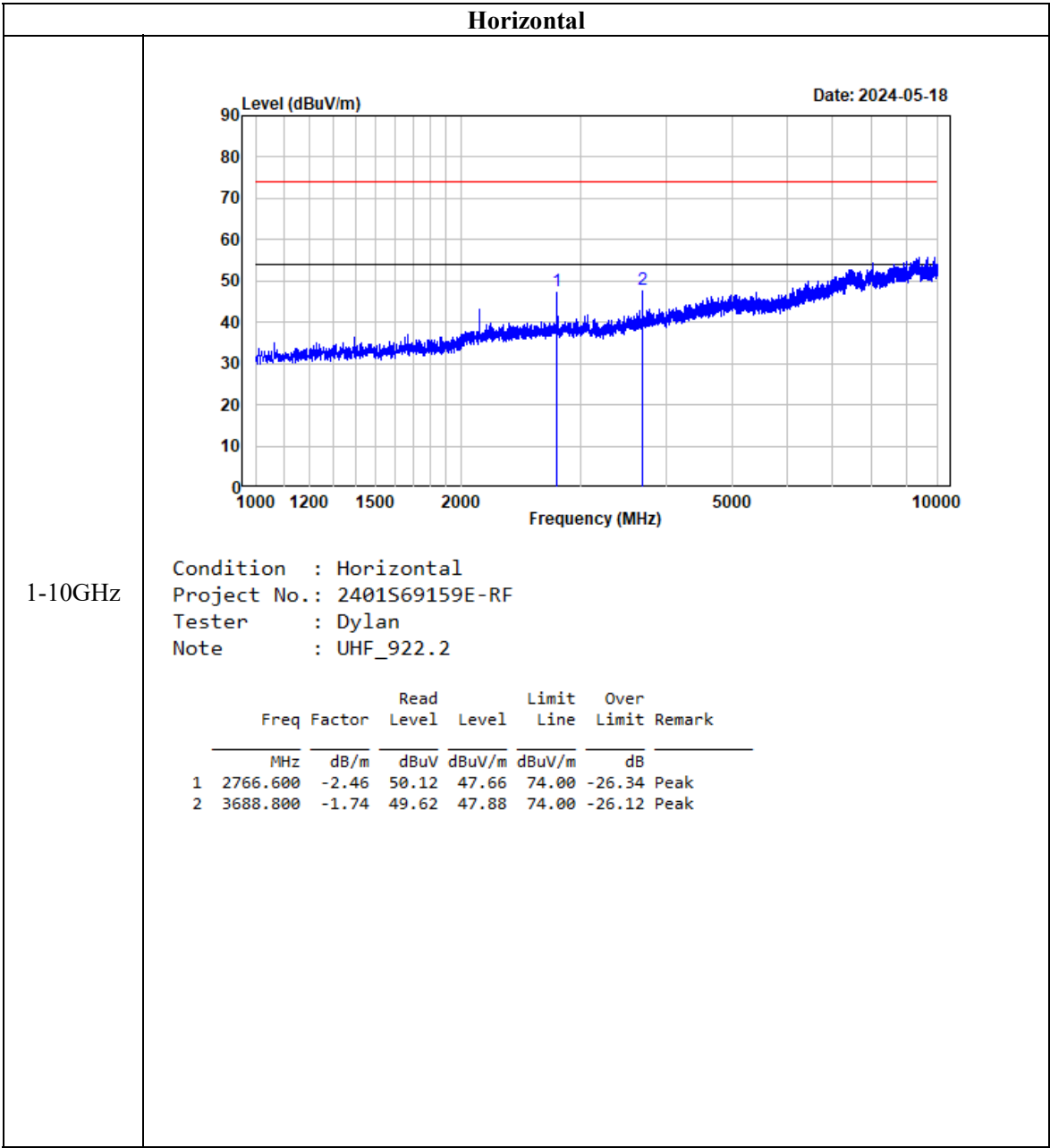
Corrected Amplitude = Factor + Reading

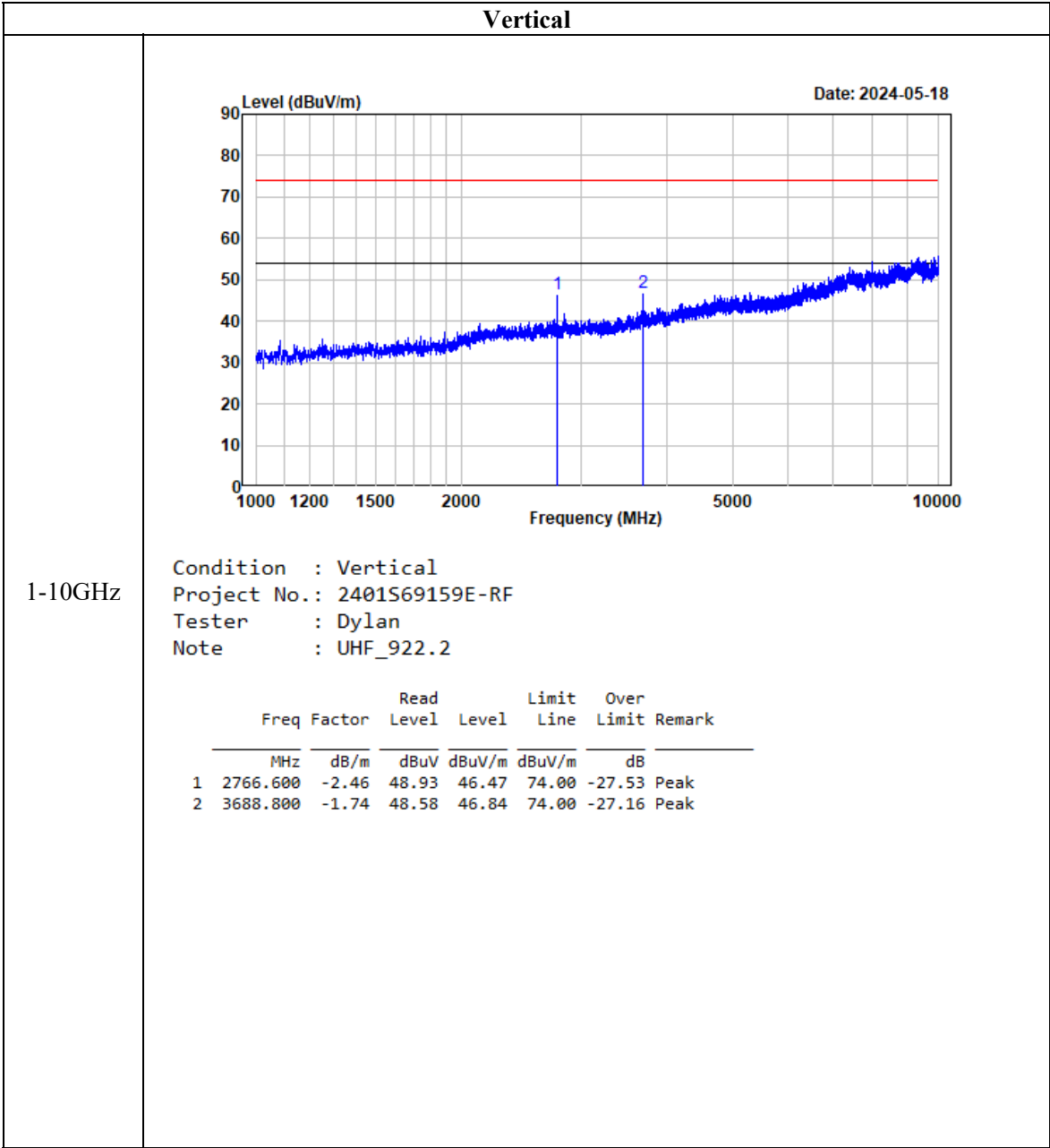
Margin = Corrected. Amplitude - Limit

The other spurious emission which is in the noise floor level was not recorded.

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

Harmonic and Emissions Measurements:





## FCC §15.247(a) (1) - CHANNEL SEPARATION

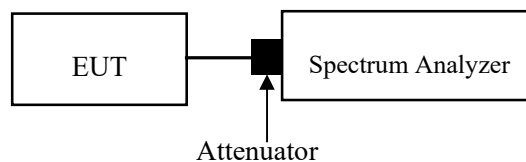
### Applicable Standard

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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

### Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.2

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.



