

FCC Co-Location Test Report

FCC ID : O6ZHXQX1AM0S
Equipment : 8-Channel LoRa Module
Model No. : HXQX1AM0S
Brand Name : machineQ
Applicant : Humax Co., Ltd.
Address : HUMAX BLDG., 2, HUMAX BLDG., 2,
Yeongmun-ro, Cheoin-gu, Yongin-si,
Gyeonggi-do, South Korea, 17040
Standard : 47 CFR FCC Part 15.247
Received Date : Mar. 05, 2019
Tested Date : Mar. 07 ~ Mar. 08, 2019

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:



Along Chen / Assistant Manager

Approved by:



Gary Chang / Manager



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Release Record

Report No.	Version	Description	Issued Date
FR782401-10CO	Rev. 01	Initial issue	Mar. 26, 2019

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 1513.70MHz 53.70 (Margin -0.30dB) - AV	Pass

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 values of gain for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of the gain.

1 General Description

1.1 Information

This is a Class II Permissive Change report.

This report is issued as a supplementary report to original ICC report no. FR782401-07CO.

The difference is concerned with following items:

- ✧ Modification of PCB and components of non-RF section for ESD, Ethernet Port Surge and LED circuit Improvement and GPIO circuit.
- ✧ Remove matching circuit and replace by band pass filter on Lora external antenna area
- ✧ Lora External antenna connector location is moved out 3.15 mm
- ✧ Having longer screw post on heat sink for WiFi
- ✧ Remove an adapter (Brand name: PHIHONG, Model name: PSAC24A-120L6)

Radiated emission tests had been re-tested and presented in following sections.

1.1.1 Specification of the Equipment under Test (EUT)

Operating Frequency	902 MHz ~ 928 MHz
Modulation Type	CSS

1.1.2 Information of Host

Brand Name	machineQ
Product name	8-Channel LoRa Gateway
Model name	HXQX1AM0S
FCC ID	O6ZHLC0000

1.1.2.1 Antenna of Host

Ant. No.	Model	Type	Gain (dBi)	Connector	Remark
1	CON 1	PIFA	3.76	UFL	Wi-Fi Antenna
2	CON 2	PIFA	3.86	UFL	Wi-Fi Antenna
3	LoRa antenna (External)	Dipole	0.96	SMA	Lora Antenna
4	LoRa antenna (Internal)	Monopole	1.02	UFL	Lora Antenna

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	12Vdc from adapter
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1.2 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber 3 / (03CH03-WS)				
Tested Date	Mar. 07 ~ Mar. 08, 2019				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101499	Jan. 07, 2019	Jan. 06, 2020
Receiver	R&S	ESR3	101658	Dec. 11, 2018	Dec. 10, 2019
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-685	Apr. 19, 2018	Apr. 18, 2019
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Jan. 07, 2019	Jan. 06, 2020
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2018	Nov. 14, 2019
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 08, 2018	Oct. 07, 2019
Preamplifier	EMC	EMC02325	980187	Aug. 24, 2018	Aug. 23, 2019
Preamplifier	Agilent	83017A	MY53270014	Aug. 09, 2018	Aug. 08, 2019
Preamplifier	EMC	EMC184045B	980192	Aug. 09, 2018	Aug. 08, 2019
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Oct. 01, 2018	Sep. 30, 2019
RF cable-8M	EMC	EMC104-SM-SM-80 00	181107	Oct. 01, 2018	Sep. 30, 2019
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22624/4	Oct. 01, 2018	Sep. 30, 2019
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800 -001	Oct. 01, 2018	Sep. 30, 2019
LF cable-3M	EMC	EMC8D-NM-NM-300 0	131103	Oct. 01, 2018	Sep. 30, 2019
LF cable-13M	EMC	EMC8D-NM-NM-130 00	131104	Oct. 01, 2018	Sep. 30, 2019
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 15.247 Meas Guidance v05r01

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

1.1 Deviation from Test Standard and Measurement Procedure

None

1.2 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 \leq 1GHz	± 3.96 dB
Radiated emission $>$ 1GHz	± 4.51 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Radiated Emissions	03CH03-WS	20-21°C / 66%	Rober Lu

