

FCC Test Report

Report No.:2405X67746ECApplicane:Dragino Technology Co., Limited.Address:Room 202,BaoChengTai industrial park,No.8 CaiYun LongCheng
Street,LongGang District,Shenzhen ChinaProduct Name:LoRaWAN CO2 SensorProduct Model:AQS01-LMultiple Models:N/AFCC ID:ZHZAQS01-LStandards:FCC FR Title 47 Part 15C (§15.247)Test Pate:024-09-13 to 2024-09-26Report Name:2024-09-29

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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Revision History

Version No.	/ersion No. Issued Date D	
00	2024-09-29	Original



Contents

1	Gen	eral Info	rmation	. 4
	1.1	Client	Information	. 4
	1.2	Produ	ct Description of EUT	. 4
	1.3	Anten	na information	. 4
	1.4	Relate	ed Submittal(s)/Grant(s)	. 5
	1.5	Measu	rement Uncertainty	. 5
	1.6	Labora	atory Location	. 5
	1.7	Test M	lethodology	. 5
2	Des	cription of	of Measurement	. 6
	2.1	Test C	onfiguration	. 6
	2.2	Test A	uxiliary Equipment	. 6
	2.3	Interco	onnecting Cables	. 6
	2.4	Block	Diagram of Connection between EUT and AE	. 7
	2.5	Test S	etup	. 7
	2.6	Test P	rocedure	. 9
	2.7	Measu	rement Method	10
	2.8	Measu	Irement Equipment	11
3	Tes	t Results		12
	3.1	Test S	ummary	12
	3.2	Limit		13
	3.3	AC Lir	ne Conducted Emissions Test Data	14
	3.4	Radiat	ted emission Test Data	15
	3.5	RF Co	nducted Test Data	28
		3.5.1	20 dB Emission Bandwidth	28
		3.5.2	99% Occupied Bandwidth	28
		3.5.3	Maximum Conducted Peak Output Power	28
		3.5.4	Channel separation	28
		3.5.5	Number of hopping Frequency	29
		3.5.6	Time of occupancy (dwell time)	29
		3.5.7	100 kHz Bandwidth of Frequency Band Edge	29
4	Tes	t Setup P	hoto	35
5	E.U.	.T Photo		36

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 CO2 Sensor that contains BLE and LoRa radios, this report covers the full testing of the LoRa radio.

Sample Serial Number	2R1C-3 for RE test, 2R1C-4 for RF conducted test (assigned by WATC)
Sample Received Date	2024-09-05
Sample Status	Good Condition
Frequency Range	902.3MHz-914.9MHz
Maximum Conducted Peak Output Power	10.76dBm
Modulation Technology	CSS
Spatial Streams	SISO (1TX, 1RX)
Antenna Gain [#]	0.61dBi
Power Supply	DC 3.6V from battery
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: DTS, FCC ID: ZHZAQS01-L

1.5 Measurement Uncertainty

Parameter		Expanded Uncertainty (Confidence of 95%(U = 2Uc(y)))	
AC Power Lines Condu	cted Emissions	±3.14dB	
	Below 30MHz	±2.78dB	
Emissions, Radiated	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			

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: <u>qa@watc.com.cn</u>

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 DTS Meas Guidance v05r02 ANSI C63.10-2020



2 Description of Measurement

2.1 Test Configuration

Operating channels:								
Channel No.	Frequency (MHz)	Channel No.	Frequenc (MHz)	y Chanr No.	nel F	Frequency (MHz)	Channe No.	I Frequency (MHz)
1	902.3	17	905.5	33		908.7	49	911.9
2	902.5	18	905.7	34		908.9	50	912.1
15	905.1	31	908.3	47		911.5	63	914.7
16	905.3	32	908.5	48		911.7	64	914.9
channel, and	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			ŀ	lighest ch	annel
Channel No	Frequer (MHz	· (,	hannel No.	•	Frequency (MHz)		l No.	Frequency (MHz)
1	902.3	3	33 908.7		64		914.9	

Test Mode:					
Transmitting mode:	g mode: The system was configured for testing in Engineering Mode, which was provided by the manufacturer.				
Exercise software [#] :	Exercise software [#] : Serial Port Utility				
Mode	Data rate	Power Level Setting [#]			
Wode	Dala Tale	Low Channel	Middle Channel	High Channel	
Lora-125K	/	10	10	10	
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 radiated emission 9kHz-30MHz was performed with the EUT transmits at the channel with highest output power as worst-case scenario.

