FCC Co-Location Test Report

FCC ID	:	**MXF-WLRGFM100**
Equipment	:	**IOT Femto Gateway**
Model No.	:	**WLRGFM-100**
Brand Name	:	**Gemtek**
Applicant	:	**Gemtek Technology Co., Ltd.**
Address	:	**No. 15-1 Zhonghua Road, Hsinchu Industrial Park, Hukou, Hsinchu, Taiwan, 30352.**
Standard	:	**47 CFR FCC Part 15.247**
Received Date	:	**Apr. 10, 2017**
Tested Date	:	**May 11, 2017**

We, International Certification Corp., 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: **Approved by:**

Along Chen / Assistant Manager **Gary Chang / Manager**

Testing Laboratory 2732

Table of Contents

1 GENERAL DESCRIPTION 5

1.1 Information 5
1.2 The Equipment List 6
1.3 Test Standards 6
1.4 Measurement Uncertainty 6

2 TEST CONFIGURATION 7

2.1 Testing Condition 7
2.2 The Worst Test Modes and Channel Details 7

3 TRANSMITTER TEST RESULTS 8

3.1 Unwanted Emissions into Restricted Frequency Bands 8

4 TEST LABORATORY INFORMATION 18

Release Record

Report No.	Version	Description	Issued Date
FR741001CO	Rev. 01	Initial issue	May 31, 2017

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 1510.00MHz 53.53 (Margin -0.47dB) - AV	Pass

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

WLAN	
Operating Frequency	802.11b/g/n: 2412 MHz ~ 2462 MHz
Modulation Type	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM)
LoRa	
Operating Frequency	923.3 MHz ~ 927.5 MHz
Modulaton Type	CSS

1.1.2 Antenna Details

For WLAN

Ant. No.	Type	Connector	Gain (dBi)	Remark
1	Monopole	R-SMA	3.6	---
2	Monopole	R-SMA	3.42	---

For LoRa

Ant. No.	Type	Connector	Gain (dBi)	Remark
1	Dipole	SMA	0.28	External antenna
2	Printed	I-PEX	-0.39	Internal antenna

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	5Vdc from adapter

1.2 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101498	Nov. 25, 2016	Nov. 24, 2017
Receiver	R&S	ESR3	101658	Nov. 24, 2016	Nov. 23, 2017
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Aug. 04, 2016	Aug. 03, 2017
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 21, 2016	Dec. 20, 2017
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 10, 2016	Nov. 09, 2017
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Dec. 09, 2016	Dec. 08, 2017
Preamplifier	EMC	EMC02325	980225	Aug. 05, 2016	Aug. 04, 2017
Preamplifier	Agilent	83017A	MY39501308	Oct. 06, 2016	Oct. 05, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Dec. 09, 2016	Dec. 08, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Dec. 09, 2016	Dec. 08, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16139/4	Dec. 09, 2016	Dec. 08, 2017
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	16052	Dec. 09, 2016	Dec. 08, 2017
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Dec. 09, 2016	Dec. 08, 2017
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Dec. 09, 2016	Dec. 08, 2017
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.3 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247
ANSI C63.10-2013
FCC KDB 558074 D01 DTS Meas Guidance v04
FCC KDB 662911 D01 Multiple Transmitter Output v02r01

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty	
Parameters	**Uncertainty**
Radiated emission ≤ 1GHz	±3.66 dB
Radiated emission > 1GHz	±5.63 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Radiated Emissions	03CH01-WS	24°C / 63%	Kevin Lee

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- IC site registration No.: 10807A-1

2.2 The Worst Test Modes and Channel Details

Test item	Test Mode
Radiated Emissions	2.4G 11g ch6 + LoRa 927.5MHz

Note:
1. Test configuration are listed as listed as follows:
   Test Configuration 1: Wifi module + LoRa module with external antenna
   Test Configuration 2: Wifi module + LoRa module with internal antenna
2. The selected channel is the maximum power channel of Wifi & LoRa module

