FCC TEST REPORT

FCC ID : LE2RFB01
Applicant : JSW Pacific Corporation
Address : 3F-3, No 700, Chung-Zweng Road Chung Ho City, Taipei, Hsien, Taiwan

Equipment Under Test (EUT) :
Product Name : 2.4GHz Wireless Digital Transceiver Module
Model No. : RFB01

Standards : FCC CFR47 Part 15 Section 15.247:2009

Date of Test : October 13, 2011 ~ October 26, 2011
Date of Issue : November 3, 2011

Test Engineer : Hunk yan / Engineer 

Reviewed By : Philo zhong / Manager 

Test Result	**: PASS**

Prepared By:
Waltek Services (Shenzhen) Co., Ltd.
1/F, Fukangtai Building, West Baima Rd., Songgang Street, Baoan District,
Shenzhen 518105, China

Tel :+86-755-27553488
Fax:+86-755-27553868

✧ The sample detailed above has been tested to the requirements of Council Directives ANSI C63.4:2003. The test results have been reviewed against the Directives above and found to meet their essential requirements.

2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions (9kHz to 25GHz)	15.205(a) 15.209 15.247(d)	PASS
Conduct Emission	15.207	PASS
20dB Bandwidth	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS

3 Contents

4 General Information

4.1 Client Information

Applicant	: JSW Pacific Corporation
Address of Applicant	: 3F-3, No 700, Chung-Zweng Road Chung Ho City, Taipei, Hsien, Taiwan
Manufacturer	: JSW Pacific Corporation
Address of Manufacturer	: 3F-3, No 700, Chung-Zweng Road Chung Ho City, Taipei, Hsien, Taiwan

4.2 General Description of E.U.T.

Product Name	: 2.4GHz Wireless Digital Transceiver Module
Model No.	: RFB01

4.3 Details of E.U.T.

Technical Data	: DC 3.3V / ± 0.1
Operation Frequency	: 2414.25MHz ~ 2461.50MHz
Antenna Gain	: 3.0 dBi

4.4 Description of Support Units

The EUT has been tested as an independent unit.

4.5 Standards Applicable for Testing

The customer requested FCC tests for a 2.4GHz Wireless Digital Transceiver Module. The standards used were FCC CFR47 Part 15 Section 15.247, Section 15.203, Section 15.207 and Section 15.209.

4.6 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: IC7760A**
  Waltek Services(Shenzhen) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration 7760A, August 3, 2010.

- **FCC – Registration No.: 880581**
  Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 880581, May 26, 2011.

4.7 Test Location

All the tests were performed at:
Waltek Services(Shenzhen) Co., Ltd. at 1/F, Fukangtai Building, West Baima Rd.,Songgang Street, Baoan District, Shenzhen, China

5 Equipment Used during Test

Equipment Name	Manufacturer Model	Equipment No	Internal No	Specification	Cal. Date	Due Date	Uncertainty
EMC Analyzer	Agilent/ E7405A	MY45114943	W2008001	9k-26.5GHz	Aug. 2, 2011	Aug. 1, 2012	±1dB
Trilog Broadband Antenne	SCHWARZBECK MESS-ELEKTROM / VULB9163	336	W2008002	30-3000 MHz	Aug. 2, 2011	Aug. 1, 2012	±1dB
Broad-band Horn Antenna	SCHWARZBECK MESS-ELEKTROM / BBHA 9120D(1201)	667	W2008003	1-18GHz	Aug. 2, 2011	Aug. 1, 2012	f < 10 GHz : ±1dB 10GHz < f < 18 GHz : ±1.5dB
Broadband Preamplifier	SCHWARZBECK MESS-ELEKTROM / BBV 9718	9718-148	W2008004	0.5-18GHz	Aug. 2, 2011	Aug. 1, 2012	±1.2dB
10m Coaxial Cable with N-male Connectors	SCHWARZBECK MESS-ELEKTROM / AK 9515 H	-	-	-	Aug. 2, 2011	Aug. 1, 2012	-
10m 50 Ohm Coaxial Cable	SCHWARZBECK MESS-ELEKTROM / AK 9513	-	-	-	Aug. 2, 2011	Aug. 1, 2012	-
Positioning Controller	C&C LAB/ CC-C-IF	-	-	-	Aug. 2, 2011	Aug. 1, 2012	-
Color Monitor	SUNSPO/ SP-14C	-	-	-	Aug. 2, 2011	Aug. 1, 2012	-
Test Receiver	ROHDE&SCHWARZ/ ESPI	101155	W2005001	9k-3GHz	Aug. 2, 2011	Aug. 1, 2012	±1dB
Two-Line V-Network	ROHDE&SCHWARZ/ ENV216	100115	W2005002	50Ω/50μH	Aug. 2, 2011	Aug. 1, 2012	±10%
RF Generator	TESEQ GmbH/ NSG4070	25781	W2008008	Fraq-range : 9K-1GHz RF voltage : -60 dBm-+10dBm	Aug. 2, 2011	Aug. 1, 2012	Power_freq distinguish0.1Hz RFeletricity distinguish 0.1B
Active Loop Antenna	Beijing Dazhi / ZN30900A	-	-	-	Aug. 2, 2011	Aug. 1, 2012	±1dB

6 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.4:2003
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class:	Class B
Limit:	66-56 dBμV between 0.15MHz & 0.5MHz 56 dBμV between 0.5MHz & 5MHz 60 dBμV between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth) Quasi-Peak & Average if maximised peak within 6dB of Average Limit

E.U.T. Operation

Operating Environment:

Temperature: 25.5 °C
Humidity: 51 % RH
Atmospheric Pressure: 1012 mbar

EUT Operation:

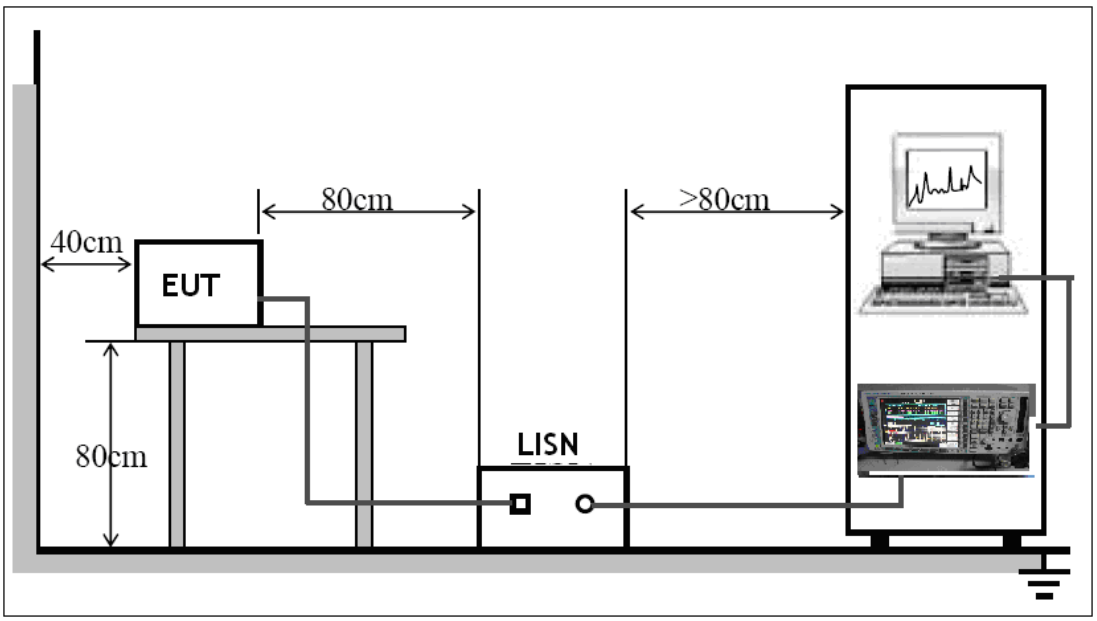
The EUT was pre-test in continuously transmit and receive mode, for each mode, the low, middle and high frequency had been tested, the worse mode is the continuously transmit in middle frenquency, so the data show is that mode's only.

The EUT was tested according to ANSI C63.4:2003. The frequency spectrum from 150kHz to 30MHz was investigated.

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.4:2003, The specification used in this report was the FCC Part15 B 15.207 limits.

