



FCC PART 15.249 TEST REPORT

For

Shenzhen Winext Technology Co. Ltd

No.602, Building E, Shenzhen Creative & Cultural Park, Futian District, Futian Shenzhen, China

FCC ID: 2AFI2M100B-H

Report Type: Product Type:

Original Report LoRa transceiver module

Report Number: RSZ171010009-00A

Report Date: 2018-03-28

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TABLE OF CONTENTS

GENERAL INFORMATION	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	3
RELATED SUBMITTAL(S)/GRANT(S)	
TEST METHODOLOGY	
MEASUREMENT UNCERTAINTY	
TEST FACILITY	4
SYSTEM TEST CONFIGURATION	5
JUSTIFICATION	
EUT Exercise Software	
EQUIPMENT MODIFICATIONS	
SUPPORT EQUIPMENT LIST AND DETAILS	
EXTERNAL I/O CABLE	
BLOCK DIAGRAM OF TEST SETUP	
SUMMARY OF TEST RESULTS	8
TEST EQUIPMENT LIST	9
FCC§15.203 - ANTENNA REQUIREMENT	10
APPLICABLE STANDARD	
ANTENNA CONNECTOR CONSTRUCTION	10
FCC§15.205, §15.209 & §15.249 - RADIATED EMISSIONS	
APPLICABLE STANDARD	
TEST EQUIPMENT SETUP	
EUT SETUP Test Procedure	
CORRECTED AMPLITUDE & MARGIN CALCULATION	
TEST RESULTS SUMMARY	
TEST DATA	
FCC§15.215(C) - 20DB EMISSION BANDWIDTH	
APPLICABLE STANDARD	
TEST PROCEDURE	
TEST I ROCEDURE	

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The Shenzhen Winext Technology Co. Ltd's product, model number: M100B-H (FCC ID: 2AFI2M100B-H) or the "EUT" in this report was a LoRa transceiver module, which was measured approximately: 20 mm (L) * 25 mm (W) * 2.4 mm (H), rated with input voltage: DC 3.3V from battery.

Report No.: RSZ171010009-00A

*All measurement and test data in this report was gathered from production sample serial number: 1702214 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2017-10-10.

Objective

This report is prepared on behalf of *Shenzhen Winext Technology Co. Ltd* in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209, 15.215 and 15.249 rules.

Related Submittal(s)/Grant(s)

N/A

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter	uncertainty
Occupied Channel Bandwidth	±5%
RF Output Power with Power meter	±0.5dB
RF conducted test with spectrum	±1.5dB
AC Power Lines Conducted Emissions	±1.95dB
All emissions, radiated	±4.88dB
Temperature	±3℃
Humidity	±6%
Supply voltages	±0.4%

FCC Part 15.249 Page 3 of 25

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

Report No.: RSZ171010009-00A

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

FCC Part 15.249 Page 4 of 25

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing in testing mode, which was provided by manufacturer.

EUT operating frequency range list table as below:

For 125 kHz Bandwidth:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	902.6	27	907.9	53	913.3	79	918.5
2	902.9	28	908.1	54	913.5	80	918.7
3	903.1	29	908.3	55	913.7	81	918.9
4	903.3	30	908.5	56	913.9	82	919.1
5	903.5	31	908.7	57	914.1	83	919.3
6	903.7	32	908.9	58	914.3	84	919.5
7	903.9	33	909.1	59	914.5	85	919.7
8	904.1	34	909.3	60	914.7	86	919.9
9	904.3	35	909.5	61	914.9	87	920.1
10	904.5	36	909.7	62	915.1	88	920.3
11	904.7	37	909.9	63	915.3	89	920.5
12	904.9	38	910.1	64	915.5	90	920.7
13	905.1	39	910.3	65	915.7	91	920.9
14	905.3	40	910.5	66	915.9	92	921.1
15	905.5	41	910.7	67	916.1	93	921.3
16	905.7	42	910.9	68	916.3	94	921.5
17	905.9	43	911.1	69	916.5	95	921.7
18	906.1	44	911.3	70	916.7	96	921.9
19	906.3	45	911.5	71	916.9	97	922.1
20	906.5	46	911.7	72	917.1	98	922.3
21	906.7	47	911.9	73	917.3	99	922.5
22	906.9	48	912.1	74	917.5	100	922.7
23	907.1	49	912.3	75	917.7	101	922.9
24	907.3	50	912.5	76	917.9	102	923.1
25	907.5	51	912.7	77	918.1	103	923.3
26	907.7	52	913.0	78	918.3	/	/