- FCC Designation No.: TW0009
- FCC site registration No.: 207696
- IC site registration No.: 10807C-1

2.2 The Worst Test Modes and Channel Details

Test item	Test Mode	Test Configuration
Radiated Emissions	2.4G HT20 ch6 + LoRa 923.3MHz	1, 2
<p>Note:</p> <ol style="list-style-type: none"> 1. Test configuration are listed as listed as follows: <ul style="list-style-type: none"> Test Configuration 1: Wi-Fi + LoRa module with external antenna Test Configuration 2: Wi-Fi + LoRa module with internal antenna 2. The selected channel is the maximum power channel of Wifi & LoRa 		

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

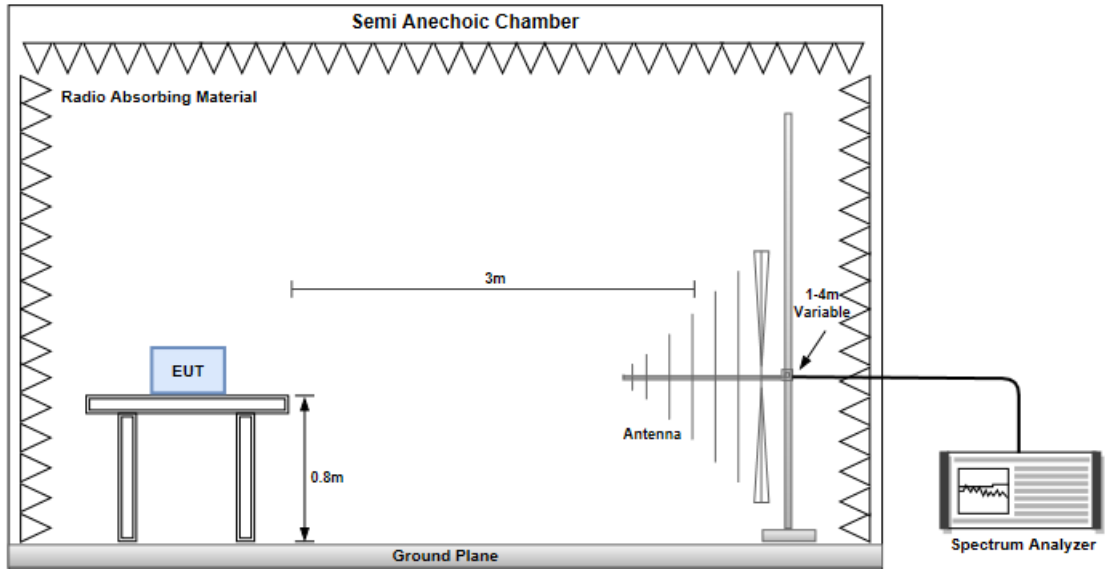
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission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

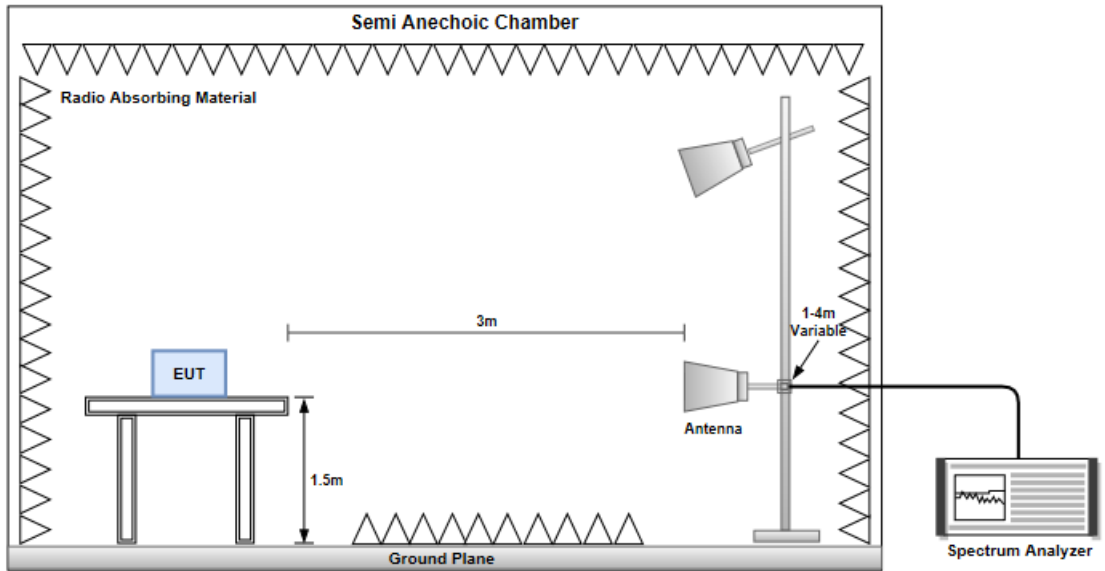
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above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

