

# TEST REPORT

Applicant Name: Astera LED Technology GmbH  
Address: Schatzbogen 60, 81829 Munich, Germany  
Report Number: 2401Z64580E-RF-00  
FCC ID: X55AST-QUKSP

**Test Standard (s)**

FCC PART 15.247

**Sample Description**

Product Type: QuikSpot  
Model No.: AST-QUKSP  
Multiple Model(s) No.: N/A  
Trade Mark: Astera  
Date Received: 2024/11/13  
Issue Date: 2025/04/02

Test Result:	Pass▲
--------------	-------

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

**Prepared and Checked By:**

Ekko. Wu

Ekko Wu  
RF Engineer

**Approved By:**

Nancy Wang

Nancy Wang  
RF Supervisor

Note: The information marked<sup>#</sup> 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.

This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

This report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP or any agency of the U.S. Government.

This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "▼".

**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](http://www.baclcorp.com.cn)

## **TABLE OF CONTENTS**

<b>DOCUMENT REVISION HISTORY .....</b>	<b>4</b>
<b>GENERAL INFORMATION.....</b>	<b>5</b>
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) .....	5
OBJECTIVE .....	5
TEST METHODOLOGY .....	5
MEASUREMENT UNCERTAINTY .....	6
TEST FACILITY .....	6
<b>SYSTEM TEST CONFIGURATION.....</b>	<b>7</b>
DESCRIPTION OF TEST CONFIGURATION .....	7
EUT EXERCISE SOFTWARE .....	7
SPECIAL ACCESSORIES.....	7
EQUIPMENT MODIFICATIONS .....	7
SUPPORT EQUIPMENT LIST AND DETAILS .....	7
EXTERNAL I/O CABLE.....	8
BLOCK DIAGRAM OF TEST SETUP .....	8
<b>SUMMARY OF TEST RESULTS .....</b>	<b>10</b>
<b>TEST EQUIPMENT LIST .....</b>	<b>11</b>
<b>FCC §15.247 (I) &amp; §1.1307 (B) (3) &amp; §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE).....</b>	<b>12</b>
APPLICABLE STANDARD .....	12
RESULT .....	12
<b>FCC §15.203 - ANTENNA REQUIREMENT.....</b>	<b>13</b>
APPLICABLE STANDARD .....	13
ANTENNA CONNECTOR CONSTRUCTION .....	13
<b>FCC §15.207 (A) - AC LINE CONDUCTED EMISSIONS.....</b>	<b>14</b>
APPLICABLE STANDARD .....	14
EUT SETUP .....	14
EMI TEST RECEIVER SETUP.....	14
TEST PROCEDURE .....	14
FACTOR & OVER LIMIT CALCULATION.....	15
TEST DATA .....	15
<b>FCC §15.205, §15.209 &amp; §15.247(D) - RADIATED EMISSIONS.....</b>	<b>18</b>
APPLICABLE STANDARD .....	18
EUT SETUP .....	18
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP .....	19
TEST PROCEDURE .....	20
FACTOR & OVER LIMIT/MARGIN CALCULATION .....	20
TEST DATA .....	20
<b>FCC §15.247(A) (1) - CHANNEL SEPARATION.....</b>	<b>28</b>
APPLICABLE STANDARD .....	28
TEST PROCEDURE .....	28
TEST DATA .....	28

<b>FCC §15.247(A) (1) - 20 DB EMISSION BANDWIDTH.....</b>	<b>30</b>
APPLICABLE STANDARD .....	30
TEST PROCEDURE .....	30
TEST DATA .....	31
<b>FCC §15.247(A) (1) (I) - NUMBER OF HOPPING FREQUENCY.....</b>	<b>33</b>
APPLICABLE STANDARD .....	33
TEST PROCEDURE .....	33
TEST DATA .....	33
<b>FCC §15.247(A) (1) (I) - TIME OF OCCUPANCY (DWELL TIME).....</b>	<b>35</b>
APPLICABLE STANDARD .....	35
TEST PROCEDURE .....	35
TEST DATA .....	35
<b>FCC §15.247(B) (2) - MAXIMUM CONDUCTED OUTPUT POWER .....</b>	<b>37</b>
APPLICABLE STANDARD .....	37
TEST PROCEDURE .....	37
TEST DATA .....	38
<b>FCC §15.247(D) § 5.5 - 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE .....</b>	<b>40</b>
APPLICABLE STANDARD .....	40
TEST PROCEDURE .....	40
TEST DATA .....	41
<b>EUT PHOTOGRAPHS.....</b>	<b>43</b>
<b>TEST SETUP PHOTOGRAPHS.....</b>	<b>44</b>

## DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	2401Z64580E-RF-00	Original Report	2025/04/02

## GENERAL INFORMATION

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

Product	QuikSpot
Tested Model	AST-QUKSP
Multiple Model(s)	N/A
Frequency Range	917-922.2 MHz
Transmit Peak Power	7.45dBm
Modulation Technique	LORA
Antenna Specification <sup>#</sup>	-2.79dBi (provided by the applicant)
Voltage Range	DC 18V from battery or AC100V~240V, 60/50Hz
Sample serial number	2TZJ-3 for Conducted and Radiated Emissions Test 2TZJ-2 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		109.2kHz(k=2, 95% level of confidence)
RF output power, conducted		0.86dB(k=2, 95% level of confidence)
AC Power Lines Conducted Emissions	9kHz-150kHz	3.63dB(k=2, 95% level of confidence)
	150kHz-30MHz	3.66dB(k=2, 95% level of confidence)
Radiated Emissions	9kHz - 30MHz	3.60dB(k=2, 95% level of confidence)
	30MHz~200MHz (Horizontal)	5.32dB(k=2, 95% level of confidence)
	30MHz~200MHz (Vertical)	5.43dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Horizontal)	5.77dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Vertical)	5.73dB(k=2, 95% level of confidence)
	1GHz - 6GHz	5.34dB(k=2, 95% level of confidence)
	6GHz - 18GHz	5.40dB(k=2, 95% level of confidence)
	18GHz - 40GHz	5.64dB(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.

**Channel List**

Channel	Freq. (MHz)	Channel	Freq. (MHz)
1	917	28	919.7
2	917.1	29	919.8
...	...	...	...
...	...	...	...
...	...	52	922.1
26	919.5	53	922.2
27	919.6	/	/

Test on channel 1, 27 and 53.

### EUT Exercise Software

“AsteraSerialLogInstaller.msi<sup>#</sup>” exercise software was used and the power level is Default<sup>#</sup>. The software and 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

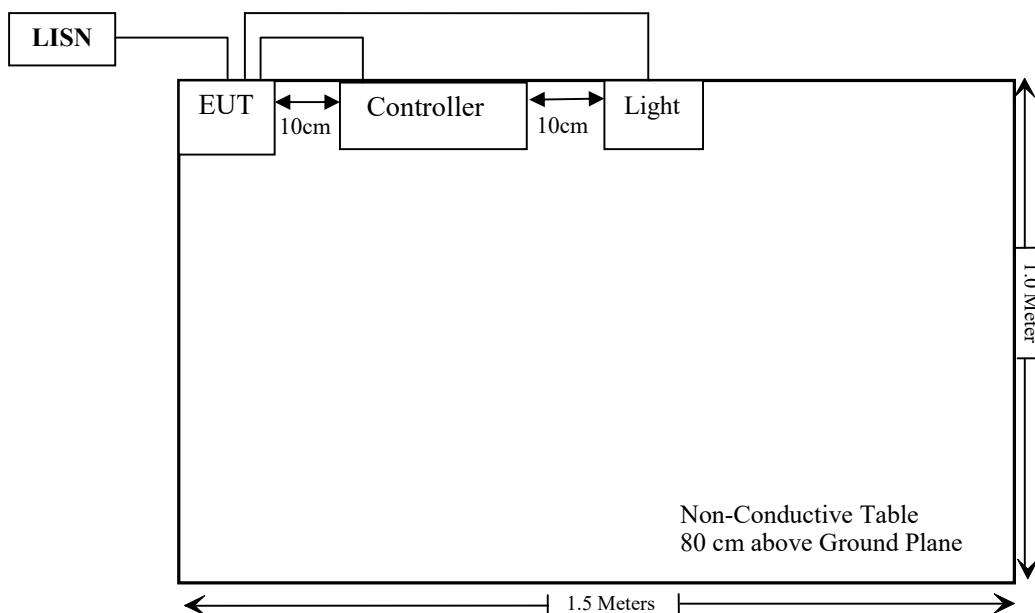
Manufacturer	Description	Model	Serial Number
Astera	Light	AST-QUKSP	/
Astera	Controller	/	/

