FCC Test Report

Report No.:	2405X62415EC
Applicant:	Dragino Technology Co., Limited.
Address:	Room 202,BaoChengTai industrial park,No.8 CaiYun LongCheng Street,LongGang District,Shenzhen China
Product Name:	LoRaWAN Lidar Distance Sensor
Product Model:	DS20L
Multiple Models:	N/A
Trade Mark:	DRAGINO
FCC ID:	ZHZDS20L
Standards:	FCC CFR Title 47 Part 15C (§15.247)
Test Date:	2024-09-13 to 2024-10-18
Test Result:	Complied
Report Date:	2024-10-21

Reviewed by:	Abel chen	**Approved by:**	Jacob Gong
	Abel Chen Project Engineer		Jacob Kong Manager

Prepared by:

World Alliance Testing & Certification (Shenzhen) Co., Ltd

No. 1002, East Block, Laobing Building, Xingye Road 3012, Xixiang street, Bao'an District, Shenzhen, Guangdong, People's Republic of China

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Announcement

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2. The results in this report apply only to the sample tested.

3. This sample tested is in compliance with the limits of the above regulation.

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

5. 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.

Revision History

Version No.	Issued Date	Description
00	*2024-10-21*	*Original*

Contents

1 General Information

1.1 Client Information

Applicant:	Dragino Technology Co., Limited.
Address:	Room 202,BaoChengTai industrial park,No.8 CaiYun LongCheng Street,LongGang District,Shenzhen China
Manufacturer:	Dragino Technology Co., Limited.
Address:	Room 202,BaoChengTai industrial park,No.8 CaiYun LongCheng Street,LongGang District,Shenzhen China

1.2 Product Description of EUT

The EUT is LoRaWAN Lidar Distance Sensor that contains LoRa radio, this report covers the full testing of the LoRa radio DTS mode.

Sample Serial Number	2R1Z-1 for CE test, 2R1Z-2 for RE test, 2R1Z-3 for RF conducted test (assigned by WATC)
Sample Received Date	2024-09-05
Sample Status	Good Condition
Frequency Range	903MHz-914.2MHz
Maximum Conducted Peak Output Power	10.06dBm
Modulation Technology	CSS
Spatial Streams	SISO (1TX, 1RX)
Antenna Gain#	-7.98 dBi
Power Supply	DC 3.0~3.6V(typical DC 3.0V battery or DC 3.3V by External power)
Adapter Information	N/A
Modification	Sample No Modification by the test lab

1.3 Antenna information

15.203 requirement:

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, 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.

Device Antenna information:	

The Lora antenna is an internal antenna which cannot replace by end-user, please see product internal photos for details.

1.4 Related Submittal(s)/Grant(s)

FCC Part 15, Subpart C, Equipment Class: DSS, FCC ID: ZHZDS20L

1.5 Measurement Uncertainty

Parameter		Expanded Uncertainty (Confidence of 95%(U = 2Uc(y)))
AC Power Lines Conducted Emissions		±3.14dB
Emissions, Radiated	Below 30MHz	±2.78dB
	Below 1GHz	±4.84dB
	Above 1GHz	±5.44dB
Emissions, Conducted		1.75dB
Conducted Power		0.74dB
Frequency Error		150Hz
Bandwidth		0.34%
Power Spectral Density		0.74dB
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.*		

1.6 Laboratory Location

World Alliance Testing & Certification (Shenzhen) Co., Ltd

No. 1002, East Block, Laobing Building, Xingye Road 3012, Xixiang street, Bao'an District, Shenzhen, Guangdong, People's Republic of China

Tel: +86-755-29691511, Email: qa@watc.com.cn

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. : 463912, the FCC Designation No. : CN5040.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0160.

1.7 Test Methodology

FCC CFR 47 Part 2

FCC CFR 47 Part 15

KDB 558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10-2020

2 Description of Measurement

2.1 Test Configuration

Operating channels:(903MHz-914.2MHz)					
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	903.0	4	907.8	7	912.6
2	904.6	5	909.4	8	914.2
3	906.2	6	911.0	/	/

According to ANSI C63.10-2020 chapter 5.6.1 Table 11 requirement, select lowest channel, middle channel, and highest channel in the frequency range in which device operates for testing. The detailed frequency points are as follows:

Lowest channel		Middle channel		Highest channel	
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	903.0	4	907.8	8	914.2

Test Mode:				
Transmitting mode:	The system was configured for testing in Engineering Mode, which was provided by the manufacturer.			
Exercise software#:	Serial Port Utility			
Mode	**Data rate**	**Power Level Setting#**		
		Low Channel	**Middle Channel**	**High Channel**
Lora 500KHz	/	10	10	10
Note: The exercise software and the maximum power setting that provided by manufacturer.				

Worst-Case Configuration:

For radiated emissions, EUT was investigated in three orthogonal orientation, the worst-case orientation was recorded in report

For AC power line conducted emission and radiated emission 9kHz-1GHz was performed with the EUT transmits at the channel with highest output power as worst-case scenario.

The EUT has two input power type: battery and external power, the two power type switched by a switch on the device, the battery power mode was full test, the external power mode was checked AC power line conducted emission and radiated emission 9kHz-1GHz.

2.2 Test Auxiliary Equipment

Manufacturer	Description	Model	Serial Number
UNI-T	DC power supply	UTP1310S	BC-EL-204

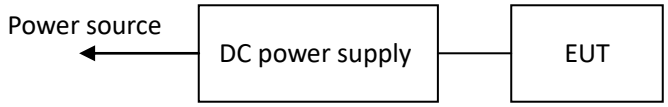
2.3 Interconnecting Cables

Manufacturer	Description	Length(m)	From	To
Unknown	DC Power Cable	1.0	DC power supply	EUT

2.4 Block Diagram of Connection between EUT and AE

Battery:

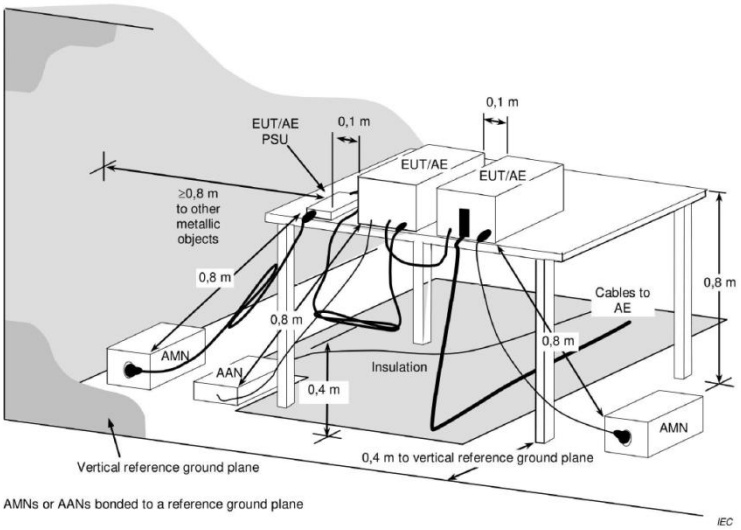
External Power:



Note: for reference only, the actual connection setup used for testing please refer to the test photos.

2.5 Test Setup

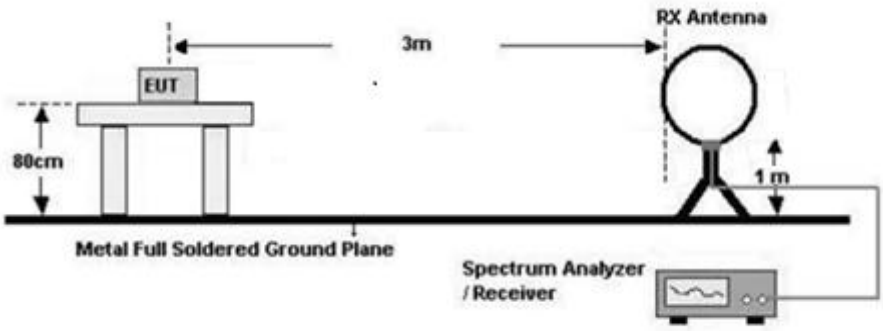
1) Conducted emission measurement:



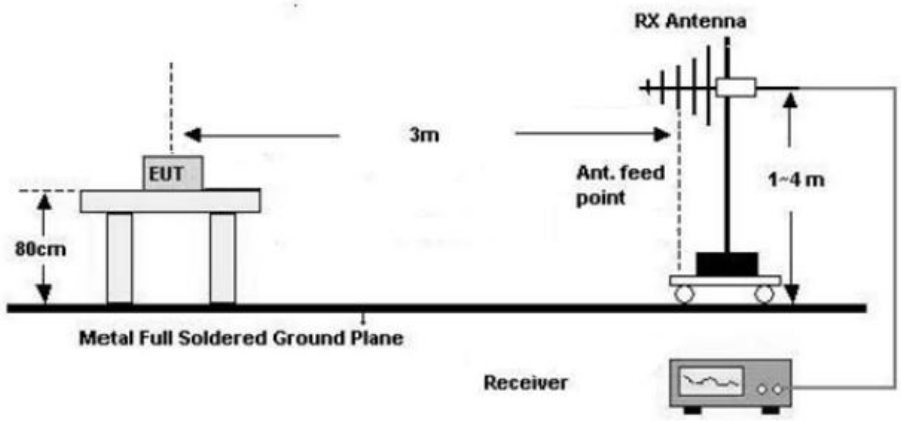
Note: The 0.8 m distance specified between EUT/AE/PSU and AMN/AAN, is applicable only to the EUT being measured. If the device is AE then it shall be >0.8 m.