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

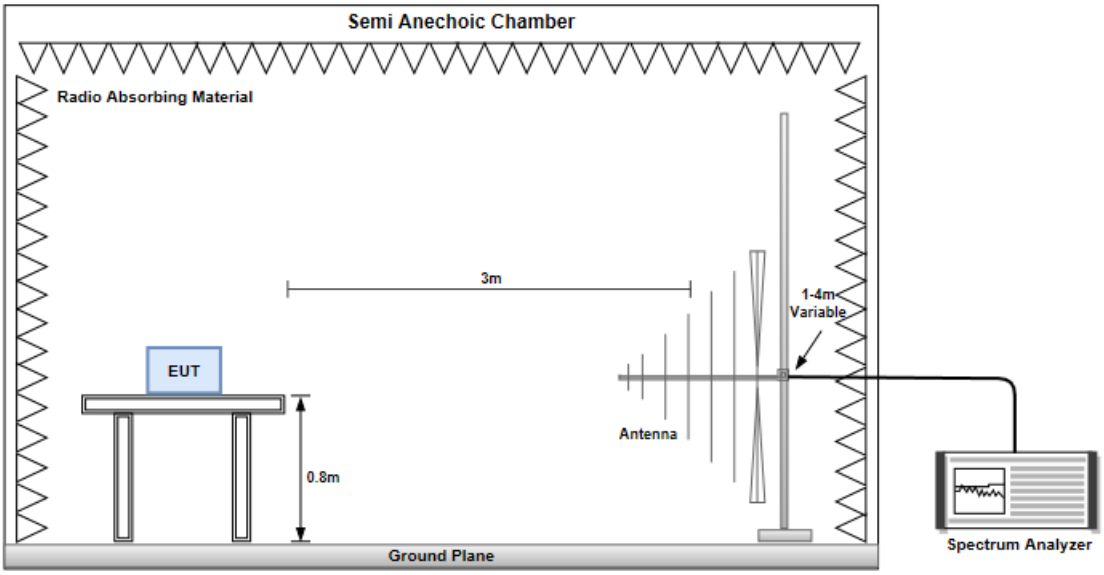
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission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

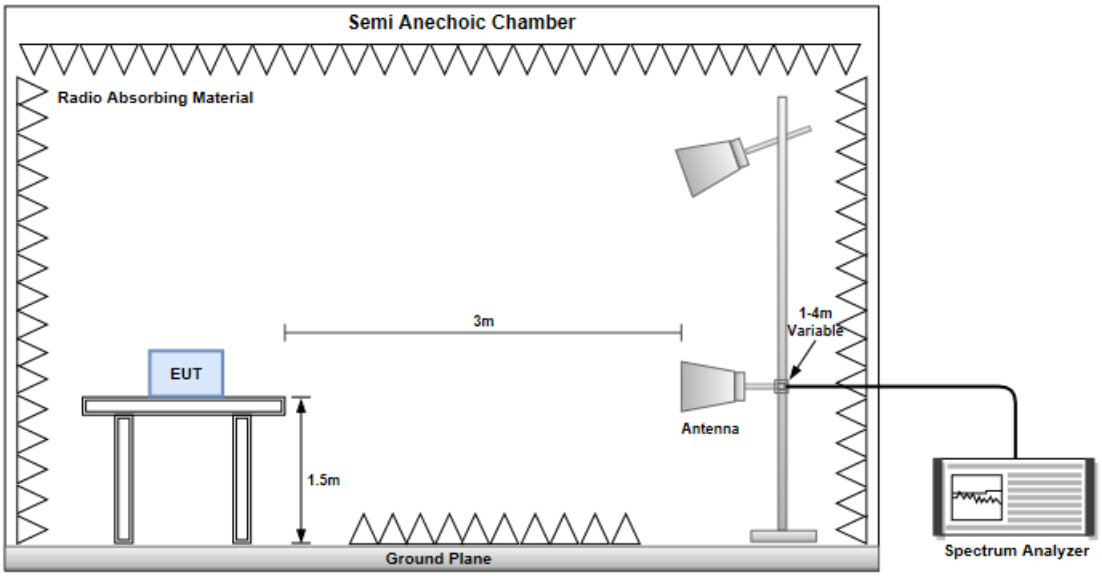
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above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