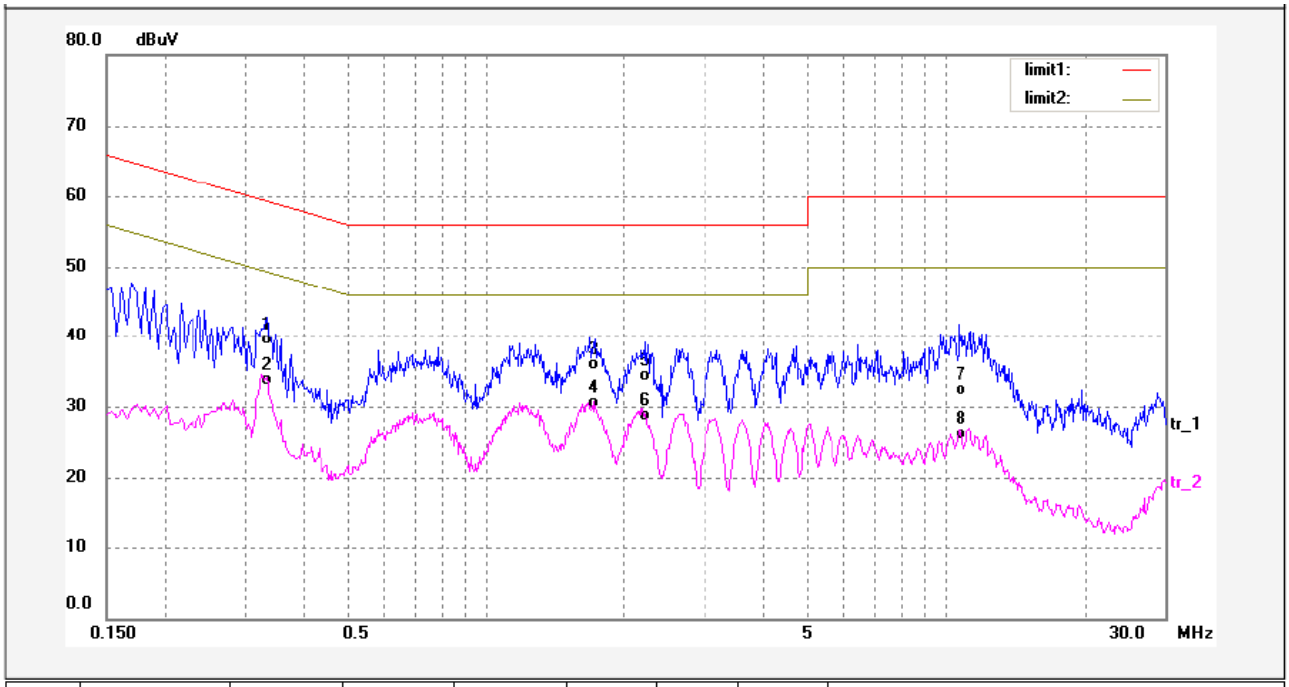


The EUT was placed on the test table in shielding room

Conducted Emission Test Result

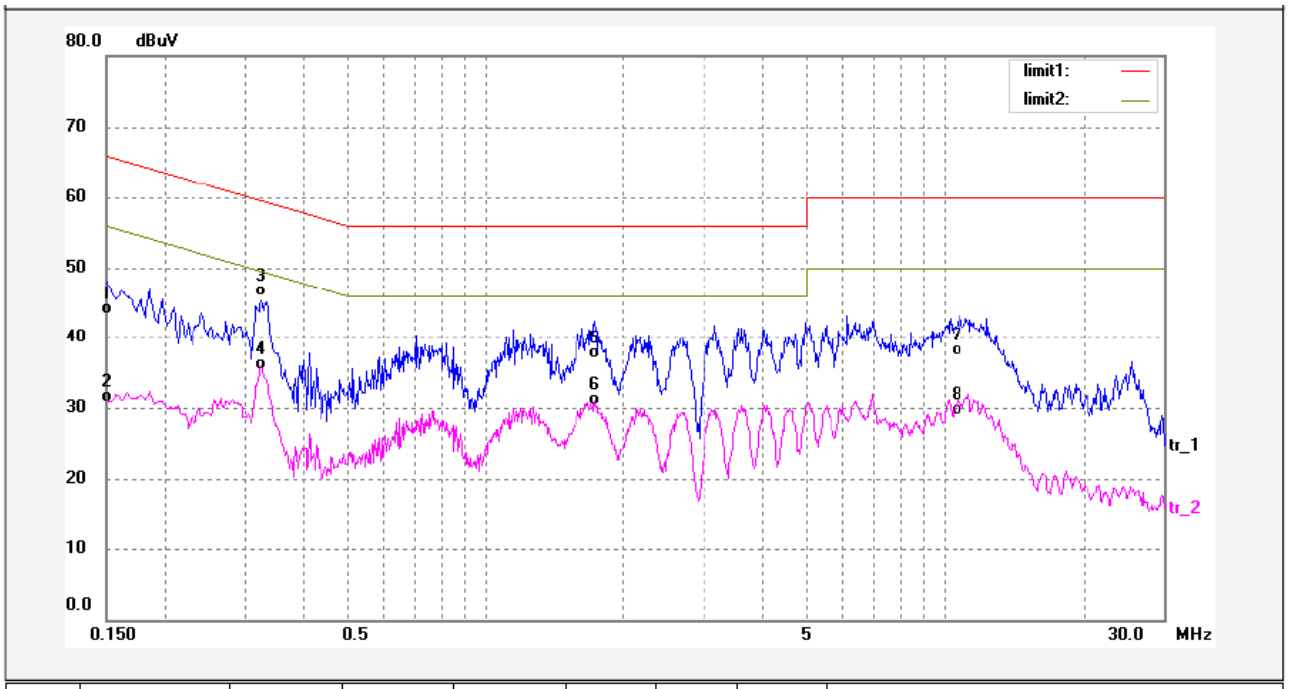
An initial pre-scan was performed on the live and neutral lines.

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.3339	28.08	10.70	38.78	59.35	-20.57	QP	
2	0.3339	22.13	10.70	32.83	49.35	-16.52	AVG	
3	1.6940	22.83	12.21	35.04	56.00	-20.96	QP	
4	1.6940	17.59	12.21	29.80	46.00	-16.20	AVG	
5	2.2260	21.27	12.25	33.52	56.00	-22.48	QP	
6	2.2260	15.75	12.25	28.00	46.00	-18.00	AVG	
7	10.7260	19.24	12.18	31.42	60.00	-28.58	QP	
8	10.7260	13.10	12.18	25.28	50.00	-24.72	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	32.55	10.67	43.22	65.99	-22.77	QP	
2	0.1500	20.09	10.67	30.76	55.99	-25.23	AVG	
3	0.3260	35.30	10.68	45.98	59.55	-13.57	QP	
4	0.3260	24.71	10.68	35.39	49.55	-14.16	AVG	
5	1.7380	24.76	12.22	36.98	56.00	-19.02	QP	
6	1.7380	18.13	12.22	30.35	46.00	-15.65	AVG	
7	10.7340	25.17	12.18	37.35	60.00	-22.65	QP	
8	10.7340	16.64	12.18	28.82	50.00	-21.18	AVG	

Photograph – Conducted Emission Test Setup

7 Radiated Spurious Emissions

Test Requirement:	FCC CFR47 Part 15 Section 15.209 & 15.247
Test Method:	Base on ANSI C63.4:2003
Test Result:	PASS
Frequency Range:	9kHz to 25GHz
Measurement Distance:	3m
15.209 Limit:	40.0 dBuV/m between 30MHz & 88MHz 43.5 dBuV/m between 88MHz & 216MHz 46.0 dBuV/m between 216MHz & 960MHz 54.0 dBuV/m above 960MHz
15.247 (d) Limit:	(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that Contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
Test mode:	The EUT was tested in continuously Transmit mode.

EUT Operation :

Operating Environment:

Temperature: 25.5 °C
Humidity: 51 % RH
Atmospheric Pressure: 1012 mbar

Measurement Uncertainty

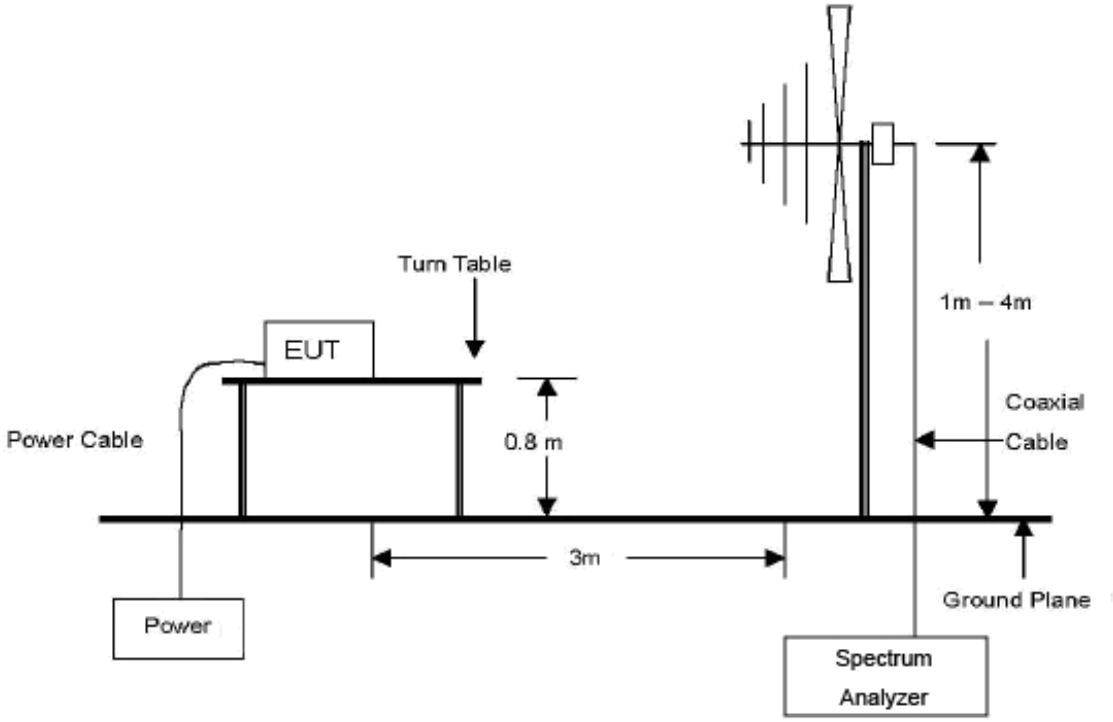
All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at Waltek EMC Lab is $\pm$5.03dB.

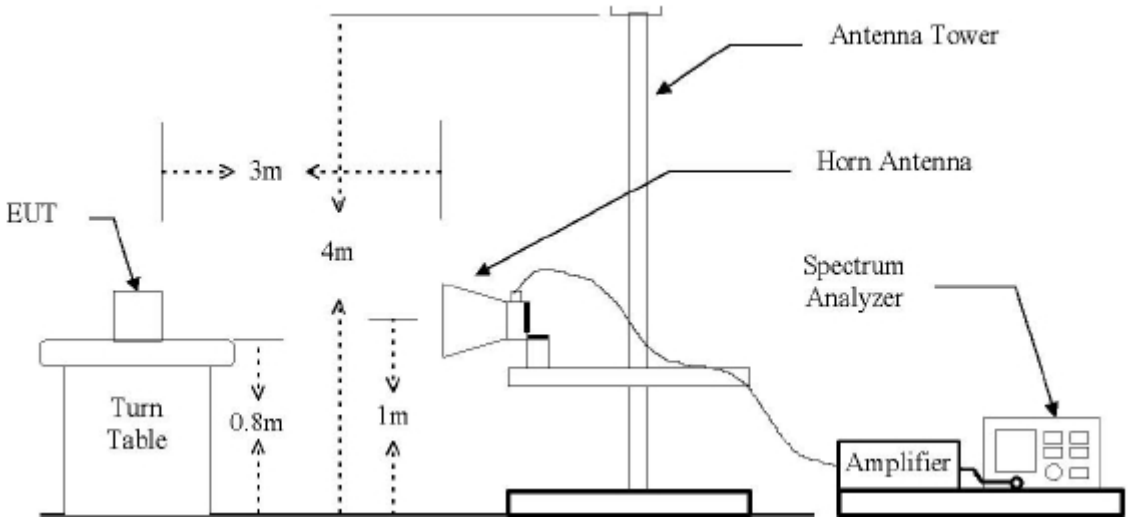
Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.4:2003.

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 25 GHz Emissions.



Spectrum Analyzer Setup

According to FCC Part15 Rules, the system was tested 9kHz to 25000MHz.

9kHz ~ 30MHz

Start Frequency	9kHz
Stop Frequency	30MHz
Sweep Speed	Auto
IF Bandwidth	10KHz
Video Bandwidth	10KHz
Resolution Bandwidth	10KHz

30MHz ~ 1GHz

Start Frequency	30 MHz
Stop Frequency	1000MHz
Sweep Speed	Auto
IF Bandwidth	120 KHz
Video Bandwidth	100KHz
Quasi-Peak Adapter Bandwidth	120 KHz
Quasi-Peak Adapter Mode	Normal
Resolution Bandwidth	100KHz

Above 1GHz

Start Frequency	1000 MHz
Stop Frequency	25000MHz
Sweep Speed	Auto
IF Bandwidth	120 KHz
Video Bandwidth	1MHz
Quasi-Peak Adapter Bandwidth	120 KHz
Quasi-Peak Adapter Mode	Normal
Resolution Bandwidth	1MHz

Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are performed in X(normal uses) axis positioning. And all the modes was tested in the report.Only the worst case is shown in the report.

Corrected Amplitude & Margin Calculation

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

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

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

Margin = Corr. Ampl. – Limit

Summary of Test Results

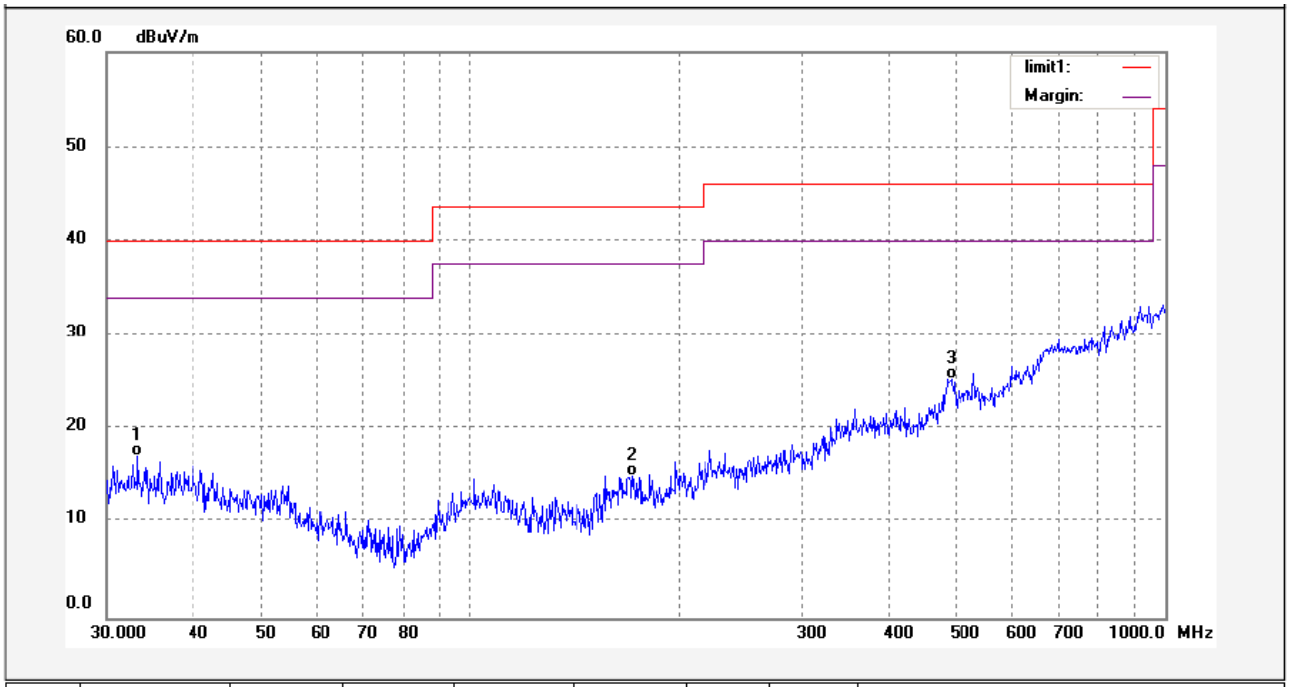
According to the data in this section, the EUT complied with the FCC CFR47 Part 15 Section 15.209 & 15.247 standards.