2) Radiated emission measurement:

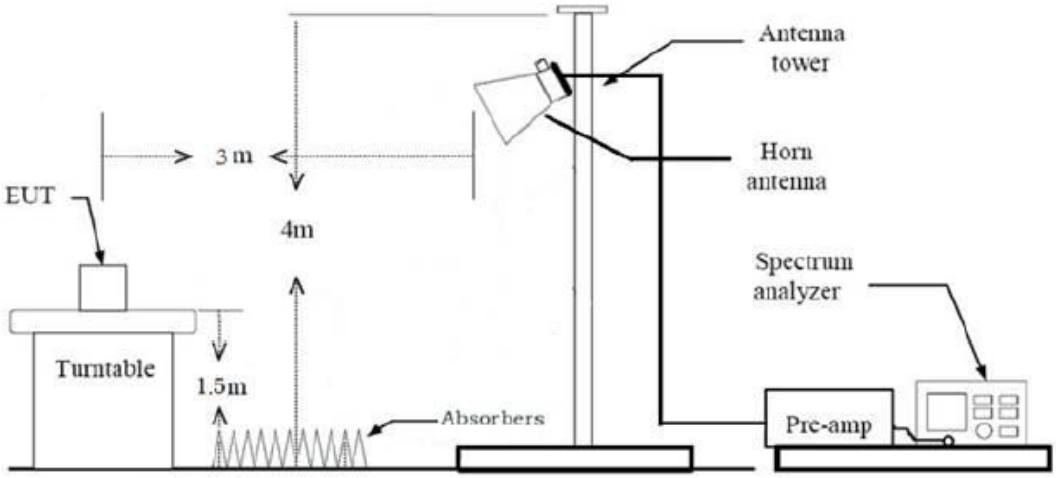
Below 30MHz (3m SAC)



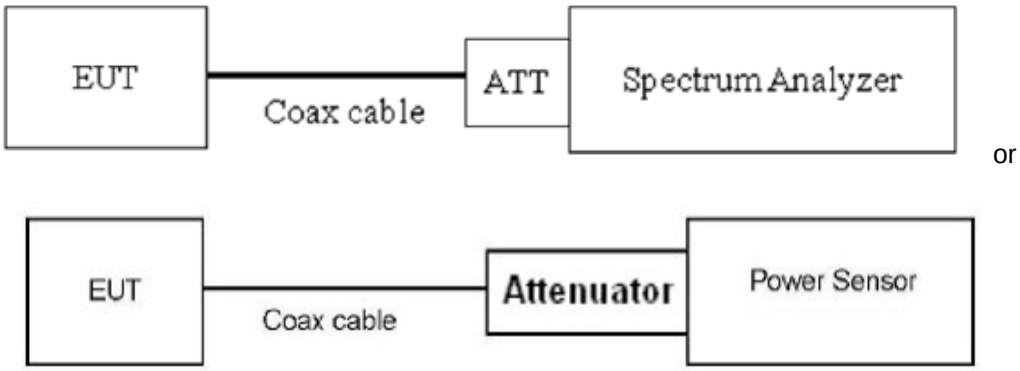
30MHz-1GHz (3m SAC)



1GHz-10GHz(3m FAC)



3) RF Conducted Test



2.6 Test Procedure

Conducted emission:

1. The E.U.T is placed on a non-conducting table 40cm from the vertical ground plane and 80cm above the horizontal ground plane (Please refer to the block diagram of the test setup and photographs).
2. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.
3. Line conducted data is recorded for both Line and Neutral

Radiated Emission Procedure:

a) For below 30MHz

1. All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz- 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (test distance / specification distance).
2. Loop antenna use, investigation was done on the three antenna orientations (parallel, perpendicular, gound-parallel)

b) For 30MHz-1GHz:

1. The EUT was placed on the tabletop of a rotating table 0.8 m the ground at a 3 m semi anechoic chamber. The measurement distance from the EUT to the receiving antenna is 3 m.
2. EUT works in each mode of operation that needs to be tested. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.

c) For above 1GHz:

1. The EUT was placed on the tabletop of a rotating table 1.5 m the ground at a 3 m fully anechoic room. The measurement distance from the EUT to the receiving antenna is 3 m (1-18GHz) and 1.5 m (above 18GHz).

2. EUT works in each mode of operation that needs to be tested，and having the EUT continuously working. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.
3. Open the test software to control the test antenna and test turntable. Perform the test, save the test results, and export the test data.
4. Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

RF Conducted Test:

1. The antenna port of EUT was connected to the RF port of the test equipment (Power Meter or Spectrum analyzer) through Attenuator and RF cable.
2. The cable assembly insertion loss of 6.5dB (including 6 dB Attenuator and 0.5dB cable) was entered as an offset in the Spectrum analyzer. Note: Actual cable loss was unavailable at the time of testing, therefore a loss of 0.5dB was assumed as worst case. This was later verified to be true by laboratory. (if the RF cable provided by client, the cable loss declared by client)
3. The EUT is keeping in continuous transmission mode and tested in all modulation modes.

2.7 Measurement Method

Description of Test	Measurement Method
AC Line Conducted Emissions	ANSI C63.10-2020 Section 6.2
Maximum Conducted Output Power	ANSI C63.10-2020 Section 11.9.1.3
Power Spectral Density	ANSI C63.10-2020 Section 11.10.2
6 dB Emission Bandwidth	ANSI C63.10-2020 Section 11.8.1
99% Occupied Bandwidth	ANSI C63.10-2020 Section 6.9.3
100kHz Bandwidth of Frequency Band Edge	ANSI C63.10-2020 Section 6.10
Radiated emission	ANSI C63.10-2020 Section 11.11&11.12.1
Duty Cycle	ANSI C63.10-2020 Section 11.6

2.8 Measurement Equipment

Manufacturer	Description	Model	Management No.	Calibration Date	Calibration Due Date
Conducted Emission Test					
ROHDE& SCHWARZ	EMI TEST RECEIVER	ESR	101817	2024/6/4	2025/6/3
R&S	LISN	ENV216	101748	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.12	N/A	2024/6/4	2025/6/3
Farad	Test Software	EZ-EMC	Ver. EMEC-3A1	/	/
Radiated Emission Test					
R&S	EMI test receiver	ESR3	102758	2024/6/4	2025/6/3
ROHDE& SCHWARZ	SPECTRUM ANALYZER	FSV40-N	101608	2024/6/4	2025/6/3
SONOMA INSTRUMENT	Low frequency amplifier	310	186014	2024/6/4	2025/6/3
A.H. Systems	PREAMPLIFIER	PAM-0118P	531	2024/6/4	2025/6/3
BACL	Loop Antenna	1313-1A	4010611	2024/2/7	2027/2/6
SCHWARZBECK	Log - periodic wideband antenna	VULB 9163	9163-872	2023/7/7	2026/7/6
Astro Antenna Ltd	Horn antenna	AHA-118S	3015	2023/7/6	2026/7/5
Unknown	6.7G High Pass Filter	Unknown	6.7G	2024/6/4	2025/6/3
Oulitong	Band Reject Filter	OBSF-902-928-40S	OE02104362	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.9	N/A	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.15	N/A	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.16	N/A	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.17	N/A	2024/6/4	2025/6/3
Audix	Test Software	E3	191218 V9	/	/
RF Conducted Test					
ROHDE& SCHWARZ	SPECTRUM ANALYZER	FSV40	101419	2024/6/4	2025/6/3
ANRITSU	USB Power Sensor	MA24418A	12620	2024/6/4	2025/6/3
narda	6dB attenuator	603-06-1	N/A	2024/6/4	2025/6/3

Note: All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or International standards.

3 Test Results

3.1 Test Summary

ISEDC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(e)	Power Spectral Density	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
-	99% Occupied Bandwidth	Report only
§15.247(d)	100kHz Bandwidth of Frequency Band Edge	Compliance
§15.205, §15.209, §15.247(d)	Radiated emission	Compliance
-	Duty Cycle	Report only

3.2 Limit

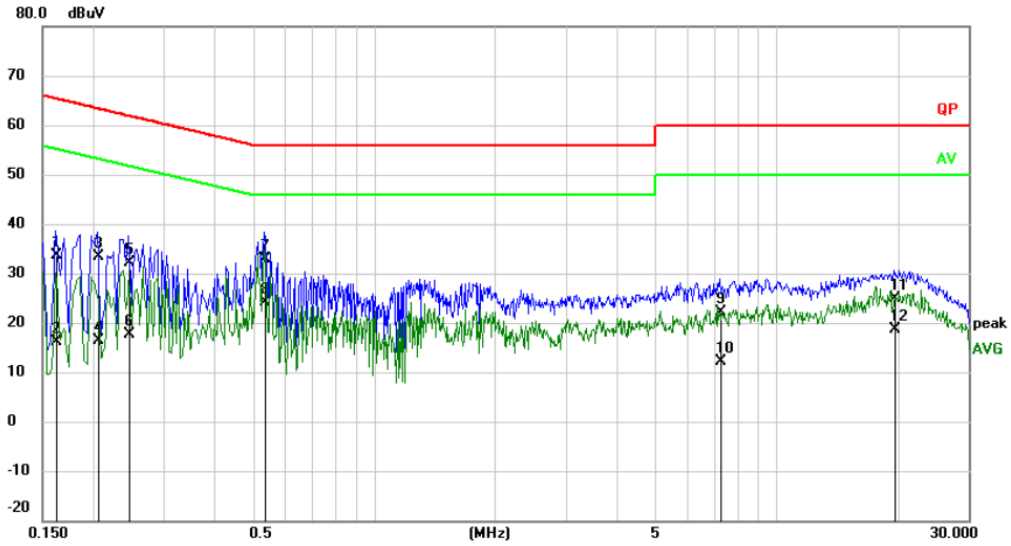
Test items	Limit
AC Line Conducted Emissions	See details §15.207 (a)
Conducted Output Power	For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.
6dB Emission Bandwidth	The minimum 6 dB bandwidth shall be at least 500 kHz.
Power Spectral Density	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
Spurious Emissions, 100kHz Bandwidth of Frequency Band Edge	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)).

