

FCC TEST REPORT

FCC ID : LE2RFB02
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. : RFB02

Standards : FCC CFR47 Part 15 Section 15.247:2009

Date of Test : November 4 ~ November 8, 2011

Date of Issue : November 10, 2011

Test Engineer : Hunk yan / Engineer



Reviewed By : Philo zhong / Manager



Test Result	: PASS
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Prepared By:

Waltek Services (Shenzhen) Co., Ltd.

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- ✧ 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.

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Reference No.: WT11116044-D-E-F

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

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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. : RFB02

4.3 Details of E.U.T.

Technical Data : DC 3.3V / ± 0.1
Operation Frequency : 2408.625MHz ~ 2474.875MHz
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	SUNSPOT/ 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 RFelectricity 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 dB μ V between 0.15MHz & 0.5MHz 56 dB μ V between 0.5MHz & 5MHz 60 dB μ V 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:

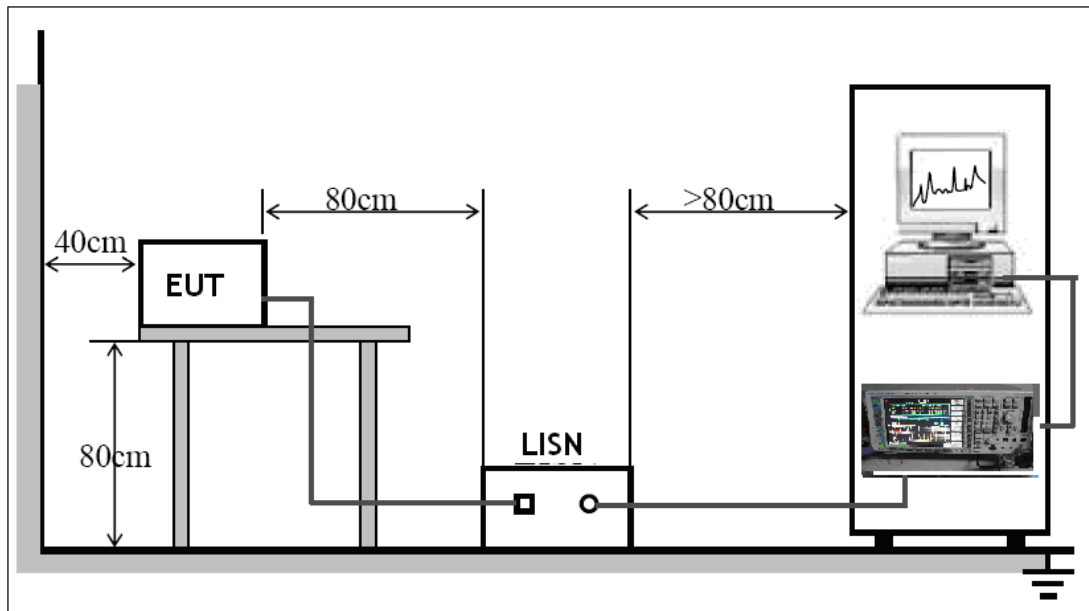
The EUT was pre-test in continuously transmit and receive mode, for each mode, the low, middle and high frequency had been tested, the worse mode is the continuously transmit in middle frequency, so the data show is that mode's only.

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.

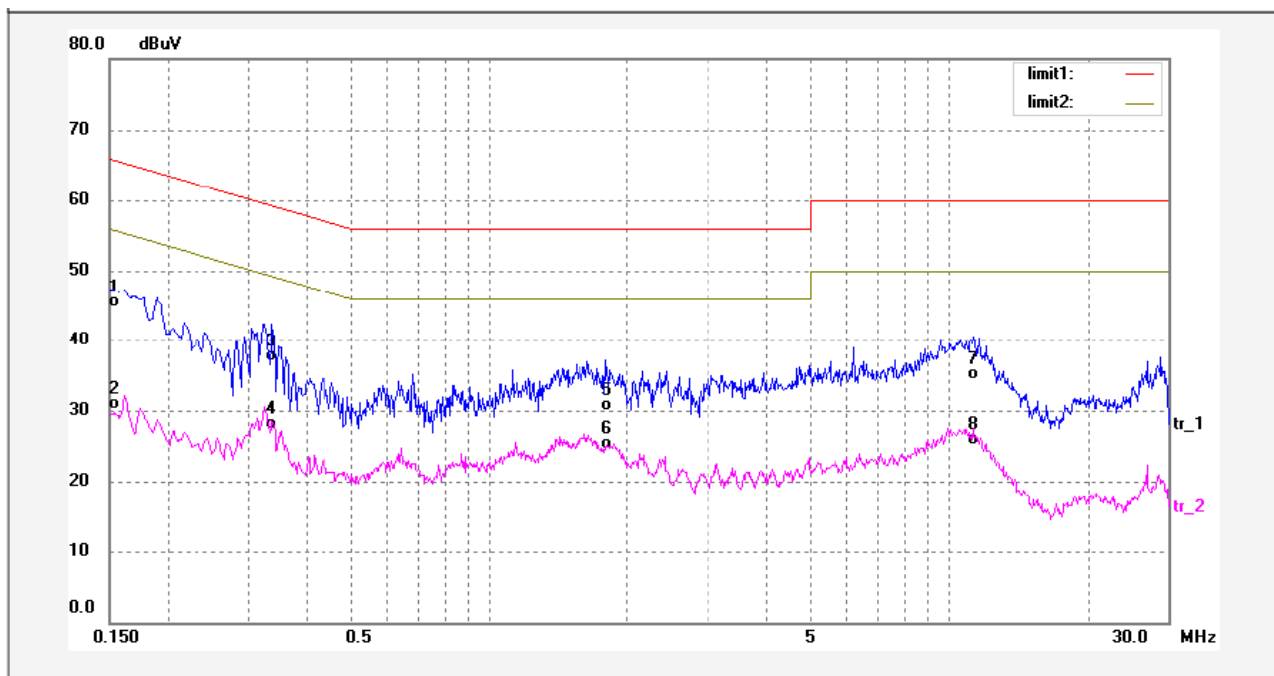


The EUT was placed on the test table in shielding room

Conducted Emission Test Result

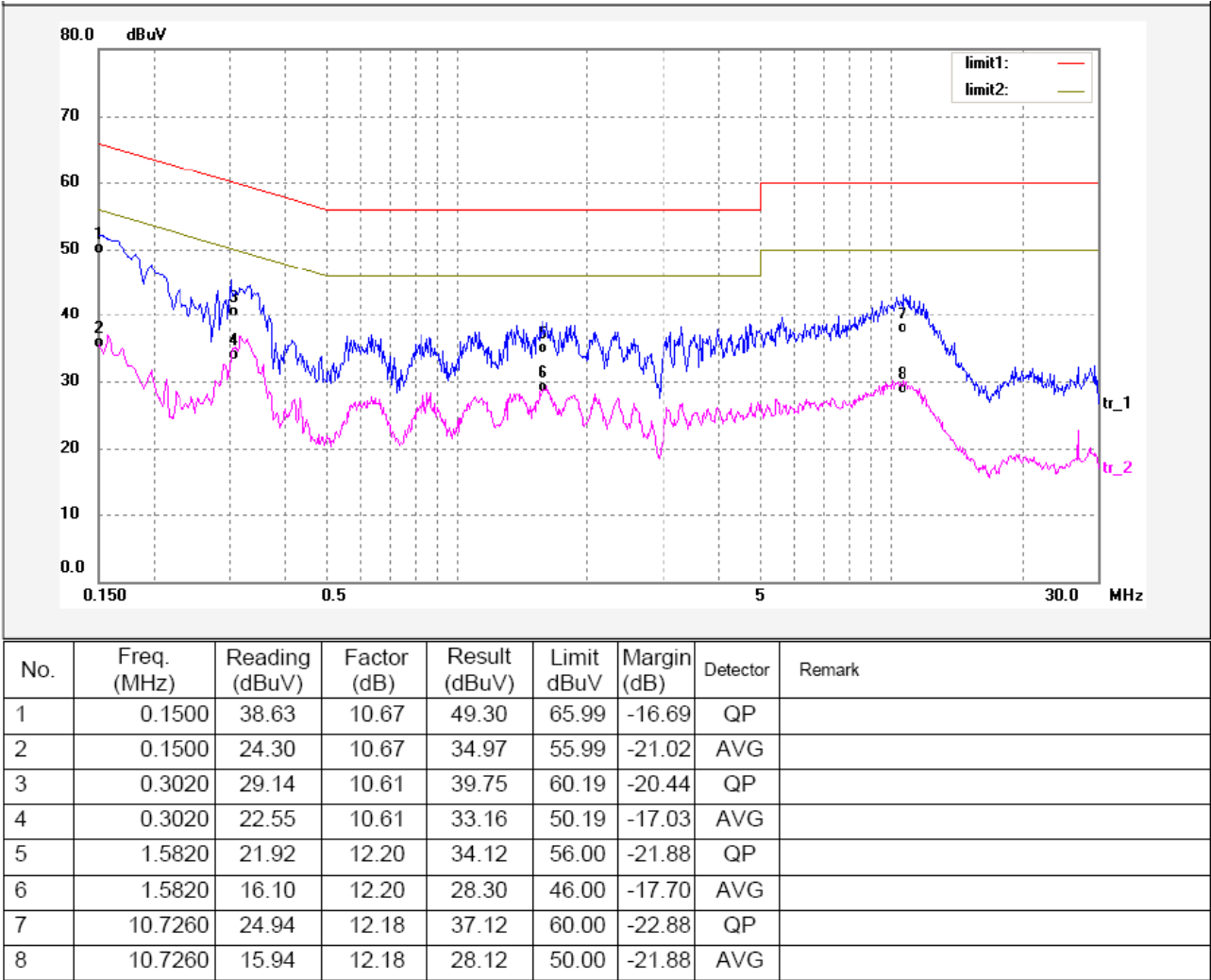
An initial pre-scan was performed on the live and neutral lines.

