FCC Test Report

FCC ID	:	**2AAS9DW10**
Equipment	:	**MerryIoT Open/Close**
Model No.	:	**DW10**
Brand Name	:	**MerryIoT**
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	:	**Jan. 12, 2022**
Tested Date	:	**Feb. 16 ~ Feb. 19, 2022**

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 shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:	**Approved by:**
Along Chen / Assistant Manager	**Gary Chang / Manager**

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Release Record

Report No.	Version	Description	Issued Date
FR211201AH	Rev. 01	Initial issue	Mar. 08, 2022

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	Note	N/A
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 2706.90MHz 52.89 (Margin -1.11dB) – AV	Pass
15.247(d)	Band Edge	Meet the requirement of limit	Pass
15.247(b)(2)(3)	Conducted Output Power	Power [dBm]: 19.34	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
Note: The EUT consumes DC power from battery, so the test is not required.			

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 List	Data Rate (bit/sec)	Spread Factor	Channel Bandwidth (kHz)
902 ~ 928	902.3 ~ 914.9	64 channels	980~5470	7 ~ 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	No	0.61

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	Brand: RAMWAY Model: ER14250 Rating: 3.6V/1.2Ah

1.1.5 Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	902.3	16	905.5	32	908.7	48	911.9
1	902.5	17	905.7	33	908.9	49	912.1
2	902.7	18	905.9	34	909.1	50	912.3
3	902.9	19	906.1	35	909.3	51	912.5
4	903.1	20	906.3	36	909.5	52	912.7
5	903.3	21	906.5	37	909.7	53	912.9
6	903.5	22	906.7	38	909.9	54	913.1
7	903.7	23	906.9	39	910.1	55	913.3
8	903.9	24	907.1	40	910.3	56	913.5
9	904.1	25	907.3	41	910.5	57	913.7
10	904.3	26	907.5	42	910.7	58	913.9
11	904.5	27	907.7	43	910.9	59	914.1
12	904.7	28	907.9	44	911.1	60	914.3
13	904.9	29	908.1	45	911.3	61	914.5
14	905.1	30	908.3	46	911.5	62	914.7
15	905.3	31	908.5	47	911.7	63	914.9

1.1.6 Test Tool and Duty Cycle

Test Tool	CMD, Version: V6.1.7601	
Duty Cycle and Duty Factor	**Duty Cycle (%)**	**Duty Factor (dB)**
125KHz	91.13%	0.40

1.1.7 Power Index of Test Tool

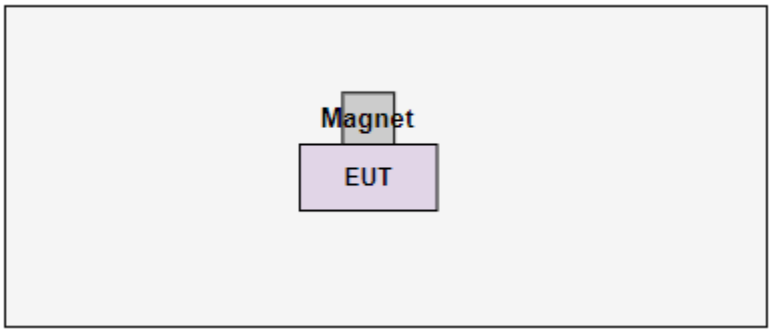
Test Frequency (MHz)	Power Index
902.3	20
908.5	20
914.9	20

1.2 Local Support Equipment List

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

1.3 Test Setup Chart

Test Setup Diagram



Note: The support notebook and USB cable with Fixture were disconnected from EUT and removed from test table when EUT is set to transmit/receive continuously.

1.4 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Feb. 16, 2022				
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	Nov. 29, 2021	Nov. 28, 2022
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 08, 2021	Nov. 07, 2022
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. 03, 2021	Dec. 02, 2022
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170508	Jan. 11, 2022	Jan. 10, 2023
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-NW-11000	200801	Oct. 05, 2021	Oct. 04, 2022
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160502	Oct. 05, 2021	Oct. 04, 2022
RF Cable	EMC	EMC104-35M-35M-8000	210920	Oct. 05, 2021	Oct. 04, 2022
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	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	Feb. 19, 2022				
Instrument	**Brand**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101498	Nov. 29, 2021	Nov. 28, 2022
Power Meter	Anritsu	ML2495A	1241002	Nov. 07, 2021	Nov. 06, 2022
Power Sensor	Anritsu	MA2411B	1207366	Nov. 07, 2021	Nov. 06, 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
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	Channel Bandwidth (kHz)	Test Frequency (MHz)	Separating Factor
Radiated Emissions Conducted Output Power Hopping Channel Separation 20dB and Occupied bandwidth Power Spectral Density Unwanted Emissions into Non-Restricted Frequency Bands	125	902.3 / 908.5 / 914.9	SF10
Number of Hopping Channels	125	902.3 ~ 914.9	SF10
Dwell Time	125	902.3	SF10, 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 **Y-plane** result was found as the worst case and was 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

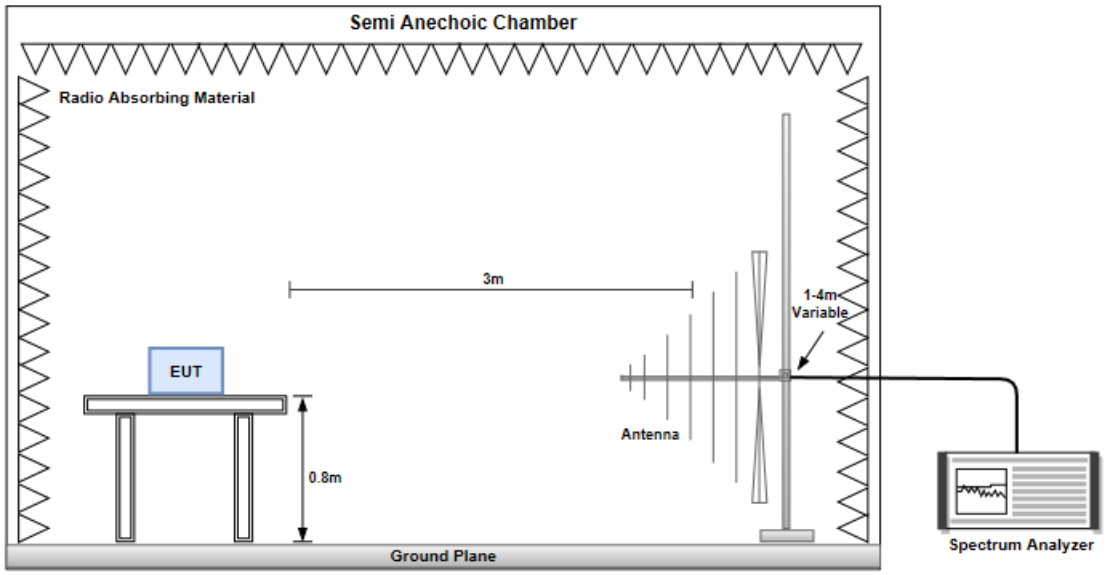
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission 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:

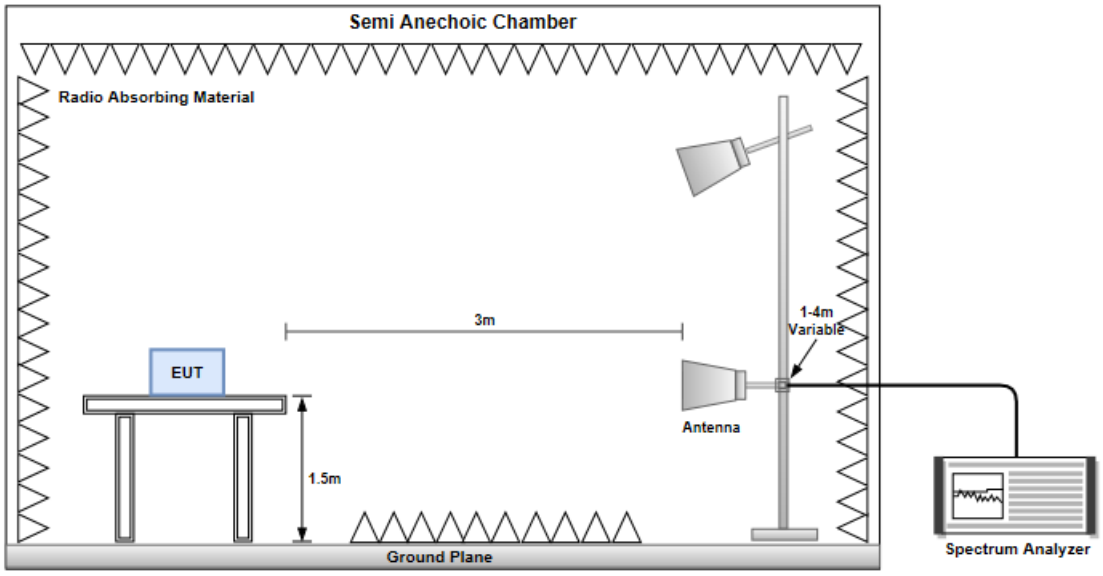
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above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

3.1.3 Test Setup

Radiated Emissions below 1 GHz



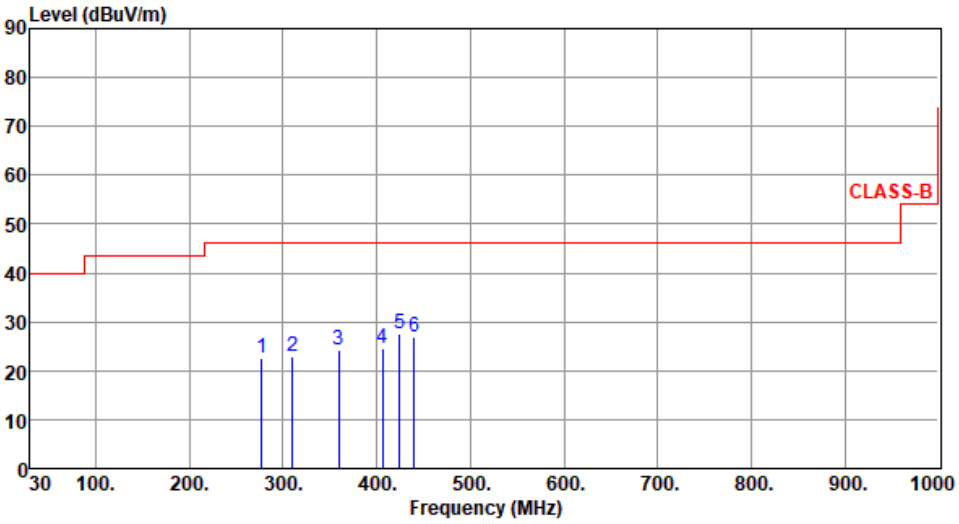
Radiated Emissions above 1 GHz



3.1.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation / SF	LORA / 10	Test Freq. (MHz)	902.3
Polarization	Horizontal		

Test By :Brad Wu Temperature(℃):22 Humidity(%):65

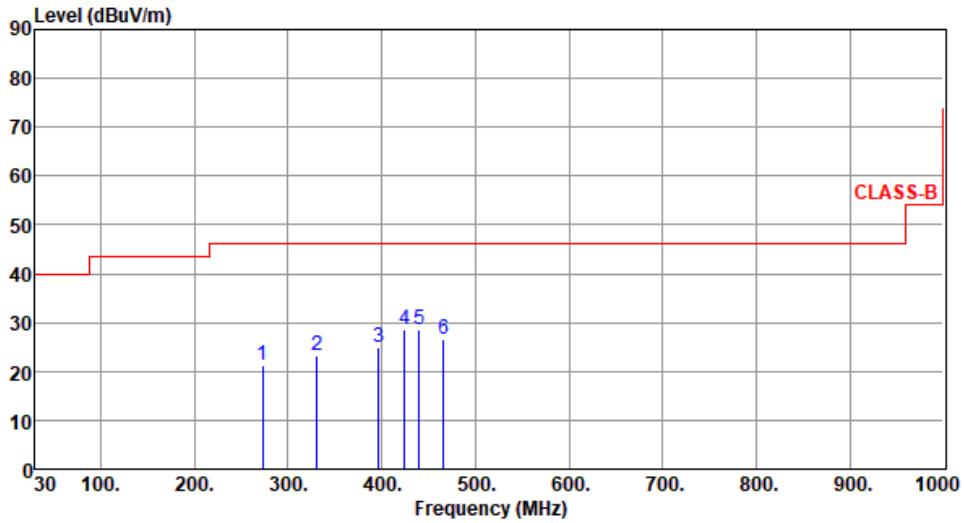


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	277.60	22.42	46.00	-23.58	31.20	-8.78	Peak	---	---
2	310.40	23.08	46.00	-22.92	30.86	-7.78	Peak	---	---
3	359.20	24.15	46.00	-21.85	30.85	-6.70	Peak	---	---
4	406.40	24.68	46.00	-21.32	30.32	-5.64	Peak	---	---
5	424.80	27.61	46.00	-18.39	32.63	-5.02	Peak	---	---
6	440.00	27.05	46.00	-18.95	31.62	-4.57	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)
*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 :Brad Wu Temperature(℃):22 Humidity(%):65

