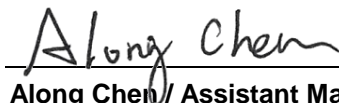


FCC Test Report

FCC ID : 2AAS9CD10
Equipment : MerryloT Air Quality CO2
Model No. : CD10
Brand Name : MerryloT
Applicant : Browan Communications Incorporation.
Address : No.15-1, Zhonghua Rd., Hsinchu Industrial Park,
Hukou Hsinchu Hsien Taiwan 303
Standard : 47 CFR FCC Part 15.247
Received Date : Nov. 08, 2021
Tested Date : Nov. 10 ~ Nov. 17, 2021

We, International Certification Corporation, would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:



Along Chen / Assistant Manager

Approved by:



Gary Chang / Manager



Table of Contents

1	GENERAL DESCRIPTION	5
1.1	Information.....	5
1.2	Local Support Equipment List	7
1.3	Test Setup Chart	7
1.4	The Equipment List	8
1.5	Test Standards	9
1.6	Reference Guidance	9
1.7	Deviation from Test Standard and Measurement Procedure.....	9
1.8	Measurement Uncertainty	9
2	TEST CONFIGURATION	10
2.1	Testing Facility.....	10
2.2	The Worst Test Modes and Channel Details	10
3	TRANSMITTER TEST RESULTS.....	11
3.1	Unwanted Emissions into Restricted Frequency Bands	11
3.2	Unwanted Emissions into Non-Restricted Frequency Bands	25
3.3	Conducted Output Power	28
3.4	Number of Hopping Frequency	29
3.5	20dB and Occupied Bandwidth	31
3.6	Channel Separation.....	35
3.7	Number of Dwell Time.....	39
3.8	Power Spectral Density	46
4	TEST LABORATORY INFORMATION	50

Release Record

Report No.	Version	Description	Issued Date
FR1N0801AH	Rev. 01	Initial issue	Dec. 01, 2021

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	Note ¹	N/A
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 2706.90MHz 52.06 (Margin -1.94dB) - AV	Pass
15.247(d)	Band Edge	Meet the requirement of limit	Pass
15.247(b)(2)(3)	Conducted Output Power	Power [dBm]: 19.20	Pass
15.247(a)(1)(i)	Number of Hopping Channels	Meet the requirement of limit	Pass
15.247(a)(1)	Hopping Channel Separation	Meet the requirement of limit	Pass
15.247(f)	Dwell Time	Meet the requirement of limit	Pass
15.247(f)	Power spectral density	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass
<p>N/A means Not Applicable. Note¹: The EUT consumes DC power, so the test is not required.</p>			

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information					
Frequency Range (MHz)	Ch. Freq. (MHz)	Channel Number	Data Rate (bit/sec)	Spread Factor	Channel Bandwidth (kHz)
902 ~ 928	902.3 ~ 914.9	1-64 [64]	5470 ~ 980	SF7~10	125
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power. Note 2: The device uses Lora modulation. Note 3: The device supports hybrid mode.					

1.1.2 Antenna Details

Ant. No.	Type	Connector	Gain (dBi)
1	Monopole	UFL	1.09

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.6Vdc from battery
--------------------------	---------------------

1.1.4 Accessories

Accessories		
No.	Equipment	Description
1	Battery x2	Brand: RAMWAY Model: ER14505 Rating: 3.6V/2.7Ah
2	screw pack	---
3	3M VHB sticker	---

1.1.5 Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	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
3	902.7	19	905.9	35	909.1	51	912.3
4	902.9	20	906.1	36	909.3	52	912.5
5	903.1	21	906.3	37	909.5	53	912.7
6	903.3	22	906.5	38	909.7	54	912.9
7	903.5	23	906.7	39	909.9	55	913.1
8	903.7	24	906.9	40	910.1	56	913.3
9	903.9	25	907.1	41	910.3	57	913.5
10	904.1	26	907.3	42	910.5	58	913.7
11	904.3	27	907.5	43	910.7	59	913.9
12	904.5	28	907.7	44	910.9	60	914.1
13	904.7	29	907.9	45	911.1	61	914.3
14	904.9	30	908.1	46	911.3	62	914.5
15	905.1	31	908.3	47	911.5	63	914.7
16	905.3	32	908.5	48	911.7	64	914.9

1.1.6 Test Tool and Duty Cycle

Test Tool	CMD, version: V6.1.7601
Duty cycle	91.60 %
Duty Factor (dB)	0.38

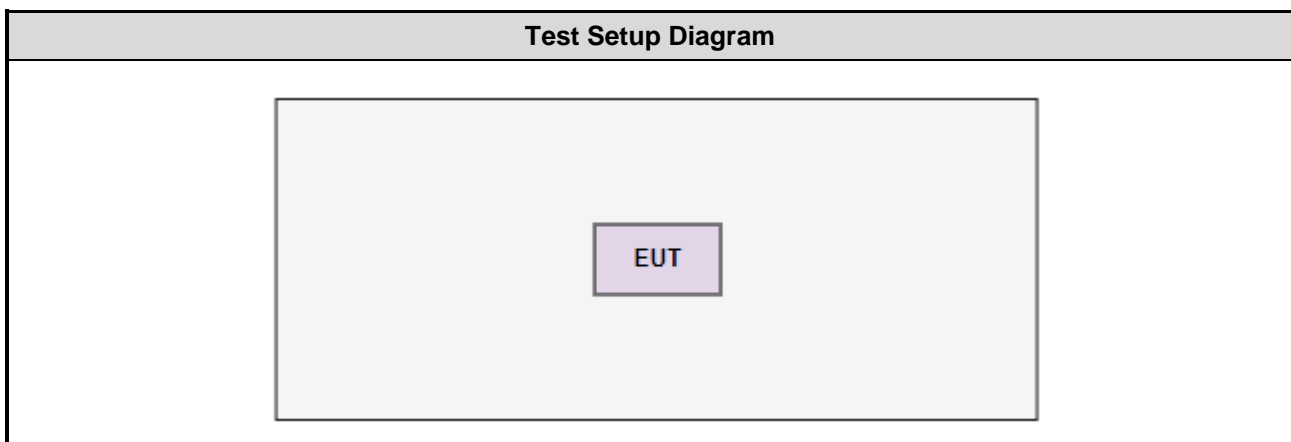
1.1.7 Power Index of Test Tool

Modulation Mode	Test Frequency (MHz)		
	902.3	908.5	914.9
LORA	20	20	20

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	Notebook	DELL	Latitude E5470	DoC	---
2	USB cable	---	---	---	Provided by applicant.
3	Fixture	---	---	---	Provided by applicant.

1.3 Test Setup Chart



Note: The USB cable, notebook and fixture are disconnected from EUT and removed from test table when EUT is set to transmit continuously.

1.4 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Nov. 10 ~ Nov. 15, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Mar. 12, 2021	Mar. 11, 2022
Spectrum Analyzer	R&S	FSV40	101498	Dec. 04, 2020	Dec. 03, 2021
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 17, 2020	Nov. 16, 2021
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jun. 30, 2021	Jun. 29, 2022
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 11, 2020	Dec. 10, 2021
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170508	Dec. 31, 2020	Dec. 30, 2021
Preamplifier	EMC	EMC02325	980225	Jun. 29, 2021	Jun. 28, 2022
Preamplifier	Agilent	83017A	MY39501308	Sep. 28, 2021	Sep. 27, 2022
Preamplifier	EMC	EMC184045B	980192	Jul. 14, 2021	Jul. 13, 2022
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 05, 2021	Oct. 04, 2022
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 05, 2021	Oct. 04, 2022
LF cable 11M	EMC	EMCCFD400-NW-N W-11000	200801	Oct. 05, 2021	Oct. 04, 2022
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	160502	Oct. 05, 2021	Oct. 04, 2022
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 05, 2021	Oct. 04, 2022
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Oct. 05, 2021	Oct. 04, 2022
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Tested Date	Nov. 17, 2021				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101498	Dec. 04, 2020	Dec. 03, 2021
Power Meter	Anritsu	ML2495A	1218007	Jan. 26, 2021	Jan. 25, 2022
Power Sensor	Anritsu	MA2411B	1207367	Jan. 26, 2021	Jan. 25, 2022
Measurement Software	Sporton	SENSE-15247_FS	V5.10.7.11	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

47 CFR FCC Part 15.247

ANSI C63.10-2013

1.6 Reference Guidance

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

1.7 Deviation from Test Standard and Measurement Procedure

None

1.8 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

Measurement Uncertainty	
Parameters	Uncertainty
Bandwidth	±34.130 Hz
Conducted power	±0.808 dB
Power density	±0.583 dB
Conducted emission	±2.715 dB
Radiated emission ≤ 1GHz	±3.41 dB
Radiated emission > 1GHz	±4.59 dB

2 Test Configuration

2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	03CH01-WS, TH01-WS
Address of Test Site	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- ISED#: 10807A
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Test Frequency (MHz)	Channel Bandwidth (kHz)	Modulation / SF	Test Configuration
Conducted Emissions	902.3 / 908.5 / 914.9	125	Lora / 10	---
Radiated Emissions ≤ 1GHz	902.3 / 908.5 / 914.9	125	Lora / 10	---
Conducted Output Power Hopping Channel Separation 20dB and Occupied bandwidth Power Spectral Density	902.3 / 908.5 / 914.9	125	Lora / 10	---
Radiated Emissions >1GHz	902.3 / 908.5 / 914.9	125	Lora / 10	---
Number of Hopping Channels	902.3 ~ 914.9	125	Lora / 10	---
Dwell Time	902.3	125	Lora / 10, 9, 8, 7	---
NOTE:				
1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The X-plane results were found as the worst case and were shown in this report.				

3 Transmitter Test Results

3.1 Unwanted Emissions into Restricted Frequency Bands

3.1.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.1.2 Test Procedures

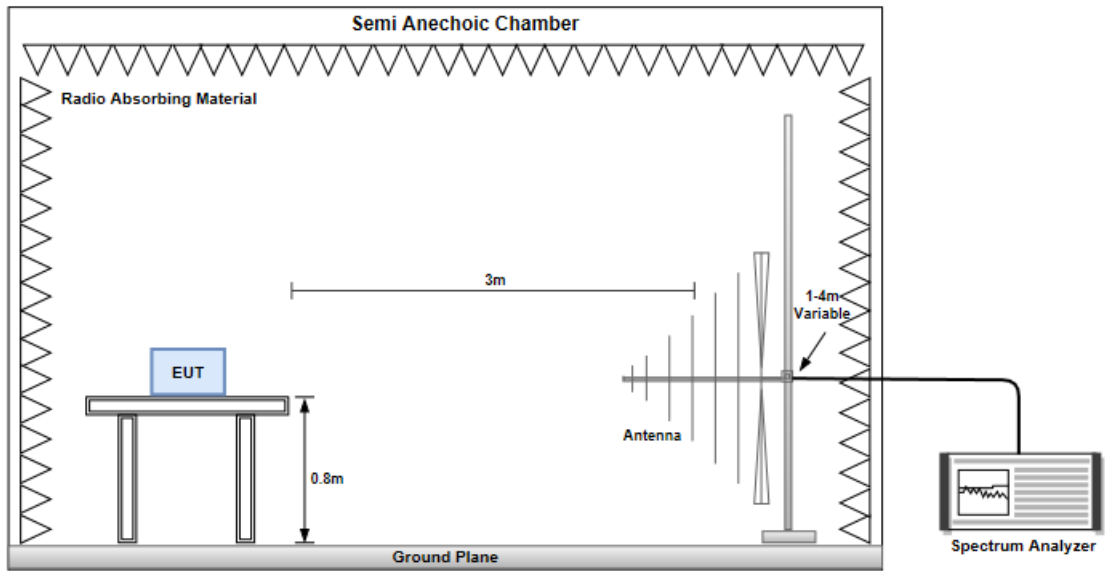
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

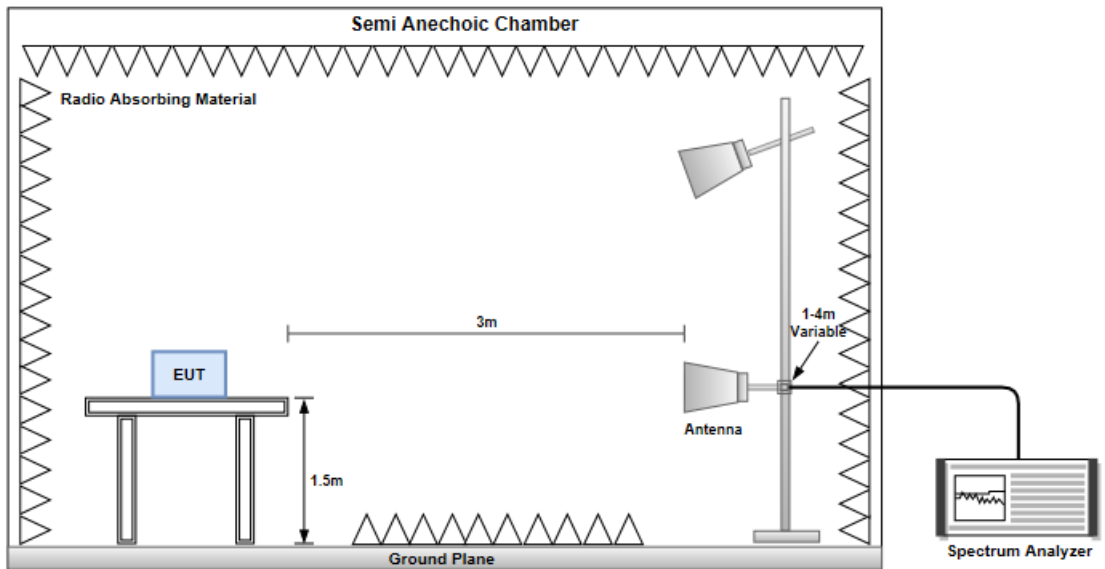
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.1.3 Test Setup