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	34.13	10.67	44.80	65.99	-21.19	QP	
2	0.1500	19.42	10.67	30.09	55.99	-25.90	AVG	
3	0.3379	26.14	10.71	36.85	59.25	-22.40	QP	
4	0.3379	16.57	10.71	27.28	49.25	-21.97	AVG	
5	1.7980	17.76	12.23	29.99	56.00	-26.01	QP	
6	1.7980	12.30	12.23	24.53	46.00	-21.47	AVG	
7	11.3180	22.14	12.25	34.39	60.00	-25.61	QP	
8	11.3180	12.92	12.25	25.17	50.00	-24.83	AVG	

Neutral line:



JSW Pacific Corporation

FCC ID: LE2RFB02

Photograph – Conducted Emission Test Setup



WALTEK SERVICES

Reference No.: WT11116044-D-E-F

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

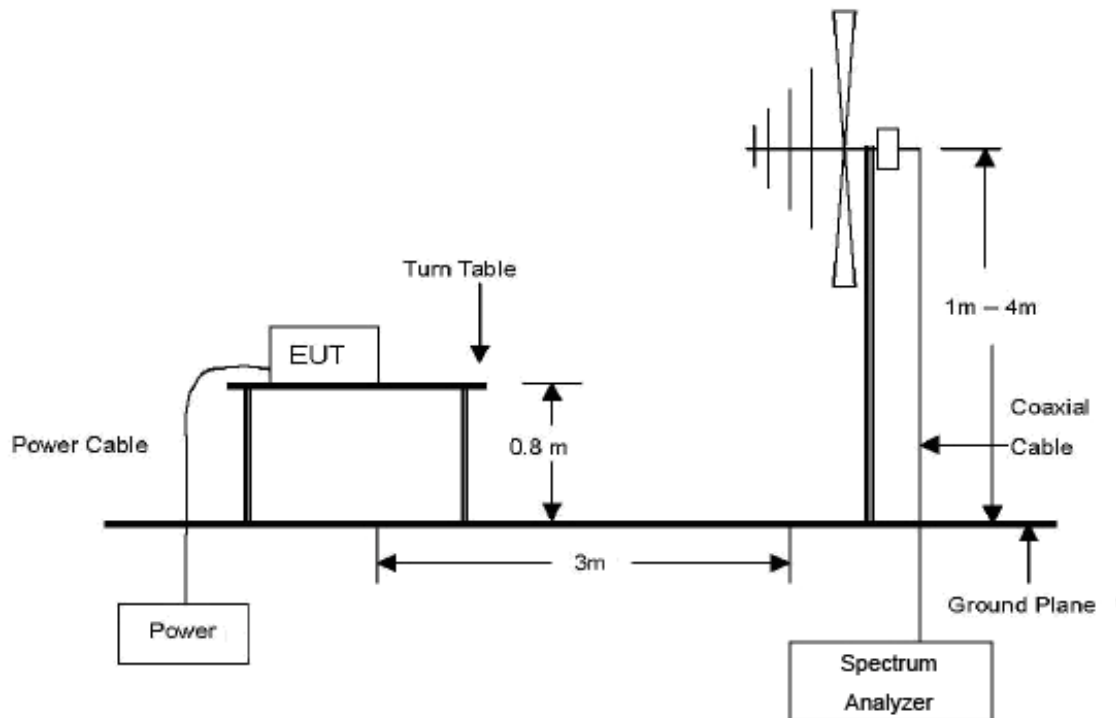
All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor 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 ± 5.03 dB.

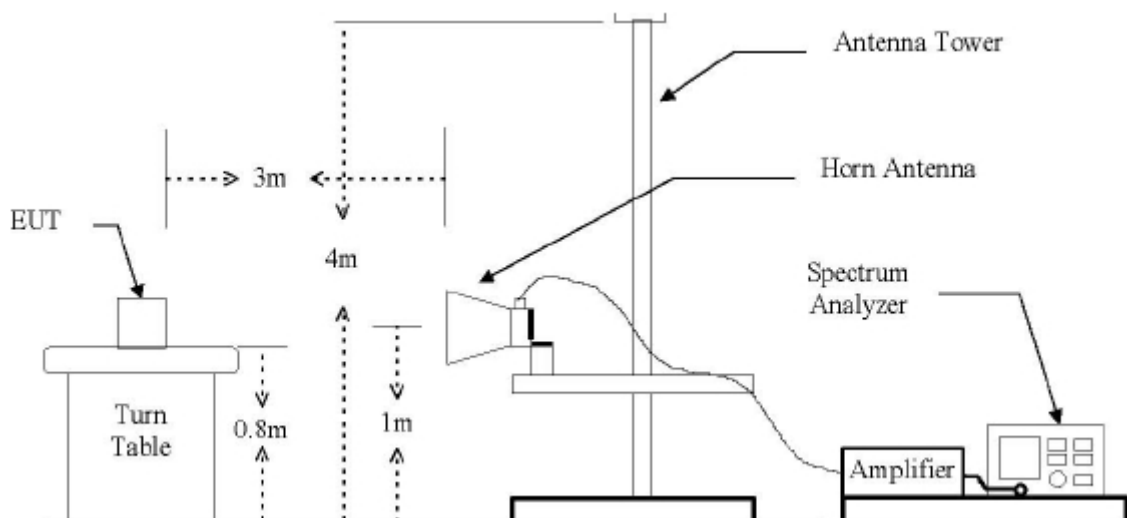
Test Setup

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:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

Summary of Test Results

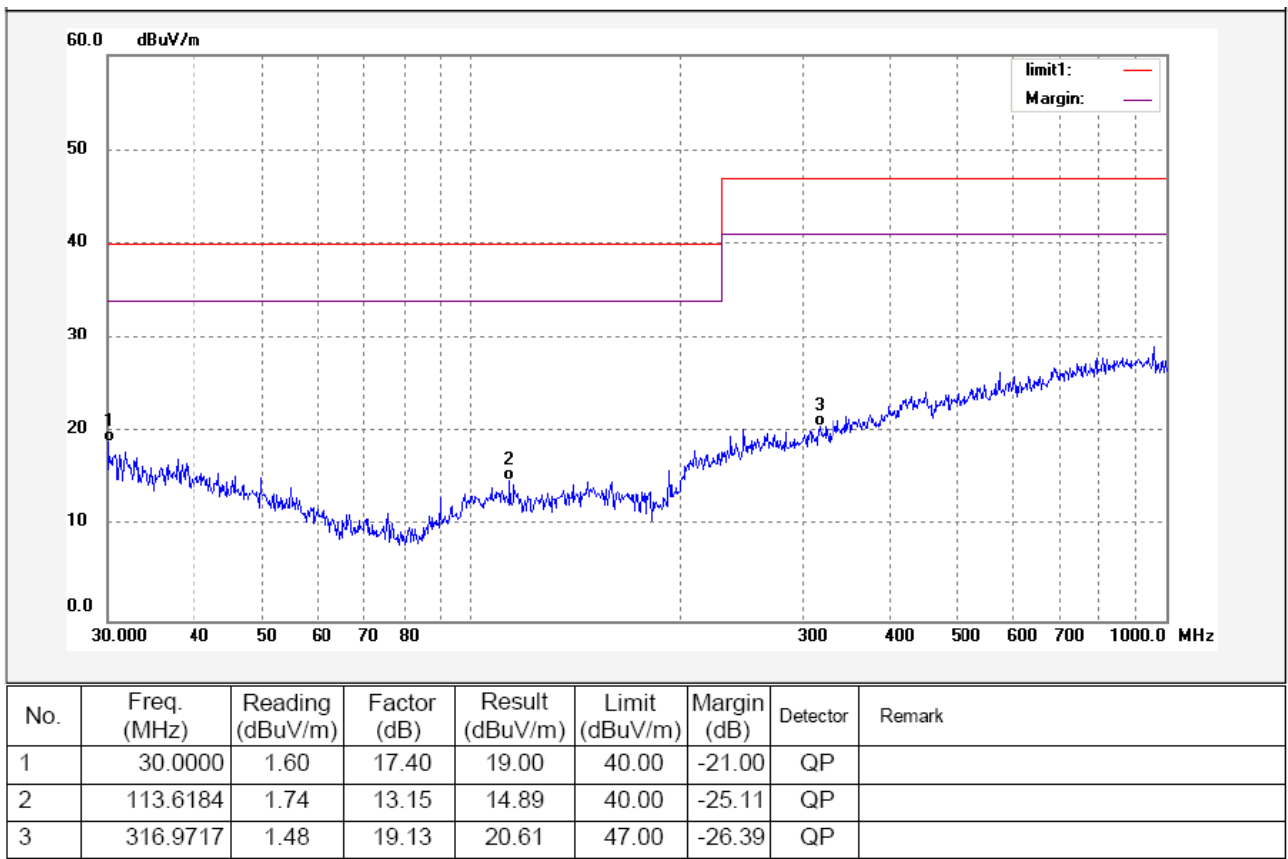
According to the data in this section, the EUT complied with the FCC CFR47 Part 15 Section 15.209 & 15.247 standards.

Test mode: continuously receive mode

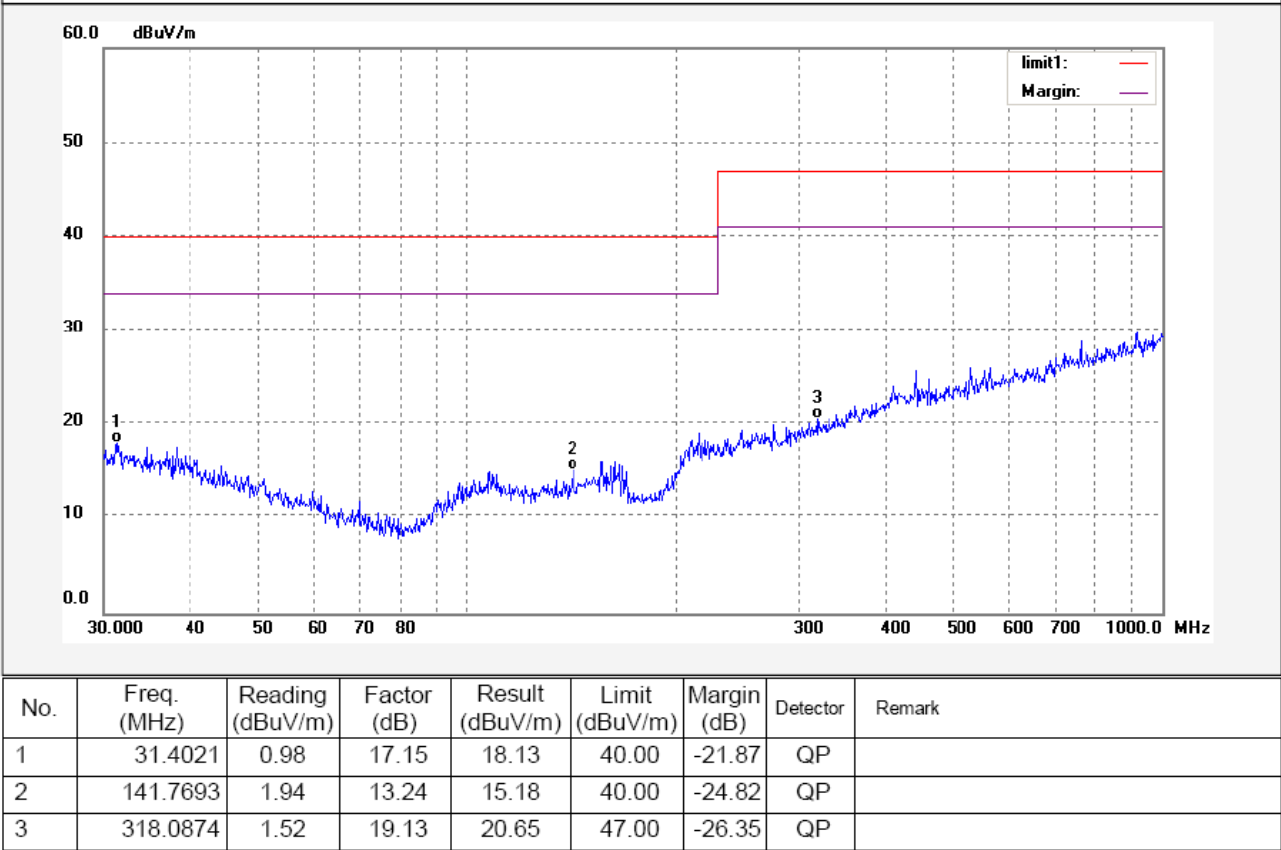
Remark: the EUT was pre-tested at the high, middle and low channel, and the worst case was the low Channel, so the data show was the low channel's only. Because the emissions below 30MHz are more than 20dB below the limit, the data is not show in the report.