3.3 AC Line Conducted Emissions Test Data

Test Date:	2024-10-18	Test By:	Lirou Li
Environment condition:	Temperature: 23.5°C; Relative Humidity:64%; ATM Pressure: 100.8kPa		

Conducted Emission Measurement

File :2405X62415E Data :#11 Date: 2024/10/18 Time: 16:15:00



Limit: QP
Mode:transmitting
Note: Lora 500kHz H channle

Phase: L1
Power: AC 120V/60Hz

Temperature: 23.5 ℃
Humidity: 64 %
Air Pressure: 1008 hpa

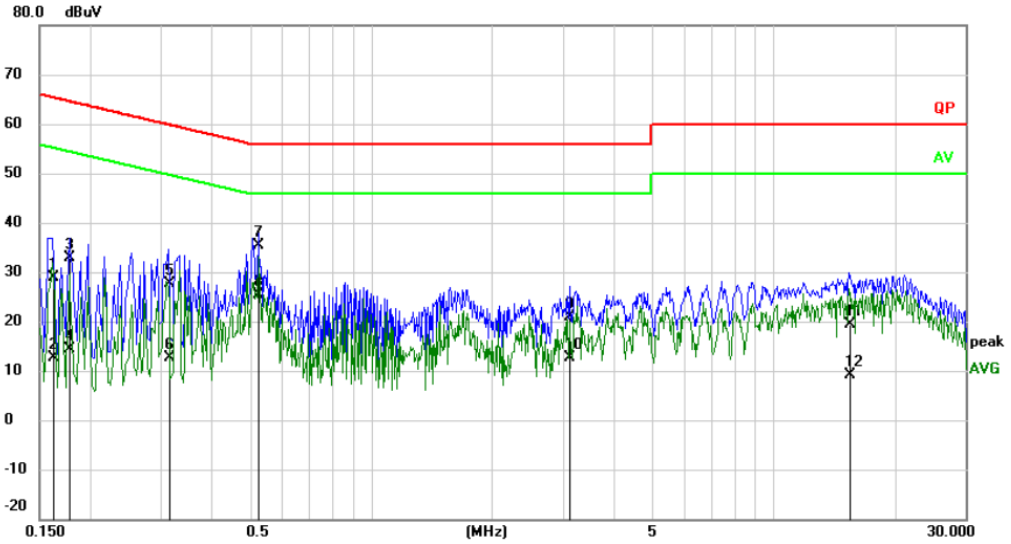
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1620	23.34	10.39	33.73	65.36	-31.63	QP	
2		0.1620	5.85	10.39	16.24	55.36	-39.12	AVG	
3		0.2060	23.11	10.31	33.42	63.37	-29.95	QP	
4		0.2060	6.12	10.31	16.43	53.37	-36.94	AVG	
5		0.2460	21.67	10.35	32.02	61.89	-29.87	QP	
6		0.2460	7.28	10.35	17.63	51.89	-34.26	AVG	
7		0.5340	22.27	10.52	32.79	56.00	-23.21	QP	
8	*	0.5340	13.72	10.52	24.24	46.00	-21.76	AVG	
9		7.2420	11.81	10.33	22.14	60.00	-37.86	QP	
10		7.2420	1.90	10.33	12.23	50.00	-37.77	AVG	
11		19.6340	14.48	10.33	24.81	60.00	-35.19	QP	
12		19.6340	8.29	10.33	18.62	50.00	-31.38	AVG	

*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Conducted Emission Measurement

File :2405X62415E Data :#12 Date: 2024/10/18 Time: 16:25:11



Limit: QP
Mode:transmitting
Note: Lora 500kHz H channle

Phase: N
Power: AC 120V/60Hz

Temperature: 23.5 ℃
Humidity: 64 %
Air Pressure: 1008 hpa

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1620	18.77	10.23	29.00	65.36	-36.36	QP	
2		0.1620	2.50	10.23	12.73	55.36	-42.63	AVG	
3		0.1780	22.64	10.27	32.91	64.58	-31.67	QP	
4		0.1780	4.04	10.27	14.31	54.58	-40.27	AVG	
5		0.3140	17.25	10.42	27.67	59.86	-32.19	QP	
6		0.3140	2.14	10.42	12.56	49.86	-37.30	AVG	
7		0.5260	24.79	10.51	35.30	56.00	-20.70	QP	
8	*	0.5260	14.93	10.51	25.44	46.00	-20.56	AVG	
9		3.1099	10.38	10.53	20.91	56.00	-35.09	QP	
10		3.1099	2.04	10.53	12.57	46.00	-33.43	AVG	
11		15.4300	8.94	10.37	19.31	60.00	-40.69	QP	
12		15.4300	-1.23	10.37	9.14	50.00	-40.86	AVG	

*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Remark:

Measurement (dBuV)= Reading Level (dBuV) + Correct Factor(dB)

Correct Factor(dB)= LISN Voltage Division Factor (dB)+ Cable loss(dB)

Over Limit = Measurement – Limit

3.4 Radiated emission Test Data

9 kHz-30MHz:

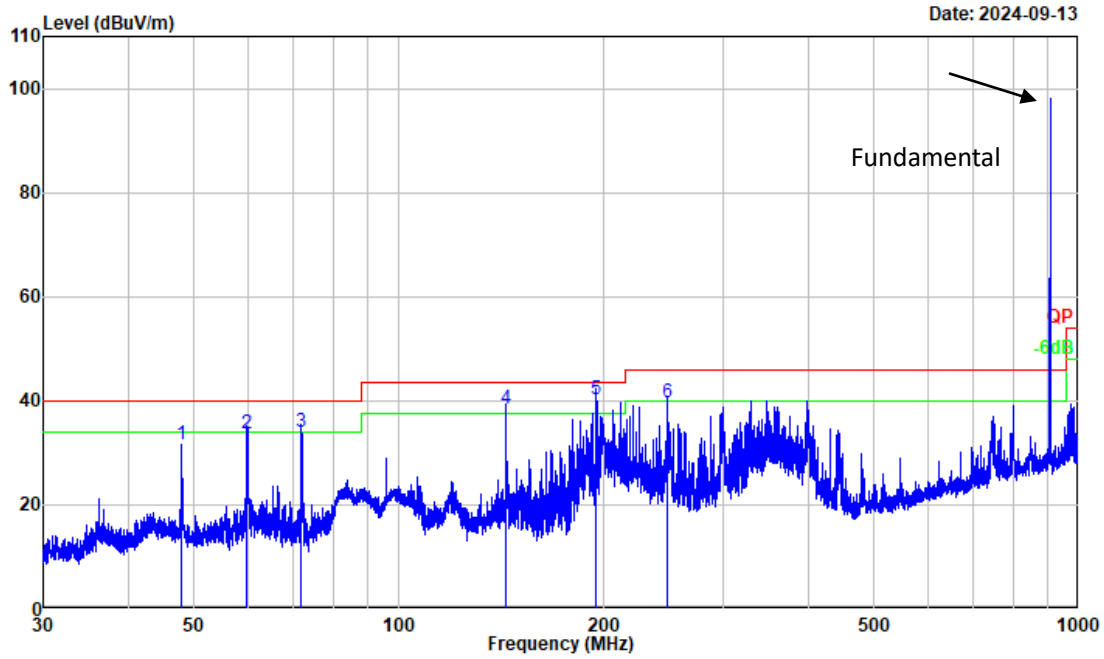
Test Date:	2024-09-13	**Test By:**	Bard Huang
Environment condition:	Temperature: 22.5°C; Relative Humidity:67%; ATM Pressure: 100kPa		

For radiated emissions below 30MHz, there were no emissions found within 20dB of limit.

30MHz-1GHz:

Test Date:	2024-09-13	Test By:	Bard Huang
Environment condition:	Temperature: 22.5°C; Relative Humidity:67%; ATM Pressure: 100kPa		

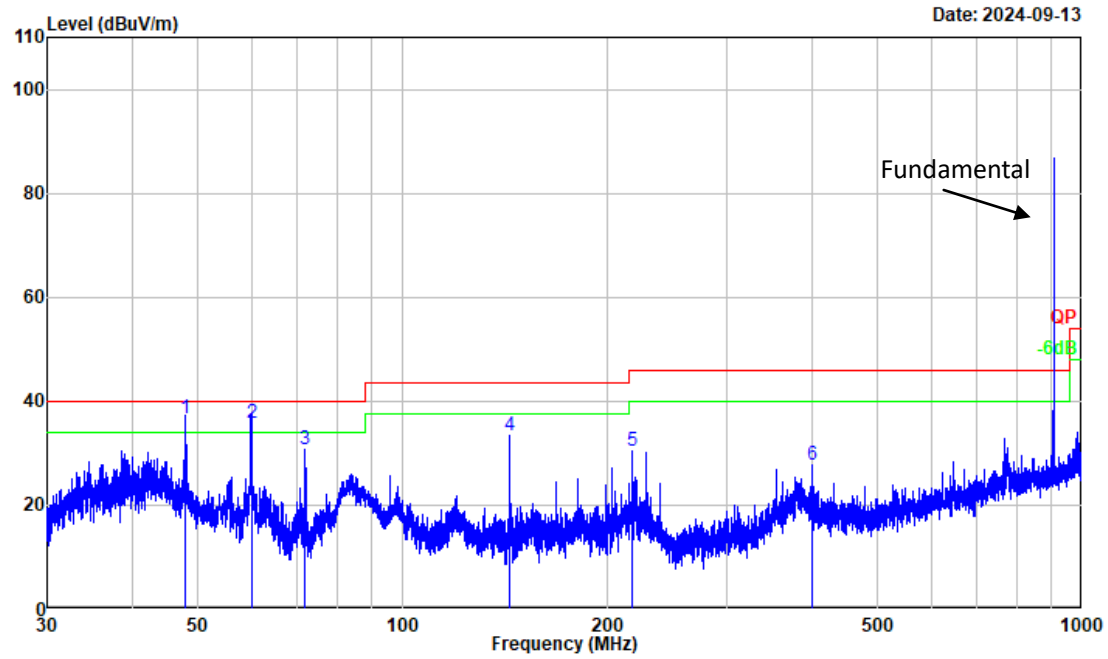
Power by battery



Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 22.5℃/67%R.H./100.0kPa
Tested by : Bard Huang
Polarization : horizontal
Remark : Lora 500K high channel

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	47.934	43.67	-12.15	31.52	40.00	-8.48	Peak
2	59.890	47.30	-13.59	33.71	40.00	-6.29	QP
3	71.934	50.70	-16.72	33.98	40.00	-6.02	QP
4	143.795	55.59	-17.13	38.46	43.50	-5.04	QP
5	195.439	53.60	-13.45	40.15	43.50	-3.35	QP
6	248.182	51.30	-11.70	39.60	46.00	-6.40	QP