2.2 Test Auxiliary Equipment

Manufacturer Description		Model	Serial Number
/	/	/	/

2.3 Interconnecting Cables

Manufacturer	Description	Length(m)	From	То
/	/	/	/	/

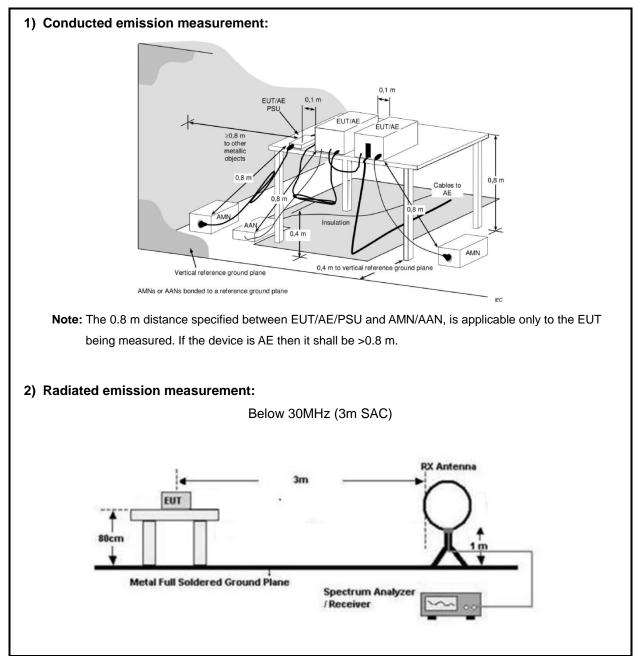


2.4 Block Diagram of Connection between EUT and AE

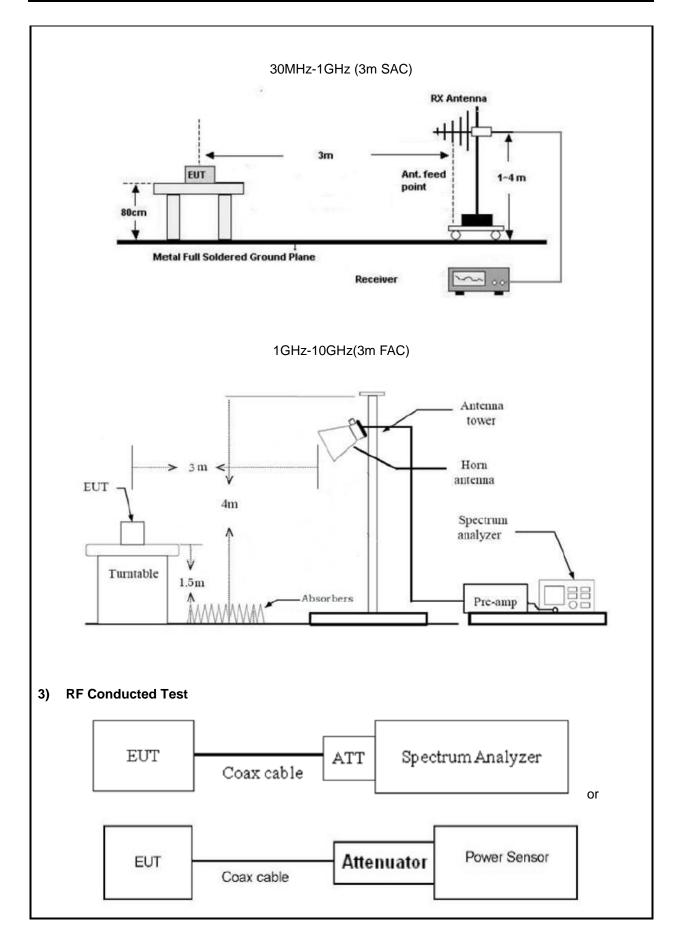


Note: for reference only, the actual connection setup used for testing please refer to the test photos.

2.5 Test Setup









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

- 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.
- 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 power meter. 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 7.8.5	
20 dB Emission Bandwidth	ANSI C63.10-2020 Section 6.9.2	
99% Occupied Bandwidth	ANSI C63.10-2020 Section 6.9.3	
Channel separation	ANSI C63.10-2020 Section 7.8.2	
Number of hopping Frequency	ANSI C63.10-2020 Section 7.8.3	
Time of occupancy (dwell time)	ANSI C63.10-2020 Section 7.8.4	
100kHz Bandwidth of Frequency Band Edge	ANSI C63.10-2020 Section 7.8.7.2&6.10	
Radiated emission	ANSI C63.10-2020 Section 7.8.8&6.3&6.4&6.5&6.6	

2.8 Measurement Equipment

Manufacturer	Description	Model	Management No.	Calibration Date	Calibration Due Date		
	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		
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	FSU-26	200680/026	2024/6/4	2025/6/3		
MEEA	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

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	N/A
§15.247 (a)(1)(i)	20dB Emission Bandwidth	Compliance
-	99% Occupied Bandwidth	Report only
§15.247 (a)(1)(i)	Channel separation	Compliance
§15.247 (a)(1)(i)	Number of hopping Frequency	Compliance
§15.247 (a)(1)(i)	Time of occupancy (dwell time)	Compliance
§15.247(b)(2)	Maximum Conducted Output Power	Compliance
§15.247(d)	§15.247(d) 100kHz Bandwidth of Frequency Band Edge	
§15.205, §15.209, §15.247(d)	Radiated emission	Compliance

N/A: the device only powered by battery.



3.2 Limit

Test items	Limit
AC Line Conducted Emissions	See details §15.207 (a)
Conducted Output Power	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.
20dB Emission Bandwidth Channel separation Number of hopping Frequency Time of occupancy (dwell time)	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.
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 §15.209(a) (see §15.205(c)).