EUT was tested with Channel 902.6MHz, 913MHz and 923.3MHz.

For 250 kHz Bandwidth:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	903.0	4	907.8	7	913.0	10	919.0
2	904.6	5	909.4	8	915.8	11	920.6
3	906.2	6	911.0	9	917.4	12	923.3

EUT was tested with Channel 903MHz, 913MHz and 923.3MHz.

FCC Part 15.249 Page 5 of 25

For 500 kHz Bandwidth:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	903.0	4	907.8	7	913.0	10	919.0
2	904.6	5	909.4	8	915.8	11	920.6
3	906.2	6	911.0	9	917.4	12	923.3

Report No.: RSZ171010009-00A

EUT was tested with Channel 903MHz, 913MHz and 923.3MHz.

EUT Exercise Software

The software "SscomE32.exe" was used for testing.

Equipment Modifications

No modifications were made to the unit tested.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
N/A	Battery N/A		N/A
Winext	Debug board	N/A	N/A
N/A	Antenna	N/A	N/A

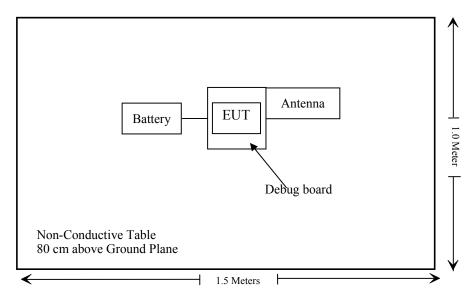
External I/O Cable

Cable Description	Length (m)	From/Port	То
N/A	N/A	N/A	N/A

FCC Part 15.249 Page 6 of 25

Block Diagram of Test Setup

Radiated Emission Below 1GHz:



FCC Part 15.249 Page 7 of 25

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Not Applicable
15.205, §15.209, §15.249	Radiated Emissions	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance

Report No.: RSZ171010009-00A

Not Applicable: This device was powered by DC voltage from battery.

FCC Part 15.249 Page 8 of 25

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
	D 11	1 D 1 1 T		Date	Due Date
	Radi	ated Emission T	est	1	1
Sunol Sciences	Horn Antenna	DRH-118	A052604	2014-12-29	2017-12-28
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2017-04-24	2018-04-24
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2017-05-21	2018-05-21
НР	Amplifier	HP8447E	1937A01046	2017-05-21	2017-11-19
HP	Amplifier	HP8447E	1937A01046	2017-11-19	2018-05-21
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2014-12-17	2017-12-16
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2016-12-07	2017-12-07
Ducommun technologies	RF Cable	UFA210A-1- 4724-30050U	MFR64369 223410-001	2017-05-19	2017-11-19
Ducommun technologies	RF Cable	UFA210A-1- 4724-30050U	MFR64369 223410-001	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	104PEA	218124002	2017-05-19	2017-11-19
Ducommun technologies	RF Cable	104PEA	218124002	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	1	2017-05-19	2017-11-19
Ducommun technologies	RF Cable	RG-214	1	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	2	2017-05-19	2017-11-22
Ducommun technologies	RF Cable	RG-214	2	2017-11-22	2018-05-22
	RF	Conducted Tes	t		
WEINSCHEL	3dB Attenuator	N/A	N/A	2017-05-23	2017-11-22
WEINSCHEL	3dB Attenuator	N/A	N/A	2017-11-22	2018-05-23
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2016-12-05	2017-12-05
Ducommun technologies	RF Cable	RG-214	3	2017-05-22	2017-11-22
Ducommun technologies	RF Cable	RG-214	3	2017-11-22	2018-05-22

^{*} **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC Part 15.249 Page 9 of 25

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

Report No.: RSZ171010009-00A

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has one I-PEX connector or half-stamp-hole antenna feeding point extraction arrangement, and the maximum antenna gain is 1 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliant.