Test mode: continuously recevie mode

Remark: the EUT was pre-tested at the high, middle and low channel, and the worst case was the low Channel, so the data show was the low channel's only. Because the emissions below 30MHz are more than 20dB below the limit, the data is not show in the report.

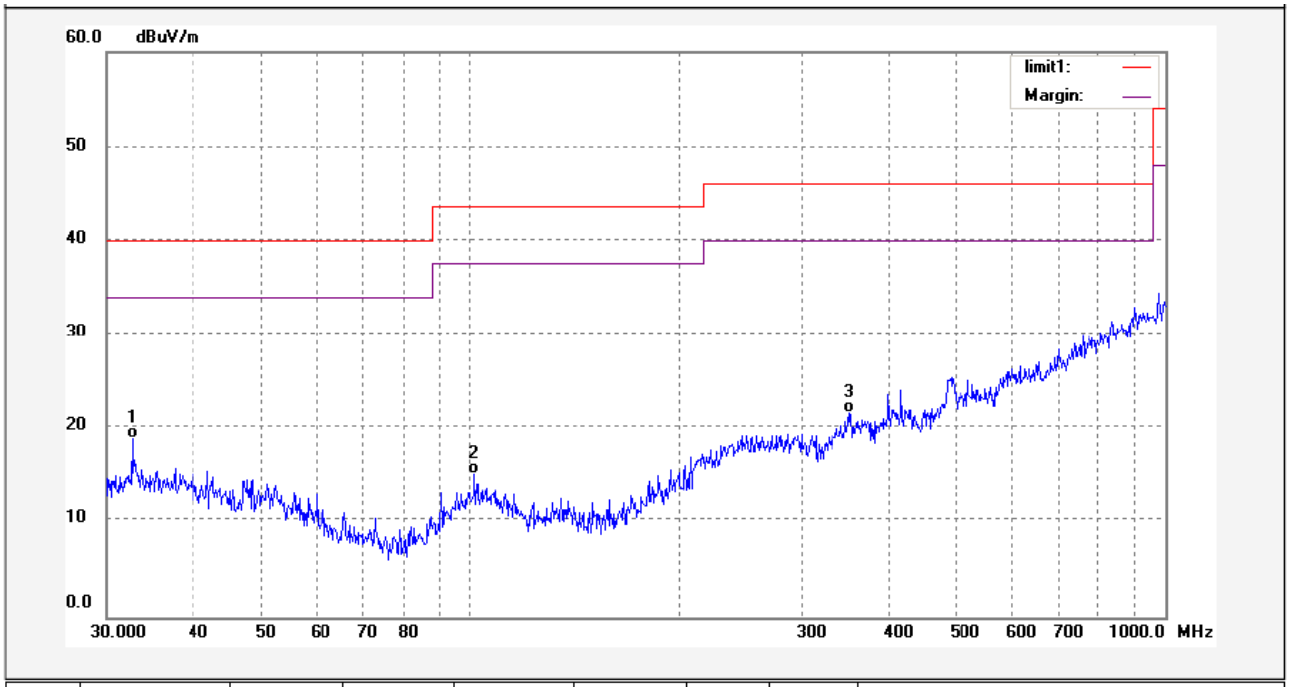
Test Frequency : 30MHz ~ 1000MHz

Antenna polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	33.2180	0.55	16.56	17.11	40.00	-22.89	QP	
2	171.3890	2.97	12.15	15.12	43.50	-28.38	QP	
3	491.7700	0.04	25.29	25.33	46.00	-20.67	QP	

Antenna polarization: Horizontal

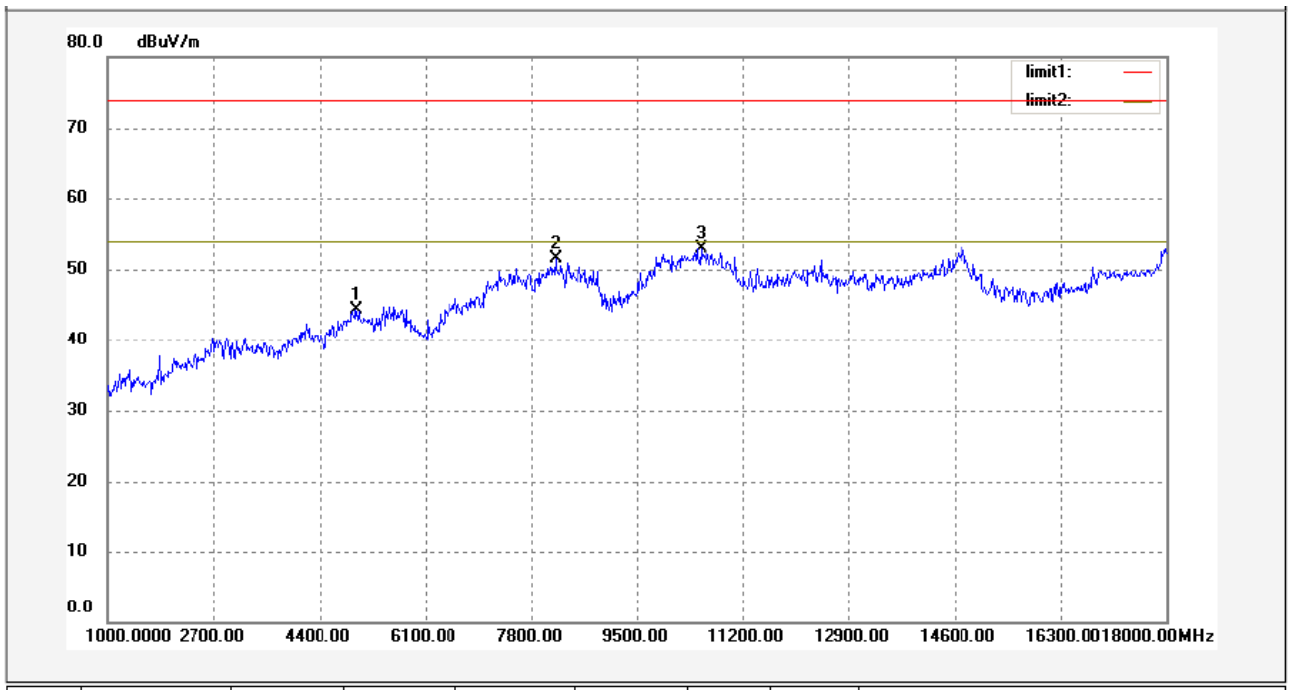


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	32.6395	2.35	16.58	18.93	40.00	-21.07	QP	
2	101.5358	1.12	14.06	15.18	43.50	-28.32	QP	
3	350.9722	1.48	20.19	21.67	46.00	-24.33	QP	

Test Frequency: Above 1GHz radiation test data:

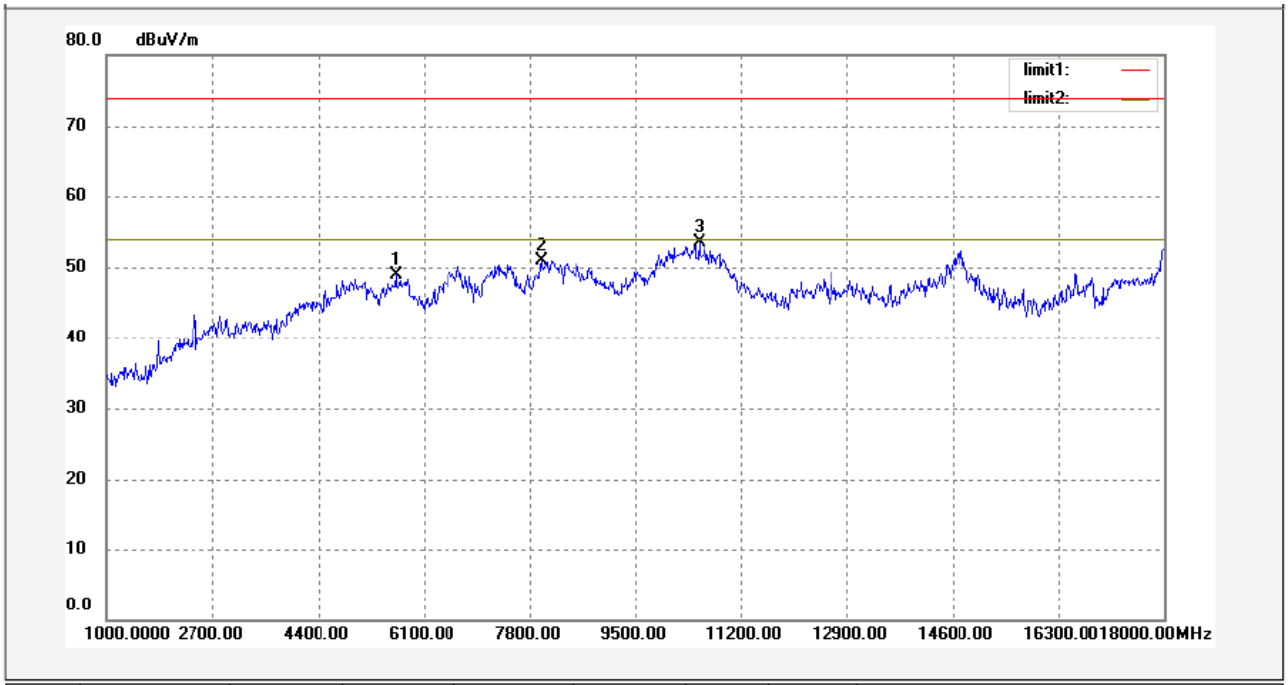
Remark: above 18GHz, the test signal below the noise level, so the data was not perfromed.