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

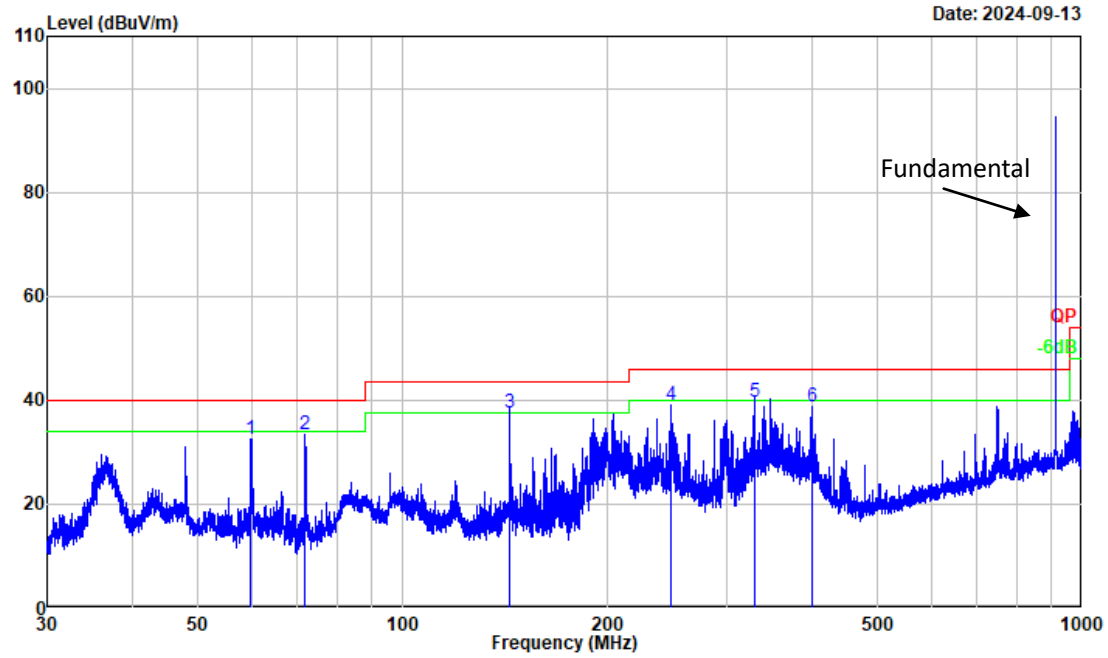


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 22.5℃/67%R.H./100.0kPa
Tested by : Bard Huang
Polarization : vertical
Remark : Lora 500K high channel

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	47.934	48.70	-12.15	36.55	40.00	-3.45	QP
2	59.917	49.30	-13.59	35.71	40.00	-4.29	QP
3	71.903	47.34	-16.71	30.63	40.00	-9.37	Peak
4	143.795	50.52	-17.13	33.39	43.50	-10.11	Peak
5	218.267	43.49	-12.96	30.53	46.00	-15.47	Peak
6	400.386	35.12	-7.35	27.77	46.00	-18.23	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

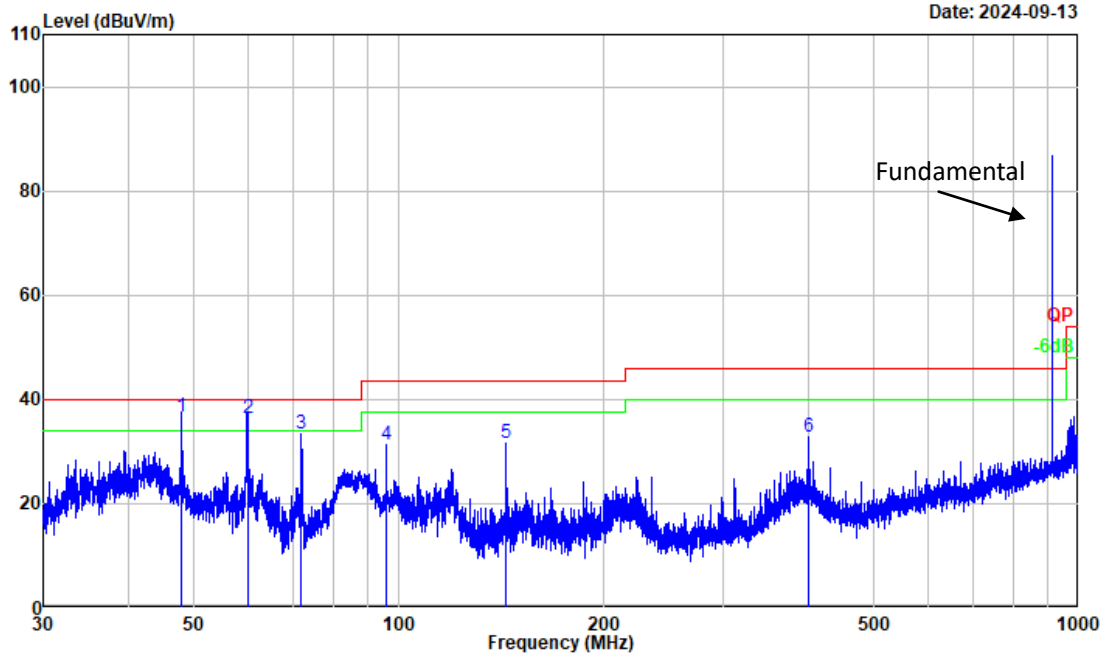
Power by External power



Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : DC 3.3V
Environment : 22.5℃/67%R.H./100.0kPa
Tested by : Bard Huang
Polarization : horizontal
Remark : Lora 500K high channel

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	59.864	46.21	-13.59	32.62	40.00	-7.38	Peak
2	71.871	50.22	-16.69	33.53	40.00	-6.47	Peak
3	143.921	54.80	-17.13	37.67	43.50	-5.83	QP
4	248.182	50.90	-11.70	39.20	46.00	-6.80	Peak
5	329.571	49.10	-9.40	39.70	46.00	-6.30	QP
6	400.913	46.25	-7.35	38.90	46.00	-7.10	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit



Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : DC 3.3V
Environment : 22.5℃/67%R.H./100.0kPa
Tested by : Bard Huang
Polarization : vertical
Remark : Lora 500K high channel

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	47.913	48.70	-12.15	36.55	40.00	-3.45	QP
2	59.917	50.00	-13.59	36.41	40.00	-3.59	QP
3	71.934	50.12	-16.72	33.40	40.00	-6.60	Peak
4	95.860	45.58	-14.36	31.22	43.50	-12.28	Peak
5	143.858	48.78	-17.13	31.65	43.50	-11.85	Peak
6	400.913	40.14	-7.35	32.79	46.00	-13.21	Peak

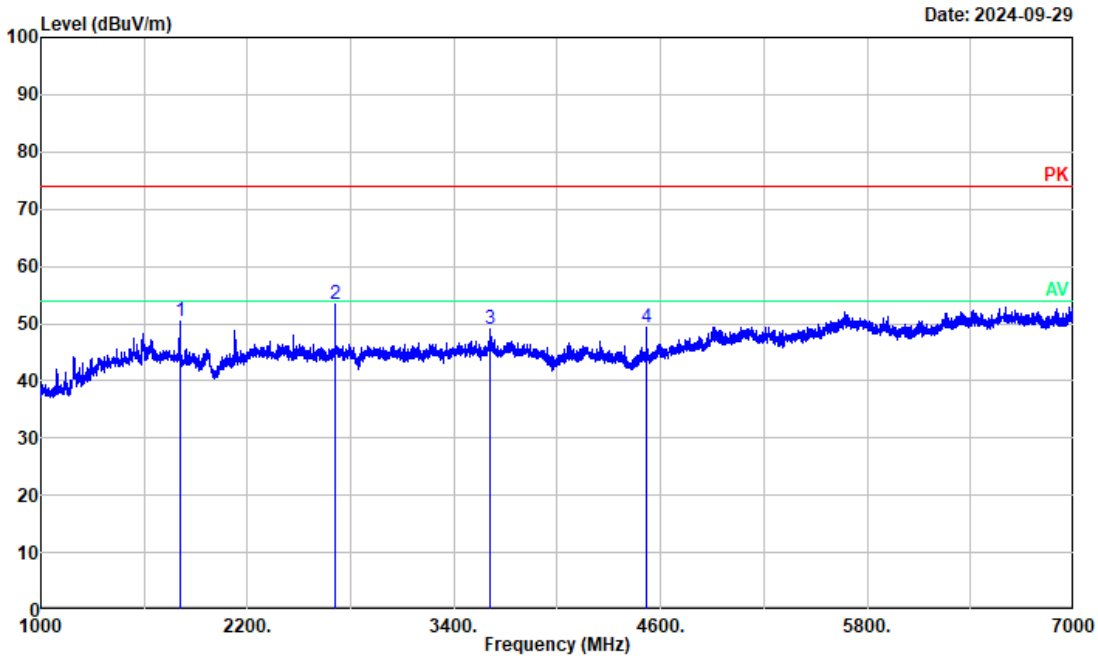
Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Above 1GHz:

Test Date:	2024-09-29	Test By:	Bard Huang
Environment condition:	Temperature: 23.3°C; Relative Humidity:61%; ATM Pressure: 100.3kPa		

Test plot for example as below:

Mode:	Lora	Channel:	903MHz

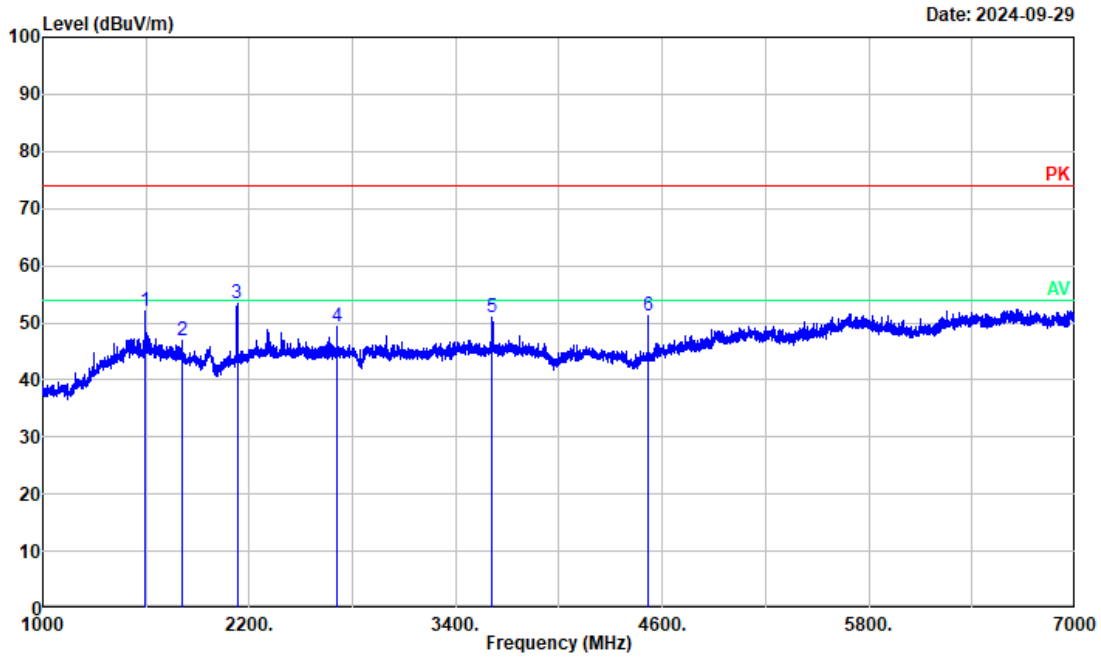


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : horizontal
Remark : 500K low channel 903Mhz