**External I/O Cable**

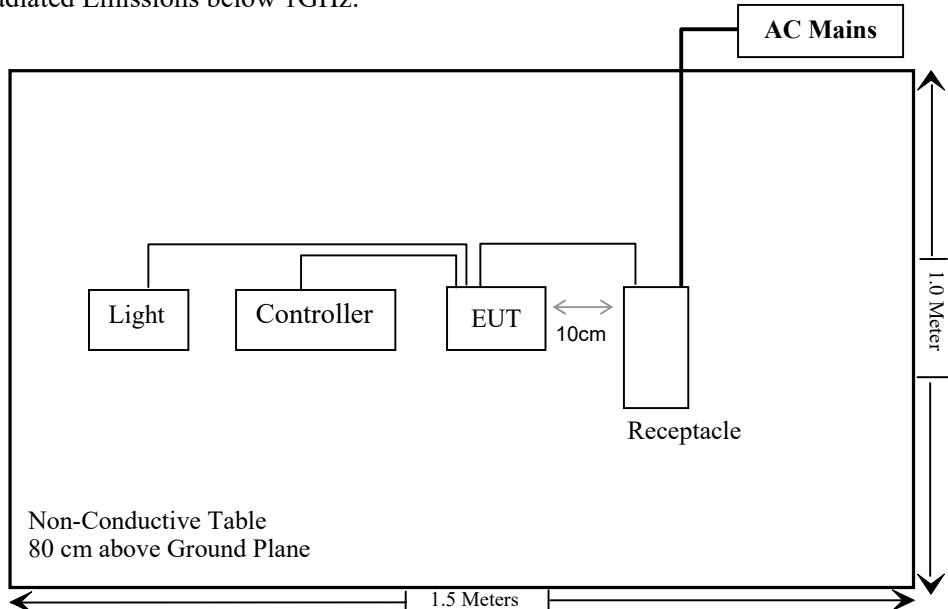
Cable Description	Length (m)	From Port	To
Un-shielding Detachable AC Cable	1.5	Receptacle	LISN/AC Mains
Un-shielding Detachable Control Cable	0.8	EUT	Controller
Un-shielding Detachable Control Cable	0.8	EUT	Light

**Block Diagram of Test Setup**

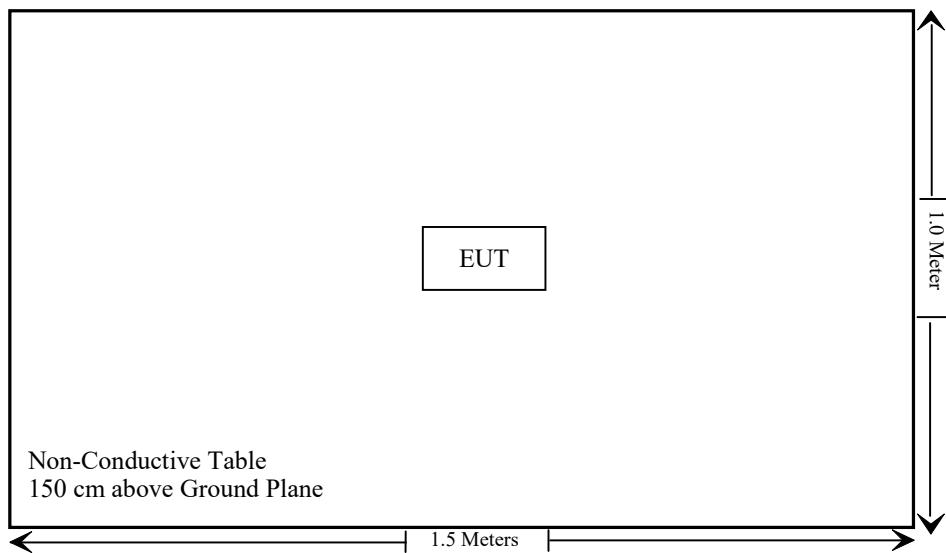
For Conducted Emissions:



For Radiated Emissions below 1GHz:



For Radiated Emissions above 1GHz:



## SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
FCC §15.247 (i) & §1.1307 (b) (3) & §2.1091	Maximum Permissible Exposure (MPE)	Compliant
FCC §15.203	Antenna Requirement	Compliant
FCC §15.107(a)	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d)	Radiated Spurious emissions	Compliant
FCC §15.247(a)(1)	20 dB 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	2024/12/04	2025/12/03
Rohde & Schwarz	LISN	ENV216	101613	2024/12/04	2025/12/03
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2024/05/21	2025/05/20
Unknown	CE Cable	Unknown	UF A210B-1-0720-504504	2024/05/21	2025/05/20
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
<b>Radiated Emission Test</b>					
Rohde & Schwarz	EMI Test Receiver	ESR3	102455	2024/12/04	2025/12/03
Sonoma instrument	Pre-amplifier	310 N	186238	2024/05/21	2025/05/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2026/07/19
Unknown	Cable	Chamber A Cable 1	N/A	2024/06/18	2025/06/17
Unknown	Cable	XH500C	J-10M-A	2024/06/18	2025/06/17
BACL	Active Loop Antenna	1313-1A	4031911	2024/05/14	2027/05/13
Unknown	Cable	2Y194	0735	2024/12/04	2025/12/03
Unknown	Cable	PNG214	1354	2024/12/04	2025/12/03
Rohde & Schwarz	Spectrum Analyzer	FSV40	101605	2024/03/27	2025/03/26
A.H.System	Preamplifier	PAM-0118P	489	2024/11/15	2025/11/14
Schwarzbeck	Horn Antenna	BBHA9120D(1201)	1143	2023/07/26	2026/07/25
Unknown	RF Cable	KMSE	735	2024/12/04	2025/12/03
Unknown	RF Cable	UFA147	219661	2024/12/04	2025/12/03
Unknown	RF Cable	XH750A-N	J-10M	2024/12/04	2025/12/03
JD	Filter Switch Unit	DT7220FSU	DS79906	2024/09/09	2025/09/08
JD	Multiplex Switch Test Control Set	DT7220SCU	DS79903	2024/09/09	2025/09/08
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
<b>RF Conducted Test</b>					
Rohde & Schwarz	Spectrum Analyzer	FSV40	101473	2024/12/04	2025/12/03
WEINSCHEL	3dB Attenuator	Unknown	F-03-EM220	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 §15.247 (i) & §1.1307 (b) (3) & §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 V01

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)(3)(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 <sup>2</sup> .
1.34-30	3,450 R <sup>2</sup> /f <sup>2</sup> .
30-300	3.83 R <sup>2</sup> .
300-1,500	0.0128 R <sup>2</sup> f.
1,500-100,000	19.2R <sup>2</sup> .

R is the minimum separation distance in meters

f = frequency in MHz

### Result

Mode	Frequency (MHz)	Tune up conducted power <sup>#</sup> (dBm)	Antenna Gain <sup>#</sup>		ERP		Evaluation Distance (m)	ERP Limit (mW)
			(dBi)	(dBd)	(dBm)	(mW)		
Lora	917-922.2	7.5	-2.79	-4.94	2.56	1.8	0.2	469.5
BT	2402-2480	9	-5.25	-7.4	1.6	1.4	0.2	768
BLE	2402-2480	7	-5.25	-7.4	-0.4	0.9	0.2	768
2.4G WIFI	2412-2462	27	-5.25	-7.4	19.6	91.2	0.2	768

Note: The tune up conducted power and antenna gain was declared by the applicant.  
EUT's Bluetooth and WiFi module ESP32 is contain ID. And all wireless functions cannot be sent at the same time.

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 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 have two internal antennas arrangement, which was permanently attached, the UHF antenna gain<sup>#</sup> is -2.79dBi and 2.4G antenna gain<sup>#</sup> is -5.25dBi, fulfill the requirement of this section. Please refer to the EUT photos.

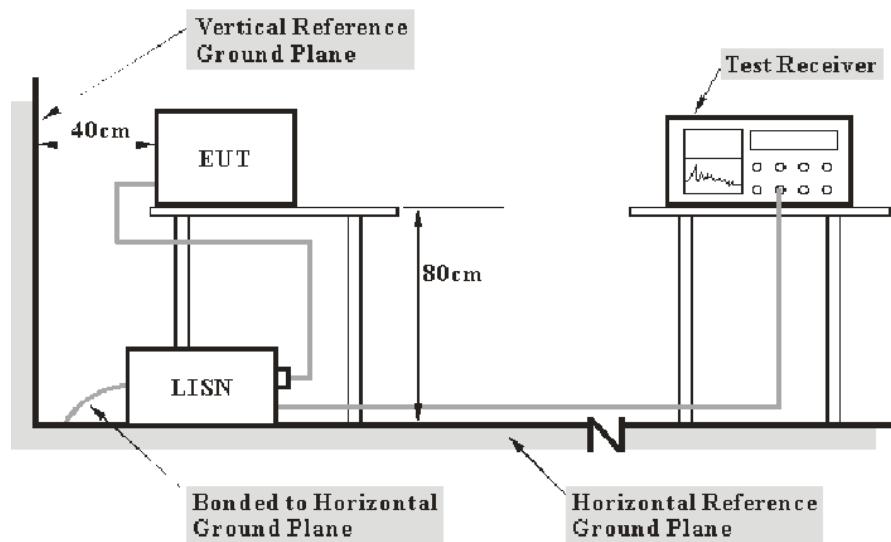
**Result: Compliant**

## 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:

$$\text{Over Limit} = \text{Level} - \text{Limit}$$
$$\text{Level} = \text{Read Level} + \text{Factor}$$