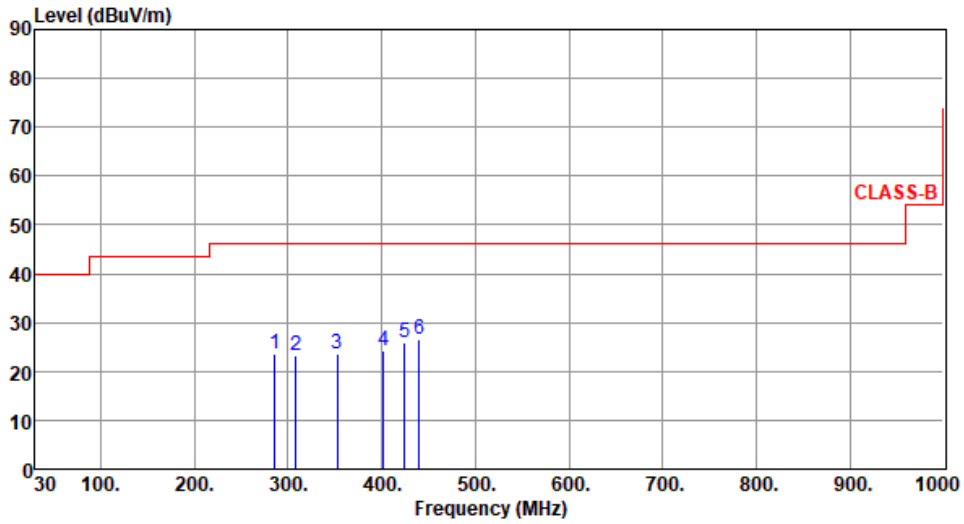


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	272.80	21.14	46.00	-24.86	30.13	-8.99	Peak	---	---
2	331.20	23.16	46.00	-22.84	30.57	-7.41	Peak	---	---
3	396.80	24.79	46.00	-21.21	30.64	-5.85	Peak	---	---
4	424.80	28.60	46.00	-17.40	33.62	-5.02	Peak	---	---
5	440.00	28.58	46.00	-17.42	33.15	-4.57	Peak	---	---
6	466.40	26.49	46.00	-19.51	30.49	-4.00	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)
*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 :Brad Wu Temperature(℃):22 Humidity(%):65

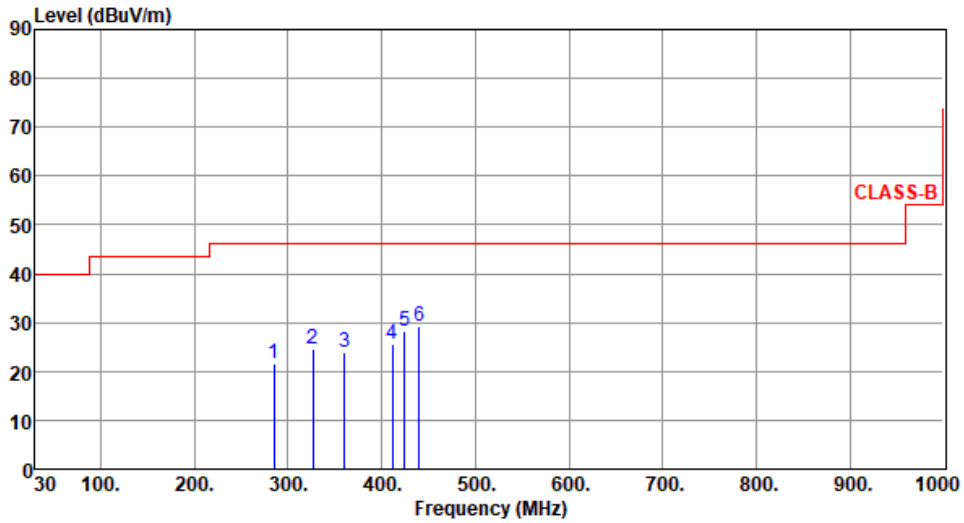


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	285.60	23.73	46.00	-22.27	32.28	-8.55	Peak	---	---
2	308.00	23.30	46.00	-22.70	31.18	-7.88	Peak	---	---
3	352.80	23.71	46.00	-22.29	30.68	-6.97	Peak	---	---
4	401.60	24.30	46.00	-21.70	30.05	-5.75	Peak	---	---
5	424.80	25.95	46.00	-20.05	30.97	-5.02	Peak	---	---
6	440.00	26.61	46.00	-19.39	31.18	-4.57	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)
*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 :Brad Wu Temperature(℃):22 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	284.80	21.48	46.00	-24.52	30.05	-8.57	Peak	---	---
2	326.40	24.56	46.00	-21.44	32.01	-7.45	Peak	---	---
3	360.80	23.80	46.00	-22.20	30.44	-6.64	Peak	---	---
4	411.20	25.48	46.00	-20.52	31.01	-5.53	Peak	---	---
5	424.80	28.25	46.00	-17.75	33.27	-5.02	Peak	---	---
6	440.00	29.17	46.00	-16.83	33.74	-4.57	Peak	---	---

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

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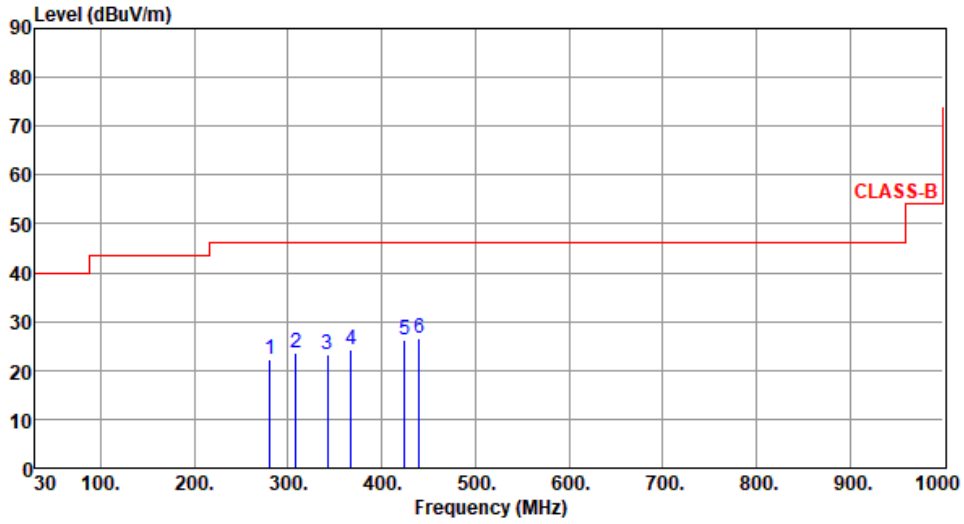
Modulation / SF	LORA / 10	Test Freq. (MHz)	914.9
Polarization	Horizontal		

Test By :Brad Wu Temperature(℃):22 Humidity(%):65

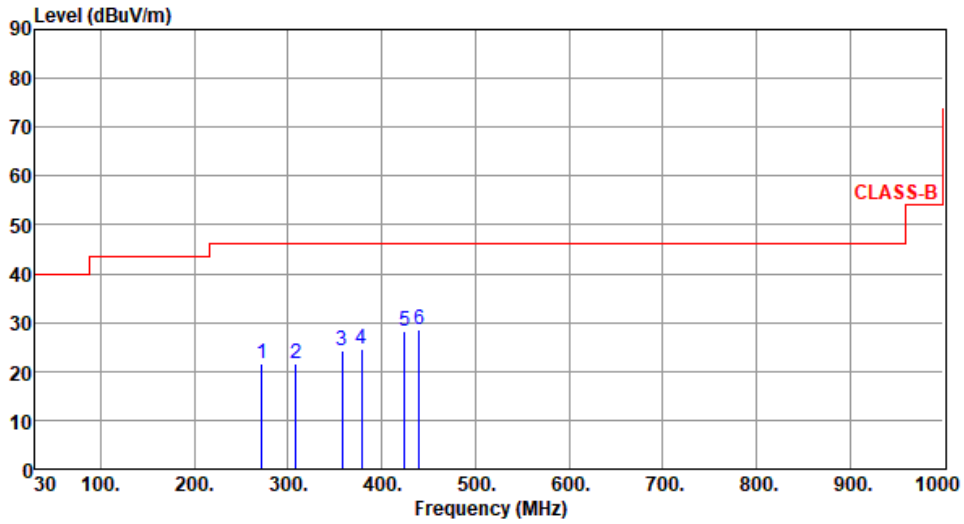


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	280.80	22.20	46.00	-23.80	30.85	-8.65	Peak	---	---
2	308.80	23.71	46.00	-22.29	31.56	-7.85	Peak	---	---
3	342.40	23.11	46.00	-22.89	30.37	-7.26	Peak	---	---
4	367.20	24.24	46.00	-21.76	30.75	-6.51	Peak	---	---
5	424.80	26.27	46.00	-19.73	31.29	-5.02	Peak	---	---
6	440.00	26.57	46.00	-19.43	31.14	-4.57	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)
*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)	914.9
Polarization	Vertical		

Test By :Brad Wu Temperature(℃):22 Humidity(%):65



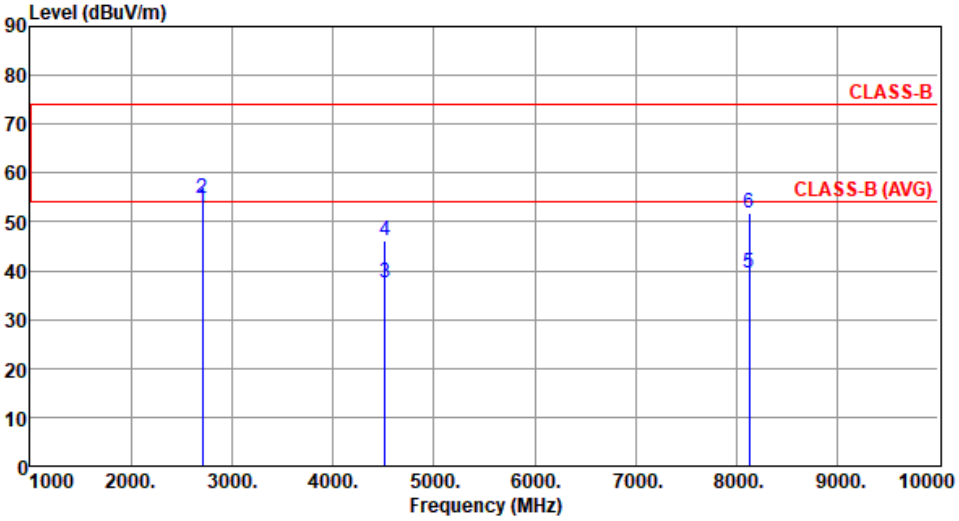
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	272.00	21.48	46.00	-24.52	30.50	-9.02	Peak	---	---
2	308.80	21.64	46.00	-24.36	29.49	-7.85	Peak	---	---
3	357.60	24.28	46.00	-21.72	31.05	-6.77	Peak	---	---
4	378.40	24.70	46.00	-21.30	30.95	-6.25	Peak	---	---
5	424.80	28.24	46.00	-17.76	33.26	-5.02	Peak	---	---
6	440.00	28.65	46.00	-17.35	33.22	-4.57	Peak	---	---