### Test Data

#### Environmental Conditions

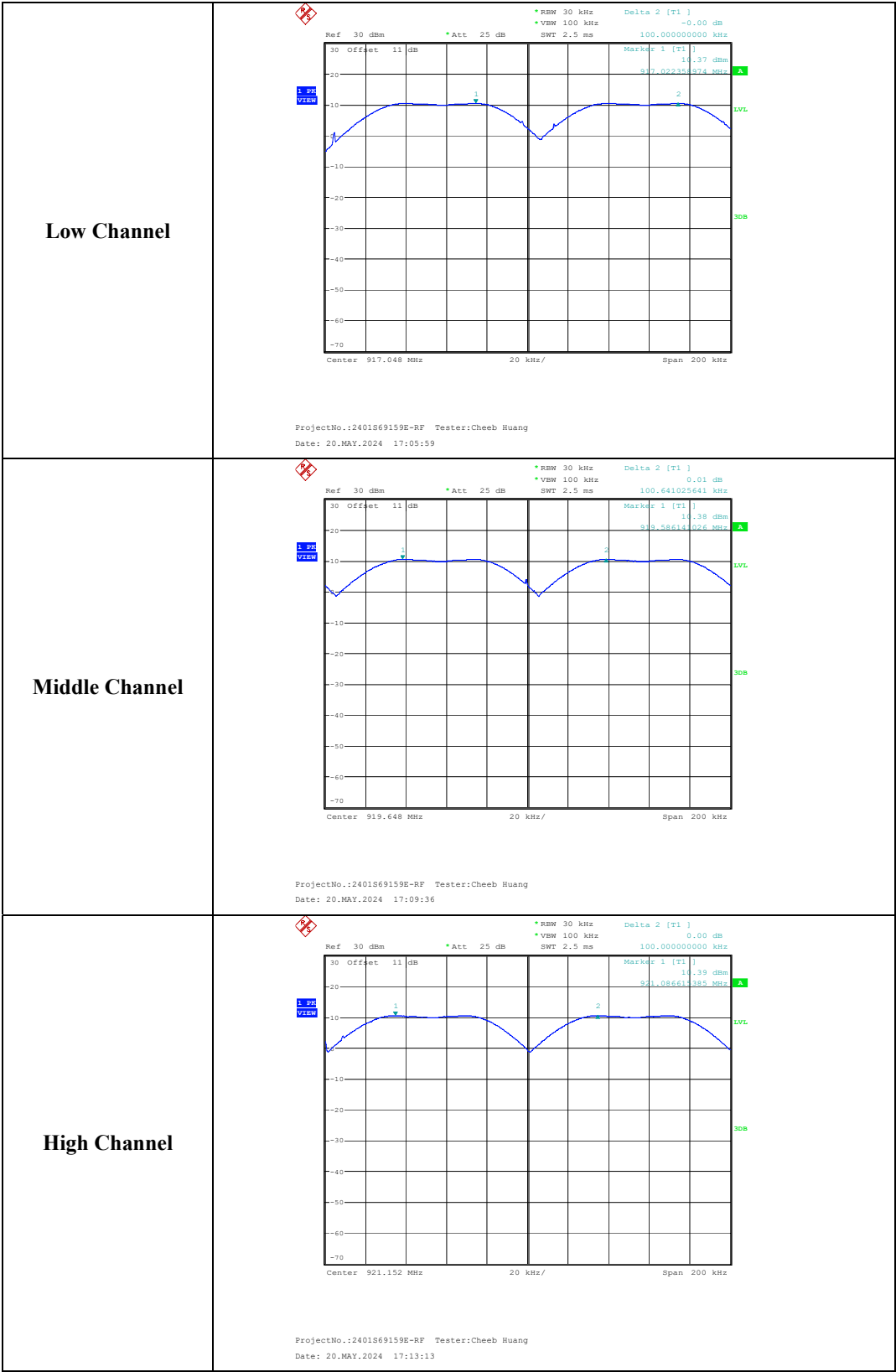
|                    |         |
|--------------------|---------|
| Temperature:       | 26.1 °C |
| Relative Humidity: | 55 %    |
| ATM Pressure:      | 101 kPa |

*The testing was performed by Cheeb Huang on 2024-05-20.*

*EUT operation mode: Transmitting*

***Test Result: Compliant.***

| Test Channel                            | Test Frequency (MHz) | Channel Separation (MHz) | Limits (MHz) |
|-----------------------------------------|----------------------|--------------------------|--------------|
| Lowest                                  | 917.0                | 0.100                    | 0.068        |
| Middle                                  | 919.6                | 0.101                    | 0.068        |
| Highest                                 | 922.2                | 0.100                    | 0.069        |
| Limit= MAX{25 kHz, BW <sub>20dB</sub> } |                      |                          |              |



