

**ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT
INTENTIONAL RADIATOR CERTIFICATION TO
FCC PART 15 SUBPART C
REQUIREMENT**

OF

Codeybot

MODEL No.: CODEYBOT-001

Trademark: Makeblock

FCC ID: 2AH9Q-CODEYBOT

REPORT NO: ES160127023E1

ISSUE DATE: July 07, 2016

Prepared for

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VERIFICATION OF COMPLIANCE


Applicant:	Shenzhen Maker Works Technology Co., Ltd.
Manufacturer:	Shenzhen Maker Works Technology Co., Ltd.
Product Description:	Codeybot
Model Number:	CODEYBOT-001
Date of Test:	January 27, 2016 to July 07, 2016


We hereby certify that:

The above equipment was tested by EMTEK(SHENZHEN) CO., LTD.. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.249.

The test results of this report relate only to the tested sample identified in this report.

Date of Test : January 27, 2016 to July 07, 2016

Prepared by : 
Yaping Shen/Editor

Reviewer : 
Joe Xia/Supervisor


Approve & Authorized Signer : 
Lisa Wang/Manager

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1. GENERAL INFORMATION

1.1. Product Description

Product:	Codeybot
Model Number:	CODEYBOT-001
Power supply:	DC 3.7V by battery or DC 5V by external power
WIFI information:	
Operating Frequency Range:	2412-2462MHz for 802.11b/g; 2412-2462MHz for 802.11n(HT20); 2422-2452MHz for 802.11n(HT40);
Modulation:	DSSS with DBPSK/DQPSK/CCK for 802.11b; OFDM with BPSK/QPSK/16QAM/64QAM for 802.11g/n;
Number of Channels:	11 channels for 802.11b/g; 11 channels for 802.11n(HT20); 7 channels for 802.11n(HT40);
Antenna Type:	Copper tube antenna
Antenna Gain:	2 dBi
Transmit Power (ERP):	19.88dBm
General 2.4G information:	
Operating Frequency Range:	2410-2470MHz
Modulation:	GFSK
Number of Channels:	61 channels
Antenna Type:	PCB antenna
Antenna Gain:	-0.35 dBi
Temperature Range:	-20°C ~ +55°C

1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: 2AH9Q-CODEYBOT filing to comply with Section 15.249 of the FCC Part 15, Subpart C Rules.

1.3. Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

1.4. Special Accessories

Not available for this EUT intended for grant.

1.5. Equipment Modifications

Not available for this EUT intended for grant.

1.6. Measurement Uncertainty

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±3.00dB
Fundamental Fieldstrength	Not Applicable	95%	±2.94dB
Transmitter 20 dB Bandwidth	Not Applicable	95%	±0.92PPm
Radiated Spurious Emissions	30 MHz to 40 GHz	95%	±3.00dB

1.7. Test Facility

Site Description

EMC Lab.

: Accredited by CNAS, 2013.10.29
The certificate is valid until 2016.10.28
The Laboratory has been assessed and proved to be in compliance with CNAS-CL01: 2006(identical to ISO/IEC17025: 2005)
The Certificate Registration Number is L2291

Accredited by TUV Rheinland Shenzhen, 2010.5.25
The Laboratory has been assessed according to the requirements ISO/IEC 17025.

Name of Firm

: Accredited by FCC, July 24, 2013
The Certificate Registration Number is 406365.

Site Location

: Accredited by FCC, April 17, 2013
The Certificate Registration Number is 709623.

2. SYSTEM TEST CONFIGURATION

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

2.3. Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

2.3.2 Radiated Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. Emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013.

2.4. Description of test modes

The EUT has been tested under normal operating condition.

Pre-scanned tests, X, Y, Z in the three orthogonal panels, were conducted to determine the final configuration from all possible combinations. Let EUT transmit with highest power, and the worst result was reported with modulation GFSK. The 3 channels of lower, medium and higher were chosen for test.

Pretest Mode	Description
Mode 1	Low – 2410MHz
Mode 2	Middle – 2440MHz
Mode 3	High -2470MHz

For Conducted Test	
Final Test Mode	Description
Mode 1	Wireless ON

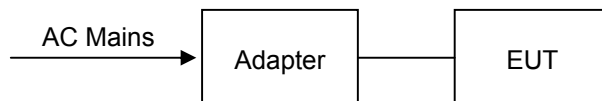
For Radiated Test	
Mode 1	Low – 2410MHz
Mode 2	Middle – 2440MHz
Mode 3	High -2470MHz

3. SUMMARY OF TEST RESULTS

FCC Part15, Subpart C		
Standard Section	Test Item	Result
FCC		
15.207	Conducted Emission	Pass
15.209 15.205 15.249	Radiated Emission	Pass
15.35(c)	Periodic Operation	Pass
15.249 15.209 15.205	Band edge test	Pass
15.249	20dB Bandwidth	Pass
15.203	Antenna Requirement	Pass

3.1. CONFIGURATION OF TESTED SYSTEM

Fig. 2-1 Configuration of Tested System



3.2. DESCRIPTION OF SUPPORT UNITS

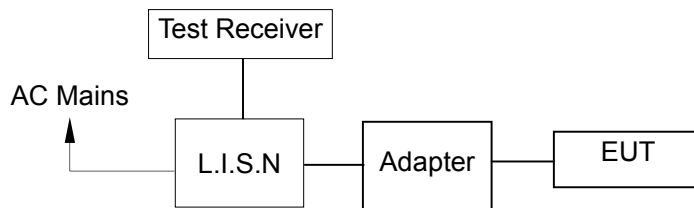
Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.	Note
1.	Adapter	DTL	DTL05020UG	N/A	1509000045	N/A

4. CONDUCTED EMISSIONS TEST

4.1. Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

4.2. Test SET-UP (Block Diagram of Configuration)



4.3. Measurement Equipment Used:

Conducted Emission Test Site # 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Receiver	Rohde & Schwarz	ESCS30	828985/018	May 28, 2016	May 28, 2017
L.I.S.N	Rohde & Schwarz	ESH2-Z5	834549/005	May 28, 2016	May 28, 2017
L.I.S.N	Rohde & Schwarz	ENV216	834549/005	May 28, 2016	May 28, 2017
50Ω Coaxial Switch	Anritsu	MP59B	M20531	May 28, 2016	May 28, 2017

4.4. Conducted Emission Limit

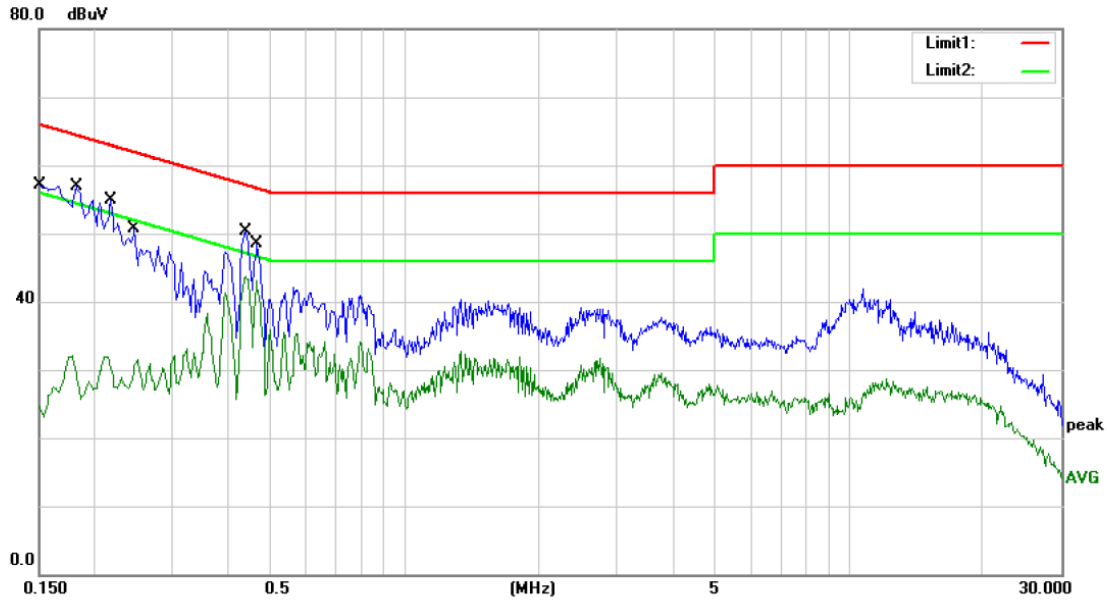
Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.5. Measurement Result:



Site Conducted #3

Phase: **L1**

Temperature: 22

Limit: (CE)FCC PART 15 C

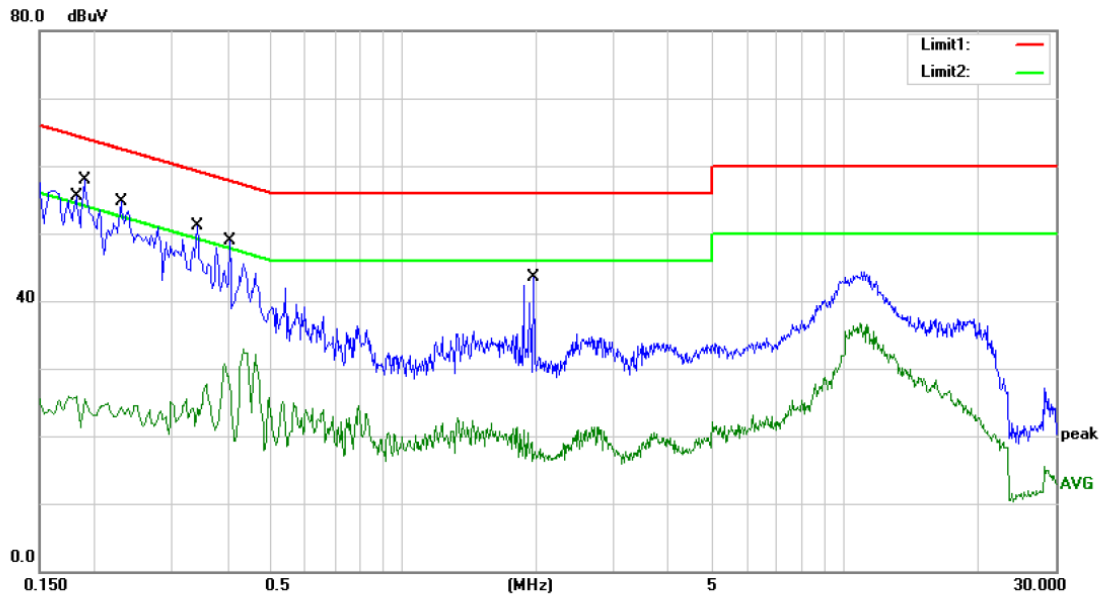
Power: AC 120V/60Hz

Humidity: 50 %

Mode: ON

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1500	47.42	9.62	57.04	66.00	-8.96	QP	
2		0.1500	15.08	9.62	24.70	56.00	-31.30	AVG	
3		0.1820	47.17	9.63	56.80	64.39	-7.59	QP	
4		0.1820	19.34	9.63	28.97	54.39	-25.42	AVG	
5		0.2180	45.17	9.64	54.81	62.89	-8.08	QP	
6		0.2180	22.24	9.64	31.88	52.89	-21.01	AVG	
7		0.2460	41.01	9.64	50.65	61.89	-11.24	QP	
8		0.2460	18.49	9.64	28.13	51.89	-23.76	AVG	
9		0.4380	40.68	9.70	50.38	57.10	-6.72	QP	
10	*	0.4380	33.94	9.70	43.64	47.10	-3.46	AVG	
11		0.4660	38.79	9.70	48.49	56.58	-8.09	QP	
12		0.4660	32.09	9.70	41.79	46.58	-4.79	AVG	



Site Conducted #3 Phase: **N** Temperature: 22
 Limit: (CE)FCC PART 15 C Power: AC 120V/60Hz Humidity: 50 %
 Mode: ON
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.1820	45.80	9.63	55.43	64.39	-8.96	QP	
2		0.1820	16.29	9.63	25.92	54.39	-28.47	AVG	
3	*	0.1904	47.17	9.63	56.80	64.02	-7.22	QP	
4		0.1904	15.97	9.63	25.60	54.02	-28.42	AVG	
5		0.2300	45.03	9.64	54.67	62.45	-7.78	QP	
6		0.2300	14.75	9.64	24.39	52.45	-28.06	AVG	
7		0.3420	41.41	9.67	51.08	59.15	-8.07	QP	
8		0.3420	14.45	9.67	24.12	49.15	-25.03	AVG	
9		0.4060	39.21	9.69	48.90	57.73	-8.83	QP	
10		0.4060	19.27	9.69	28.96	47.73	-18.77	AVG	
11		1.9780	33.67	9.85	43.52	56.00	-12.48	QP	
12		1.9780	7.84	9.85	17.69	46.00	-28.31	AVG	

5. RADIATED EMISSION TEST

5.1. Measurement Procedure

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10. The test distance is 3m. The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013

Below 30MHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The Antenna should be positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop shall be 1 m above the ground. For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT.

30MHz-1GHz:

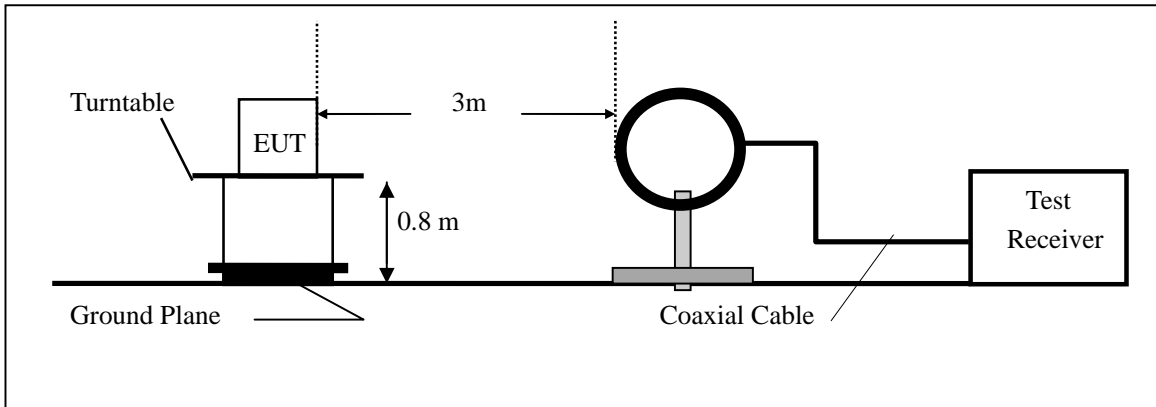
The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

Above 1GHz:

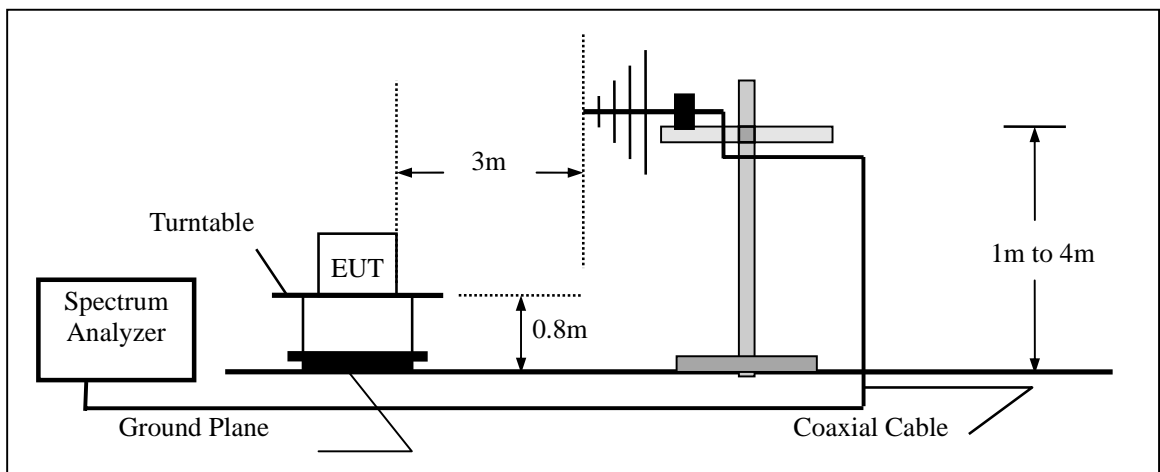
The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

5.2. Test SET-UP (Block Diagram of Configuration)

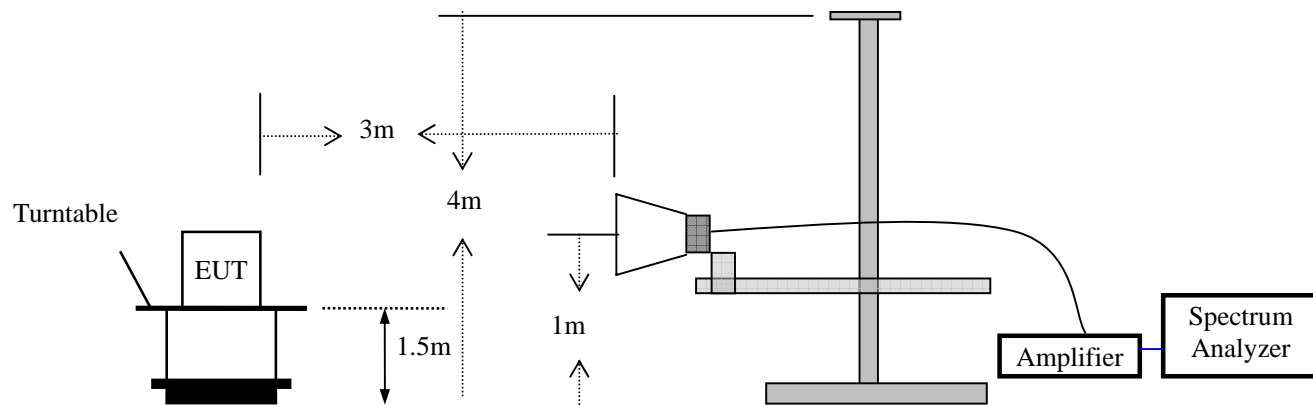
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



5.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSP7	839511/010	May 28, 2016	May 28, 2017
Spectrum Analyzer	HP	E4407B	839840481	May 28, 2016	May 28, 2017
EMI Test Receiver	Rohde & Schwarz	ESCS30	828985/018	May 28, 2016	May 28, 2017
Pre-Amplifier	HP	8447D	2944A07999	May 28, 2016	May 28, 2017
Bilog Antenna	Schwarzbeck	VULB9163	142	May 28, 2016	May 28, 2017
Loop Antenna	ARA	PLA-1030/B	1029	May 28, 2016	May 28, 2017
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	May 28, 2016	May 28, 2017
Horn Antenna	Schwarzbeck	BBHA 9120	D143	May 28, 2016	May 28, 2017

5.4 Radiated Emission Limit

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

Harmonic emissions limits comply with below 54 dBuV/m at 3m. Other emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or comply with the radiated emissions limits specified in section 1 5.209(a) limit in the table below has to be followed.

Note:

- (1) The tighter limit applies at the band edges.
- (2) Emission level (dBuV/m)=20log Emission level (uV/m).

Limits of radiated emission measurement (FCC 15.209)

FREQUENCY (MHz)	(dBuV/m) (at 3m)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

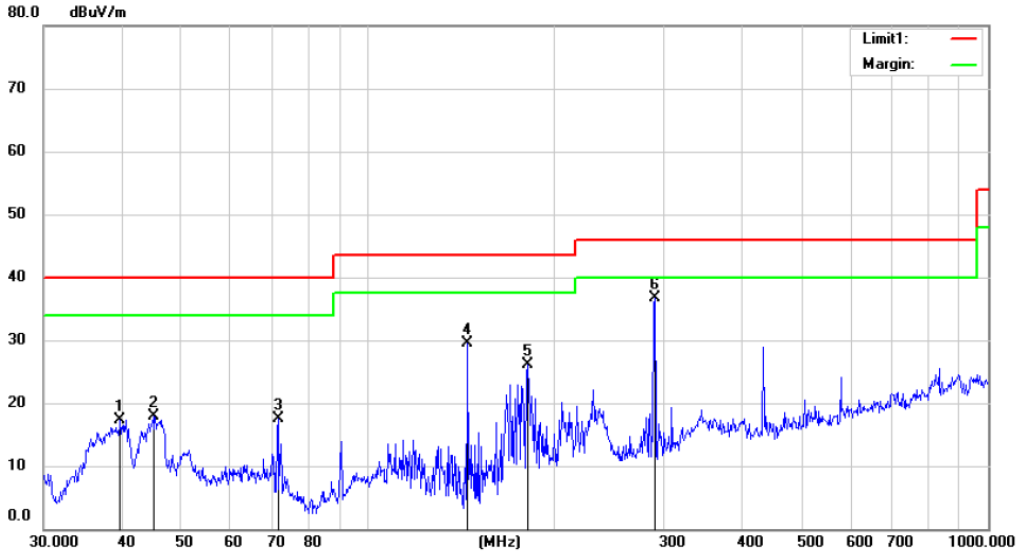
- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m) = 20log Emission level (uV/m).

Limits of radiated emission measurement (FCC 15.249)

FCC Part15 (15.249) , Subpart C	
Limit	Frequency Range (MHz)
Field strength of fundamental 50000uV/m (94 dBV/m) @ 3 m	2400-2483.5
Field strength of harmonics 500uV/m (54 dBV/m) @ 3 m	Above 2483.5

All the x/y/z orientation has been investigated, and only worst case is presented in this report.