--No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Over Limit (dB)	Detector
1	1806.000	53.21	-2.75	50.46	74.00	-23.54	Peak
2	2709.000	55.33	-1.86	53.47	74.00	-20.53	Peak
3	3612.000	51.12	-2.10	49.02	74.00	-24.98	Peak
4	4515.000	53.15	-3.82	49.33	74.00	-24.67	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	903MHz

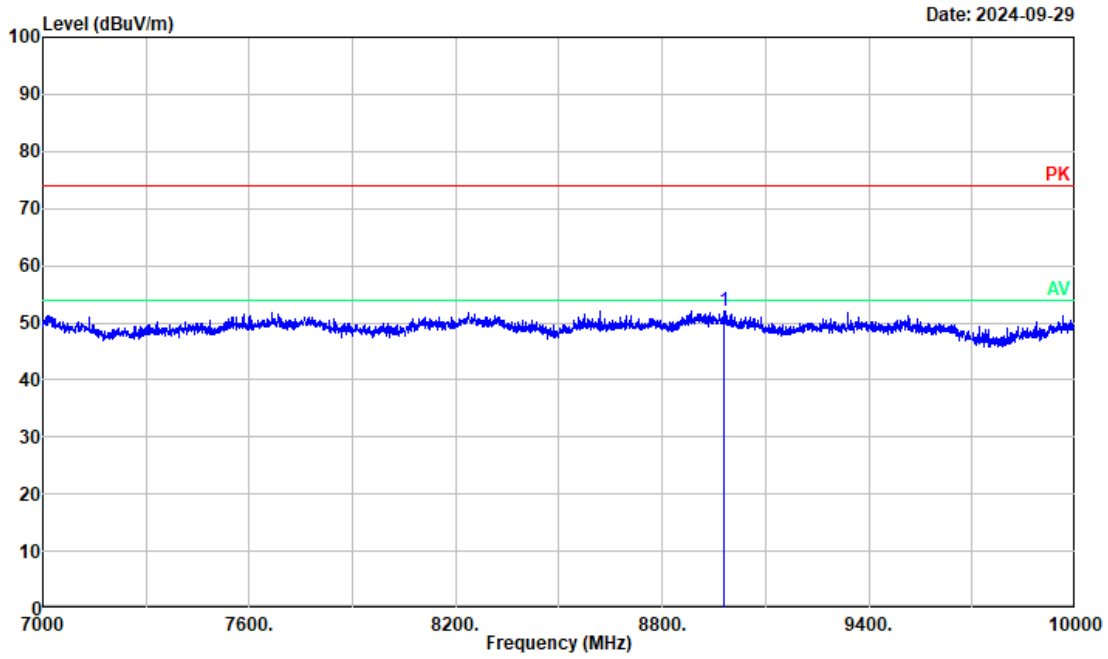


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : vertical
Remark : 500K low channel 903Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	1592.099	55.09	-3.11	51.98	74.00	-22.02	Peak
2	1806.000	49.58	-2.75	46.83	74.00	-27.17	Peak
3	2129.188	56.63	-3.11	53.52	74.00	-20.48	Peak
4	2709.000	51.30	-1.86	49.44	74.00	-24.56	Peak
5	3612.000	53.08	-2.10	50.98	74.00	-23.02	Peak
6	4515.000	54.99	-3.82	51.17	74.00	-22.83	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	903MHz

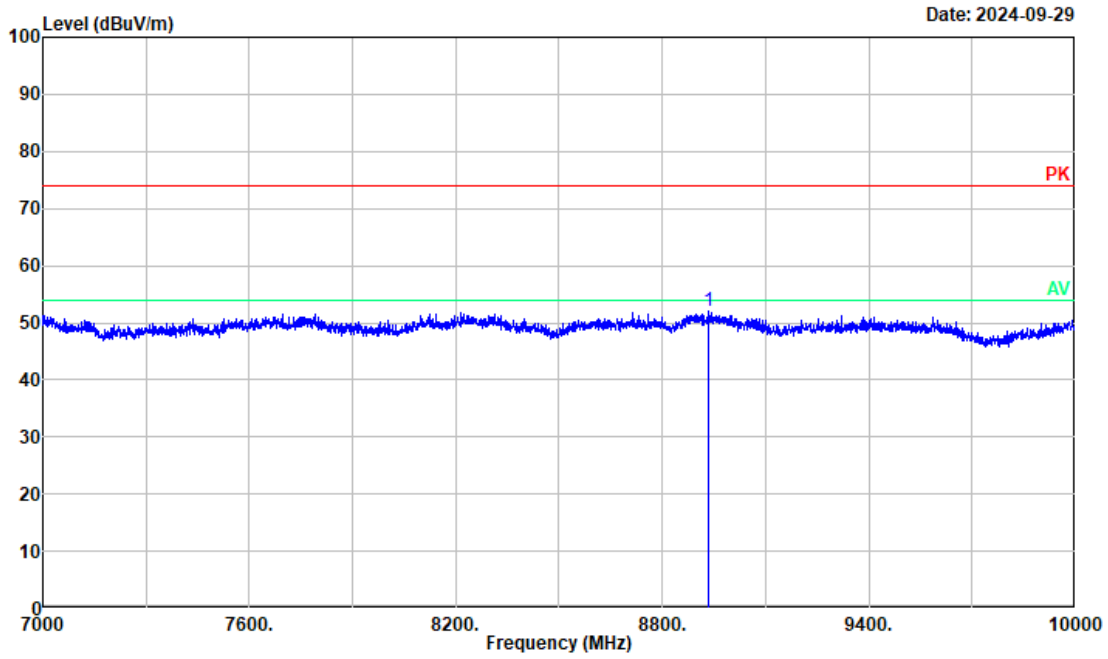


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : horizontal
Remark : 500K low channel 903Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	8978.659	51.01	1.03	52.04	74.00	-21.96	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	903MHz

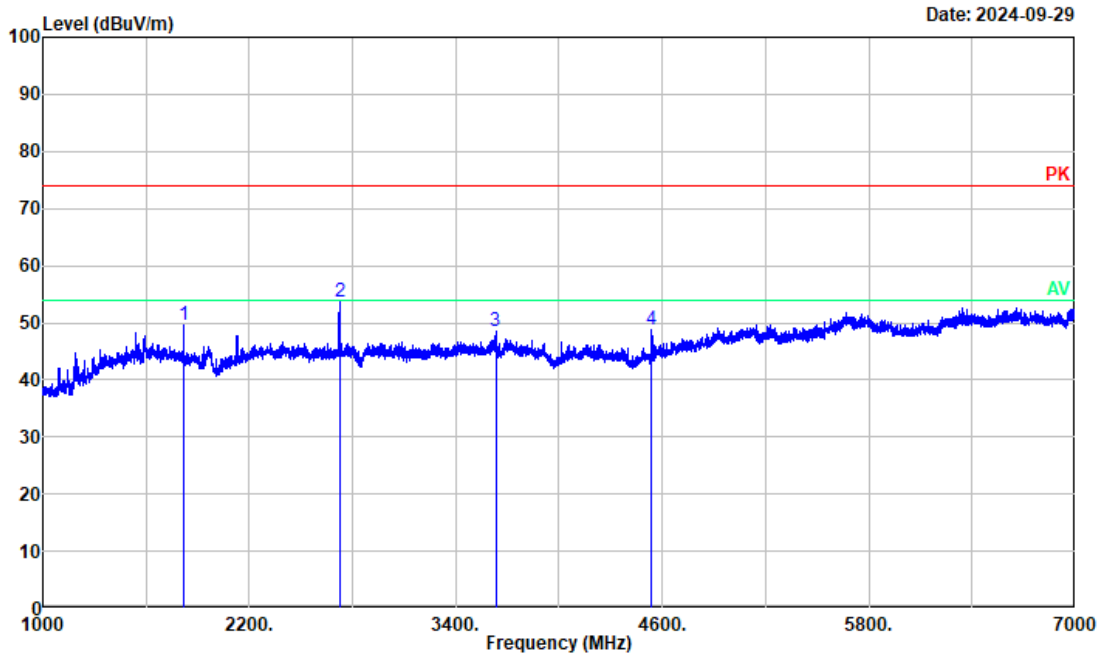


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : vertical
Remark : 500K low channel 903Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	8932.645	50.97	0.99	51.96	74.00	-22.04	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	907.8MHz