Antenna polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	4985.972	39.15	5.12	44.27	74.00	-29.73	peak	
2	8188.377	36.98	14.58	51.56	74.00	-22.44	peak	
3	10522.044	34.45	18.52	52.97	74.00	-21.03	peak	

Antenna polarization: Horizontal



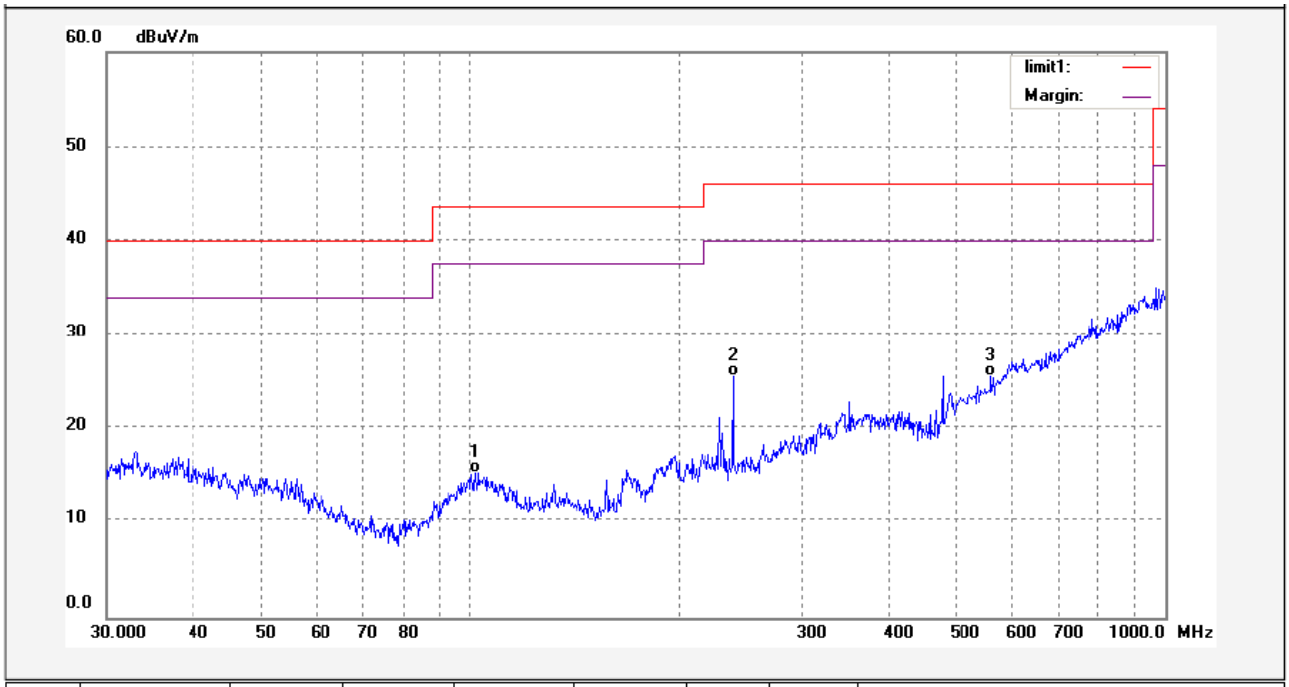
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	5650.301	39.56	9.37	48.93	74.00	-25.07	peak	
2	7983.968	32.74	18.16	50.90	74.00	-23.10	peak	
3	10522.044	32.60	20.84	53.44	74.00	-20.56	peak	

Test mode: Continuously Transmit mode

Test Frequency : 30MHz ~ 1000MHz

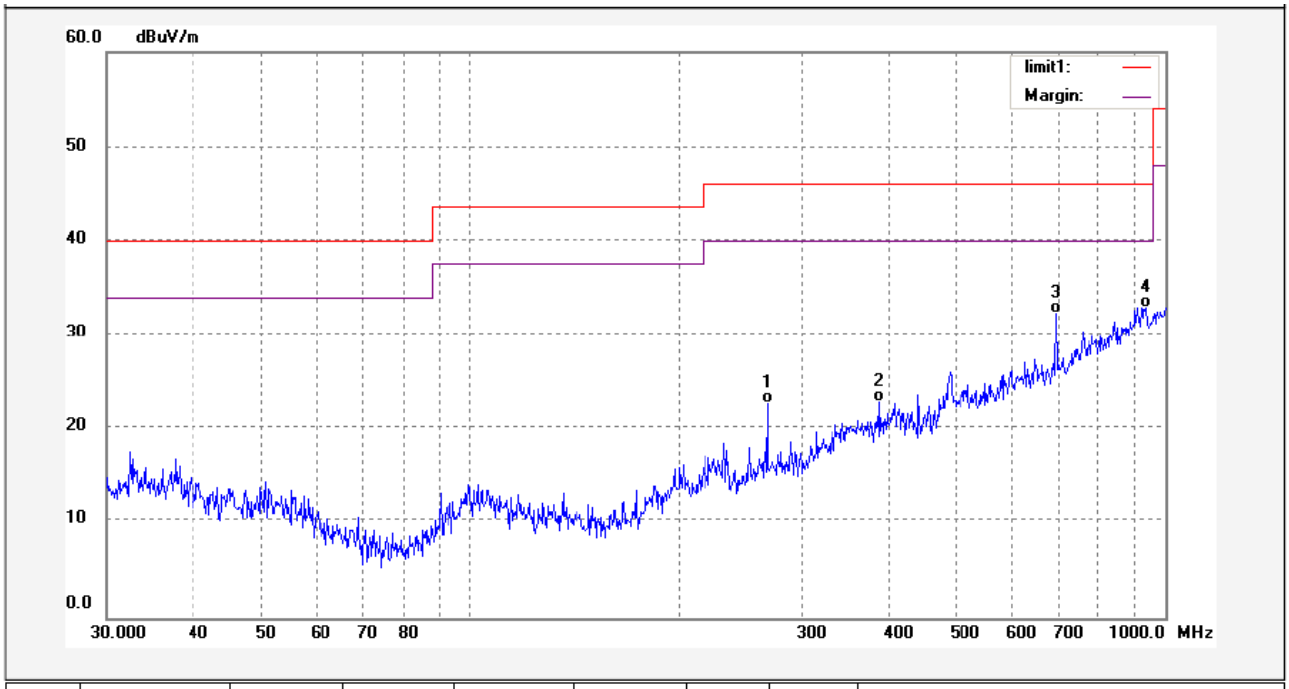
Remark: the EUT was pre-tested at the high, middle and low channel, and the worse case was the low Channel, so the data show was the low channel's only. Because the emissions below 30MHz are more than 20dB below the limit, the data is not show in the report.

Antenna polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	101.8932	1.31	14.09	15.40	43.50	-28.10	QP	
2	239.3020	10.09	15.53	25.62	46.00	-20.38	QP	
3	562.0143	2.09	23.54	25.63	46.00	-20.37	QP	

Antenna polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	267.7787	6.14	16.60	22.74	46.00	-23.26	QP	
2	388.6196	2.38	20.48	22.86	46.00	-23.14	QP	
3	696.3525	5.99	26.29	32.28	46.00	-13.72	QP	
4	938.7139	0.97	31.90	32.87	46.00	-13.13	QP	

Test Frequency: 1GHz ~ 25GHz

And the below is the Fundamental and Harmonic

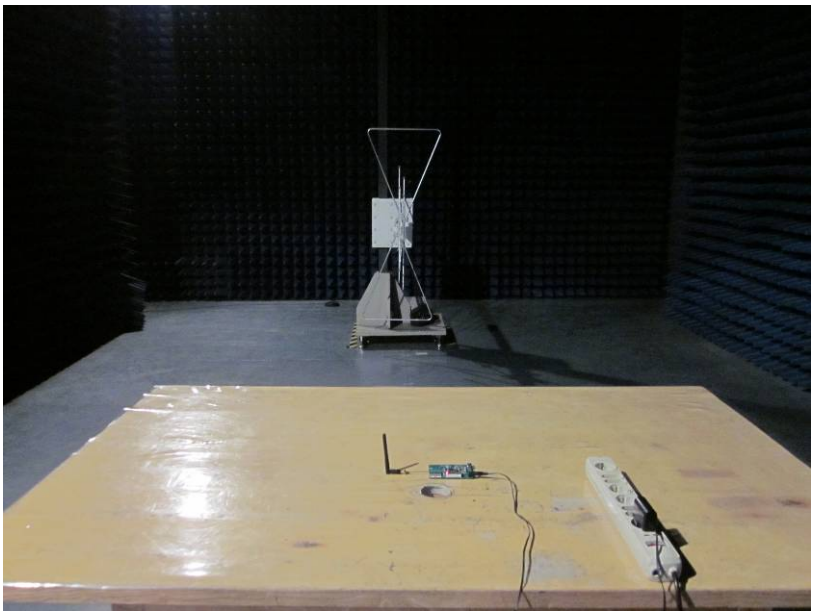
Frequency (MHz)	Detector	Antenna Polarization	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Turntable Angle (°)
Low frequency							
2414.25	AV	Vertical	100.78		(Fund.)	1.2	30
4828.50	AV	Vertical	44.98	54.00	-9.02	1.2	75
7242.75	AV	Vertical	45.92	54.00	-8.08	1.5	150
9657.00	AV	Vertical	42.65	54.00	-11.35	1.8	90
12071.25	AV	Vertical	39.01	54.00	-14.99	1.6	165
14485.50	AV	Vertical	40.30	54.00	-13.70	1.4	150
16899.75	AV	Vertical	37.11	54.00	-16.89	1.7	130
19314.00	AV	Vertical	35.39	54.00	-18.61	1.5	90
21728.25	AV	Vertical	33.17	54.00	-20.83	1.6	30
24142.50	AV	Vertical	34.32	54.00	-19.68	1.2	90
2414.25	AV	Horizontal	95.26		(Fund.)	2.3	30
4828.50	AV	Horizontal	44.29	54.00	-9.71	2.0	150
7242.75	AV	Horizontal	42.04	54.00	-11.96	2.1	90
9657.00	AV	Horizontal	39.15	54.00	-14.85	2.5	130
12071.25	AV	Horizontal	41.13	54.00	-12.87	1.8	90
14485.50	AV	Horizonta	36.04	54.00	-17.96	2.2	150
16899.75	AV	Horizontal	42.14	54.00	-11.86	1.9	130
19314.00	AV	Horizontal	33.99	54.00	-20.01	1.6	130
21728.25	AV	Horizontal	35.32	54.00	-18.68	2.6	130
24142.50	AV	Horizontal	37.09	54.00	-16.91	2.0	40
2414.25	PK	Vertical	119.65		(Fund.)	1.5	30
4828.50	PK	Vertical	57.98	74.00	-16.02	1.8	90
7242.75	PK	Vertical	58.92	74.00	-15.08	1.6	120
9657.00	PK	Vertical	55.65	74.00	-18.35	1.4	210
12071.25	PK	Vertical	52.01	74.00	-21.99	1.2	90
14485.50	PK	Vertical	53.30	74.00	-20.70	1.2	90
16899.75	PK	Vertical	50.11	74.00	-23.89	1.4	165
19314.00	PK	Vertical	48.39	74.00	-25.61	1.2	150
21728.25	PK	Vertical	46.17	74.00	-27.83	1.7	90
24142.50	PK	Vertical	47.32	74.00	-26.68	1.4	120
2414.25	PK	Horizontal	114.79		(Fund.)	2.1	90
4828.50	PK	Horizontal	49.29	74.00	-24.71	2.3	120
7242.75	PK	Horizontal	47.04	74.00	-26.96	2.6	90
9657.00	PK	Horizontal	44.15	74.00	-29.85	1.8	30
12071.25	PK	Horizontal	46.13	74.00	-27.87	2.0	165
14485.50	PK	Horizontal	41.04	74.00	-32.96	1.5	30
16899.75	PK	Horizontal	47.14	74.00	-26.86	2.2	210