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

### **Applicable Standard**

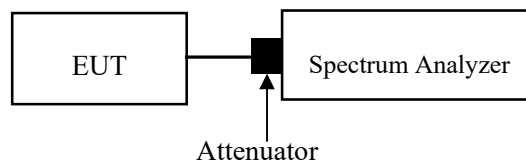
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; 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**

According to ANSI C63.10-2013 Clause 7.8.7 & Clause 6.9.2

The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20dB bandwidth if the device is not transmitting continuously.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW/ 20dB bandwidth and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.



Test Data

Environmental Conditions

|                    |         |
|--------------------|---------|
| Temperature:       | 26.1 °C |
| Relative Humidity: | 55 %    |
| ATM Pressure:      | 101 kPa |

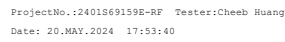
The testing was performed by Cheeb Huang on 2024-05-20.

EUT operation mode: Transmitting

Test Result: Compliant.

| Test Channel | Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Limit (MHz) |
|--------------|----------------------|-----------------------|-------------|
| Lowest       | 917.0                | 0.068                 | <0.25       |
| Middle       | 919.6                | 0.068                 | <0.25       |
| Highest      | 922.2                | 0.069                 | <0.25       |

### Low Channel



ProjectNo.:2401S69159E-RF Tester:Cheeb Huang  
Date: 20.MAY.2024 17:55:15

ProjectNo.:2401S69159E-RF Tester:Cheeb Huang  
Date: 20.MAY.2024 17:56:42

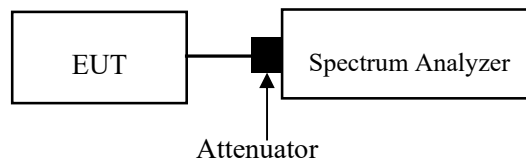
**FCC §15.247(a) (1) (i) - NUMBER OF HOPPING FREQUENCY****Applicable Standard**

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**

Test Method: ANSI C63.10-2013 Clause 7.8.3

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the max-hold function record the quantity of the channel.

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

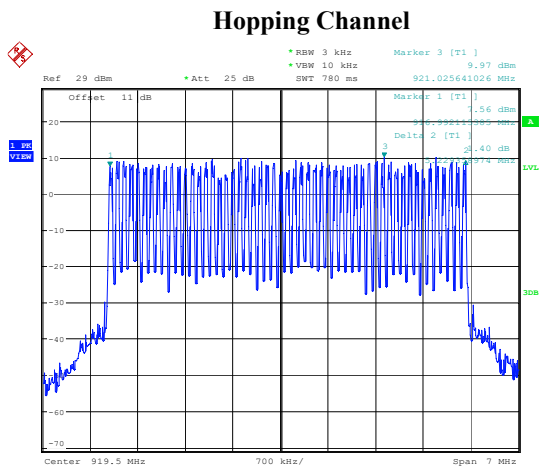
|                    |         |
|--------------------|---------|
| Temperature:       | 26.1 °C |
| Relative Humidity: | 55 %    |
| ATM Pressure:      | 101 kPa |

*The testing was performed by Cheeb Huang on 2024-05-20.*

*EUT operation mode: Transmitting*

***Test Result: Compliant.***

| Frequency Range<br>(MHz) | Number of Hopping Channel<br>(CH) | Limits<br>(CH) |
|--------------------------|-----------------------------------|----------------|
| 902-928                  | 53                                | ≥50            |



ProjectNo.:2401S69159E-RF    Tester:Cheeb Huang  
Date: 20.MAY.2024    16:36:59

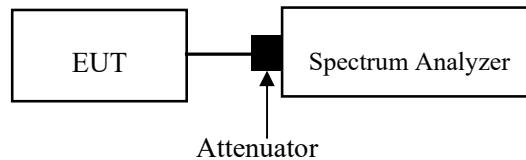
**FCC §15.247(a) (1) (i) - TIME OF OCCUPANCY (DWELL TIME)****Applicable Standard**

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**

According to ANSI C63.10-2013 Section 7.8.4

1. The EUT was worked in channel hopping.
2. Set the RBW to: 10kHz.
3. Set the VBW  $\geq 3 \times$  RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