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

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(℃):22 Humidity(%):65

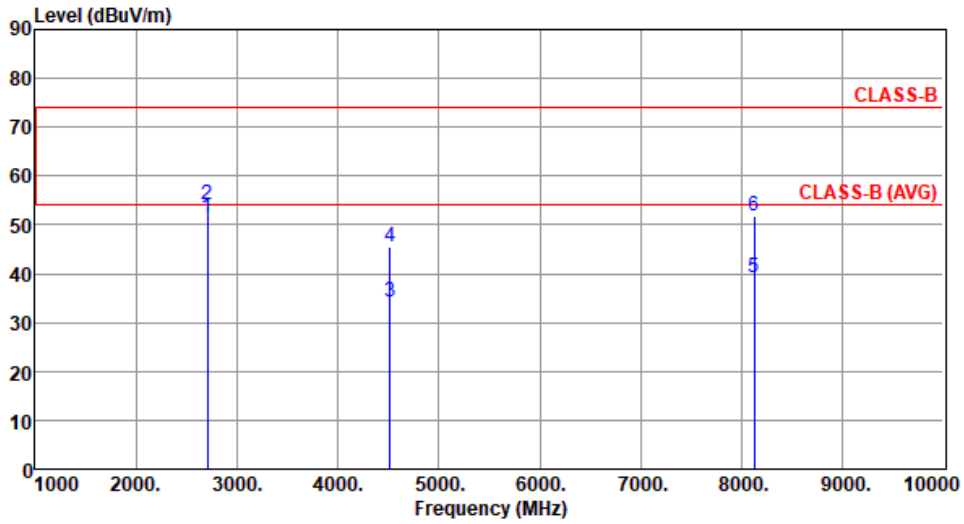


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2706.90	52.89	54.00	-1.11	54.58	-1.69	Average	100	36
2	2706.90	54.94	74.00	-19.06	56.63	-1.69	Peak	100	36
3	4511.50	37.61	54.00	-16.39	34.59	3.02	Average	100	125
4	4511.50	46.27	74.00	-27.73	43.25	3.02	Peak	100	125
5	8120.70	39.36	54.00	-14.64	29.31	10.05	Average	100	90
6	8120.70	51.94	74.00	-22.06	41.89	10.05	Peak	100	90

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)
*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(℃):22 Humidity(%):65

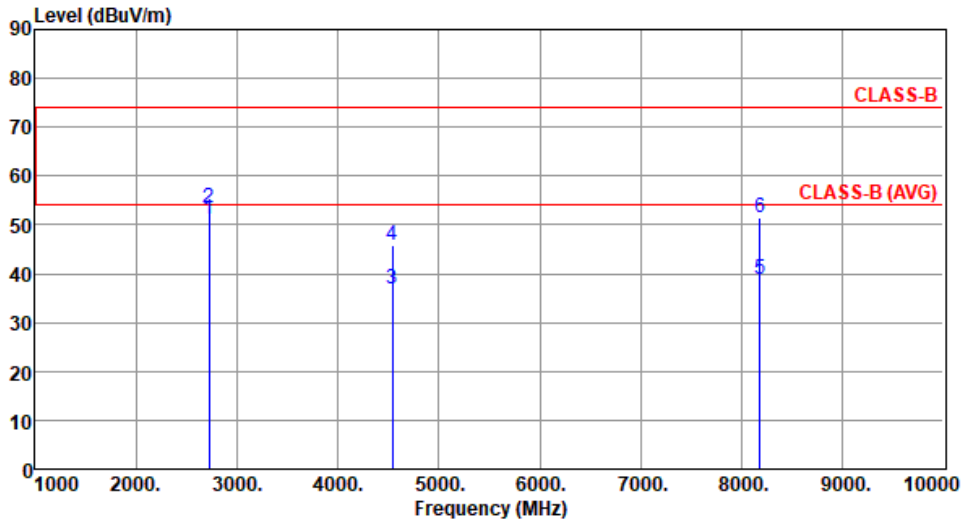


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2706.90	51.56	54.00	-2.44	53.25	-1.69	Average	105	316
2	2706.90	54.26	74.00	-19.74	55.95	-1.69	Peak	105	316
3	4511.50	34.31	54.00	-19.69	31.29	3.02	Average	120	310
4	4511.50	45.47	74.00	-28.53	42.45	3.02	Peak	120	310
5	8120.70	39.20	54.00	-14.80	29.15	10.05	Average	100	70
6	8120.70	51.72	74.00	-22.28	41.67	10.05	Peak	100	70

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)
*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(℃):22 Humidity(%):65

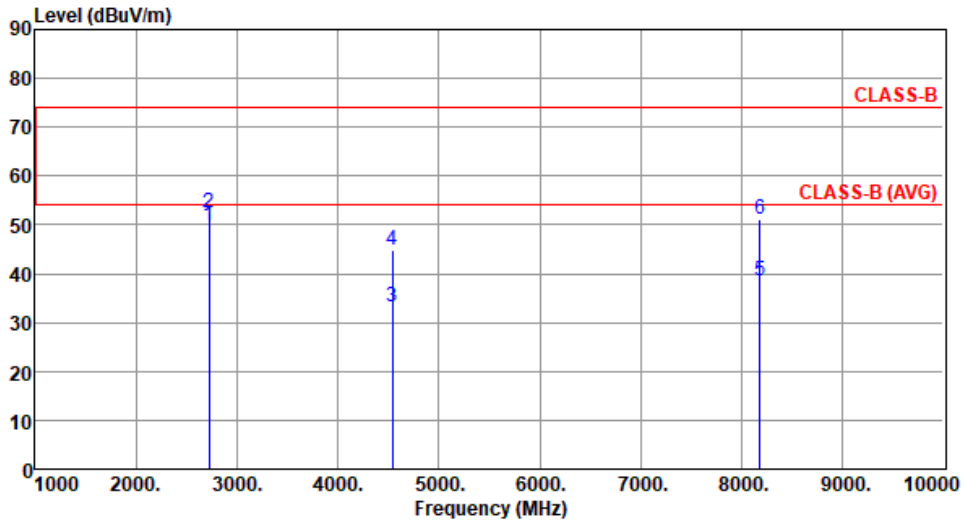


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2725.50	51.11	54.00	-2.89	52.74	-1.63	Average	100	38
2	2725.50	53.60	74.00	-20.40	55.23	-1.63	Peak	100	38
3	4542.50	37.01	54.00	-16.99	33.90	3.11	Average	100	128
4	4542.50	45.68	74.00	-28.32	42.57	3.11	Peak	100	128
5	8176.50	38.95	54.00	-15.05	29.05	9.90	Average	100	60
6	8176.50	51.49	74.00	-22.51	41.59	9.90	Peak	100	60

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)
*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(℃):22 Humidity(%):65



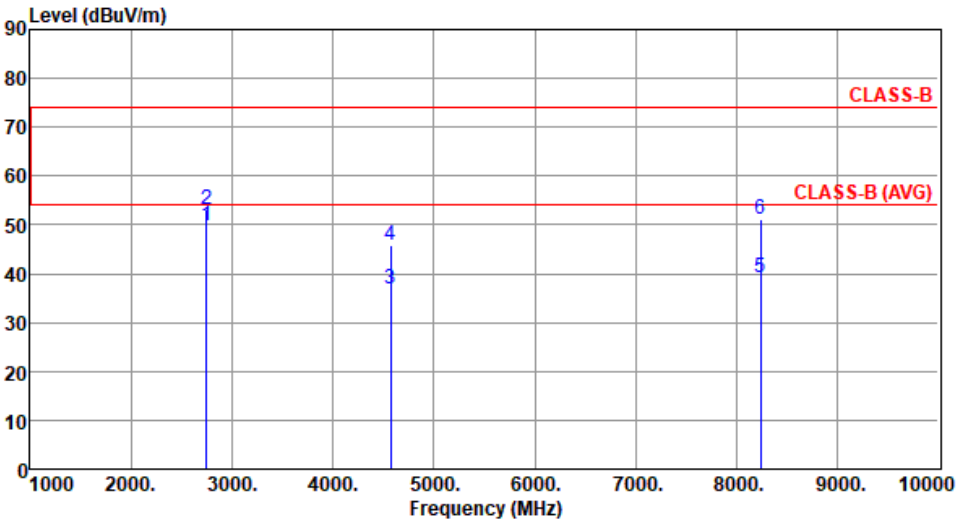
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2725.50	49.94	54.00	-4.06	51.57	-1.63	Average	104	311
2	2725.50	52.47	74.00	-21.53	54.10	-1.63	Peak	104	311
3	4542.50	33.37	54.00	-20.63	30.26	3.11	Average	128	316
4	4542.50	44.88	74.00	-29.12	41.77	3.11	Peak	128	316
5	8176.50	38.57	54.00	-15.43	28.67	9.90	Average	100	60
6	8176.50	51.16	74.00	-22.84	41.26	9.90	Peak	100	60

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

T

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

Test By :Roger Lu Temperature(℃):22 Humidity(%):65

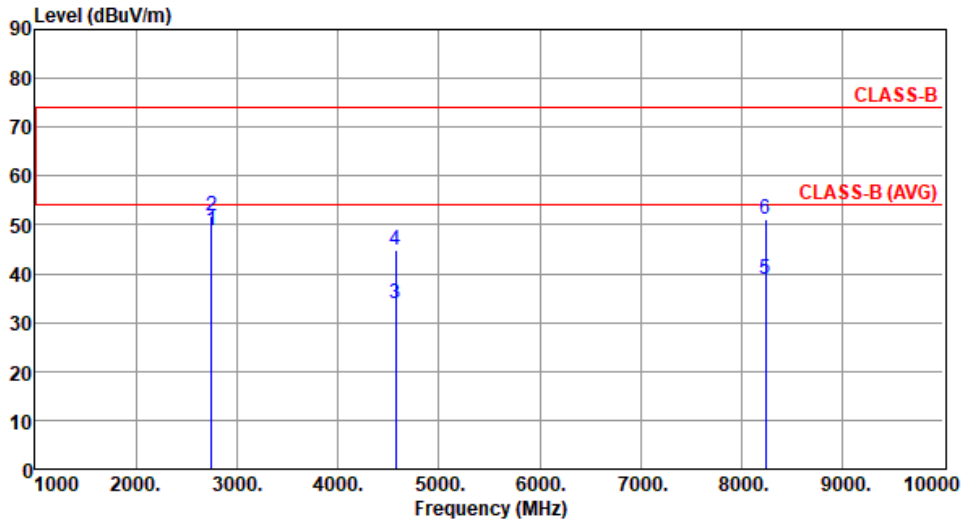


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB/m	Remark	ANT High cm	Turn Table deg
1	2744.70	49.98	54.00	-4.02	51.54	-1.56	Average	100	18
2	2744.70	53.12	74.00	-20.88	54.68	-1.56	Peak	100	18
3	4574.50	36.82	54.00	-17.18	33.56	3.26	Average	100	125
4	4574.50	45.69	74.00	-28.31	42.43	3.26	Peak	100	125
5	8234.10	39.07	54.00	-14.93	29.25	9.82	Average	100	50
6	8234.10	51.28	74.00	-22.72	41.46	9.82	Peak	100	50

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)
*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)	914.9
Polarization	Vertical		

Test By :Roger Lu Temperature(℃):22 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	48.70	54.00	-5.30	50.26	-1.56	Average	100	315
2	2744.70	51.89	74.00	-22.11	53.45	-1.56	Peak	100	315
3	4574.50	33.71	54.00	-20.29	30.45	3.26	Average	131	310
4	4574.50	44.71	74.00	-29.29	41.45	3.26	Peak	131	310
5	8234.10	38.84	54.00	-15.16	29.02	9.82	Average	100	30
6	8234.10	51.02	74.00	-22.98	41.20	9.82	Peak	100	30