FCC Part 15.249 Page 10 of 25

FCC§15.205, §15.209 & §15.249 - RADIATED EMISSIONS

Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Field strength of fundamental (millivolts/meter)		Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

Report No.: RSZ171010009-00A

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

Test Equipment Setup

The spectrum analyzer or receiver is set as:

Below 1000MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

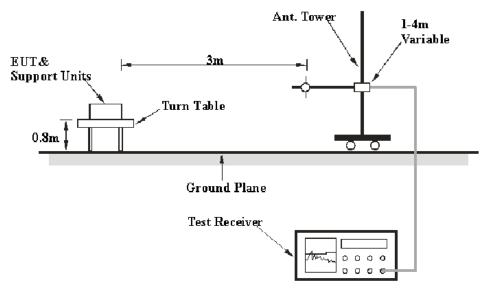
Above 1000MHz:

Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

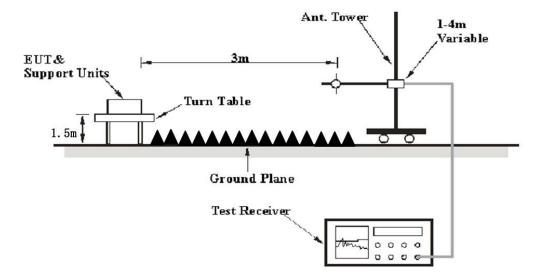
FCC Part 15.249 Page 11 of 25

EUT Setup

Below 1G:



Above 1GHz:



The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC part 15.209, 15.205 and FCC part 15.249 limits.

FCC Part 15.249 Page 12 of 25

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Report No.: RSZ171010009-00A

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter above ground plane for below 1GHz and 1.5 meter above ground plane for above 1GHz, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "Margin" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.205, 15.209 & §15.249

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_{\rm m} + U_{(L{\rm m})} \leq L_{\rm lim} + U_{\rm cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr} , if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

Test Data

Environmental Conditions

Temperature:	23-24 ℃
Relative Humidity:	51-56 %
ATM Pressure:	100.8-101.0 kPa

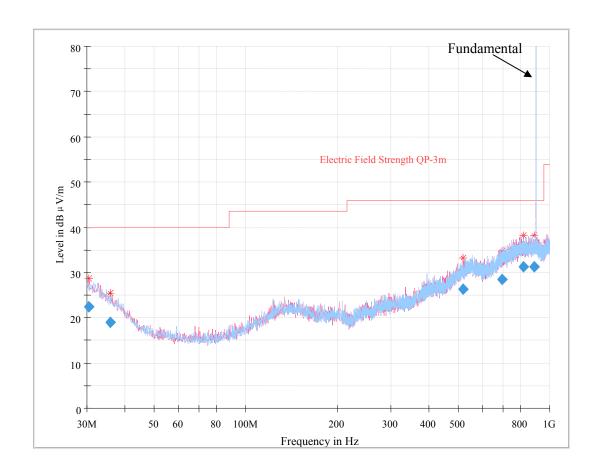
The testing was performed by Jacob Kong from 2017-10-25 to 2017-11-28.

Test mode: Transmitting

Test range 30MHz – 10GHz, please refer to the following tables and plots.