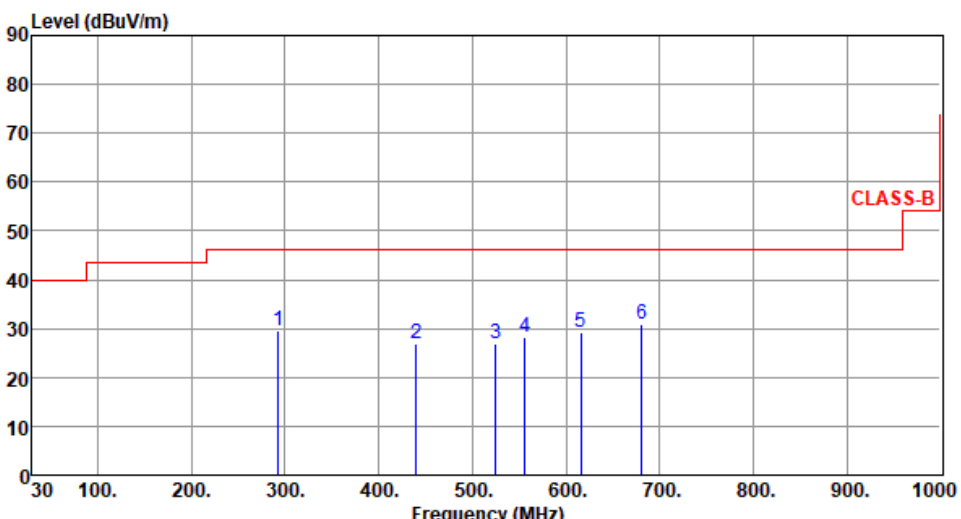
Radiated Emissions below 1 GHz



Radiated Emissions above 1 GHz

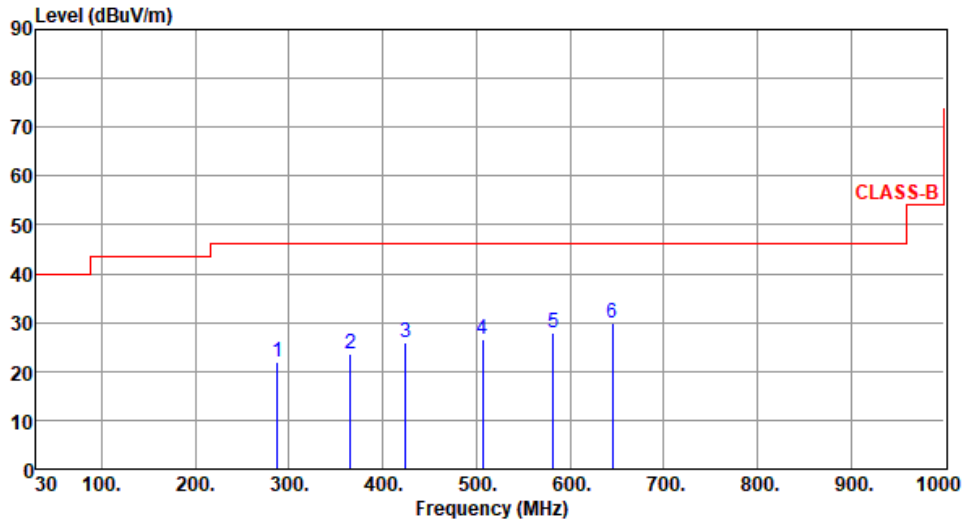


3.1.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation / SF	Lora / 10	Test Freq. (MHz)	902.3																																																																
Polarization	Horizontal																																																																		
Test By : Roger Lu Temperature(°C):24 Humidity(%):62																																																																			
																																																																			
	<table border="1"> <thead> <tr> <th>Freq. MHz</th> <th>Emission level dBuV/m</th> <th>Limit dBuV/m</th> <th>Margin dB</th> <th>SA reading dBuV</th> <th>Factor dB/m</th> <th>Remark</th> <th>ANT High cm</th> <th>Turn Table deg</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>292.45</td> <td>29.54</td> <td>46.00</td> <td>-16.46</td> <td>37.83</td> <td>-8.29</td> <td>Peak</td> <td>---</td> </tr> <tr> <td>2</td> <td>440.00</td> <td>26.99</td> <td>46.00</td> <td>-19.01</td> <td>31.56</td> <td>-4.57</td> <td>Peak</td> <td>---</td> </tr> <tr> <td>3</td> <td>524.80</td> <td>26.98</td> <td>46.00</td> <td>-19.02</td> <td>29.90</td> <td>-2.92</td> <td>Peak</td> <td>---</td> </tr> <tr> <td>4</td> <td>556.00</td> <td>28.26</td> <td>46.00</td> <td>-17.74</td> <td>30.56</td> <td>-2.30</td> <td>Peak</td> <td>---</td> </tr> <tr> <td>5</td> <td>616.00</td> <td>29.17</td> <td>46.00</td> <td>-16.83</td> <td>29.83</td> <td>-0.66</td> <td>Peak</td> <td>---</td> </tr> <tr> <td>6</td> <td>680.80</td> <td>30.86</td> <td>46.00</td> <td>-15.14</td> <td>31.01</td> <td>-0.15</td> <td>Peak</td> <td>---</td> </tr> </tbody> </table>	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg	1	292.45	29.54	46.00	-16.46	37.83	-8.29	Peak	---	2	440.00	26.99	46.00	-19.01	31.56	-4.57	Peak	---	3	524.80	26.98	46.00	-19.02	29.90	-2.92	Peak	---	4	556.00	28.26	46.00	-17.74	30.56	-2.30	Peak	---	5	616.00	29.17	46.00	-16.83	29.83	-0.66	Peak	---	6	680.80	30.86	46.00	-15.14	31.01	-0.15	Peak	---			
Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg																																																											
1	292.45	29.54	46.00	-16.46	37.83	-8.29	Peak	---																																																											
2	440.00	26.99	46.00	-19.01	31.56	-4.57	Peak	---																																																											
3	524.80	26.98	46.00	-19.02	29.90	-2.92	Peak	---																																																											
4	556.00	28.26	46.00	-17.74	30.56	-2.30	Peak	---																																																											
5	616.00	29.17	46.00	-16.83	29.83	-0.66	Peak	---																																																											
6	680.80	30.86	46.00	-15.14	31.01	-0.15	Peak	---																																																											
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m). Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.																																																																			

Modulation / SF	Lora / 10	Test Freq. (MHz)	902.3
Polarization	Vertical		

Test By :Roger Lu Temperature(°C):24 Humidity(%):62



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	287.20	21.79	46.00	-24.21	30.26	-8.47	Peak	---	---
2	365.60	23.47	46.00	-22.53	30.02	-6.55	Peak	---	---
3	424.80	25.92	46.00	-20.08	30.94	-5.02	Peak	---	---
4	506.40	26.65	46.00	-19.35	29.80	-3.15	Peak	---	---
5	582.40	28.01	46.00	-17.99	29.57	-1.56	Peak	---	---
6	645.60	29.91	46.00	-16.09	30.33	-0.42	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

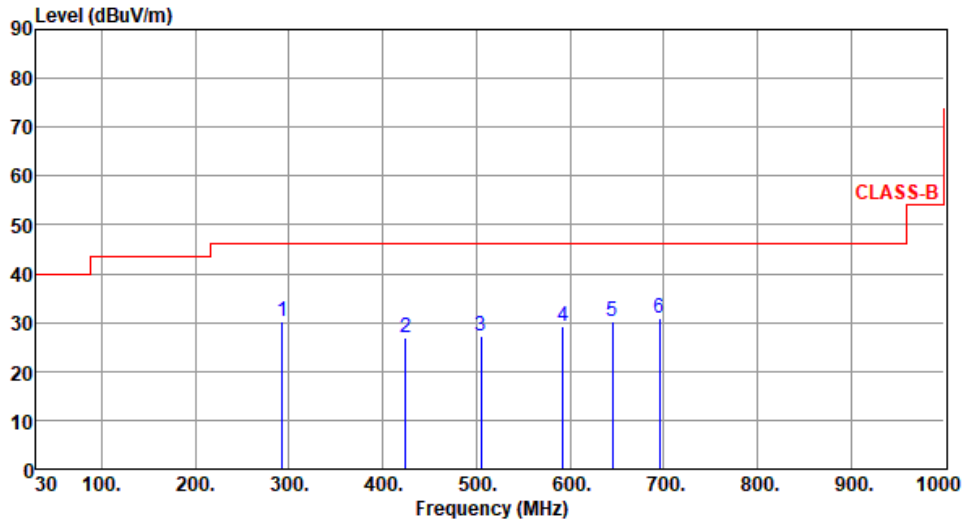
*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation / SF	Lora / 10	Test Freq. (MHz)	908.5
Polarization	Horizontal		

Test By :Roger Lu Temperature(°C):24 Humidity(%):62



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	292.80	30.11	46.00	-15.89	38.39	-8.28	Peak	---	---
2	424.80	27.02	46.00	-18.98	32.04	-5.02	Peak	---	---
3	504.80	27.15	46.00	-18.85	30.33	-3.18	Peak	---	---
4	592.80	29.08	46.00	-16.92	30.42	-1.34	Peak	---	---
5	645.60	30.34	46.00	-15.66	30.76	-0.42	Peak	---	---
6	696.00	31.02	46.00	-14.98	30.83	0.19	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

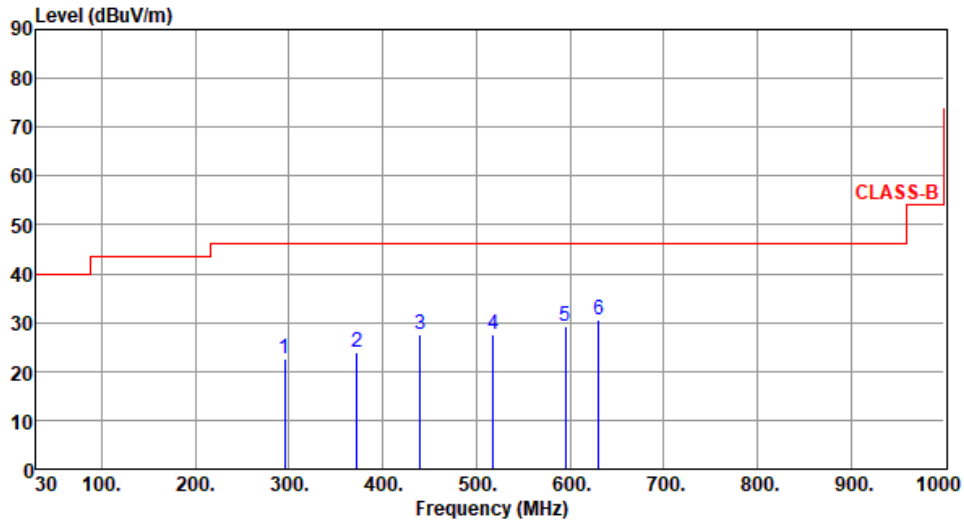
*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation / SF	Lora / 10	Test Freq. (MHz)	908.5
Polarization	Vertical		

Test By :Roger Lu Temperature(°C):24 Humidity(%):62



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	295.20	22.47	46.00	-23.53	30.71	-8.24	Peak	---	---
2	372.80	23.97	46.00	-22.03	30.34	-6.37	Peak	---	---
3	440.00	27.40	46.00	-18.60	31.97	-4.57	Peak	---	---
4	517.60	27.62	46.00	-18.38	30.56	-2.94	Peak	---	---
5	595.20	29.24	46.00	-16.76	30.55	-1.31	Peak	---	---
6	630.40	30.69	46.00	-15.31	31.13	-0.44	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

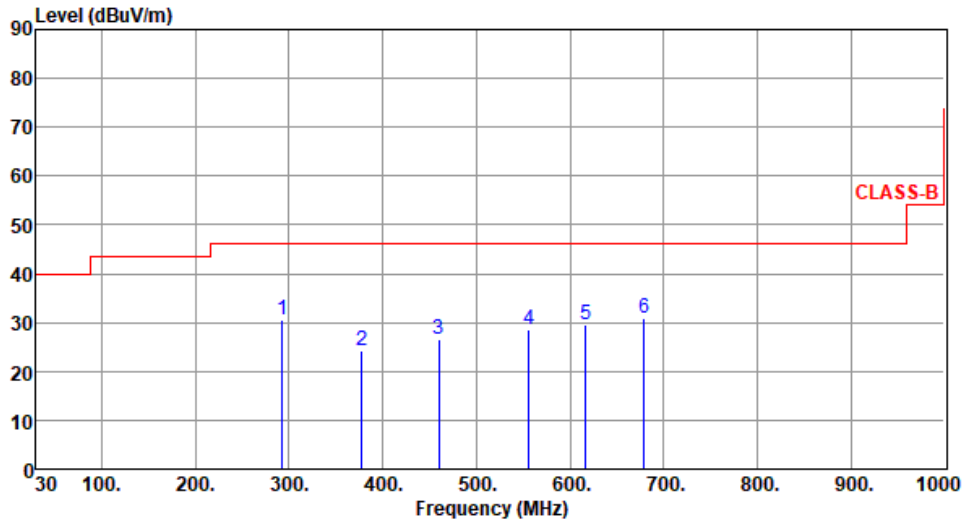
*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation / SF	Lora / 10	Test Freq. (MHz)	914.9
Polarization	Horizontal		