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

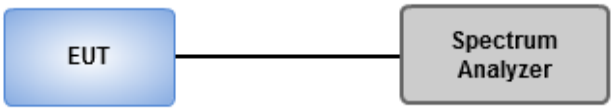
Reference Level Measurement

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

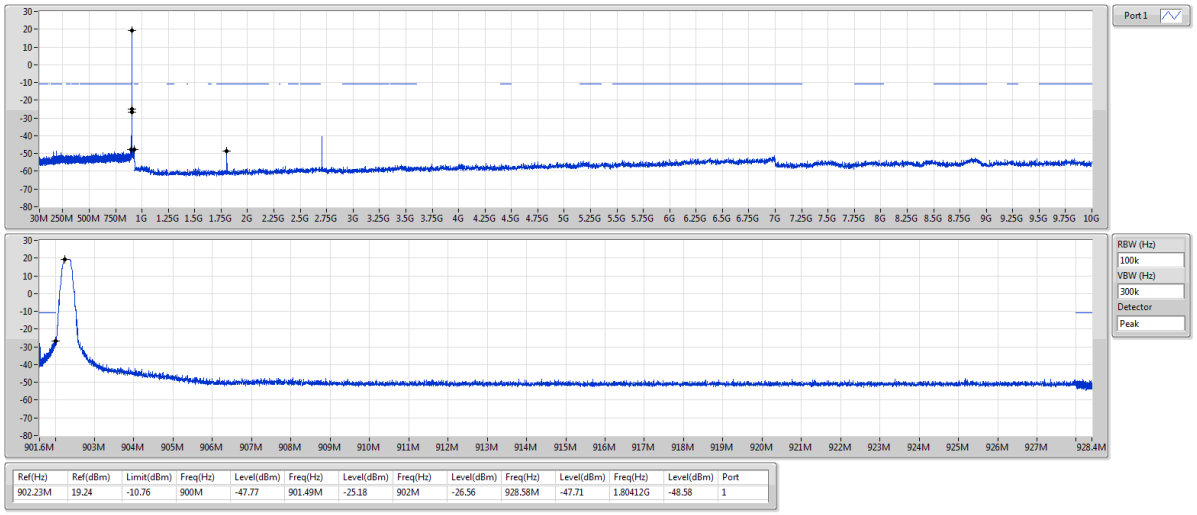


3.2.4 Unwanted Emissions into Non-Restricted Frequency Bands

Ambient Condition	18°C / 67%	Tested By	Aska Huang

LoRa (125kHz) **CSENdB-FS**

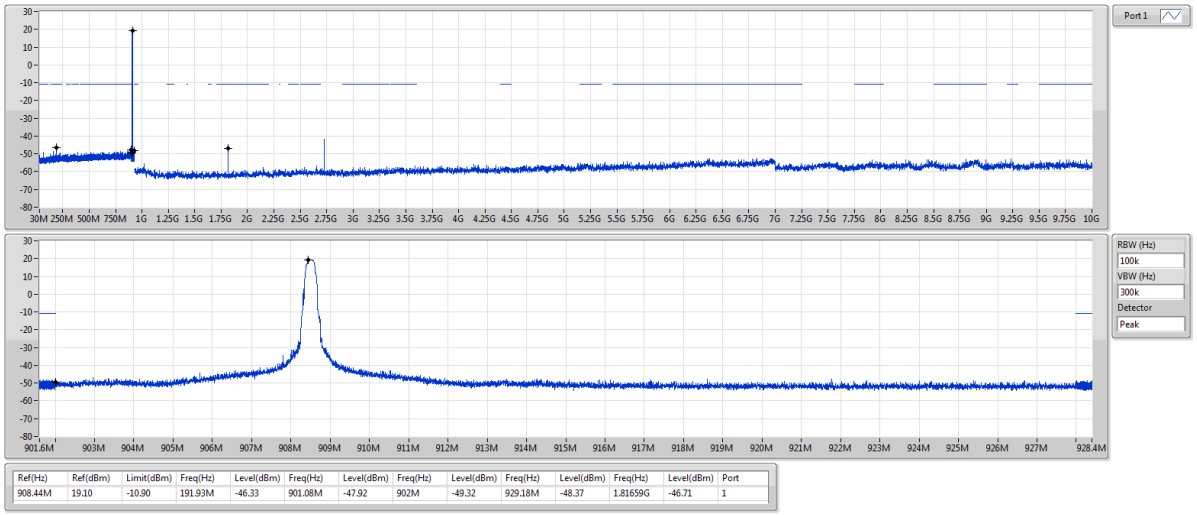
902.3MHz



Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
902.23M	19.24	-10.76	900M	-47.77	901.49M	-25.18	902M	-26.56	928.58M	-47.71	1.80412G	-48.58	1

LoRa (125kHz) **CSENdB-FS**

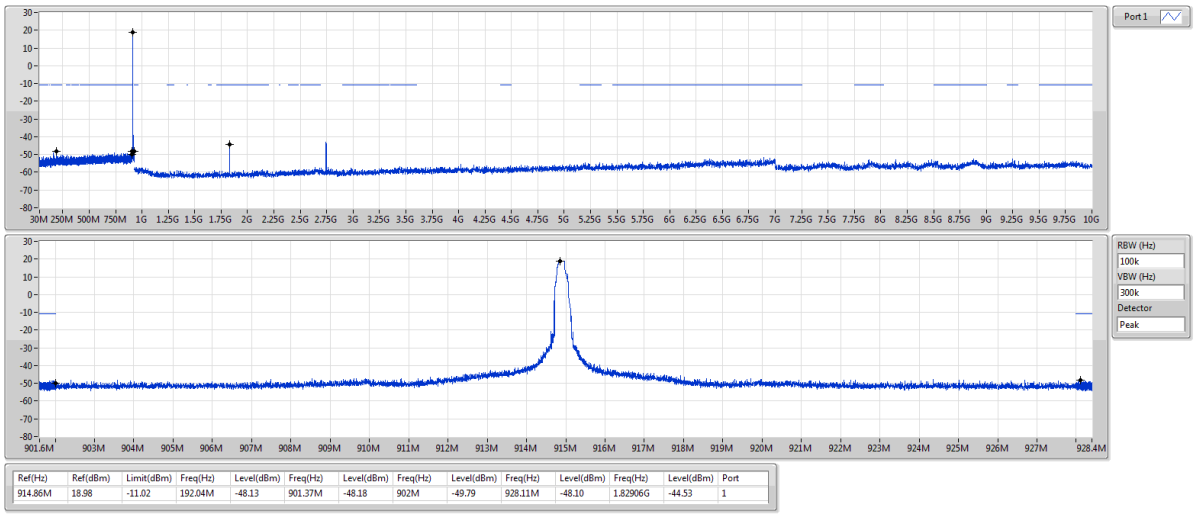
908.5MHz



Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
908.44M	19.10	-10.90	191.93M	-46.33	901.08M	-47.92	902M	-49.32	929.18M	-48.37	1.81659G	-46.71	1

LoRa (125kHz) **CSENdB-FS**

914.9MHz

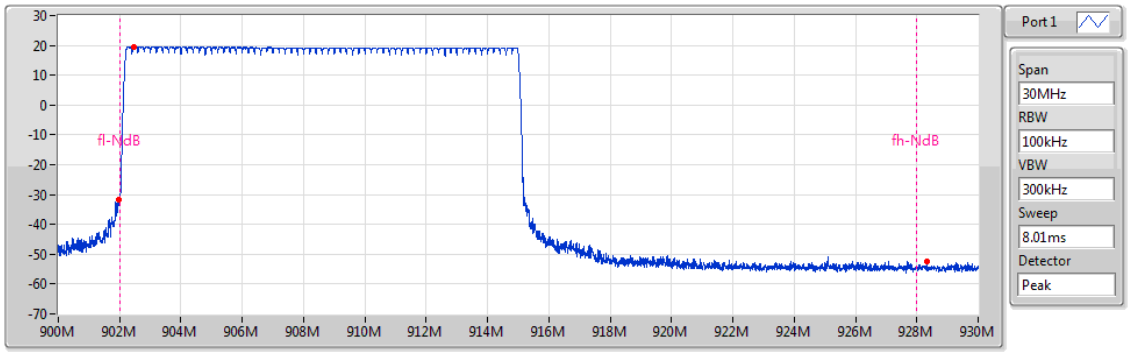


Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
914.86M	18.98	-11.02	192.04M	-48.13	901.37M	-48.18	902M	-49.79	928.11M	-48.10	1.82906G	-44.53	1

LoRa (125kHz)

902.3MHz

Hopping Ch Bandedge (Non-restricted Band)



Limit(dBm)	Ref(Hz)	Ref(dBm)	BE-l(Hz)	BE-l(dBm)	BE-h(Hz)	BE-h(dBm)
-0.66	902.45625M	19.34	901.965M	-31.63	928.3425M	-52.55

3.3 Conducted Output Power

3.3.1 Limit of Conducted Output Power

1W

3.3.2 Test Procedures

1. A wideband power meter is used for power measurement. Bandwidth of power senor 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	18°C / 67%	Tested By	Aska Huang

Summary

Mode	Power (dBm)	Power (W)
902-928MHz	-	-
LoRa (125kHz)	19.34	0.08590

Result

Mode	Result	Antenna Gain (dBi)	Power (dBm)	Power Limit (dBm)
LoRa (125kHz)	-	-	-	-
902.3MHz	Pass	0.61	19.34	30.00
908.5MHz	Pass	0.61	19.22	30.00
914.9MHz	Pass	0.61	19.09	30.00

3.4 Number of Hopping Frequency

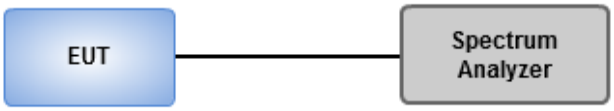
3.4.1 Limit of Number of Hopping Frequency

Number of Hopping Frequencies Limit for Frequency Hopping Systems	
☒	902-928 MHz Band:
	☐ N ≥ 50, 20 dB bandwidth of the hopping channel is less than 250 kHz
	☐ N ≥ 25, 20 dB bandwidth of the hopping channel is 250 kHz or greater
	☒ 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

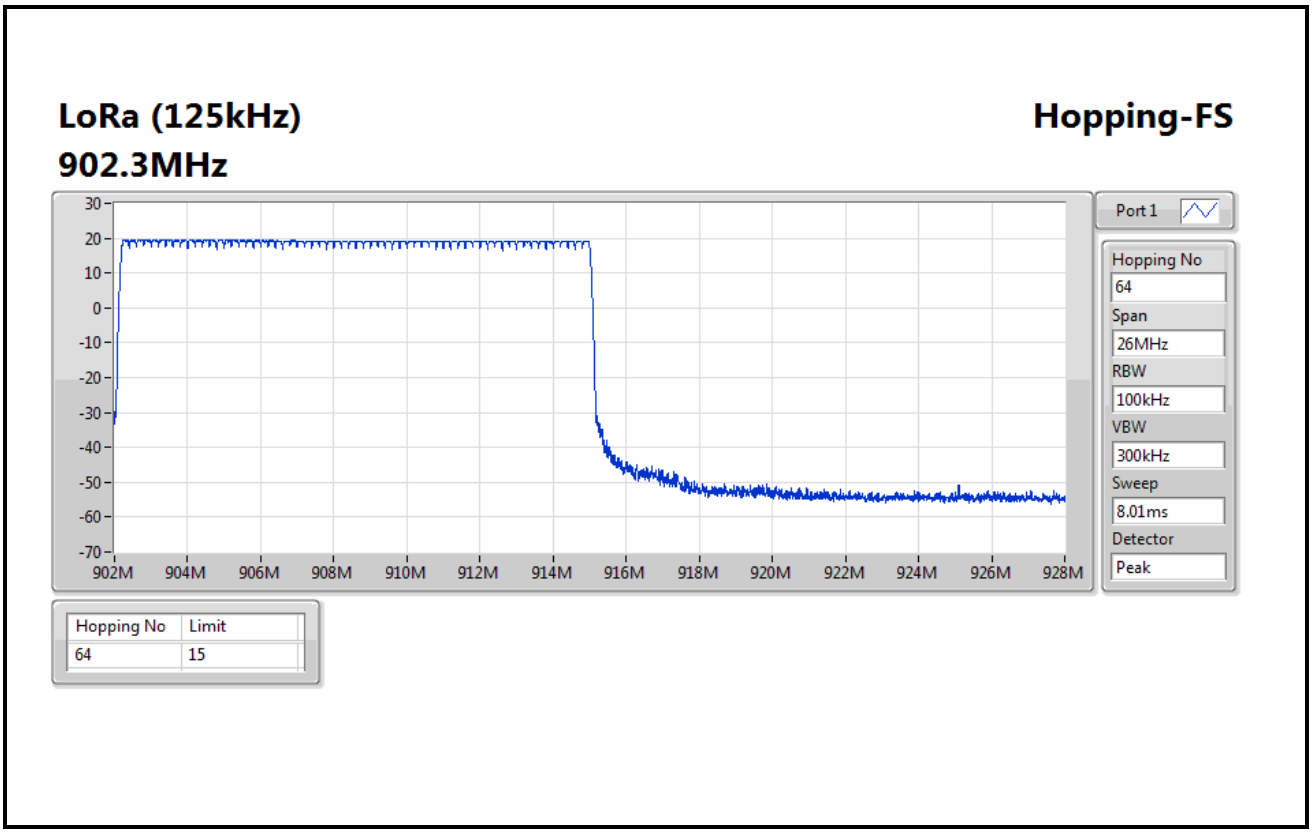
Ambient Condition	18°C / 67%	Tested By	Aska Huang