Operation Mode: 2410MHz Test Date : May 09, 2016
 Frequency Range: 30~1000MHz Temperature : 24°C
 Test Result: PASS Humidity : 55 %
 Measured Distance: 3m Test By: SYP



Site 3m Chamber #3 Polarization: **Horizontal** Temperature: 24 C
 Limit: (RE)FCC PART 15 SUBPART C Power: AC 120V/60Hz Humidity: 53 %
 Mode:TX2410
 Note:

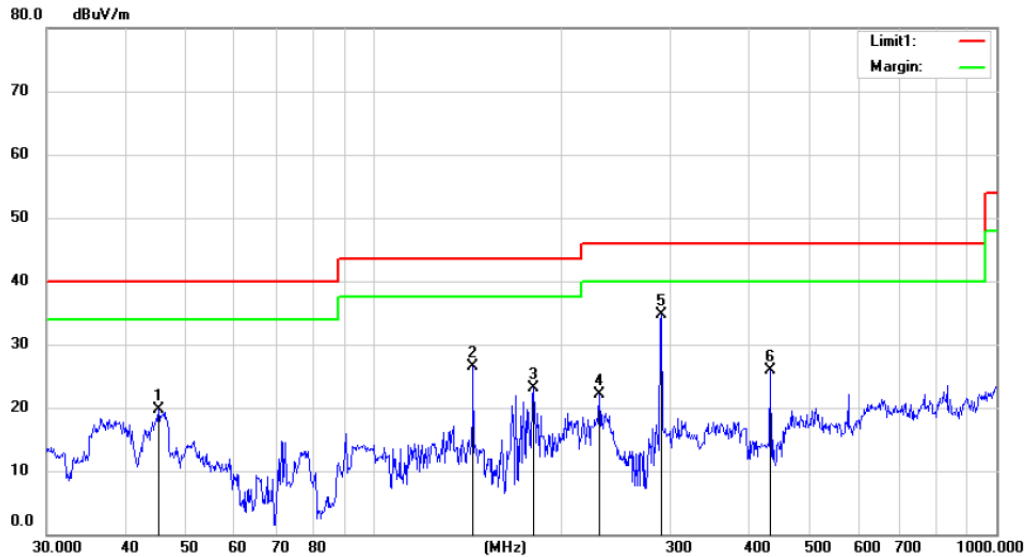
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	
1		39.8542	32.83	-15.54	17.29	40.00	-22.71	QP		
2		45.0583	32.12	-14.19	17.93	40.00	-22.07	QP		
3		71.5806	35.71	-18.23	17.48	40.00	-22.52	QP		
4		144.8418	48.42	-18.98	29.44	43.50	-14.06	QP		
5		180.6488	43.20	-17.14	26.06	43.50	-17.44	QP		
6	*	290.0172	48.65	-12.02	36.63	46.00	-9.37	QP		

*:Maximum data x:Over limit !:over margin

Operator: CSL

Operation Mode: 2440MHz
 Frequency Range: 30~1000MHz
 Test Result: PASS
 Measured Distance: 3m

Test Date : May 09, 2016
 Temperature : 24°C
 Humidity : 55 %
 Test By: SYP

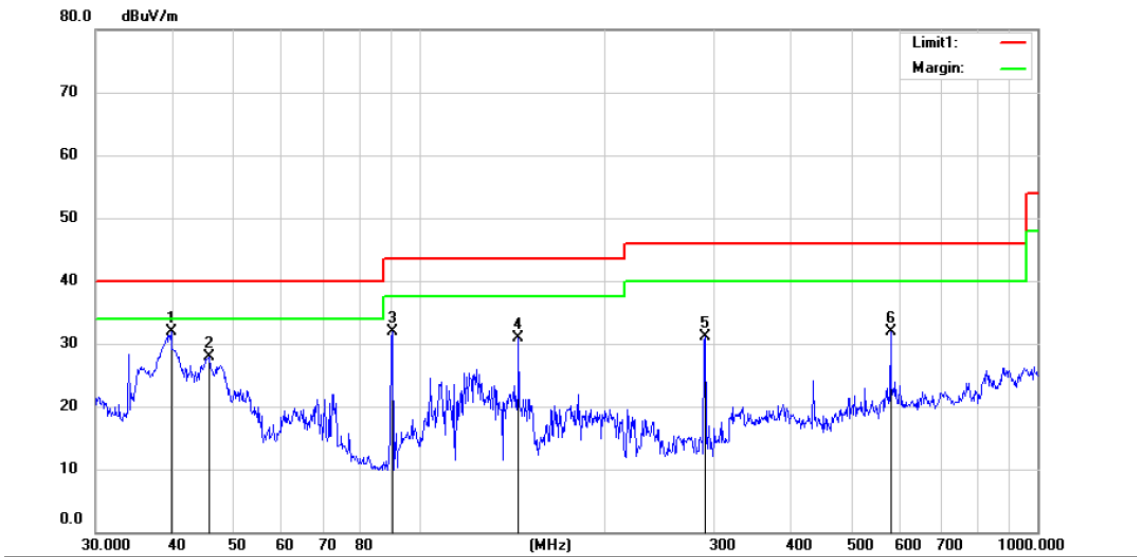


Site 3m Chamber #3 Polarization: *Horizontal* Temperature: 24 C
 Limit: (RE)FCC PART 15 SUBPART C Power: AC 120V/60Hz Humidity: 53 %
 Mode:TX2440
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		45.3753	33.86	-14.15	19.71	40.00	-20.29	QP		
2		144.8417	45.42	-18.98	26.44	43.50	-17.06	QP		
3		180.6486	40.20	-17.14	23.06	43.50	-20.44	QP		
4		230.9067	36.20	-14.19	22.01	46.00	-23.99	QP		
5	*	290.0172	46.65	-12.02	34.63	46.00	-11.37	QP		
6		434.0650	34.75	-8.87	25.88	46.00	-20.12	QP		

*:Maximum data x:Over limit !:over margin

Operator: CSL



Site 3m Chamber #3 Polarization: *Vertical* Temperature: 24 C
 Limit: (RE)FCC PART 15 SUBPART C Power: AC 120V/60Hz Humidity: 53 %
 Mode:TX 2440
 Note:

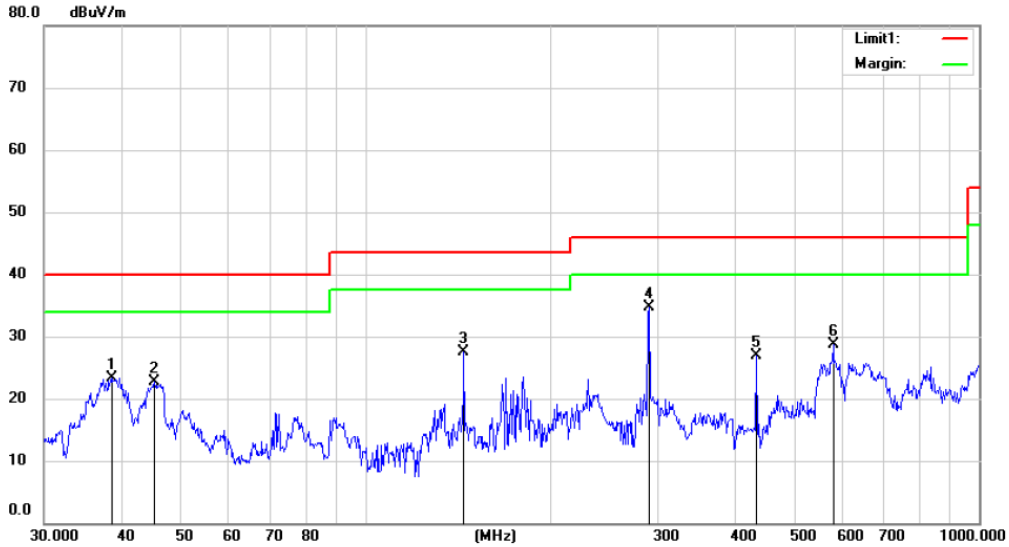
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	39.7146	47.52	-15.59	31.93	40.00	-8.07	QP		
2		45.6946	42.08	-14.12	27.96	40.00	-12.04	QP		
3		90.5374	49.52	-17.66	31.86	43.50	-11.64	QP		
4		144.8417	49.91	-18.98	30.93	43.50	-12.57	QP		
5		290.0172	43.11	-12.02	31.09	46.00	-14.91	QP		
6		578.6700	38.19	-6.19	32.00	46.00	-14.00	QP		

*:Maximum data x:Over limit !:over margin

Operator: CSL

Operation Mode: 2470MHz
 Frequency Range: 30~1000MHz
 Test Result: PASS
 Measured Distance: 3m