Test Frequency : 30MHz ~ 1000MHz

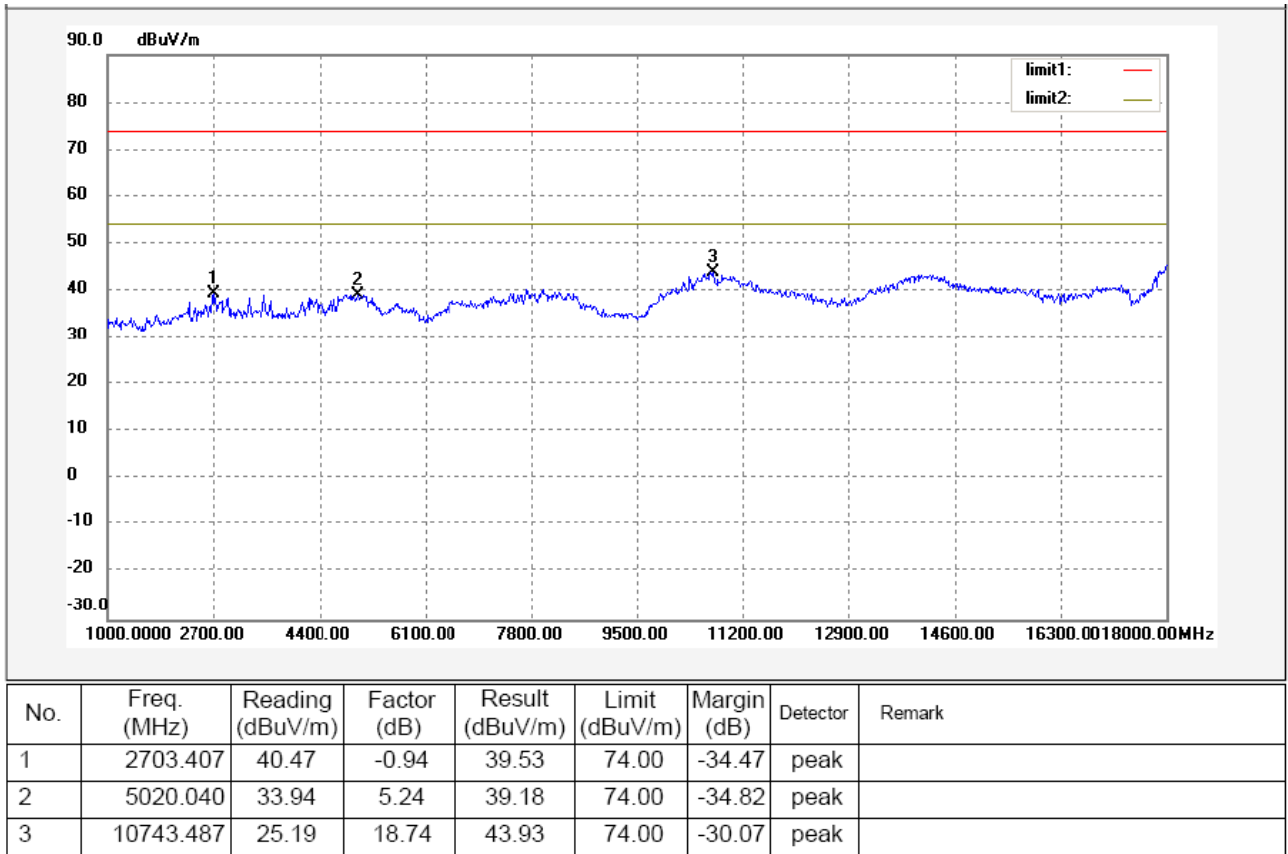
Antenna polarization: Vertical



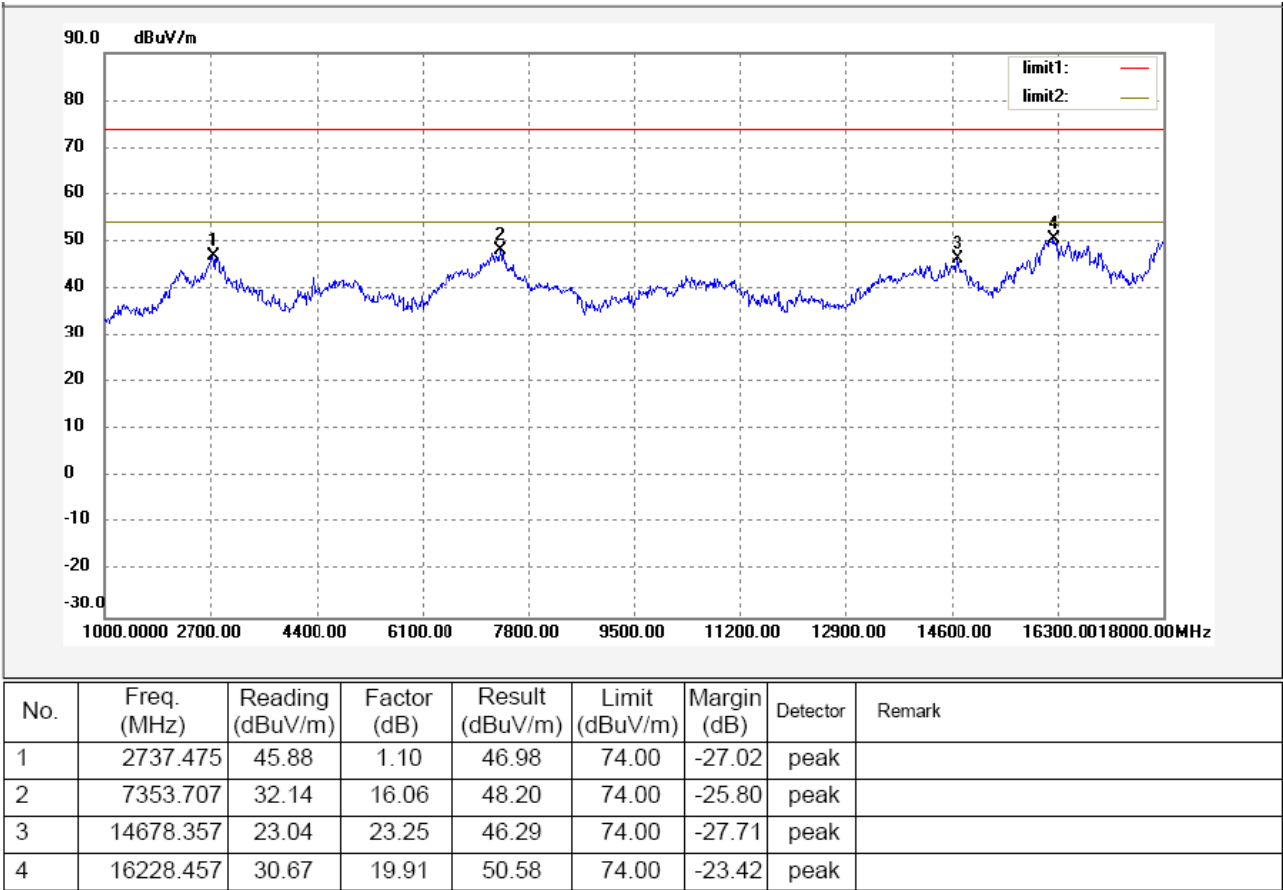
Antenna polarization: Horizontal



Test Frequency: Above 1GHz radiation test data:
Remark: above 18GHz, the test signal below the noise level, so the data was not performed.
Antenna polarization: Vertical