FCC Part 15.249 Page 13 of 25

 $Pre-scan\ with\ 125kHz, 250kHz\ and\ 500kHz\ modes,\ and\ worst\ case\ for\ 500\ kHz\ Bandwidth,\ Low\ channel\ as\ below:$



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
30.379418	22.45	322.0	Н	178.0	0.0	40.00	17.55
35.743875	18.95	197.0	Н	308.0	-3.4	40.00	21.05
517.342500	26.30	137.0	V	311.0	3.6	46.00	19.70
698.510375	28.53	347.0	V	252.0	6.6	46.00	17.47
817.920125	31.36	367.0	V	0.0	9.0	46.00	14.64

FCC Part 15.249 Page 14 of 25

125 kHz Bandwidth:

(MHz) Reading	Receiver		Turntable	Rx Antenna			Corrected	FCC Part 15.249/15.205/15.209	
	Reading (dBµV)	PK/QP/Ave.	Degree	Height (m)	Polar (H/V)	Factor (dB/m)	Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
			L	ow Cha	nnel				
902.60	83.60	QP	179	1.4	Н	9.6	93.20	94	0.80
902.60	83.70	QP	192	1.4	V	9.6	93.30	94	0.70
901.99	31.90	QP	207	1.8	Н	9.6	41.50	46	4.50
901.99	34.60	QP	263	2.0	V	9.6	44.20	46	1.80
1805.20	57.29	PK	32	2.2	Н	-4.87	52.42	74	21.58
1805.20	55.49	Ave.	32	2.2	Н	-4.87	50.62	54	3.38
1805.20	51.36	PK	28	1.5	V	-4.87	46.49	74	27.51
1805.20	41.51	Ave.	28	1.5	V	-4.87	36.64	54	17.36
	Middle Channel								
913.00	83.80	QP	349	1.0	Н	9.3	93.10	94	0.90
913.00	83.90	QP	346	1.9	V	9.3	93.20	94	0.80
1826.00	59.18	PK	57	1.8	Н	-4.87	54.31	74	19.69
1826.00	55.59	Ave.	57	1.8	Н	-4.87	50.72	54	3.28
1826.00	52.14	PK	82	1.5	V	-4.87	47.27	74	26.73
1826.00	48.74	Ave.	82	1.5	V	-4.87	43.87	54	10.13
			Н	Iigh Cha	nnel				
923.30	84.30	QP	285	1.7	Н	9.0	93.30	94	0.70
923.30	84.30	QP	356	2.2	V	9.0	93.30	94	0.70
928.10	30.90	QP	29	1.6	Н	9.0	39.90	46	6.10
928.10	30.70	QP	151	1.7	V	9.0	39.70	46	6.30
1846.60	57.53	PK	136	1.4	Н	-4.87	52.66	74	21.34
1846.60	55.65	Ave.	136	1.4	Н	-4.87	50.78	54	3.22
1846.60	53.97	PK	316	1.1	V	-4.87	49.10	74	24.90
1846.60	49.29	Ave.	316	1.1	V	-4.87	44.42	54	9.58

FCC Part 15.249 Page 15 of 25

250 kHz Bandwidth:

Frequency (MHz)	Receiver		Turntable	Rx Antenna			Corrected	FCC Part 15.249/15.205/15.209	
	Reading (dBµV)	PK/QP/Ave.	Degree	Height (m)	Polar (H/V)	Factor (dB/m)	Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
			L	ow Cha	nnel				
903.00	82.50	QP	28	1.2	Н	9.6	92.10	94	1.90
903.00	82.60	QP	2	1.7	V	9.6	92.20	94	1.80
901.99	27.30	QP	157	2.2	Н	9.6	36.90	46	9.10
901.99	28.90	QP	229	1.2	V	9.6	38.50	46	7.50
1806.00	58.67	PK	138	2.2	Н	-4.87	53.80	74	20.20
1806.00	55.68	Ave.	138	2.2	Н	-4.87	50.81	54	3.19
1806.00	50.41	PK	221	1.8	V	-4.87	45.54	74	28.46
1806.00	44.33	Ave.	221	1.8	V	-4.87	39.46	54	14.54
	Middle Channel								
913.00	83.10	QP	267	1.7	Н	9.3	92.40	94	1.60
913.00	81.30	QP	322	2.3	V	9.3	90.60	94	3.40
1826.00	58.51	PK	295	1.8	Н	-4.87	53.64	74	20.36
1826.00	55.67	Ave.	295	1.8	Н	-4.87	50.80	54	3.20
1826.00	51.24	PK	185	2.0	V	-4.87	46.37	74	27.63
1826.00	47.10	Ave.	185	2.0	V	-4.87	42.23	54	11.77
			Н	ligh Cha	nnel				
923.30	83.00	QP	42	2	Н	9.0	92.00	94	2.00
923.30	83.20	QP	38	1.7	V	9.0	92.20	94	1.80
928.10	30.80	QP	65	1.7	Н	9.0	39.80	46	6.20
928.10	31.10	QP	213	1.5	V	9.0	40.10	46	5.90
1846.60	56.21	PK	199	1.2	Н	-4.87	51.34	74	22.66
1846.60	55.42	Ave.	199	1.2	Н	-4.87	50.55	54	3.45
1846.60	54.13	PK	28	1.8	V	-4.87	49.26	74	24.74
1846.60	52.46	Ave.	28	1.8	V	-4.87	47.59	54	6.41

FCC Part 15.249 Page 16 of 25

500 kHz Bandwidth:

Frequency	Receiver		Turntable	Rx Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.249/15.205/15.209	
(MHz)	Reading (dBµV)	PK/QP/Ave.	Degree	Height (m)	Polar (H/V)	(dB/m)	(dBµV/m)	Limit (dBµV/m)	Margin (dB)
Low Channel (903 MHz)									
903.00	80.60	QP	3	1.9	Н	9.6	90.20	94	3.80
903.00	80.70	QP	243	1.3	V	9.6	90.30	94	3.70
901.99	28.90	QP	238	1.5	Н	9.6	38.50	46	7.50
901.99	30.30	QP	30	2	V	9.6	39.90	46	6.10
1806.00	60.52	PK	218	1.7	Н	-4.87	55.65	74	18.35
1806.00	55.85	Ave.	218	1.7	Н	-4.87	50.98	54	3.02
1806.00	52.09	PK	192	2.2	V	-4.87	47.22	74	26.78
1806.00	47.80	Ave.	192	2.2	V	-4.87	42.93	54	11.07
	Middle Channel(913MHz)								
913.00	81.10	QP	243	1.6	Н	9.3	90.40	94	3.60
913.00	81.30	QP	33	2	V	9.3	90.60	94	3.40
1826.00	59.17	PK	229	2.3	Н	-4.87	54.30	74	19.70
1826.00	56.21	Ave.	229	2.3	Н	-4.87	51.34	54	2.66
1826.00	53.46	PK	282	1.1	V	-4.87	48.59	74	25.41
1826.00	50.19	Ave.	282	1.1	V	-4.87	45.32	54	8.68
			High Ch	nannel(9	23.3 M	Hz)			
923.30	81.10	QP	349	1.9	Н	9.0	90.10	94	3.90
923.30	81.40	QP	108	1.1	V	9.0	90.40	94	3.60
928.10	31.10	QP	149	1.5	Н	9.0	40.10	46	5.90
928.10	30.60	QP	158	1.4	V	9.0	39.60	46	6.40
1846.60	59.50	PK	35	1.2	Н	-4.87	54.63	74	19.37
1846.60	55.53	Ave.	35	1.2	Н	-4.87	50.66	54	3.34
1846.60	57.35	PK	358	2.3	V	-4.87	52.48	74	21.52
1846.60	53.71	Ave.	358	2.3	V	-4.87	48.84	54	5.16

Note:

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor Corrected Amplitude = Corrected Factor + Reading

