

# FCC Co-Location Test Report

**FCC ID** : 2AMUGTBG100  
**Equipment** : LoRaWAN Gateway  
**Model No.** : TBGW100  
**Brand Name** : Tabs  
**Applicant** : TrackNet, Inc  
**Address** : 900 LAFAYETTE ST #329, SANTA CLARA,  
California, United States, 95050  
**Standard** : 47 CFR FCC Part 15.247  
47 CFR FCC Part 15.407  
**Received Date** : Oct. 05, 2017  
**Tested Date** : Oct. 16 ~ Nov. 01, 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:

  
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Along Chen / Assistant Manager

Approved by:

  
\_\_\_\_\_  
Gary Chang / Manager



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## Release Record

Report No.	Version	Description	Issued Date
FR7O0501CO	Rev. 01	Initial issue	Nov. 22, 2017

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## Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.247(d) 15.407(b) 15.209	Radiated Emissions	[dBuV/m at 3m]: 60.23MHz 38.99 (Margin -1.01dB) - QP	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 802.11a/n/ac: 5180 MHz ~ 5240 MHz, 5745 ~ 5825 MHz
Modulation Type	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n/ac: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)
LoRa	
Operating Frequency	923.3 MHz ~ 927.5 MHz
Modulation Type	CSS

### 1.1.2 Antenna Details

#### For WLAN

Ant. No.	Model	Type	Connector	Frequency band (MHz) / Antenna Gain (dBi)		
				2400~2483.5	5150~5250	5725~5850
1	N2410DTR-PK1-G55UR2	Embedded Antenna	I-PEX	2.7	5.7	5.7
2	N2410DBK-T-PK1-G45UR3	Embedded Antenna	I-PEX	2.16	3.78	3.78

#### For LoRa

Ant. No.	Type	Connector	Gain (dBi)	Remark
1	PIFA	ipex	1	---

### 1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	12Vdc from AC adapter
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#### 1.1.4 Accessories

Accessories		
No.	Equipment	Description
1	AC adapter 1	Brand: APD Model: WA-24Q12FU Power Rating: I/P: 100-240Vac, 50-60Hz, 0.7A Max. O/P: 12Vdc, 2A Power Line: AC 1.2m non-shielded without core
2	AC adapter 2	Brand: PHIHONG Model: PSAC24A-120L6 Power Rating: I/P: 100-240Vac, 50-60Hz, 0.6A O/P: 12Vdc, 2A Power Line: AC 1.2m non-shielded without core
3	USB cable	1m shielded without core
4	RJ45 (Flat)	1m non-shielded without core

## 1.2 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Oct. 16, 2017				
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	Jul. 25, 2017	Jul. 24, 2018
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 21, 2016	Dec. 20, 2017
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 25, 2016	Oct. 24, 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	Jul. 28, 2017	Jul. 27, 2018
Preamplifier	Agilent	83017A	MY39501308	Oct. 06, 2017	Oct. 05, 2018
Preamplifier	EMC	EMC184045B	980192	Aug. 22, 2017	Aug. 21, 2018
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-N M-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.

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Test date	Nov. 01, 2017				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Mar. 15, 2017	Mar. 14, 2018
Measurement Software	Sporton	Sporton_1	1.3.30	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

47 CFR FCC Part 15.407

ANSI C63.10-2013

FCC KDB 558074 D01 DTS Meas Guidance v04

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04

FCC KDB 644545 D03 Guidance for IEEE 802 11ac New Rules v01

FCC KDB 412172 D01 Determining ERP and EIRP v01r01

### 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 $\leq$ 1GHz	$\pm 3.66$ dB
Radiated emission $>$ 1GHz	$\pm 5.63$ dB



## 2 Test Configuration

### 2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Radiated Emissions	03CH01-WS	25°C / 63-66%	Aska Huang Vincent Yeh

- 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 + 11a ch149 + LoRa 500KHz 923.3MHz
Conducted Emissions	2.4G 11g ch6 + 11a ch149

**NOTE:**

1. Two adapters (APD & PHIHONG) had been covered during the pretest and found that **PHIHONG adapter** was the worst case and was selected for final testing.
2. Conducted emission test is only performed for Wi-Fi function since common antenna is used
3. The selected channel is the maximum power channel of each function.