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

## Test Data

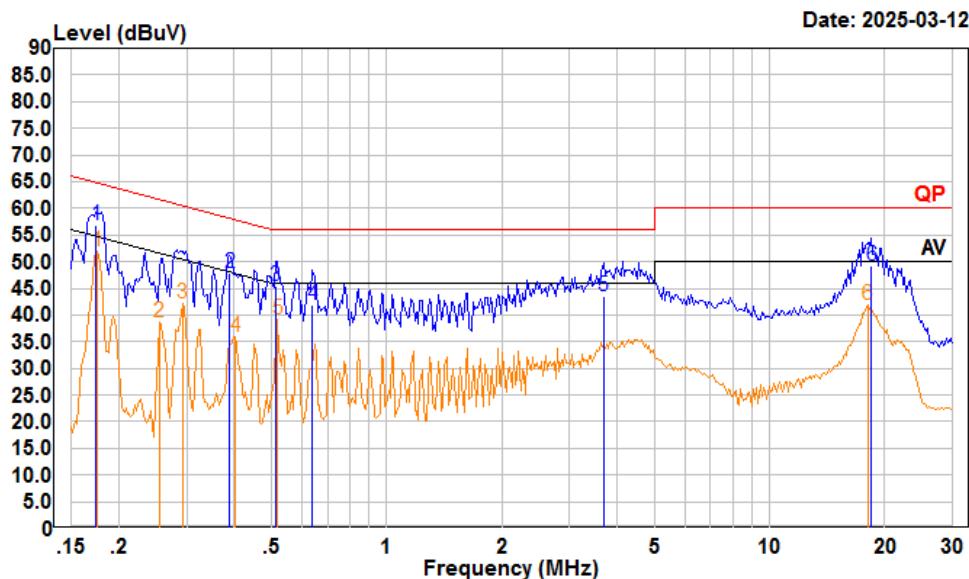
### Environmental Conditions

<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	45 %
<b>ATM Pressure:</b>	100 kPa

*The testing was performed by Macy Shi on 2025-03-12.*

*EUT operation mode: Transmitting (Maximum output power mode, 917.0MHz)*

## AC 120V/60 Hz, Line



Condition: Line

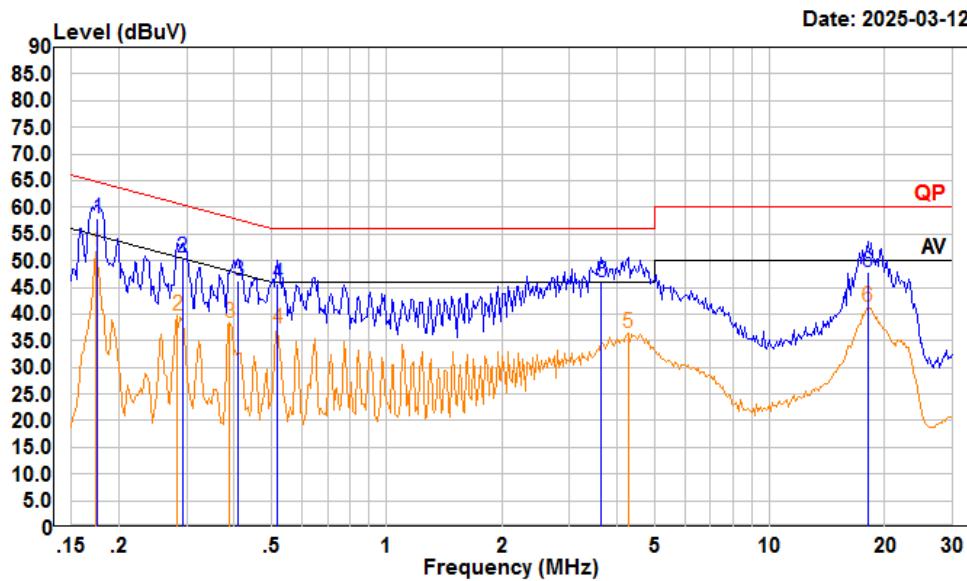
Project : 2401Z64580E-RF

tester : Macy.shi Note:Transmitting

Setting : RBW:9kHz VBW:30KHz Detector Peak

Freq	Read	LISN	Cable	Limit	Over	Remark
	MHz	dBuV	dBuV	dB	dB	
1	0.174	36.69	56.84	10.05	10.10	64.77 -7.93 QP
2	0.389	27.50	47.94	10.34	10.10	58.08 -10.14 QP
3	0.513	24.89	45.55	10.52	10.14	56.00 -10.45 QP
4	0.641	21.10	41.88	10.65	10.13	56.00 -14.12 QP
5	3.681	23.30	43.54	10.04	10.20	56.00 -12.46 QP
6	18.426	28.80	49.33	10.34	10.19	60.00 -10.67 QP
	Read	LISN	Cable	Limit	Over	
Freq	Level	Level	Factor	Loss	Line	Limit Remark
	MHz	dBuV	dBuV	dB	dB	dB
1	0.176	31.82	51.95	10.03	10.10	54.68 -2.73 Average
2	0.255	18.37	38.51	10.06	10.08	51.60 -13.09 Average
3	0.292	21.88	42.14	10.15	10.11	50.46 -8.32 Average
4	0.402	15.47	35.93	10.36	10.10	47.81 -11.88 Average
5	0.518	18.49	39.15	10.52	10.14	46.00 -6.85 Average
6	18.039	21.30	41.82	10.33	10.19	50.00 -8.18 Average

## AC 120V/60 Hz, Neutral



Condition: Neutral

Project : 2401Z64580E-RF

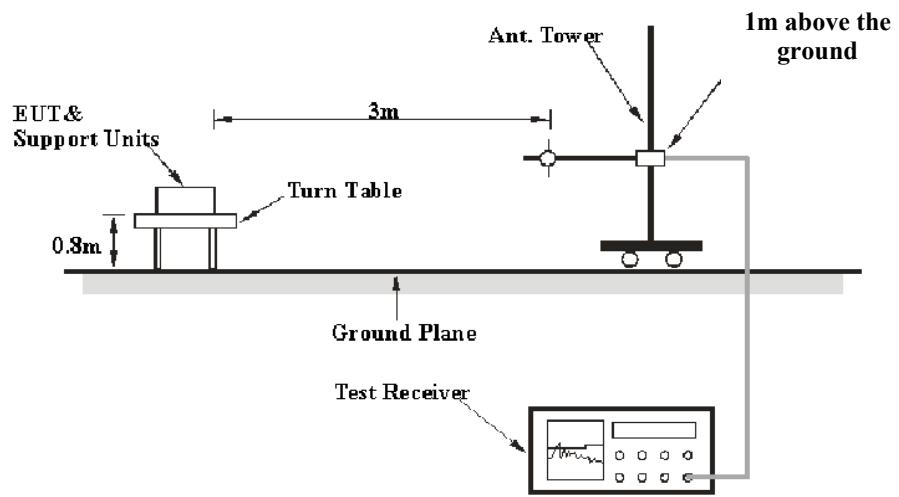
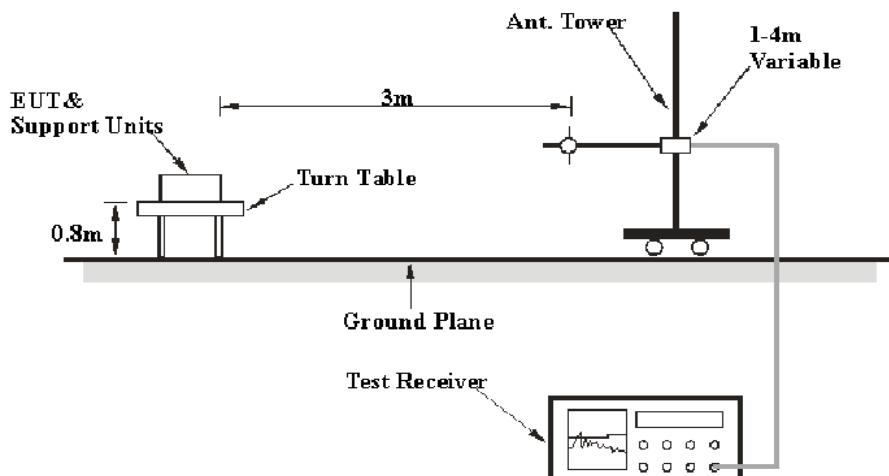
tester : Macy.shi Note:Transmitting

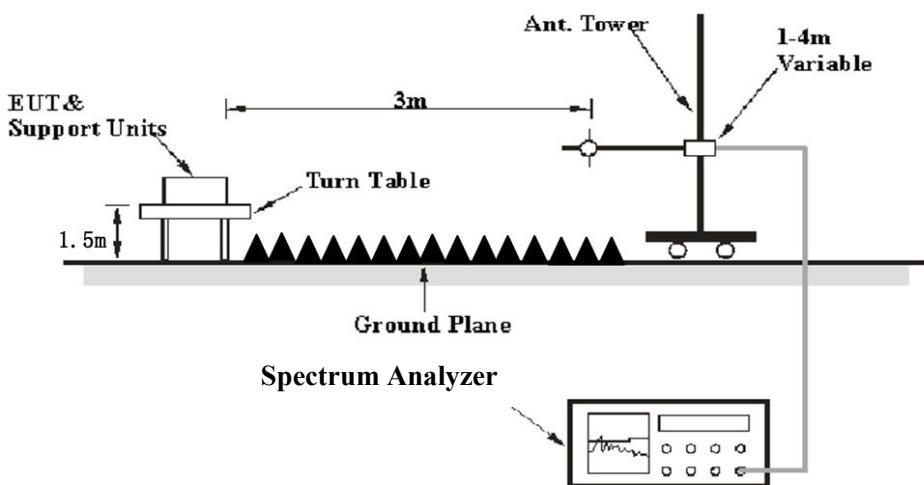
Setting : RBW:9kHz VBW:30KHz Detector Peak

