



Shenzhen CTL Testing Technology Co., Ltd.  
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# TEST REPORT

## FCC PART 15 SUBPART C 15.249

Report Reference No. .... : CTL2210113051-WF

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**Product Name** ..... : RTK Reference Station

**Model/Type reference** ..... : RTK0001

**List Model(s)** ..... : N/A

**Trade Mark** ..... : Mammotion

**FCC ID** ..... : 2A8QJ-RTK

**Applicant's name** ..... : Mammotion Technology Co., Limited

**Address of applicant** ..... : 98 CHEONG TAI COMM BLDG 66 WING LOK ST SHEUNG WAN HONG KONG

**Test Firm** ..... : Shenzhen CTL Testing Technology Co., Ltd.

**Address of Test Firm** ..... : Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055

**Test specification** ..... :

**Standard** ..... : FCC Part 15.249:Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz and 24.0 - 24.25 GHz.

**TRF Originator** ..... : Shenzhen CTL Testing Technology Co., Ltd.

**Master TRF** ..... : Dated 2011-01

**Date of receipt of test item** ..... : Oct. 10, 2022

**Date of sampling** ..... : Oct. 10, 2022

**Date of Test Date** ..... : Oct. 10, 2022–Nov. 28, 2022

**Date of Issue** ..... : Nov. 28, 2022

**Result** ..... : Pass

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# TEST REPORT

<b>Test Report No. :</b>	<b>CTL2210113051-WF</b>	Nov. 28, 2022
		Date of issue

Equipment under Test : RTK Reference Station

Sample No. CTL221011305-1-S001

Model /Type : RTK0001

Listed Models : N/A

**Applicant** : **Mammotion Technology Co., Limited**

Address : 98 CHEONG TAI COMM BLDG 66 WING LOK ST  
SHEUNG WAN HONG KONG

**Manufacturer** : **Mammotion Technology Co., Limited**

Address : 98 CHEONG TAI COMM BLDG 66 WING LOK ST  
SHEUNG WAN HONG KONG

<b>Test result</b>	<b>Pass *</b>
--------------------	---------------

\* In the configuration tested, the EUT complied with the standards specified page 5.

The test results presented in this report relate only to the object tested.

This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.

## \*\* Modified History \*\*

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## 1. SUMMARY

### 1.1. TEST STANDARDS

The tests were performed according to following standards:

**FCC Rules Part 15.249:** Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 -24.25 GHz.

**ANSI C63.10:2013:** American National Standard for Testing Unlicensed Wireless Devices.

### 1.2. Test Description

<b>FCC PART 15.249</b>		
FCC Part 15.249(a)	Field Strength of Fundamental	PASS
FCC Part 15.209	Spurious Emission	PASS
FCC Part 15.215(c)	20dB bandwidth	PASS
FCC Part 15.207	Conducted Emission	PASS
FCC Part 15.203	Antenna Requirement	PASS

## 1.3. Test Facility

### 1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.

Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.10 and CISPR 32/EN 55032 requirements.

### 1.3.2 Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

#### CNAS-Lab Code: L7497

Shenzhen CTL Testing Technology Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

#### A2LA-Lab Cert. No. 4343.01

Shenzhen CTL Testing Technology Co., Ltd, EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

#### IC Registration No.: 9618B

#### CAB identifier: CN0041

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements with Registration No.: 9618B on Jan. 22, 2019.

#### FCC-Registration No.: 399832

#### Designation No.: CN1216

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 399832, December 08, 2017.

## 1.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements" and is documented in the Shenzhen CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CTL laboratory is reported:

Test	Measurement Uncertainty	Notes
Transmitter power conducted	±0.57 dB	(1)
Transmitter power Radiated	±2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	±2.20 dB	(1)
Occupied Bandwidth	±0.01ppm	(1)

Radiated Emission 30~1000MHz	$\pm 4.10$ dB	(1)
Radiated Emission Above 1GHz	$\pm 4.32$ dB	(1)
Conducted Disturbance 0.15~30MHz	$\pm 3.20$ dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

## 2. GENERAL INFORMATION

### 2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

### 2.2. General Description of EUT

Product Name:	RTK Reference Station
Model/Type reference:	RTK0001
Power supply:	Input: 100-240V~50/60Hz
Hardware version:	V07
Software version:	1.2.1.215
<b>SRD:</b>	
Operation frequency:	902.125MHz-927.125MHz
Modulation:	FM
Channel number:	26
Channel separation:	1MHz
Antenna type:	Rob Antenna
Antenna gain:	3.5dBi

Note1: For more details, please refer to the user's manual of the EUT.

### 2.3. Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing.

#### Operation Frequency

Channel	Frequency (MHz)
00	902.125
01	903.125
:	:
12	914.125
13	915.125
14	916.125
:	:
24	926.125
25	927.125

### 2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.12	2022/05/06	2023/05/05
LISN	R&S	ESH2-Z5	860014/010	2022/05/06	2023/05/05
Double Cone logarithmic antenna	Schwarzbeck	VULB 9168	824	2020/04/07	2023/04/06

Active Loop Antenna	Da Ze	ZN30900A	/	2021/05/13	2024/05/12
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2021/12/23	2024/12/22
Horn Antenna	Ocean Microwave	OBH100400	26999002	2019/11/28	2022/11/27
EMI Test Receiver	R&S	ESCI	1166.5950.03	2022/05/06	2023/05/05
Spectrum Analyzer	Agilent	N9020	US46220290	2022/05/07	2023/05/06
Spectrum Analyzer	RS	FSP	1164.4391.38	2022/05/07	2023/05/06
Controller	EM Electronics	EM 1000	060859	2022/05/20	2023/05/19
Amplifier	Agilent	8449B	3008A02306	2022/05/07	2023/05/06
Amplifier	Agilent	8447D	2944A10176	2022/05/06	2023/05/05
Amplifier	Brief&Smart	LNA-4018	2104197	2022/05/07	2023/05/06
Temperature/Humidity Meter	Ji Yu	MC501	/	2022/05/07	2023/05/06
Power Sensor	Agilent	U2021XA	MY55130004	2022/05/07	2023/05/06
Power Sensor	Agilent	U2021XA	MY55130006	2022/05/07	2023/05/06
Power Sensor	Agilent	U2021XA	MY54510008	2022/05/07	2023/05/06
Power Sensor	Agilent	U2021XA	MY55060003	2022/05/07	2023/05/06
High-Pass Filter	micro-tranics	HPM50108	G174	2022/05/07	2023/05/06
High-Pass Filter	micro-tranics	HPM50111	G142	2022/05/07	2023/05/06
Coaxial Cables	HUBER+SUHNE R	SUCOFLEX 104PEA-10M	10m	2022/05/07	2023/05/06
Coaxial Cables	HUBER+SUHNE R	SUCOFLEX 104PEA-3M	3m	2022/05/07	2023/05/06
Coaxial Cables	HUBER+SUHNE R	SUCOFLEX 104PEA-3M	3m	2022/05/07	2023/05/06
RF Cable	Megalon	RF-A303	N/A	2022/05/07	2023/05/06
RF Control Unit	Tonsecnd	JS0806-2	20J8060323	2022/05/07	2023/05/06
Test Software	Tonsecnd	JS1120-3	2.6.880341	N/A	N/A
Test software	EZ	EZ_EMU	1.1.4.2	N/A	N/A

The calibration interval was one year

## 2.5. Special Accessories

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

Description	Manufacturer	Model	Technical Parameters	Certificate	Provided by
AC-DC Adapter	Mammotion	GQ24-120200-E3	Input:AC100-240V-50/60Hz,1.0A Output:DC 12V,2.0A	FCC SDOC	Laboratory
/	/	/	/	/	/
/	/	/	/	/	/
/	/	/	/	/	/

## 2.6. Related Submittal(s) / Grant(s)

This submittal(s) (test report) is intended to comply with Section 15.249 of the FCC Part 15, Subpart C Rules.

## 2.7. Modifications

No modifications were implemented to meet testing criteria.

### 3. TEST CONDITIONS AND RESULTS

#### 3.1. Conducted Emissions Test

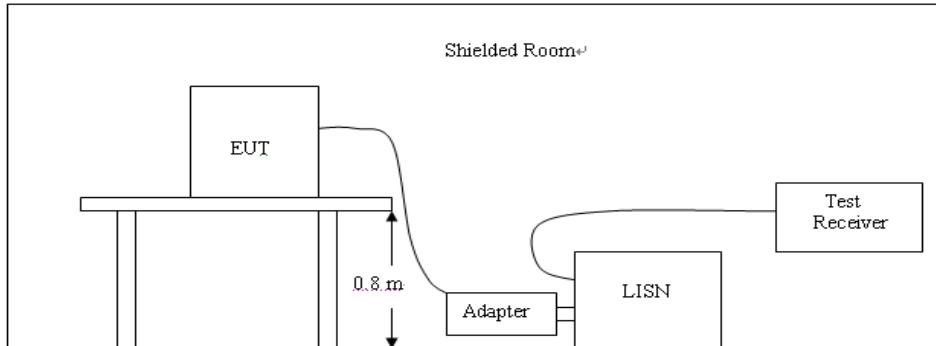
##### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency.