3.1.3 Test Setup

Radiated Emissions below 1 GHz

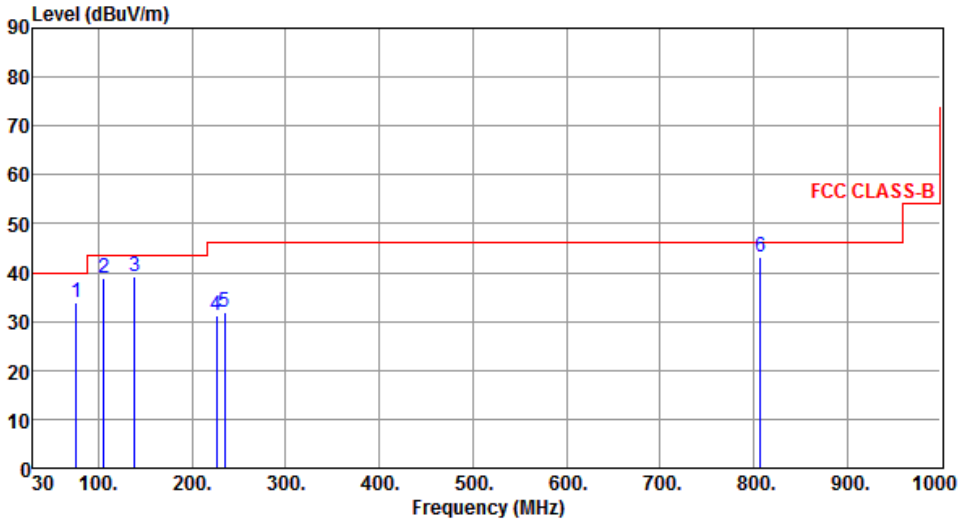


Radiated Emissions above 1 GHz



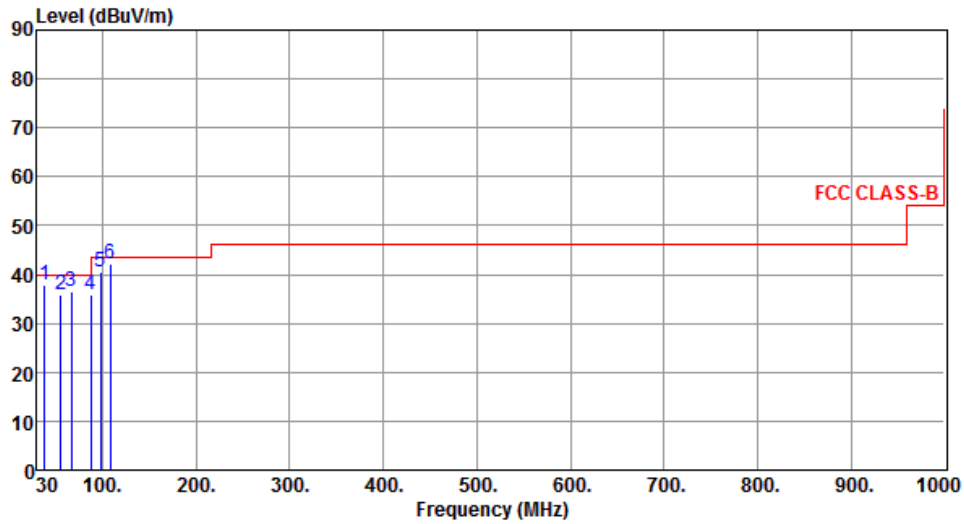
Configuration 1: Wifi module + LoRa module with external antenna