Test By :Roger Lu Temperature(°C):24 Humidity(%):62



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	292.45	30.56	46.00	-15.44	38.85	-8.29	Peak	---	---
2	377.60	24.24	46.00	-21.76	30.52	-6.28	Peak	---	---
3	460.00	26.61	46.00	-19.39	30.72	-4.11	Peak	---	---
4	556.26	28.64	46.00	-17.36	30.93	-2.29	Peak	---	---
5	616.49	29.64	46.00	-16.36	30.29	-0.65	Peak	---	---
6	679.20	30.75	46.00	-15.25	30.96	-0.21	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

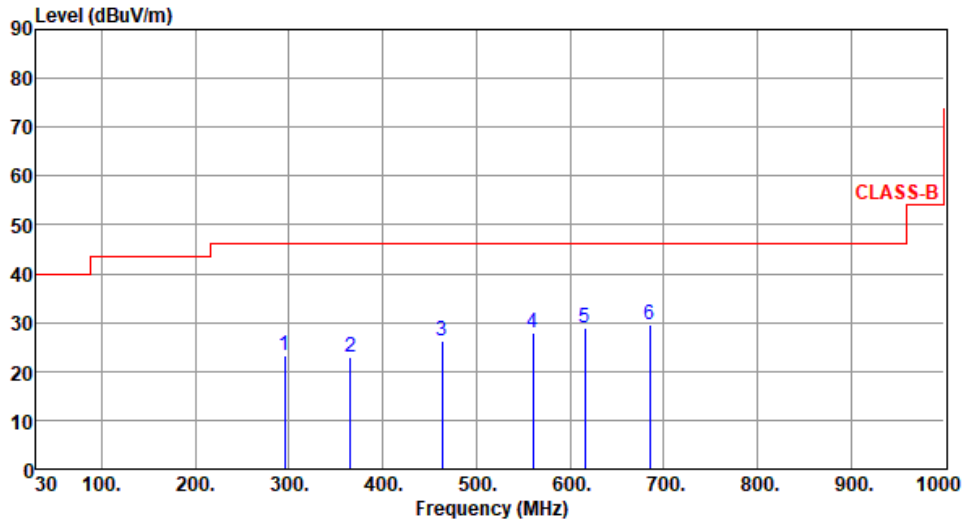
*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation / SF	Lora / 10	Test Freq. (MHz)	914.9
Polarization	Vertical		

Test By :Roger Lu Temperature(°C):24 Humidity(%):62



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	295.45	23.21	46.00	-22.79	31.43	-8.22	Peak	---	---
2	365.86	22.98	46.00	-23.02	29.51	-6.53	Peak	---	---
3	463.20	26.21	46.00	-19.79	30.26	-4.05	Peak	---	---
4	560.80	27.78	46.00	-18.22	29.89	-2.11	Peak	---	---
5	616.00	28.95	46.00	-17.05	29.61	-0.66	Peak	---	---
6	684.80	29.43	46.00	-16.57	29.40	0.03	Peak	---	---

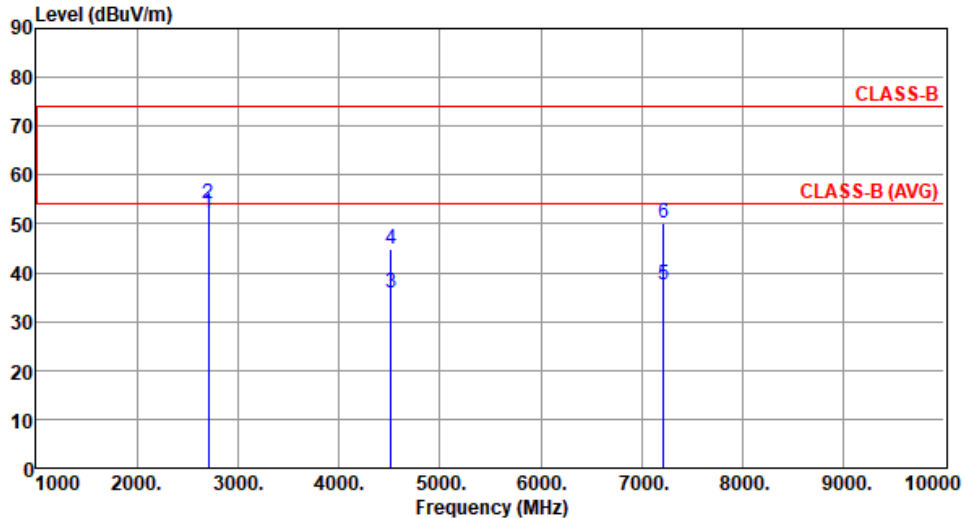
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

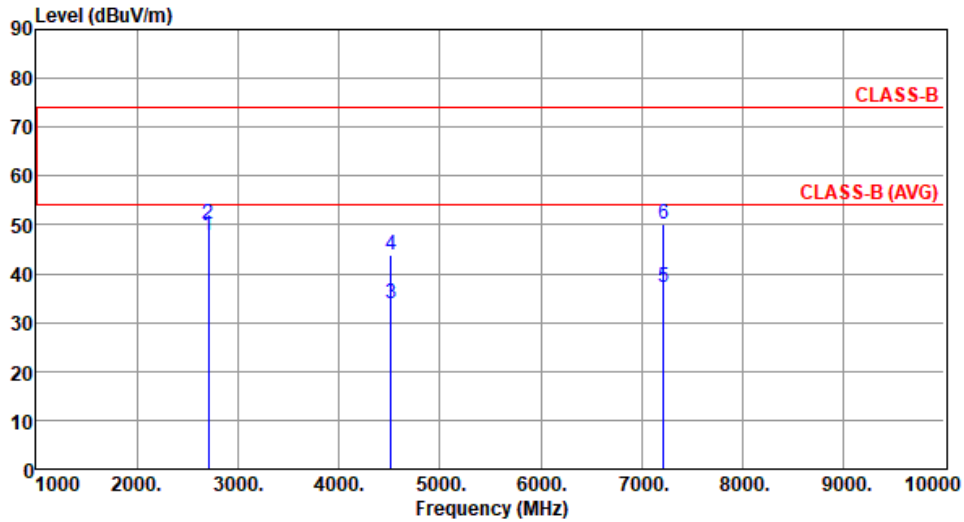
3.1.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation / SF	Lora / 10	Test Freq. (MHz)	902.3						
Polarization	Horizontal								
Test By : Roger Lu		Temperature(°C): 23			Humidity(%): 65				
 <p>The graph plots Level (dBuV/m) on the y-axis (0 to 90) against Frequency (MHz) on the x-axis (1000 to 10000). Two horizontal red lines represent limits: CLASS-B at approximately 74 dBuV/m and CLASS-B (AVG) at approximately 54 dBuV/m. Six vertical blue lines indicate emission levels at specific frequencies, labeled 2, 3, 4, 5, and 6. Peak 2 is at 2706.90 MHz, peak 3 at 4511.50 MHz, peak 4 at 4511.50 MHz, peak 5 at 7218.40 MHz, and peak 6 at 7218.40 MHz.</p>									
	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		cm	deg
1	2706.90	52.06	54.00	-1.94	54.26	-2.20	Average	248	301
2	2706.90	54.17	74.00	-19.83	56.37	-2.20	Peak	248	301
3	4511.50	35.79	54.00	-18.21	33.12	2.67	Average	100	22
4	4511.50	44.93	74.00	-29.07	42.26	2.67	Peak	100	22
5	7218.40	37.39	54.00	-16.61	28.55	8.84	Average	100	20
6	7218.40	50.12	74.00	-23.88	41.28	8.84	Peak	100	20

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation / SF	Lora / 10	Test Freq. (MHz)	902.3
Polarization	Vertical		

Test By :Roger Lu Temperature(°C):23 Humidity(%):65



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2706.90	47.91	54.00	-6.09	50.11	-2.20	Average	100	7
2	2706.90	50.15	74.00	-23.85	52.35	-2.20	Peak	100	7
3	4511.50	33.92	54.00	-20.08	31.25	2.67	Average	111	4
4	4511.50	43.83	74.00	-30.17	41.16	2.67	Peak	111	4
5	7218.40	37.29	54.00	-16.71	28.45	8.84	Average	100	60
6	7218.40	49.99	74.00	-24.01	41.15	8.84	Peak	100	60

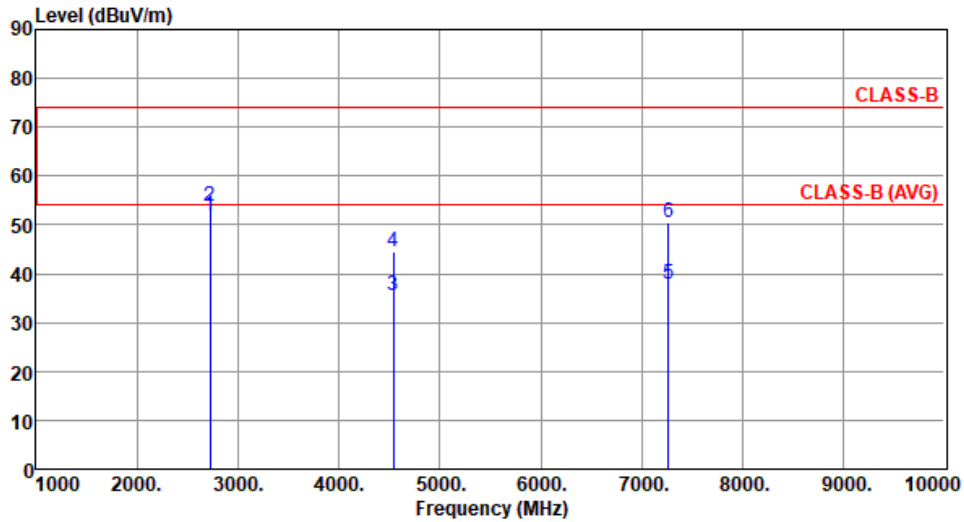
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation / SF	Lora / 10	Test Freq. (MHz)	908.5
Polarization	Horizontal		

Test By :Roger Lu Temperature(°C):23 Humidity(%):65

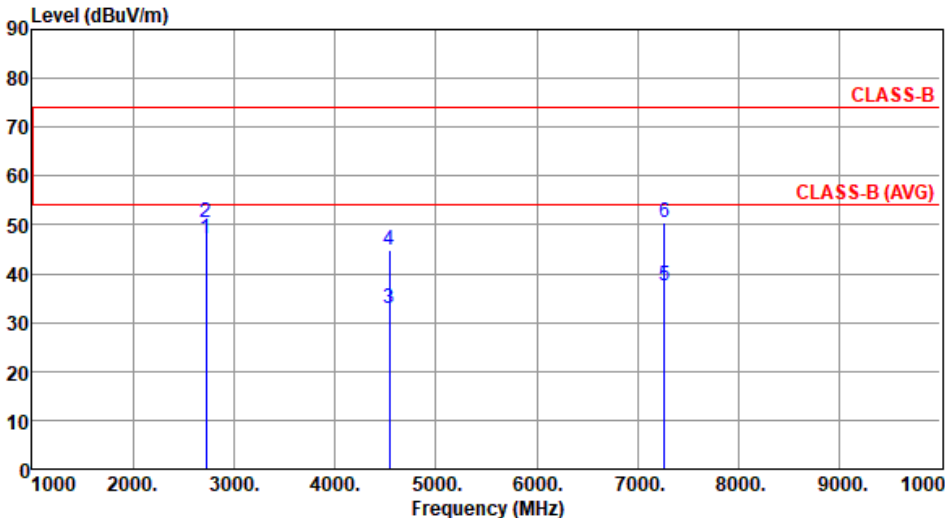


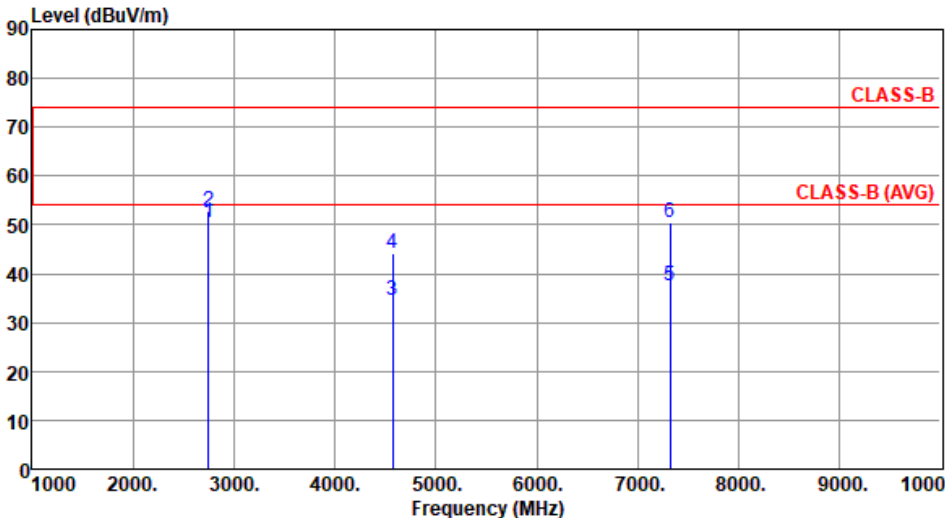
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2725.50	51.66	54.00	-2.34	53.73	-2.07	Average	243	299
2	2725.50	53.81	74.00	-20.19	55.88	-2.07	Peak	243	299
3	4542.50	35.52	54.00	-18.48	32.76	2.76	Average	100	26
4	4542.50	44.46	74.00	-29.54	41.70	2.76	Peak	100	26
5	7268.00	37.71	54.00	-16.29	28.83	8.88	Average	100	40
6	7268.00	50.44	74.00	-23.56	41.56	8.88	Peak	100	40