Test Date : May 09, 2016
 Temperature : 24°C
 Humidity : 55 %
 Test By: SYP

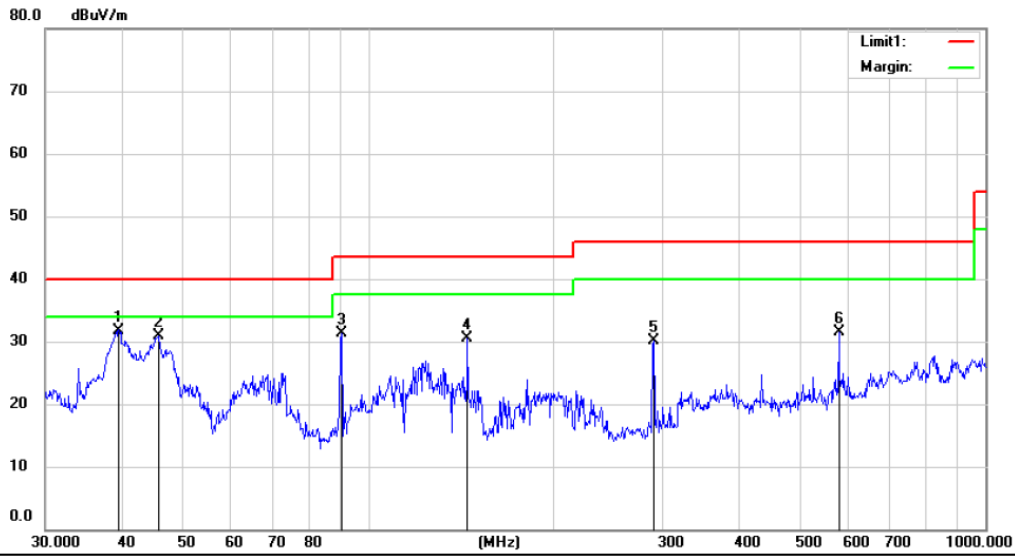


Site 3m Chamber #3 Polarization: *Horizontal* Temperature: 24 C
 Limit: (RE)FCC PART 15 SUBPART C Power: AC 120V/60Hz Humidity: 53 %
 Mode:TX 2470
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		38.6160	39.29	-15.94	23.35	40.00	-16.65	QP		
2		45.3753	36.86	-14.15	22.71	40.00	-17.29	QP		
3		144.8417	46.42	-18.98	27.44	43.50	-16.06	QP		
4	*	290.0172	46.65	-12.02	34.63	46.00	-11.37	QP		
5		434.0650	35.75	-8.87	26.88	46.00	-19.12	QP		
6		578.6700	34.82	-6.19	28.63	46.00	-17.37	QP		

*:Maximum data x:Over limit !:over margin

Operator: CSL



Site 3m Chamber #3 Polarization: *Vertical* Temperature: 24 C
 Limit: (RE)FCC PART 15 SUBPART C Power: AC 120V/60Hz Humidity: 53 %
 Mode:TX 2470
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	
1	*	39.4371	47.47	-15.67	31.80	40.00	-8.20	QP		
2		45.6946	45.08	-14.12	30.96	40.00	-9.04	QP		
3		90.5374	49.02	-17.66	31.36	43.50	-12.14	QP		
4		144.8417	49.41	-18.98	30.43	43.50	-13.07	QP		
5		290.0172	42.11	-12.02	30.09	46.00	-15.91	QP		
6		578.6700	37.69	-6.19	31.50	46.00	-14.50	QP		

*:Maximum data x:Over limit !:over margin

Operator: CSL

Operation Mode: 2402MHz Test Date : May 09, 2016
 Frequency Range: 1-25GHz Temperature : 24°C
 Test Result: PASS Humidity : 55 %
 Measured Distance: 3m Test By: SYP

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)			Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV Factor (dB)	AV	PK	AV	PK	AV
4951	V	58.33	-9.26	49.07	74.00	54.00	-15.67	-4.93
7450	V	57.95	-9.26	48.69	74.00	54.00	-16.05	-5.31
11921	V	57.92	-9.26	48.66	74.00	54.00	-16.08	-5.34
3982	H	56.68	-9.26	47.42	74.00	54.00	-17.32	-6.58
4968	H	57.42	-9.26	48.16	74.00	54.00	-16.58	-5.84
11904	H	52.36	-9.26	43.10	74.00	54.00	-21.64	-10.9

- Note:**
- (1) All Readings are Peak Value and AV.
 - (2) Emission Level= Reading Level+Probe Factor +Cable Loss
 - (3) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
 - (4) All the x/y/z orientation has been investigated, and only worst case is presented in this report.

Operation Mode: 2441MHz Test Date : May 09, 2016
 Frequency Range: 1-25GHz Temperature : 24°C
 Test Result: PASS Humidity : 55 %
 Measured Distance: 3m Test By: SYP

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)			Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV Factor (dB)	AV	PK	AV	PK	AV
3812	V	55.07	-9.26	45.81	74.00	54.00	-18.93	-8.19
5036	V	57.87	-9.26	48.61	74.00	54.00	-16.13	-5.39
10748	V	59.62	-9.26	50.36	74.00	54.00	-14.38	-3.64
4900	H	56.99	-9.26	47.73	74.00	54.00	-17.01	-6.27
9966	H	57.62	-9.26	48.36	74.00	54.00	-16.38	-5.64
11887	H	53.26	-9.26	44.00	74.00	54.00	-20.74	-10.00

- Note:**
- (1) All Readings are Peak Value and AV.
 - (2) Emission Level= Reading Level+Probe Factor +Cable Loss
 - (3) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
 - (4) All the x/y/z orientation has been investigated, and only worst case is presented in this report.

Operation Mode: 2480MHz Test Date : May 09, 2016
 Frequency Range: 1-25GHz Temperature : 24°C
 Test Result: PASS Humidity : 55 %
 Measured Distance: 3m Test By: SYP

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)			Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV Factor (dB)	AV	PK	AV	PK	AV
4985	V	57.51	-9.26	48.25	74.00	54.00	-16.49	-5.75
9966	V	55.62	-9.26	46.36	74.00	54.00	-18.38	-7.64
12975	V	55.42	-9.26	46.16	74.00	54.00	-18.58	-7.84
4951	H	58.07	-9.26	48.81	74.00	54.00	-15.93	-5.19
10068	H	53.69	-9.26	44.43	74.00	54.00	-20.31	-9.57
11853	H	55.62	-9.26	46.36	74.00	54.00	-18.38	-7.64

- Note:**
- (1) All Readings are Peak Value and AV.
 - (2) Emission Level= Reading Level+Probe Factor +Cable Loss
 - (3) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
 - (4) All the x/y/z orientation has been investigated, and only worst case is presented in this report.