3.1.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Test Mode	2.4G HT20 ch6 + LoRa 923.3MHz								
Polarization	Horizontal								
 <p>The graph displays the radiated unwanted emissions for a 2.4G HT20 channel 6 + LoRa 923.3MHz configuration. The y-axis represents the emission level in dBuV/m, ranging from 0 to 90. The x-axis represents the frequency in MHz, ranging from 30 to 1000. A red line indicates the FCC CLASS-B limit, which is 40 dBuV/m from 30 MHz to 100 MHz, 45 dBuV/m from 100 MHz to 200 MHz, and 50 dBuV/m from 200 MHz to 1000 MHz. Six emission peaks are identified and numbered 1 through 6. Peak 6 at 807.20 MHz is the most significant, reaching 43.14 dBuV/m. The table below provides the detailed data for these peaks.</p>									
	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn
	MHz	level	dBuV/m	dB	reading	dB		High	Table
		dBuV/m			dBuV			cm	deg
1	76.44	33.85	40.00	-6.15	45.89	-12.04	Peak	---	---
2	105.61	38.87	43.50	-4.63	51.49	-12.62	Peak	---	---
3	138.57	39.05	43.50	-4.45	47.94	-8.89	Peak	---	---
4	226.40	31.19	46.00	-14.81	41.69	-10.50	Peak	---	---
5	234.40	31.72	46.00	-14.28	41.64	-9.92	Peak	---	---
6	807.20	43.14	46.00	-2.86	39.75	3.39	QP	100	206

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.

Test Mode	2.4G HT20 ch6 + LoRa 923.3MHz
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	38.46	37.95	40.00	-2.05	46.59	-8.64	QP	100	235
2	55.79	35.86	40.00	-4.14	44.28	-8.42	QP	100	26
3	66.79	36.65	40.00	-3.35	46.57	-9.92	QP	100	224
4	87.52	35.75	40.00	-4.25	49.84	-14.09	QP	100	298
5	98.21	40.59	43.50	-2.91	54.31	-13.72	QP	100	307
6	108.49	42.04	43.50	-1.46	54.15	-12.11	QP	100	315

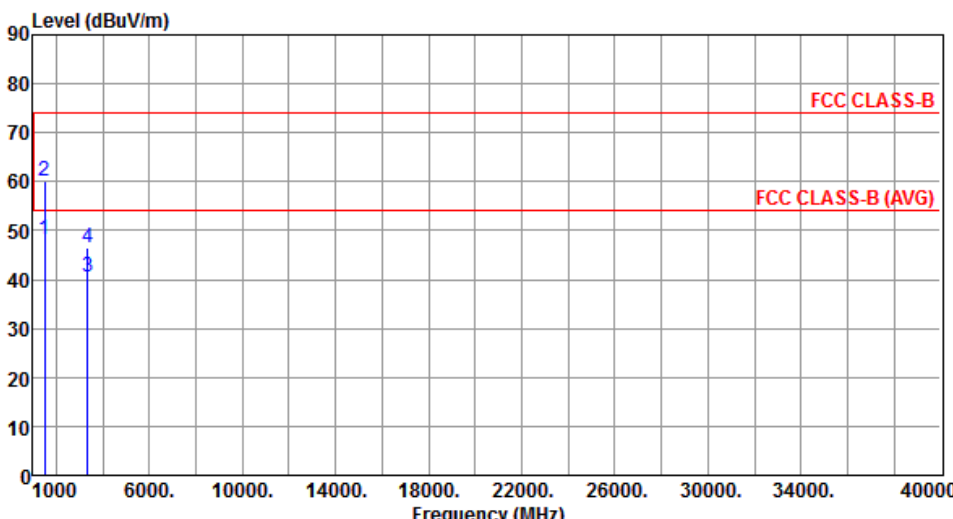
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