Antenna polarization: Horizontal

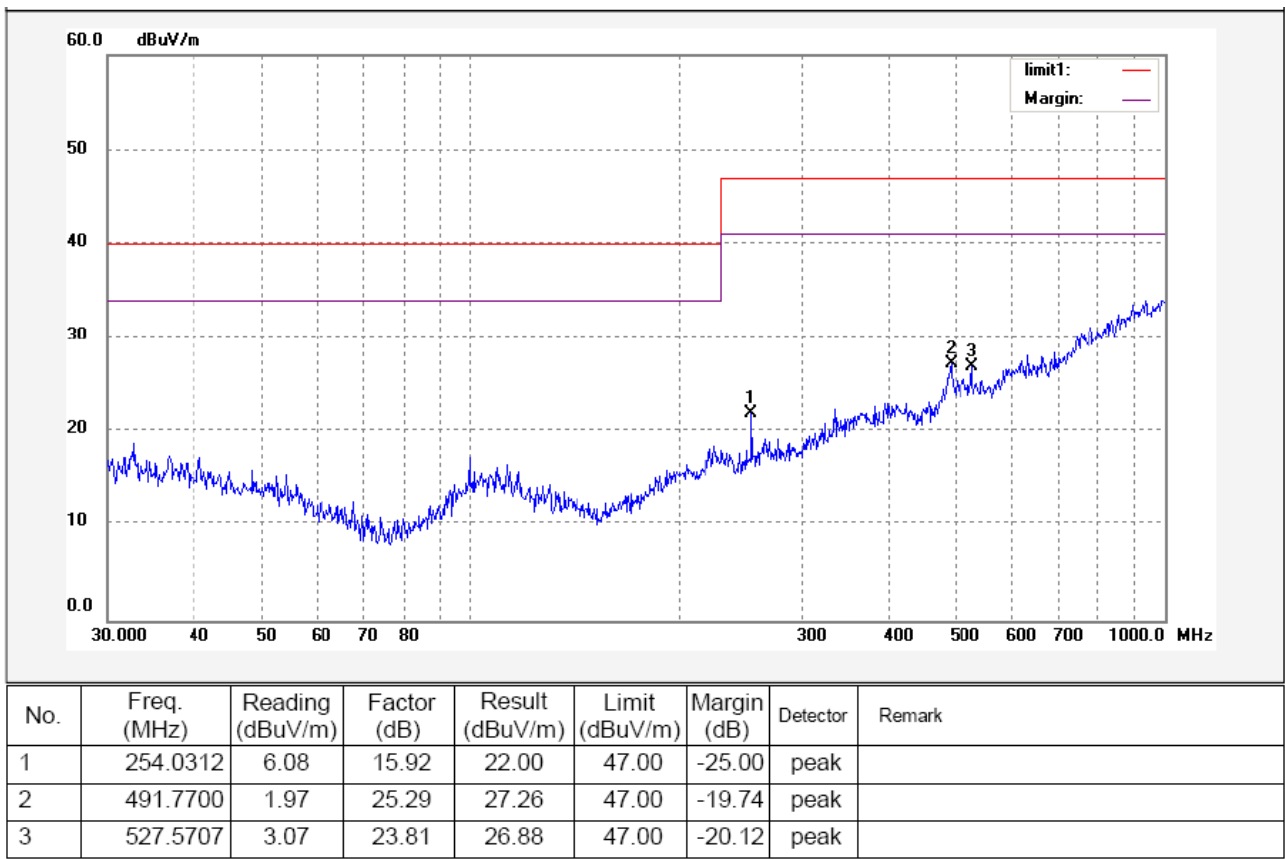


Test mode: Continuously Transmit mode

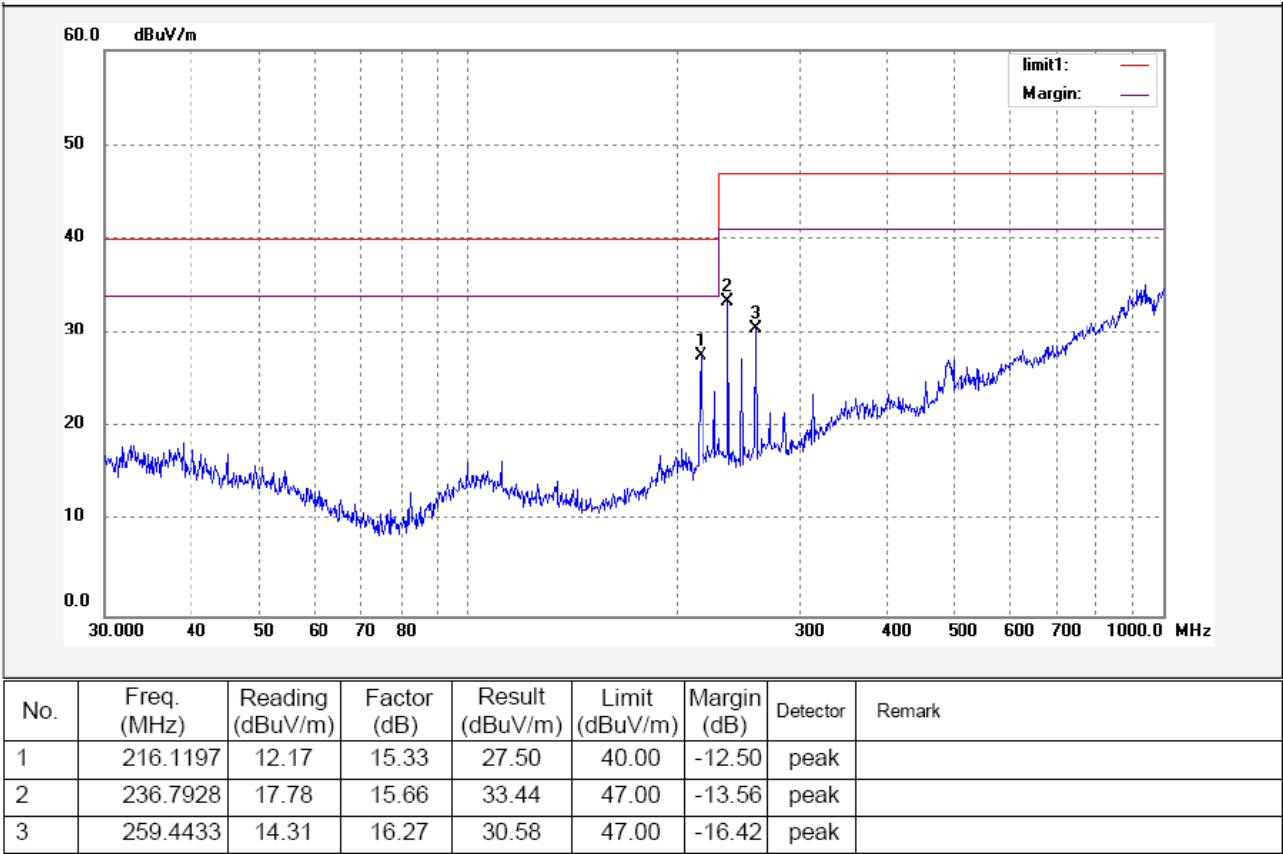
Test Frequency : 30MHz ~ 1000MHz

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



Antenna polarization: Horizontal



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							
2408.63	AV	Vertical	101.12		(Fund.)	1.3	40
4817.25	AV	Vertical	45.32	54.00	-8.68	1.1	65
7225.88	AV	Vertical	46.26	54.00	-7.74	1.6	160
9634.50	AV	Vertical	42.99	54.00	-11.01	1.7	80
12043.13	AV	Vertical	39.35	54.00	-14.65	1.7	175
14451.75	AV	Vertical	40.64	54.00	-13.36	1.3	140
16860.38	AV	Vertical	37.45	54.00	-16.55	1.8	140
19269.00	AV	Vertical	35.73	54.00	-18.27	1.4	80
21677.63	AV	Vertical	33.51	54.00	-20.49	1.7	40
24086.25	AV	Vertical	34.66	54.00	-19.34	1.1	80
2408.63	AV	Horizontal	95.60		(Fund.)	2.4	40
4817.25	AV	Horizontal	44.63	54.00	-9.37	1.9	140
7225.88	AV	Horizontal	42.38	54.00	-11.62	2.2	100
9634.50	AV	Horizontal	39.49	54.00	-14.51	2.4	120
12043.13	AV	Horizontal	41.47	54.00	-12.53	1.9	100
14451.75	AV	Horizontal	36.38	54.00	-17.62	2.1	140
16860.38	AV	Horizontal	42.48	54.00	-11.52	2.0	140
19269.00	AV	Horizontal	34.33	54.00	-19.67	1.5	120
21677.63	AV	Horizontal	35.66	54.00	-18.34	2.7	140
24086.25	AV	Horizontal	37.43	54.00	-16.57	1.9	30
2408.63	PK	Vertical	119.99		(Fund.)	1.6	40
4817.25	PK	Vertical	58.32	74.00	-15.68	1.7	80
7225.88	PK	Vertical	59.26	74.00	-14.74	1.7	130
9634.50	PK	Vertical	55.99	74.00	-18.01	1.3	200
12043.13	PK	Vertical	52.35	74.00	-21.65	1.3	100
14451.75	PK	Vertical	53.64	74.00	-20.36	1.1	80
16860.38	PK	Vertical	50.45	74.00	-23.55	1.5	175
19269.00	PK	Vertical	48.73	74.00	-25.27	1.1	140
21677.63	PK	Vertical	46.51	74.00	-27.49	1.8	100
24086.25	PK	Vertical	47.66	74.00	-26.34	1.3	110
2408.63	PK	Horizontal	115.13		(Fund.)	2.2	100
4817.25	PK	Horizontal	49.63	74.00	-24.37	2.2	110
7225.88	PK	Horizontal	47.38	74.00	-26.62	2.7	100
9634.50	PK	Horizontal	44.49	74.00	-29.51	1.7	20
12043.13	PK	Horizontal	46.47	74.00	-27.53	2.1	175
14451.75	PK	Horizontal	41.38	74.00	-32.62	1.4	20
16860.38	PK	Horizontal	47.48	74.00	-26.52	2.3	220

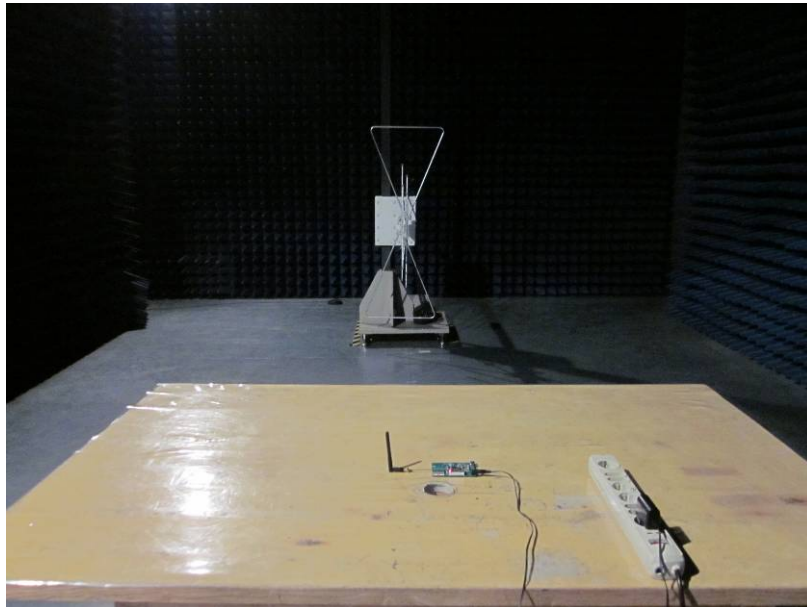
WALTEK SERVICES

Reference No.: WT11116044-D-E-F

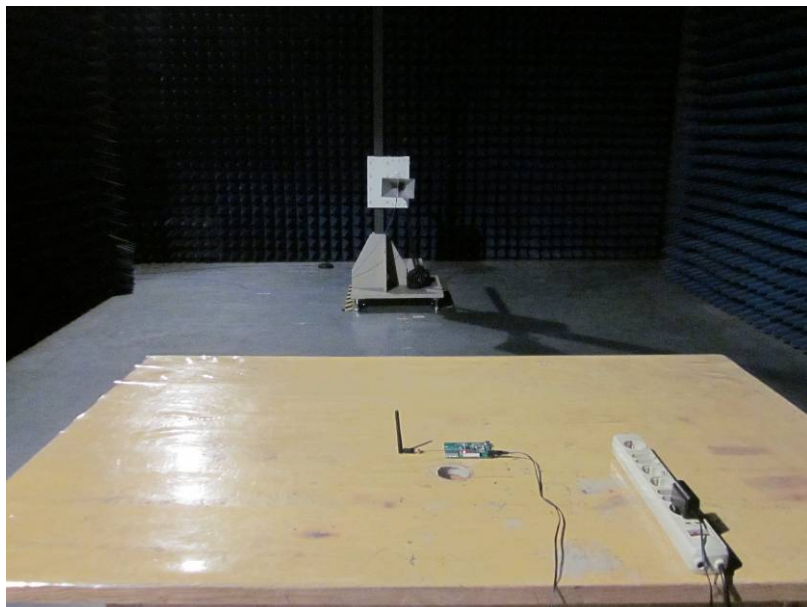
19269.00	PK	Horizontal	39.33	74.00	-34.67	2.4	80
21677.63	PK	Horizontal	40.66	74.00	-33.34	2.0	160
24086.25	PK	Horizontal	42.43	74.00	-31.57	2.3	80
Middle frequency							
2439.03	AV	Vertical	98.24		(Fund.)	1.3	40
4878.05	AV	Vertical	45.82	54.00	-8.18	1.2	110
7317.08	AV	Vertical	43.93	54.00	-10.07	1.3	130
9756.10	AV	Vertical	39.79	54.00	-14.21	1.6	50
12195.13	AV	Vertical	43.03	54.00	-10.97	1.7	60
14634.15	AV	Vertical	35.70	54.00	-18.30	1.4	170
17073.18	AV	Vertical	38.95	54.00	-15.05	1.5	230
19512.20	AV	Vertical	33.76	54.00	-20.24	1.3	80
21951.23	AV	Vertical	37.75	54.00	-16.25	1.7	220
24390.25	AV	Vertical	30.81	54.00	-23.19	1.2	110
2439.03	AV	Horizontal	92.13		(Fund.)	2.1	160
4878.05	AV	Horizontal	40.89	54.00	-13.11	1.8	140
7317.08	AV	Horizontal	42.62	54.00	-11.38	2.2	310
9756.10	AV	Horizontal	36.73	54.00	-17.27	2.5	140
12195.13	AV	Horizontal	39.48	54.00	-14.52	1.6	190
14634.15	AV	Horizontal	34.88	54.00	-19.12	2.0	230
17073.18	AV	Horizontal	32.07	54.00	-21.93	2.0	175
19512.20	AV	Horizontal	34.76	54.00	-19.24	1.6	110
21951.23	AV	Horizontal	35.99	54.00	-18.01	2.4	190
24390.25	AV	Horizontal	30.67	54.00	-23.33	1.8	170
2439.03	PK	Vertical	118.81		(Fund.)	1.6	40
4878.05	PK	Vertical	58.82	74.00	-15.18	1.8	110
7317.08	PK	Vertical	56.93	74.00	-17.07	1.4	140
9756.10	PK	Vertical	52.79	74.00	-21.21	1.2	170
12195.13	PK	Vertical	56.03	74.00	-17.97	1.3	220
14634.15	PK	Vertical	48.70	74.00	-25.30	1.2	260
17073.18	PK	Vertical	51.95	74.00	-22.05	1.2	40
19512.20	PK	Vertical	46.76	74.00	-27.24	1.0	170
21951.23	PK	Vertical	50.75	74.00	-23.25	1.8	175
24390.25	PK	Vertical	43.81	74.00	-30.19	1.4	140
2439.03	PK	Horizontal	114.65		(Fund.)	1.9	40
4878.05	PK	Horizontal	53.89	74.00	-20.11	2.1	95
7317.08	PK	Horizontal	55.62	74.00	-18.38	2.7	130
9756.10	PK	Horizontal	49.73	74.00	-24.27	1.8	80
12195.13	PK	Horizontal	52.48	74.00	-21.52	1.8	190
14634.15	PK	Horizontal	47.88	74.00	-26.12	1.3	200
17073.18	PK	Horizontal	45.07	74.00	-28.93	2.3	160
19512.20	PK	Horizontal	47.76	74.00	-26.24	2.5	170
21951.23	PK	Horizontal	48.99	74.00	-25.01	1.7	40