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

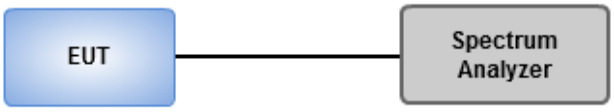
20dB Bandwidth

1. Set RBW=3kHz, 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=3kHz, VBW=10kHz,Sweep time = Auto, Detector=Peak, 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	18°C / 67%	Tested By	Aska Huang

Summary

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
902-928MHz	-	-	-	-	-
LoRa (125kHz)	139.855k	125.904k	126KF1D	138.406k	125.904k

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

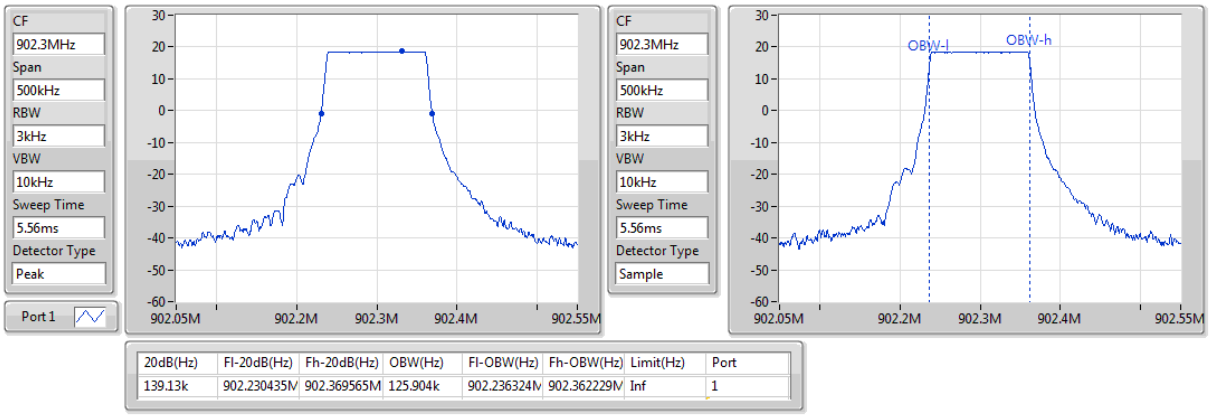
Result

Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
LoRa (125kHz)	-	-	-	-
902.3MHz	Pass	Inf	139.13k	125.904k
908.5MHz	Pass	Inf	138.406k	125.904k
914.9MHz	Pass	Inf	139.855k	125.904k

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

LoRa (125kHz) **EBW-FS**

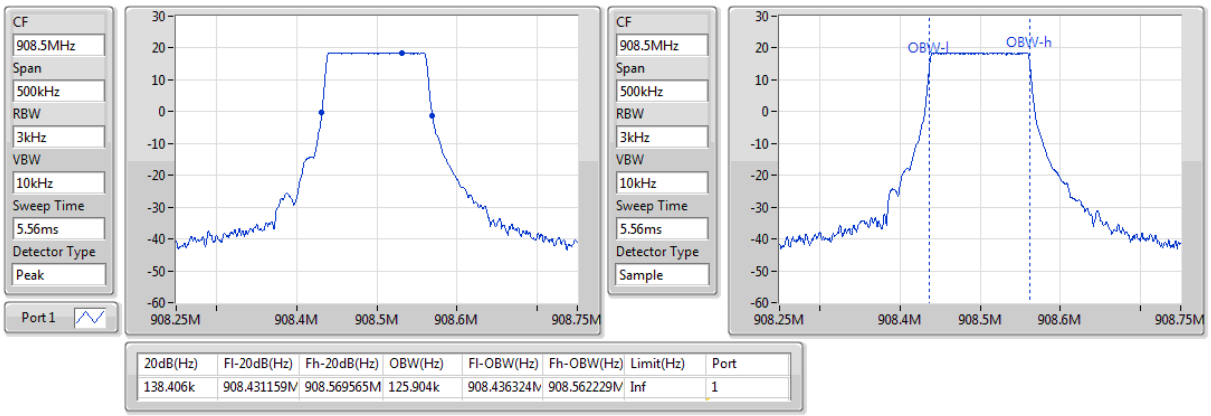
902.3MHz



20dB(Hz)	Fl-20dB(Hz)	Fh-20dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
139.13k	902.230435M	902.369565M	125.904k	902.236324M	902.362229M	Inf	1

LoRa (125kHz) **EBW-FS**

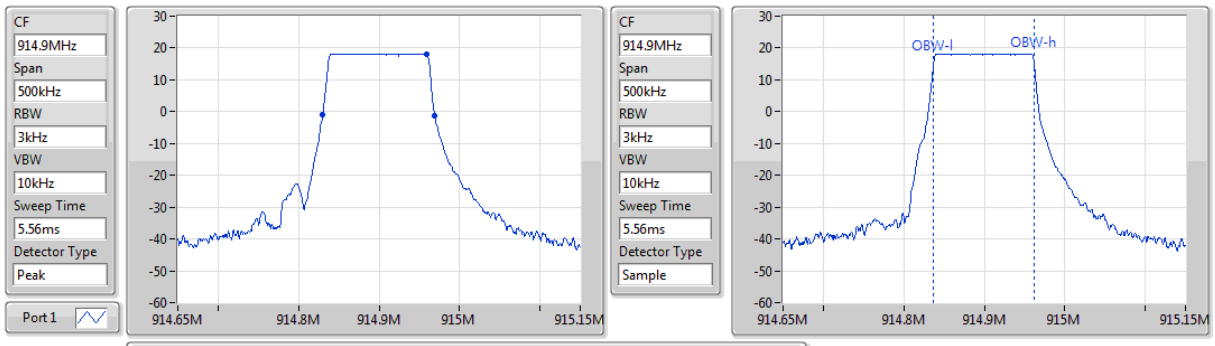
908.5MHz



20dB(Hz)	Fl-20dB(Hz)	Fh-20dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
138.406k	908.431159M	908.569565M	125.904k	908.436324M	908.562229M	Inf	1

LoRa (125kHz) **EBW-FS**

914.9MHz



20dB(Hz)	Fl-20dB(Hz)	Fh-20dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
139.855k	914.82971M	914.969565M	125.904k	914.836324M	914.962229M	Inf	1

3.6 Channel Separation

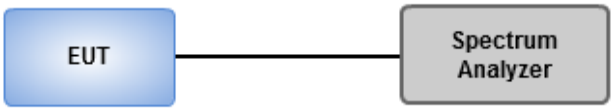
3.6.1 Limit of Channel Separation

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	18°C / 67%	Tested By	Aska Huang

Summary

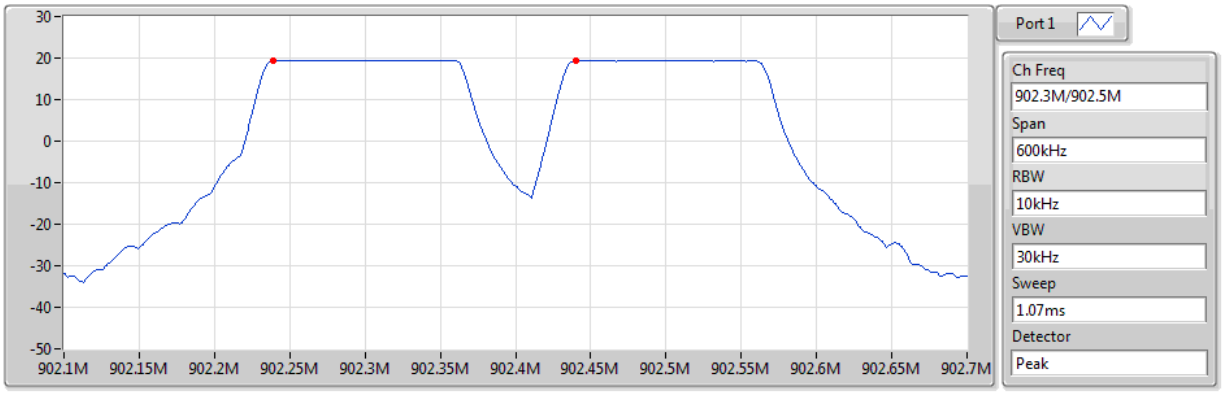
Mode	Max-Space (Hz)	Min-Space (Hz)
902-928MHz	-	-
LoRa (125kHz)	200.869565k	200k

Result

Mode	Result	Fl (Hz)	Fh (Hz)	Ch.Space (Hz)	Limit (Hz)
LoRa (125kHz)	-	-	-	-	-
902.3MHz	Pass	902.23913M	902.44M	200.869565k	139.13k
908.5MHz	Pass	908.43913M	908.63913M	200k	138.406k
914.9MHz	Pass	914.638261M	914.83913M	200.869565k	139.855k