##### TEST CONFIGURATION

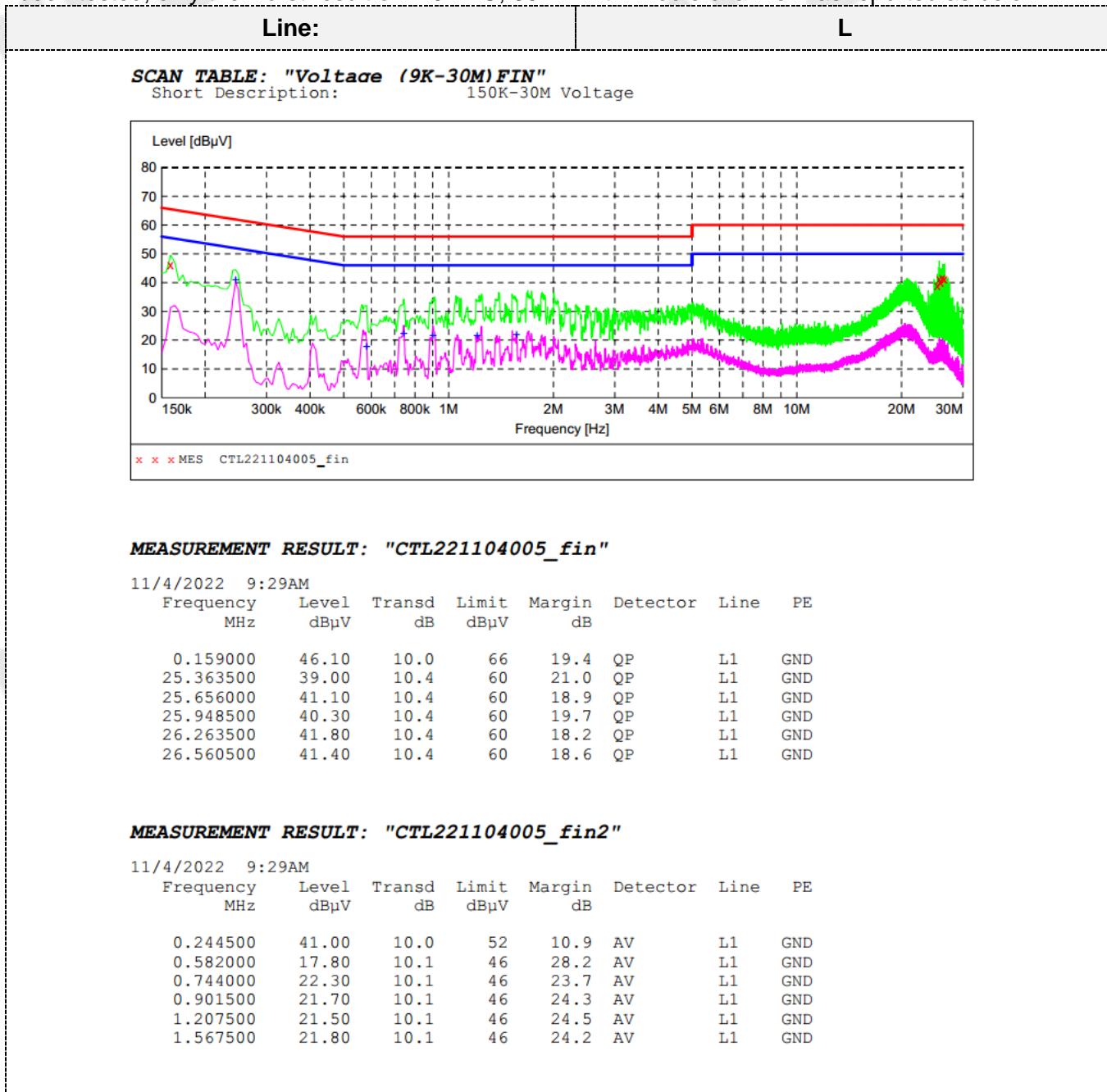


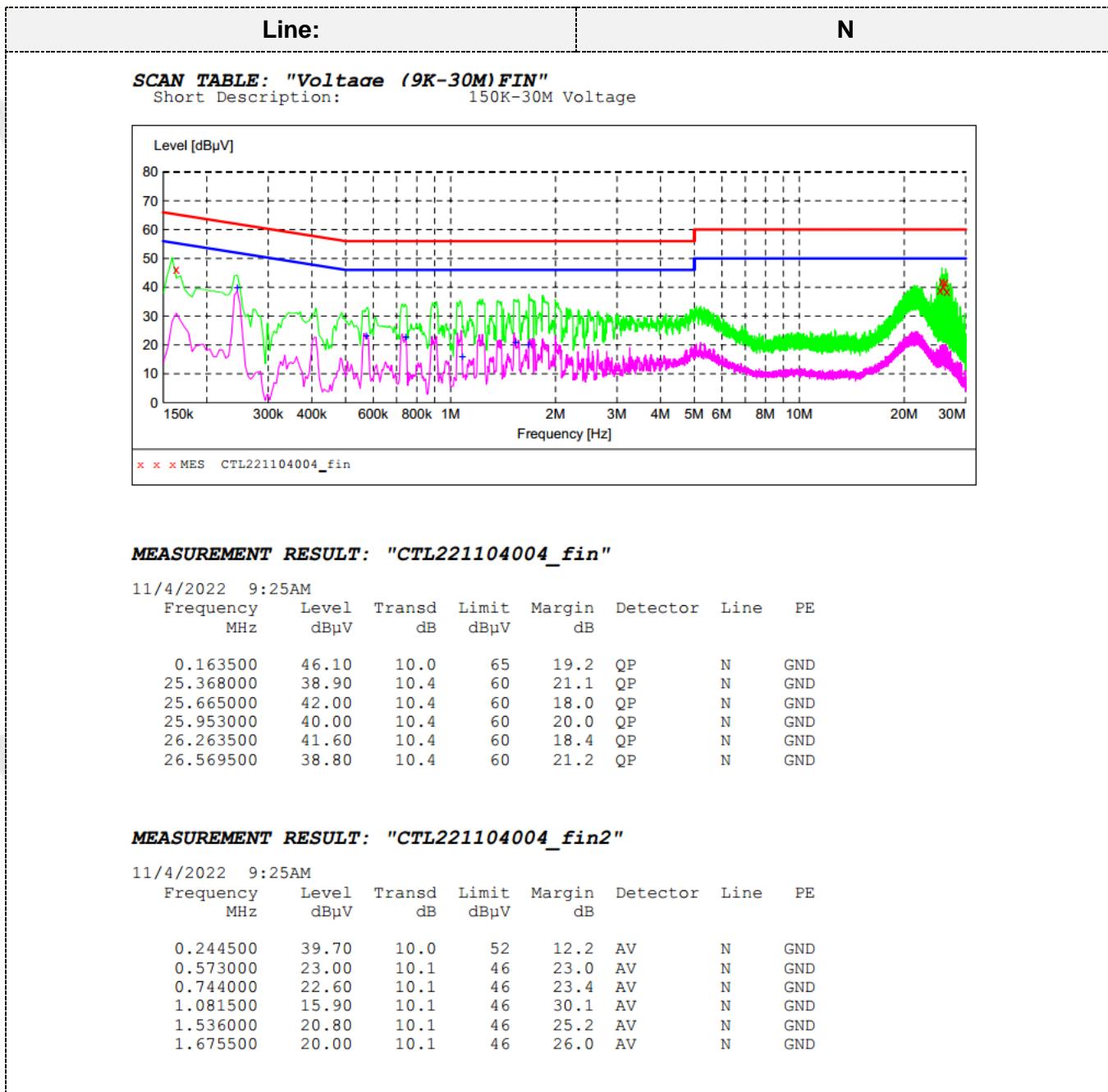
##### TEST PROCEDURE

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

## TEST RESULTS

Remark: Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply(charge from adapter)have been tested, only the worst result of 120 VAC, 60 Hz with middle channel was reported as below:





Remark: Level(dB $\mu$ V)=Reading(dB $\mu$ V) + Factor(dB)

Margin=Limit(dB $\mu$ V/m)-Level(dB $\mu$ V/m)

### 3.2. Radiated Emissions

#### Limit

According 15.249, the field strength of emissions from intentional radiators operated within 902-928 MHz shall not exceed 94dB $\mu$ V/m (50mV/m):

FCC PART 15.249(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

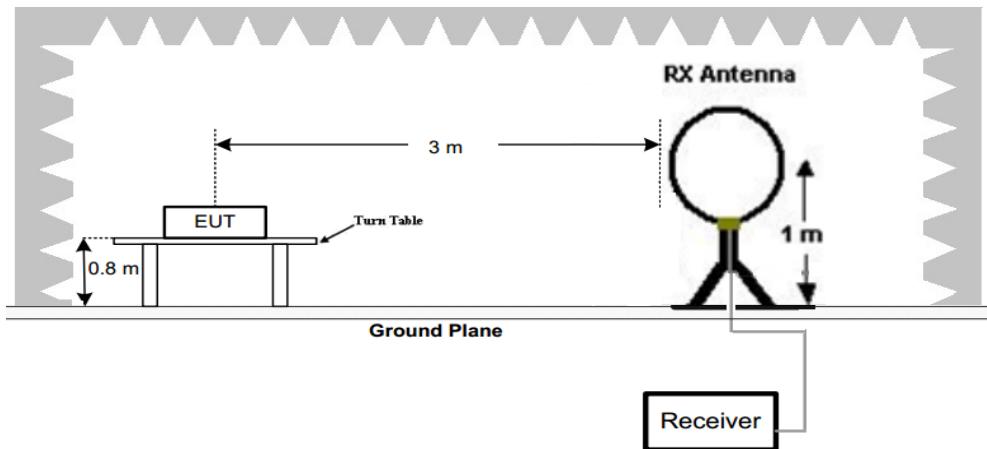
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Radiated emission limits

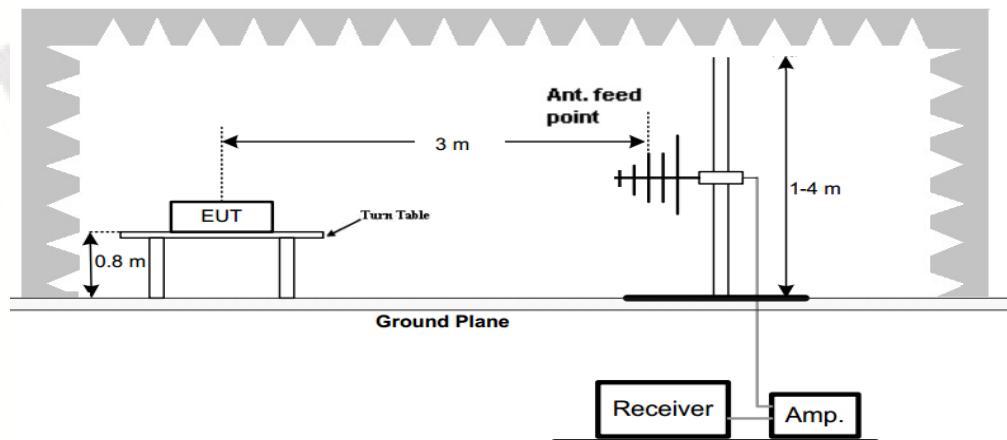
Frequency (MHz)	Distance (Meters)	Radiated (dB $\mu$ V/m)	Radiated ( $\mu$ V/m)
0.009-0.49	3	$20\log(2400/F(\text{KHz}))+40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz}))+40\log(30/3)$	$24000/F(\text{KHz})$
1.705-30	3	$20\log(30)+40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

#### TEST CONFIGURATION

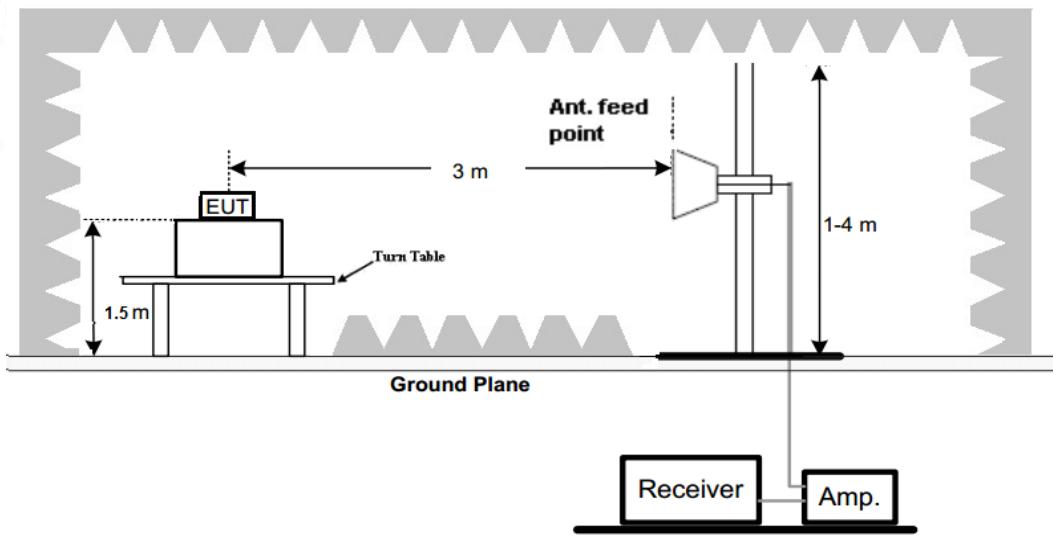
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



## (C) Radiated Emission Test Set-Up, Frequency above 1000MHz

**Test Procedure**

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 10GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Bilog Antenna	3
1GHz-18GHz	Horn Antenna	3
18GHz-40GHz	Horn Antenna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