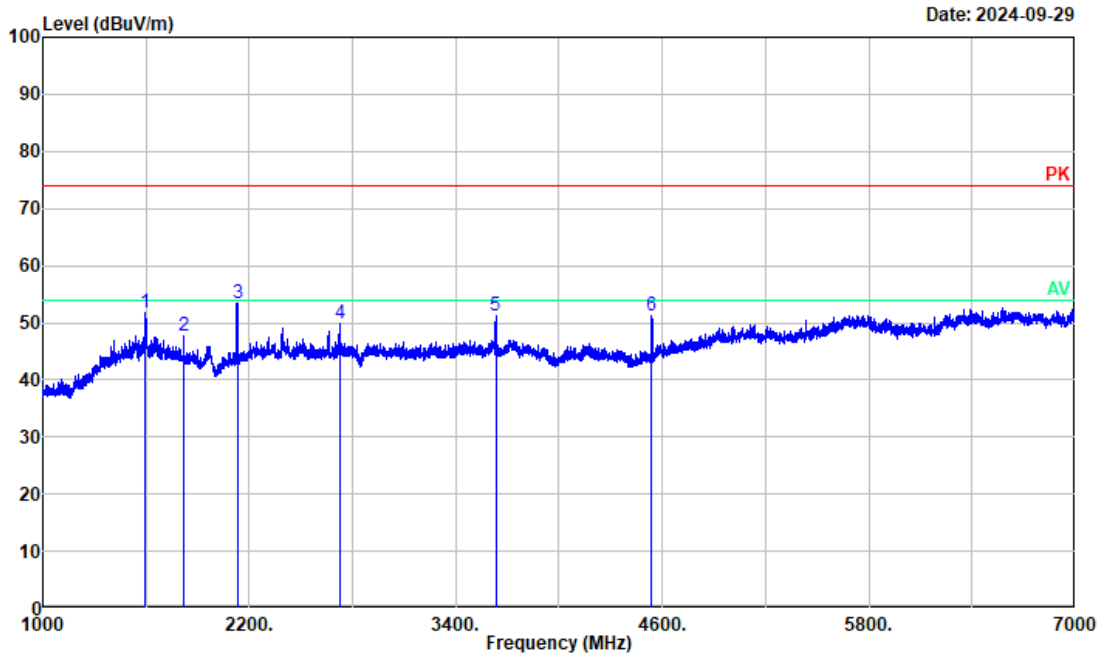


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : horizontal
Remark : 500K middle channel 907.8Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	1815.600	52.41	-2.79	49.62	74.00	-24.38	Peak
2	2723.400	55.63	-1.87	53.76	74.00	-20.24	Peak
3	3631.200	50.57	-2.13	48.44	74.00	-25.56	Peak
4	4539.000	52.35	-3.45	48.90	74.00	-25.10	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	907.8MHz

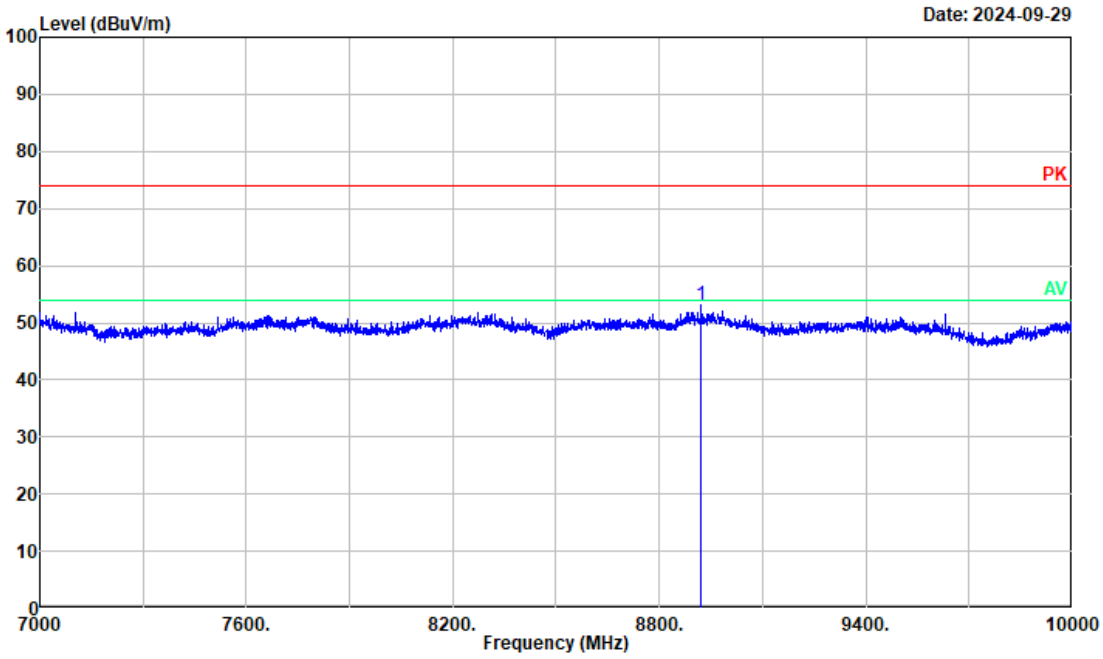


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : vertical
Remark : 500K middle channel 907.8Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	1597.099	54.78	-3.07	51.71	74.00	-22.29	Peak
2	1815.600	50.36	-2.79	47.57	74.00	-26.43	Peak
3	2130.188	56.47	-3.11	53.36	74.00	-20.64	Peak
4	2723.400	51.65	-1.87	49.78	74.00	-24.22	Peak
5	3631.200	53.36	-2.13	51.23	74.00	-22.77	Peak
6	4539.000	54.61	-3.45	51.16	74.00	-22.84	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	907.8MHz

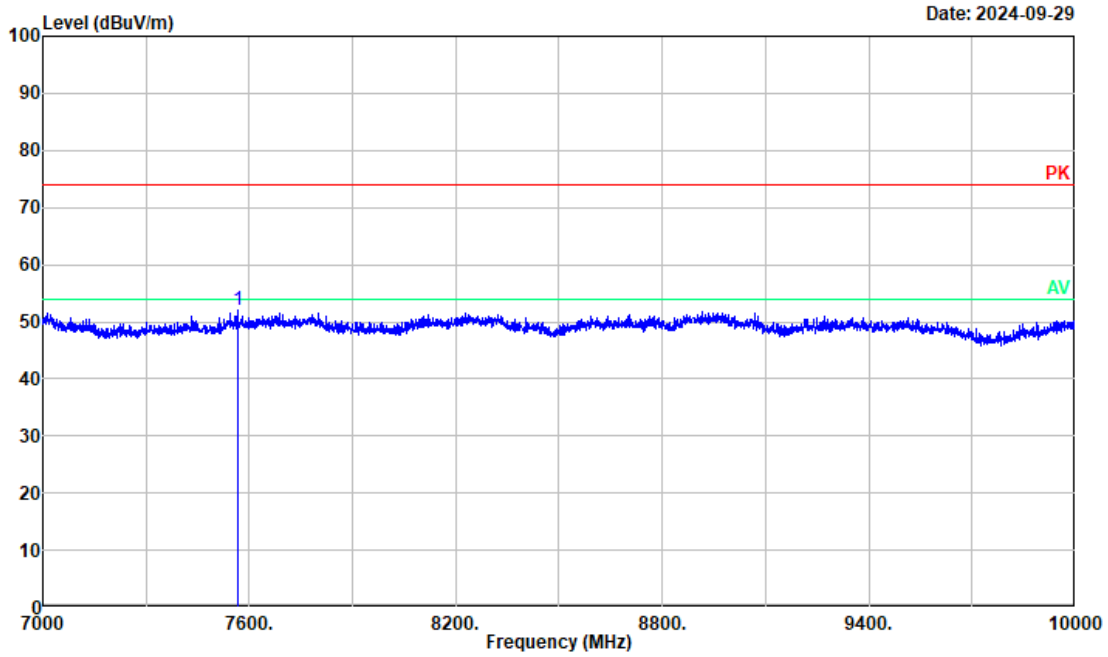


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : horizontal
Remark : 500K middle channel 907.8Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	8921.641	52.09	1.01	53.10	74.00	-20.90	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	907.8MHz

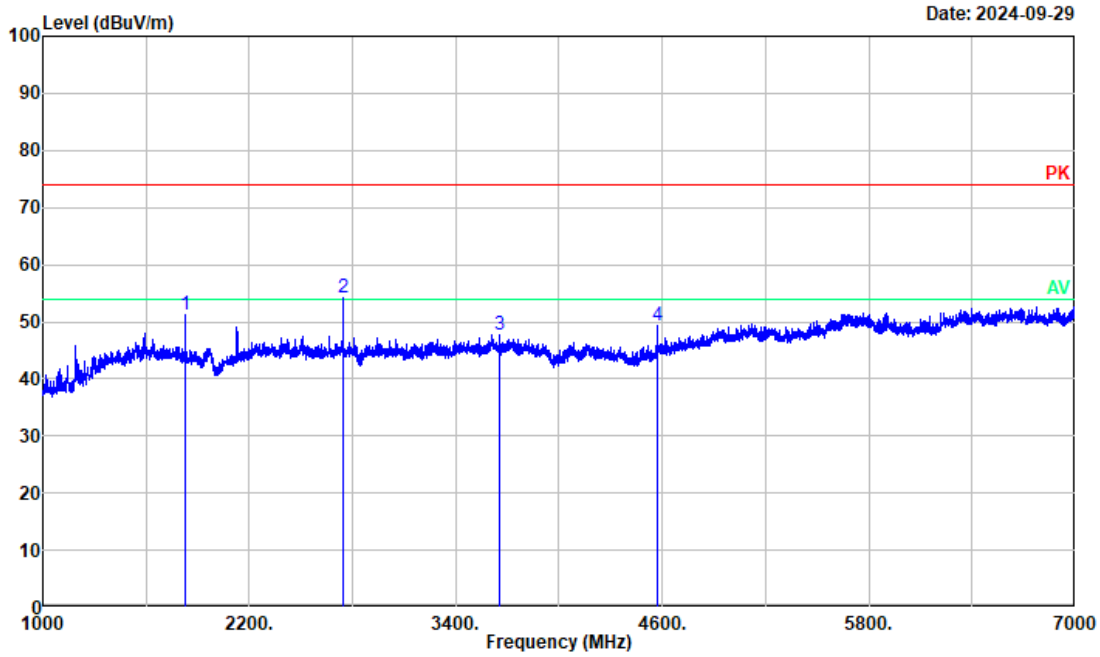


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : vertical
Remark : 500K middle channel 907.8Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	7565.188	53.42	-1.37	52.05	74.00	-21.95	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	914.2MHz