LoRa (125kHz) **Channel Separation-FS**

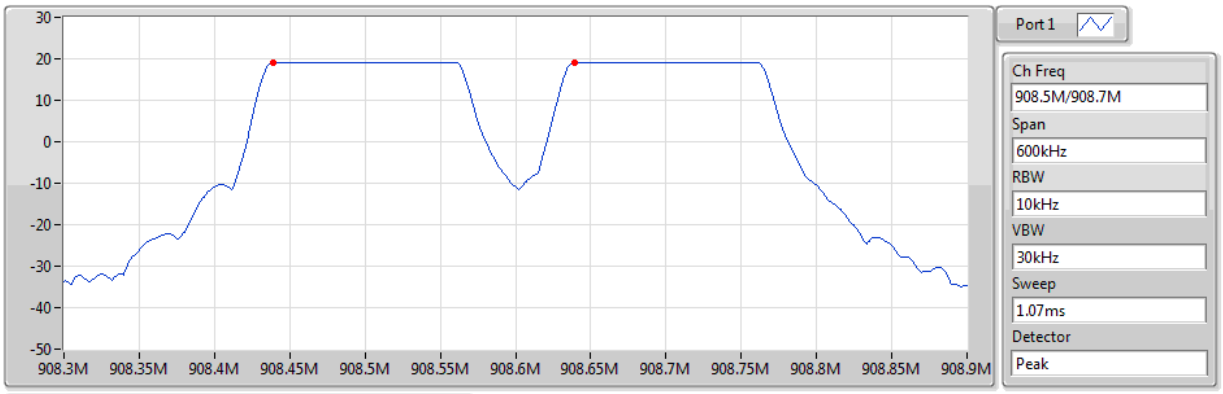
902.3M/902.5MHz



Fl(Hz)	Fh(Hz)	Ch.Space(Hz)	Limit(Hz)
902.23913M	902.44M	200.869565k	139.13k

LoRa (125kHz) **Channel Separation-FS**

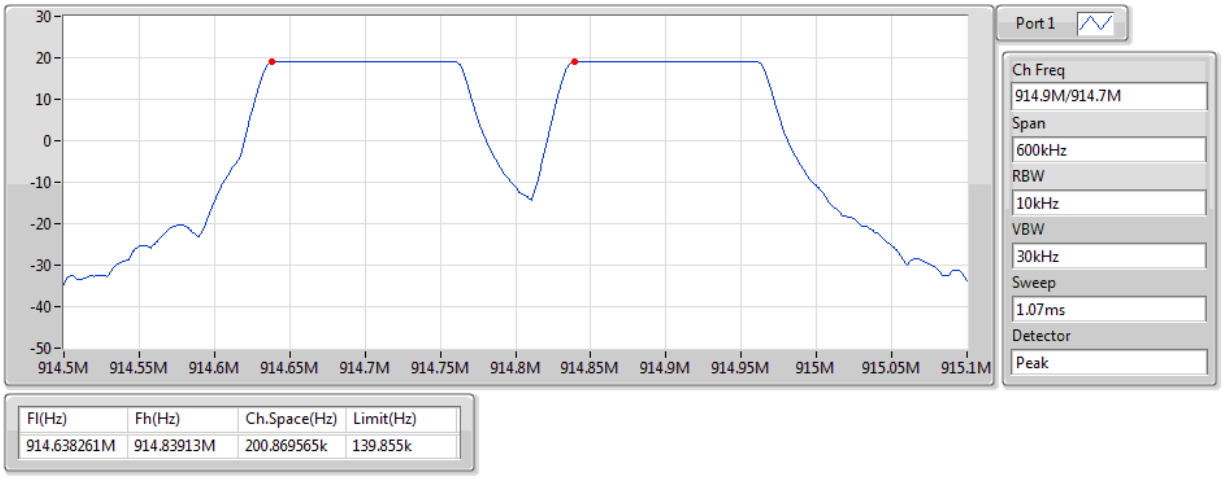
908.5M/908.7MHz



Fl(Hz)	Fh(Hz)	Ch.Space(Hz)	Limit(Hz)
908.43913M	908.63913M	200k	138.406k

LoRa (125kHz) **Channel Separation-FS**

914.9M/914.7MHz



Fl(Hz)	Fh(Hz)	Ch.Space(Hz)	Limit(Hz)
914.638261M	914.83913M	200.869565k	139.855k

3.7 Number of Dwell Time

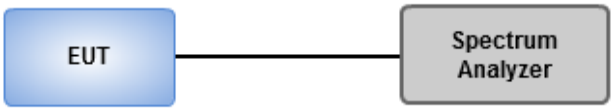
3.7.1 Limit of Dwell time

Time of Occupancy (Dwell Time) Limit for Frequency Hopping Systems	
☒	902-928 MHz Band:
	☐ ≤ 0.4 second within a 20 second period, 20 dB bandwidth of the hopping channel is less than 250 kHz
	☐ ≤ 0.4 second within a 10 second period, 20 dB bandwidth of the hopping channel is 250 kHz or greater
	☒ 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=200kHz, VBW=1000kHz, Sweep time=3.2s / 500ms, Detector=Peak, Span=0Hz, Trace max hold for 8 hopping channels.
2. Set RBW=200kHz, VBW=1000kHz, Sweep time=6.4s / 500ms, Detector=Peak, Span=0Hz, Trace max hold for 16 hopping channels.
3. Set RBW=200kHz, VBW=1000kHz, Sweep time=25.6s / 500ms, Detector=Peak, Span=0Hz, Trace max hold for 64 hopping channels.
4. Measure and record the burst on time.

3.7.3 Test Setup

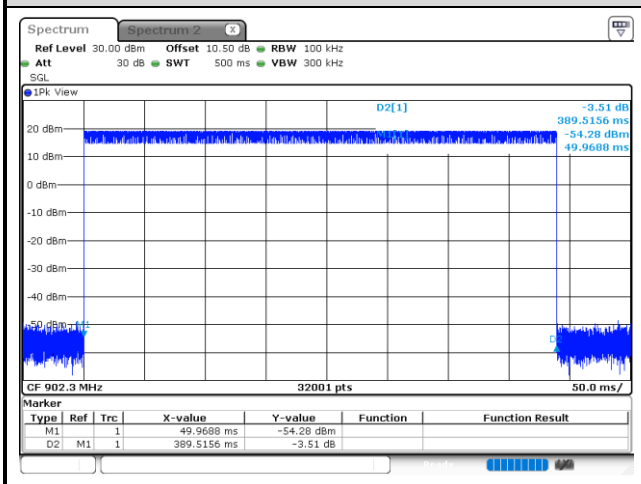


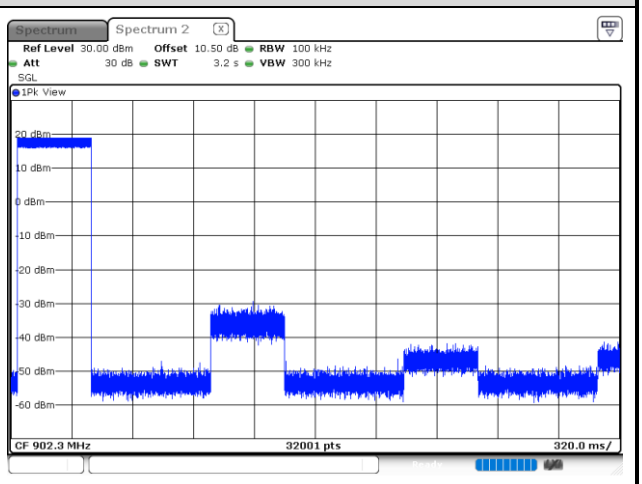
3.7.4 Test Result of Dwell Time

Ambient Condition	18°C / 67%	Tested By	Aska Huang

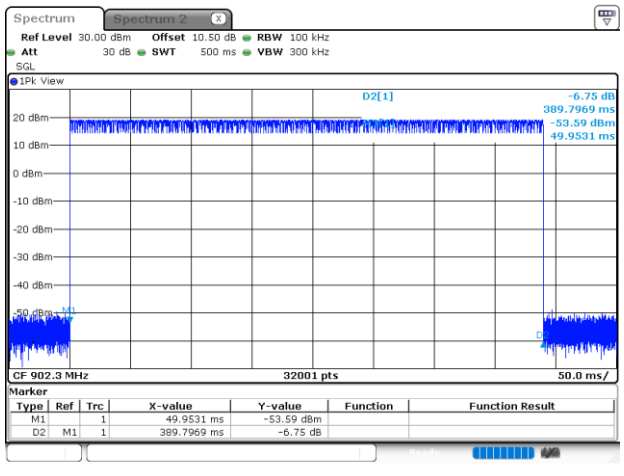
Mode	SF	Frequency (MHz)	Length of transmission time (sec)	Number of transmission in a 3.2 S (8 Hopping*0.4S)	Result (s)	Limit (s)	Pass/Fail
LoRa	7	902.3	0.389516	1	0.389516	0.4	PASS
LoRa	8	902.3	0.389797	1	0.389797	0.4	PASS
LoRa	9	902.3	0.390313	1	0.390313	0.4	PASS
LoRa	10	902.3	0.370828	1	0.370828	0.4	PASS

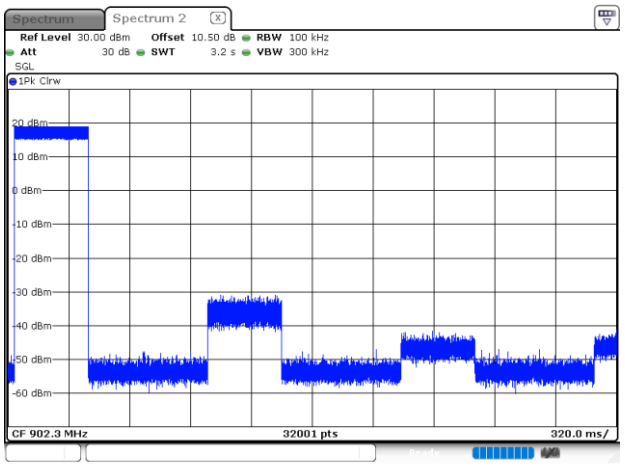
SF 7



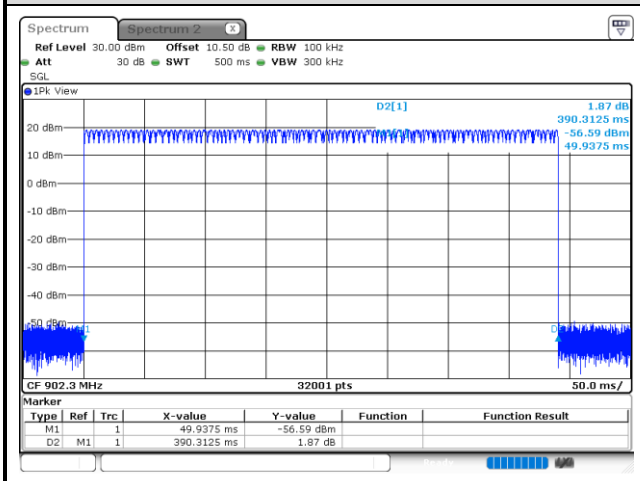


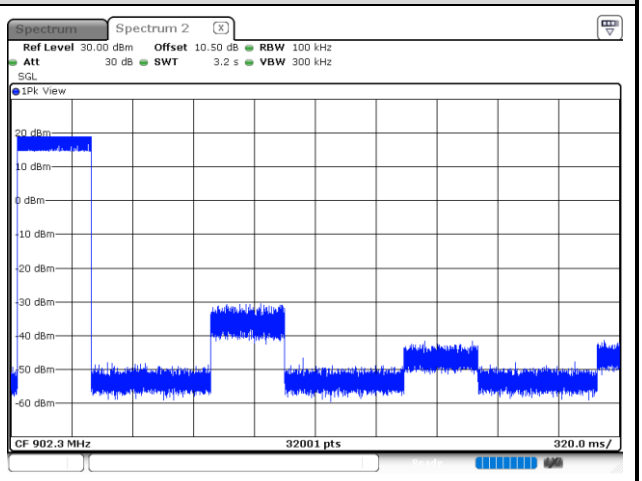
SF 8



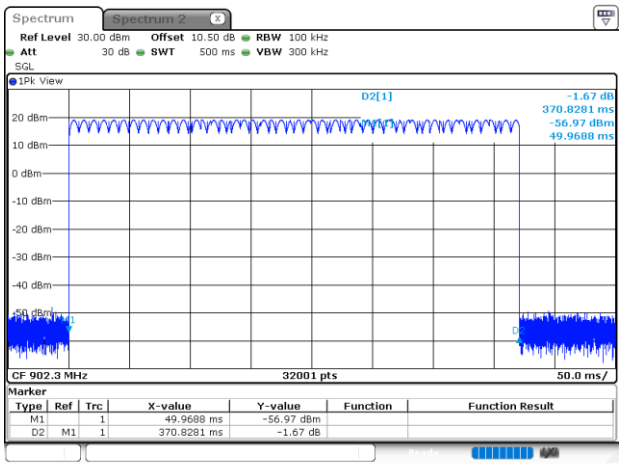


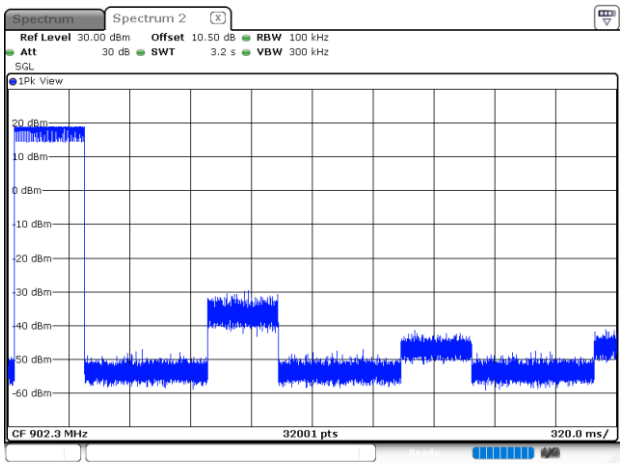
SF 9


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 500 ms VBW 300 kHz
SGL
1Pk View
D2[1] 1.87 dB
390.3125 ms
M1[1] -56.59 dBm
49.9375 ms
CF 902.3 MHz 32001 pts 50.0 ms/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 49.9375 ms -56.59 dBm
D2 M1 1 390.3125 ms 1.87 dB


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 3.2 s VBW 300 kHz
SGL
1Pk View
CF 902.3 MHz 32001 pts 320.0 ms/

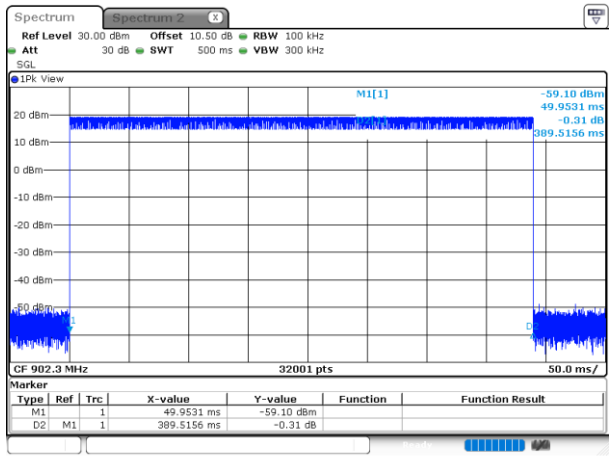
SF 10

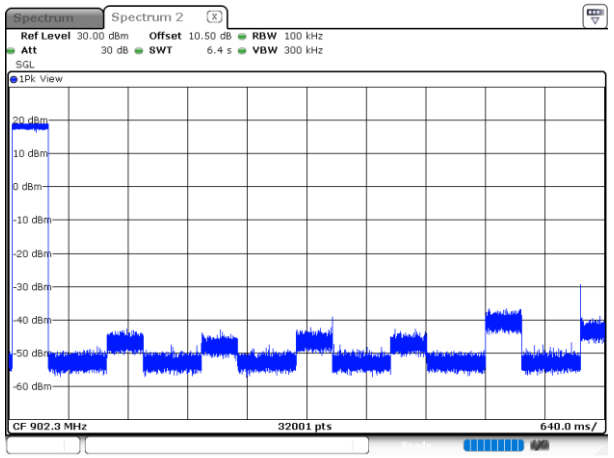

Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 500 ms VBW 300 kHz
SGL
1Pk View
D2[1] -1.67 dB
370.8281 ms
M1[1] -56.97 dBm
49.9688 ms
CF 902.3 MHz 32001 pts 50.0 ms/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 49.9688 ms -56.97 dBm
D2 M1 1 370.8281 ms -1.67 dB