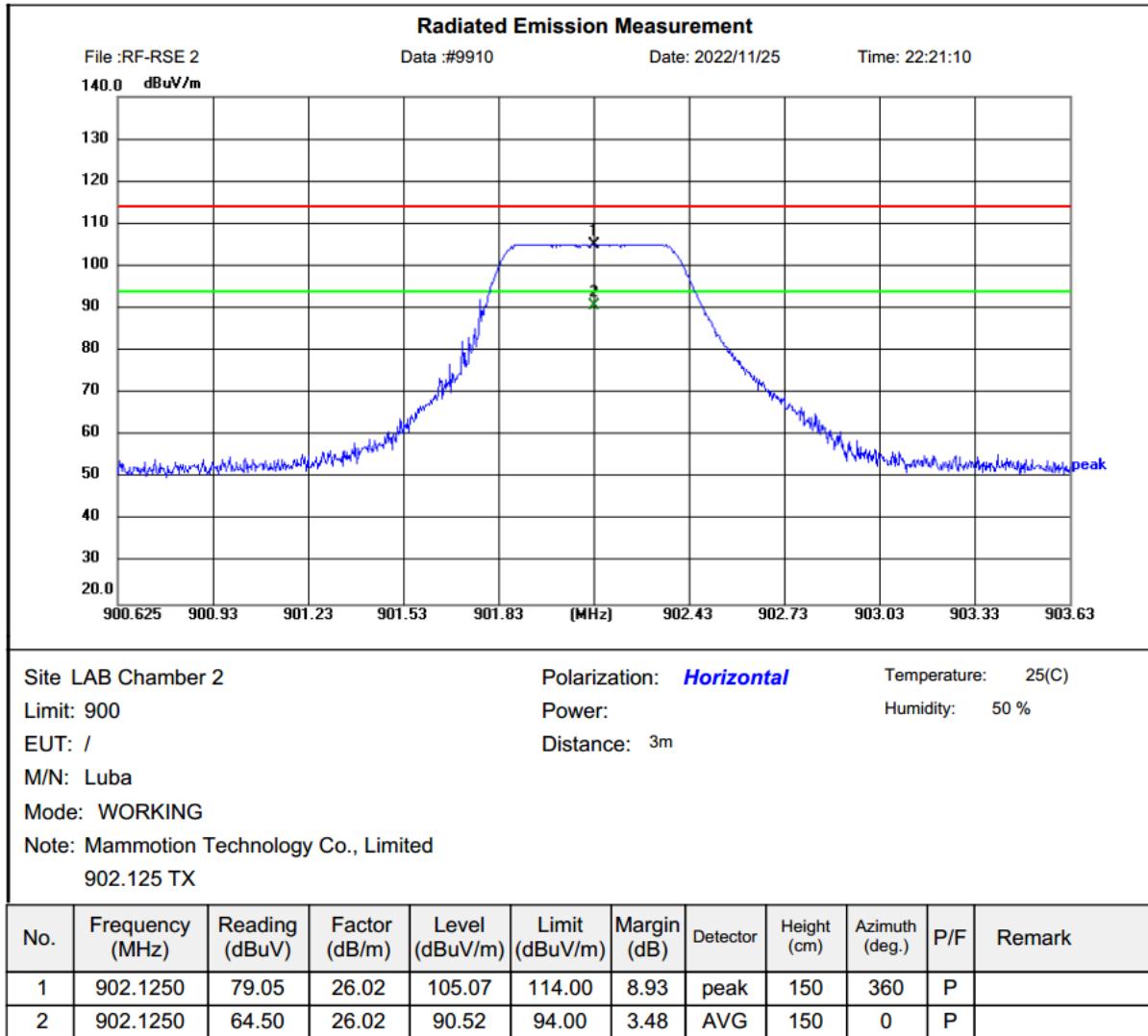
## TEST RESULTS

## Field Strength of Fundamental:

Remark: This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

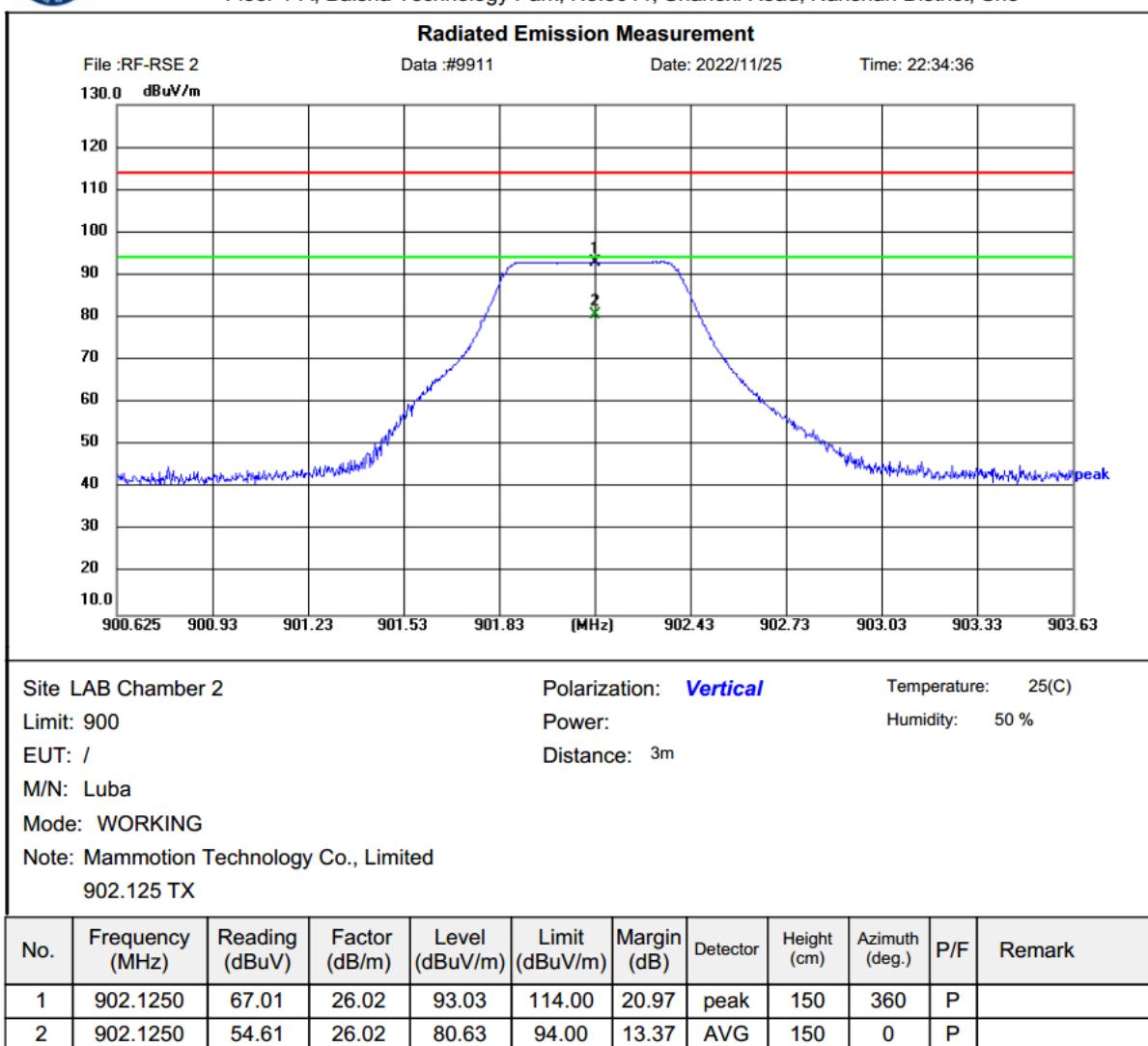


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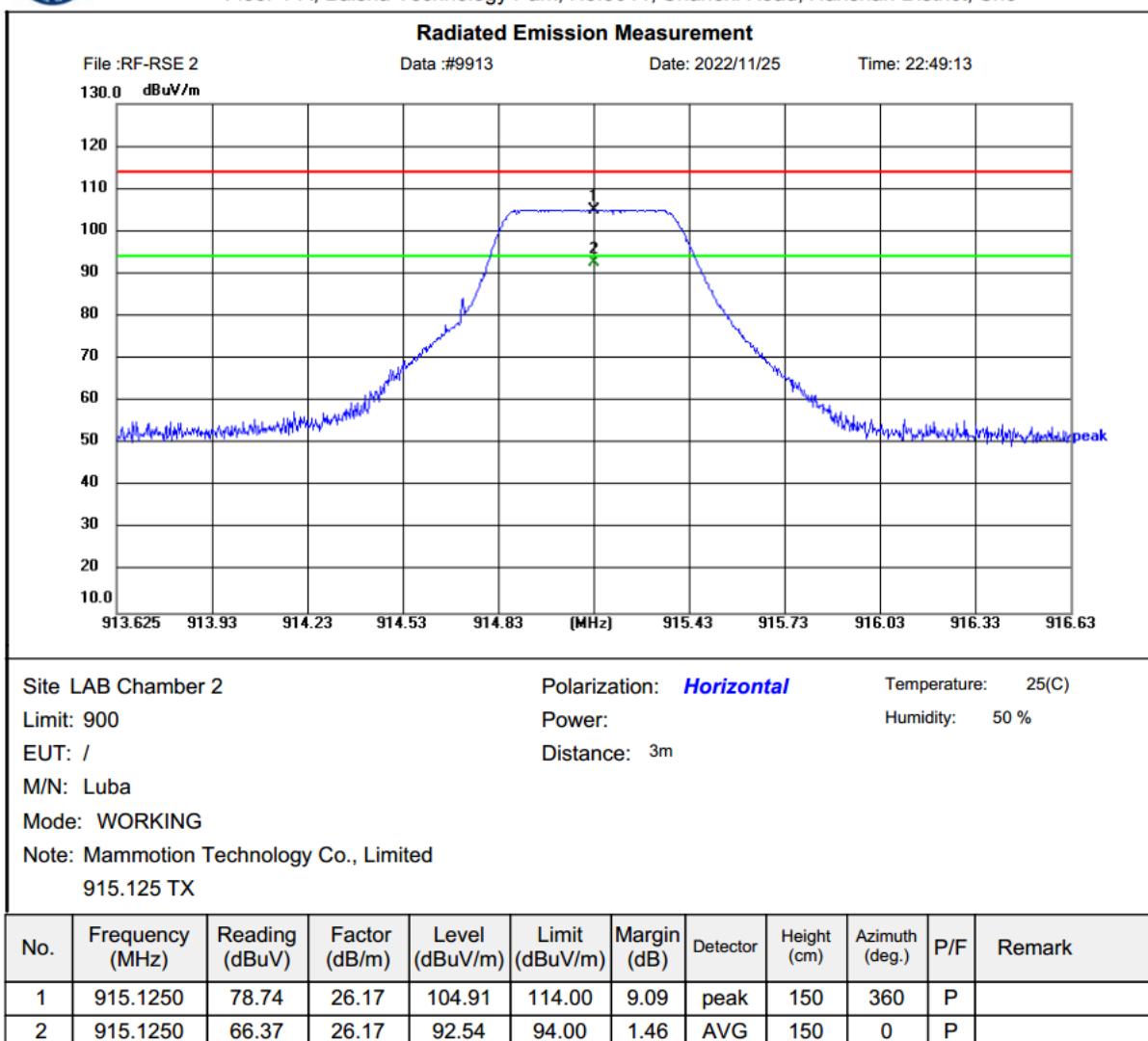