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

|                    |         |
|--------------------|---------|
| Temperature:       | 26.1 °C |
| Relative Humidity: | 55 %    |
| ATM Pressure:      | 101 kPa |

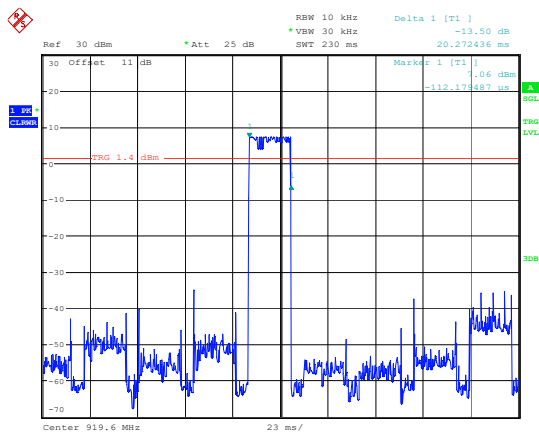
*The testing was performed by Cheeb Huang on 2024-05-20.*

*EUT operation mode: Transmitting*

***Test Result: Compliant.***

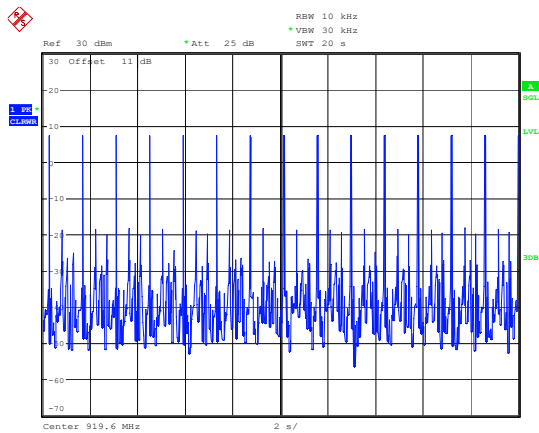
| Test Frequency (MHz) | Pulse width (ms) | Observation time (s) | Hopping Numbers in Observation time | Dwell Time (s) | Limit (s) |
|----------------------|------------------|----------------------|-------------------------------------|----------------|-----------|
| 919.6                | 20.272           | 20                   | 15                                  | 0.304          | 0.400     |

Pulse time



ProjectNo.:2401S69159E-RF Tester:Cheeb Huang  
Date: 20.MAY.2024 16:57:42

Hopping Number in 20s



ProjectNo.:2401S69159E-RF Tester:Cheeb Huang  
Date: 20.MAY.2024 16:53:09

## **FCC §15.247(b) (2) - MAXIMUM CONDUCTED OUTPUT POWER**

### **Applicable Standard**

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

### **Test Procedure**

According to ANSI C63.10-2013 Section 7.8.5

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:

- 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- 2) RBW > 20 dB bandwidth of the emission being measured.
- 3) VBW  $\geq$  RBW.
- 4) Sweep: Auto.
- 5) Detector function: Peak.
- 6) Trace: Max hold.

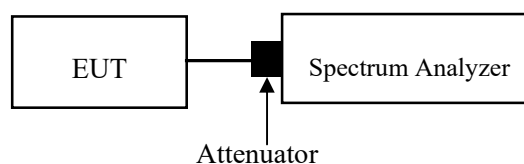
b) Allow trace to stabilize.

c) Use the marker-to-peak function to set the marker to the peak of the emission.

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

e) A plot of the test results and setup description shall be included in the test report.

NOTE— A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.



Test Data

Environmental Conditions

|                    |          |
|--------------------|----------|
| Temperature:       | 25~26 °C |
| Relative Humidity: | 55~58 %  |
| ATM Pressure:      | 101 kPa  |

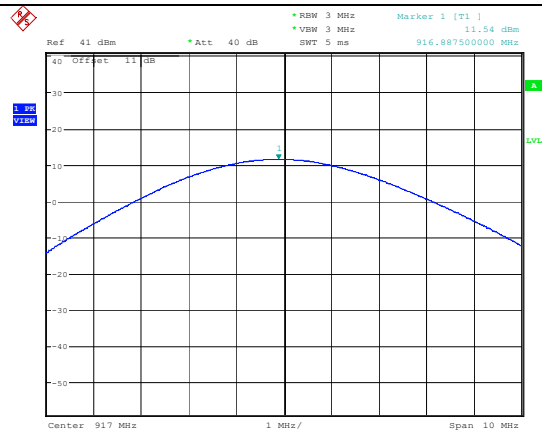
The testing was performed by Cheeb Huang from 2024-07-02 to 2024-07-04.