3.1.3 Test Setup

Radiated Emissions below 1 GHz



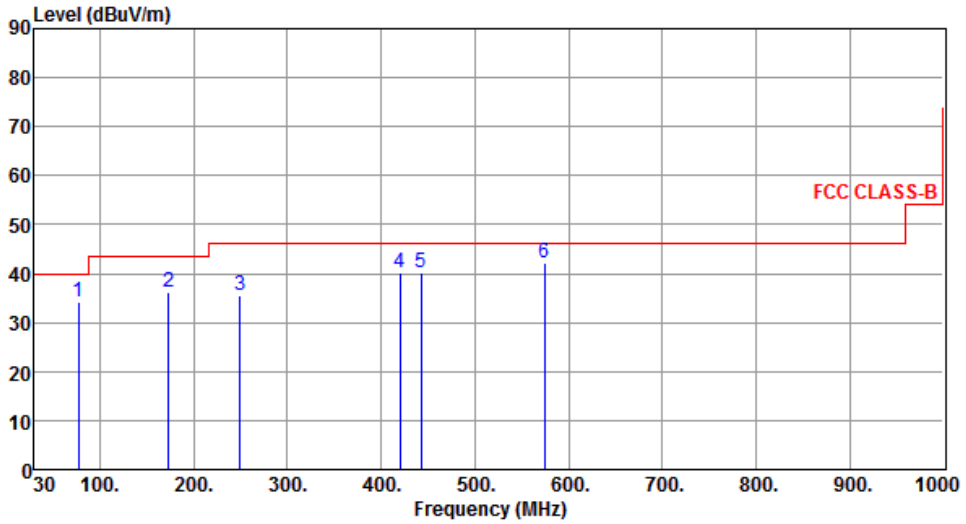
Radiated Emissions above 1 GHz



Configuration 1: Wifi module + LoRa module with external antenna

3.1.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

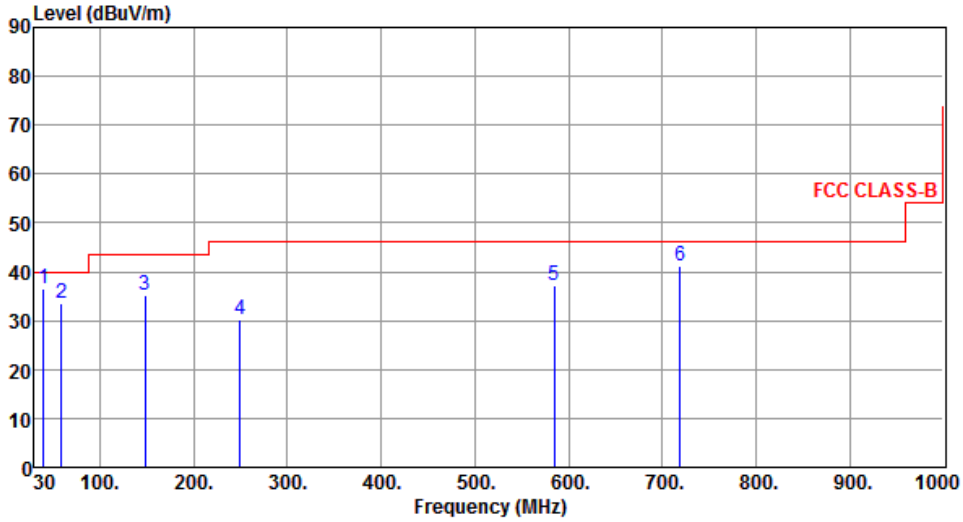
Modulation	2.4G 11g ch6 + LoRa 927.5MHz
Polarization	Horizontal



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	77.53	34.18	40.00	-5.82	46.28	-12.10	Peak	---	---
2	173.56	36.23	43.50	-7.27	45.21	-8.98	Peak	---	---
3	249.60	35.41	46.00	-10.59	44.63	-9.22	Peak	---	---
4	420.00	40.32	46.00	-5.68	44.81	-4.49	Peak	---	---
5	442.40	40.26	46.00	-5.74	44.19	-3.93	Peak	---	---
6	574.40	42.33	46.00	-3.67	43.60	-1.27	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	2.4G 11g ch6 + LoRa 927.5MHz
Polarization	Vertical