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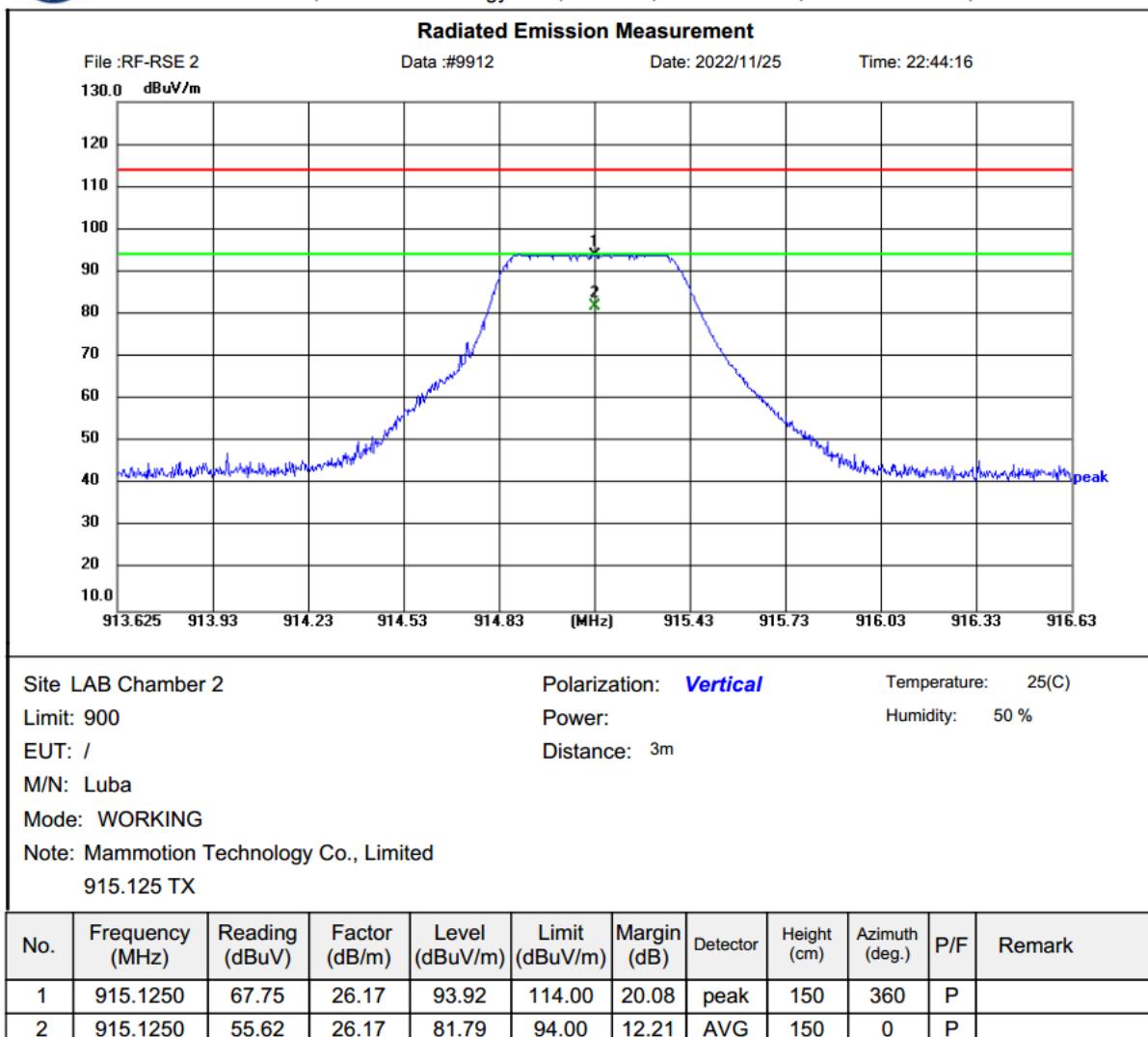


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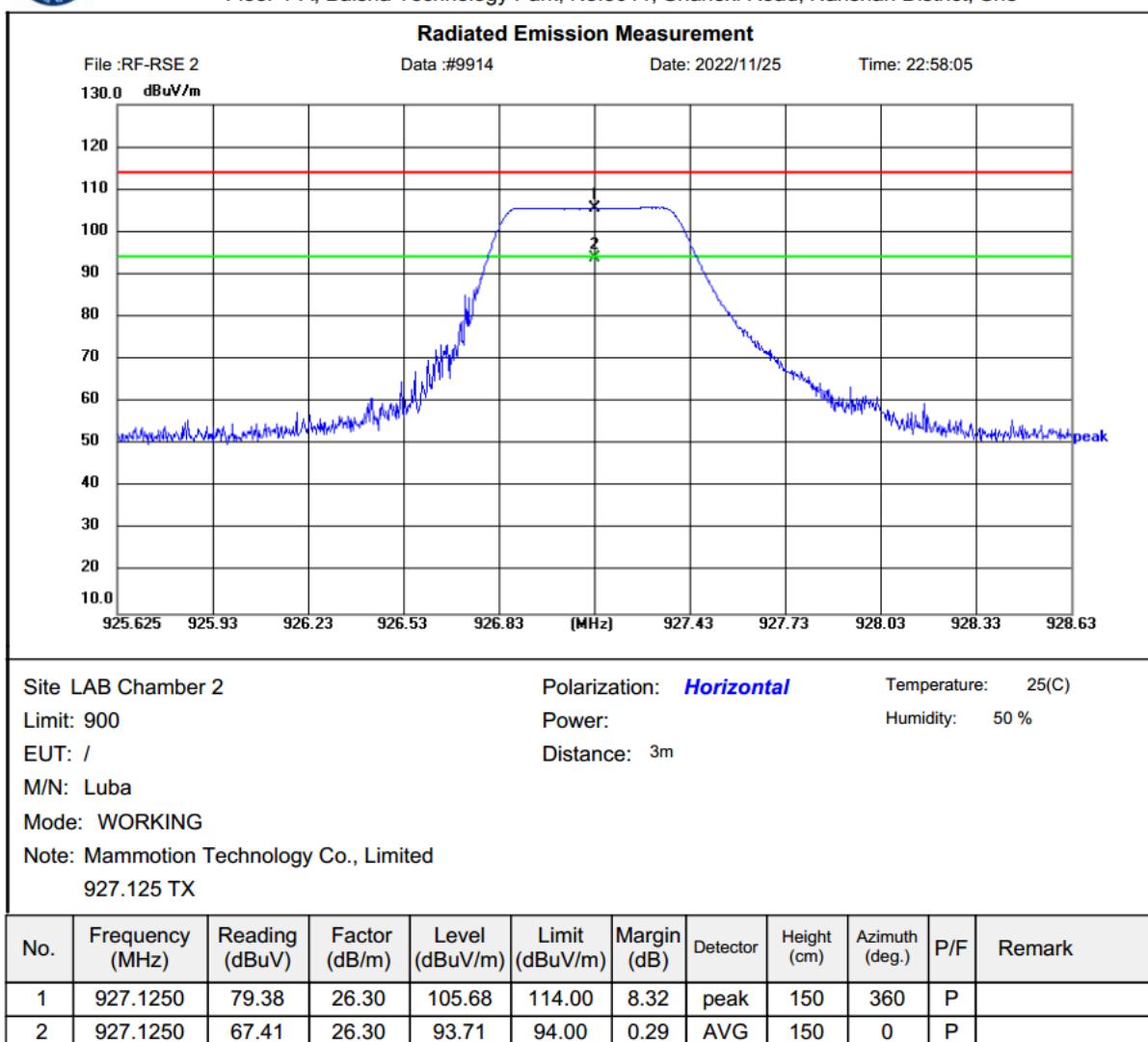


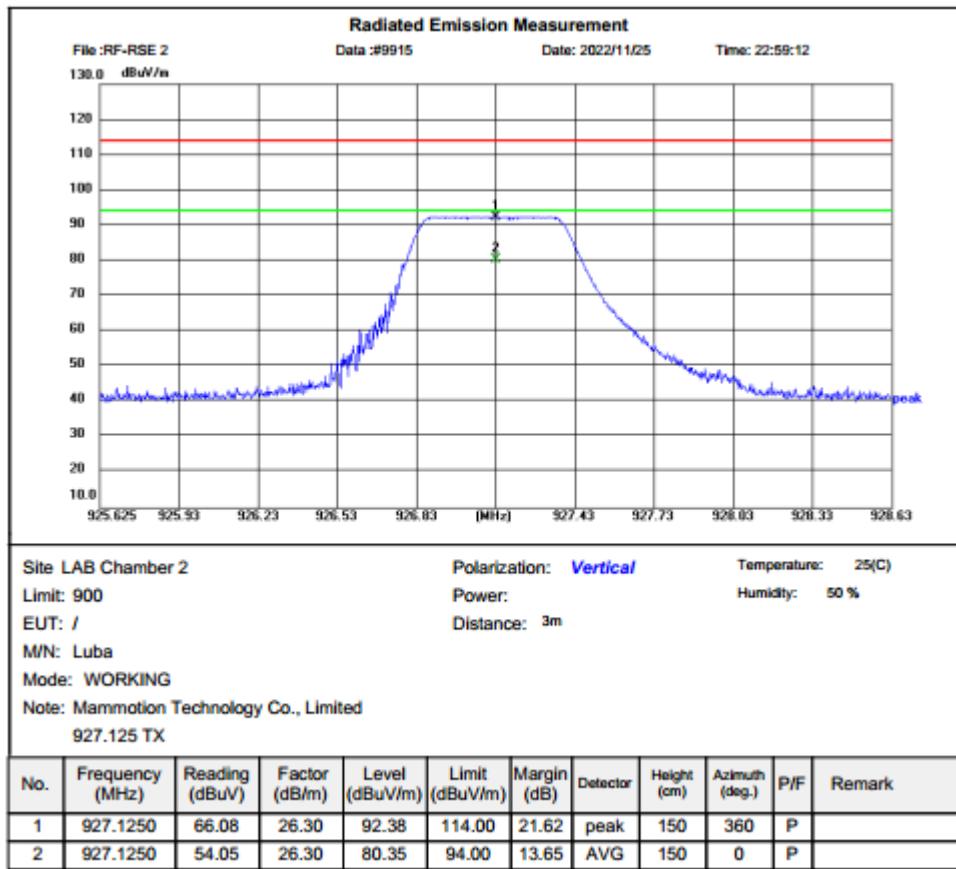
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**REMARKS:**