	Freq	Read	LISN	Cable	Limit	Over	Remark
		MHz	dBuV	dBuV	dB	dB	
1	0.176	37.70	57.99	10.19	10.10	64.68	-6.69 QP
2	0.292	30.29	50.71	10.31	10.11	60.46	-9.75 QP
3	0.410	25.71	46.30	10.49	10.10	57.64	-11.34 QP
4	0.518	25.00	45.73	10.59	10.14	56.00	-10.27 QP
5	3.642	25.60	45.93	10.13	10.20	56.00	-10.07 QP
6	18.039	27.50	47.85	10.16	10.19	60.00	-12.15 QP
		Read	LISN	Cable	Limit	Over	
	Freq	Level	Level	Factor	Loss	Line	Limit
	MHz	dBuV	dBuV		dB	dBuV	dB
1	0.174	31.30	51.60	10.20	10.10	54.77	-3.17 Average
2	0.283	19.43	39.82	10.29	10.10	50.72	-10.90 Average
3	0.389	17.83	38.39	10.46	10.10	48.08	-9.69 Average
4	0.518	16.48	37.21	10.59	10.14	46.00	-8.79 Average
5	4.269	16.04	36.40	10.16	10.20	46.00	-9.60 Average
6	18.039	21.00	41.35	10.16	10.19	50.00	-8.65 Average

**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=N1\*L1+N2\*L2+...Nn-1\*Ln-1+Nn\*Ln,  
Where N1 is number of type 1 pulses, L1 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

<b>Temperature:</b>	22.5~24.6 °C
<b>Relative Humidity:</b>	27~50 %
<b>ATM Pressure:</b>	101.1~102.3 kPa

*The testing was performed by Carl Zhu on 2024-12-20 for below 1GHz and Dylan Yang on 2024-12-25 for above 1GHz.*

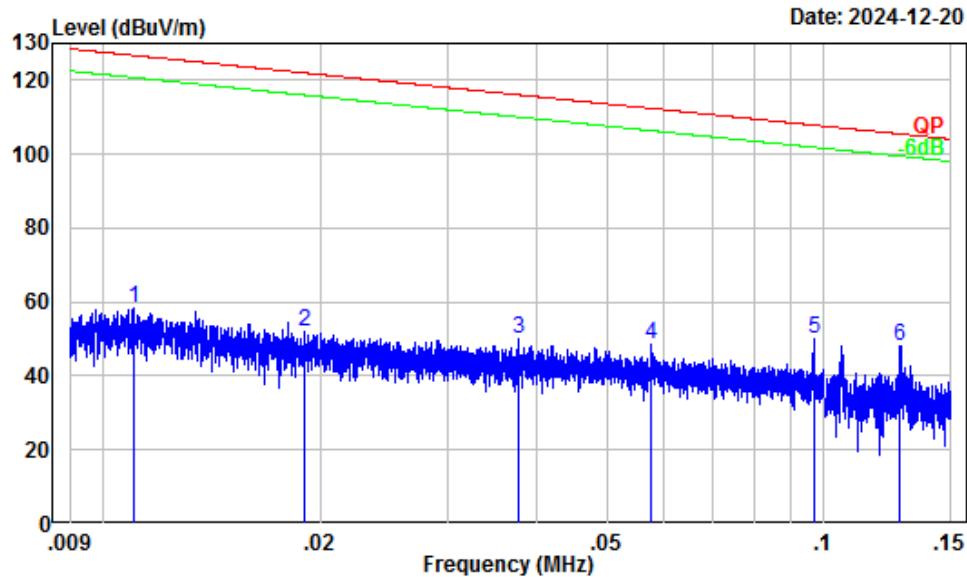
*Test mode: Transmitting*

*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:**

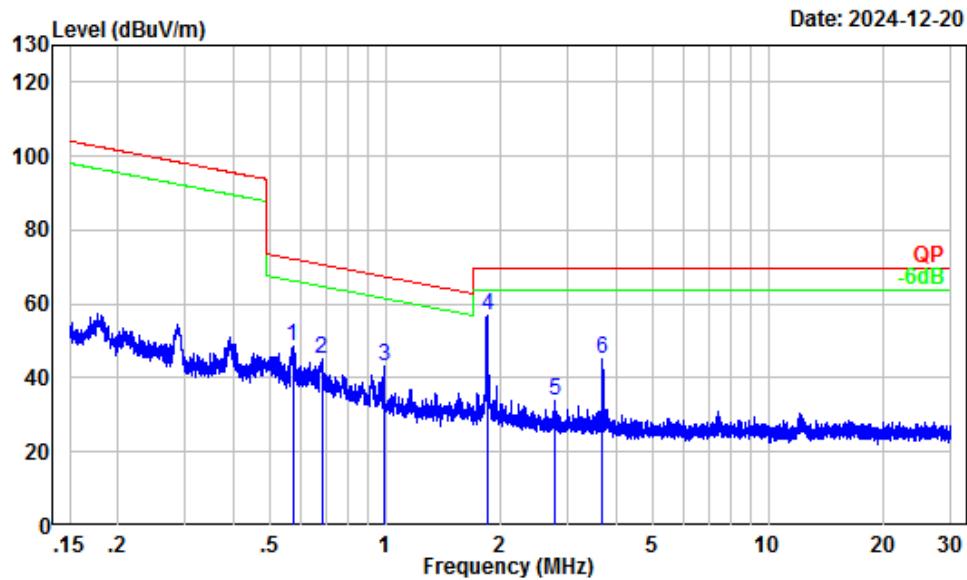
Note: When the test result of peak was less than the limit of QP/Average more than 6dB, just peak value were recorded.

Parallel (worst case) (Maximum output power mode, 917.0MHz)



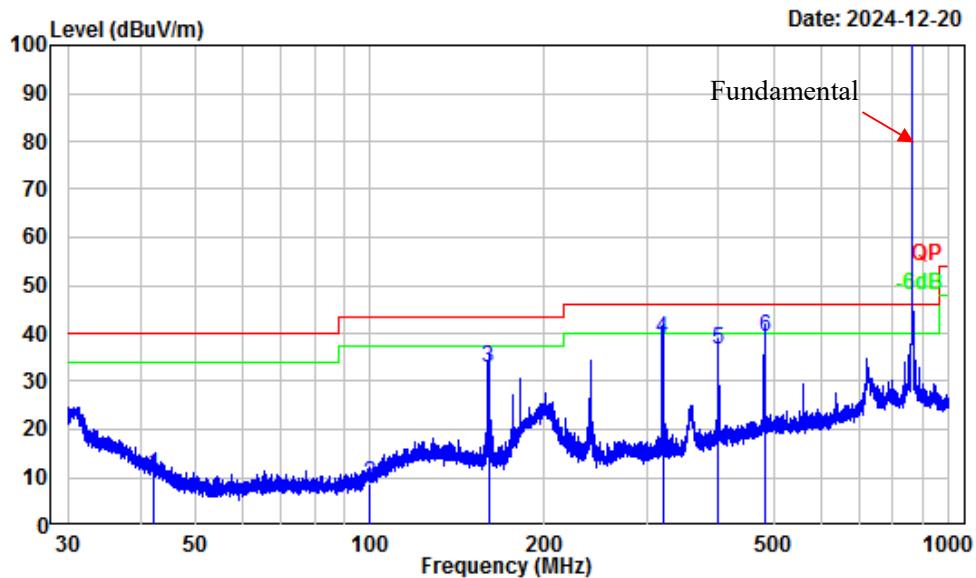
Site : Chamber A  
Condition : 3m  
Project Number : 2401Z64580E-RF  
Test Mode : Transmitting  
Detector Peak RBW: 0.3KHz VBW:1KHz  
Tester : Carl Zhu

Freq Factor	MHz	Read	Limit	Over	Remark
		Level	Level	Line	
1	0.01	32.10	26.09	58.19	-68.56 Peak
2	0.02	30.59	21.61	52.20	-69.83 Peak
3	0.04	27.68	22.31	49.99	-66.06 Peak
4	0.06	25.63	22.95	48.58	-63.80 Peak
5	0.10	22.22	27.74	49.96	-57.92 Peak
6	0.13	20.37	27.77	48.14	-57.34 Peak



Site : Chamber A  
Condition : 3m  
Project Number : 2401Z64580E-RF  
Test Mode : Transmiting  
Detector Peak RBW: 10KHz VBW:30KHz  
Tester : Carl Zhu