EUT operation mode: Transmitting

Test Result: Compliant.

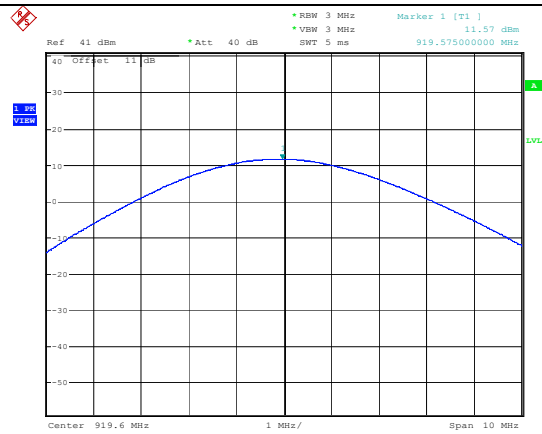
| Test Channel | Test Frequency (MHz) | Peak Conducted Output Power (dBm) | Limits (dBm) |
|--------------|----------------------|-----------------------------------|--------------|
| Lowest       | 917.0                | 11.54                             | 30           |
| Middle       | 919.6                | 11.57                             | 30           |
| Additional   | 921.0                | 11.70                             | 30           |
| Highest      | 922.2                | 11.58                             | 30           |

### Low Channel



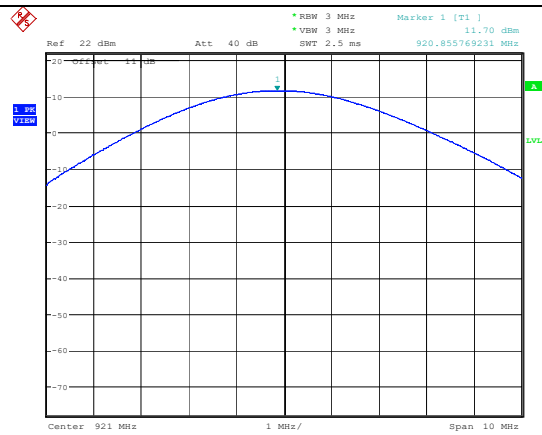
ProjectNo.:2401S69159E-RF Tester:Cheeb Huang  
Date: 2.JUL.2024 13:58:55

### Middle Channel



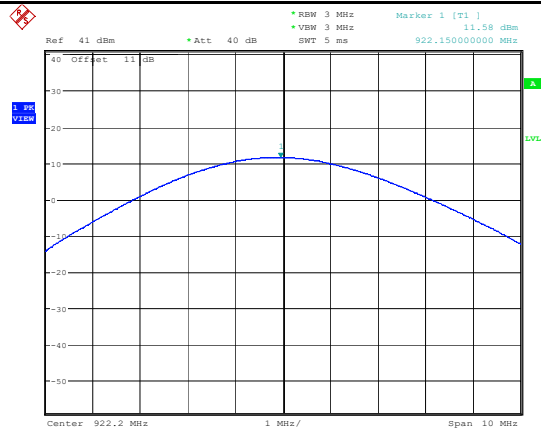
ProjectNo.:2401S69159E-RF Tester:Cheeb Huang  
Date: 2.JUL.2024 14:00:06

### Additional



ProjectNo.:2401S69159E-RF Tester:Cheeb Huang  
Date: 4.JUL.2024 11:12:21

### High Channel



ProjectNo.:2401S69159E-RF    Tester:Cheeb Huang  
Date: 2.JUL.2024    14:01:05

## FCC §15.247(d) § 5.5 - 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)).

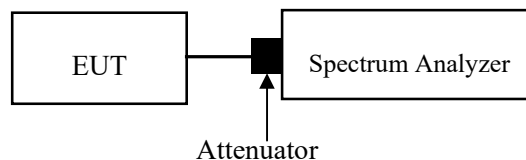
### Test Procedure

According to ANSI C63.10-2013 Section 7.8.6 & Clause 6.10

For band-edge measurements, use the band-edge procedure in 6.10. Band-edge measurements shall be tested both on single channels, and with the EUT hopping.