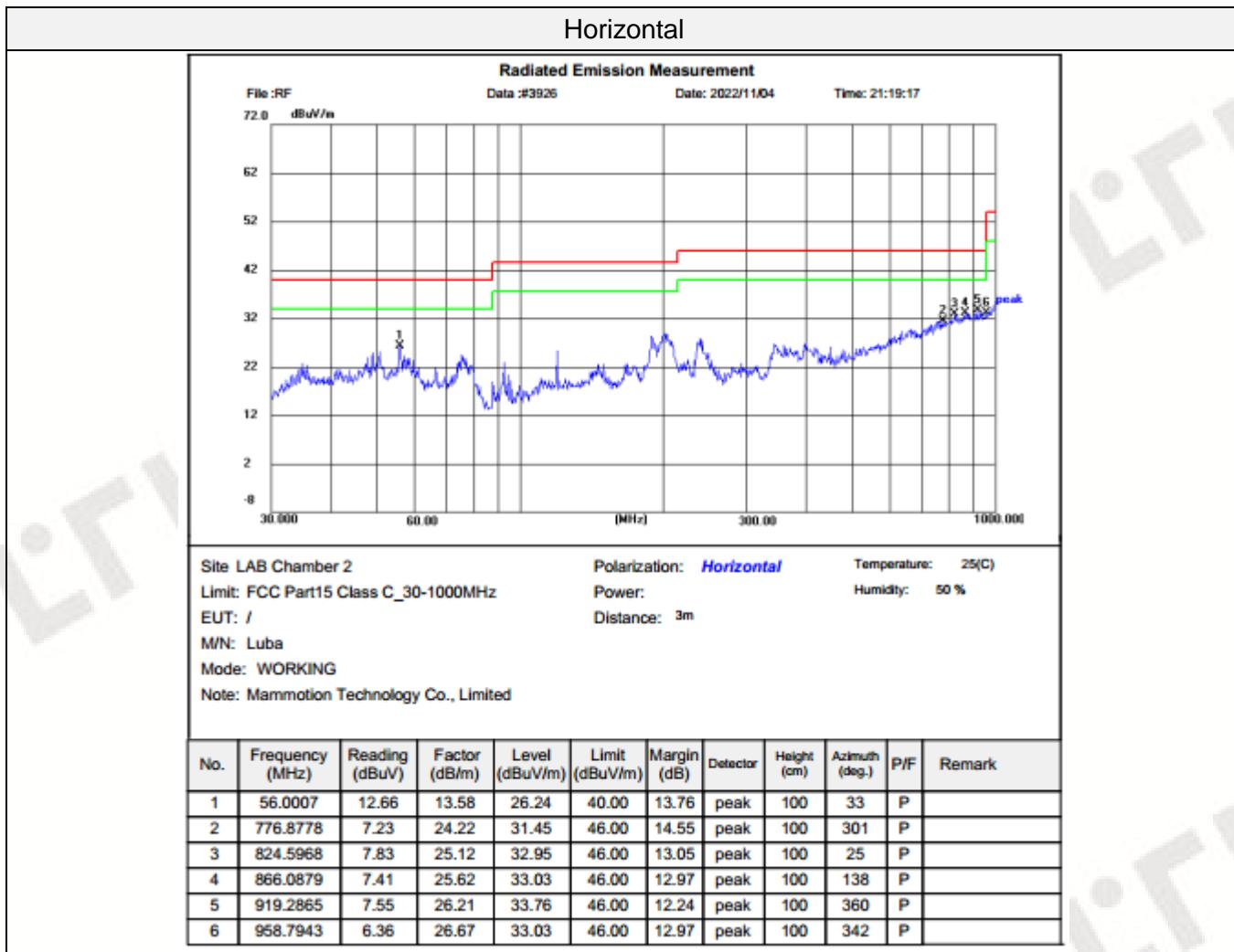
1. Emission level (dBuV/m) = Reading (dBuV)+ Factor (dB/m)
2. Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.

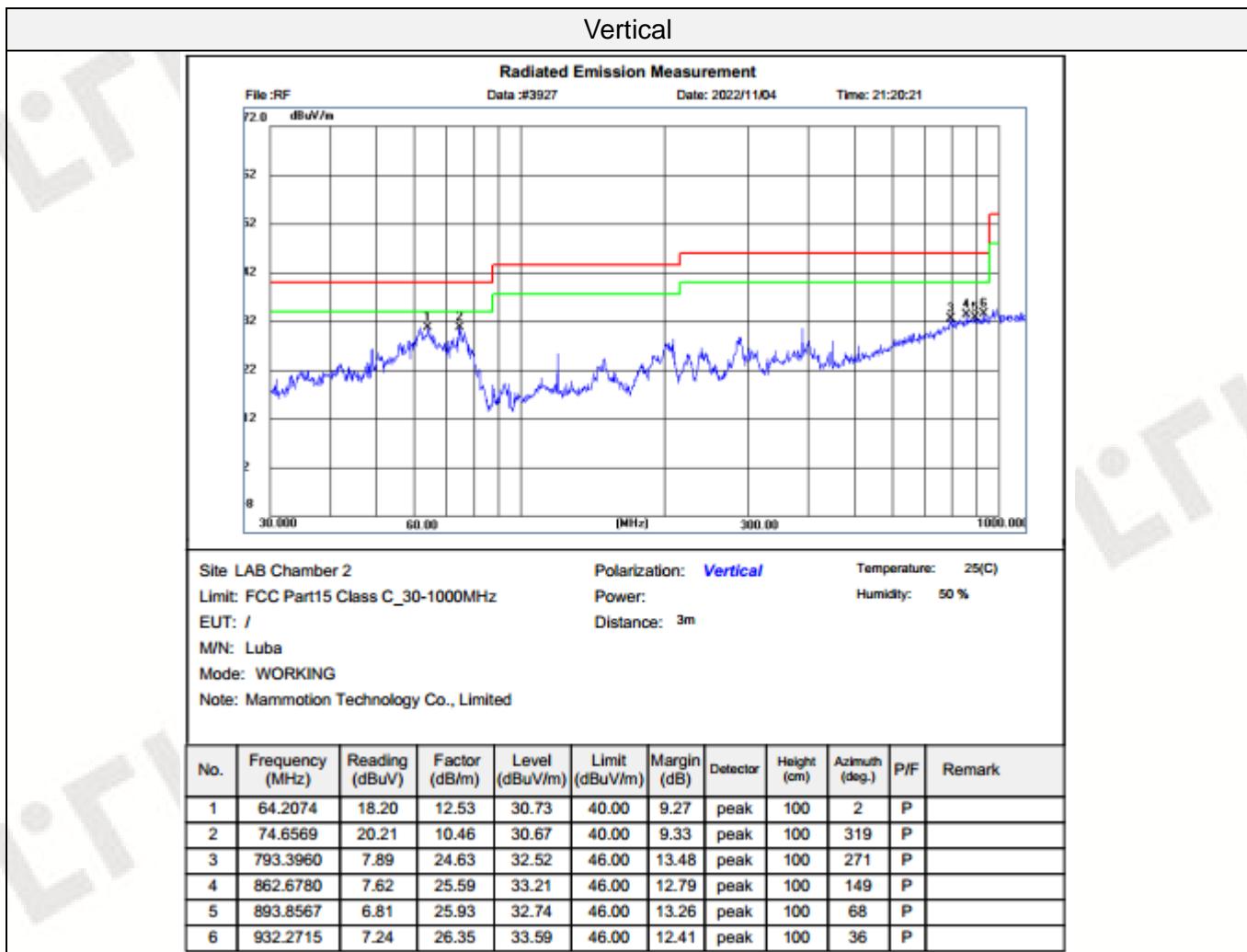
### **Emissions radiated outside of the specified frequency bands:**

### Remark:

1. This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in Z position.
2. For below 1GHz testing recorded worst at low channel.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and the emission levels from 9kHz to 30MHz are attenuated 20dB below the limit and not recorded in report.

For 30MHz-1GHz





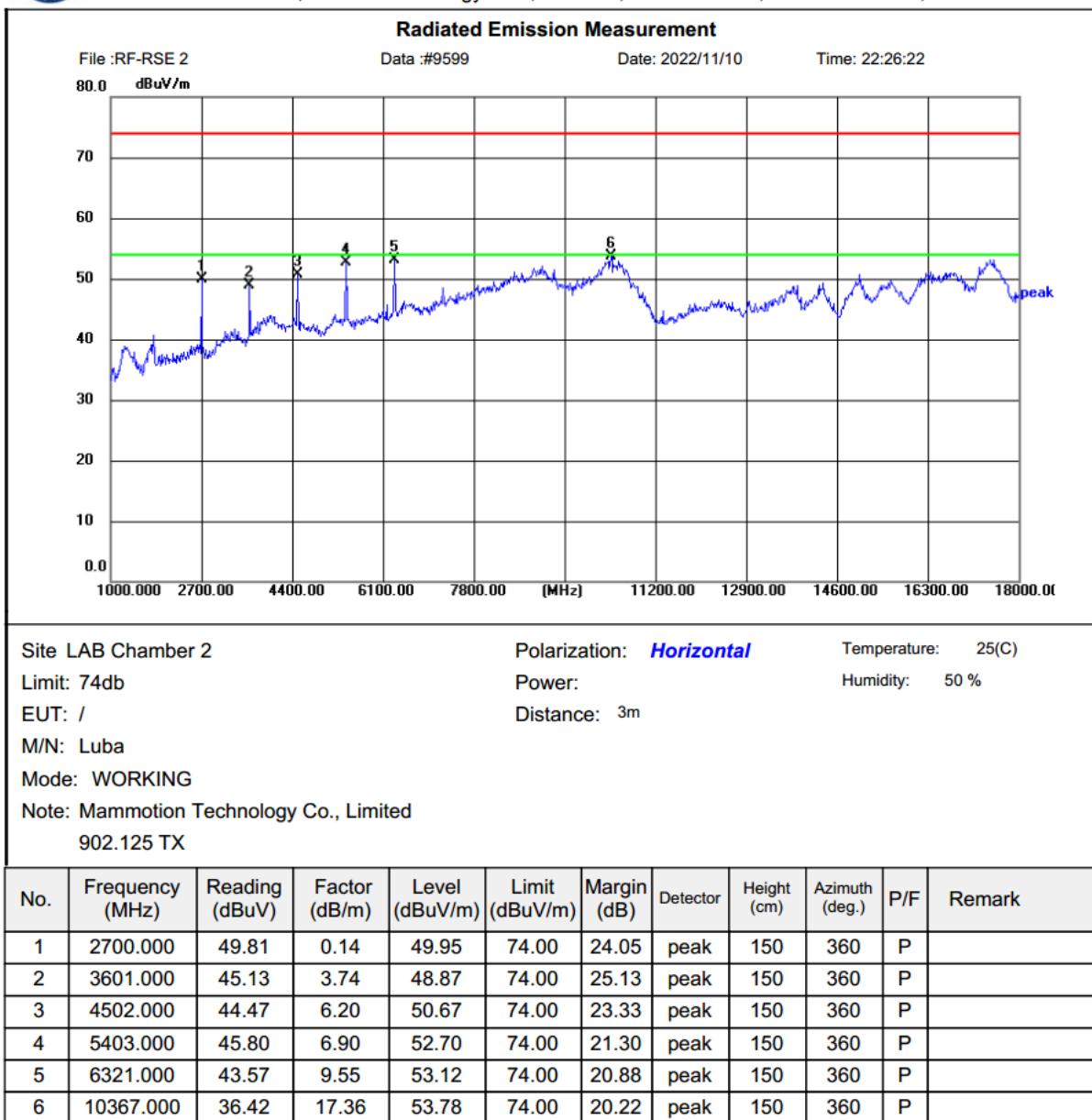
Remark: Level(dBuV/m)=Reading(dBuV)+Factor(dB/m)

Margin= Level(dBuV/m)-Limit(dBuV/m)