### 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

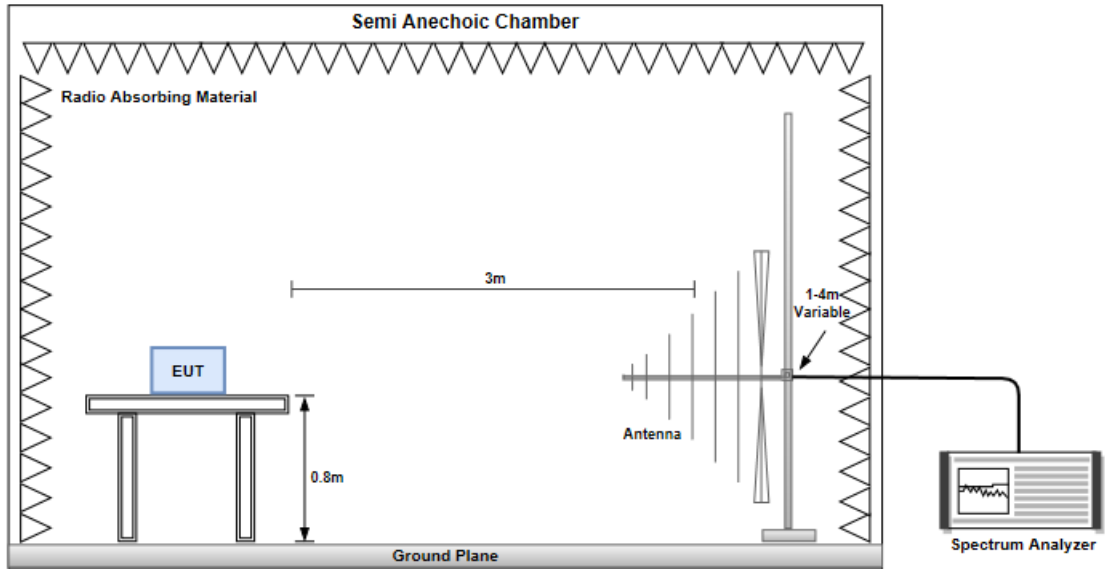
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission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

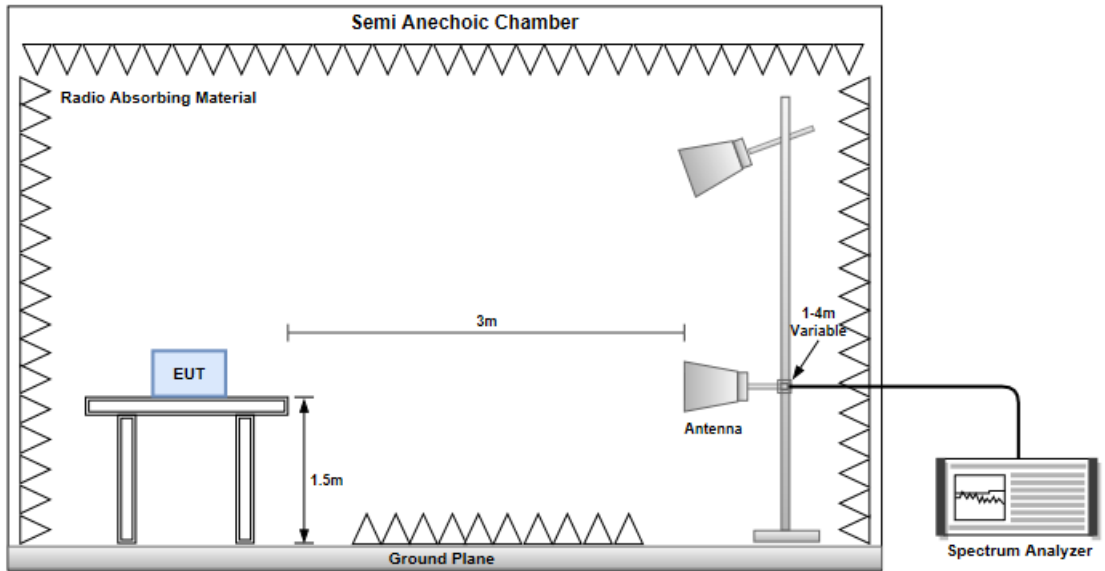
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above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