Transmitter Fundamental Field Strength

Operation Mode: CH0: 2410MHz Test Date : May 09, 2016
 FCC Part: 15.249(a) Temperature : 24°C
 Test Result: PASS Humidity : 55 %
 Measured Distance: 3m Test By: SYP
 Test Method Used:

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)			Limit 3m(dBuV/m)		Over(dB)	
		PK (dBuV/m)	AV Factor (dB)	AV (dBuV/m)	PK (dBuV/m)	AV (dBuV/m)	PK (dB)	AV (dB)
2410	V	85.69	-9.26	76.43	114	94	-28.31	-17.57
2410	H	87.63	-9.26	78.37	114	94	-26.37	-15.63

Operation Mode: CH30: 2440MHz Test Date : May 09, 2016
 FCC Part: 15.249(a) Temperature : 24°C
 Test Result: PASS Humidity : 55 %
 Measured Distance: 3m Test By: SYP
 Test Method Used:

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)			Limit 3m(dBuV/m)		Over(dB)	
		PK (dBuV/m)	AV Factor (dB)	AV (dBuV/m)	PK (dBuV/m)	AV (dBuV/m)	PK (dB)	AV (dB)
2440	V	86.92	-9.26	77.66	114	94	-27.08	-16.34
2440	H	88.92	-9.26	79.66	114	94	-25.08	-14.34

Operation Mode: CH60: 2470MHz Test Date : May 09, 2016
 FCC Part: 15.249(a) Temperature : 24°C
 Test Result: PASS Humidity : 55 %
 Measured Distance: 3m Test By: SYP
 Test Method Used:

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)			Limit 3m(dBuV/m)		Over(dB)	
		PK (dBuV/m)	AV Factor (dB)	AV (dBuV/m)	PK (dBuV/m)	AV (dBuV/m)	PK (dB)	AV (dB)
2470	V	85.69	-9.26	76.43	114	94	-28.31	-17.57
2470	H	87.95	-9.26	78.69	114	94	-26.05	-15.31

- Note:**
- (1) All Readings are Peak Value and AV.
 - (2) Emission Level= Reading Level+Probe Factor +Cable Loss
 - (3) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
 - (4) All the x/y/z orientation has been investigated, and only worst case is presented in this report.

6. Periodic Operation

The duty cycle was determined by the following equation:

To calculate the actual field intensity, the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

$$\text{Duty Cycle(\%)} = \frac{\text{Total On interval in a complete pulse train}}{\text{Length of a complete pulse train}} * \%$$

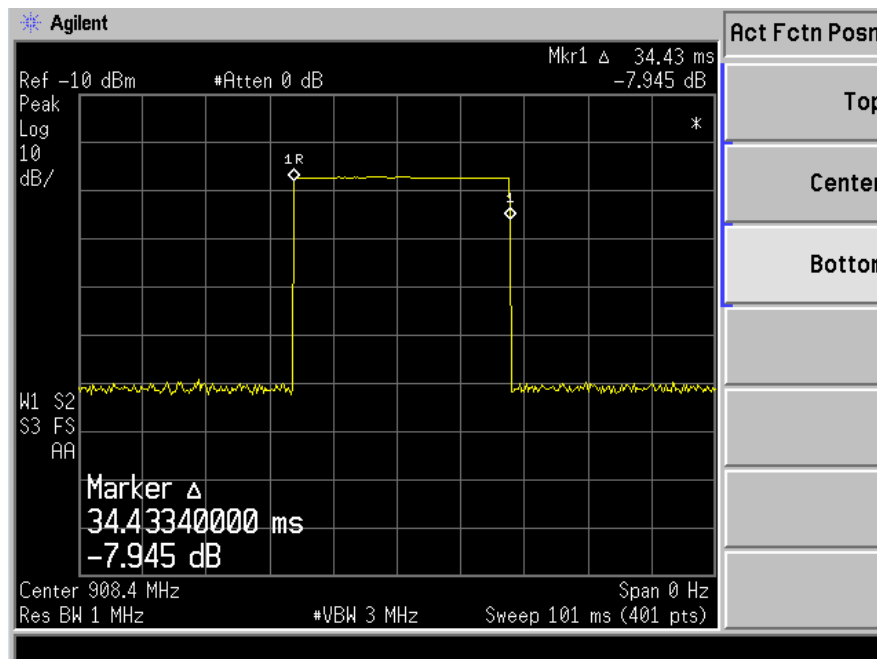
$$\text{Duty Cycle Correction Factor(dB)} = 20 * \text{Log}_{10}(\text{Duty Cycle(\%)})$$

Total transmission time(ms)	100.00
Length of a complete transmission period(ms)	34.43
Duty Cycle(%)	34.43
Duty Cycle Correction Factor(dB)	-9.26

Refer to the duty cycle plot (as below), This device meets the FCC requirement.

Length of a complete pulse train:

Remark: FCC part 15.35(c) required that a complete pulse train is more than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

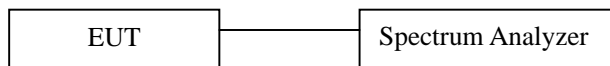


7. BANDWIDTH TEST

7.1. Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

7.2. Test SET-UP (Block Diagram of Configuration)



7.3. Measurement Equipment Used:

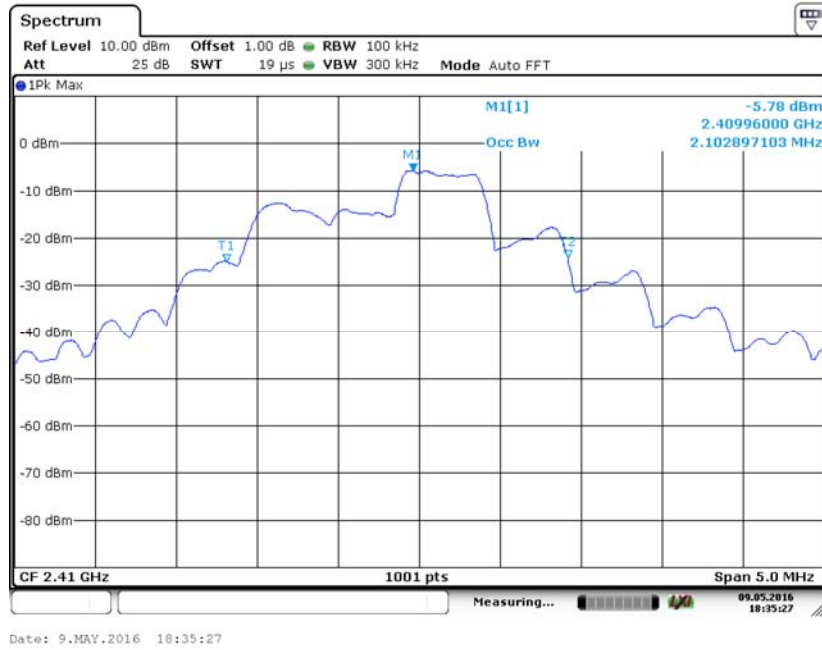
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	E4407B	88156318	05/28/2016	05/28/2017

7.4. Measurement Results:

20dB Bandwidth test data Chart:
Refer to attached data chart.

Spectrum Detector:	PK	Test Date:	May 09, 2016
Test By:	SYP	Temperature:	24 °C
Test Result:	PASS	Humidity:	55 %
Modulation:	GFSK		

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
CH0	2410	2102.9
CH30	2440	1408.6
CH60	2470	1368.6





Date: 9.MAY.2016 19:02:07

8. BAND EDGE TEST

8.1. Measurement Procedure

1. The EUT was Operating in hopping mode or could be controlled its channel. Printed out test result from the spectrum by hard copy function.
2. The EUT was placed on a turn table which is 0.8m above ground plane.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until all frequency measured were complete.