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

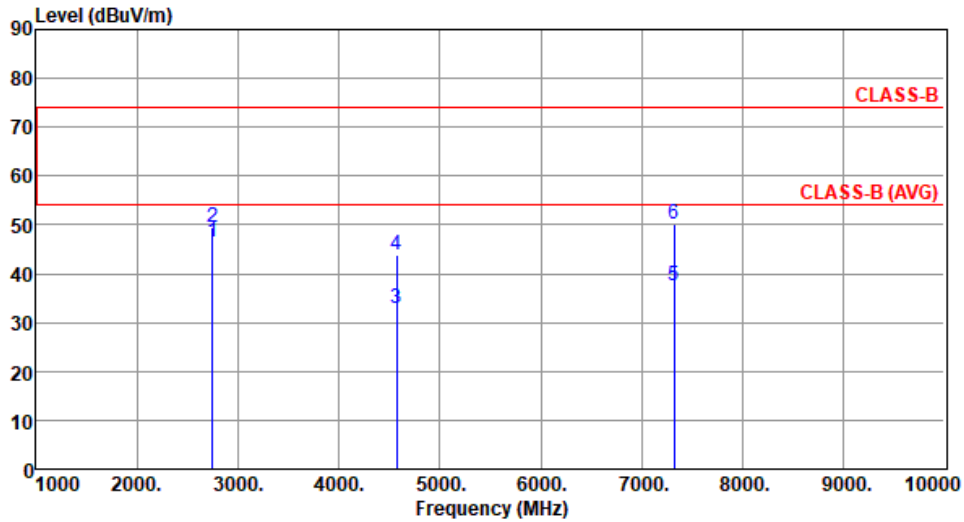
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation / SF	Lora / 10	Test Freq. (MHz)	908.5						
Polarization	Vertical								
Test By :Roger Lu		Temperature(°C):23			Humidity(%):65				
									
	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn
	MHz	level	dBuV/m	dB	reading	dB/m		High	Table
		dBuV/m			dBuV			cm	deg
1	2725.50	47.15	54.00	-6.85	49.22	-2.07	Average	100	5
2	2725.50	50.46	74.00	-23.54	52.53	-2.07	Peak	100	5
3	4542.50	32.97	54.00	-21.03	30.21	2.76	Average	110	2
4	4542.50	44.75	74.00	-29.25	41.99	2.76	Peak	110	2
5	7268.00	37.44	54.00	-16.56	28.56	8.88	Average	100	40
6	7268.00	50.37	74.00	-23.63	41.49	8.88	Peak	100	40
<p>Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).</p>									

Modulation / SF	Lora / 10	Test Freq. (MHz)	914.9						
Polarization	Horizontal								
Test By :Roger Lu		Temperature(°C):23			Humidity(%):65				
									
	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m		cm	deg
1	2744.70	50.34	54.00	-3.66	52.26	-1.92	Average	247	296
2	2744.70	52.87	74.00	-21.13	54.79	-1.92	Peak	247	296
3	4574.50	34.47	54.00	-19.53	31.59	2.88	Average	105	23
4	4574.50	44.03	74.00	-29.97	41.15	2.88	Peak	105	23
5	7319.20	37.58	54.00	-16.42	28.67	8.91	Average	100	30
6	7319.20	50.40	74.00	-23.60	41.49	8.91	Peak	100	30
<p>Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).</p>									

Modulation / SF	Lora / 10	Test Freq. (MHz)	914.9
Polarization	Vertical		

Test By :Roger Lu Temperature(°C):23 Humidity(%):65



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2744.70	46.39	54.00	-7.61	48.31	-1.92	Average	100	9
2	2744.70	49.34	74.00	-24.66	51.26	-1.92	Peak	100	9
3	4574.50	33.03	54.00	-20.97	30.15	2.88	Average	111	3
4	4574.50	43.82	74.00	-30.18	40.94	2.88	Peak	111	3
5	7319.20	37.46	54.00	-16.54	28.55	8.91	Average	100	60
6	7319.20	50.16	74.00	-23.84	41.25	8.91	Peak	100	60

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.2 Unwanted Emissions into Non-Restricted Frequency Bands

3.2.1 Limit of Unwanted Emissions into Non-Restricted Frequency Bands

The peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz.

3.2.2 Test Procedures

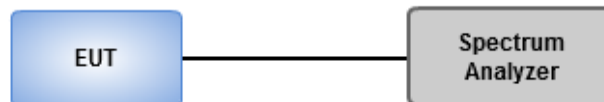
Reference Level Measurement

1. Set the RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
2. Set Sweep time = auto couple, Trace mode = max hold.
3. Allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

Unwanted Emissions Level Measurement

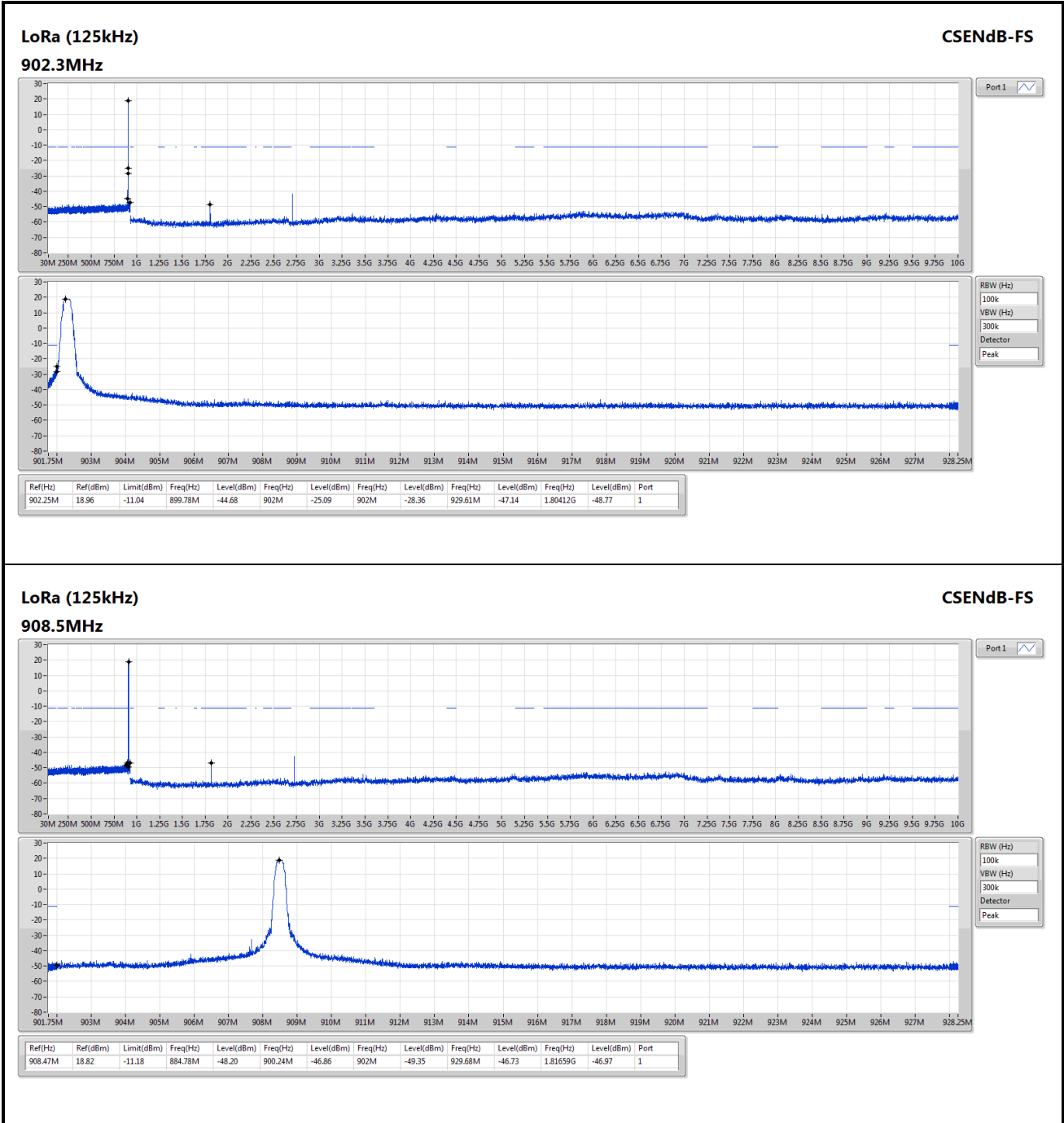
1. Set RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
2. Trace Mode = max hold, Sweep = auto couple.
3. Allow the trace to stabilize.
4. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

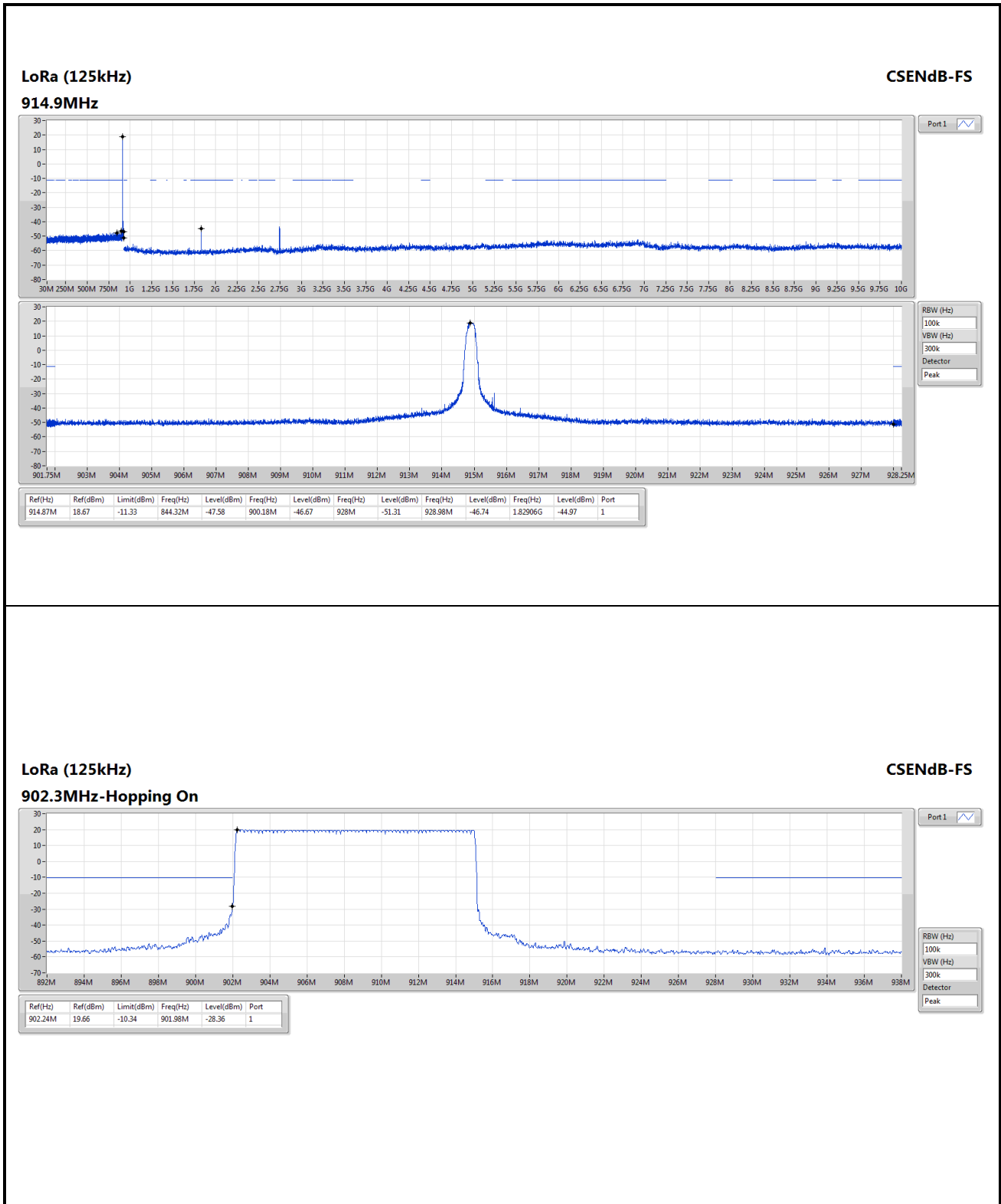
3.2.3 Test Setup



3.2.4 Unwanted Emissions into Non-Restricted Frequency Bands

Ambient Condition	23°C / 66%	Tested By	Aska Huang
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3.3 Conducted Output Power

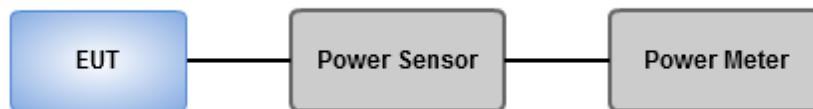
3.3.1 Limit of Conducted Output Power

- 1 Watt, systems employing at least 50 hopping channels;
- 0.25 Watt, for systems employing less than 50 hopping channels, but at least 25 hopping channels,