### 3.1.3 Test Setup

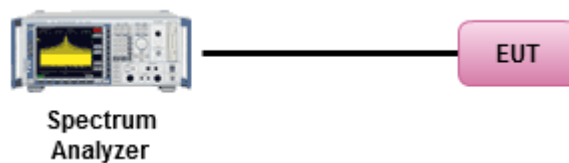
#### Radiated Emissions below 1 GHz



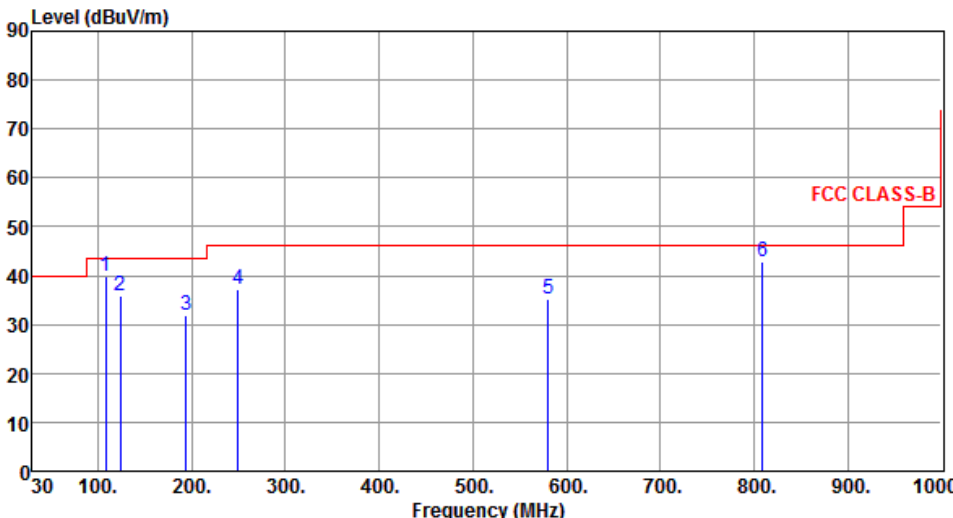
#### Radiated Emissions above 1 GHz



#### Transmitter Conducted Unwanted Emissions (30MHz~40GHz)

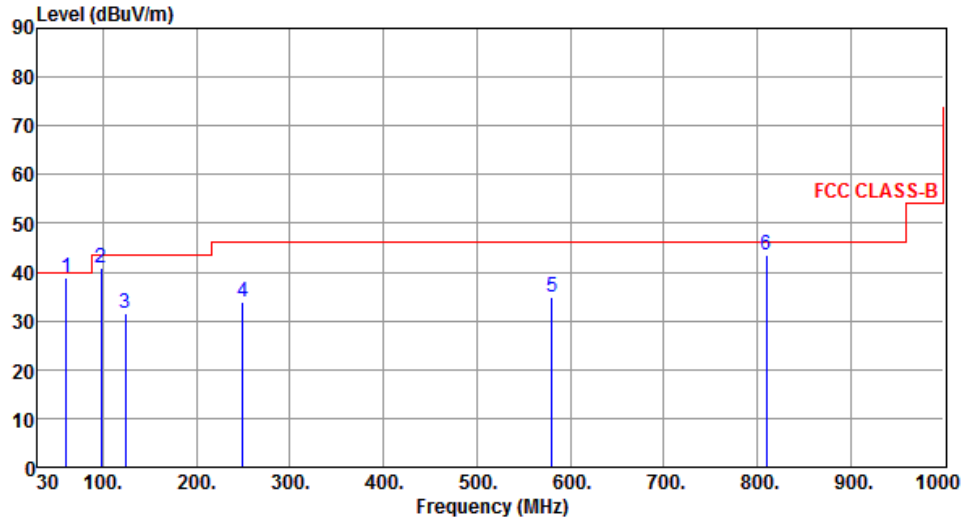


### 3.1.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

<b>Modulation</b>	2.4G 11g ch6 + 11a ch149 + LoRa 500KHz 923.3MHz								
<b>Polarization</b>	Horizontal								
									
	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn
	MHz	level	dBuV/m	dB	reading	dB		High	Table
		dBuV/m			dBuV			cm	deg
1	108.57	39.94	43.50	-3.56	51.67	-11.73	Peak	---	---
2	124.09	35.92	43.50	-7.58	46.11	-10.19	Peak	---	---
3	193.93	32.03	43.50	-11.47	42.79	-10.76	Peak	---	---
4	249.22	37.04	46.00	-8.96	46.42	-9.38	Peak	---	---
5	579.99	35.19	46.00	-10.81	36.32	-1.13	Peak	---	---
6	809.34	42.82	46.00	-3.18	40.40	2.42	QP	100	217

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.