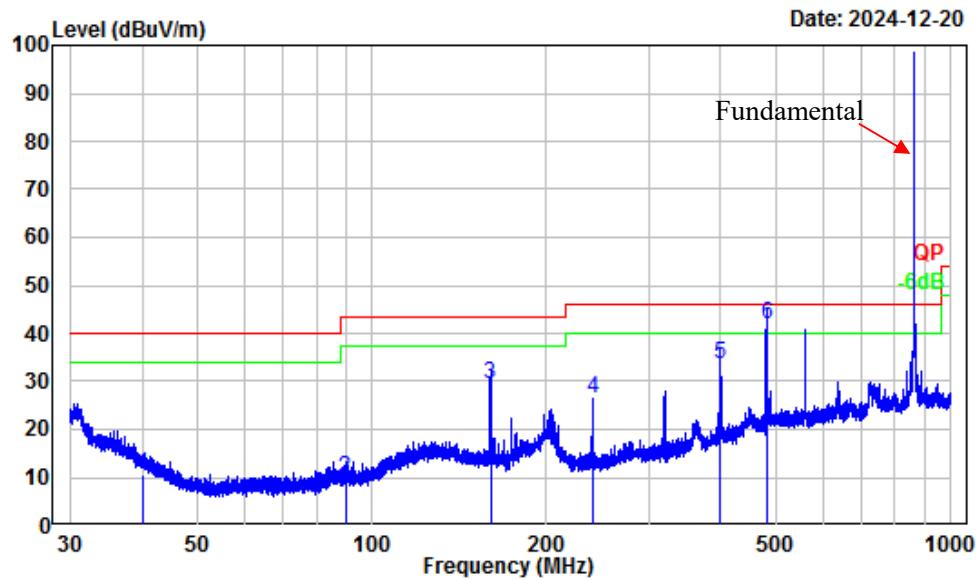
Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dBuV	dBuV/m	dBuV/m	
1	0.57	5.50	43.16	48.66	72.42	-23.76	Peak
2	0.68	4.15	40.77	44.92	70.87	-25.95	Peak
3	0.99	1.27	41.71	42.98	67.56	-24.58	Peak
4	1.84	-1.16	58.05	56.89	69.54	-12.65	Peak
5	2.76	-2.02	36.08	34.06	69.54	-35.48	Peak
6	3.68	-2.53	47.71	45.18	69.54	-24.36	Peak

**30MHz-1GHz:** (Maximum output power mode, 917.0MHz)**Horizontal**

Site : Chamber A  
Condition : 3m Horizontal  
Project Number : 2401Z64580E-RF  
Test Mode : Transmitting  
Detector QP RBW: 120KHz  
Tester : Carl Zhu

	Freq	Factor	Read Level	Limit Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dB <sub>uV</sub>	dB <sub>uV/m</sub>	dB <sub>uV/m</sub>	dB	
1	42.27	-14.06	24.78	10.72	40.00	-29.28	QP
2	99.66	-15.99	24.67	8.68	43.50	-34.82	QP
3	159.99	-12.72	45.58	32.86	43.50	-10.64	QP
4	320.08	-10.81	49.75	38.94	46.00	-7.06	QP
5	400.08	-8.41	45.11	36.70	46.00	-9.30	QP
6	480.11	-6.34	45.52	39.18	46.00	-6.82	QP

## Vertical



Site : Chamber A  
Condition : 3m Vertical  
Project Number : 2401Z64580E-RF  
Test Mode : Transmitting  
Detector QP RBW: 120KHz  
Tester : Carl Zhu

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dBuV	dBuV/m	Line	
1	40.24	-12.54	23.12	10.58	40.00	-29.42	QP
2	89.79	-17.99	27.76	9.77	43.50	-33.73	QP
3	159.99	-12.72	42.15	29.43	43.50	-14.07	QP
4	239.99	-13.32	39.71	26.39	46.00	-19.61	QP
5	400.08	-8.41	41.89	33.48	46.00	-12.52	QP
6	479.90	-6.34	48.31	41.97	46.00	-4.03	QP

**Above 1GHz:**

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
	Reading (dB $\mu$ V)	PK/AV					
Low Channel 917MHz							
2751.00	55.81	PK	H	-10.65	45.16	74.00	-28.84
2751.00	55.77	PK	V	-10.65	45.12	74.00	-28.88
3668.00	51.64	PK	H	-9.67	41.97	74.00	-32.03
3668.00	53.17	PK	V	-9.67	43.50	74.00	-30.50
Middle Channel 919.6MHz							
2758.80	55.79	PK	H	-10.64	45.15	74.00	-28.85
2758.80	55.26	PK	V	-10.64	44.62	74.00	-29.38
3678.40	51.18	PK	H	-9.62	41.56	74.00	-32.44
3678.40	52.35	PK	V	-9.62	42.73	74.00	-31.27
High Channel 922.2MHz							
2766.60	54.43	PK	H	-10.63	43.80	74.00	-30.20
2766.60	56.37	PK	V	-10.63	45.74	74.00	-28.26
3688.80	52.18	PK	H	-9.56	42.62	74.00	-31.38
3688.80	51.79	PK	V	-9.56	42.23	74.00	-31.77

**Note:**

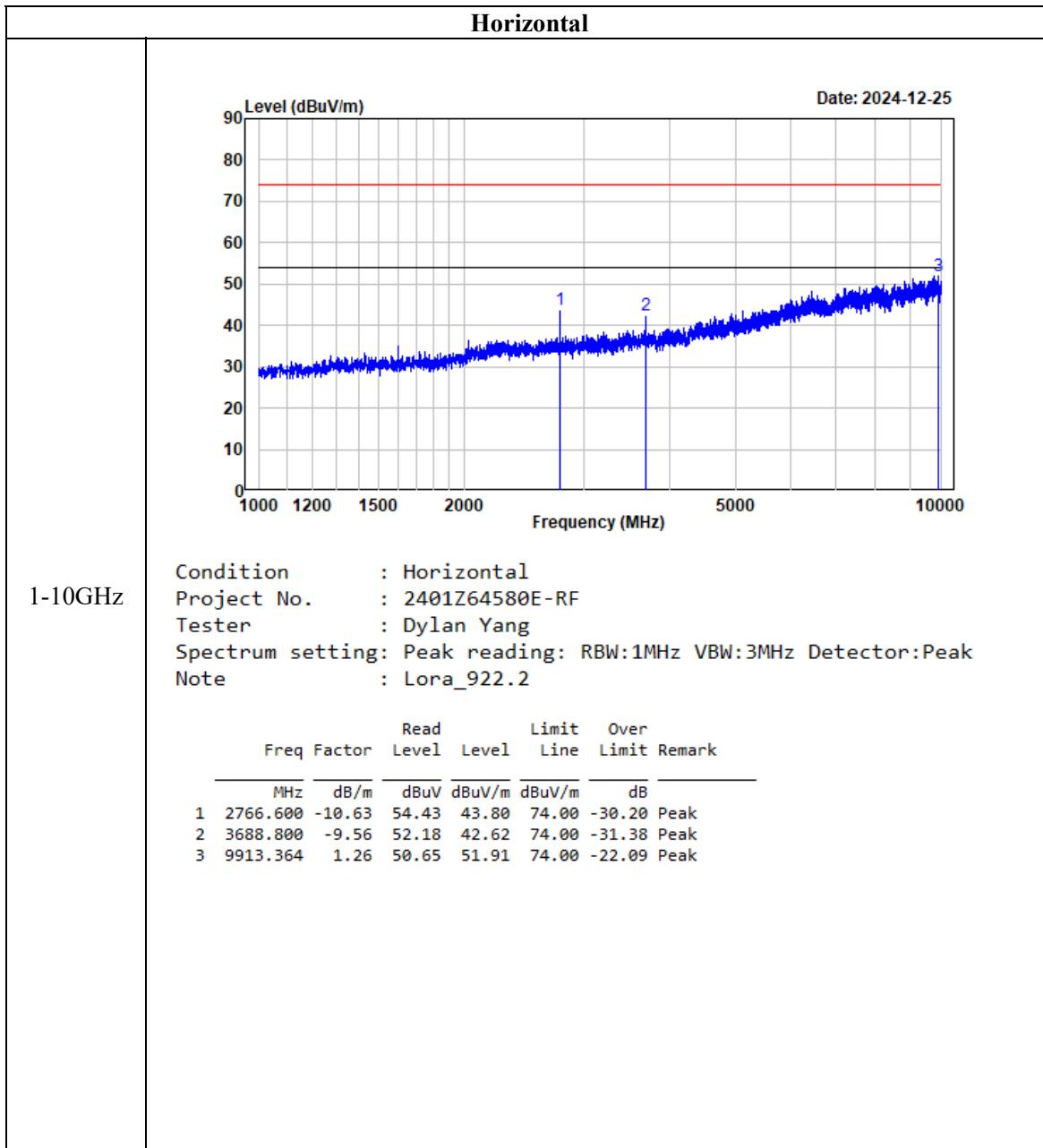
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