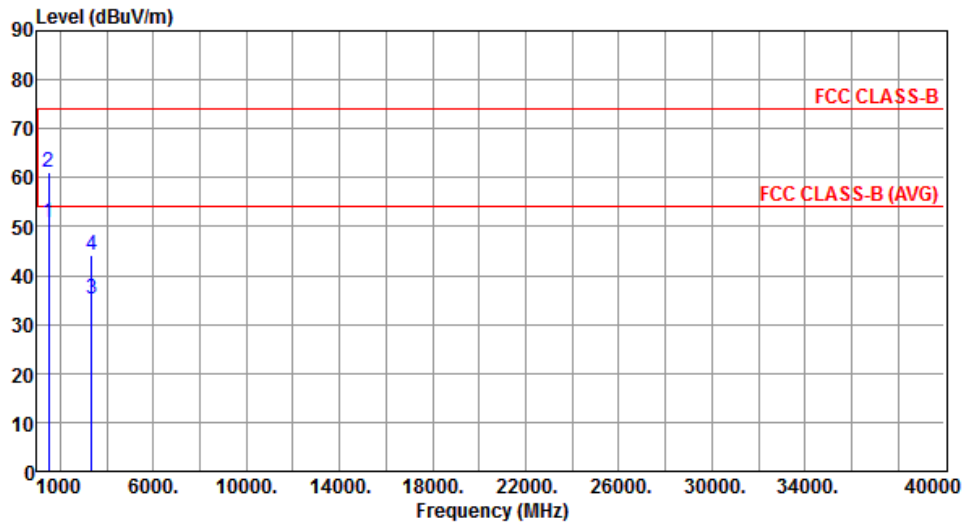
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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

3.1.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

Test Mode	2.4G HT20 ch6 + LoRa 923.3MHz								
Polarization	Horizontal								
									
	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn
	MHz	level	dBuV/m	dB	reading	dB		High	Table
		dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	1513.70	48.10	54.00	-5.90	52.99	-4.89	Average	132	311
2	1513.70	60.24	74.00	-13.76	65.13	-4.89	Peak	132	311
3	3360.30	40.44	54.00	-13.56	39.80	0.64	Average	124	156
4	3360.30	46.59	74.00	-27.41	45.95	0.64	Peak	124	156
<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>									

Test Mode	2.4G HT20 ch6 + LoRa 923.3MHz
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	1513.70	50.83	54.00	-3.17	55.72	-4.89	Average	273	128
2	1513.70	61.19	74.00	-12.81	66.08	-4.89	Peak	273	128
3	3360.30	35.28	54.00	-18.72	34.64	0.64	Average	100	120
4	3360.30	44.11	74.00	-29.89	43.47	0.64	Peak	100	120

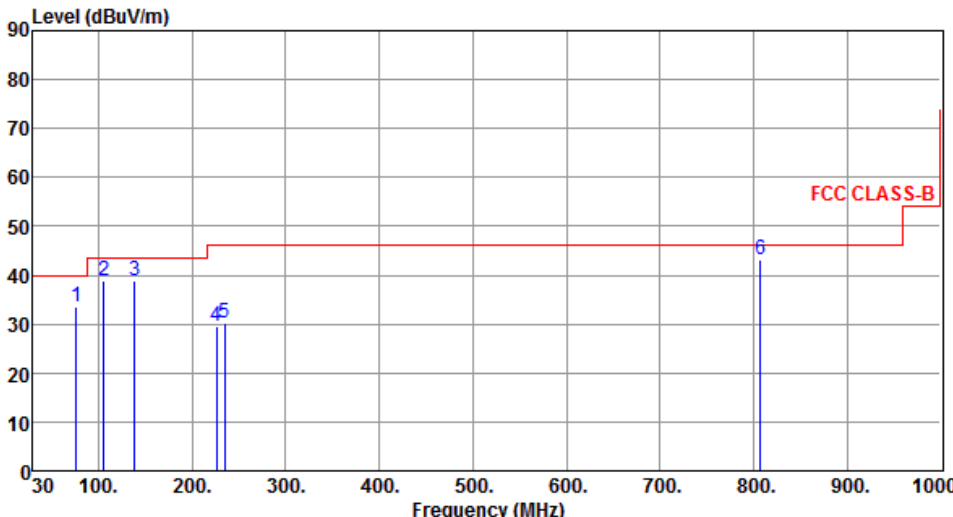
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