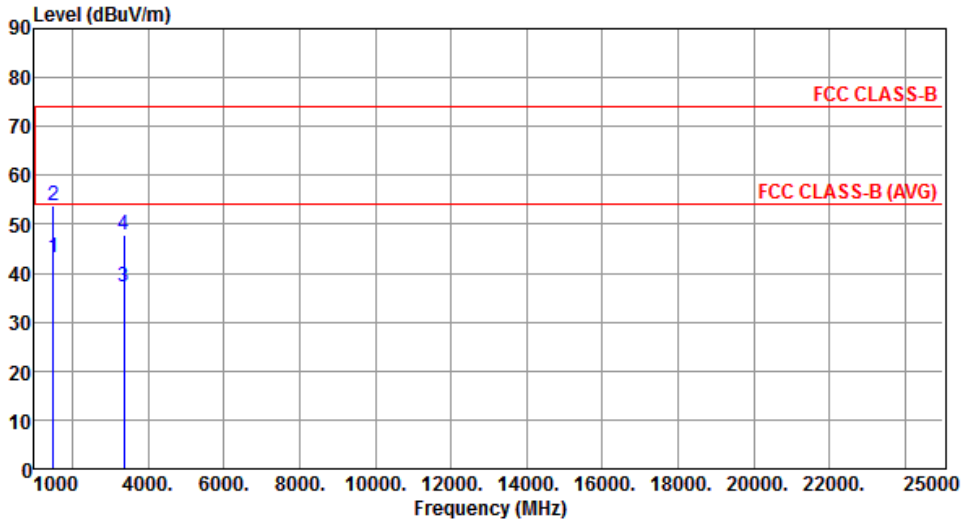


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	39.70	36.52	40.00	-3.48	44.37	-7.85	Peak	---	---
2	59.10	33.67	40.00	-6.33	42.47	-8.80	Peak	100	291
3	148.34	35.15	43.50	-8.35	43.36	-8.21	Peak	---	---
4	249.60	30.30	46.00	-15.70	39.52	-9.22	Peak	---	---
5	584.80	37.18	46.00	-8.82	38.19	-1.01	Peak	---	---
6	719.20	41.21	46.00	-4.79	40.02	1.19	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.

3.1.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

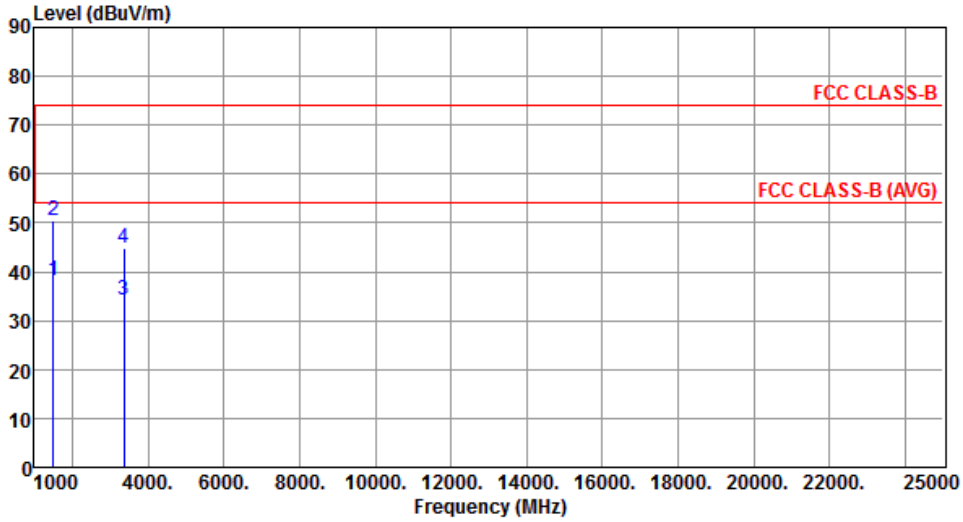
Modulation	2.4G 11g ch6 + LoRa 927.5MHz
Polarization	Horizontal



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1510.00	43.24	54.00	-10.76	49.82	-6.58	Average	100	187
2	1510.00	53.94	74.00	-20.06	60.52	-6.58	Peak	100	187
3	3365.00	37.13	54.00	-16.87	37.44	-0.31	Average	100	359
4	3365.00	47.91	74.00	-26.09	48.22	-0.31	Peak	100	359

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	2.4G 11g ch6 + LoRa 927.5MHz
Polarization	Vertical