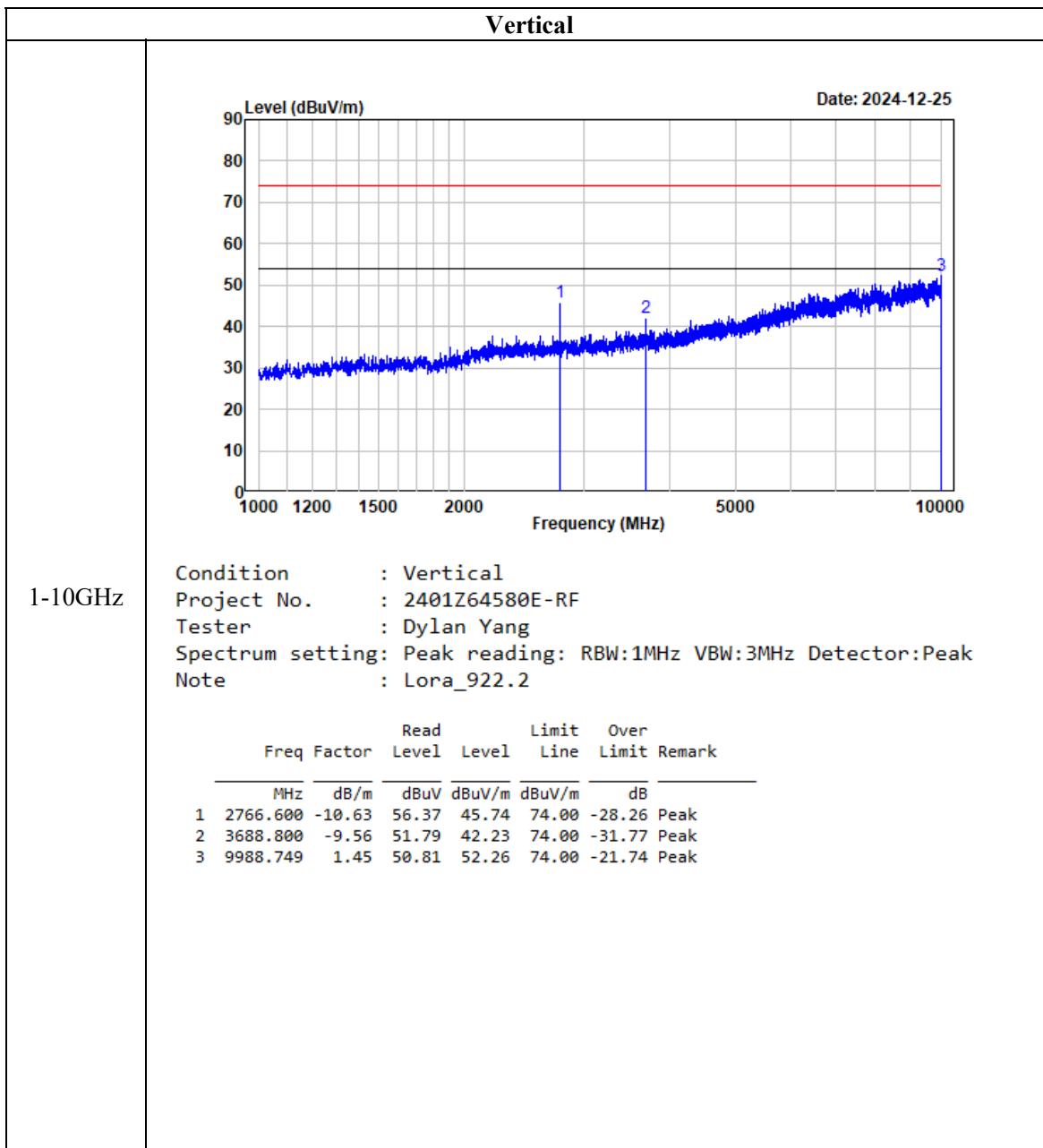
Corrected Amplitude = Factor + Reading

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.

**Listed with the worst harmonic margin test plot:**



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

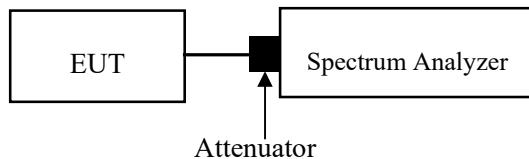
### Applicable Standard

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

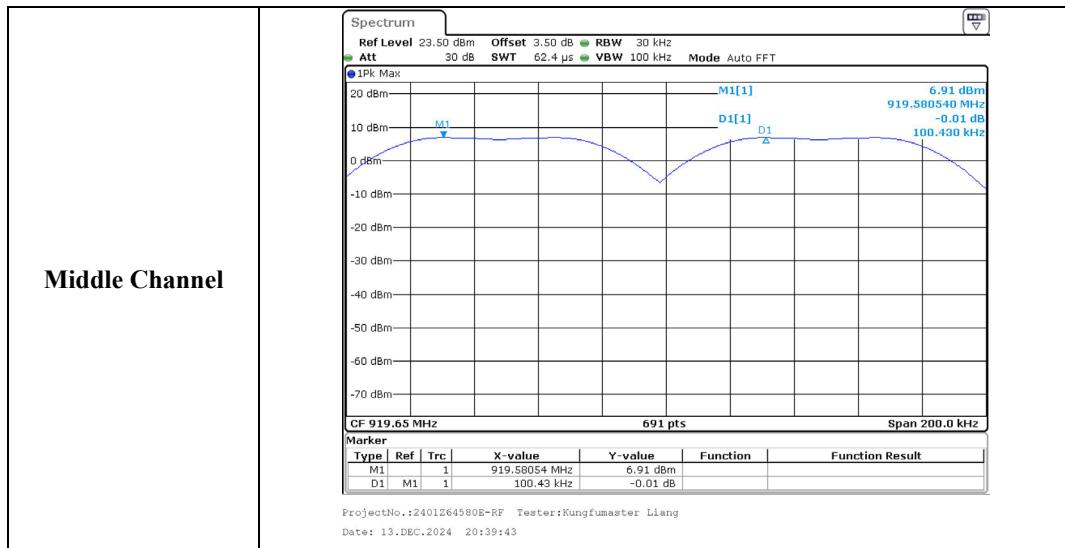
Temperature:	25.5~26.4 °C
Relative Humidity:	55%
ATM Pressure:	101 kPa

*The testing was performed by Kungfumaster Liang on 2024-12-13.*

*EUT operation mode: Transmitting*

**Test Result: Compliant.**

Test Channel	Test Frequency (MHz)	Channel Separation (MHz)	Limits (MHz)
Middle	919.6	0.1	0.069
Limit= MAX{25 kHz, BW <sub>20dB</sub> }			



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

### Applicable Standard

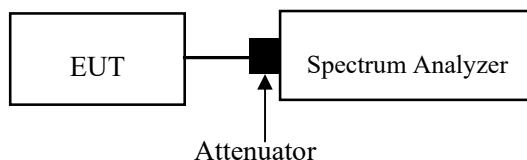
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period;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

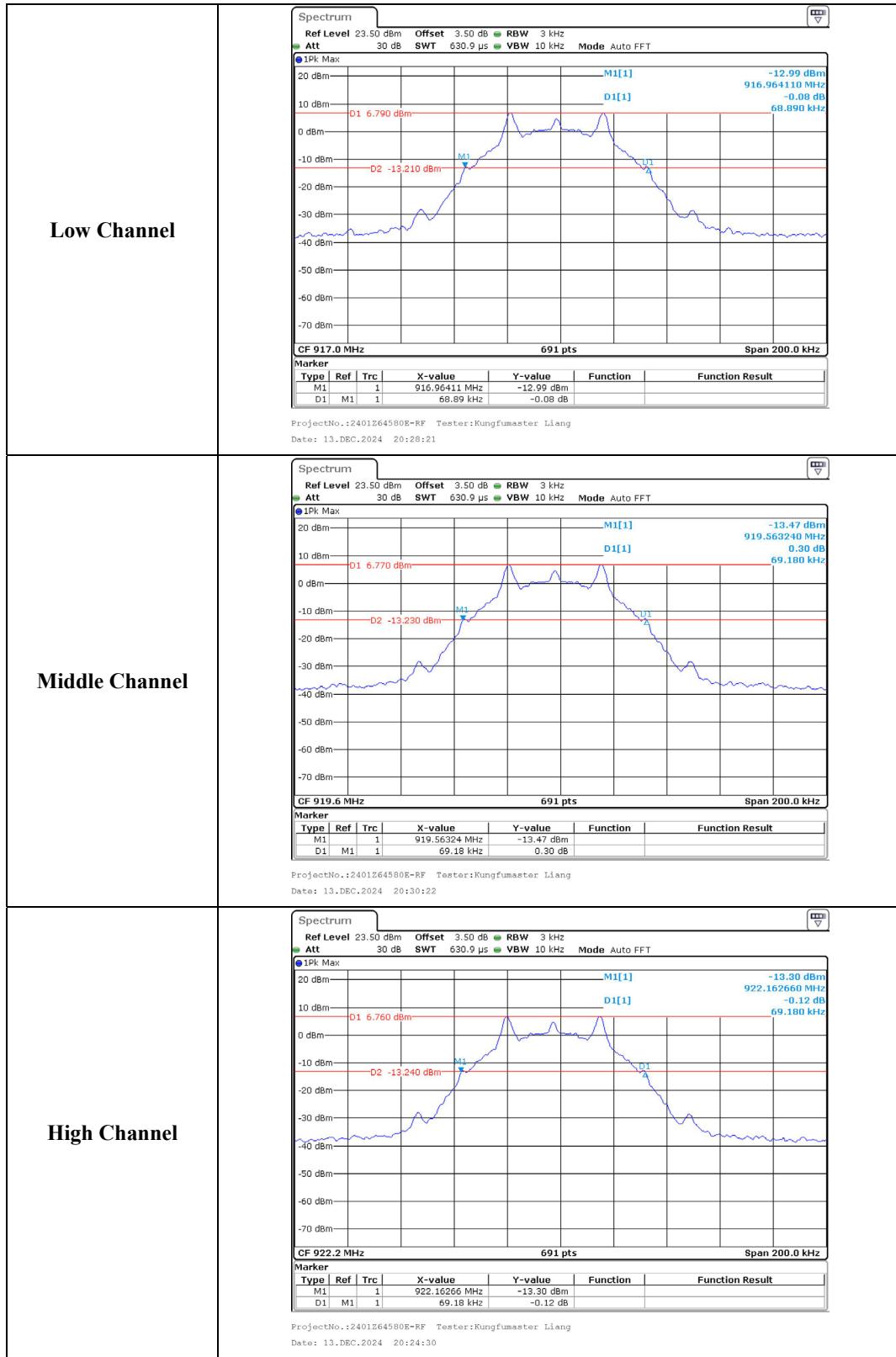
Temperature:	25.5~26.4 °C
Relative Humidity:	55%
ATM Pressure:	101 kPa

The testing was performed by Kungfumaster Liang on 2024-12-13.