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 3.2 s VBW 300 kHz
SGL
1Pk View
CF 902.3 MHz 32001 pts 320.0 ms/

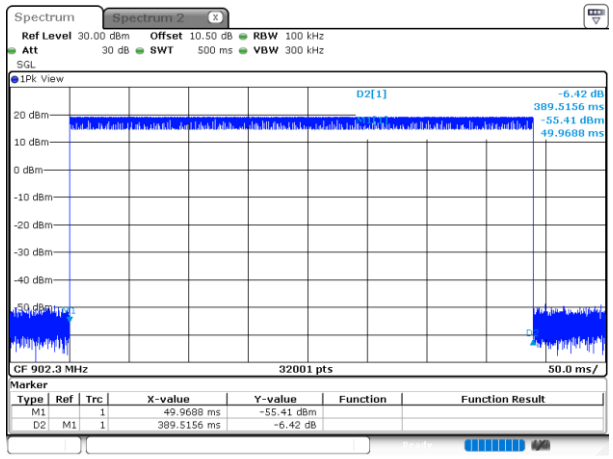
Mode	SF	Frequency (MHz)	Length of transmission time (sec)	Number of transmission in a 6.4 S (16 Hopping*0.4S)	Result (s)	Limit (s)	Pass/Fail
LoRa	7	902.3	0.389516	1	0.389516	0.4	PASS
LoRa	8	902.3	0.389516	1	0.389516	0.4	PASS
LoRa	9	902.3	0.390313	1	0.390313	0.4	PASS
LoRa	10	902.3	0.370844	1	0.370844	0.4	PASS

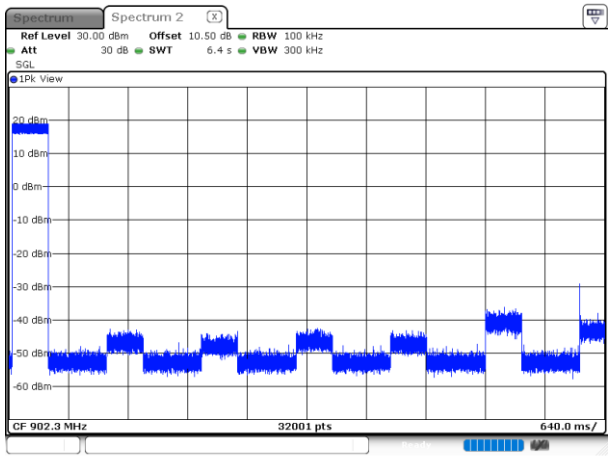
SF 7



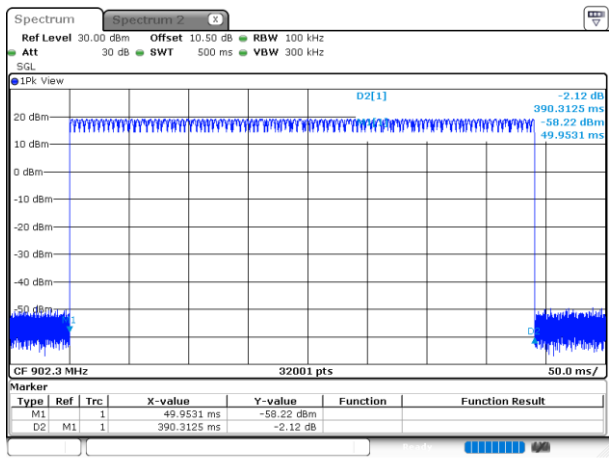


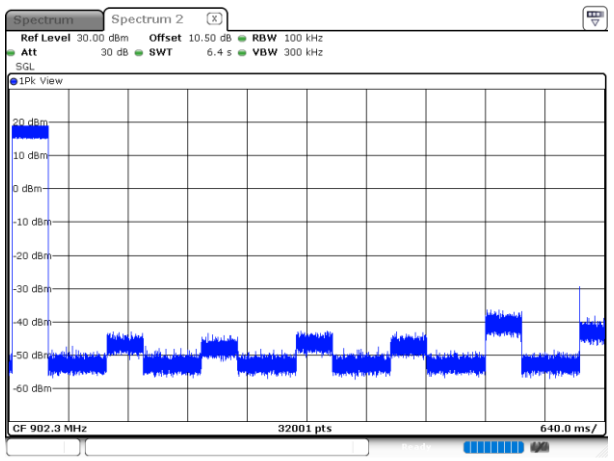
SF 8



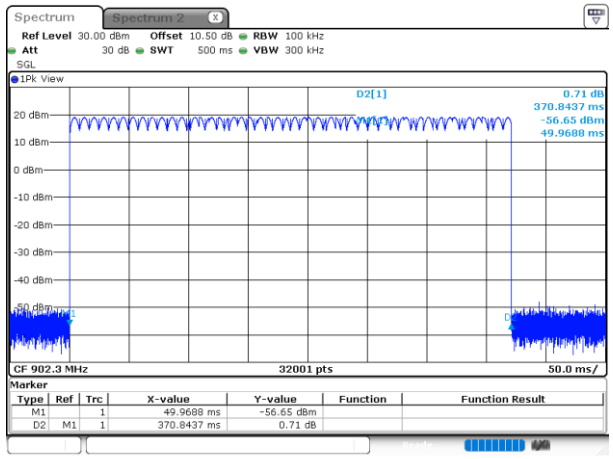


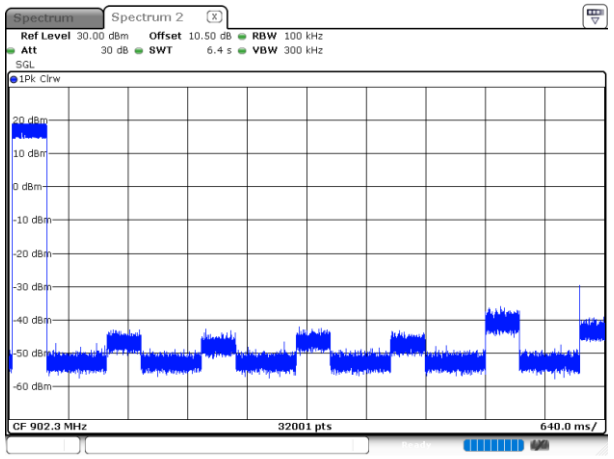
SF 9


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 500 ms VBW 300 kHz
SGL
1Pk View
D2[1] -2.12 dB
390.3125 ms
-58.22 dBm
49.9531 ms
CF 902.3 MHz 32001 pts 50.0 ms/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 49.9531 ms -58.22 dBm
D2 M1 1 390.3125 ms -2.12 dB


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 6.4 s VBW 300 kHz
SGL
1Pk View
CF 902.3 MHz 32001 pts 640.0 ms/

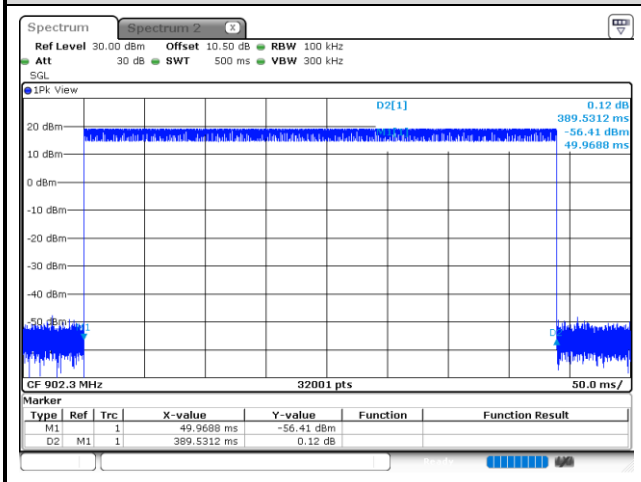
SF 10

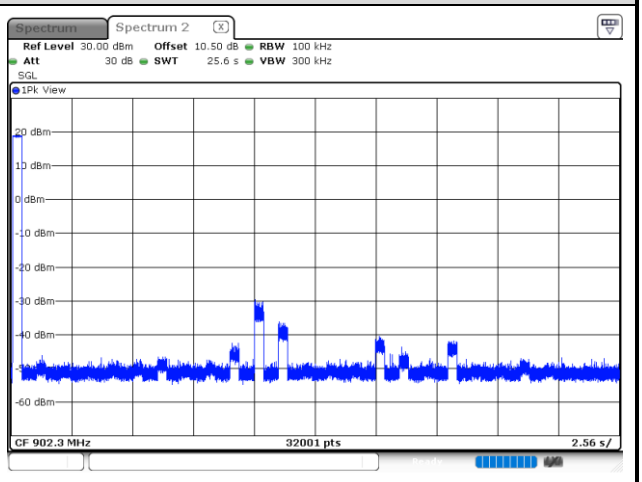

Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 500 ms VBW 300 kHz
SGL
1Pk View
D2[1] 0.71 dB
370.8437 ms
-56.65 dBm
49.9688 ms
CF 902.3 MHz 32001 pts 50.0 ms/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 49.9688 ms -56.65 dBm
D2 M1 1 370.8437 ms 0.71 dB


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 6.4 s VBW 300 kHz
SGL
1Pk Clrw
CF 902.3 MHz 32001 pts 640.0 ms/

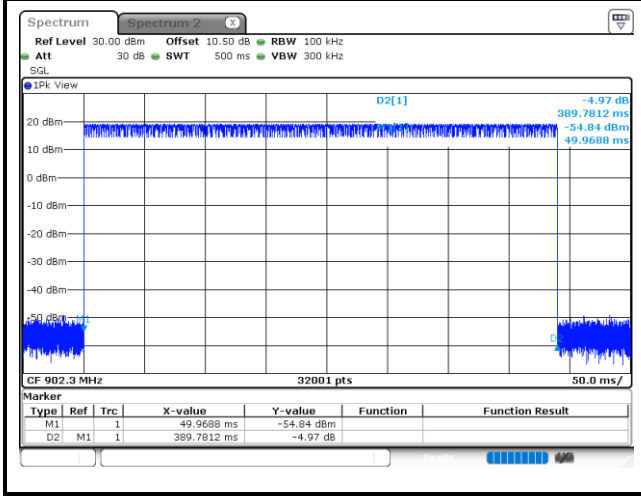
Mode	SF	Frequency (MHz)	Length of transmission time (sec)	Number of transmission in a 25.6 S (64 Hopping*0.4S)	Result (s)	Limit (s)	Pass/Fail
LORA	7	902.3	0.389531	1	0.389531	0.4	PASS
LORA	8	902.3	0.389781	1	0.389781	0.4	PASS
LORA	9	902.3	0.390313	1	0.390313	0.4	PASS
LORA	10	902.3	0.370844	1	0.370844	0.4	PASS