24390.25	PK	Horizontal	43.67	74.00	-30.33	2.2	185
High frequency							
2474.88	AV	Vertical	96.74		(Fund.)	1.5	170
4949.75	AV	Vertical	43.50	54.00	-10.50	1.4	60
7424.63	AV	Vertical	39.93	54.00	-14.07	1.5	140
9899.50	AV	Vertical	42.39	54.00	-11.61	1.8	90
12374.38	AV	Vertical	37.49	54.00	-16.51	1.9	110
14849.25	AV	Vertical	44.04	54.00	-9.96	1.6	120
17324.13	AV	Vertical	38.07	54.00	-15.93	1.7	120
19799.00	AV	Vertical	38.94	54.00	-15.06	1.5	210
22273.88	AV	Vertical	37.26	54.00	-16.74	1.9	140
24748.75	AV	Vertical	30.88	54.00	-23.12	1.4	135
2474.88	AV	Horizontal	89.16		(Fund.)	2.3	140
4949.75	AV	Horizontal	39.89	54.00	-14.11	2.0	180
7424.63	AV	Horizontal	38.20	54.00	-15.80	2.4	140
9899.50	AV	Horizontal	39.02	54.00	-14.98	2.7	180
12374.38	AV	Horizontal	36.88	54.00	-17.12	1.8	155
14849.25	AV	Horizontal	31.07	54.00	-22.93	2.2	150
17324.13	AV	Horizontal	35.28	54.00	-18.72	2.2	200
19799.00	AV	Horizontal	29.95	54.00	-24.05	1.8	60
22273.88	AV	Horizontal	32.78	54.00	-21.22	2.6	110
24748.75	AV	Horizontal	28.16	54.00	-25.84	2.0	120
2474.88	PK	Vertical	116.25		(Fund.)	1.8	200
4949.75	PK	Vertical	56.50	74.00	-17.50	2.0	30
7424.63	PK	Vertical	52.93	74.00	-21.07	1.6	130
9899.50	PK	Vertical	55.39	74.00	-18.61	1.4	130
12374.38	PK	Vertical	50.49	74.00	-23.51	1.5	110
14849.25	PK	Vertical	57.04	74.00	-16.96	1.4	60
17324.13	PK	Vertical	51.07	74.00	-22.93	1.4	110
19799.00	PK	Vertical	51.94	74.00	-22.06	1.2	150
22273.88	PK	Vertical	50.26	74.00	-23.74	2.0	140
24748.75	PK	Vertical	43.88	74.00	-30.12	1.6	135
2474.88	PK	Horizontal	107.50		(Fund.)	2.1	200
4949.75	PK	Horizontal	52.89	74.00	-21.11	2.3	90
7424.63	PK	Horizontal	51.20	74.00	-22.80	2.9	140
9899.50	PK	Horizontal	52.02	74.00	-21.98	2.0	180
12374.38	PK	Horizontal	49.88	74.00	-24.12	2.0	110
14849.25	PK	Horizontal	44.07	74.00	-29.93	1.5	120
17324.13	PK	Horizontal	48.28	74.00	-25.72	2.5	170
19799.00	PK	Horizontal	42.95	74.00	-31.05	2.7	150
22273.88	PK	Horizontal	45.78	74.00	-28.22	1.9	140
24748.75	PK	Horizontal	41.16	74.00	-32.84	2.4	210

Photograph – Radiation Spurious Emission Test Setup
Below 1GHz



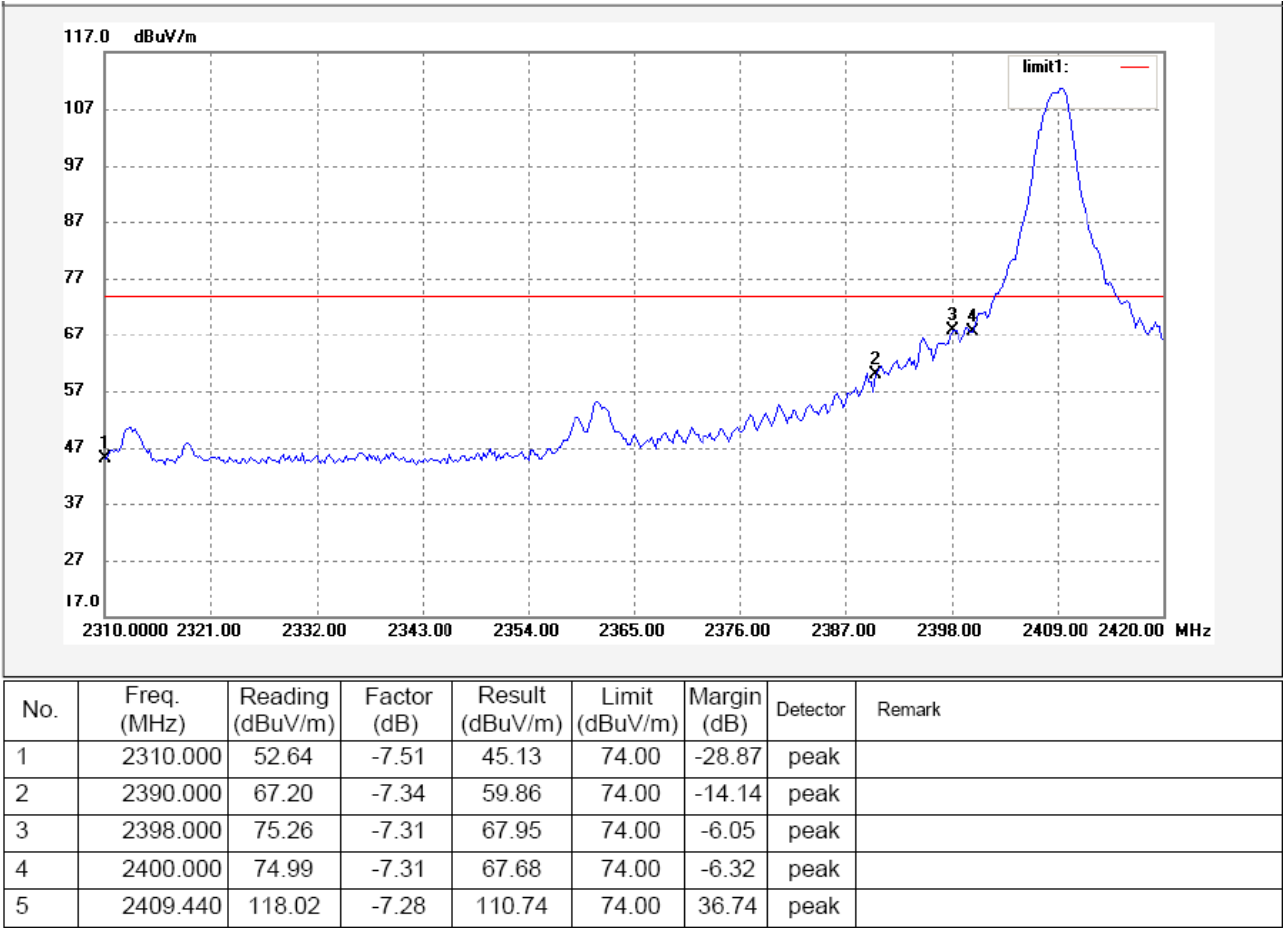
Above 1GHz



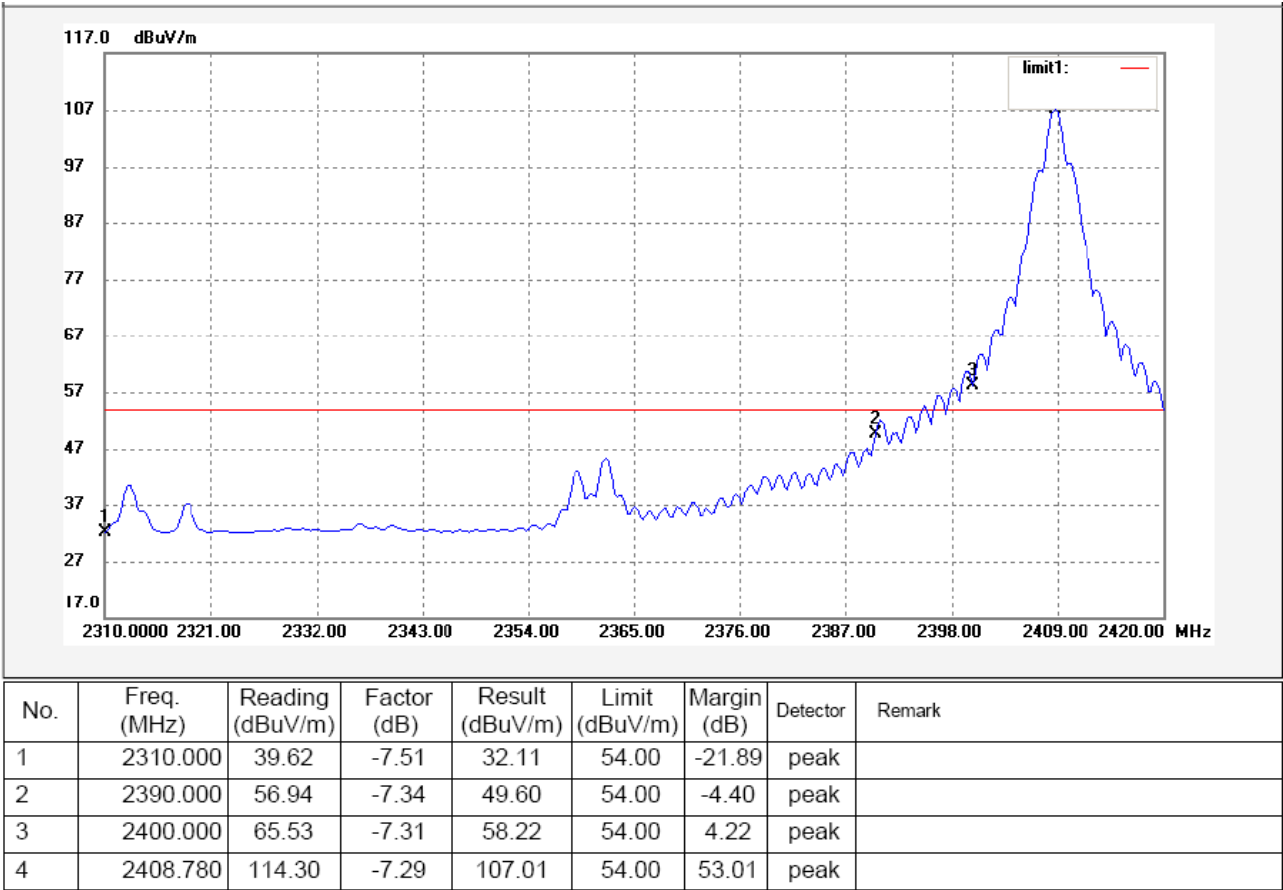
8 Radiated Emissions which fall in the restricted bands