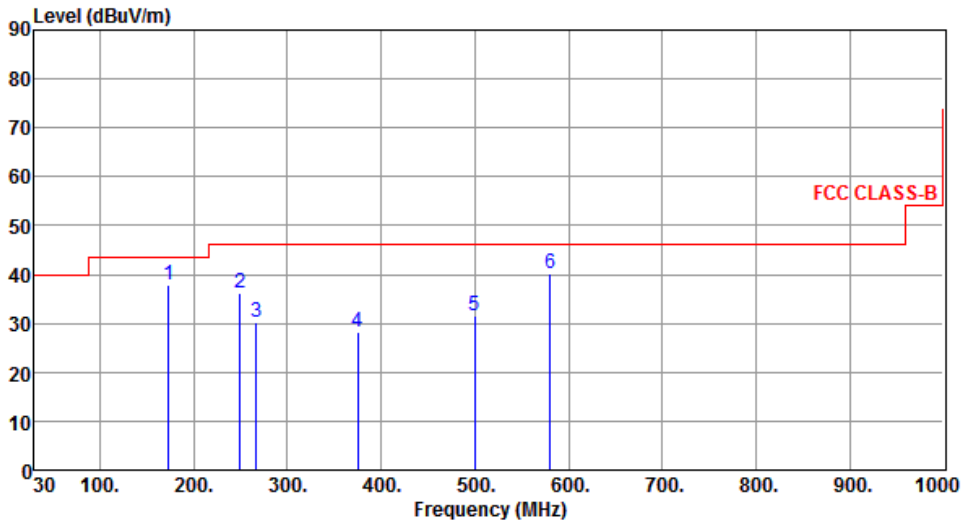
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1510.00	38.30	54.00	-15.70	44.88	-6.58	Average	100	146
2	1510.00	50.47	74.00	-23.53	57.05	-6.58	Peak	100	146
3	3365.00	34.14	54.00	-19.86	34.45	-0.31	Average	100	216
4	3365.00	44.72	74.00	-29.28	45.03	-0.31	Peak	100	216

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).

Configuration 2: Wifi module + LoRa module with internal antenna

3.1.6 Transmitter Radiated Unwanted Emissions (Below 1GHz)

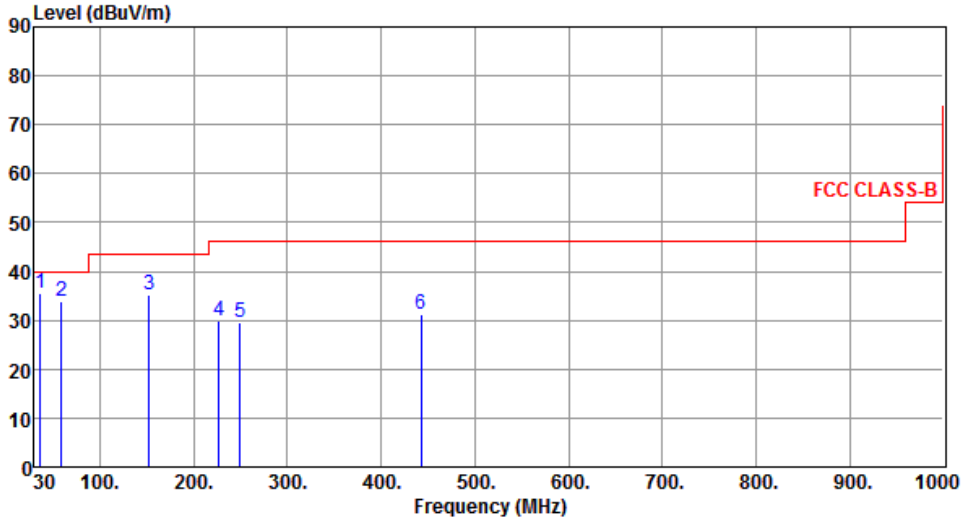
Modulation	2.4G 11g ch6 + LoRa 927.5MHz
Polarization	Horizontal



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	173.56	37.76	43.50	-5.74	46.74	-8.98	Peak	---	---
2	249.60	36.20	46.00	-9.80	45.42	-9.22	Peak	---	---
3	266.40	30.14	46.00	-15.86	38.74	-8.60	Peak	---	---
4	375.20	28.35	46.00	-17.65	33.97	-5.62	Peak	---	---
5	500.00	31.56	46.00	-14.44	34.37	-2.81	Peak	---	---
6	580.00	40.28	46.00	-5.72	41.41	-1.13	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	2.4G 11g ch6 + LoRa 927.5MHz
Polarization	Vertical