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

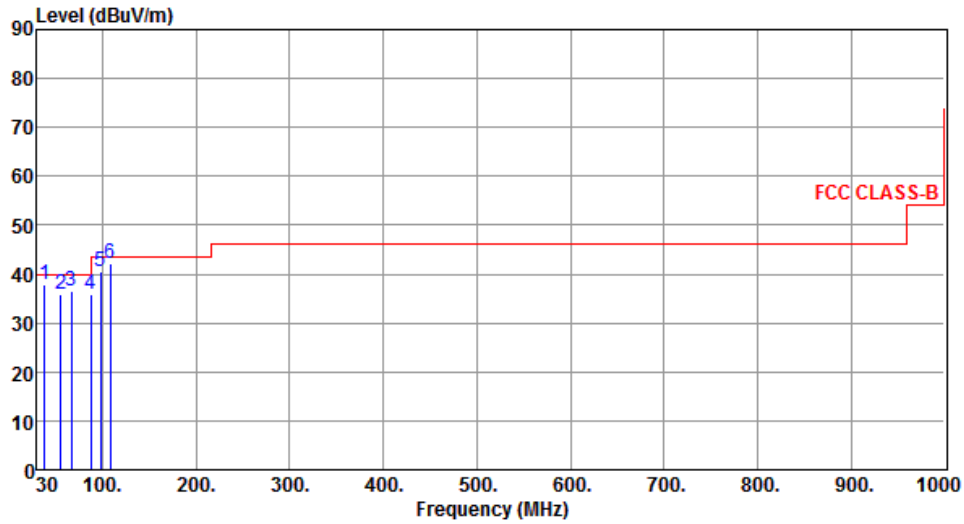
Configuration 2: Wifi module + LoRa module with internal antenna

3.1.6 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Test Mode	2.4G HT20 ch6 + LoRa 923.3MHz								
Polarization	Horizontal								
 <p>The graph displays the radiated unwanted emissions for a 2.4G HT20 ch6 + LoRa 923.3MHz module. The y-axis represents the emission level in dBuV/m, ranging from 0 to 90. The x-axis represents the frequency in MHz, ranging from 30 to 1000. A red line indicates the FCC CLASS-B limit, which is 40 dBuV/m from 30 MHz to 100 MHz, 45 dBuV/m from 100 MHz to 200 MHz, and 50 dBuV/m from 200 MHz to 1000 MHz. Six emission peaks are identified and numbered 1 through 6. Peak 6 at 807.20 MHz is the most significant, reaching 43.21 dBuV/m. The table below provides the detailed data for these peaks.</p>									
	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn
	MHz	level	dBuV/m	dB	reading	dB		High	Table
		dBuV/m			dBuV			cm	deg
1	76.49	33.69	40.00	-6.31	45.74	-12.05	Peak	---	---
2	105.48	38.85	43.50	-4.65	51.49	-12.64	Peak	---	---
3	138.45	39.02	43.50	-4.48	47.93	-8.91	Peak	---	---
4	226.40	29.72	46.00	-16.28	40.22	-10.50	Peak	---	---
5	234.40	30.17	46.00	-15.83	40.09	-9.92	Peak	---	---
6	807.20	43.21	46.00	-2.79	39.82	3.39	QP	100	205

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.

Test Mode	2.4G HT20 ch6 + LoRa 923.3MHz
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	38.52	38.02	40.00	-1.98	46.66	-8.64	QP	100	239
2	55.87	35.98	40.00	-4.02	44.41	-8.43	QP	100	25
3	66.82	36.67	40.00	-3.33	46.60	-9.93	QP	100	223
4	87.45	35.86	40.00	-4.14	49.92	-14.06	QP	100	295
5	98.12	40.55	43.50	-2.95	54.28	-13.73	QP	100	306
6	108.57	42.07	43.50	-1.43	54.16	-12.09	QP	100	316