## For 1GHz to 10GHz

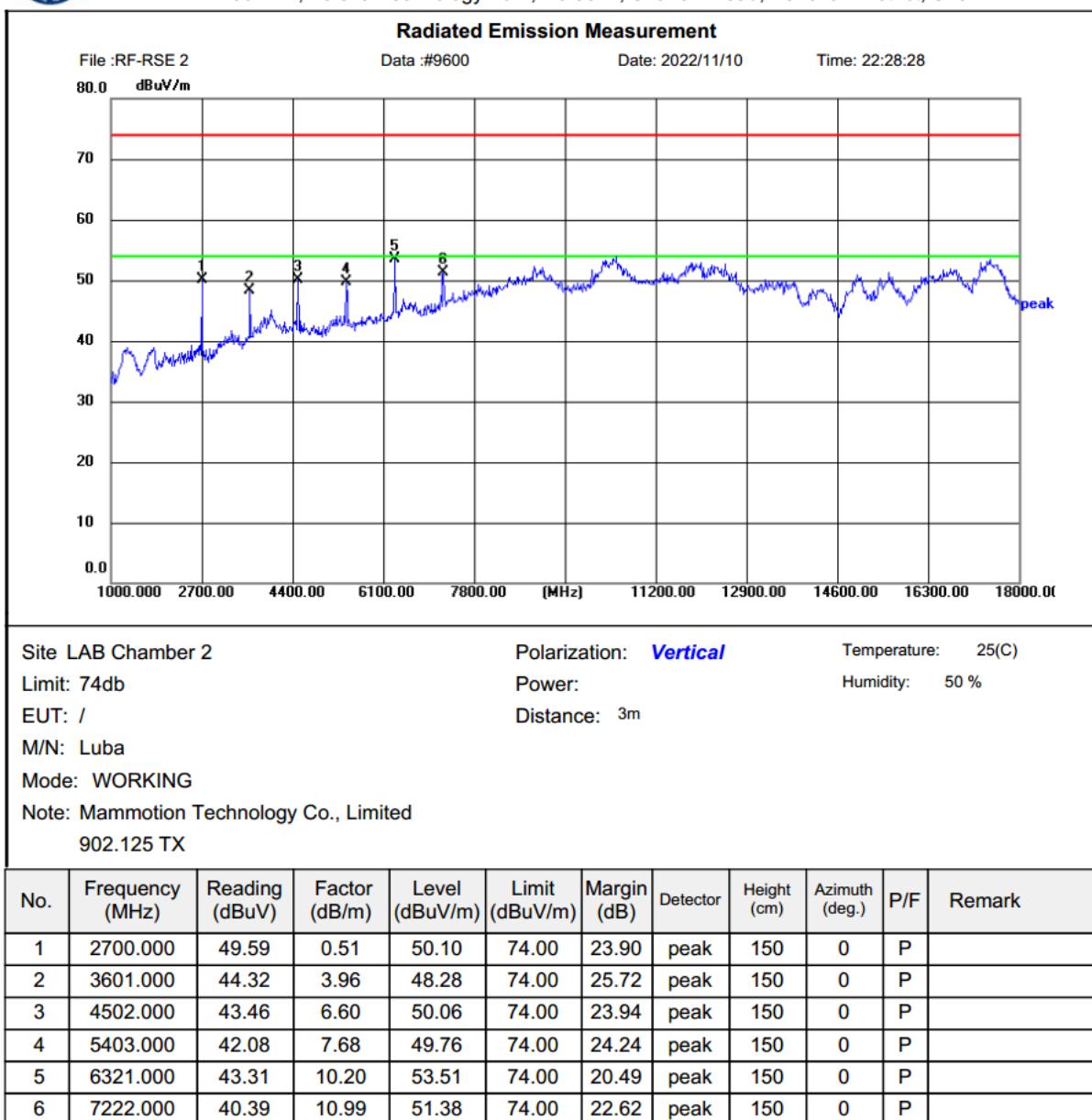


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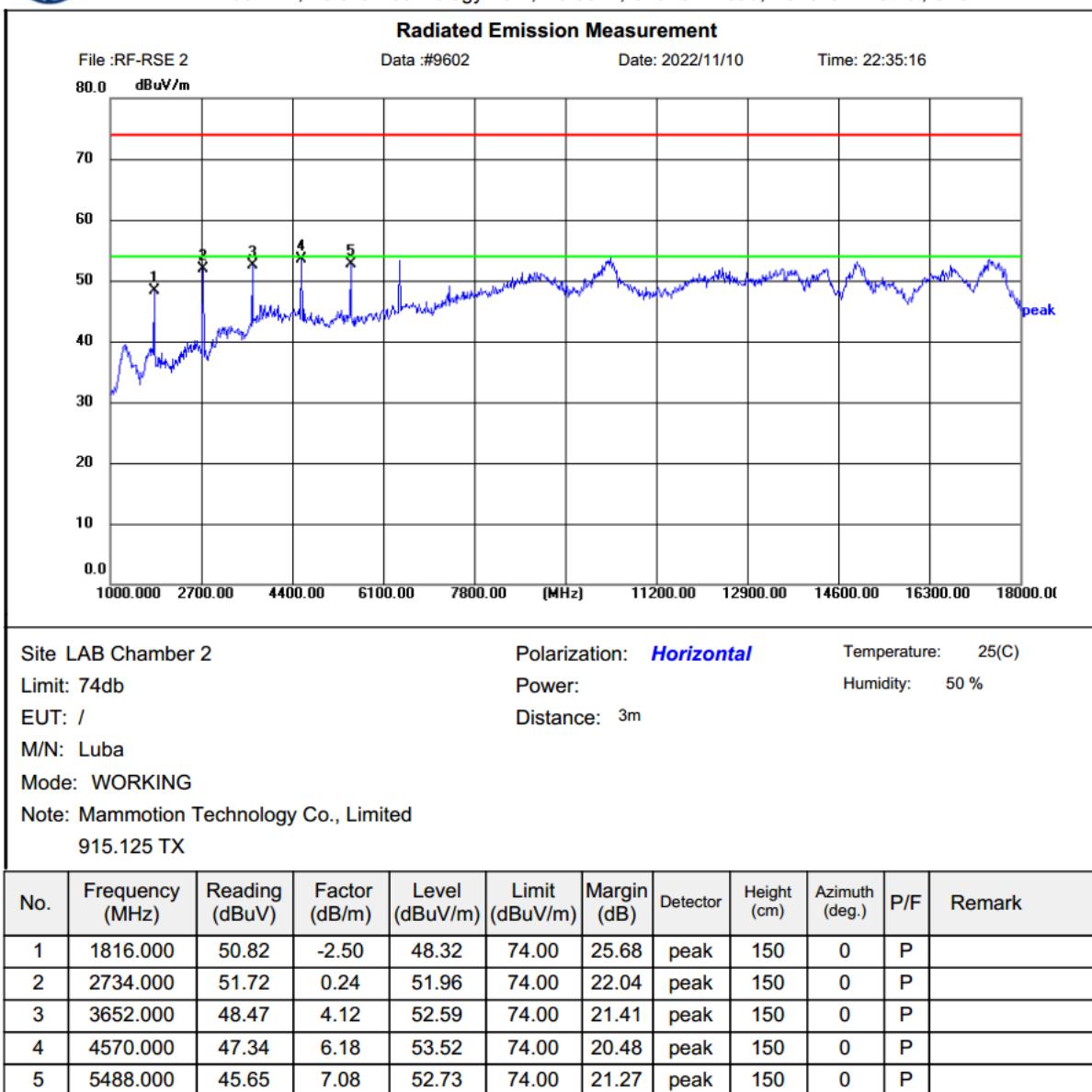


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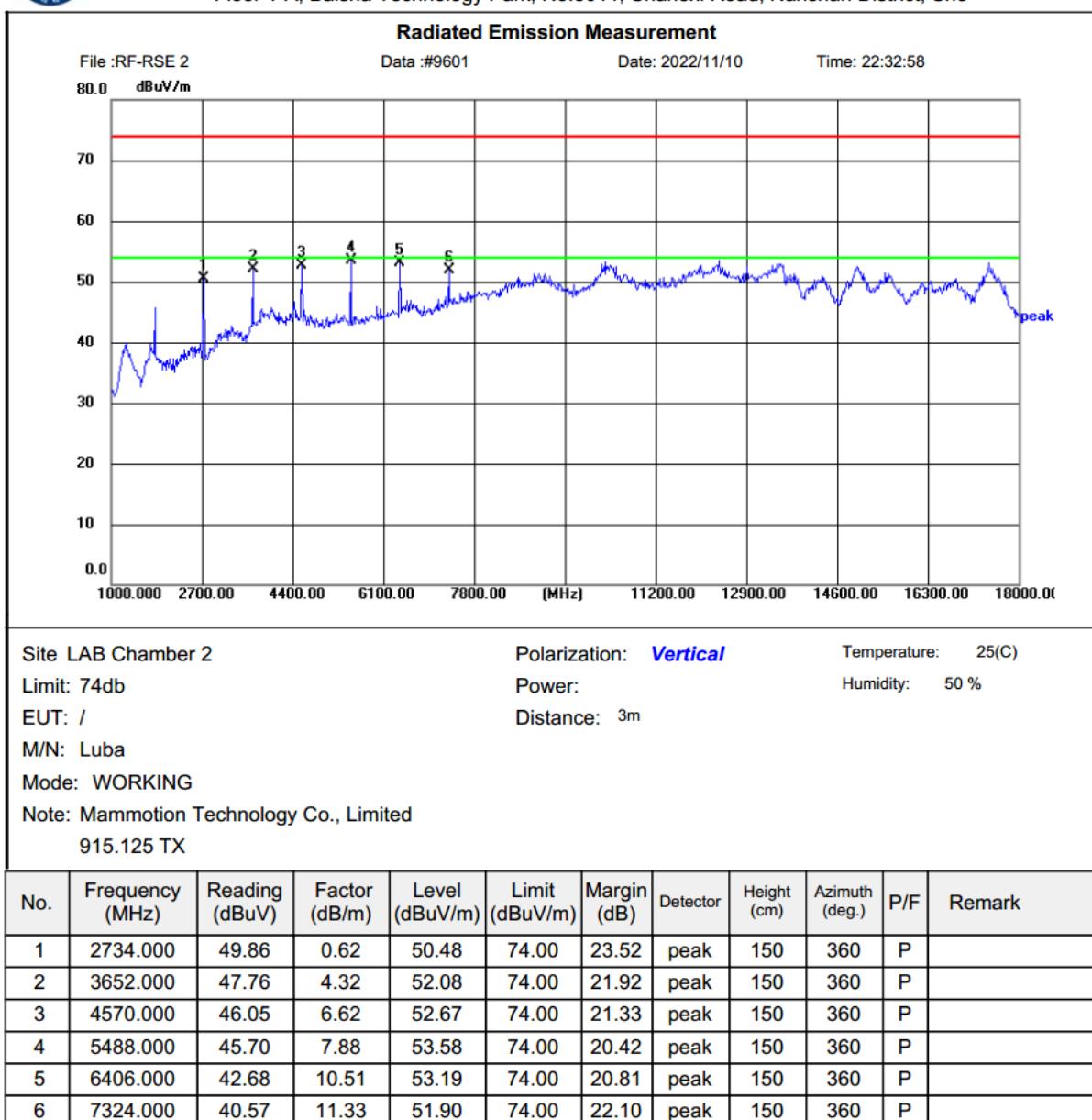