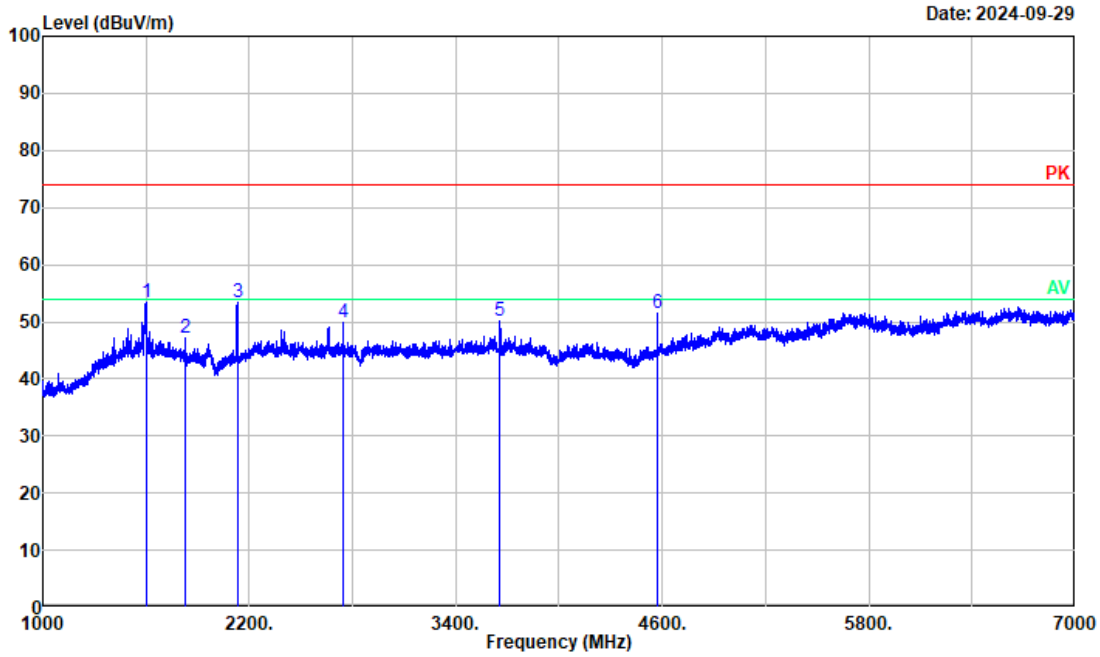


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : horizontal
Remark : 500K high channel 914.2Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	1828.400	54.14	-2.84	51.30	74.00	-22.70	Peak
2	2742.600	56.02	-1.86	54.16	74.00	-19.84	Peak
3	3656.800	49.77	-2.18	47.59	74.00	-26.41	Peak
4	4571.000	52.31	-3.03	49.28	74.00	-24.72	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	914.2MHz

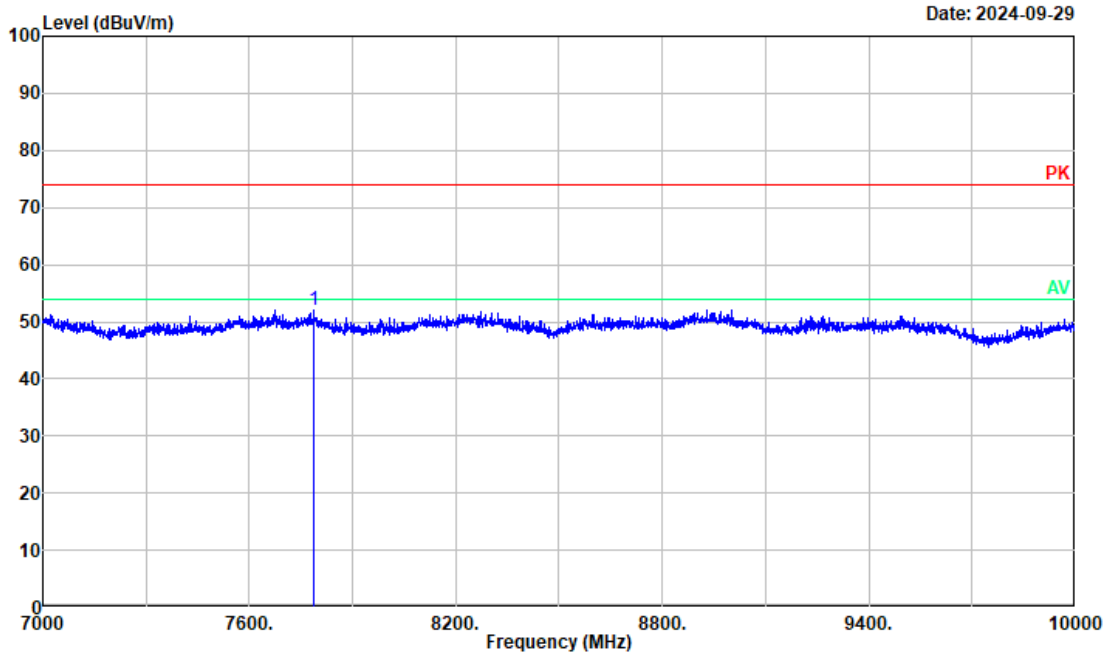


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : vertical
Remark : 500K high channel 914.2Mhz

--No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Over Limit (dB)	Detector
1	1599.100	56.53	-3.07	53.46	74.00	-20.54	Peak
2	1828.400	49.86	-2.84	47.02	74.00	-26.98	Peak
3	2132.189	56.40	-3.10	53.30	74.00	-20.70	Peak
4	2742.600	51.71	-1.86	49.85	74.00	-24.15	Peak
5	3656.800	52.19	-2.18	50.01	74.00	-23.99	Peak
6	4571.000	54.54	-3.03	51.51	74.00	-22.49	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	914.2MHz

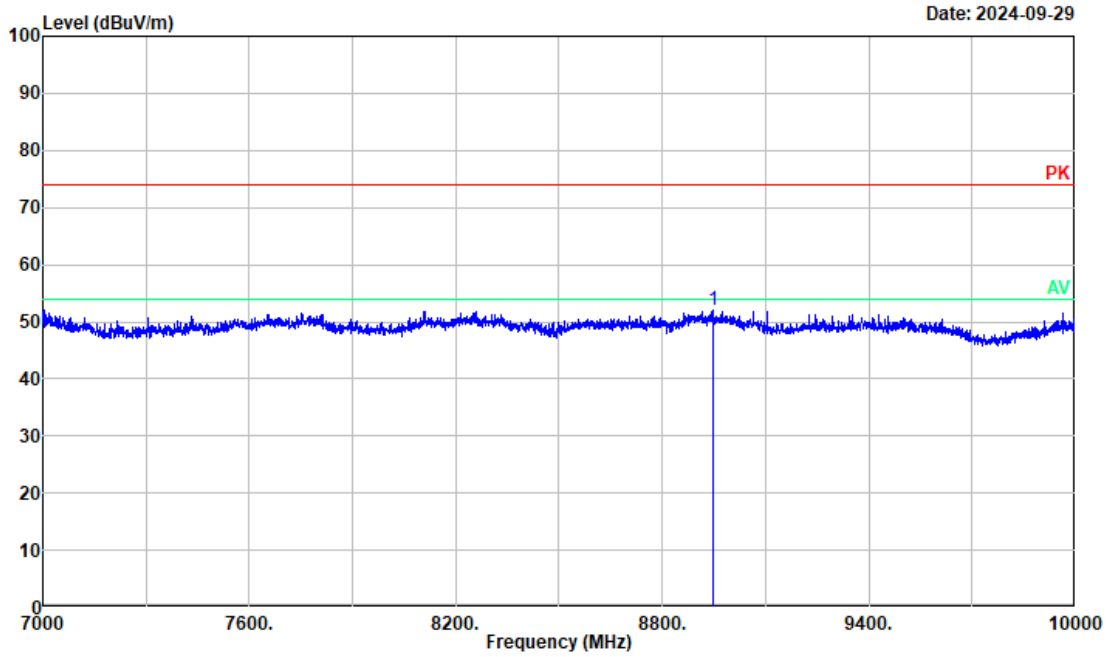


Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : horizontal
Remark : 500K high channel 914.2Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	7786.262	52.56	-0.39	52.17	74.00	-21.83	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

Mode:	Lora	Channel:	914.2MHz



Project No. : 2405X62415E
Test Mode : Transmitting
Test Voltage : Power by battery
Environment : 23.3℃/61%R.H./100.3kPa
Tested by : Bard Huang
Polarization : vertical
Remark : 500K high channel 914.2Mhz

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	8945.648	51.07	0.99	52.06	74.00	-21.94	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain
Result = Reading + Factor
Over Limit = Result - Limit

3.5 RF Conducted Test Data

Test Date:	2024-09-30~2024-10-18	Test By:	Ryan Zhang
Environment condition:	Temperature: 25.3~25.5°C; Relative Humidity:47~50%; ATM Pressure: 100.3~100.5kPa		

3.5.1 6 dB Emission Bandwidth and 99% Occupied Bandwidth

Test Mode	Channel[MHz]	6dB BW [MHz]	99% OBW[MHz]	6dB BW Limit[MHz]	Verdict
Lora-DTS	903.0	0.632	0.499	0.5	Pass
	907.8	0.627	0.508	0.5	Pass
	914.2	0.627	0.505	0.5	Pass

3.5.2 Maximum Conducted Peak Output Power

Test Mode	Channel [MHz]	Result [dBm]	Limit [dBm]	Verdict
Lora-DTS	903.0	9.86	30	Pass
	907.8	9.93	30	Pass
	914.2	10.06	30	Pass

3.5.3 Power Spectral Density

Test Mode	Channel [MHz]	Result [dBm/3kHz]	Limit [dBm/3kHz]	Verdict
Lora-DTS	903.0	-0.82	8	Pass
	907.8	-0.09	8	Pass
	914.2	-0.26	8	Pass

3.5.4 100 kHz Bandwidth of Frequency Band Edge

Test Mode	Channel [MHz]	Result [dBc]	Limit [dBc]	Verdict
Lora-DTS	903.0	47.42	20	Pass
	914.2	53.51	20	Pass

3.5.5 Duty Cycle

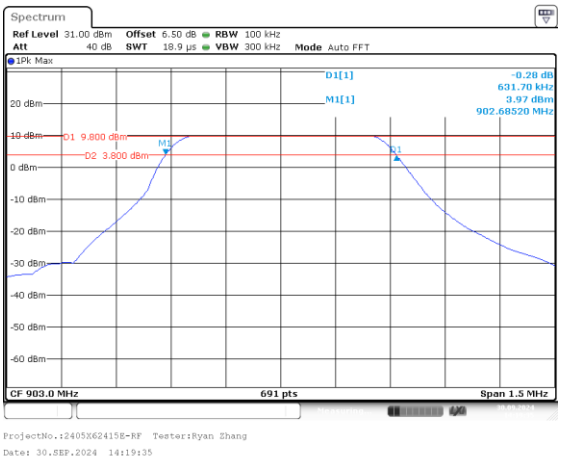
Test Mode	Channel	Ton (ms)	Ton+off (ms)	Duty Cycle [%]	1/T [Hz]	VBW setting [Hz]
Lora-DTS	907.8	25.95	66.675	38.92	38.54	50