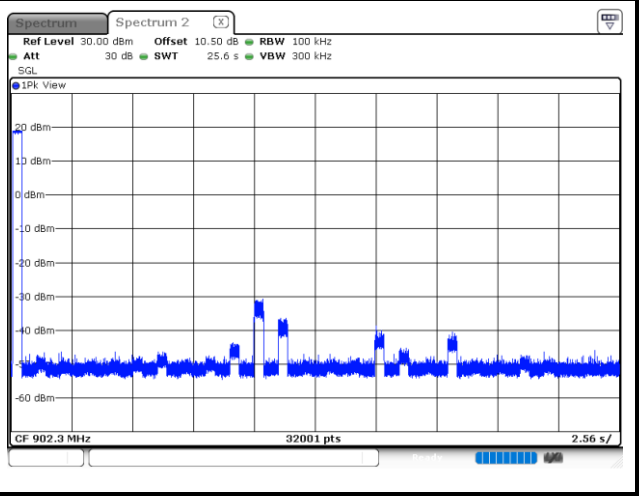
SF 7



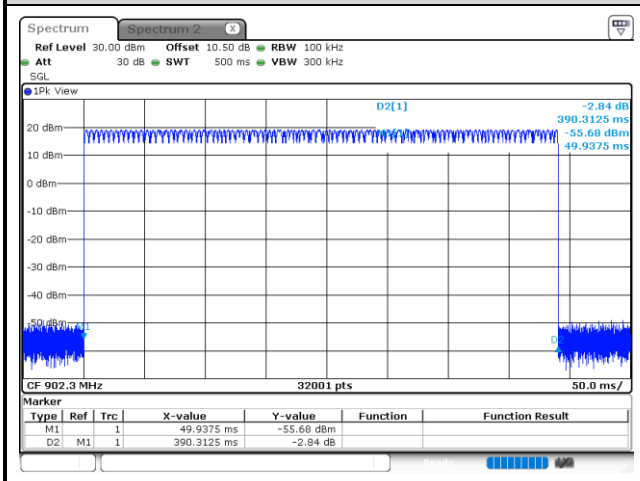


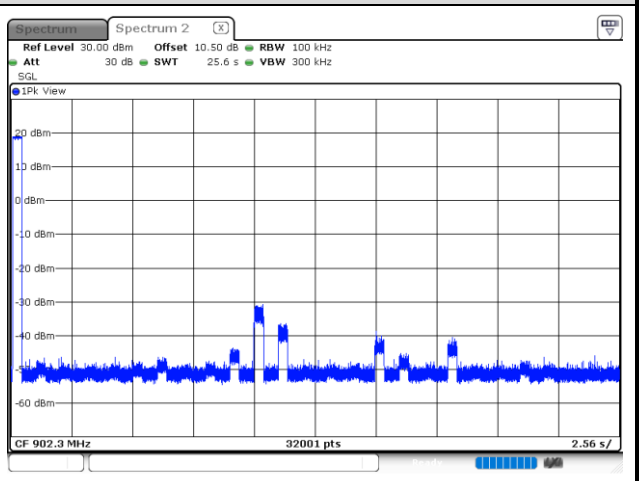
SF 8



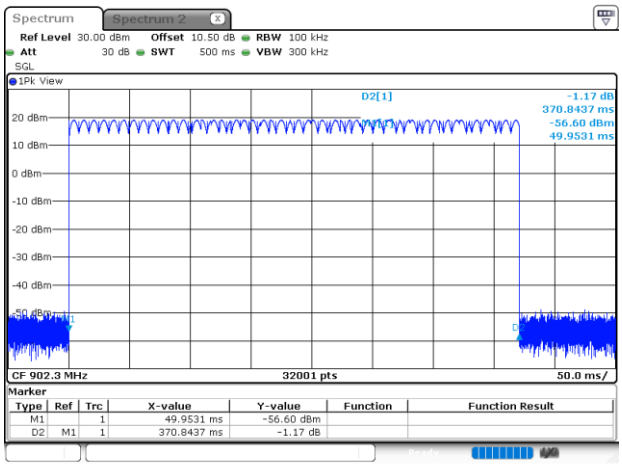


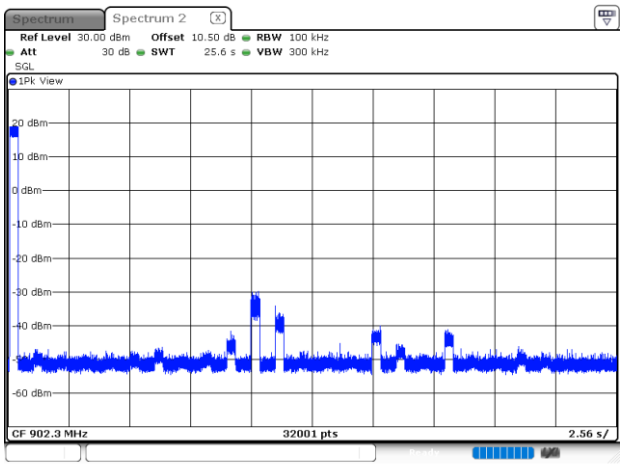
SF 9


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 500 ms VBW 300 kHz
SGL
1Pk View
D2[1] -2.84 dB
390.3125 ms
M1[1] -55.68 dBm
49.9375 ms
CF 902.3 MHz 32001 pts 50.0 ms/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 49.9375 ms -55.68 dBm
D2 M1 1 390.3125 ms -2.84 dB


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 25.6 s VBW 300 kHz
SGL
1Pk View
CF 902.3 MHz 32001 pts 2.56 s/

SF 10


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 500 ms VBW 300 kHz
SGL
1Pk View
D2[1] -1.17 dB
370.8437 ms
M1[1] -56.60 dBm
49.9531 ms
CF 902.3 MHz 32001 pts 50.0 ms/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 49.9531 ms -56.60 dBm
D2 M1 1 370.8437 ms -1.17 dB


Spectrum
Spectrum 2
Ref Level 30.00 dBm Offset 10.50 dB RBW 100 kHz
Att 30 dB SWT 25.6 s VBW 300 kHz
SGL
1Pk View
CF 902.3 MHz 32001 pts 2.56 s/

3.8 Power Spectral Density

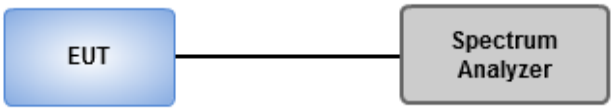
3.8.1 Limit of Power Spectral Density

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	18°C / 67%	Tested By	Aska Huang

Summary

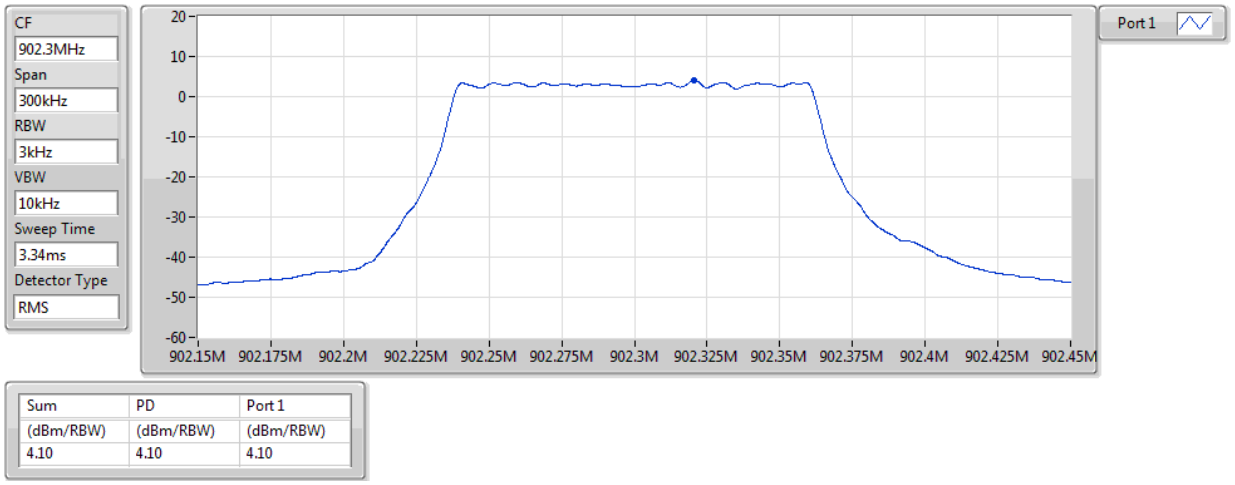
Mode	PD (dBm/3kHz)
902-928MHz	-
LoRa (125kHz)	4.43

Result

Mode	Result	Antenna Gain (dBi)	Power Density (dBm/3kHz)	Power Density Limit (dBm/3kHz)
LoRa (125kHz)	-	-	-	-
902.3MHz	Pass	0.61	4.10	8.00
908.5MHz	Pass	0.61	4.43	8.00
914.9MHz	Pass	0.61	3.90	8.00

LoRa (125kHz) **PSD**

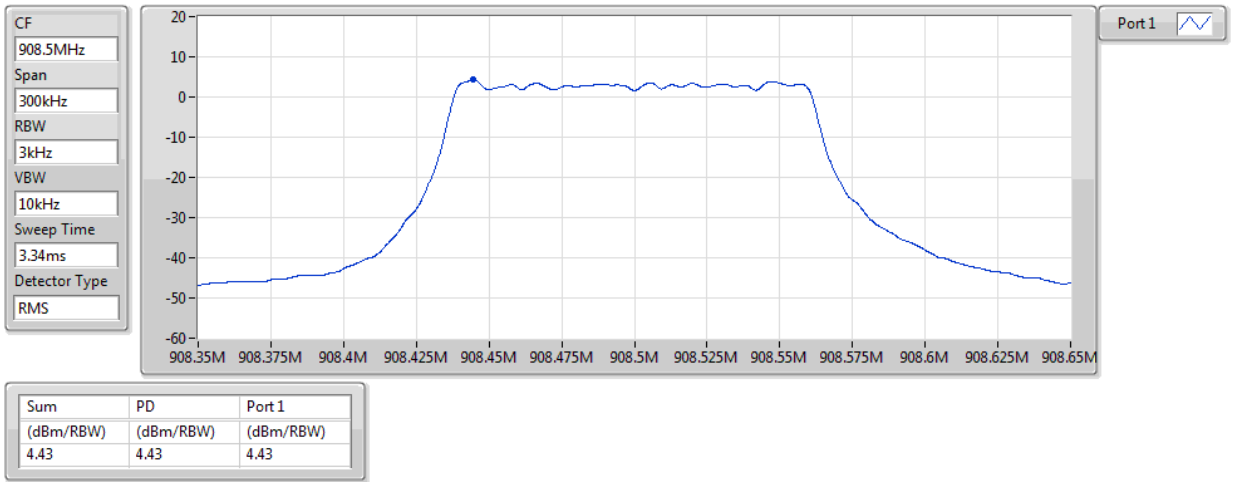
902.3MHz



Sum	PD	Port 1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
4.10	4.10	4.10

LoRa (125kHz) **PSD**

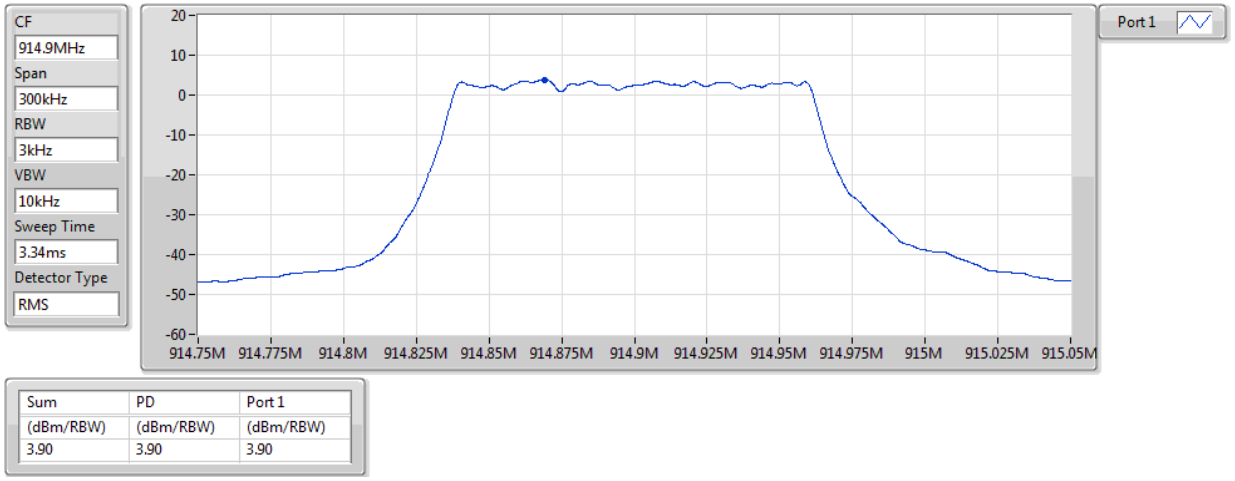
908.5MHz



Sum	PD	Port 1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
4.43	4.43	4.43

LoRa (125kHz) **PSD**

914.9MHz



Sum	PD	Port 1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
3.90	3.90	3.90

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==