EUT operation mode: Transmitting

**Test Result: Compliant.**

Test Channel	Test Frequency (MHz)	20 dB Bandwidth (MHz)	Limit (MHz)
Lowest	917	0.069	<0.25
Middle	919.6	0.069	<0.25
Highest	922.2	0.069	<0.25

**20 dB Bandwidth**

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

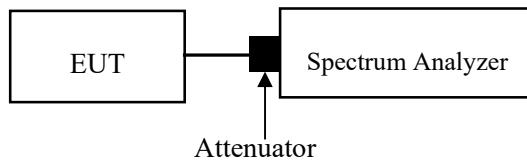
### **Applicable Standard**

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**

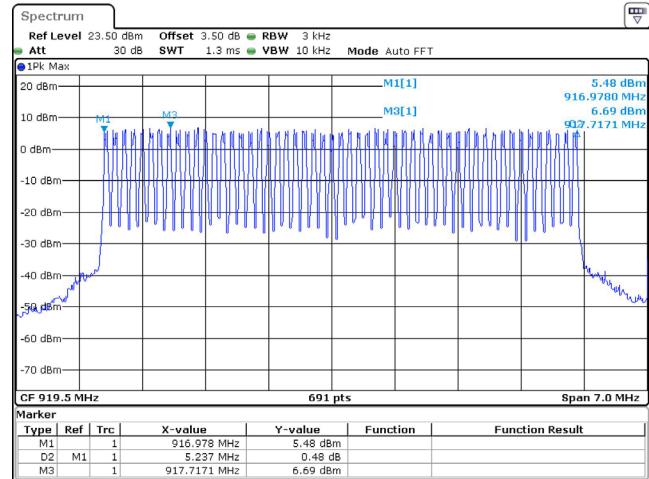
<b>Temperature:</b>	25.5~26.4 °C
<b>Relative Humidity:</b>	55%
<b>ATM Pressure:</b>	101 kPa

*The testing was performed by Kungfumaster Liang on 2024-12-13.*

*EUT operation mode: Transmitting*

**Test Result: Compliant.**

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

**Hopping Channel**

ProjectNo.:2401Z64580E-RF Tester:Kungfumaster Liang  
Date: 13.DEC.2024 20:48:52

## FCC §15.247(a) (1) (i) - TIME OF OCCUPANCY (DWELL TIME)

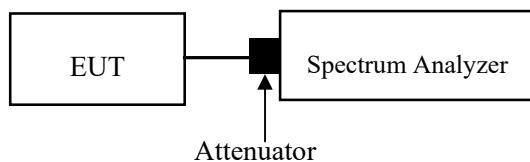
### Applicable Standard

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:	25.5~26.4 °C
Relative Humidity:	55%
ATM Pressure:	101 kPa

*The testing was performed by Kungfumaster Liang on 2024-12-13.*

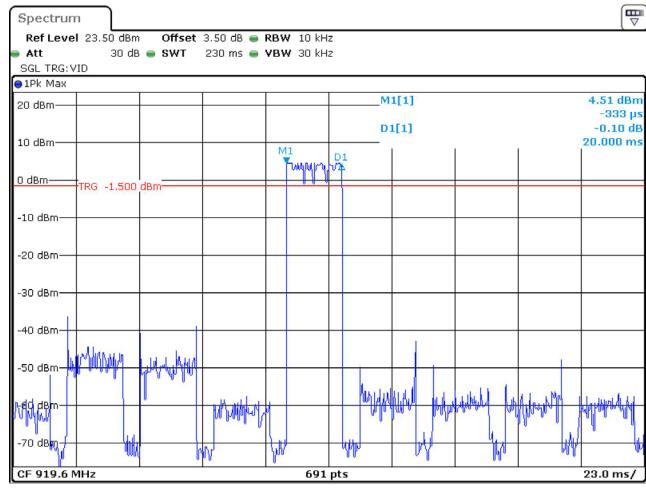
*EUT operation mode: Transmitting*

**Test Result: Compliant.**

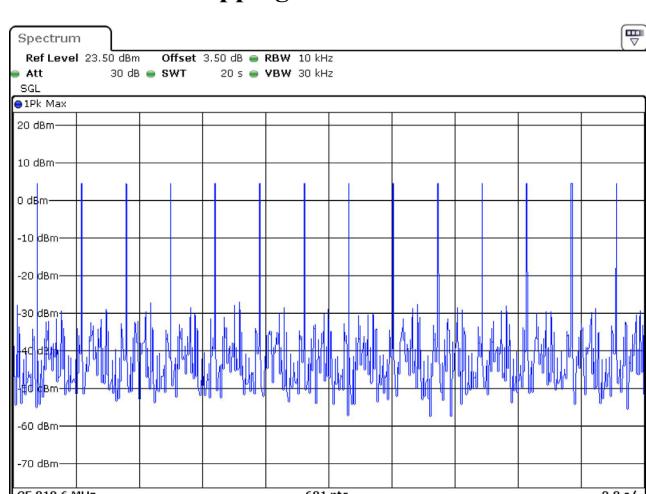
Test Frequency (MHz)	Pulse width (ms)	Observation time (s)	Hopping Numbers in Observation time	Dwell Time (s)	Limit (s)
919.6	20.000	20	15	0.300	0.400

Note: Observation time= 20s

### Pulse time



### Hopping Number in 20s



**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.

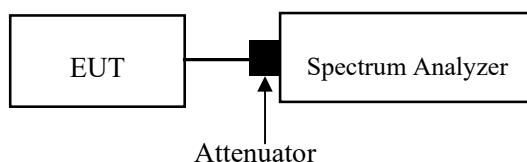
b) Allow trace to stabilize.

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**

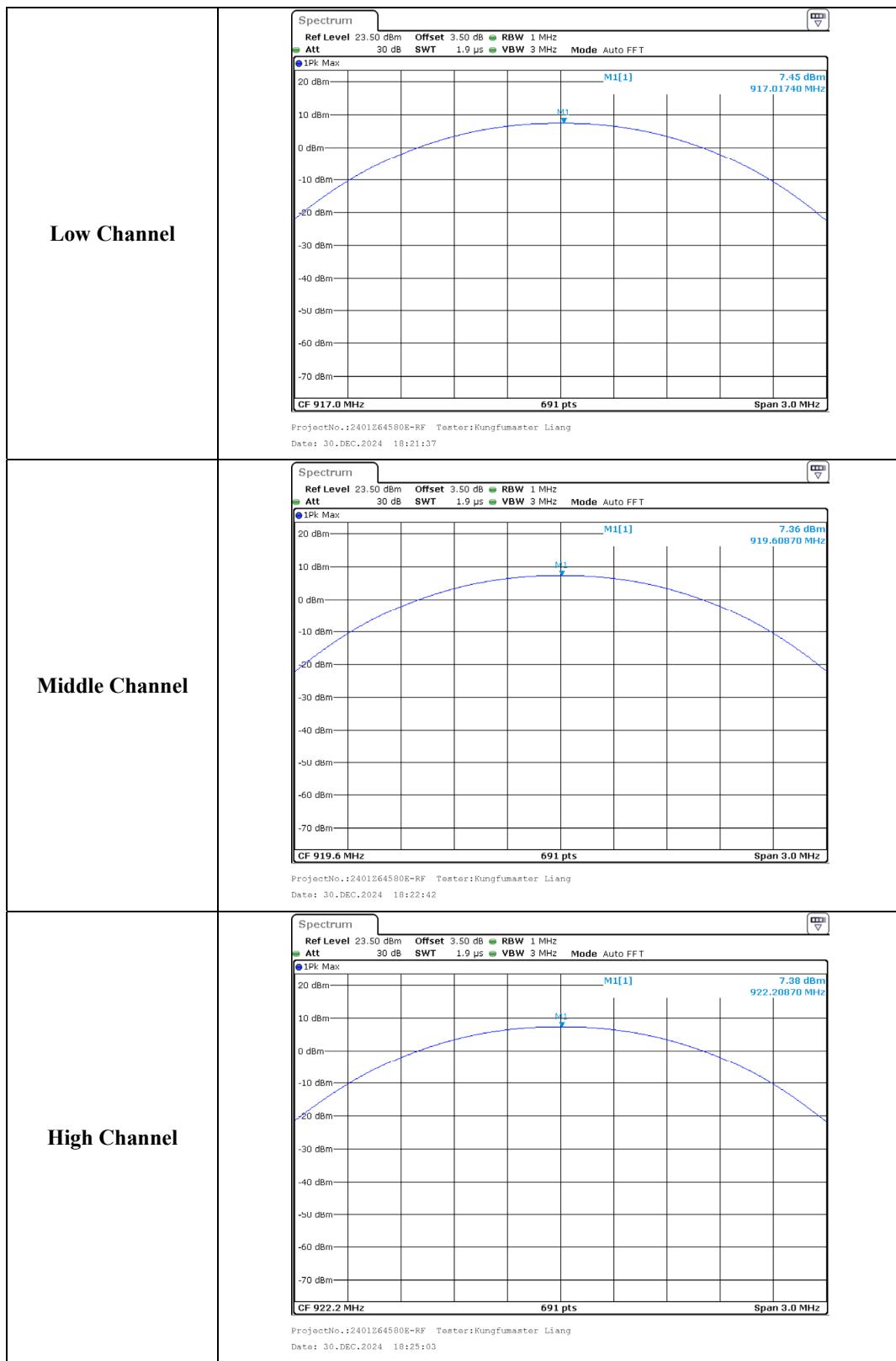
<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	55%
<b>ATM Pressure:</b>	101 kPa