<b>Modulation</b>	2.4G 11g ch6 + 11a ch149 + LoRa 500KHz 923.3MHz
<b>Polarization</b>	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	60.23	38.99	40.00	-1.01	47.54	-8.55	QP	100	232
2	97.90	40.80	43.50	-2.70	54.07	-13.27	Peak	---	---
3	124.09	31.39	43.50	-12.11	41.58	-10.19	Peak	---	---
4	249.22	33.92	46.00	-12.08	43.30	-9.38	Peak	---	---
5	579.99	34.85	46.00	-11.15	35.98	-1.13	Peak	---	---
6	809.88	43.34	46.00	-2.66	40.91	2.43	Peak	---	---

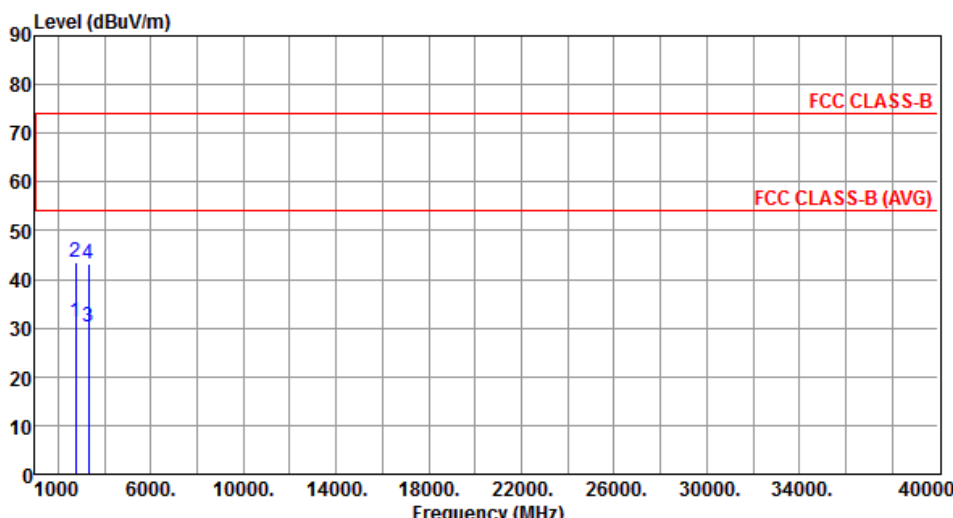
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

\*Factor includes antenna factor , cable loss and amplifier gain

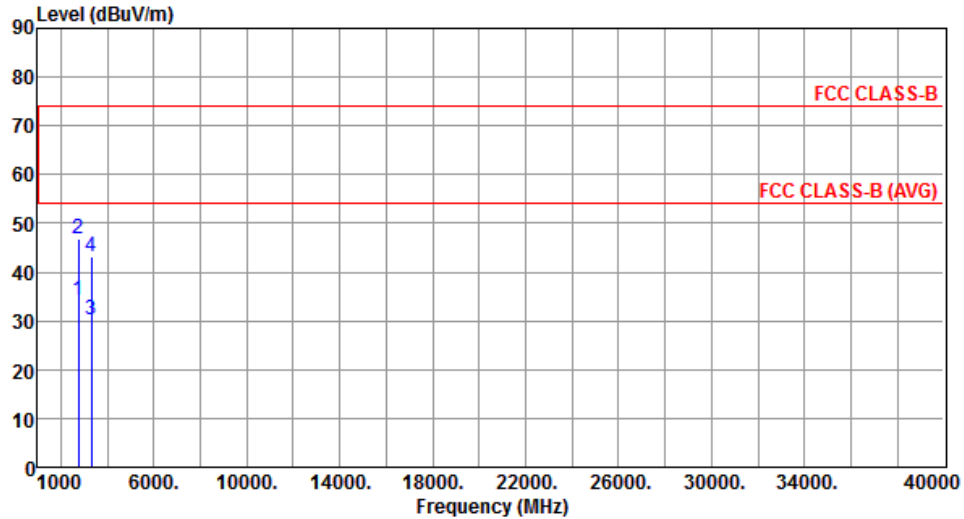
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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