3.3 AC Line Conducted Emissions Test Data

Not Applicable, the device only powered by battery



3.4 Radiated emission Test Data

9 kHz-30MHz:

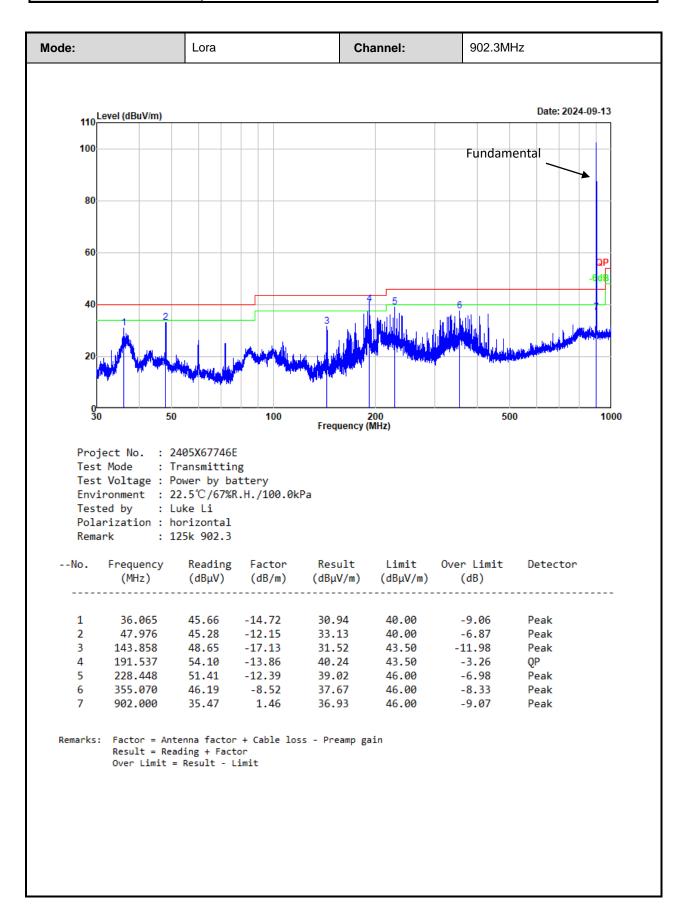
Test Date:	2024-09-13~2024-09-14	Test By:	Luke Li
Environment condition:	Temperature: 22.5°C; Relative Humidity:67%; ATM Pressure: 100.0kPa		essure: 100.0kPa

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

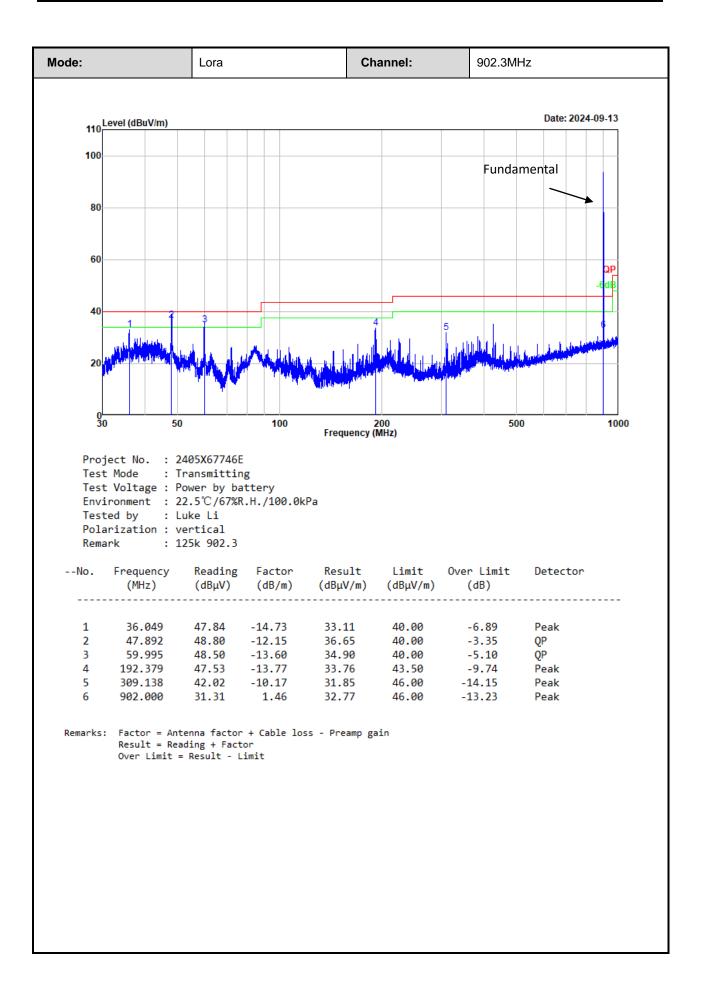


30MHz-1GHz:

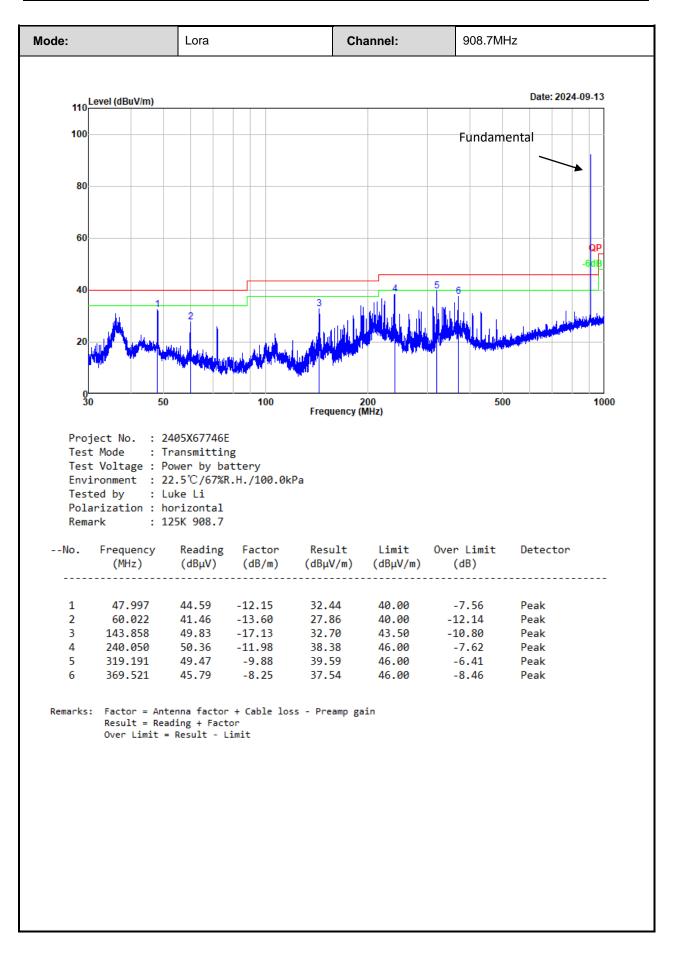
Test Date:	2024-09-13~2024-09-14	Test By:	Luke Li
Environment condition:	Temperature: 22.5°C; Relative	Humidity:67%; ATM Pr	essure: 100.0kPa