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 $f \geq 1$ GHz VBW $\geq$ RBW; Sweep = auto Detector function = peak Trace = max hold For AVG value: RBW = 1 MHz for $f \geq 1$ GHz VBW = 10Hz; Sweep = auto Detector function = AVG Trace = max hold

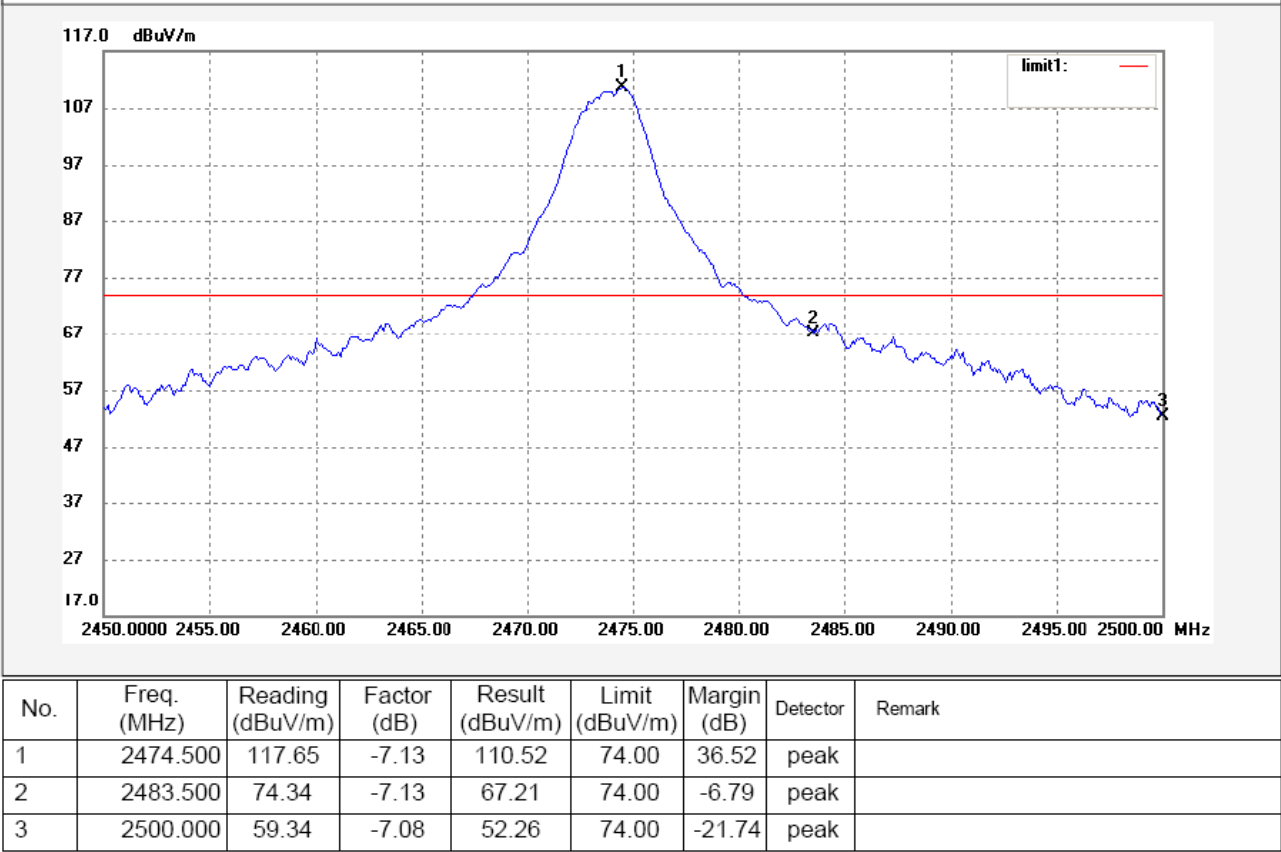
Test Result:
Low Channel – Peak



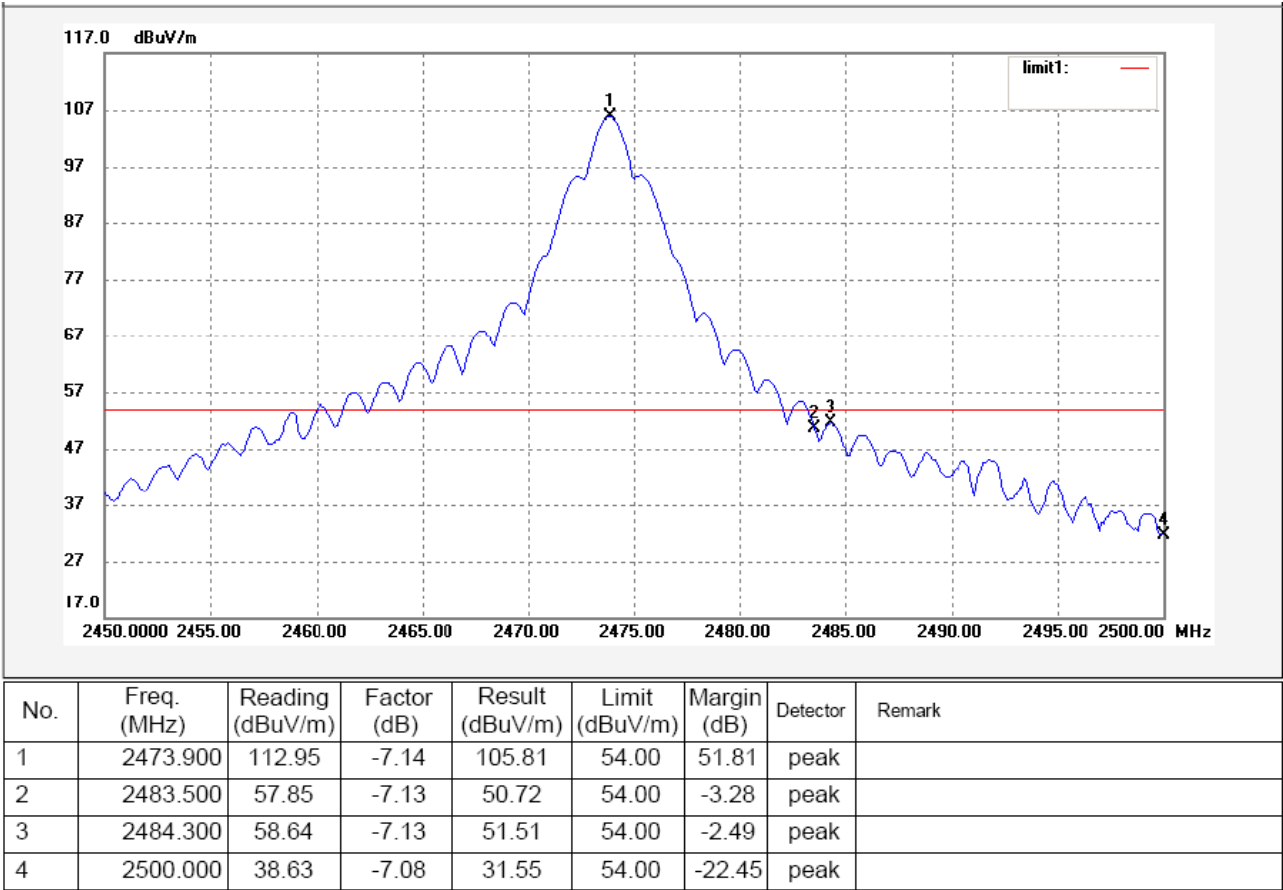
Low Channel – AV



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:

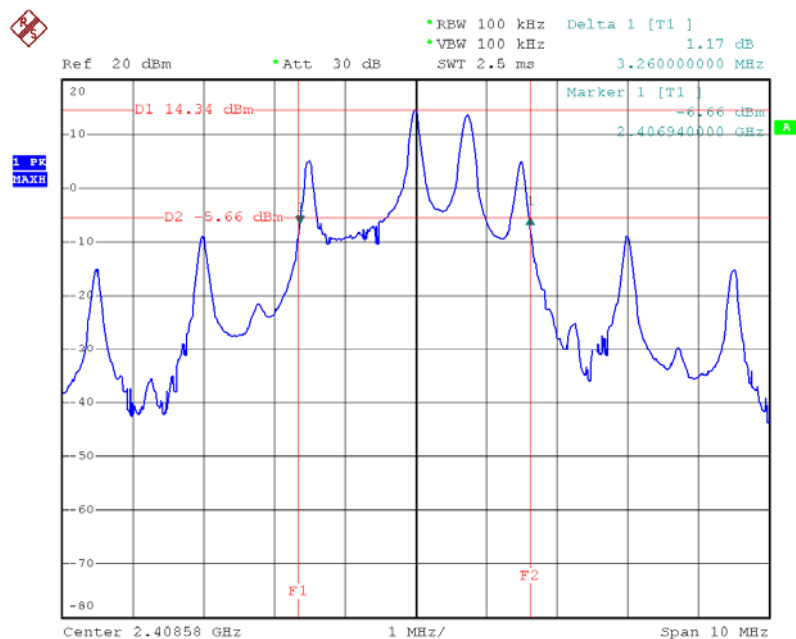
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 100kHz

Test Result:

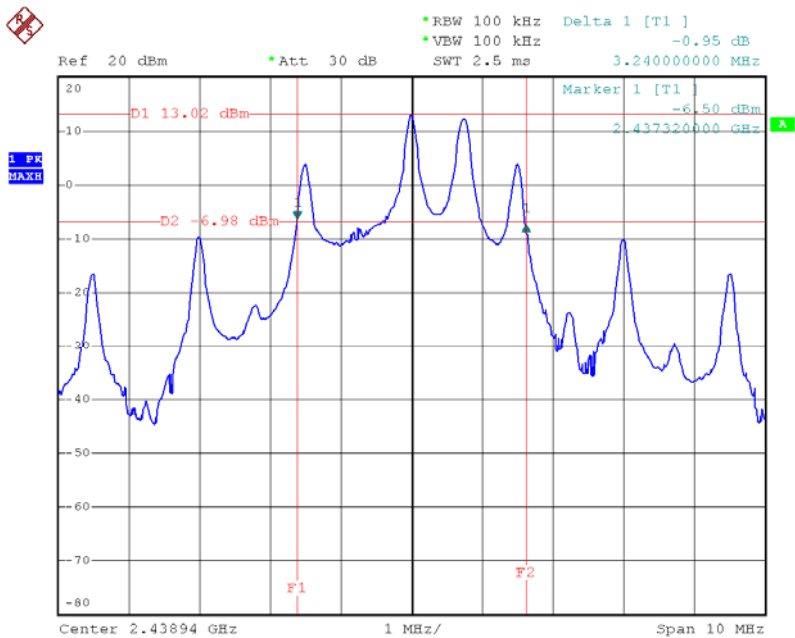
Test Channel	Bandwidth
Low	3.26MHz
Middle	3.24MHz
High	3.26MHz

Test result plot as follows:

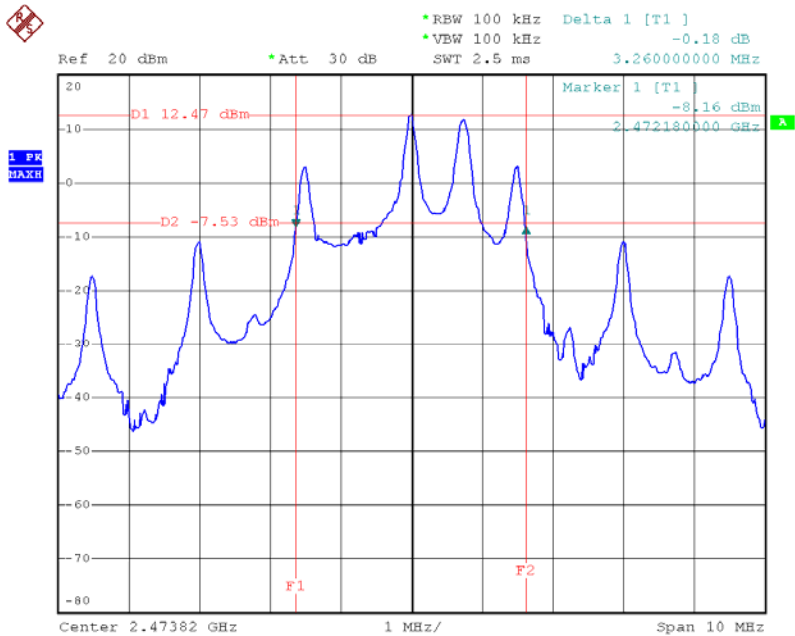
Low Channel



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: $\pm 0.5\text{dB}$

Test Channel	Read Level (dBm)	Cable Loss (dB)	Output Power (dBm)	Limit (dBm)
Low	15.52	0.8	16.32	20.97
Middle	14.02	0.8	14.82	20.97
High	12.61	0.8	13.41	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:

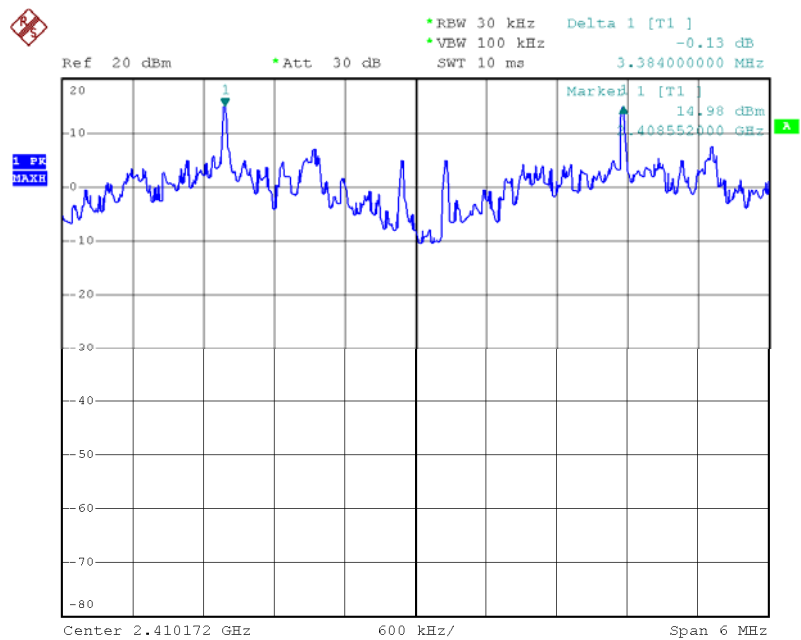
Test Channel	Separation (MHz)	Result
Low	3.384	PASS
Middle	3.384	PASS
High	3.384	PASS

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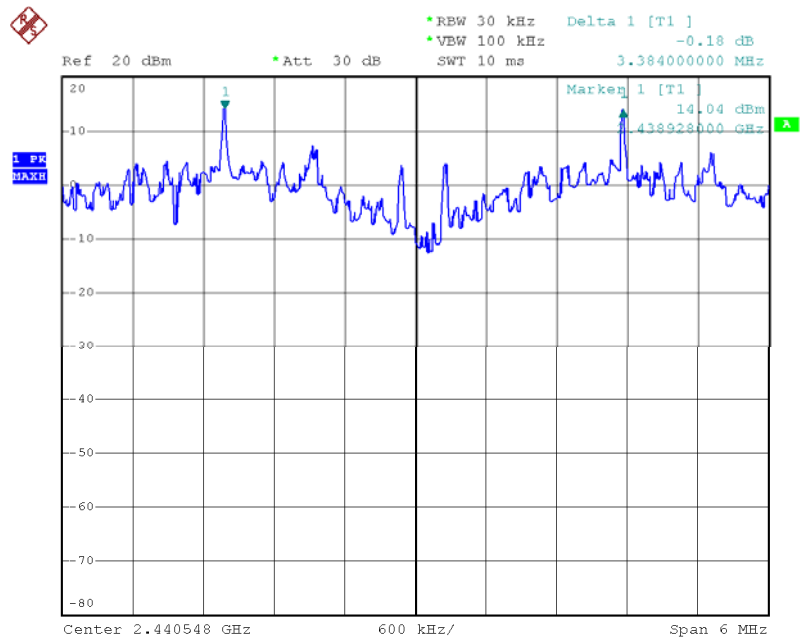
FCC ID: LE2RFB02

Test result plot as follows:

Low Channel:



Middle Channel



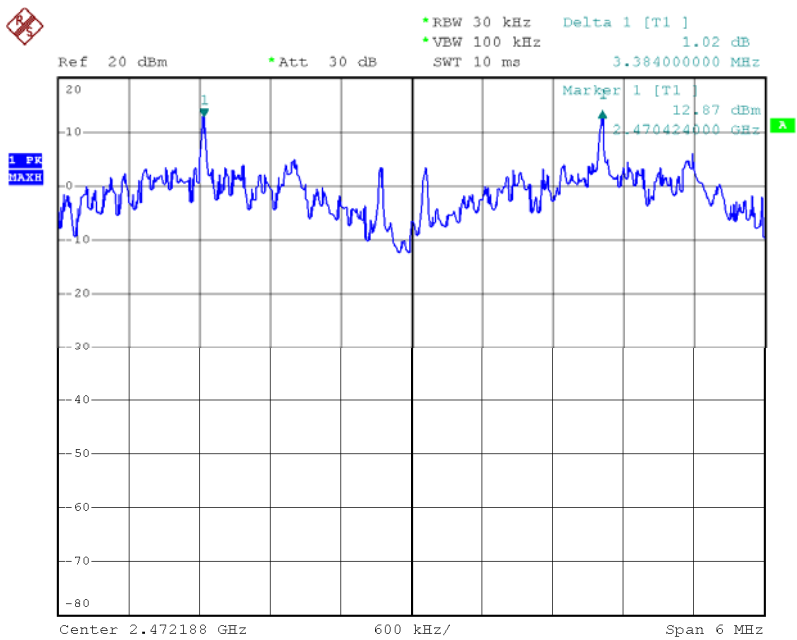
WALTEK SERVICES

Reference No.: WT11116044-D-E-F

JSW Pacific Corporation

FCC ID: LE2RFB02

High Channel



WALTEK SERVICES

Reference No.: WT11116044-D-E-F

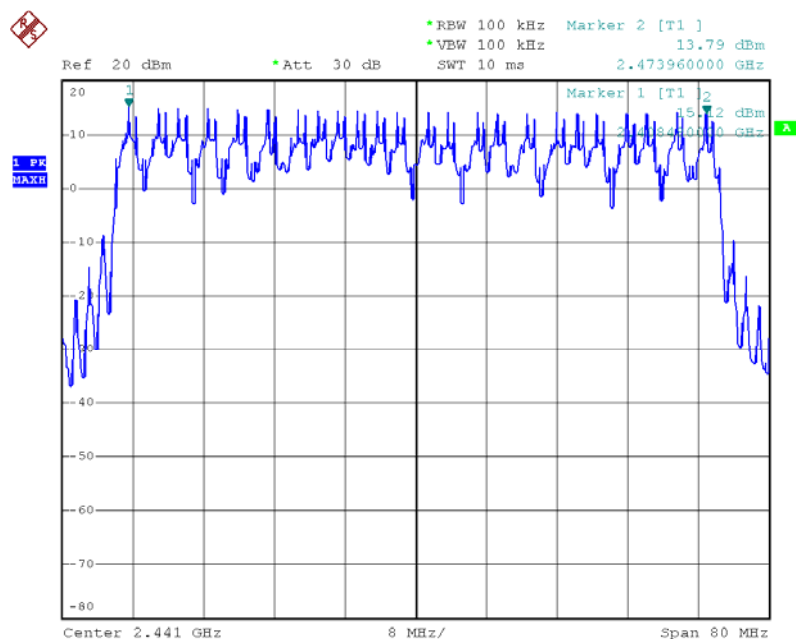
12 Number of Hopping Frequency

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 24 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: $T = 0.4(s) * 24 = 9.6 (s)$

So, the Dwell Time can be calculated as follows:

Dwell time = $9.6 * 8 * (MkrDelta) / 1000$

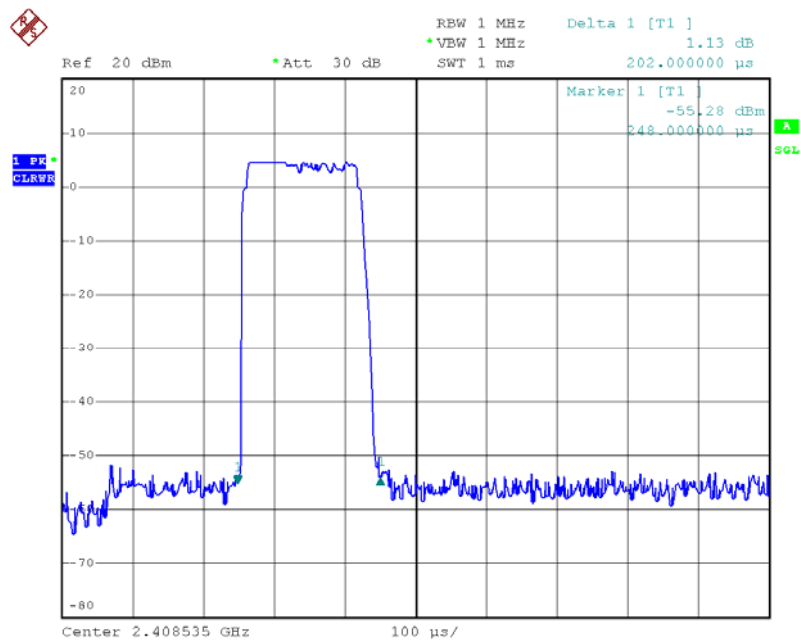
Note : Mkr Delta is once pulse time.