### 3.1.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

<b>Modulation</b>	2.4G 11g ch6 + 11a ch149 + LoRa 500KHz 923.3MHz								
<b>Polarization</b>	Horizontal								
									
	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn
	MHz	level	dBuV/m	dB	reading	dB		High	Table
		dBuV/m	dBuV/m		dBuV			cm	deg
1	2769.00	31.23	54.00	-22.77	31.82	-0.59	Average	145	356
2	2769.00	43.62	74.00	-30.38	44.21	-0.59	Peak	145	356
3	3308.00	30.24	54.00	-23.76	29.51	0.73	Average	100	155
4	3308.00	43.32	74.00	-30.68	42.59	0.73	Peak	100	155
<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>									

<b>Modulation</b>	2.4G 11g ch6 + 11a ch149 + LoRa 500KHz 923.3MHz
<b>Polarization</b>	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	2769.00	34.26	54.00	-19.74	34.85	-0.59	Average	100	5
2	2769.00	46.80	74.00	-27.20	47.39	-0.59	Peak	100	5
3	3308.00	30.20	54.00	-23.80	29.47	0.73	Average	100	322
4	3308.00	43.17	74.00	-30.83	42.44	0.73	Peak	100	322

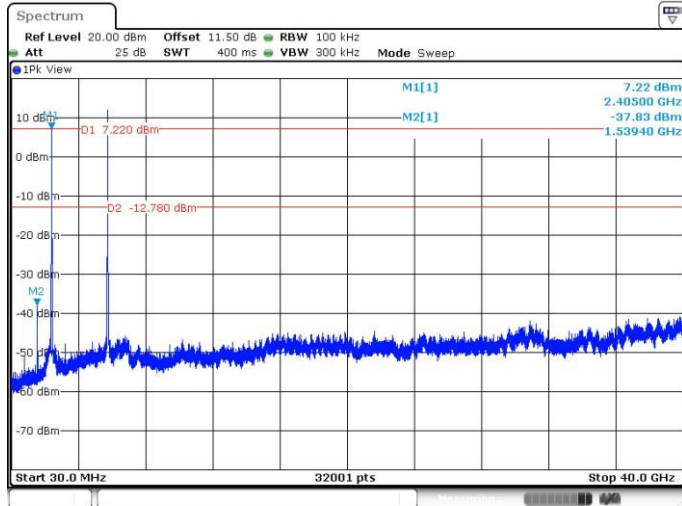
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor\* (dB)

\*Factor includes antenna factor , cable loss and amplifier gain

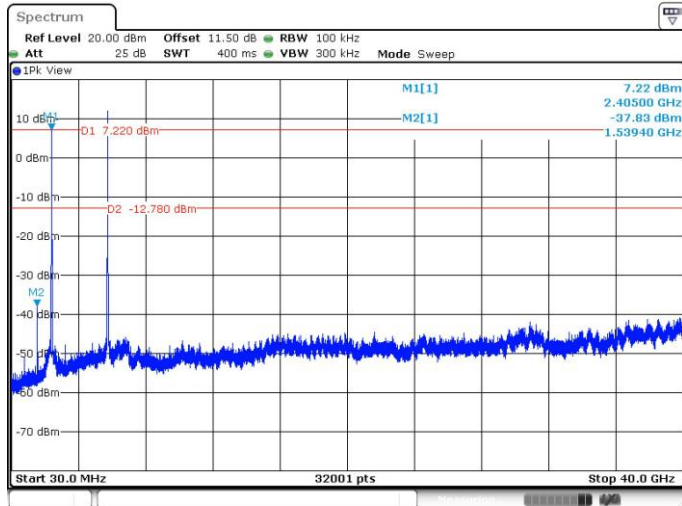
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

### 3.1.6 Conducted Emissions (30MHz~40GHz)

**Conducted Emission Plot of Antenna port 1**



**Conducted Emission Plot of Antenna port 2**





## 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>.

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City 333, Taiwan, R.O.C..

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