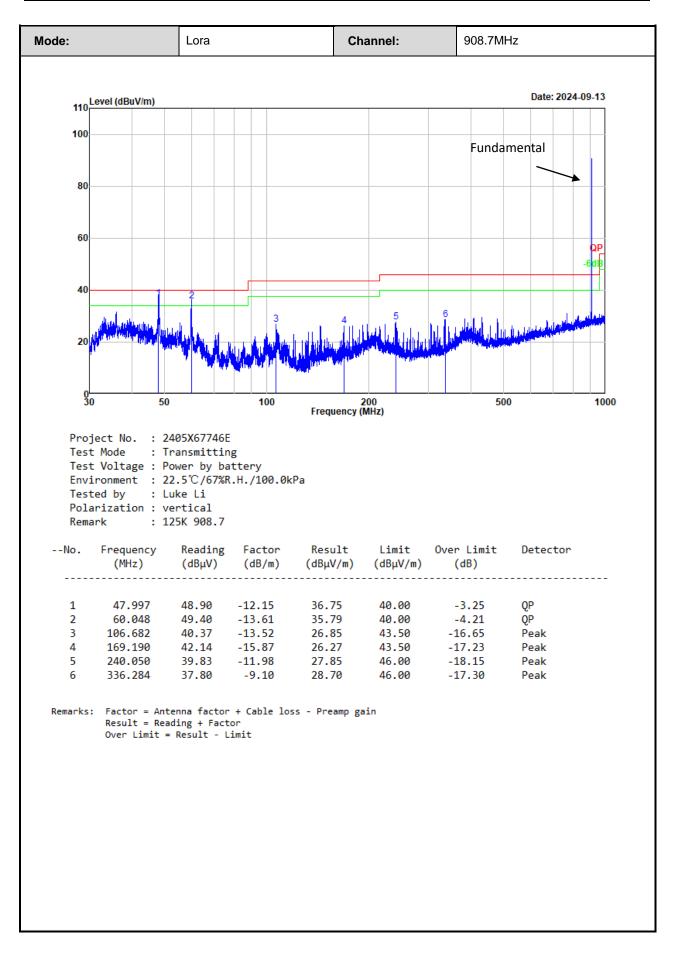




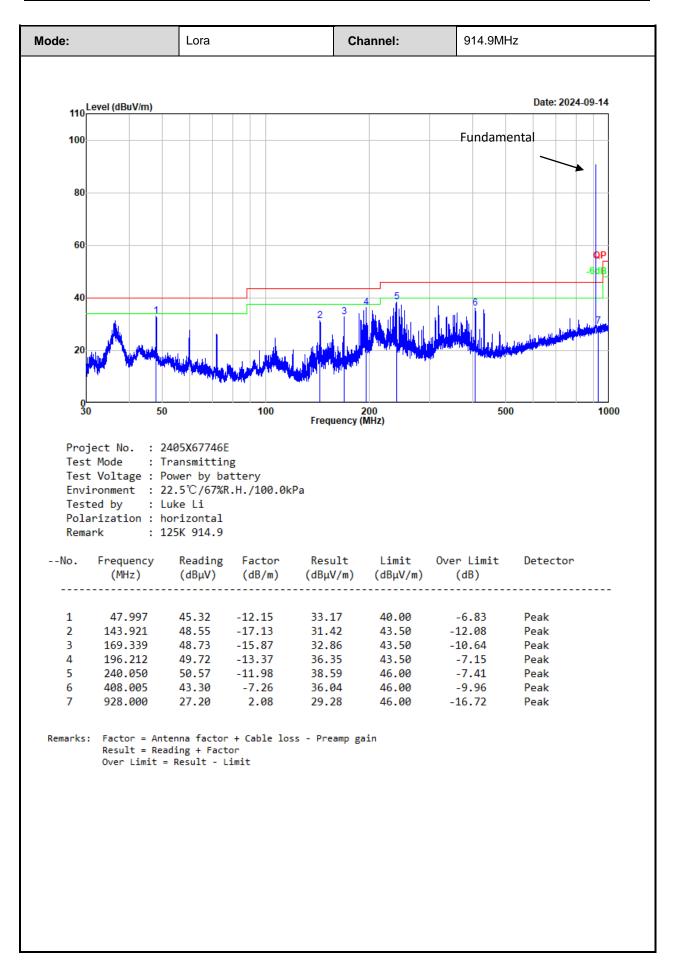




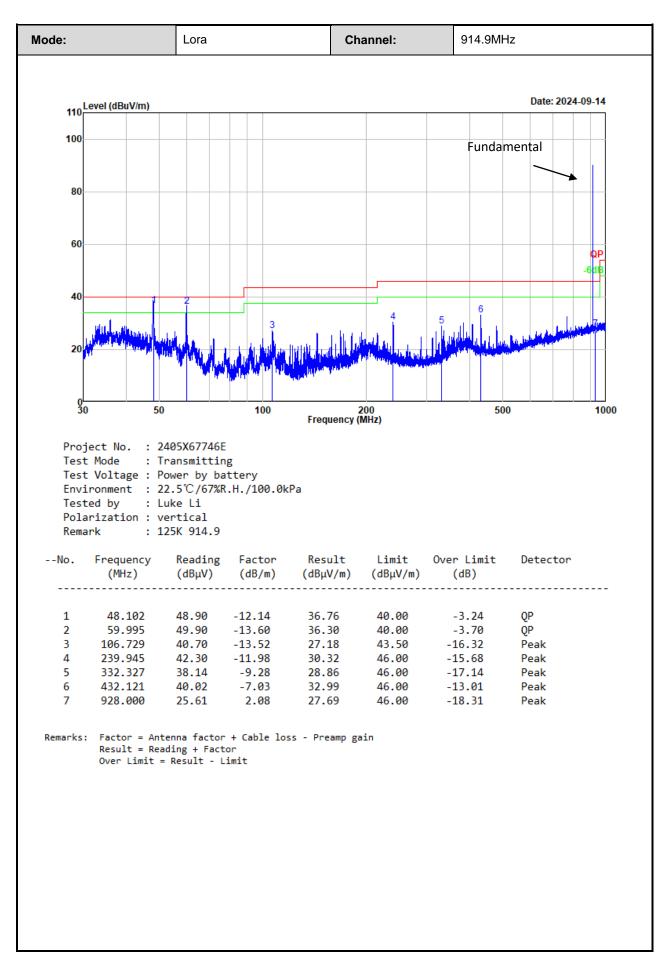