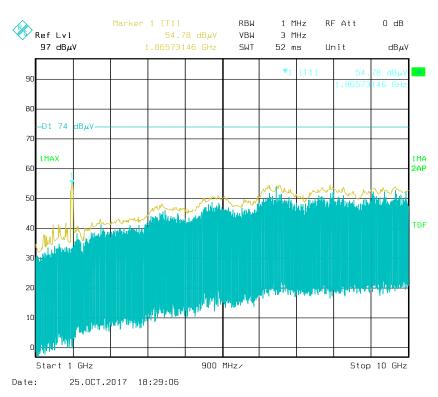
Margin = Limit - Corrected. Amplitude

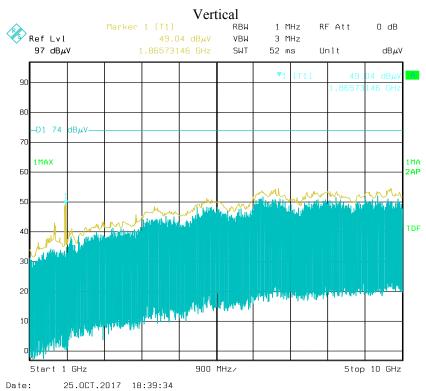
The other spurious emission which is 20dB to the limit was not recorded.

FCC Part 15.249 Page 17 of 25

Pre-scan with 125 kHz Bandwidth, High Channel:

Horizontal





FCC Part 15.249 Page 18 of 25

FCC§15.215(c) - 20dB EMISSION BANDWIDTH

Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Report No.: RSZ171010009-00A

Test Procedure

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- 3. Measure the frequency difference of two frequencies that indicated 20dB bandwidth.
- 4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	24~25 ℃		
Relative Humidity:	49~56 %		
ATM Pressure:	109.0~101.0 kPa		

The testing was performed by Jacob Kong from 2017-11-08 to 2017-11-25.

Please refer to the following table and plots.

FCC Part 15.249 Page 19 of 25

Test Mode: Transmitting

125 kHz Bandwidth

Channel	Frequency (MHz)	20dB Bandwidth (MHz)		
Low Channel	902.6	0.140		
Middle Channel	913	0.143		
High Channel	923.3	0.140		

250 kHz Bandwidth

Channel	Frequency (MHz)	20dB Bandwidth (MHz)		
Low Channel	903	0.296		
Middle Channel	913	0.304		
High Channel	923.3	0.295		

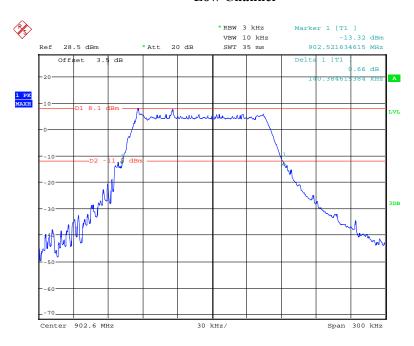
500 kHz Bandwidth

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low Channel	903	0.683
Middle Channel	913	0.673
High Channel	923.3	0.675