3.3.2 Test Procedures

1. A wideband power meter is used for power measurement. Bandwidth of power sensor and meter is 50MHz
2. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power

3.3.3 Test Setup



3.3.4 Test Result of Conducted Output Power

Ambient Condition	23°C / 66%	Tested By	Aska Huang
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Summary

Mode	Power (dBm)	Power (W)
902-928MHz	-	-
LoRa (125kHz)	19.20	0.08318

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
LoRa (125kHz)	-	-	-	-
902.3MHz	Pass	1.09	19.20	30.00
908.5MHz	Pass	1.09	19.09	30.00
914.9MHz	Pass	1.09	18.99	30.00

3.4 Number of Hopping Frequency

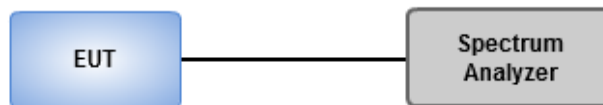
3.4.1 Limit of Number of Hopping Frequency

Number of Hopping Frequencies Limit for Frequency Hopping Systems	
<input checked="" type="checkbox"/>	902-928 MHz Band:
<input type="checkbox"/>	$N \geq 50$, 20 dB bandwidth of the hopping channel is less than 250 kHz
<input type="checkbox"/>	$N \geq 25$, 20 dB bandwidth of the hopping channel is 250 kHz or greater
<input checked="" type="checkbox"/>	Hybrid mode, No minimum number of hopping channels associated with hybrid system.
N: Number of Hopping Frequencies	

3.4.2 Test Procedures

1. Set RBW = 100kHz, VBW = 300kHz, Sweep time = Auto, Detector = Peak Trace max hold.
2. Allow trace to stabilize.

3.4.3 Test Setup



3.4.4 Test Result of Number of Hopping Frequency

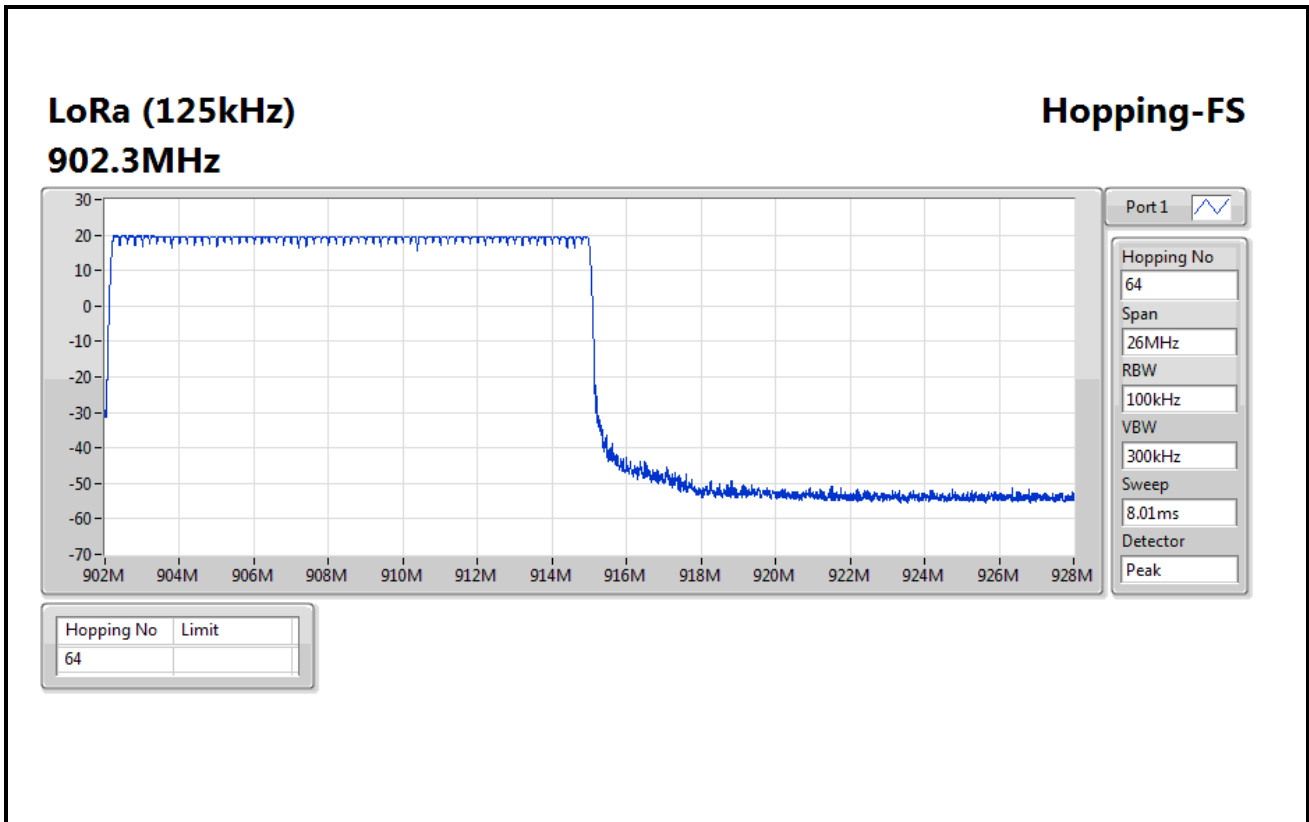
Ambient Condition	23°C / 66%	Tested By	Aska Huang
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Summary

Mode	Max-Hop No
902-928MHz	-
LoRa (125kHz)	64

Result

Mode	Result	Hopping No	Limit
LoRa (125kHz)	-	-	-
902.3MHz	Pass	64	-



3.5 20dB and Occupied Bandwidth

3.5.1 Test Procedures

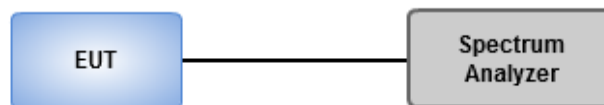
20dB Bandwidth

1. Set RBW=2kHz, VBW=10kHz, Sweep time=Auto, Detector=Peak Trace max hold.
2. Allow trace to stabilize.
3. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

1. Set RBW=2kHz, VBW=10kHz, Sweep time = Auto, Detector=Sample, Trace max hold
2. Allow trace to stabilize
3. Use Occupied bandwidth function of spectrum analyzer to measuring 99% occupied bandwidth

3.5.2 Test Setup



3.5.3 Test result of 20dB and Occupied Bandwidth

Ambient Condition	23°C / 66%	Tested By	Aska Huang
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Summary

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
902-928MHz	-	-	-	-	-
LoRa (125kHz)	137.228k	124.819k	125KF1D	135.87k	124.367k

Max-N dB = Maximum 20dB down bandwidth; Max-OBW = Maximum 99% occupied bandwidth;
Min-N dB = Minimum 20dB down bandwidth; Min-OBW = Minimum 99% occupied bandwidth

Result

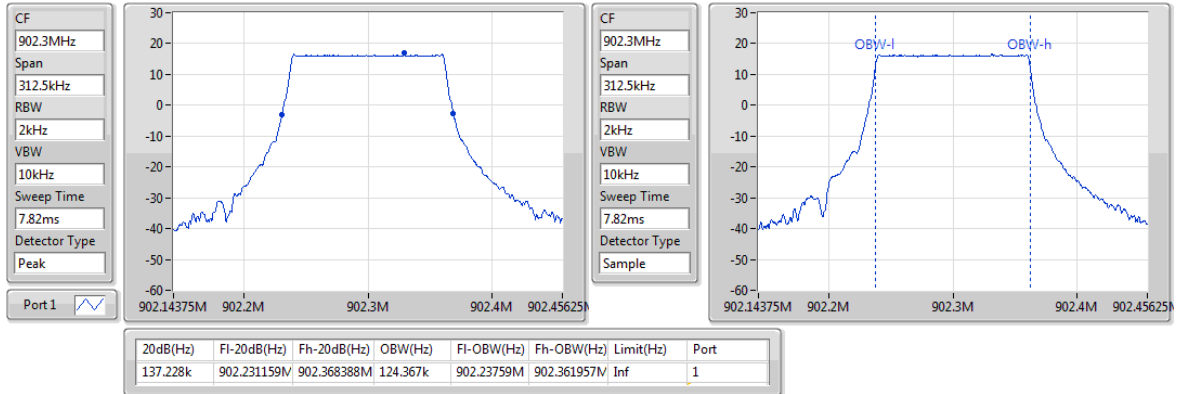
Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
LoRa (125kHz)	-	-	-	-
902.3MHz	Pass	Inf	137.228k	124.367k
908.5MHz	Pass	Inf	135.87k	124.367k
914.9MHz	Pass	Inf	135.87k	124.819k

Port X-N dB = Port X 20dB down bandwidth;
Port X-OBW = Port X 99% occupied bandwidth

LoRa (125kHz)

EBW-FS

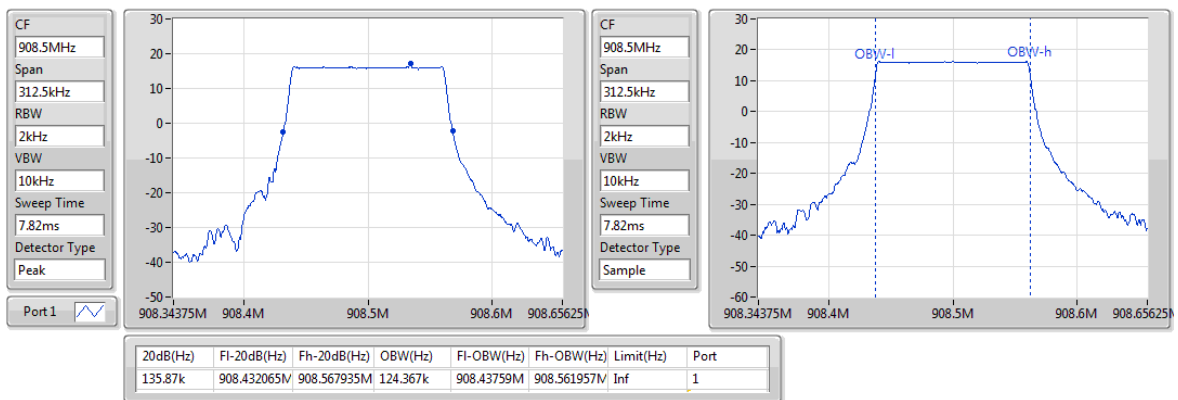
902.3MHz



LoRa (125kHz)

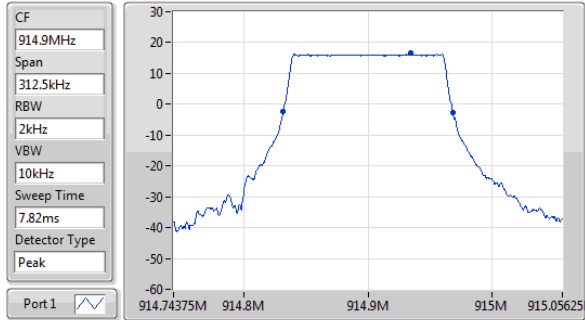
EBW-FS

908.5MHz

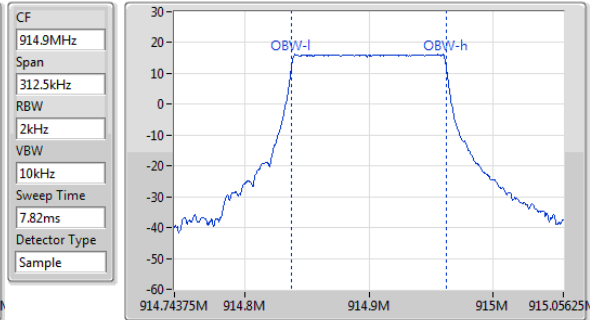


LoRa (125kHz)

914.9MHz



Port 1



EBW-FS

20dB(Hz)	F1-20dB(Hz)	Fh-20dB(Hz)	OBW(Hz)	F1-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
135.87k	914.832065M	914.967935M	124.819k	914.83759M	914.96241M	Inf	1

3.6 Channel Separation

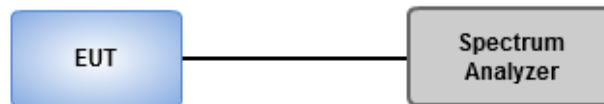
3.6.1 Limit of Channel Separation

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.