Duty Cycle = Ton/(Ton+Toff)*100%

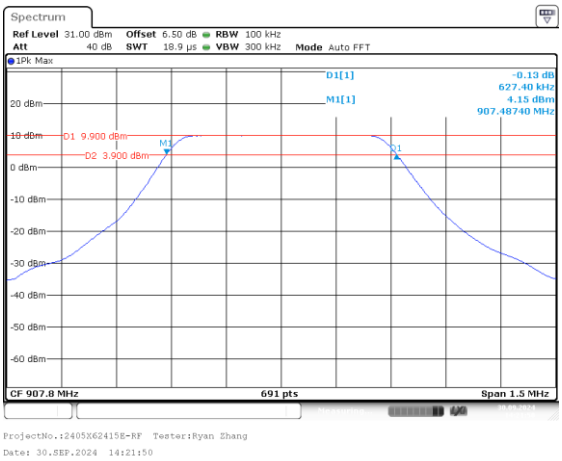
Test Plots:

6 dB Emission Bandwidth:

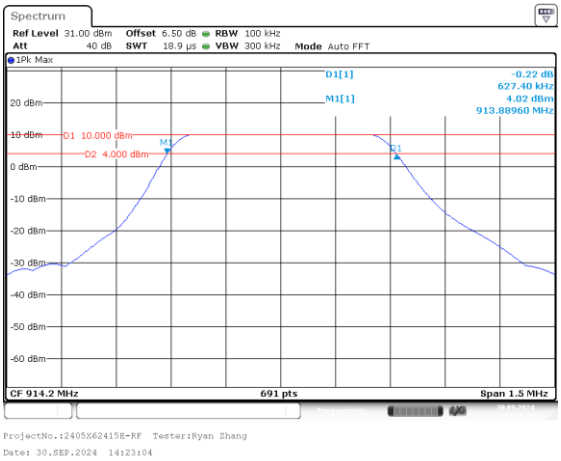
Low



Middle

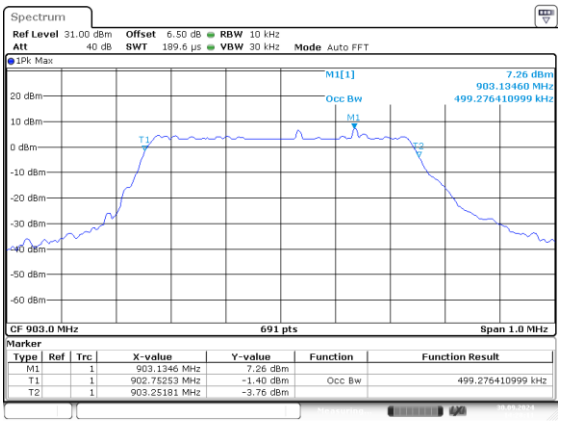


High

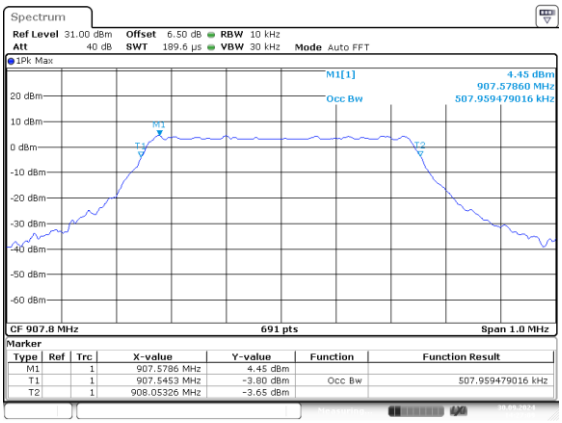


99% Occupied Bandwidth:

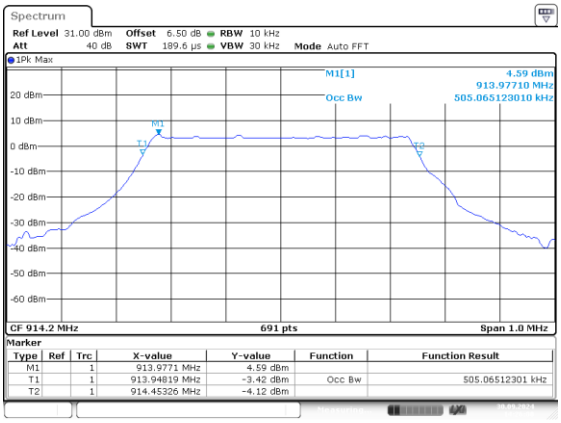
Low



Middle

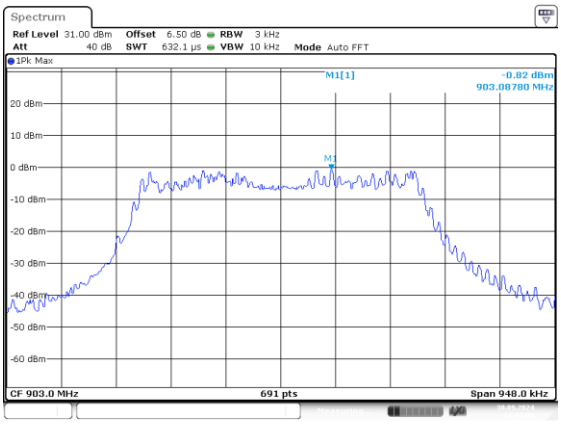


High

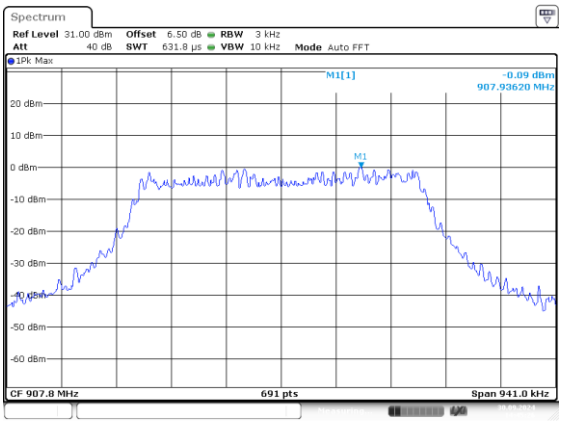


Power Spectral Density:

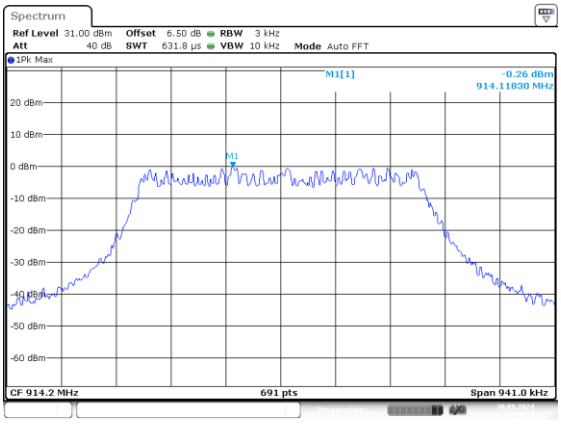
Low



Middle

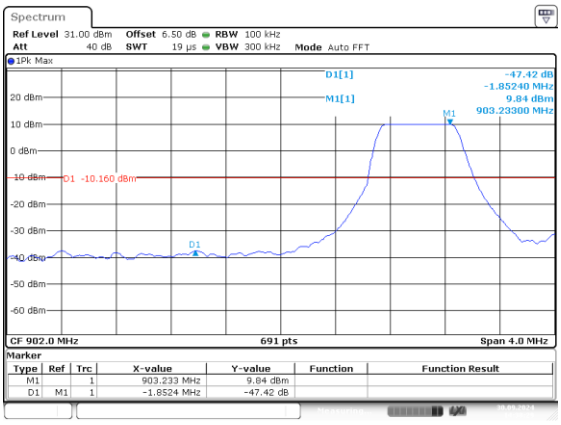


High

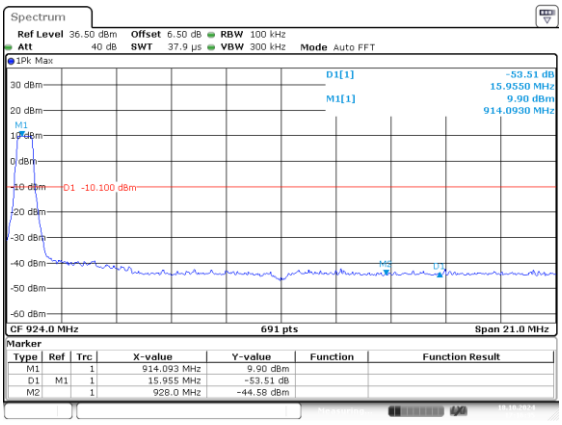


100kHz Bandwidth of Frequency Band Edge:

Low

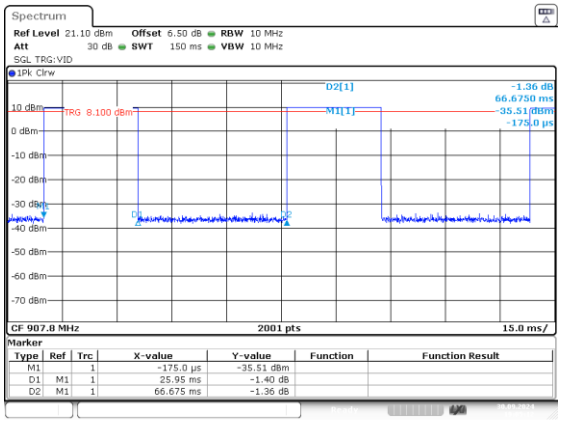


High



Duty Cycle:

Middle



4 Test Setup Photo

Please refer to the attachment 2405X62415E Test Setup photo.

5 E.U.T Photo

Please refer to the attachment 2405X62415E External photo and 2405X62415E Internal photo.

---End of Report---