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100 kHz.
- c) Set the VBW  $\geq [3 \times \text{RBW}]$ .
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements. Report the three highest emissions relative to the limit.



Test Data

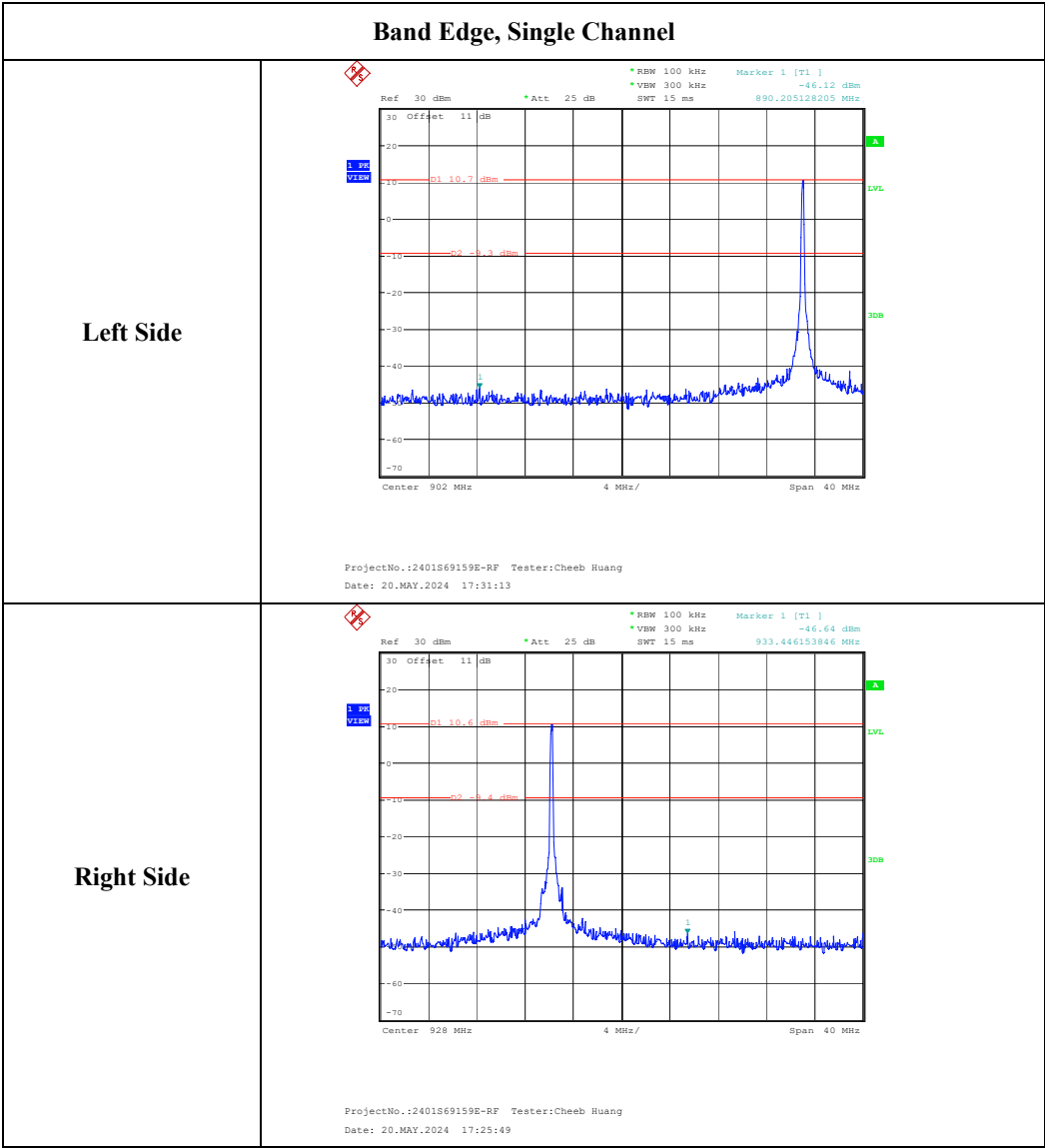
Environmental Conditions

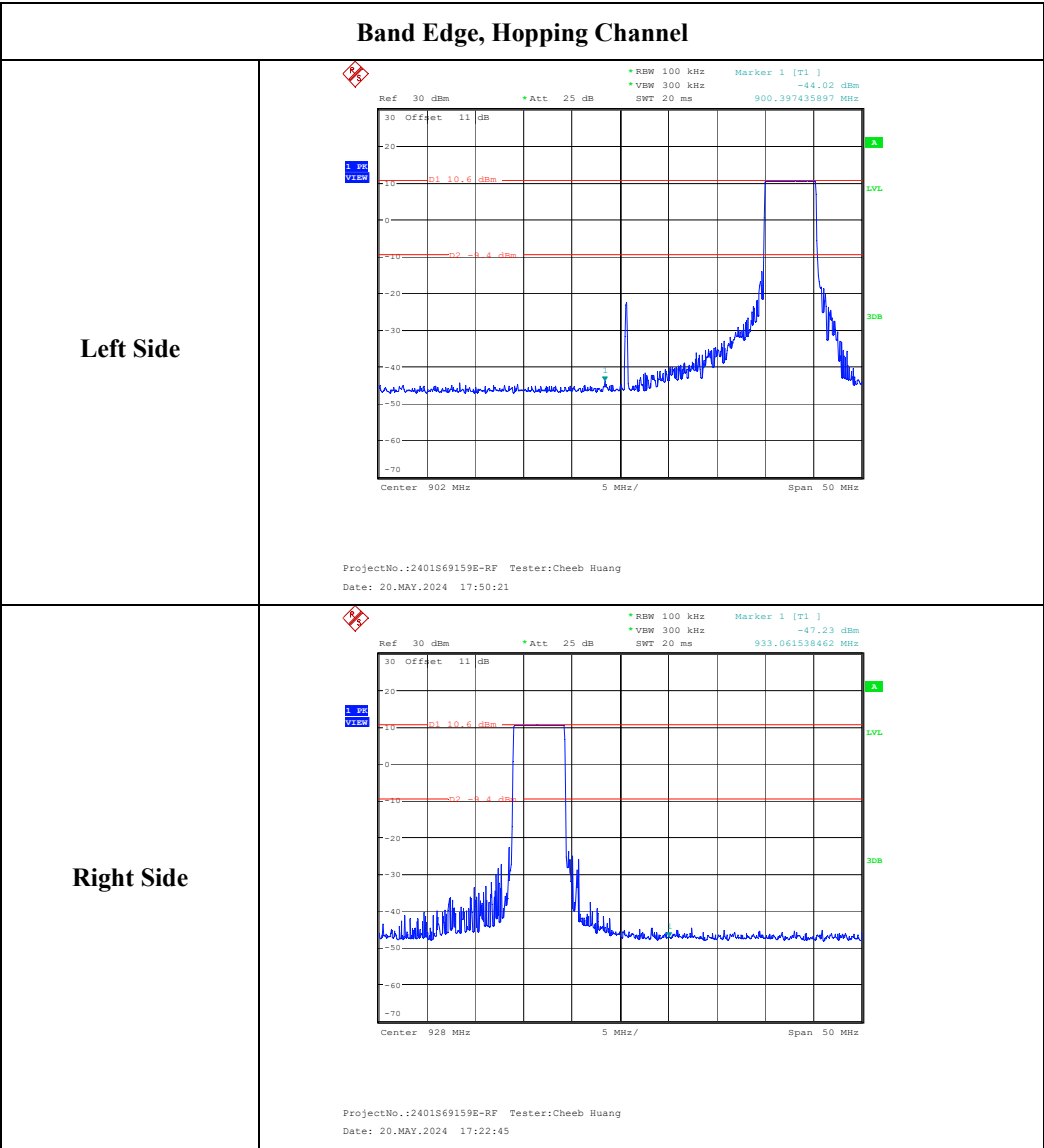
|                    |         |
|--------------------|---------|
| Temperature:       | 26.1 °C |
| Relative Humidity: | 55 %    |
| ATM Pressure:      | 101 kPa |

The testing was performed by Cheeb Huang on 2024-05-20.

EUT operation mode: Transmitting

Test Result: Compliant.





## **EUT PHOTOGRAPHS**

Please refer to the attachment 2401S69159E-RF External photo and 2401S69159E-RF Internal photo.

## **TEST SETUP PHOTOGRAPHS**

Please refer to the attachment 2401S69159E-RFB Test Setup photo.

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