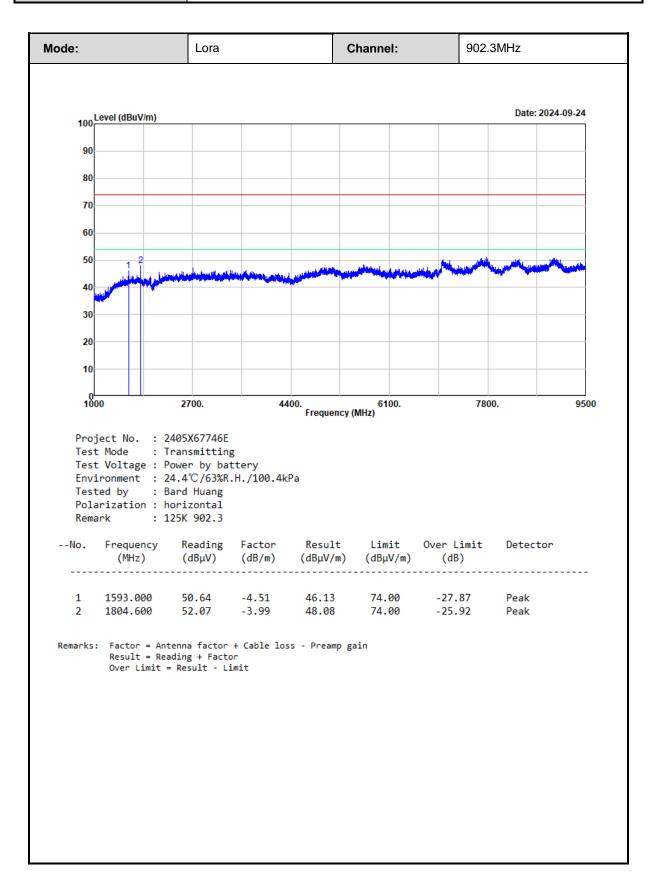




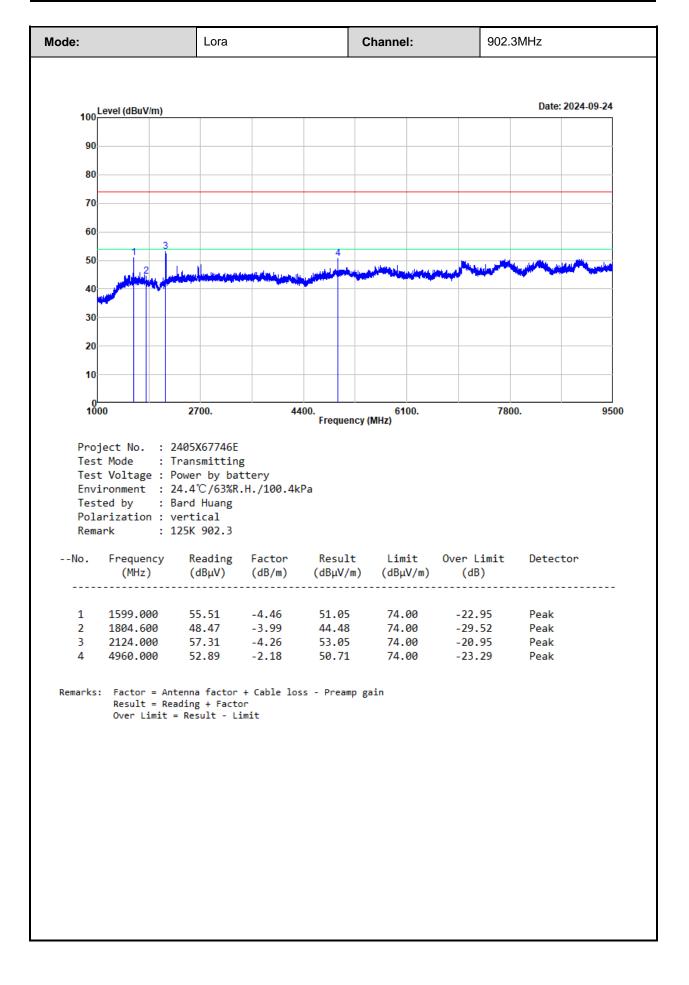


Above 1GHz:

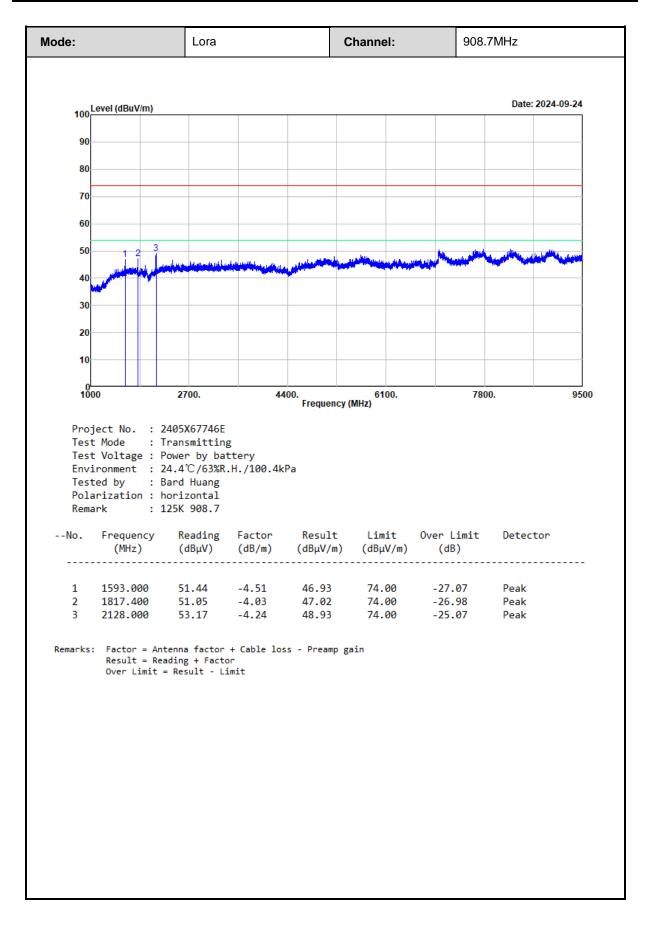
Test Date:	2024-09-24	Test By:	Bard Huang
Environment condition:	Temperature: 24.4°C; Relative	Humidity:63%; ATM P	ressure: 100.4kPa