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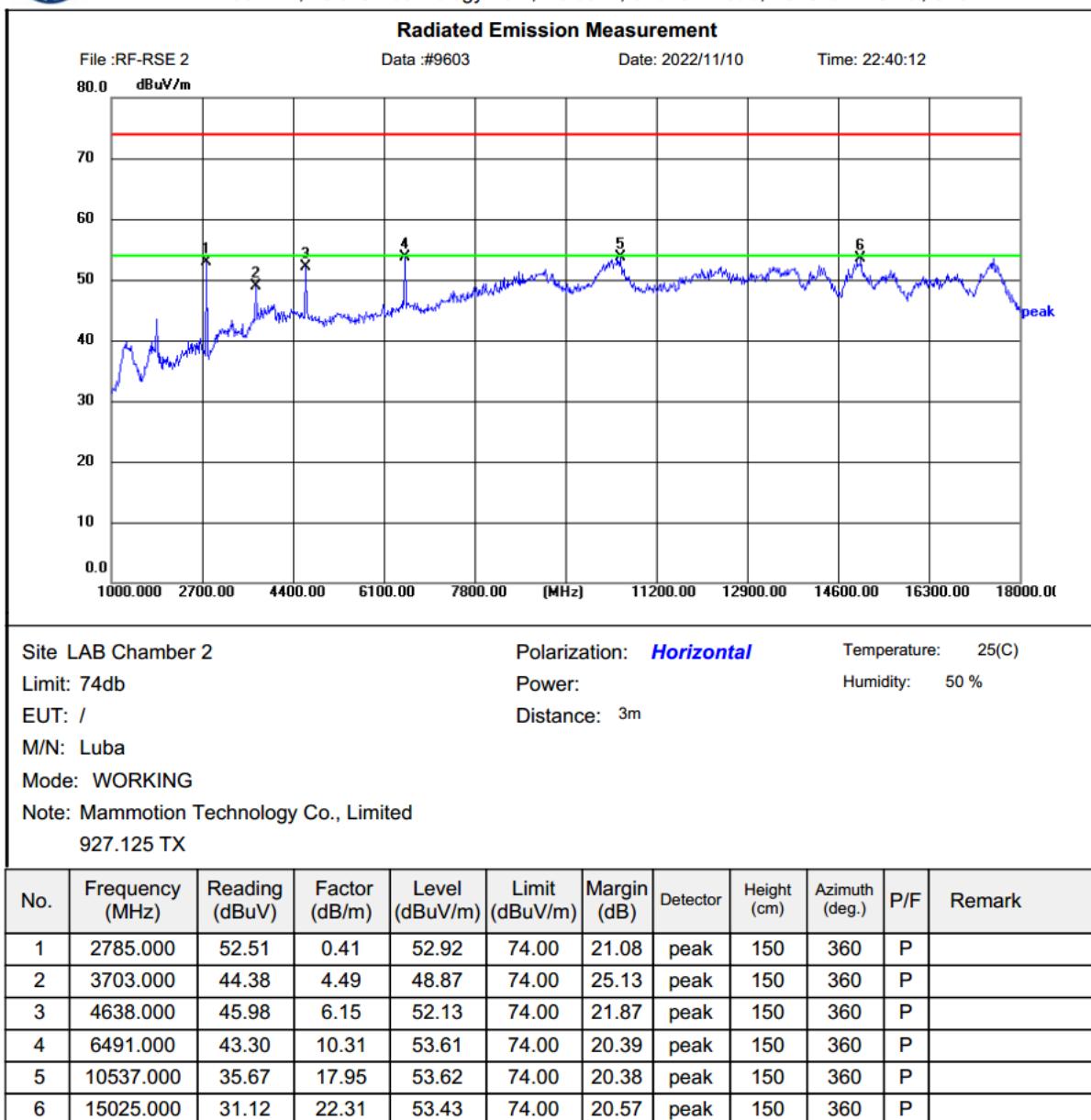


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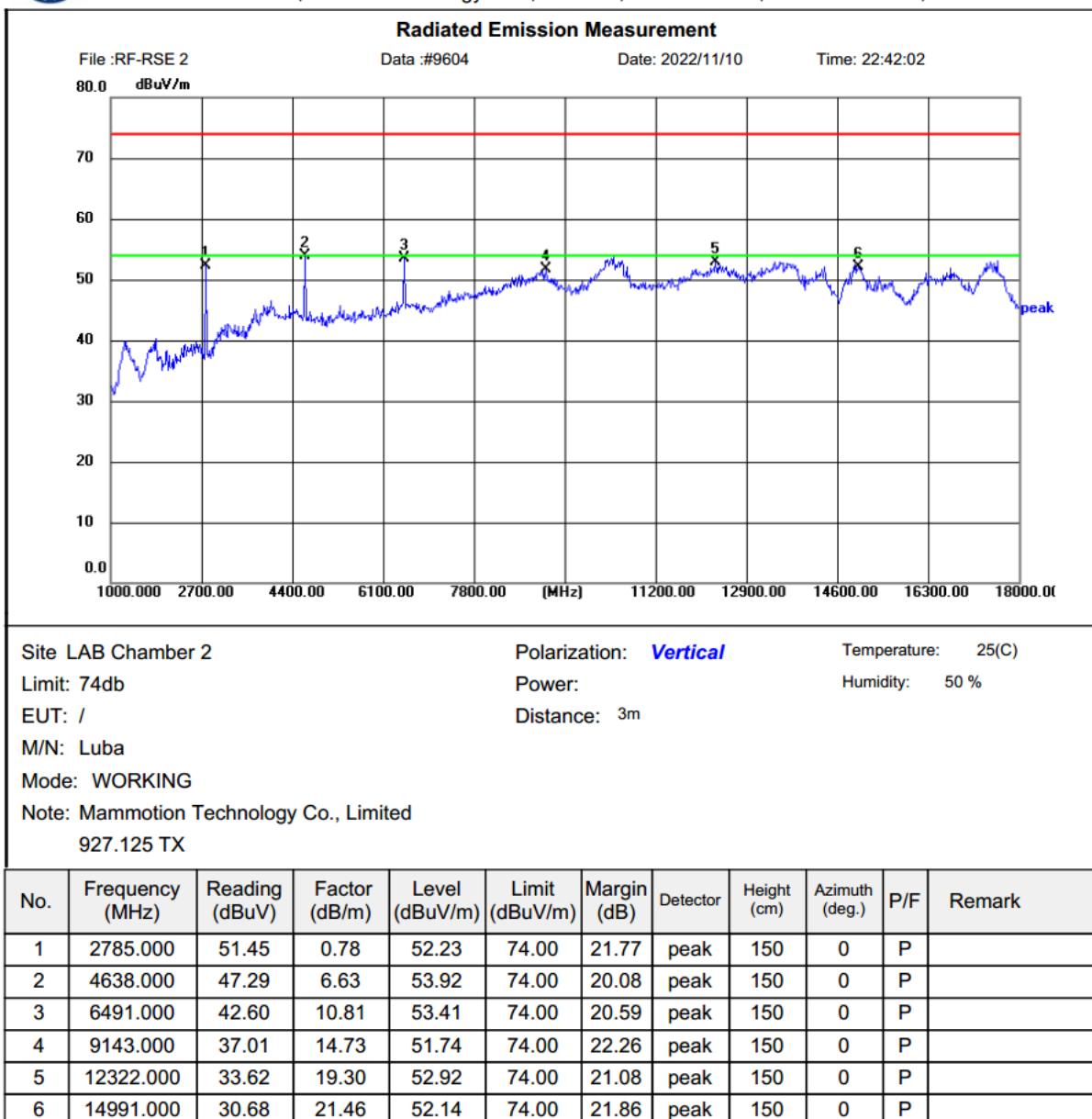


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#### REMARKS:

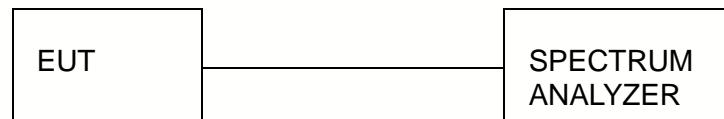
1. Emission level (dBuV/m) = Reading (dBuV) + Factor (dB/m)
2. Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) - Pre-amplifier Factor
3. Margin value = Limit value - Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels lower -6dB than the limit was not reported.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

### 3.3. Occupied Bandwidth Measurement

#### Limit

N/A

#### Test Configuration



#### Test Procedure

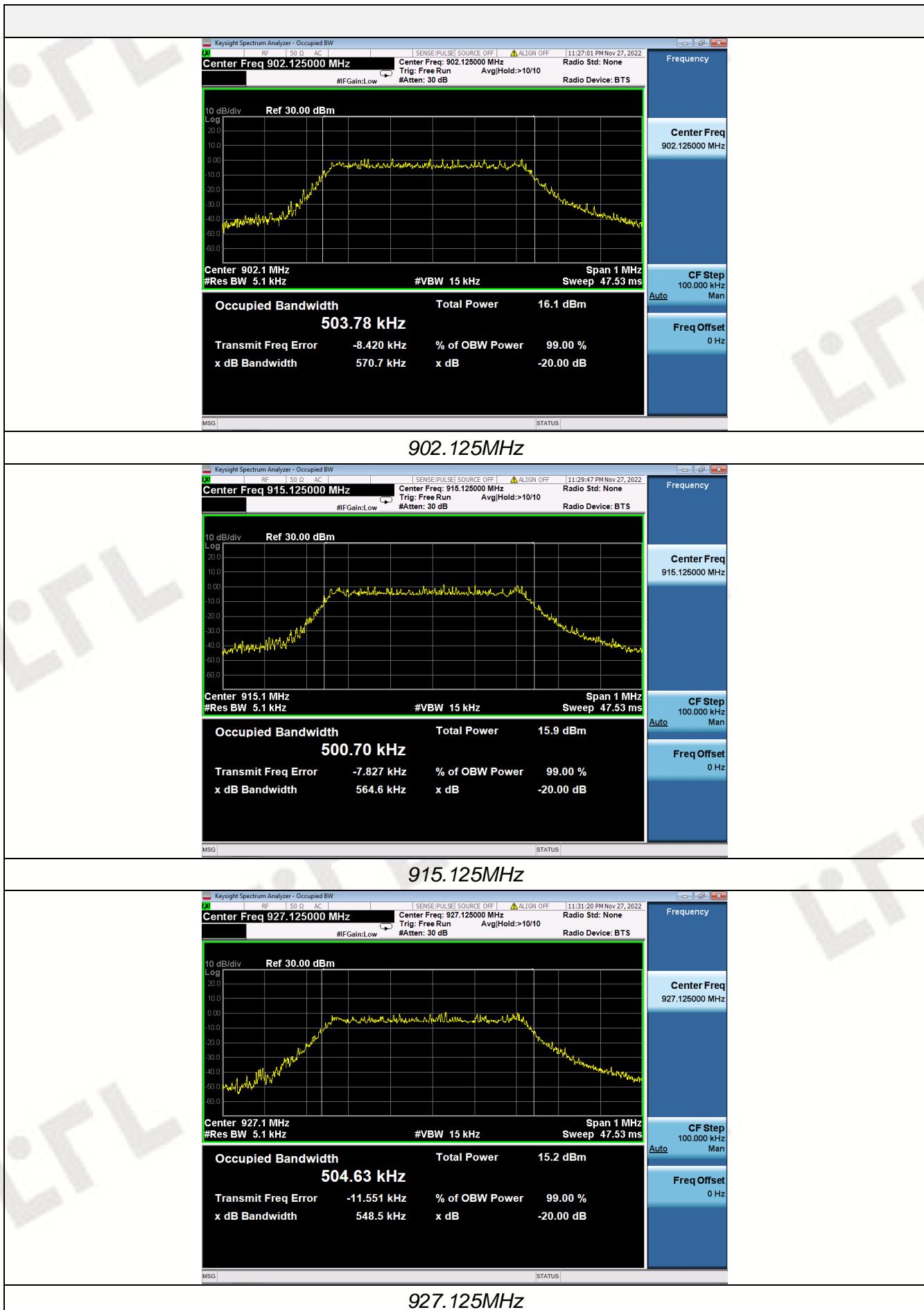
The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 5.1KHz RBW and 15KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

#### Test Results

Modulation	Test Frequency (MHz)	99% OBW (KHz)	20dB bandwidth (KHz)	Result
FM	902.125	503.78	570.7	Pass
	915.125	500.70	564.6	
	927.125	504.63	548.5	

Test plot as follows:



### 3.4. Antenna Requirement

#### Standard Applicable

For intentional device, according to FCC 47 CFR Section 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.

#### **Refer to statement below for compliance.**

The manufacturer may design the unit so that the user can replace a broken antenna, 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.

#### Antenna Connected Construction

The antenna used in this product is an Rob Antenna, The directional gains of antenna used for transmitting is 3.5dBi.