3.6.2 Test Procedures

1. Set RBW=10kHz, VBW=30kHz, Sweep time=Auto, Detector=Peak Trace max hold.
2. Allow trace to stabilize.
3. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The EUT shall show compliance with the appropriate regulatory limit

3.6.3 Test Setup



3.6.4 Test result of Channel Separation

Ambient Condition	23°C / 66%	Tested By	Aska Huang
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Summary

Mode	Max-Space (Hz)	Min-Space (Hz)
902-928MHz	-	-
LoRa (125kHz)	204.347826k	202.173913k

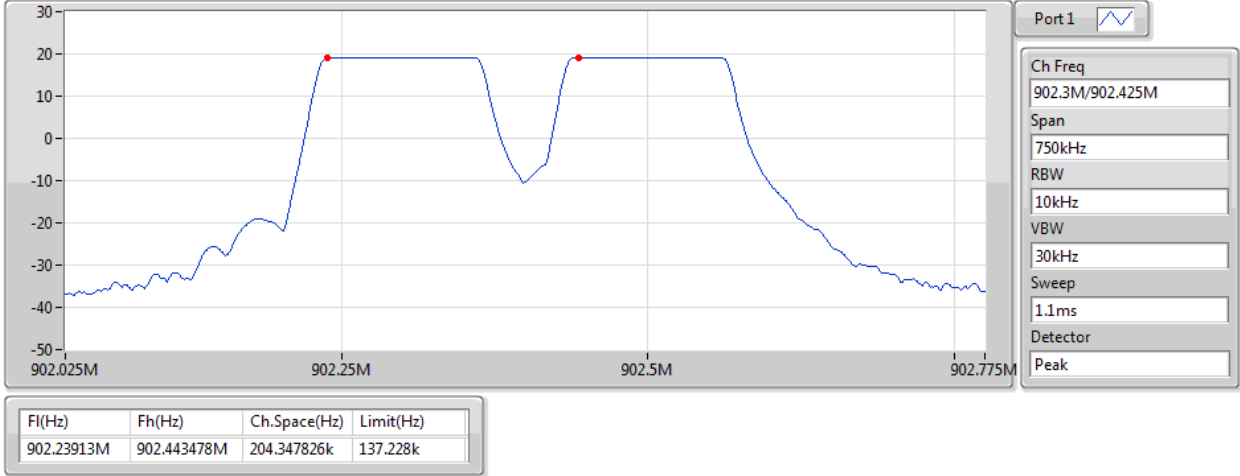
Result

Mode	Result	Fl (Hz)	Fh (Hz)	Ch.Space (Hz)	Limit (Hz)
LoRa (125kHz)	-	-	-	-	-
902.3MHz	Pass	902.23913M	902.443478M	204.347826k	137.228k
908.5MHz	Pass	908.43913M	908.641304M	202.173913k	135.87k
914.9MHz	Pass	914.63913M	914.843478M	204.347826k	135.87k

LoRa (125kHz)

Channel Separation-FS

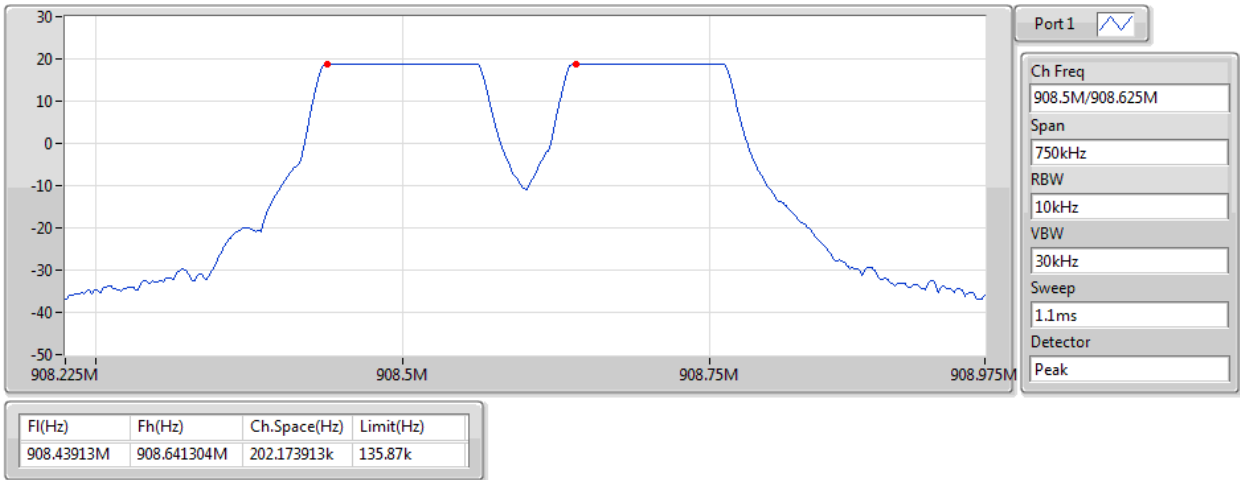
902.3M/902.425MHz



LoRa (125kHz)

Channel Separation-FS

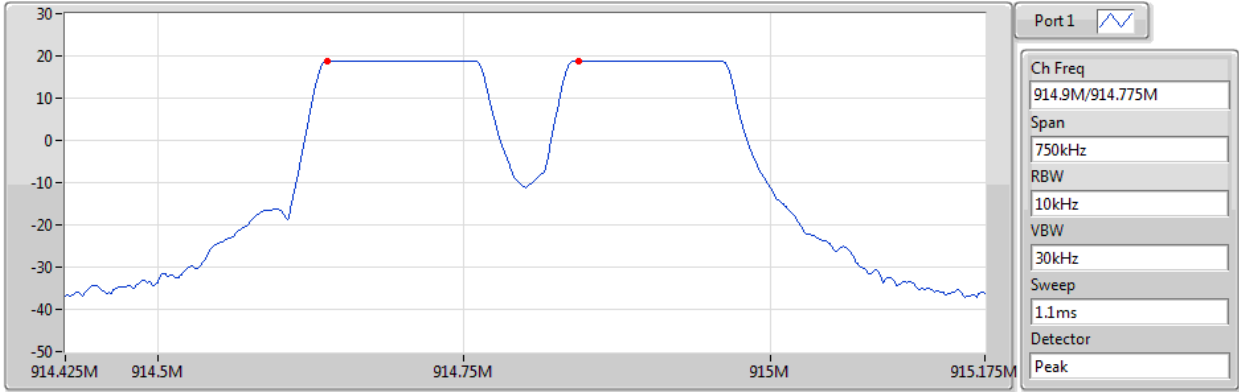
908.5M/908.625MHz




LoRa (125kHz)

Channel Separation-FS

914.9M/914.775MHz



Port 1 

Ch Freq
914.9M/914.775M

Span
750kHz

RBW
10kHz

VBW
30kHz

Sweep
1.1ms

Detector
Peak

F1(Hz)	Fh(Hz)	Ch.Space(Hz)	Limit(Hz)
914.639133M	914.843478M	204.347826k	135.87k

3.7 Number of Dwell Time

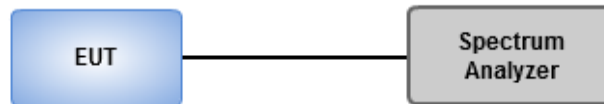
3.7.1 Limit of Dwell time

Time of Occupancy (Dwell Time) Limit for Frequency Hopping Systems	
<input checked="" type="checkbox"/>	902-928 MHz Band:
<input type="checkbox"/>	≤ 0.4 second within a 20 second period, 20 dB bandwidth of the hopping channel is less than 250 kHz
<input type="checkbox"/>	≤ 0.4 second within a 10 second period, 20 dB bandwidth of the hopping channel is 250 kHz or greater
<input checked="" type="checkbox"/>	Hybrid mode ,an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4

3.7.2 Test Procedures

1. Set RBW=100kHz, VBW=300kHz, Sweep time=3.2s / 500ms, 6.4s / 500ms, 25.6s / 500ms, Detector=Peak, Span=0Hz, Trace max hold.
2. Measure and record the burst on time.

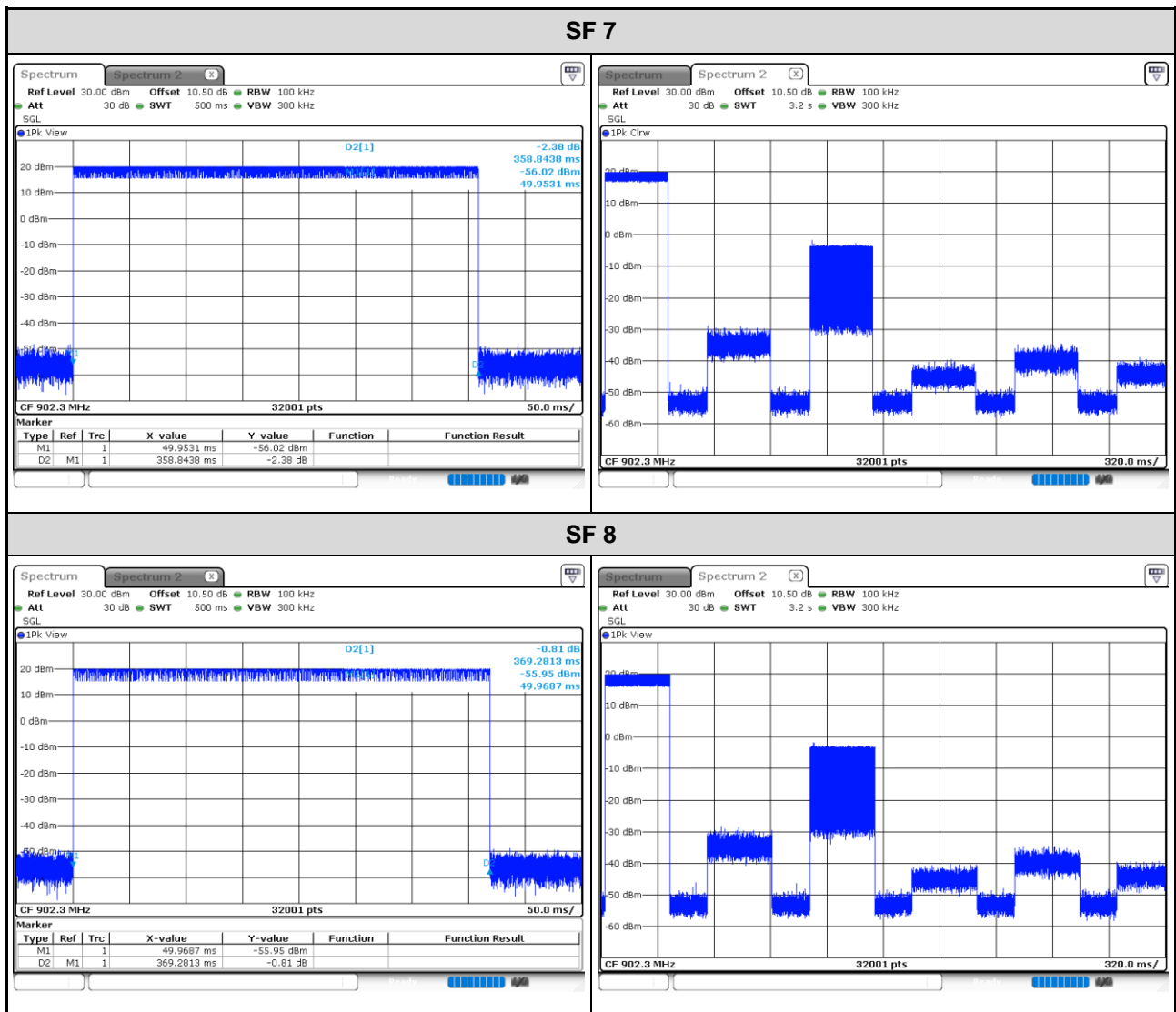
3.7.3 Test Setup



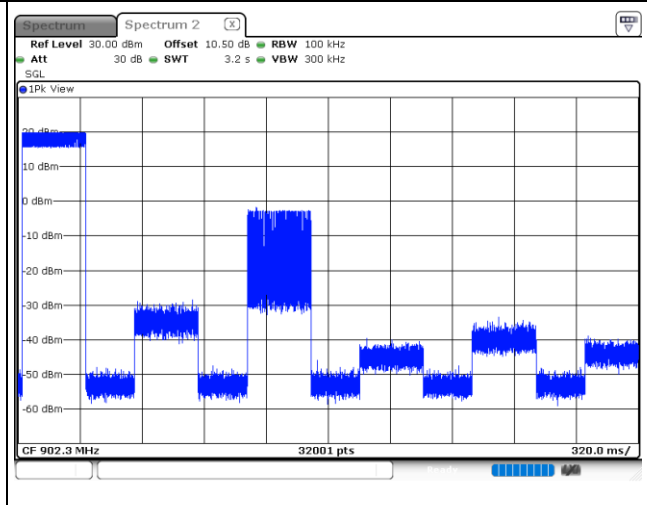
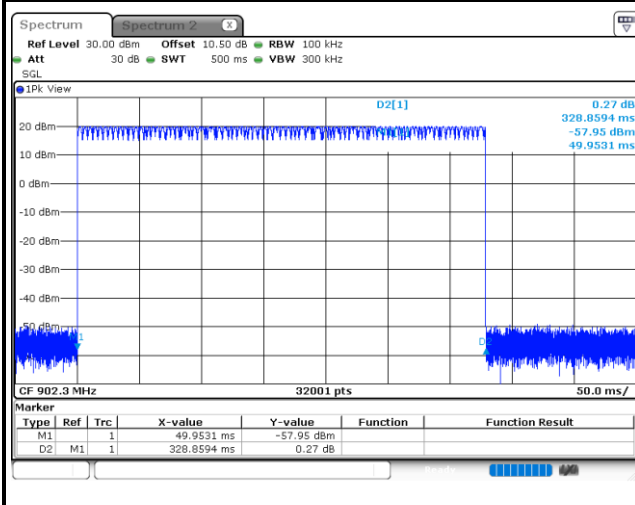
3.7.4 Test Result of Dwell Time