*The testing was performed by Kungfumaster Liang on 2024-12-30.*

*EUT operation mode: Transmitting*

**Test Result: Compliant.**

Test Channel	Test Frequency (MHz)	Peak Conducted Output Power (dBm)	Limits (dBm)
Lowest	917.0	7.45	30
Middle	919.6	7.36	30
Highest	922.2	7.38	30



## 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)).

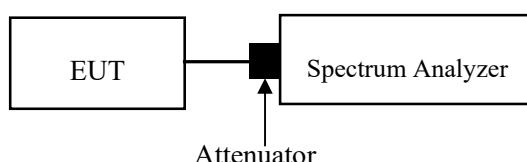
### Test Procedure

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

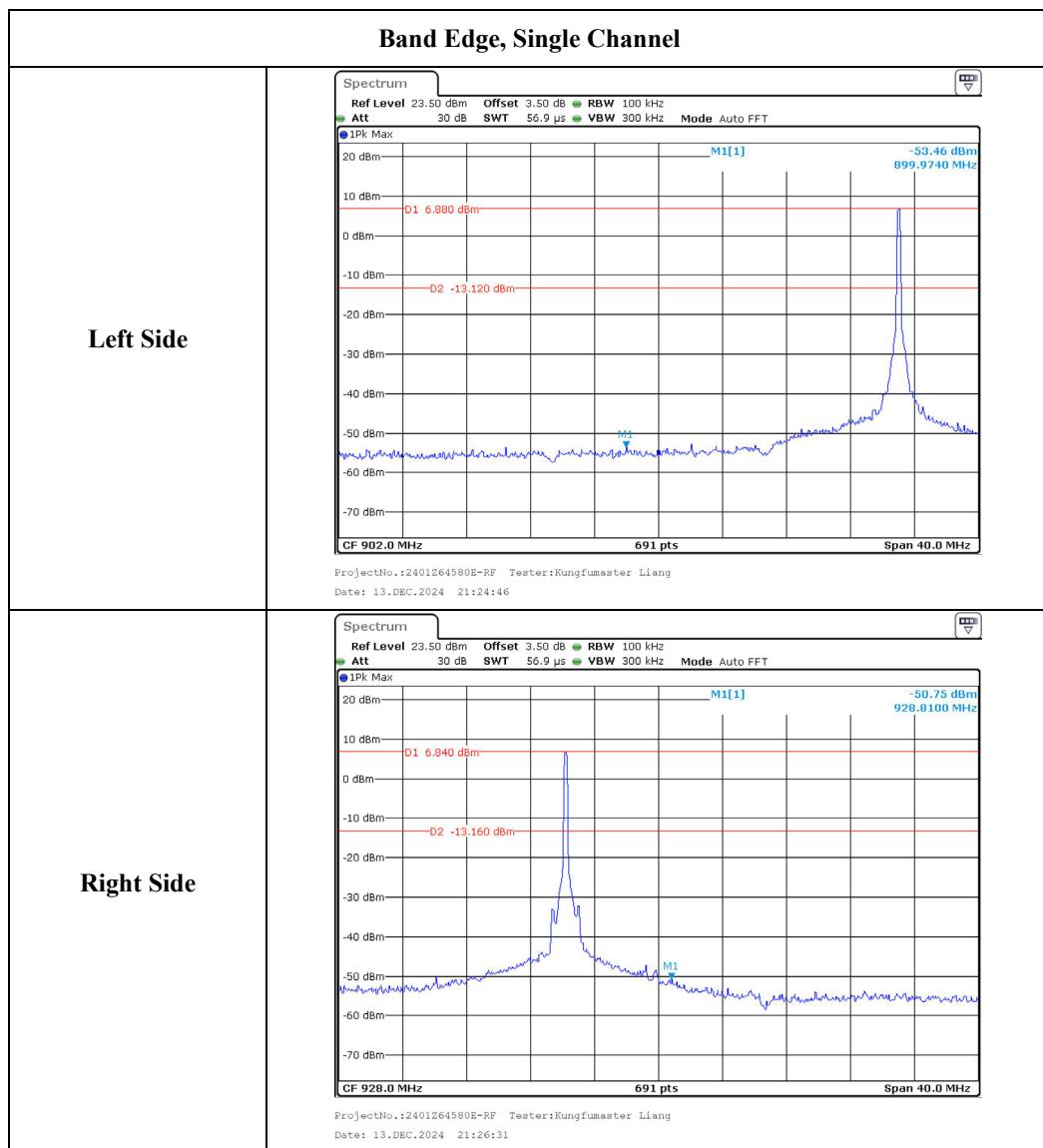
### Environmental Conditions

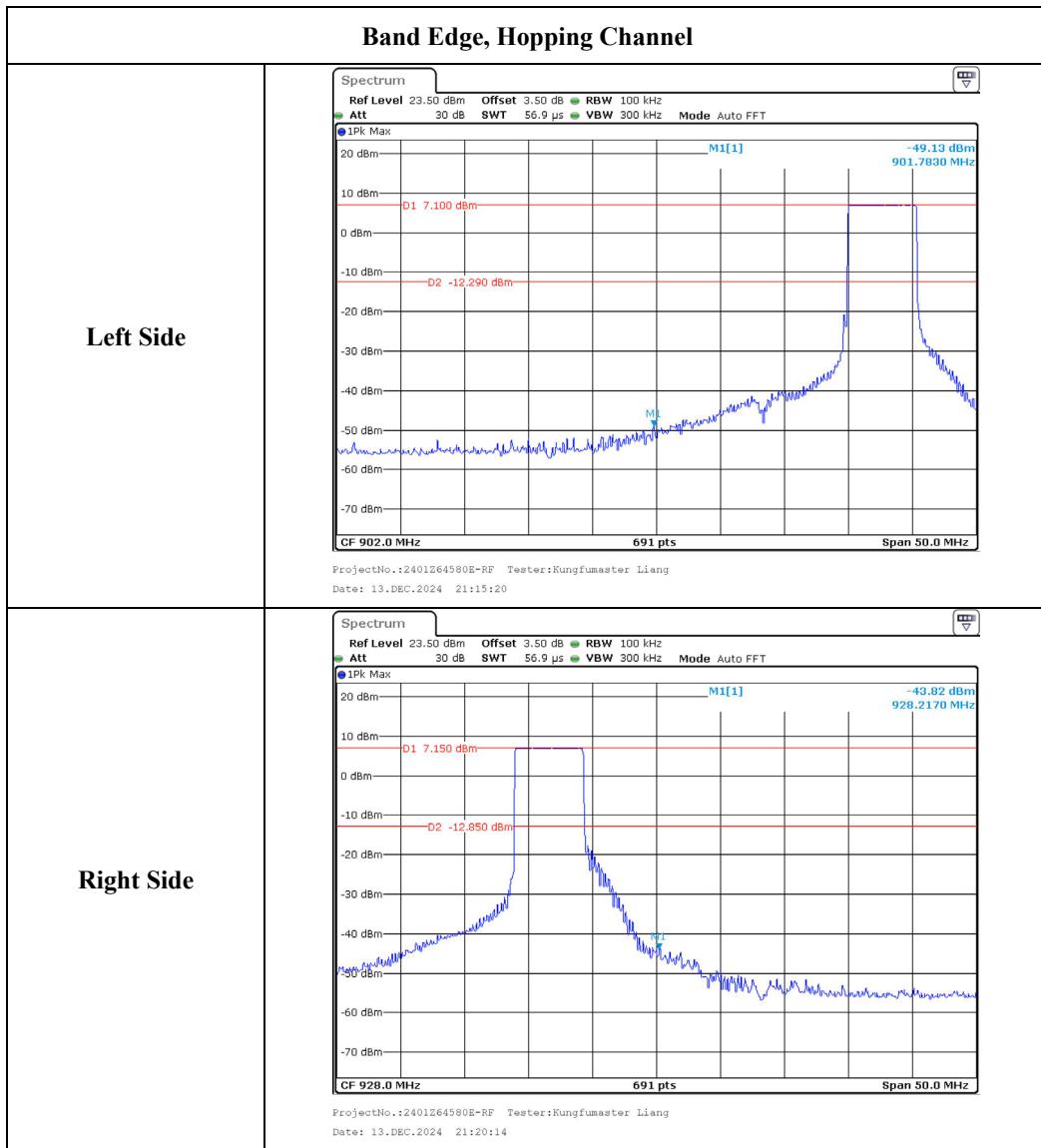
Temperature:	25.5~26.4 °C
Relative Humidity:	55%
ATM Pressure:	101 kPa

The testing was performed by Kungfumaster Liang on 2024-12-13.

EUT operation mode: Transmitting

**Test Result: Compliant.**





## **EUT PHOTOGRAPHS**

Please refer to the attachment 2401Z64580E-RF External photo and 2401Z64580E-RF Internal photo.

## **TEST SETUP PHOTOGRAPHS**

Please refer to the attachment 2401Z64580E-RFB Test Setup photo.

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