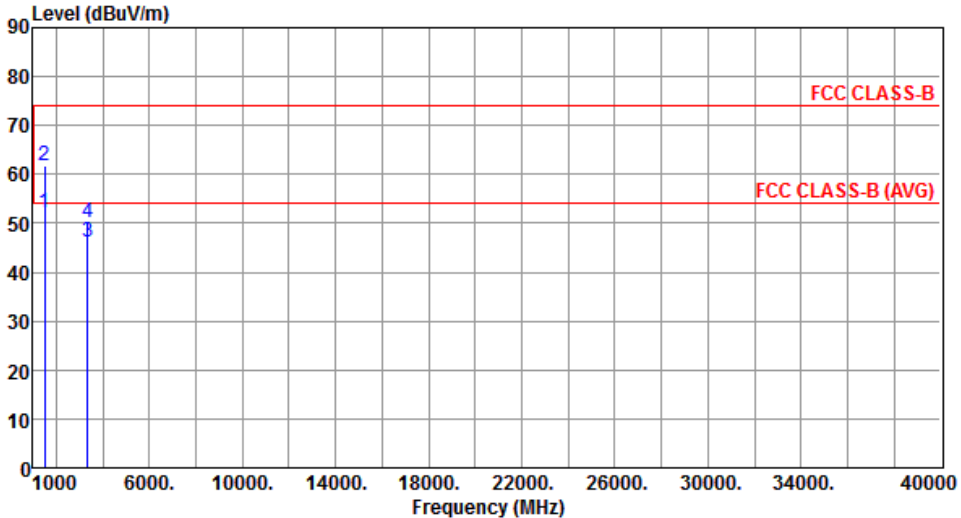
Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

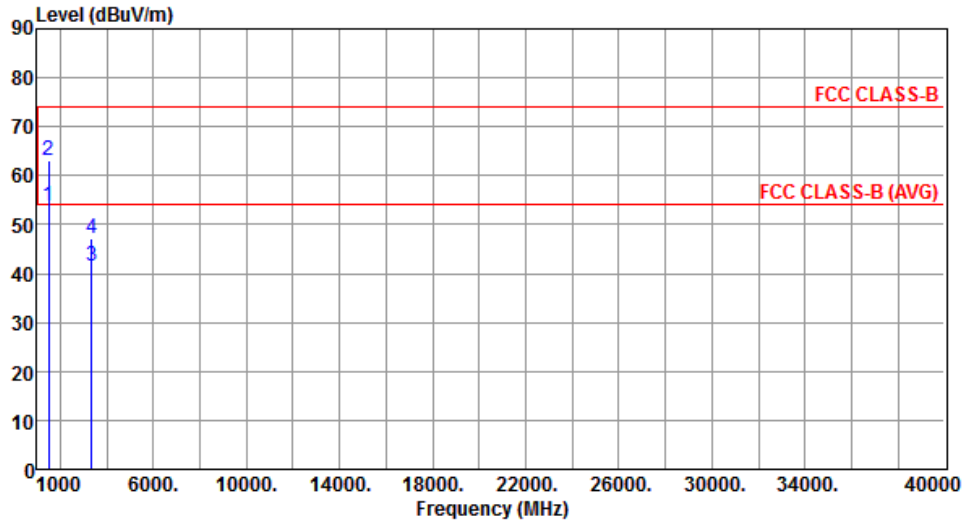
Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

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

3.1.7 Transmitter Radiated Unwanted Emissions (Above 1GHz)

Test Mode	2.4G HT20 ch6 + LoRa 923.3MHz								
Polarization	Horizontal								
									
	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	1513.70	52.14	54.00	-1.86	57.03	-4.89	Average	173	311
2	1513.70	61.86	74.00	-12.14	66.75	-4.89	Peak	173	311
3	3360.30	46.15	54.00	-7.85	45.51	0.64	Average	100	162
4	3360.30	50.19	74.00	-23.81	49.55	0.64	Peak	100	162
<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>									

Test Mode	2.4G HT20 ch6 + LoRa 923.3MHz
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	1513.70	53.70	54.00	-0.30	58.59	-4.89	Average	328	141
2	1513.70	62.97	74.00	-11.03	67.86	-4.89	Peak	328	141
3	3360.30	41.65	54.00	-12.35	41.01	0.64	Average	100	122
4	3360.30	47.17	74.00	-26.83	46.53	0.64	Peak	100	122

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

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 District, Tao Yuan City
333, Taiwan, R.O.C.

Kwei Shan Site II

Tel: 886-3-271-8640

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

Tel: 886-3-271-8666

Fax: 886-3-318-0155

Email: ICC_Service@icertifi.com.tw

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