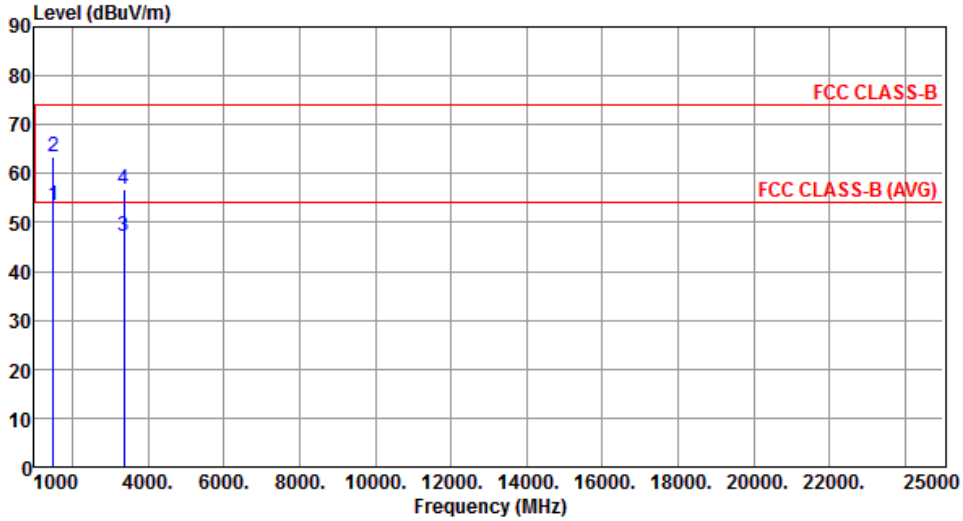


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	36.79	35.59	40.00	-4.41	43.89	-8.30	Peak	---	---
2	58.70	33.90	40.00	-6.10	42.66	-8.76	QP	100	283
3	152.22	35.12	43.50	-8.38	43.29	-8.17	Peak	---	---
4	226.91	29.90	46.00	-16.10	39.67	-9.77	Peak	---	---
5	249.22	29.61	46.00	-16.39	38.84	-9.23	Peak	---	---
6	442.25	31.13	46.00	-14.87	35.06	-3.93	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.

3.1.7 Transmitter Radiated Unwanted Emissions (Above 1GHz)

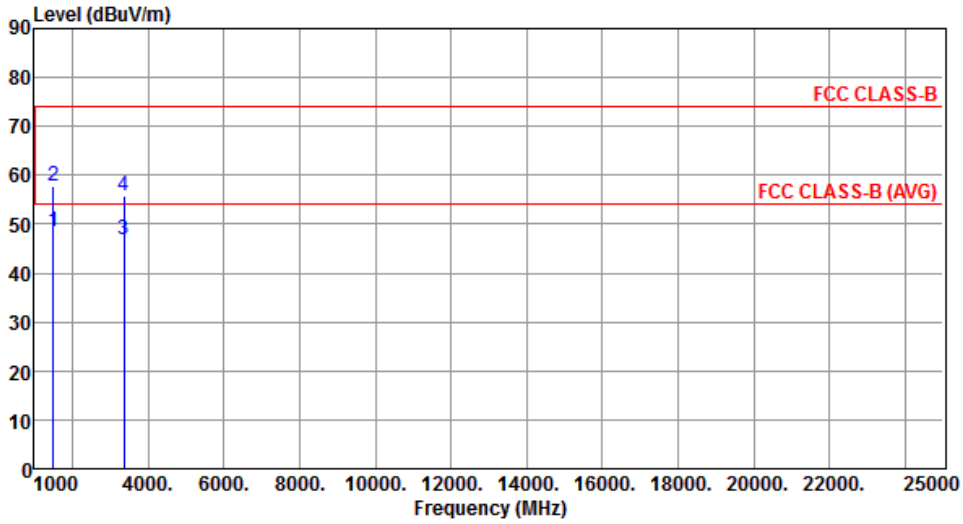
Modulation	2.4G 11g ch6 + LoRa 927.5MHz
Polarization	Horizontal



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1510.00	53.53	54.00	-0.47	60.11	-6.58	Average	107	163
2	1510.00	63.28	74.00	-10.72	69.86	-6.58	Peak	107	163
3	3365.00	47.25	54.00	-6.75	47.56	-0.31	Average	100	312
4	3365.00	56.83	74.00	-17.17	57.14	-0.31	Peak	100	312

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	2.4G 11g ch6 + LoRa 927.5MHz
Polarization	Vertical



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1510.00	48.65	54.00	-5.35	55.23	-6.58	Average	107	47
2	1510.00	57.76	74.00	-16.24	64.34	-6.58	Peak	107	47
3	3365.00	46.66	54.00	-7.34	46.97	-0.31	Average	329	352
4	3365.00	55.73	74.00	-18.27	56.04	-0.31	Peak	329	352

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).

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 Corp (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	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C..

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

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Fax: 886-3-318-0155
Email: ICC_Service@icertifi.com.tw

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