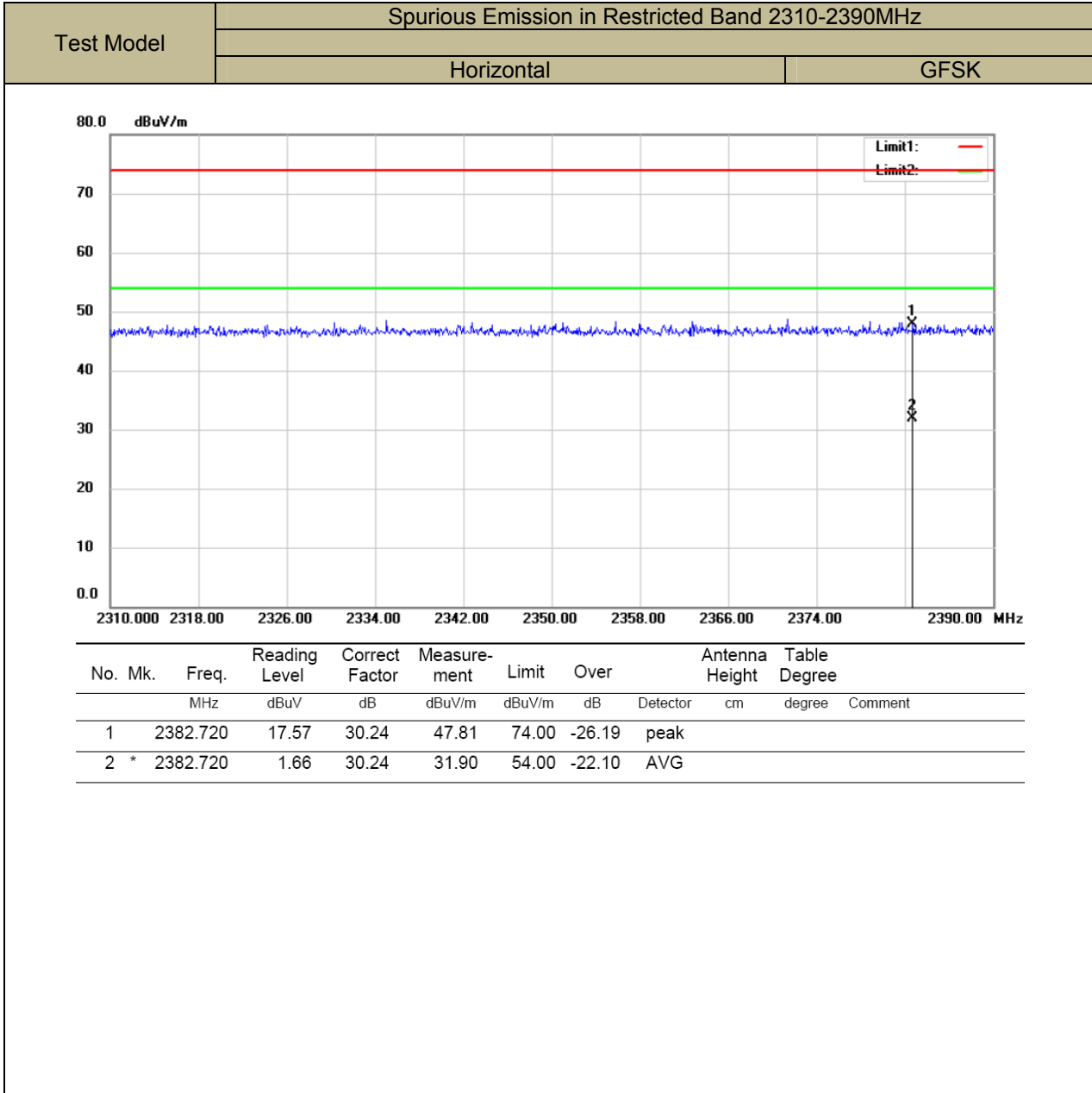
8.2. Test SET-UP (Block Diagram of Configuration)

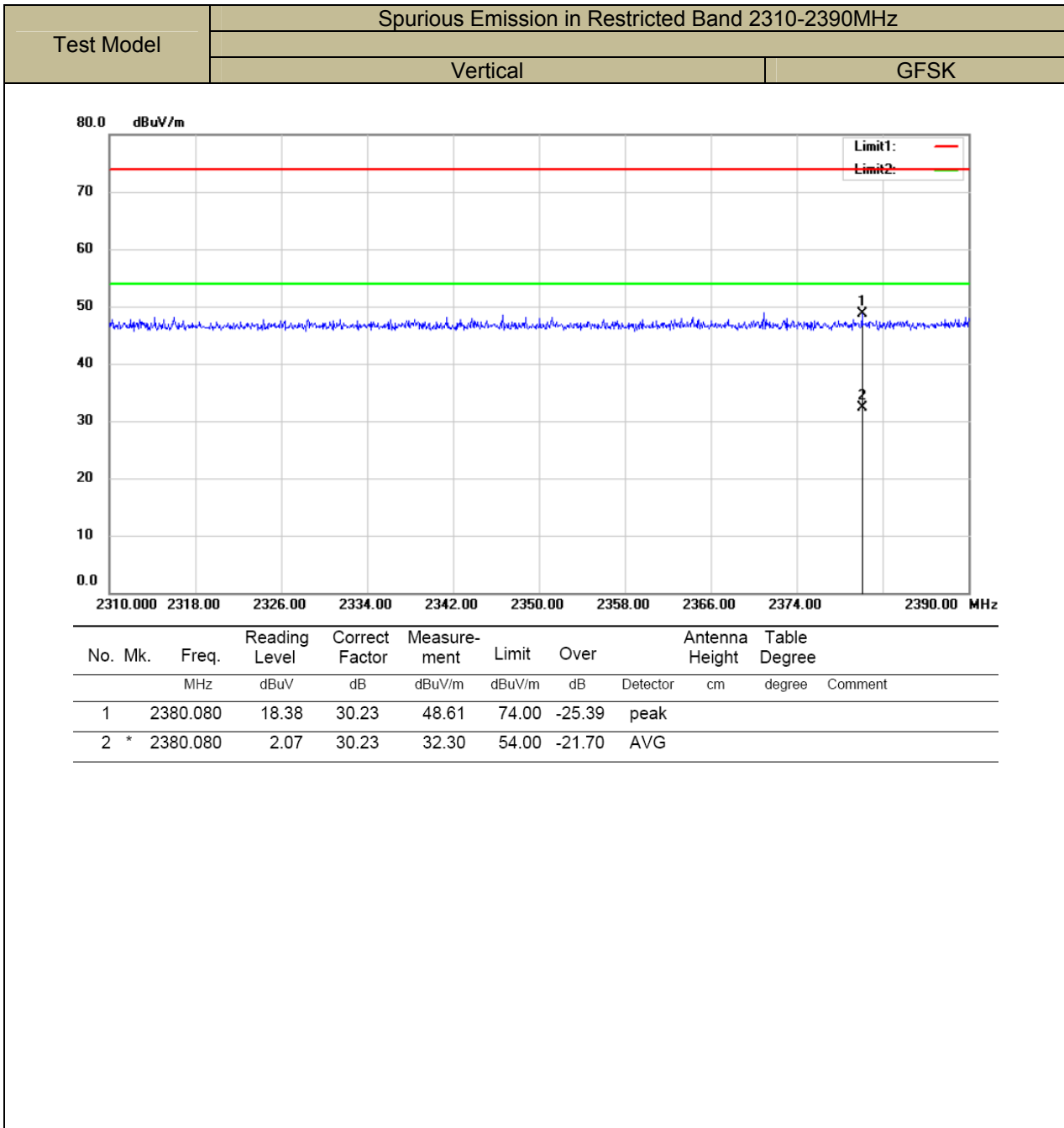
As 5.2 Test set up (B) and (C)