19314.00	PK	Horizontal	38.99	74.00	-35.01	2.5	90
21728.25	PK	Horizontal	40.32	74.00	-33.68	1.9	150
24142.50	PK	Horizontal	42.09	74.00	-31.91	2.4	90
Middle frequency							
2437.88	AV	Vertical	99.45		(Fund.)	1.1	30
4875.76	AV	Vertical	47.03	54.00	-6.97	1.1	120
7313.64	AV	Vertical	45.14	54.00	-8.86	1.4	120
9751.52	AV	Vertical	41.00	54.00	-13.00	1.7	30
12189.40	AV	Vertical	44.24	54.00	-9.76	1.5	50
14627.28	AV	Vertical	36.91	54.00	-17.09	1.3	180
17065.16	AV	Vertical	40.16	54.00	-13.84	1.6	220
19503.04	AV	Vertical	34.97	54.00	-19.03	1.4	60
21940.92	AV	Vertical	38.96	54.00	-15.04	1.5	210
24378.80	AV	Vertical	32.02	54.00	-21.98	1.1	120
2437.88	AV	Horizontal	93.34		(Fund.)	2.2	150
4875.76	AV	Horizontal	42.10	54.00	-11.90	1.9	120
7313.64	AV	Horizontal	43.83	54.00	-10.17	2.0	300
9751.52	AV	Horizontal	37.94	54.00	-16.06	2.4	150
12189.40	AV	Horizontal	40.69	54.00	-13.31	1.7	180
14627.28	AV	Horizontal	36.09	54.00	-17.91	2.1	210
17065.16	AV	Horizontal	33.28	54.00	-20.72	1.8	165
19503.04	AV	Horizontal	35.97	54.00	-18.03	1.5	120
21940.92	AV	Horizontal	37.20	54.00	-16.80	2.5	180
24378.80	AV	Horizontal	31.88	54.00	-22.12	1.9	150
2437.88	PK	Vertical	120.02		(Fund.)	1.4	30
4875.76	PK	Vertical	60.03	74.00	-13.97	1.7	120
7313.64	PK	Vertical	58.14	74.00	-15.86	1.5	130
9751.52	PK	Vertical	54.00	74.00	-20.00	1.3	150
12189.40	PK	Vertical	57.24	74.00	-16.76	1.1	210
14627.28	PK	Vertical	49.91	74.00	-24.09	1.1	270
17065.16	PK	Vertical	53.16	74.00	-20.84	1.3	30
19503.04	PK	Vertical	47.97	74.00	-26.03	1.1	150
21940.92	PK	Vertical	51.96	74.00	-22.04	1.6	165
24378.80	PK	Vertical	45.02	74.00	-28.98	1.3	150
2437.88	PK	Horizontal	115.86		(Fund.)	2.0	30
4875.76	PK	Horizontal	55.10	74.00	-18.90	2.2	75
7313.64	PK	Horizontal	56.83	74.00	-17.17	2.5	120
9751.52	PK	Horizontal	50.94	74.00	-23.06	1.7	90
12189.40	PK	Horizontal	53.69	74.00	-20.31	1.9	180
14627.28	PK	Horizontal	49.09	74.00	-24.91	1.4	180
17065.16	PK	Horizontal	46.28	74.00	-27.72	2.1	150
19503.04	PK	Horizontal	48.97	74.00	-25.03	2.4	180
21940.92	PK	Horizontal	50.20	74.00	-23.80	1.8	30

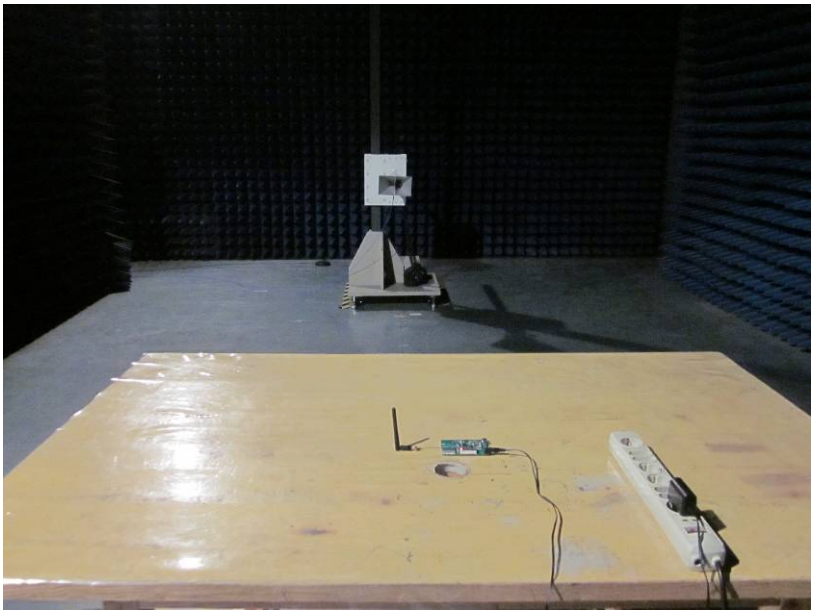
24378.80	PK	Horizontal	44.88	74.00	-29.12	2.3	165
High frequency							
2461.50	AV	Vertical	98.61		(Fund.)	1.3	160
4923.00	AV	Vertical	45.37	54.00	-8.63	1.3	10
7384.50	AV	Vertical	41.80	54.00	-12.20	1.6	130
9846.00	AV	Vertical	44.26	54.00	-9.74	1.9	70
12307.50	AV	Vertical	39.36	54.00	-14.64	1.7	100
14769.00	AV	Vertical	45.91	54.00	-8.09	1.5	130
17230.50	AV	Vertical	39.94	54.00	-14.06	1.8	110
19692.00	AV	Vertical	40.81	54.00	-13.19	1.6	190
22153.50	AV	Vertical	39.13	54.00	-14.87	1.7	130
24615.00	AV	Vertical	32.75	54.00	-21.25	1.3	145
2461.50	AV	Horizontal	91.03		(Fund.)	2.4	130
4923.00	AV	Horizontal	41.76	54.00	-12.24	2.1	160
7384.50	AV	Horizontal	40.07	54.00	-13.93	2.2	130
9846.00	AV	Horizontal	40.89	54.00	-13.11	2.6	190
12307.50	AV	Horizontal	38.75	54.00	-15.25	1.9	145
14769.00	AV	Horizontal	32.94	54.00	-21.06	2.3	130
17230.50	AV	Horizontal	37.15	54.00	-16.85	2.0	190
19692.00	AV	Horizontal	31.82	54.00	-22.18	1.7	70
22153.50	AV	Horizontal	34.65	54.00	-19.35	2.7	100
24615.00	AV	Horizontal	30.03	54.00	-23.97	2.1	100
2461.50	PK	Vertical	118.12		(Fund.)	1.6	190
4923.00	PK	Vertical	58.37	74.00	-15.63	1.9	40
7384.50	PK	Vertical	54.80	74.00	-19.20	1.7	120
9846.00	PK	Vertical	57.26	74.00	-16.74	1.5	110
12307.50	PK	Vertical	52.36	74.00	-21.64	1.3	100
14769.00	PK	Vertical	58.91	74.00	-15.09	1.3	70
17230.50	PK	Vertical	52.94	74.00	-21.06	1.5	100
19692.00	PK	Vertical	53.81	74.00	-20.19	1.3	130
22153.50	PK	Vertical	52.13	74.00	-21.87	1.8	130
24615.00	PK	Vertical	45.75	74.00	-28.25	1.5	145
2461.50	PK	Horizontal	109.37		(Fund.)	2.2	190
4923.00	PK	Horizontal	54.76	74.00	-19.24	2.4	70
7384.50	PK	Horizontal	53.07	74.00	-20.93	2.7	130
9846.00	PK	Horizontal	53.89	74.00	-20.11	1.9	190
12307.50	PK	Horizontal	51.75	74.00	-22.25	2.1	100
14769.00	PK	Horizontal	45.94	74.00	-28.06	1.6	100
17230.50	PK	Horizontal	50.15	74.00	-23.85	2.3	160
19692.00	PK	Horizontal	44.82	74.00	-29.18	2.6	160
22153.50	PK	Horizontal	47.65	74.00	-26.35	2.0	130
24615.00	PK	Horizontal	43.03	74.00	-30.97	2.5	190

Photograph – Radiation Spurious Emission Test Setup

Below 1GHz



Above 1GHz

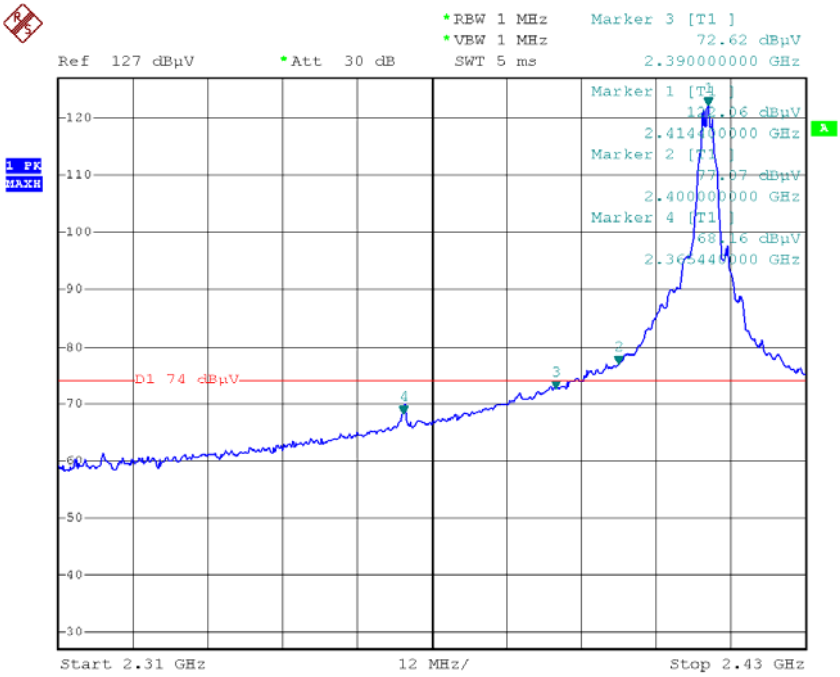


8 Radiated Emissions which fall in the restricted bands

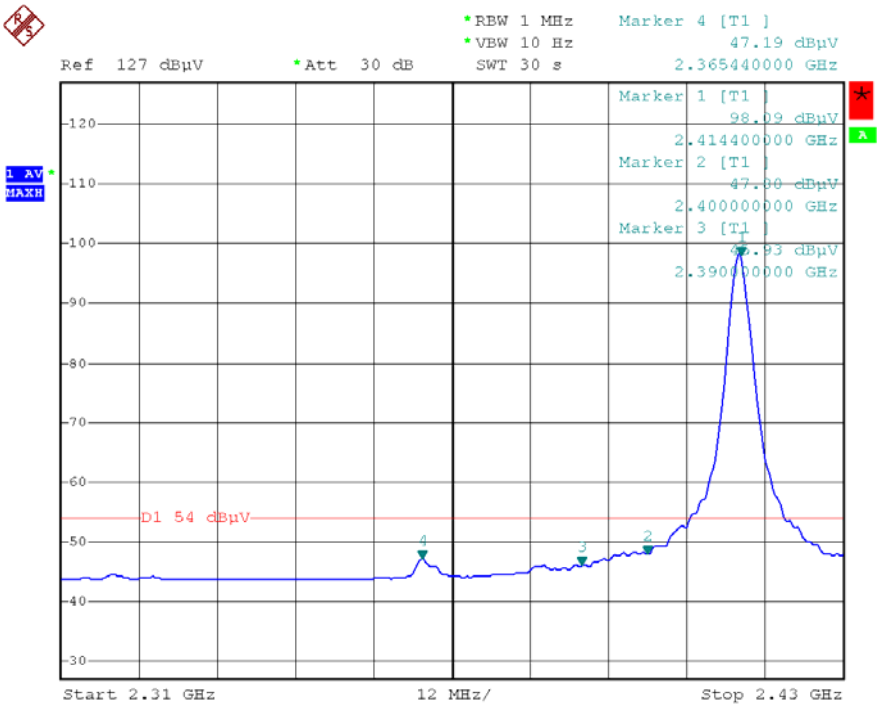
Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	Base on ANSI C63.4:2003
Measurement Distance:	3m
Limit:	40.0 dBuV/m between 30MHz & 88MHz; 43.5 dBuV/m between 88MHz & 216MHz; 46.0 dBuV/m between 216MHz & 960MHz; 54.0 dBuV/m above 960MHz. 74.0 dBuV/m for peak above 1GHz 54.0 dBuV/m for AVG above 1GHz
Detector:	For Peak value: RBW = 1 MHz for f ≥ 1 GHz VBW ≥ RBW; Sweep = auto Detector function = peak Trace = max hold For AVG value: RBW = 1 MHz for f ≥ 1 GHz VBW = 10Hz; Sweep = auto Detector function = AVG Trace = max hold