FCC Part 15.249 Page 20 of 25

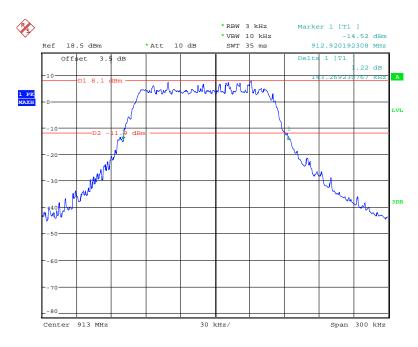
125 kHz Bandwidth

Low Channel



Date: 25.NOV.2017 15:48:15

Middle Channel

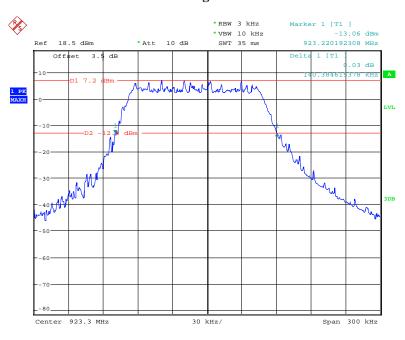


Date: 8.NOV.2017 22:25:44

FCC Part 15.249 Page 21 of 25

Report No.: RSZ171010009-00A

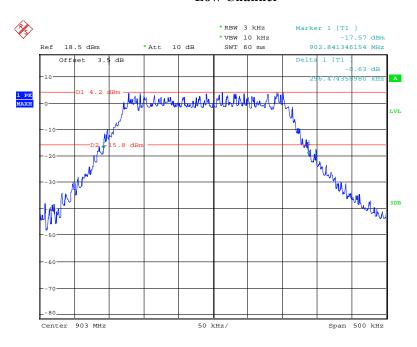
High Channel



Date: 8.NOV.2017 22:22:23

250 kHz Bandwidth

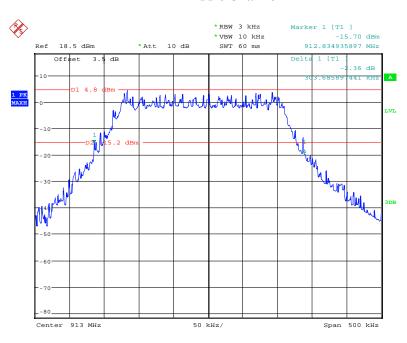
Low Channel



Date: 8.NOV.2017 22:10:11

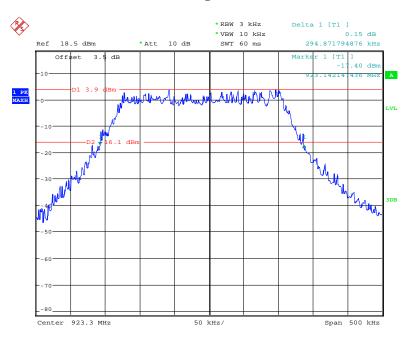
FCC Part 15.249 Page 22 of 25

Middle Channel



Date: 8.NOV.2017 22:07:44

High Channel

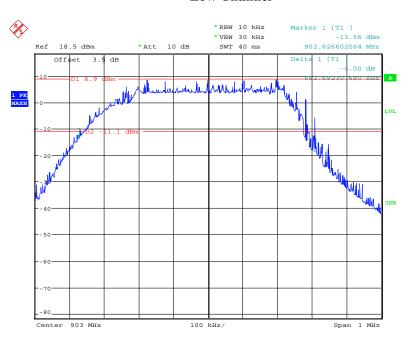


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FCC Part 15.249 Page 23 of 25

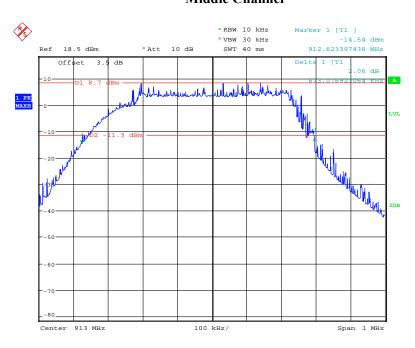
500 kHz Bandwidth

Low Channel



Date: 8.NOV.2017 22:13:13

Middle Channel

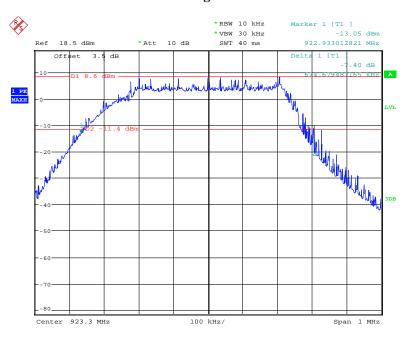


Date: 8.NOV.2017 22:16:18

FCC Part 15.249 Page 24 of 25

Report No.: RSZ171010009-00A

High Channel



Date: 8.NOV.2017 22:19:09

***** END OF REPORT *****

FCC Part 15.249 Page 25 of 25