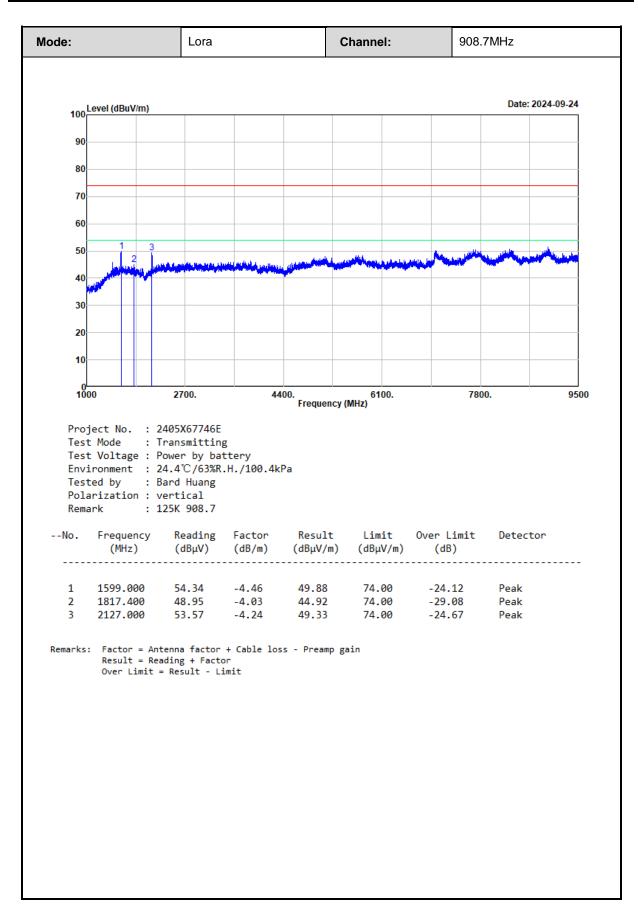




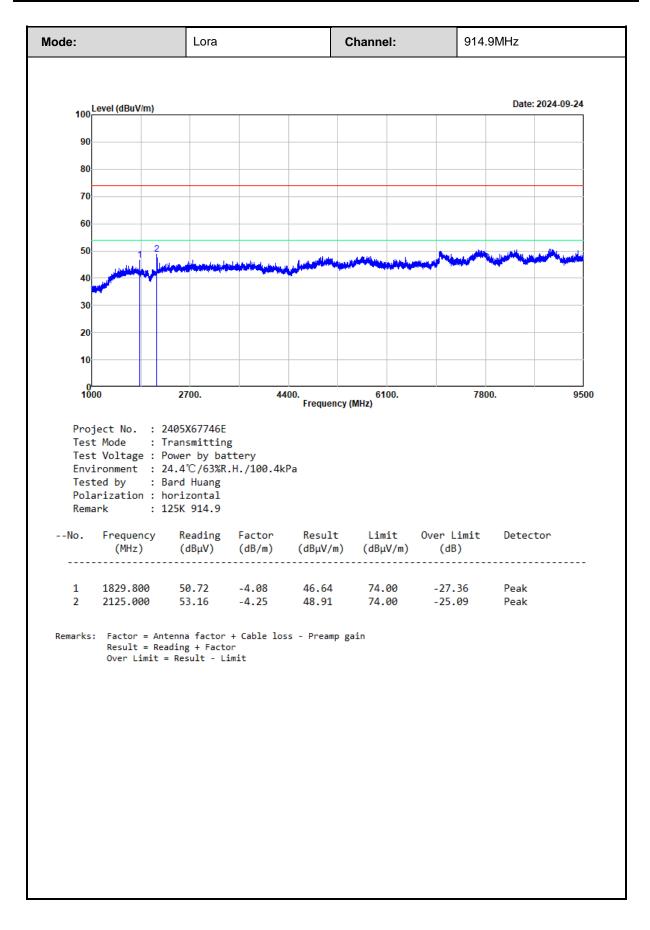




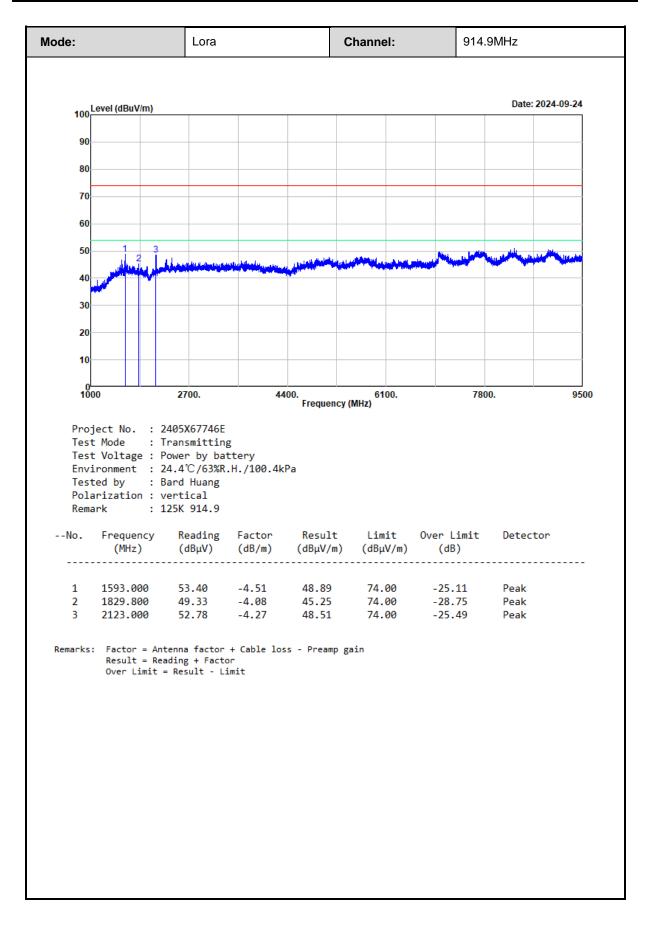














3.5 RF Conducted Test Data

Test Date:	2024-09-26	Test By:	Ryan Zhang
Environment condition:	Temperature: 25.6°C;Relative	lumidity:48%; ATM Pres	sure: 100.9kPa

3.5.1 20 dB Emission Bandwidth

Mode	Value (MHz)	Limit (MHz)
Low	0.138	<0.250
Middle	0.138	<0.250
High	0.141	<0.250

3.5.2 99% Occupied Bandwidth

Mode	99% OBW (MHz)
Low	0.126
Middle	0.126
High	0.126

3.5.3 Maximum Conducted Peak Output Power

Mode	Value (dBm)	Limit (dBm)	Result
Low	10.76	30.00	Pass
Middle	10.57	30.00	Pass
High	10.42	30.00	Pass

3.5.4 Channel separation

Mode	Value	Limit	Result
	(MHz)	(MHz)	



Mode	Value (MHz)	Limit (MHz)	Result
Low	0.200	>0.138	Pass
Middle	0.200	>0.138	Pass
High	0.200	>0.141	Pass

3.5.5 Number of hopping Frequency

Mode	Value	Limit	Result	
Hopping	64	>50	Pass	

3.5.6 Time of occupancy (dwell time)

Mode	Pulse width (ms)	Hopping Numbers in Observation time	Dwell time (s)	Limit (s)	Result
Hopping	375	1	0.375	0.400	Pass

Note:

Dwell time =Pulse* Hopping Numbers in Observation time Observation time is 20S

3.5.7 100 kHz Bandwidth of Frequency Band Edge

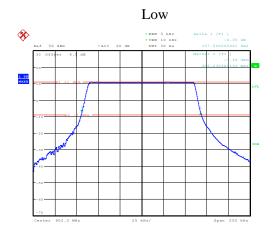
Mode	Value (dB)	Limit (dB)	Result
Low	45.58	20.00	Pass
High	56.21	20.00	Pass
Hopping_Lower	48.61	20.00	Pass
Hopping_Upper	56.61	20.00	Pass

Test Plots:

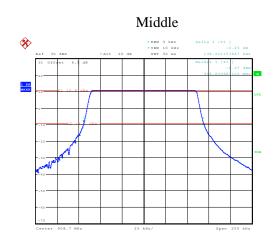
Report Template: TR-4-E-038/V1.0



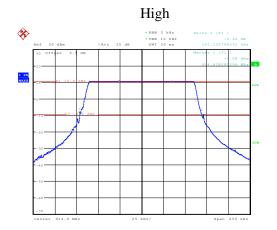
20 dB Emission Bandwidth



ProjectNo.:2405X67746E-RF Tester:Ryan Zhang Date: 26.SEP.2024 15:56:32



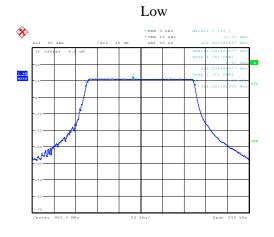
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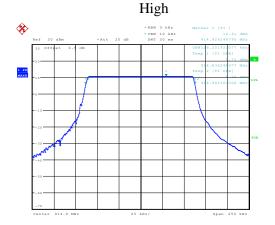
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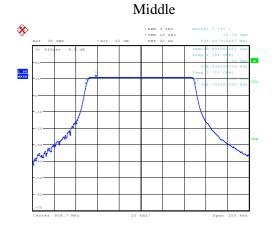
99% Occupied Bandwidth



ProjectNo.:2405X67746E-RF Tester:Ryan Zhang Date: 26.SEP.2024 15:53:12



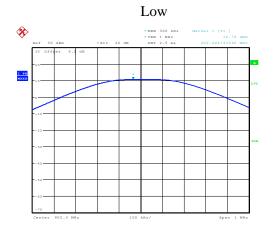
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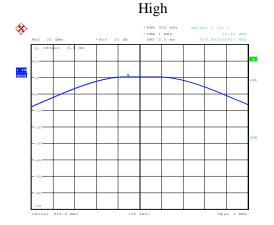
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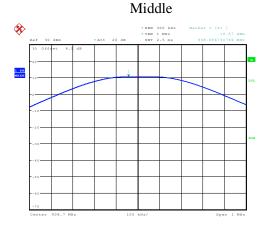
Maximum Conducted Peak Output Power



ProjectNo.:2405X67746E-RF Tester:Ryan Zhang Date: 26.SEP.2024 15:51:28



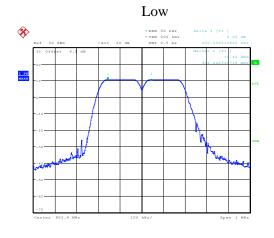
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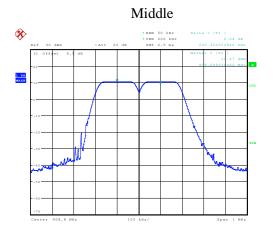


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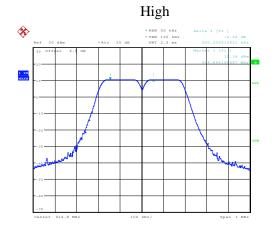
Channel separation





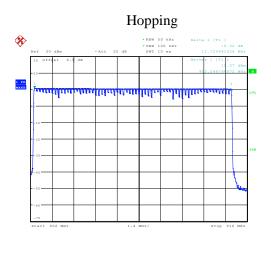
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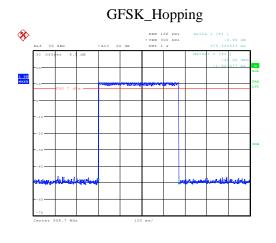
Number of hopping Frequency



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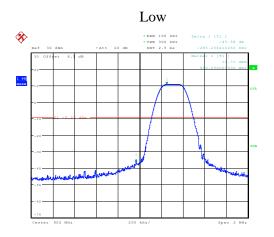
Time of occupancy (dwell time)



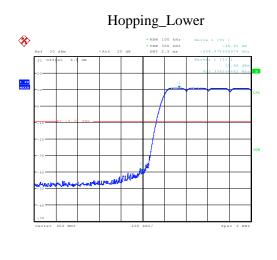
Creating the second sec

ProjectNo.:2405X67746E-RF Tester:Ryan Zhang Date: 26.SEP.2024 16:40:15

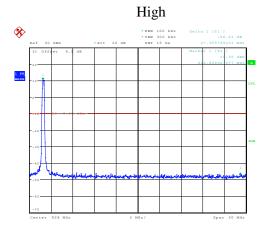
100kHz Bandwidth of Frequency Band Edge



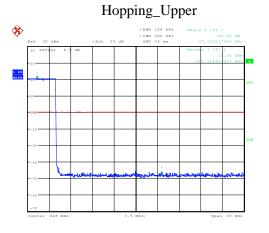
ProjectNo.:2405X67746E-RF Tester:Ryan Zhang Date: 26.SEP.2024 15:54:40



ProjectNo.:2405X67746E-RF Tester:Ryan Zhang Date: 26.SEP.2024 16:44:32



ProjectNo.:2405X67746E-RF Tester:Ryan Zhang Date: 26.SEP.2024 16:21:41



ProjectNo.:2405X67746E-RF Tester:Ryan Zhang Date: 26.SEP.2024 16:51:41

ProjectNo.:2405X67746E-RF Tester:Ryan Zhang Date: 26.SEP.2024 16:34:17

4 Test Setup Photo

Please refer to the attachment 2405X67746EC Test Setup photo.

5 E.U.T Photo

Please refer to the attachment 2405X67746E External photo and 2405X67746E Internal photo.

---End of Report---