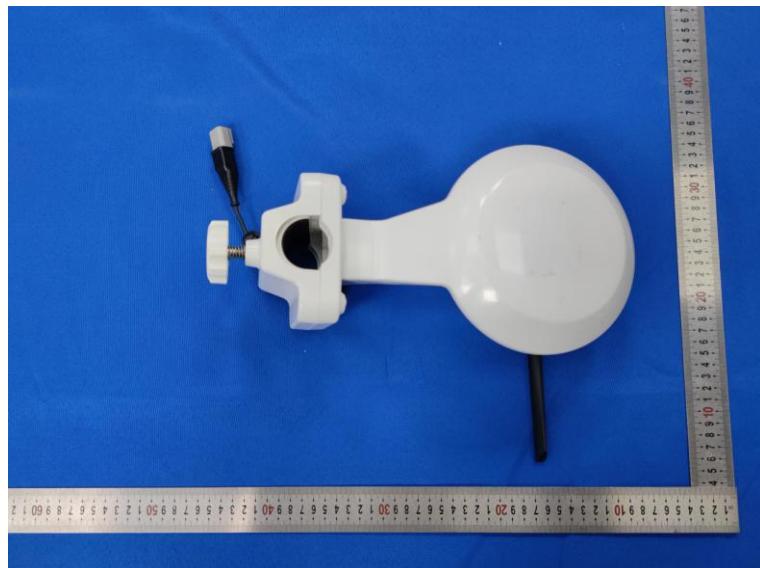
#### 4. Test Setup Photos of the EUT

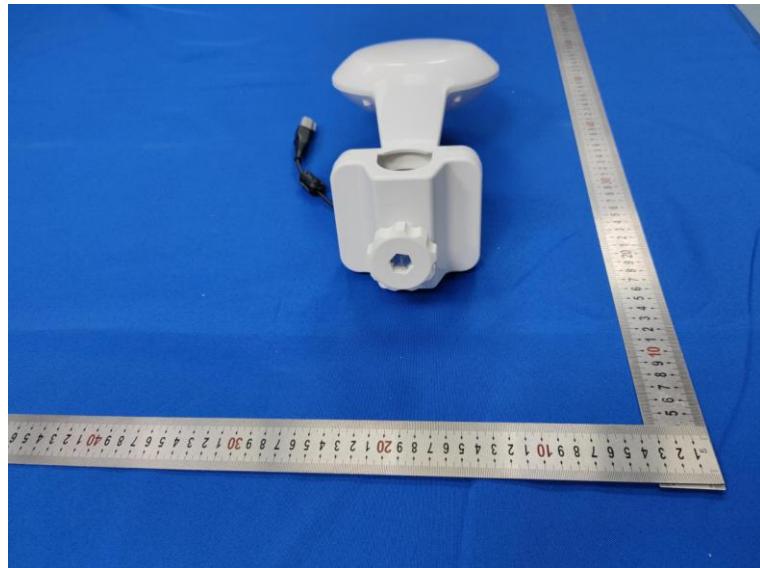


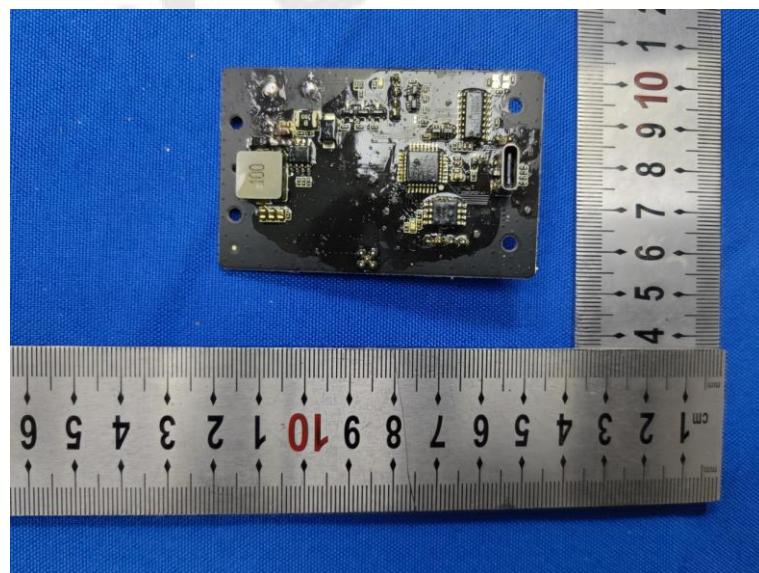
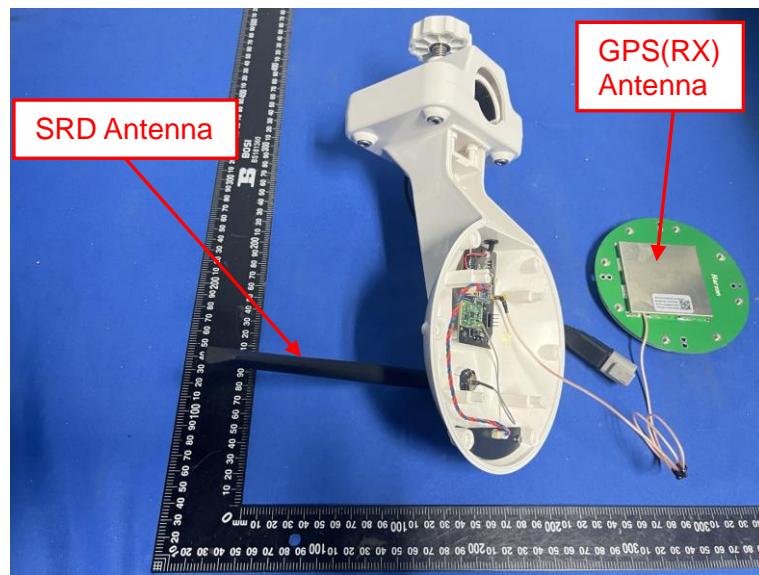
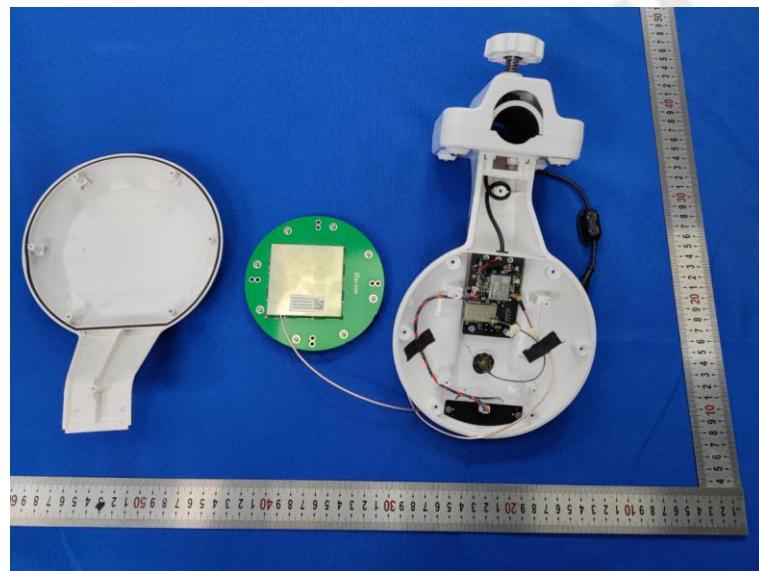
## 5. External and Internal Photos of the EUT

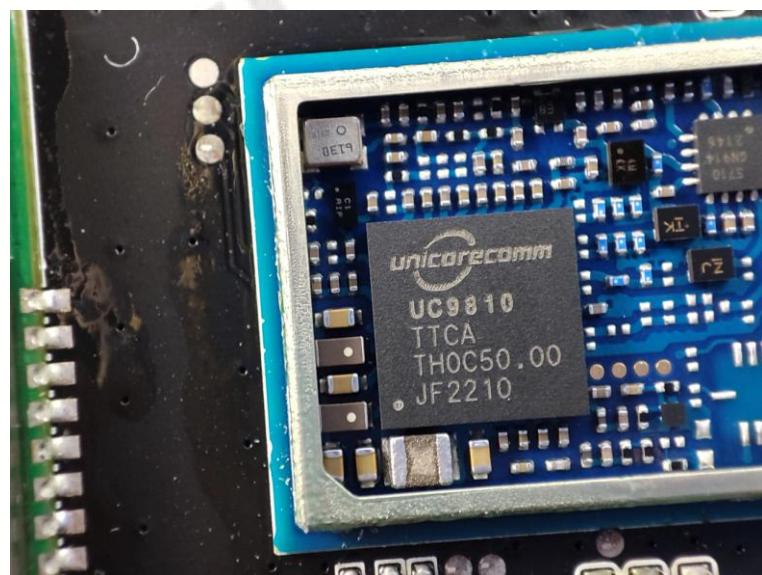
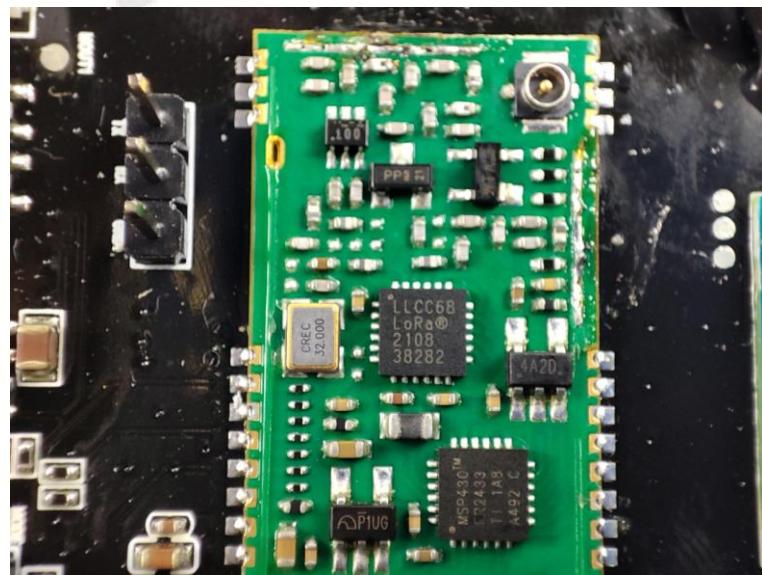
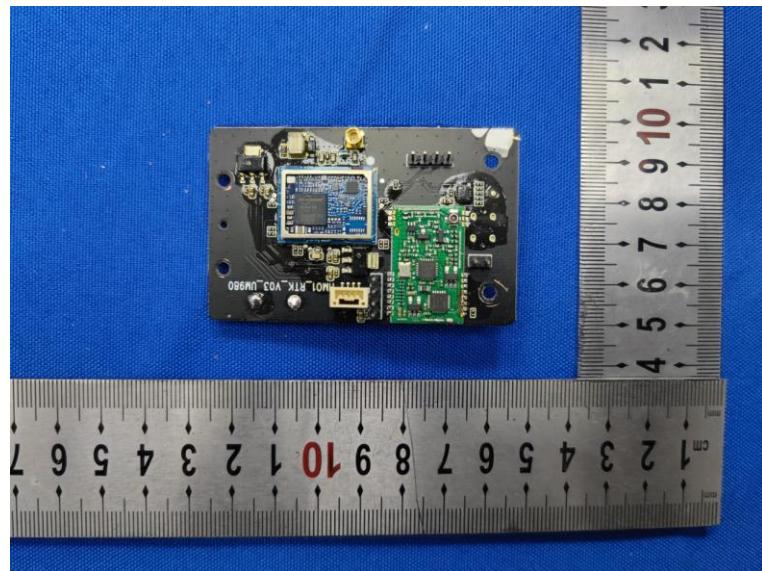
### External Photos of EUT







Internal Photos of EUT



\*\*\*\*\* End of Report \*\*\*\*\*