Test Result:

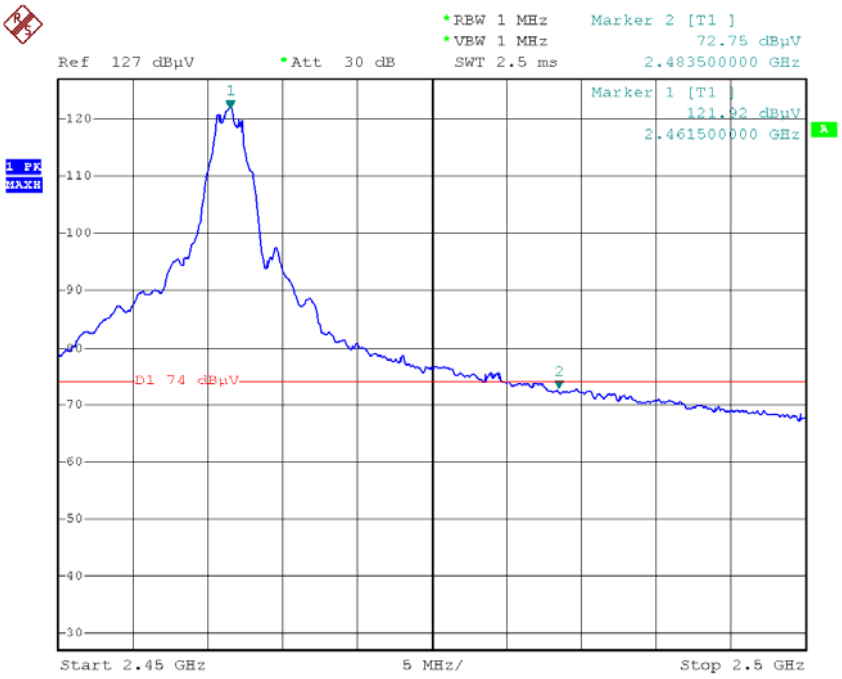
Low Channel – Peak



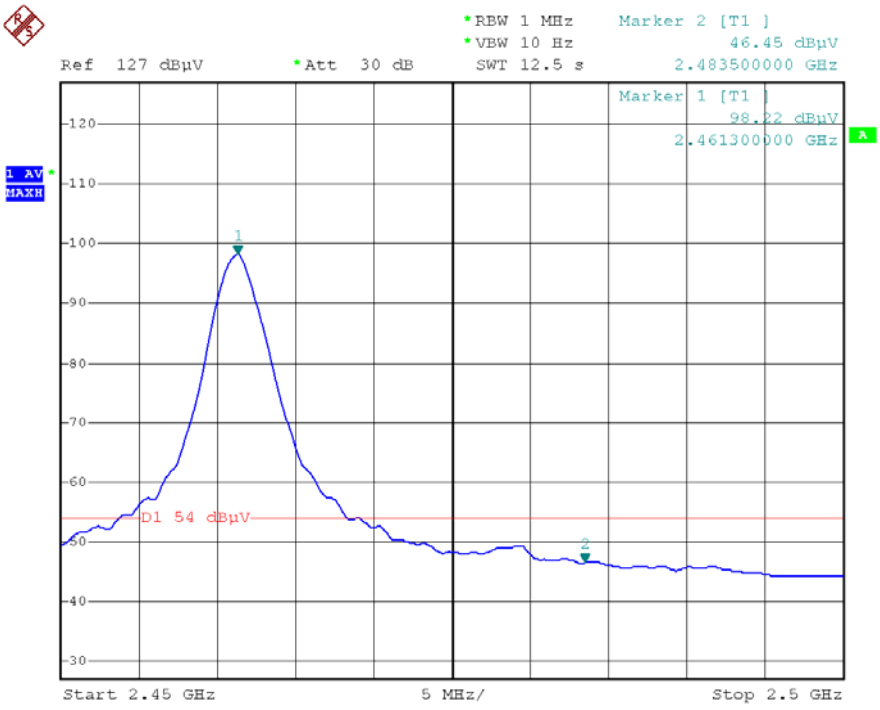
Low Channel – AV



High Channel – Peak



High Channel – AV



9 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: Based on FCC Part 15.247

Test Mode: Test in fixing operating frequency at low, Middle, high channel.

Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

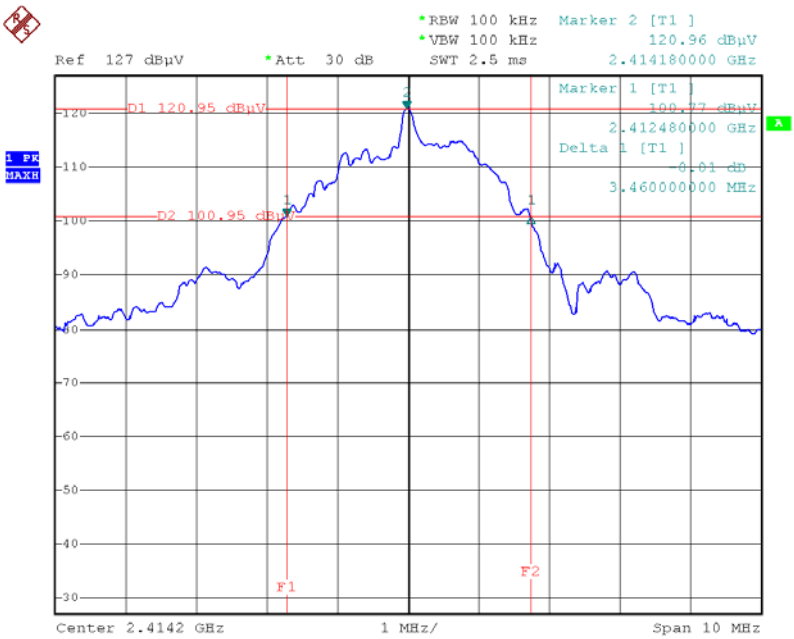
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 100kHz

Test Result:

Test Channel	Bandwidth
Low	3.46MHz
Middle	3.42MHz
High	3.38MHz

Test result plot as follows:

Low Channel



Middle Channel

High Channel

10 Maximum Peak Output Power

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	Based on ANSI C63.4:2003
Test Limit:	Regulation 15.247 (b)(1)For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. Refer to the result "Number of Hopping Frequency" of this document. The 0.125 watts (20.97 dBm) limit applies.
Test mode:	Test in fixing frequency transmitting mode.

Test Procedure:

1． Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2． Set the spectrum analyzer: RBW = 1 MHz. VBW = 1 MHz. Sweep = auto; Detector Function = Peak.

3． Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

Test Result:

Output Power = Read Level + Cable Loss

Measurement Uncertainty: ±0.5dB

Test Channel	Read Level (dBm)	Cable Loss (dB)	Output Power (dBm)	Limit (dBm)
Low	14.47	0.8	15.27	20.97
Middle	15.03	0.8	15.83	20.97
High	15.92	0.8	16.72	20.97

11 Hopping Channel Separation

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	Based on FCC Part 15.247
Test Limit:	Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
Test Mode:	Test in hopping transmitting operating mode.

Test Procedure:

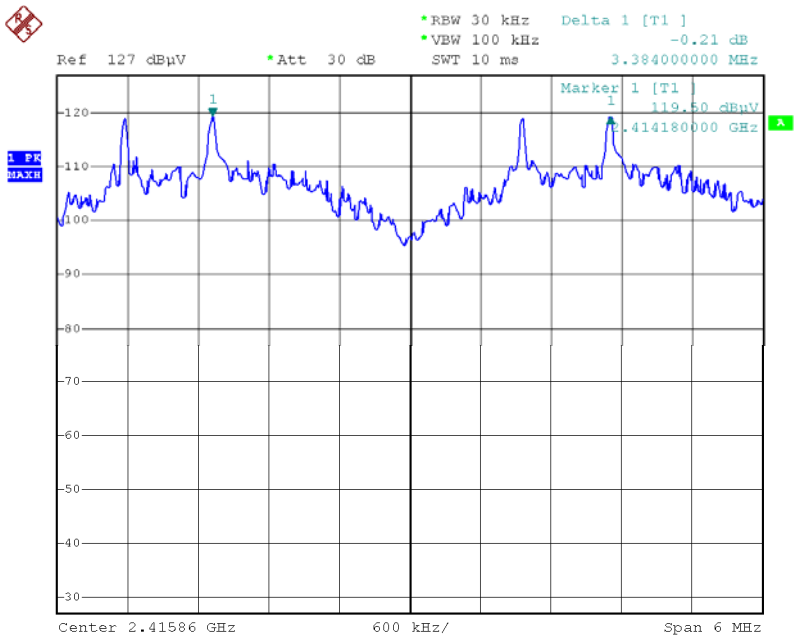
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 6MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

Test Result:

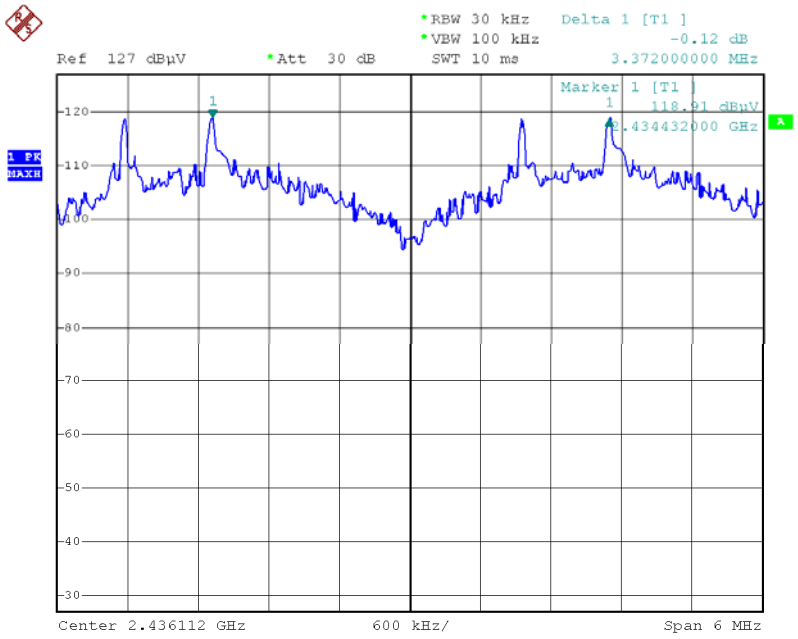
Test Channel	Separation (MHz)	Result
Low	3.384	PASS
Middle	3.372	PASS
High	3.384	PASS

Test result plot as follows:

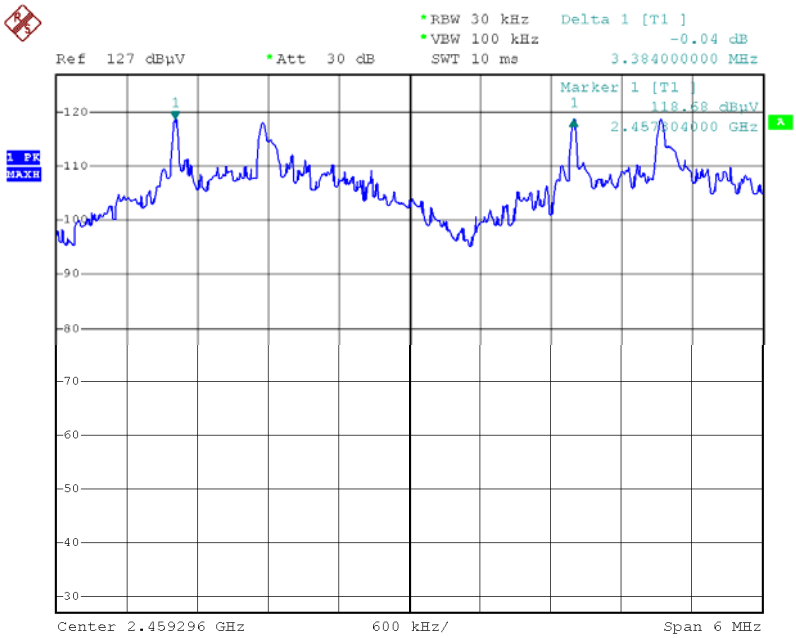
Low Channel:



Middle Channel



High Channel



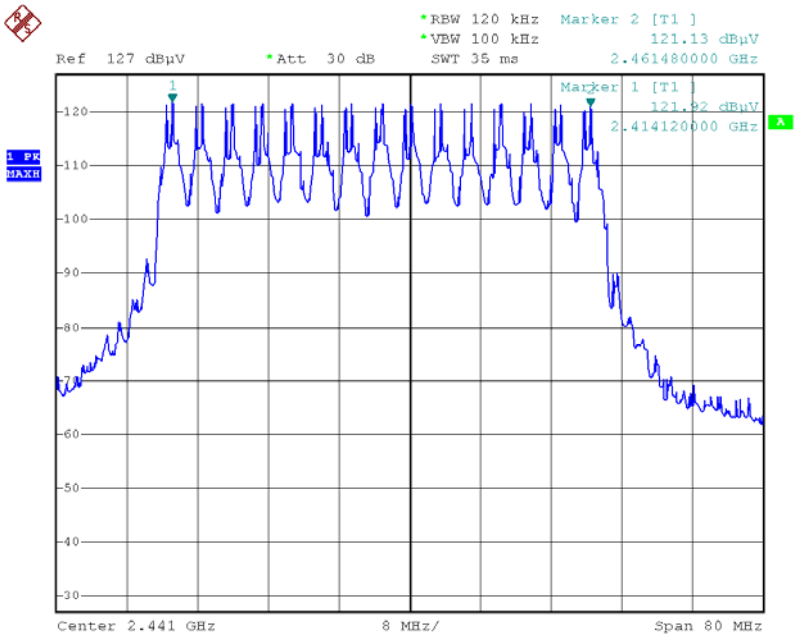
12 Number of Hopping Frequency

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	Based on FCC Part 15.247
Test Limit:	Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode:	Test in hopping transmitting operating mode.

Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100 kHz. VBW = 100 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Center Frequency = 2441MHz, Span = 80MHz. Submit the test result graph.

Test Result: Total Channels are 15 Channels.



13 Dwell Time

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: Based on FCC Part 15.247

Test Limit: Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Mode: Test in hopping transmitting operating mode.

Test Procedure:

1.Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2.Set spectrum analyzer span = 0. centered on a hopping channel;

3.Set RBW = 1MHz and VBW = 1MHz.Sweep = as necessary to capture the entire dwell time per hopping channel.

4.Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Test Result:

Dwell time = Pulse wide x (Hopping rate / Number of channels) x Period

The test period: T= 0.4(s) * 15 = 6 (s)

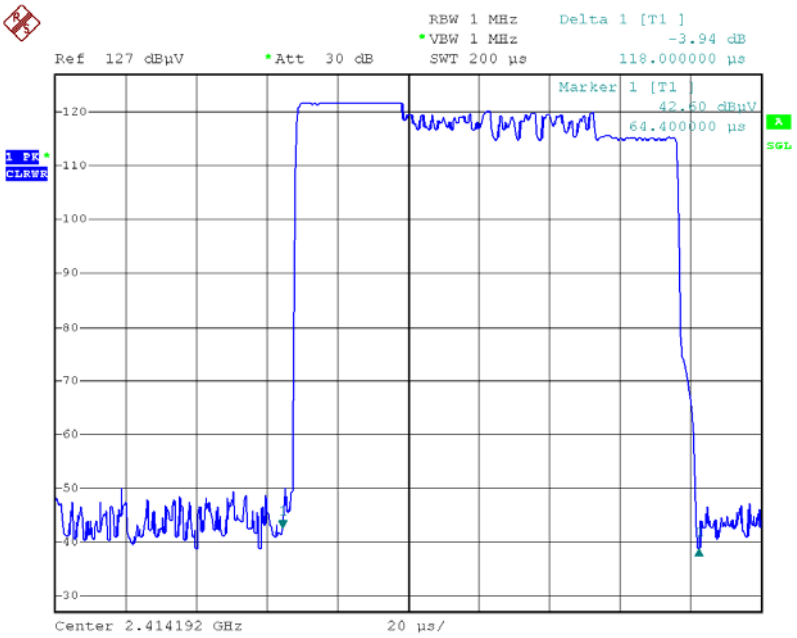
So, the Dwell Time can be calculated as follows:

Dwell time = 32 * 6 * (MkrDelta) / 1000

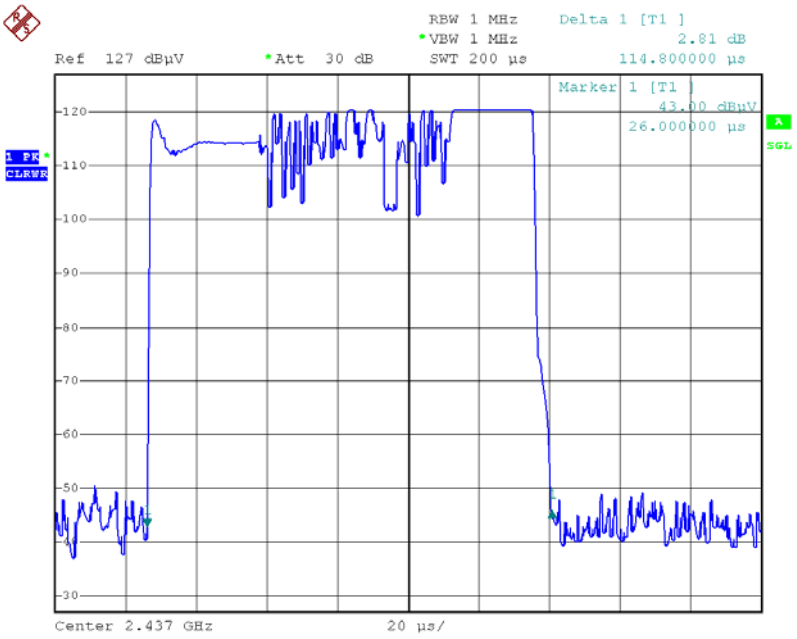
Note : Mkr Delta is once pulse time.

Frequency	Mkr Delta(ms)	Dwell Time(s)	Limits(s)	Result
2414 MHz	0.1180	0.023	0.400	Pass
2437 MHz	0.1148	0.022	0.400	Pass
2461 MHz	0.1152	0.022	0.400	Pass

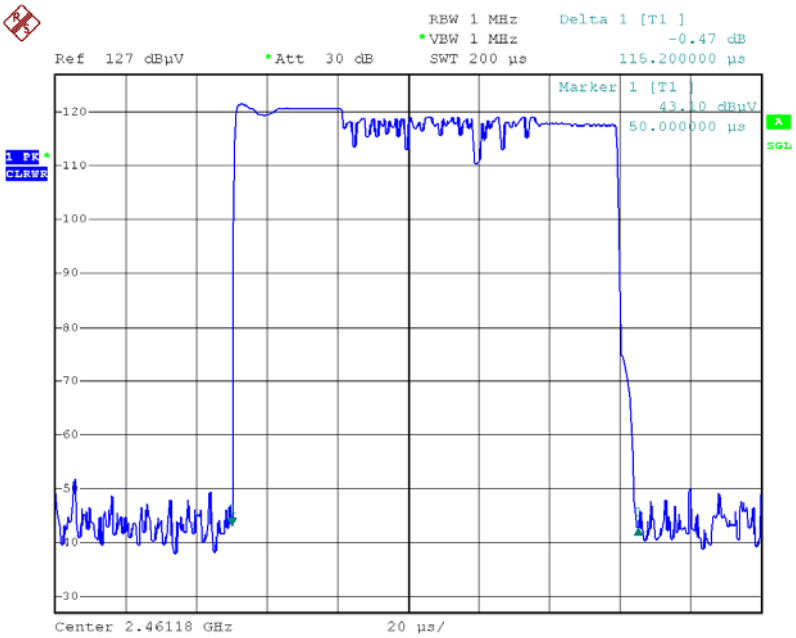
Low Channel: 2414MHz



Middle Channel: 2437MHz



High Channel: 2461MHz



14 Antenna Requirement

According to the FCC Part 15 Paragraph 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. This product has an unique coupling antenna, which fulfills the requirement of this section.

The directional gins of antenna used for transmitting is 3dBi, and the antenna connector is designed with revised SMA type and no consideration of replacement by the user. Please see EUT photo for details.

15 RF Exposure

Test Requirement: FCC Part 1.1307

Test Method: Based on FCC Part 15.247

Test Mode: The EUT work in test mode(Tx).

Requiments:

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

The procedures / limit

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$,$\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$,$\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

MPE Calculation Method

$$\text{E (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \qquad \text{Power Density: } Pd \text{ (W/m²)} = \frac{E^2}{377}$$

E = Electric field (V/m)
P = Peak RF output power (W)
G = EUT Antenna numeric gain (numeric)
d = Separation distance between radiator and human body (m)
The formula can be changed to

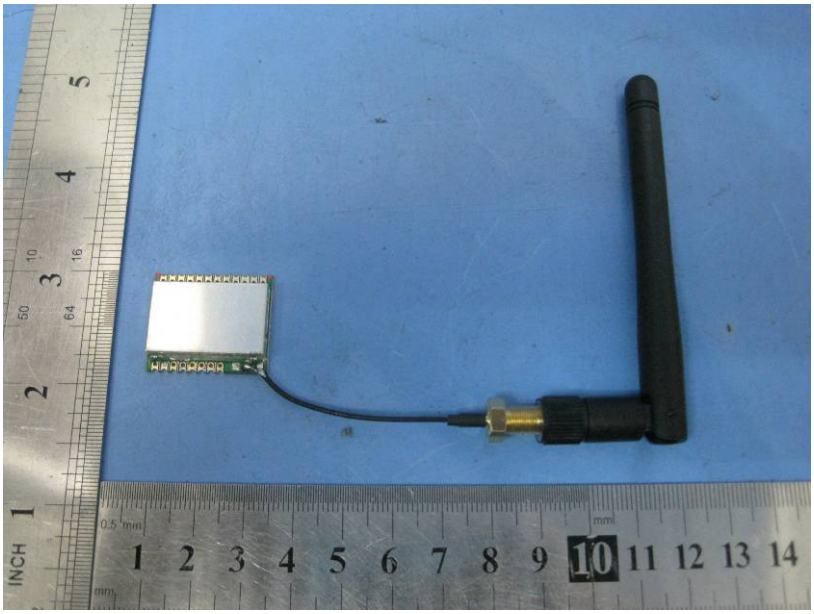
$$\boldsymbol{Pd} = \frac{30 \times P \times G}{377 \times d^2}$$