Ambient Condition	23°C / 66%	Tested By	Aska Huang
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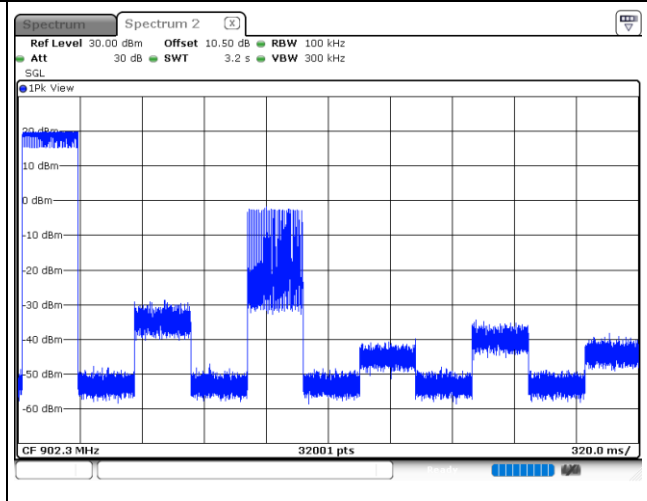
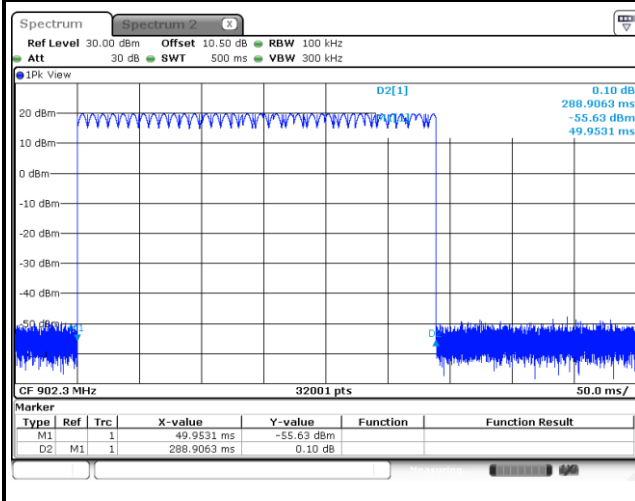
Modulation / SF	Freq. (MHz)	Length of Transmission Time (sec)	Number of Transmission in a 3.2 s (8 Hopping channels *0.4s)	Result (s)	Limit (s)
Lora / 7	902.3	0.3588125	1	0.3588125	0.4
Lora / 8	902.3	0.3692969	1	0.3692969	0.4
Lora / 9	902.3	0.3288594	1	0.3288594	0.4
Lora / 10	902.3	0.2889063	1	0.2889063	0.4



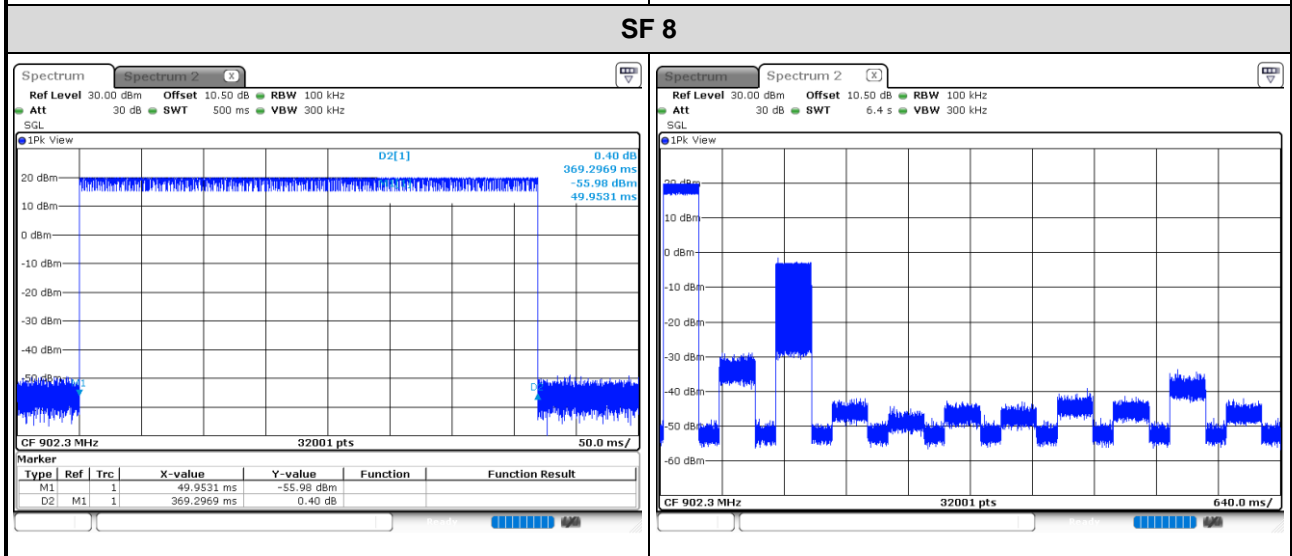
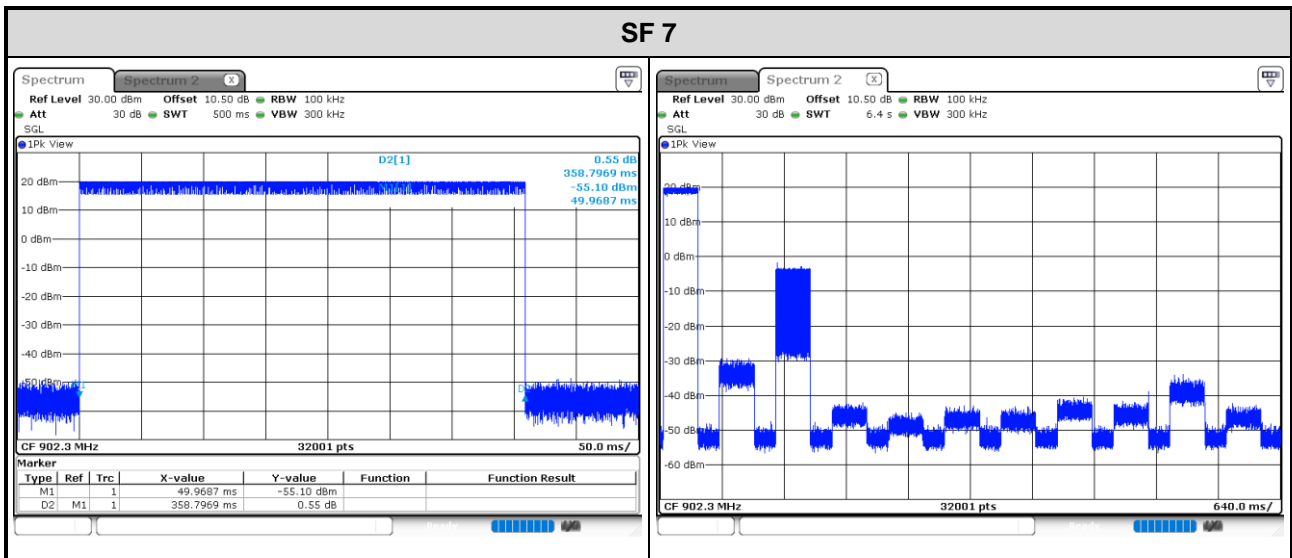
SF 9



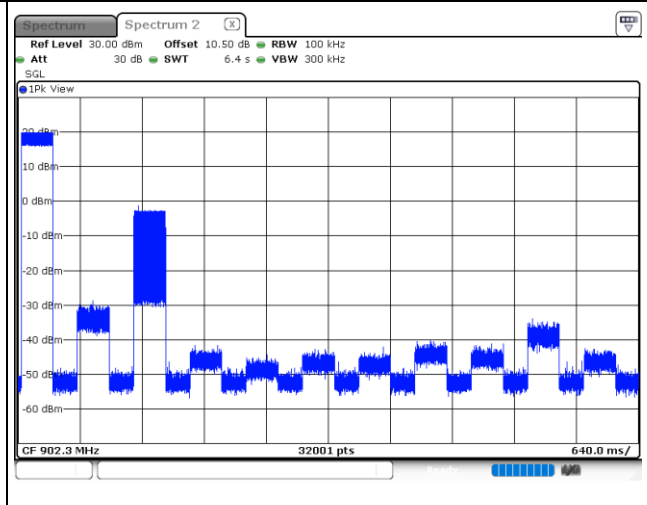
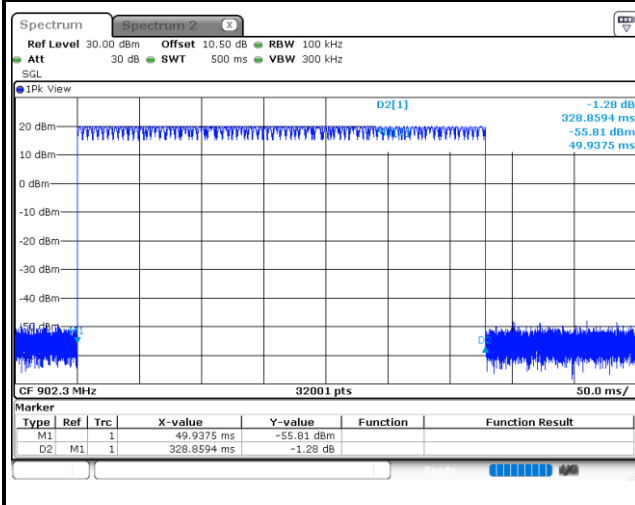
SF 10



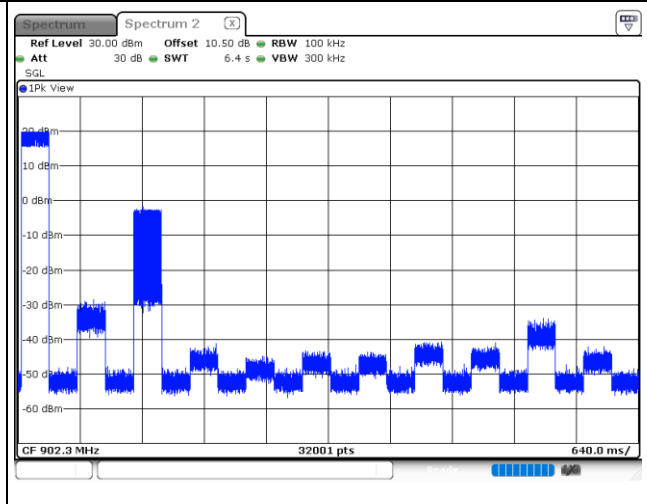
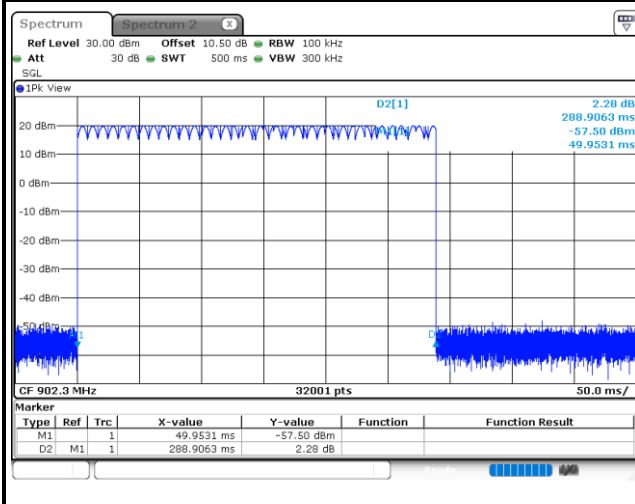
Modulation / SF	Freq. (MHz)	Length of Transmission Time (sec)	Number of Transmission in a 6.4 s (16 Hopping channels *0.4s)	Result (s)	Limit (s)
Lora / 7	902.3	0.3588594	1	0.3588594	0.4
Lora / 8	902.3	0.3693281	1	0.3693281	0.4
Lora / 9	902.3	0.3288594	1	0.3288594	0.4
Lora / 10	902.3	0.2889219	1	0.2889219	0.4