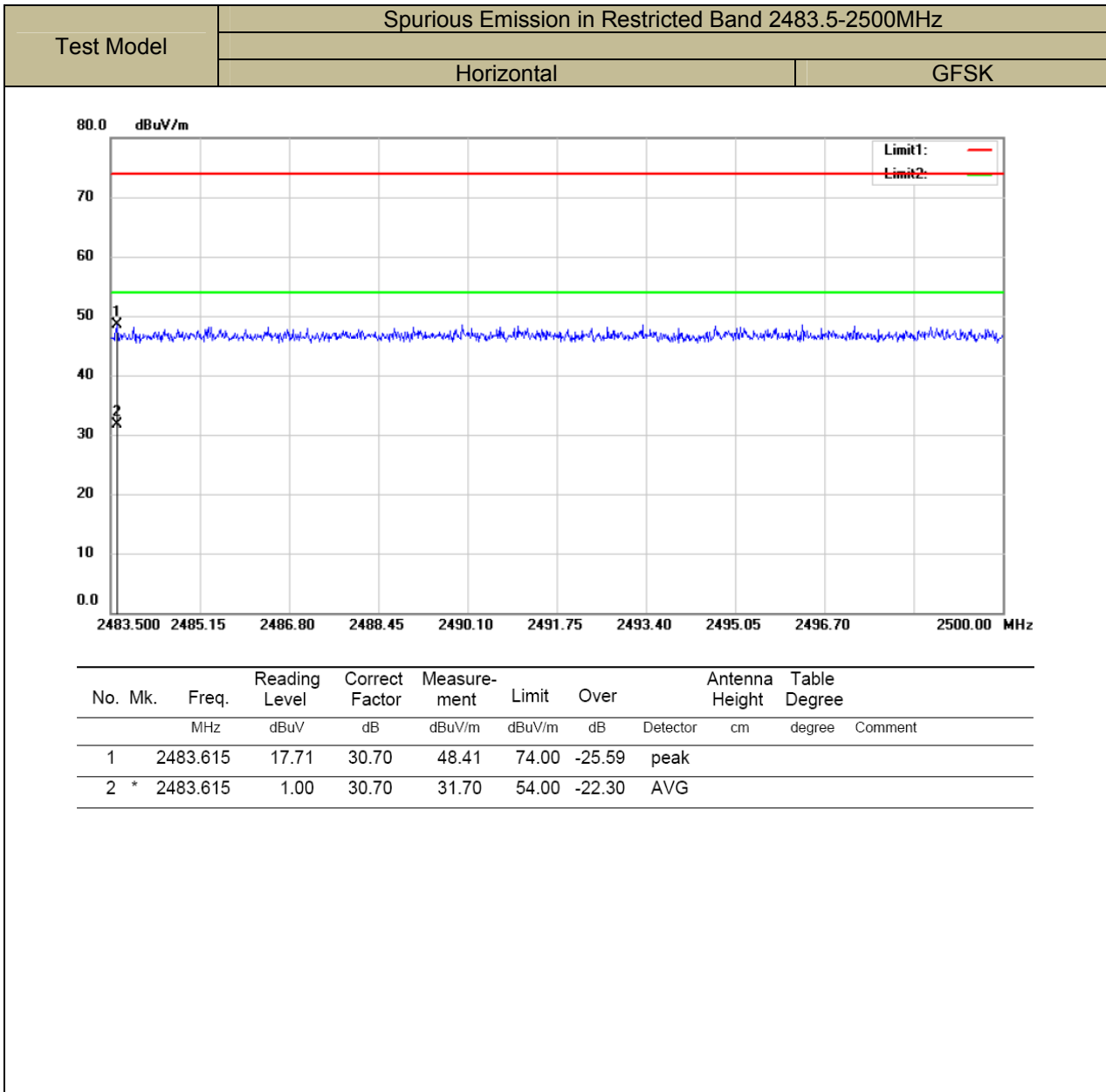
8.3. Measurement Equipment Used:

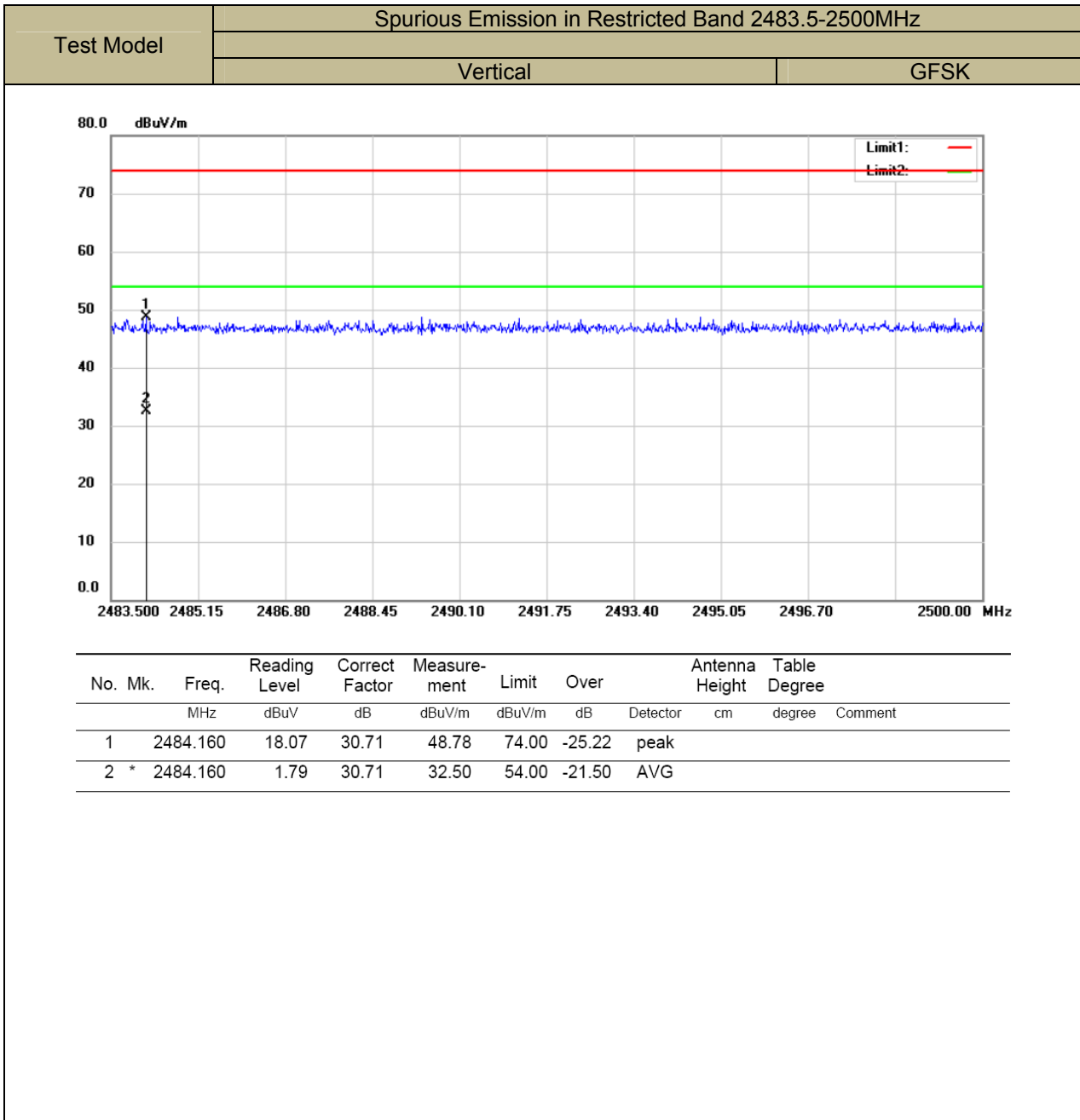
Same as 5.3 Radiated Emission Measurement.

8.4. Measurement Results:









9. Antenna Application

9.1. Antenna Requirement

Standard	Requirement
FCC CRF Part 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 use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 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. And according to FCC 47 CFR Section 15.247 (b), if 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 6dBi.

9.2. Result

There are two antennas for the product:

- a. 2.4G antenna: PCB antenna/-0.35dBi
- b. WIFI antenna: Copper tube antenna /2dBi

The two antennas can't be replaced by the user, which in accordance to section 15.203, please refer to the internal photos.