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained

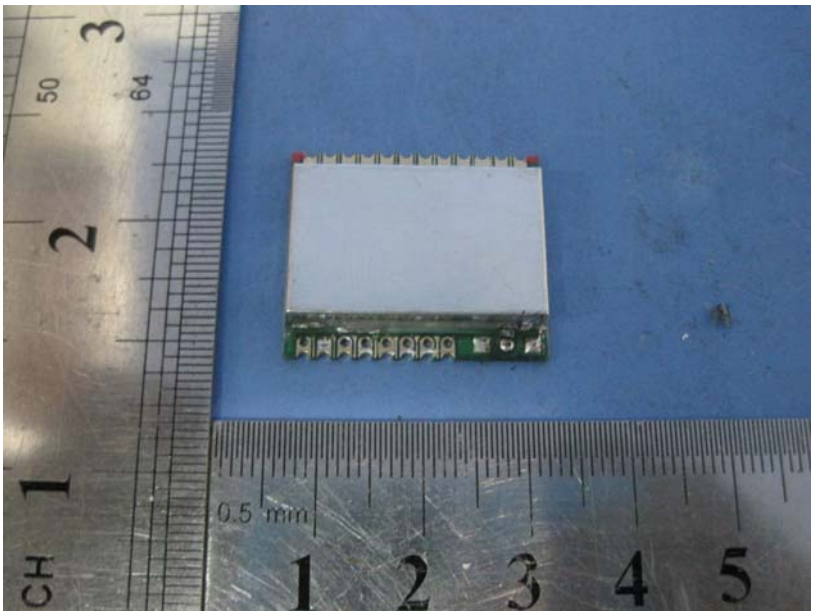
Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm2)	Limit of Power Density (S) (mW/cm2)	Test Result
3	1.995	15.27	33.651157	0.013356	1	Complies
3	1.995	15.83	38.282474	0.015194	1	Complies
3	1.995	16.72	46.989411	0.018649	1	Complies

16 Photographs - Constructional Details

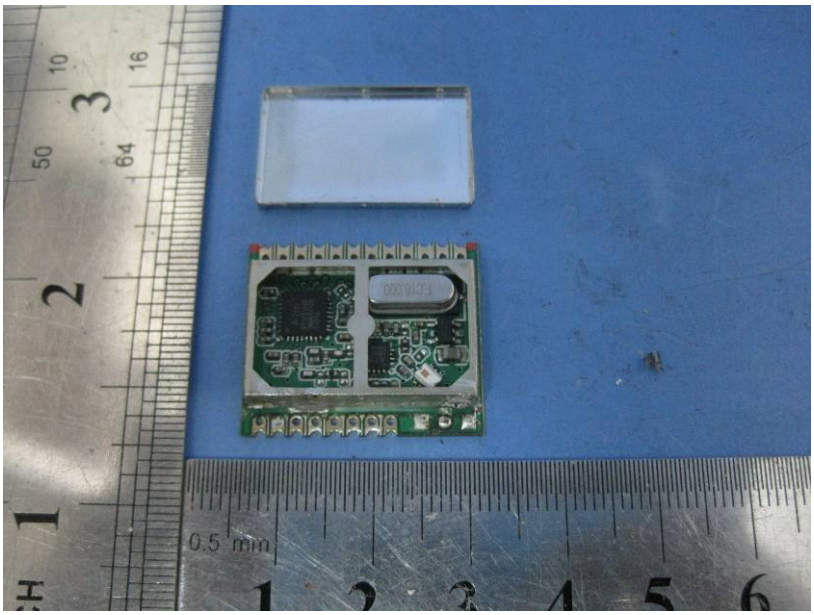
16.1 Product View



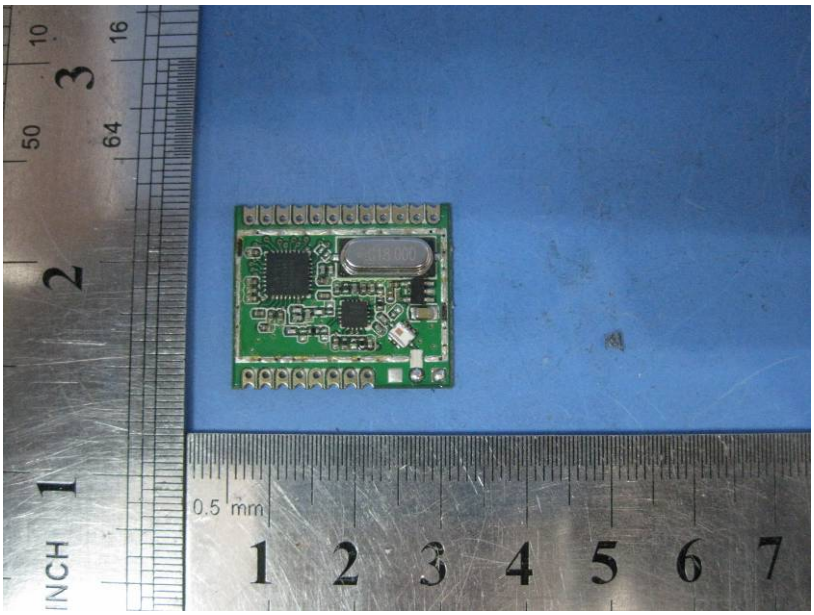
16.2 Module – Appearence View

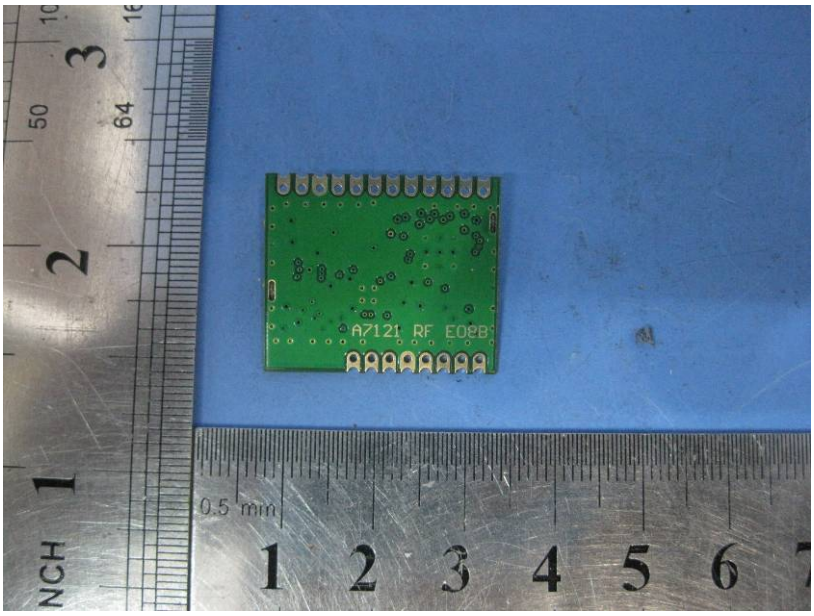


16.3 Module – Open View

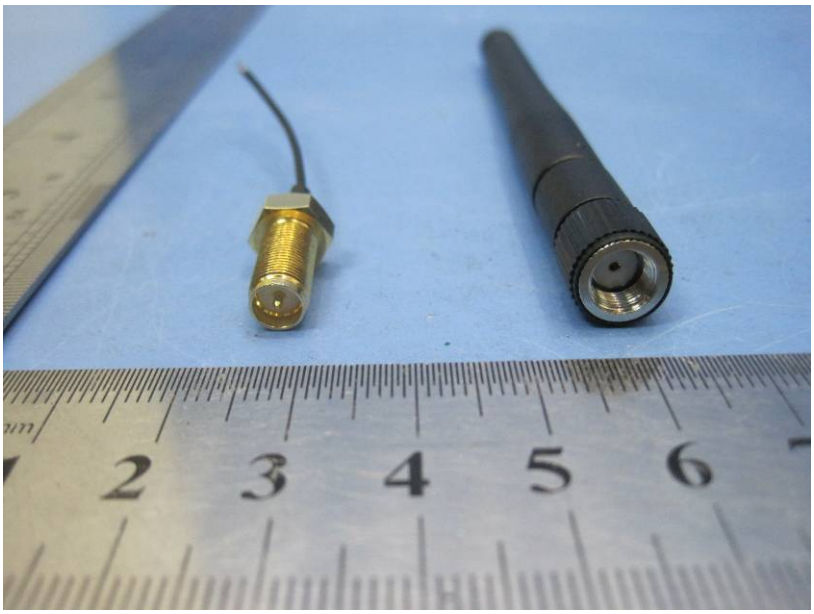


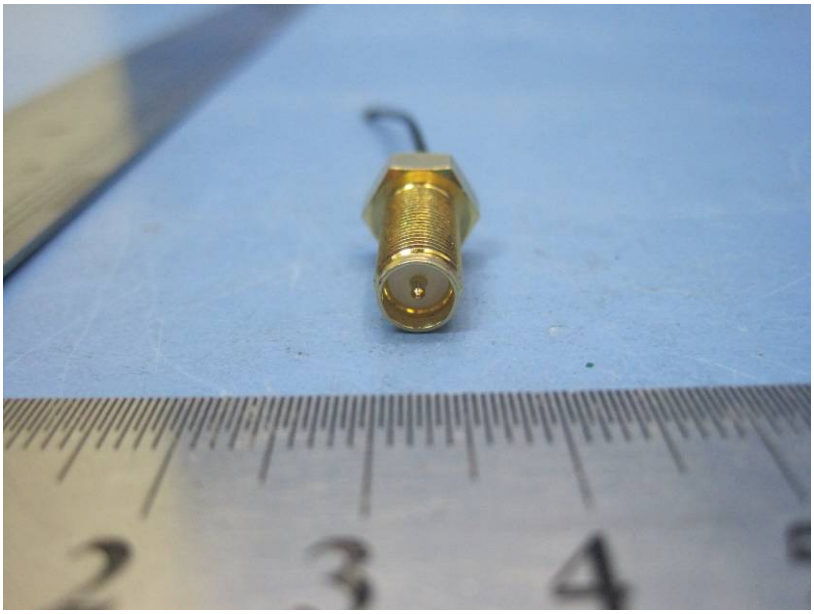
16.4 Module - PCB View

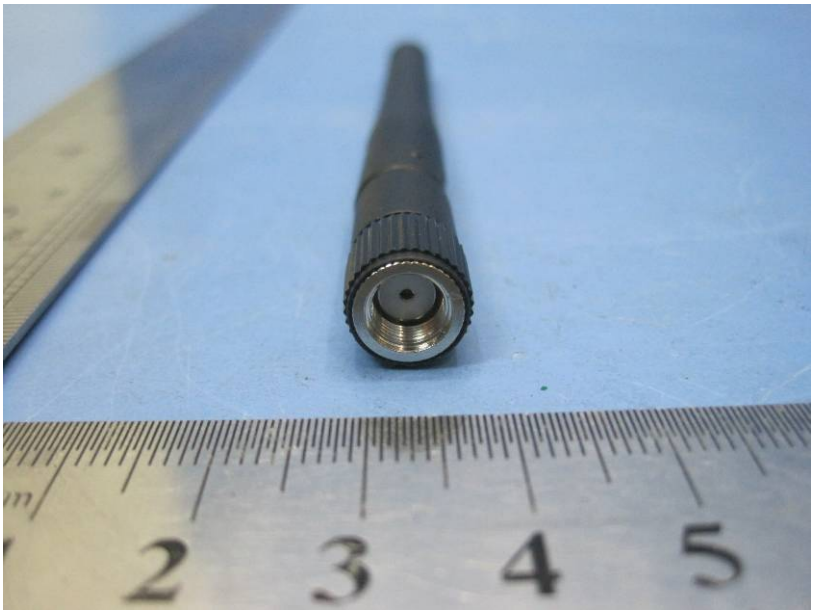




16.5 Antenna View







17 FCC Label

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

The Label must not be a stick-on paper. The Label on these products must be permanently affixed to the product and readily visible at the time of purchase and must last the expected lifetime of the equipment not be readily detachable.

Proposed Label Location on Module

Module Top View/ proposed FCC Label Location