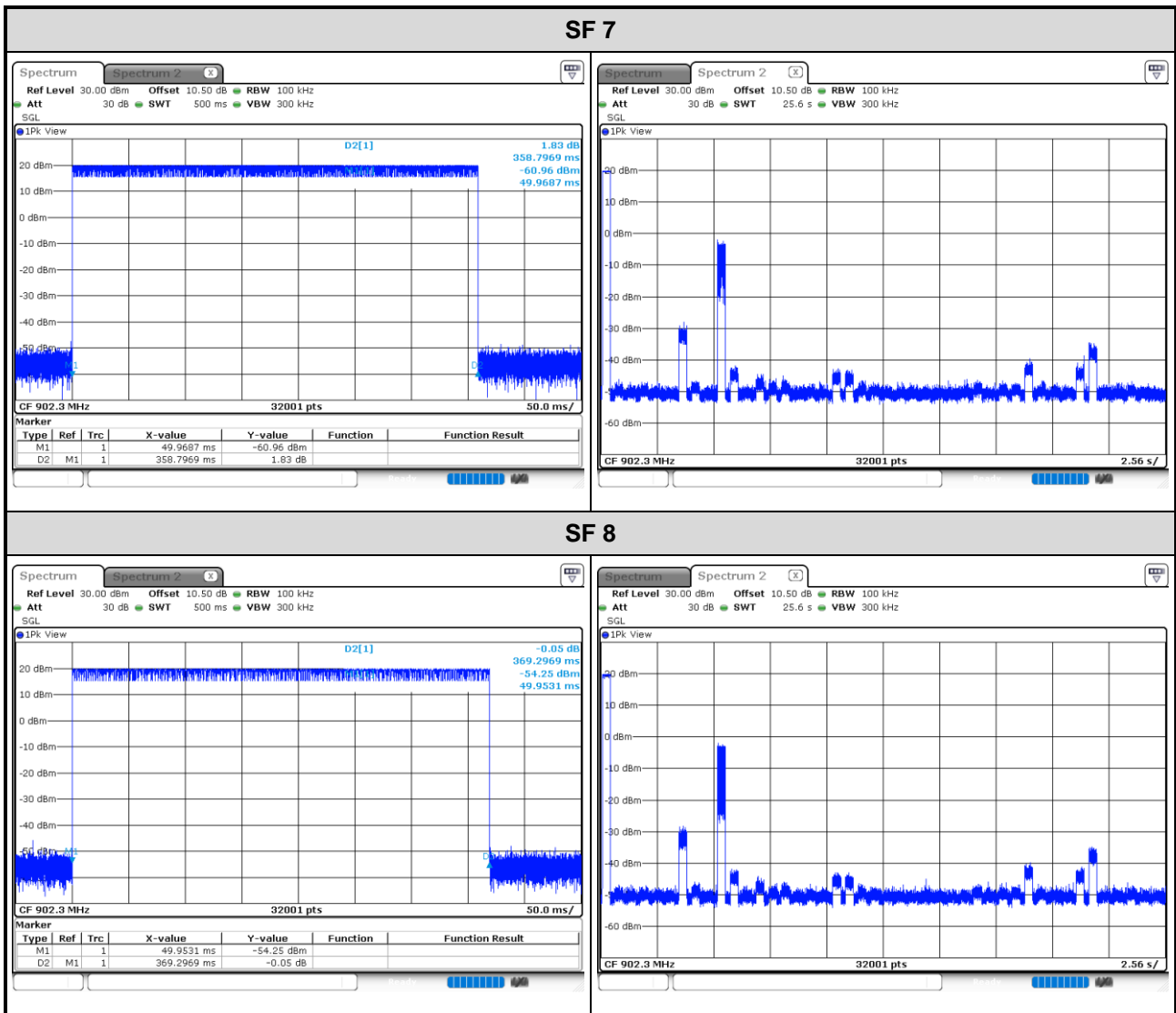
SF 9



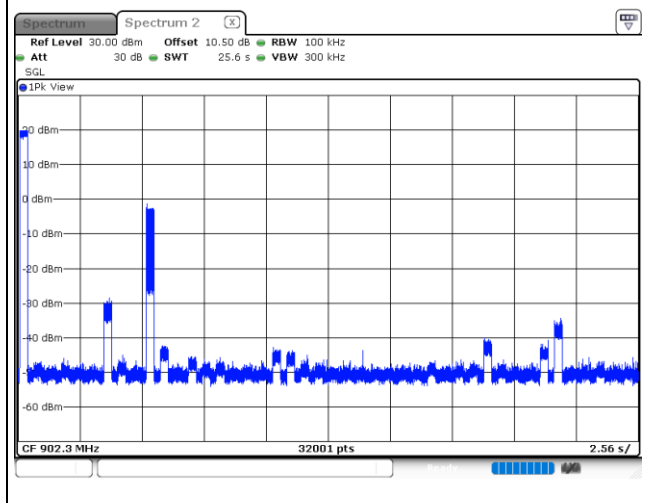
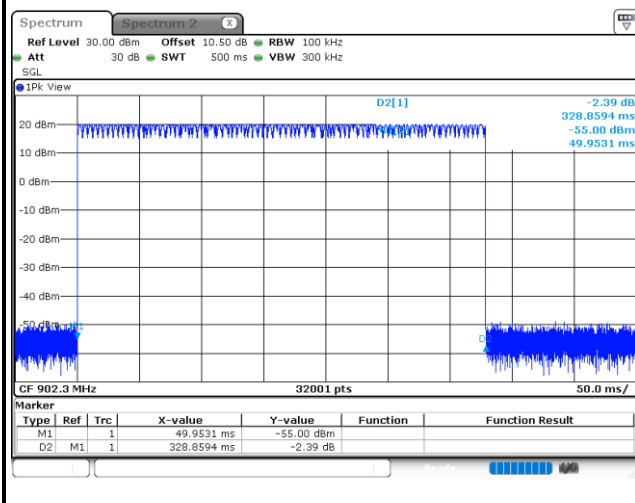
SF 10



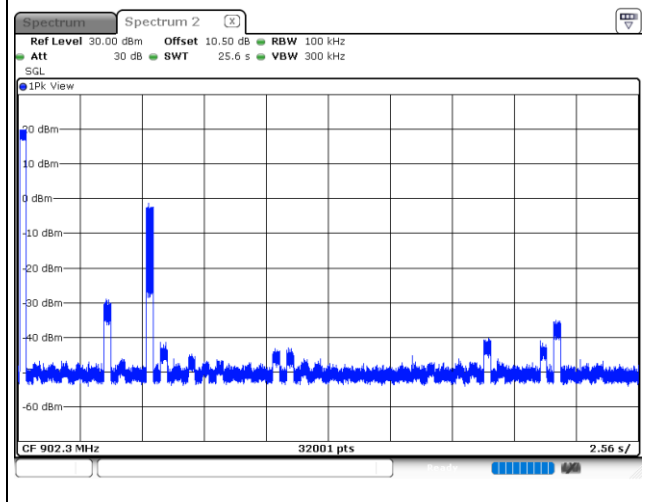
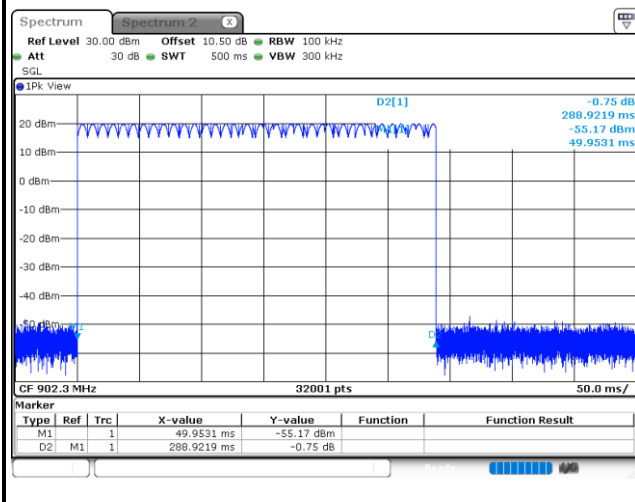
Modulation / SF	Freq. (MHz)	Length of Transmission Time (sec)	Number of Transmission in a 25.6 s (64 Hopping channels *0.4s)	Result (s)	Limit (s)
Lora / 7	902.3	0.3588281	1	0.3588281	0.4
Lora / 8	902.3	0.3693281	1	0.3693281	0.4
Lora / 9	902.3	0.3289063	1	0.3289063	0.4
Lora / 10	902.3	0.2889219	1	0.2889219	0.4



SF 9



SF 10



3.8 Power Spectral Density

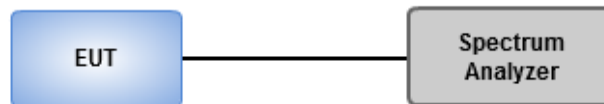
3.8.1 Limit of Power Spectral Density

Power spectral density shall not be greater than 8 dBm in any 3 kHz band. This item is for Hybrid mode.

3.8.2 Test Procedures

1. Set the RBW = 3kHz, VBW = 10 kHz.
2. Detector = RMS, Sweep time = auto couple.
3. Employ trace averaging (RMS) mode over a minimum of 100 traces
4. Use the peak marker function to determine the maximum amplitude level.

3.8.3 Test Setup



3.8.4 Test Result of Power Spectral Density

Ambient Condition	23°C / 66%	Tested By	Aska Huang
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Summary

Mode	PD (dBm/3kHz)
902-928MHz	-
LoRa (125kHz)	4.32

Result

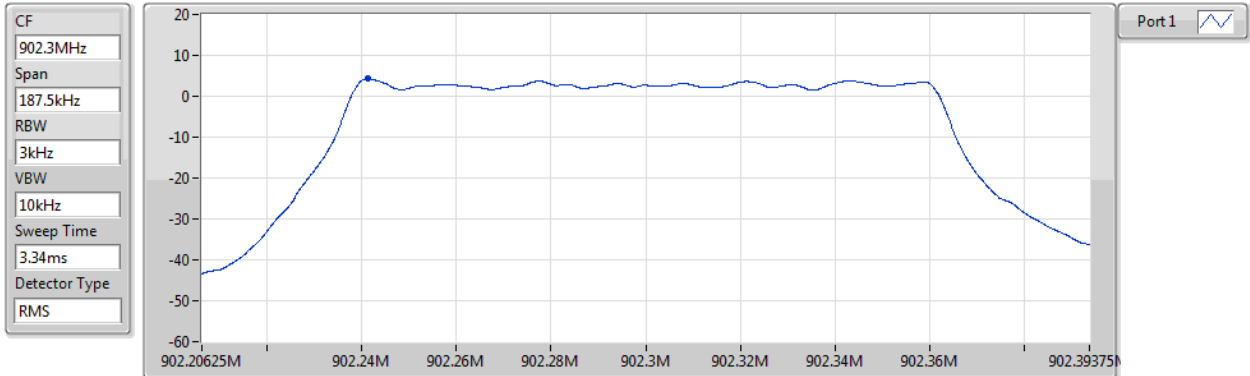
Mode	Result	Antenna Gain (dBi)	PD (dBm/3kHz)	PD Limit (dBm/3kHz)
LoRa (125kHz)	-	-	-	-
902.3MHz	Pass	1.09	4.32	8.00
908.5MHz	Pass	1.09	3.87	8.00
914.9MHz	Pass	1.09	3.82	8.00

PD =Maximum power density;

LoRa (125kHz)

PSD

902.3MHz

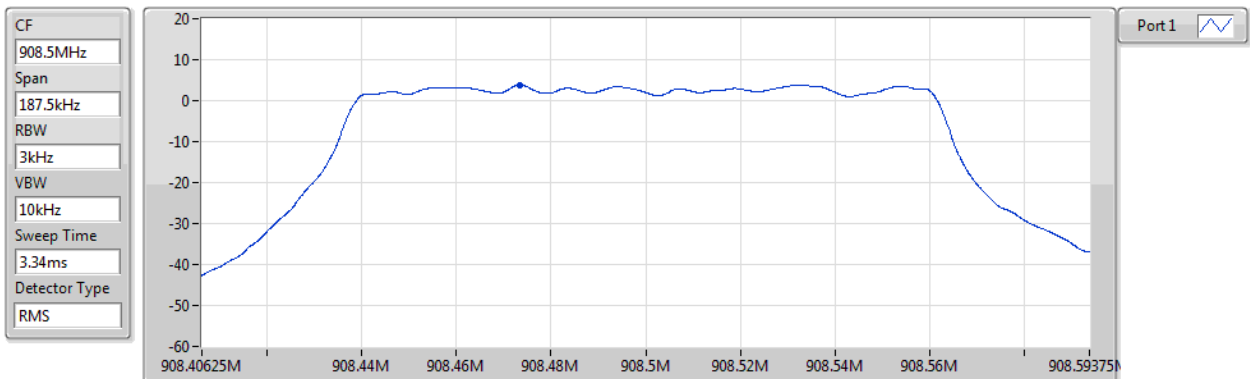


Sum	PD	Port 1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
4.32	4.32	4.32

LoRa (125kHz)

PSD

908.5MHz

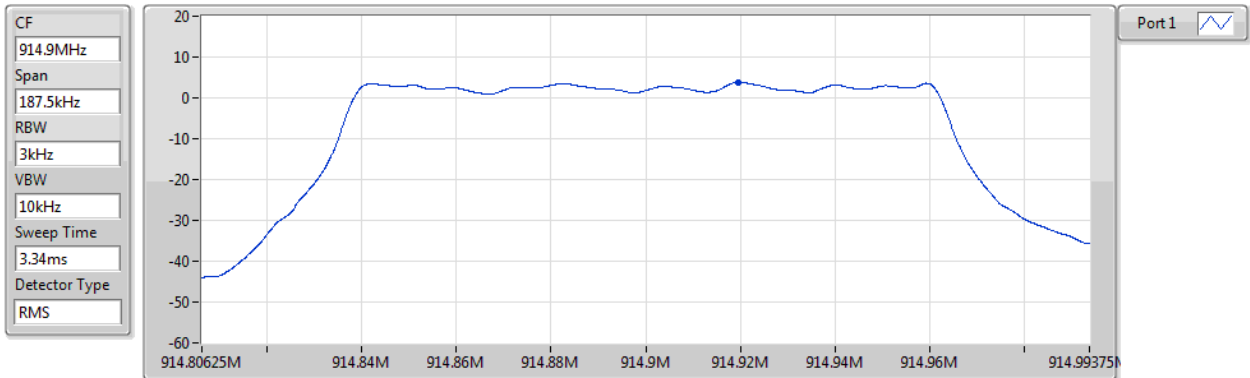


Sum	PD	Port 1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
3.87	3.87	3.87

LoRa (125kHz)

PSD

914.9MHz



Sum	PD	Port 1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
3.82	3.82	3.82

4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corporation (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

Tel: 886-2-2601-1640

No.30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan (R.O.C.)

Kwei Shan

Tel: 886-3-271-8666

No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

No.2-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

Kwei Shan Site II

Tel: 886-3-271-8640

No.14-1, Lane 19, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 333, Taiwan (R.O.C.)

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666

Fax: 886-3-318-0345

Email: ICC_Service@icertifi.com.tw

==END==