Frequency	Mkr Delta(ms)	Dwell Time(s)	Limits(s)	Result
2408 MHz	0.202	0.016	0.400	Pass
2439 MHz	0.214	0.016	0.400	Pass
2474 MHz	0.202	0.016	0.400	Pass

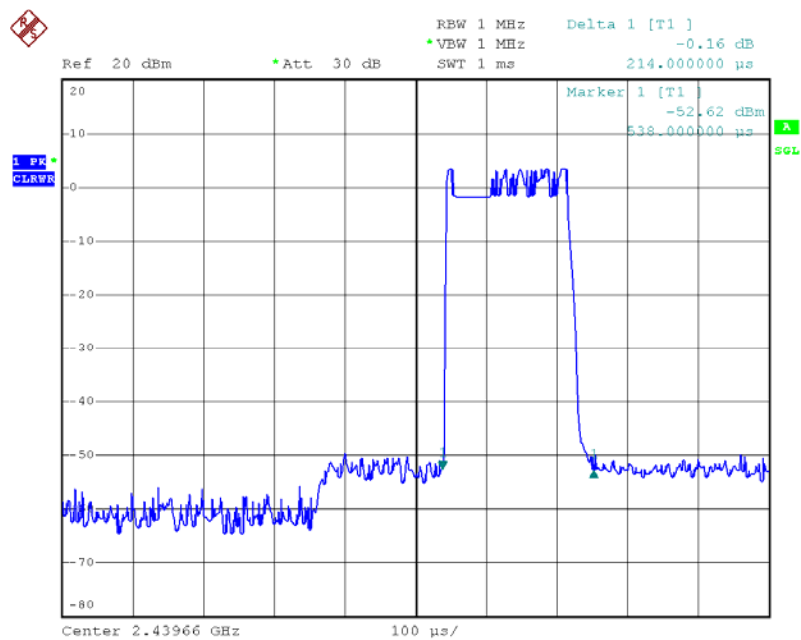
JSW Pacific Corporation

FCC ID: LE2RFB02

Low Channel: 2408MHz



Middle Channel: 2439MHz



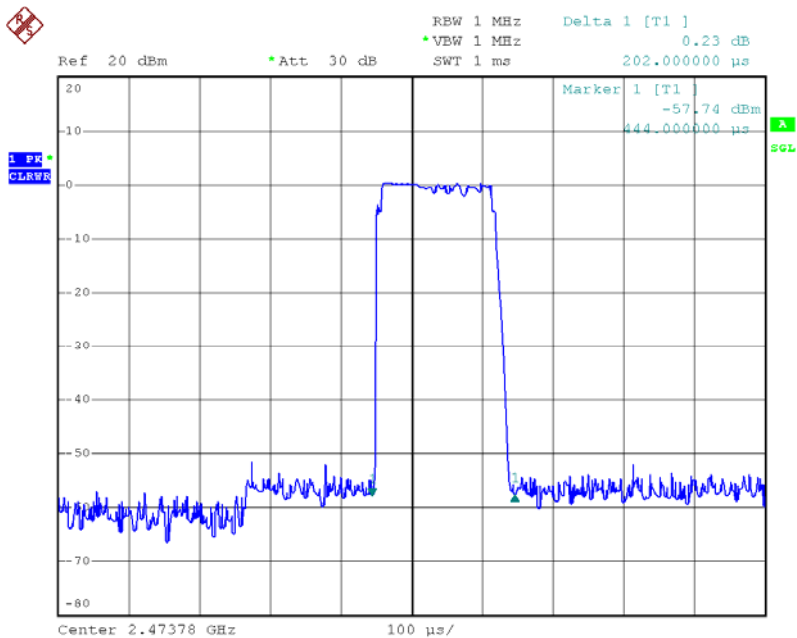
WALTEK SERVICES

Reference No.: WT11116044-D-E-F

JSW Pacific Corporation

FCC ID: LE2RFB02

High Channel: 2474MHz



WALTEK SERVICES

Reference No.: WT11116044-D-E-F

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.

The directional gains 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).

Requirements:

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

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

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

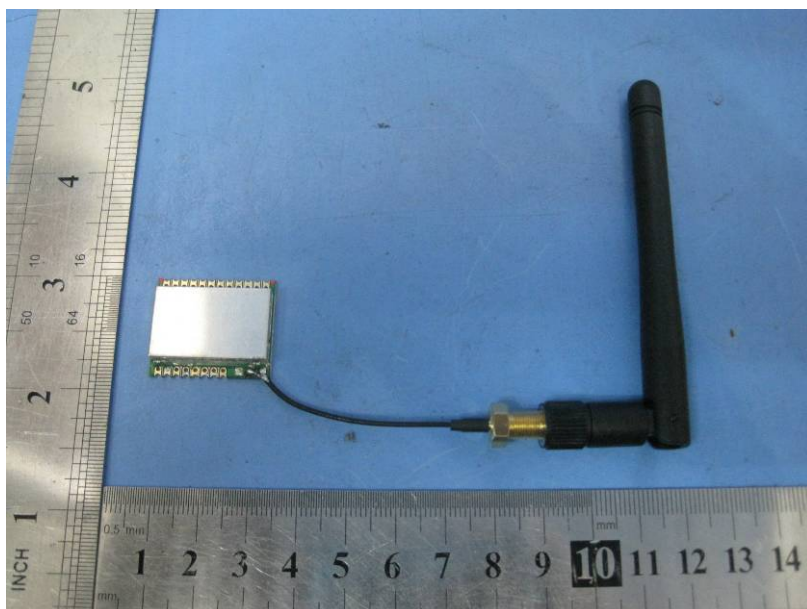
$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

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

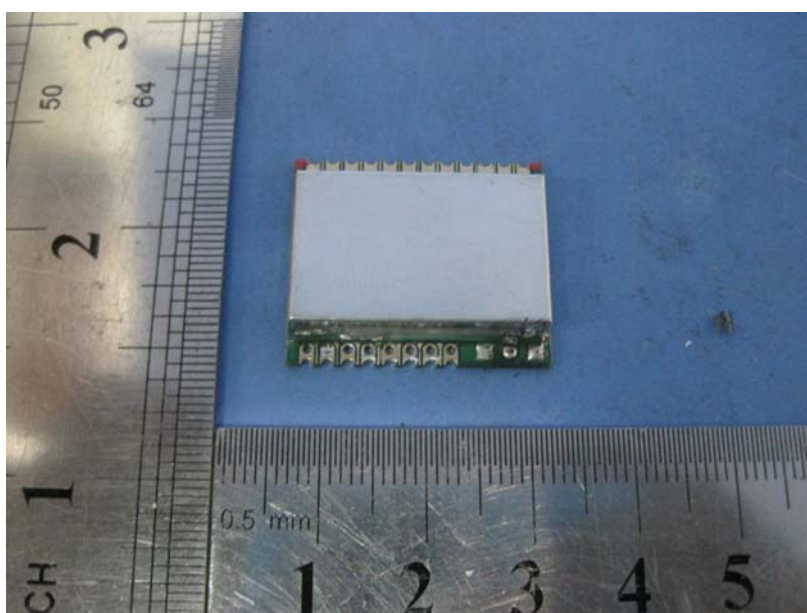
Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3	1.995	16.32	42.854852	0.017008	1	Complies
3	1.995	14.82	30.338912	0.012041	1	Complies
3	1.995	13.41	21.928049	0.008703	1	Complies

16 Photographs - Constructional Details

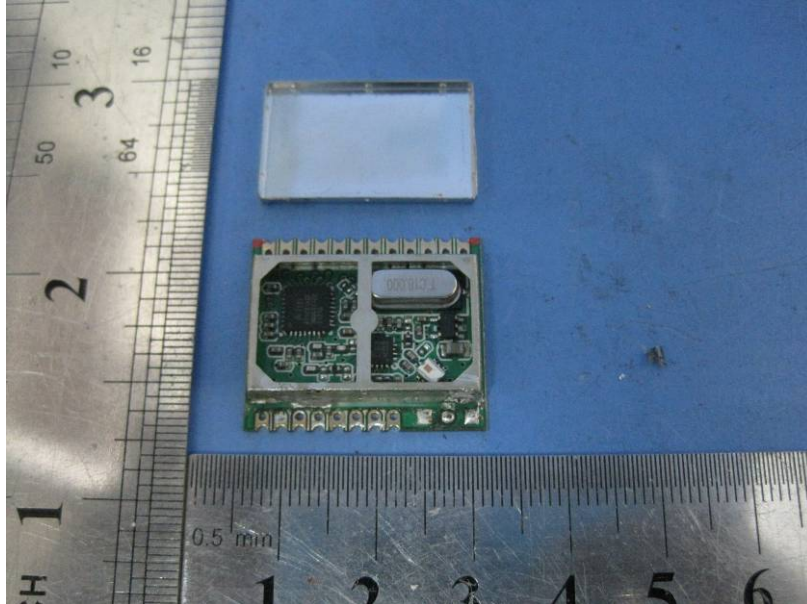
16.1 Product View



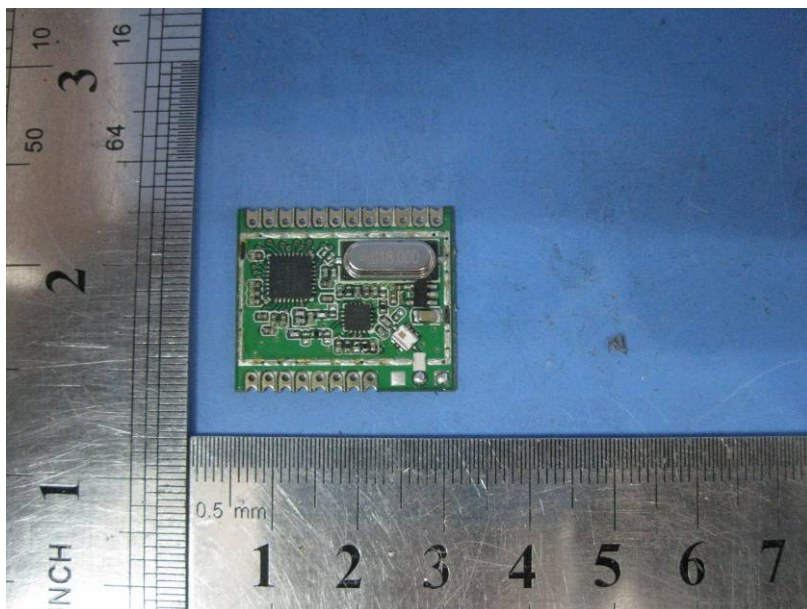
16.2 Module – Appearance View

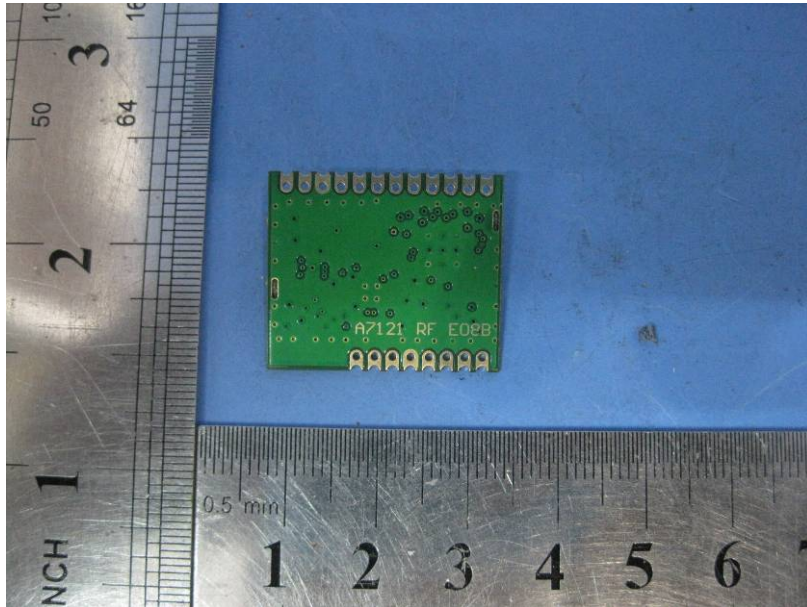


16.3 Module – Open View

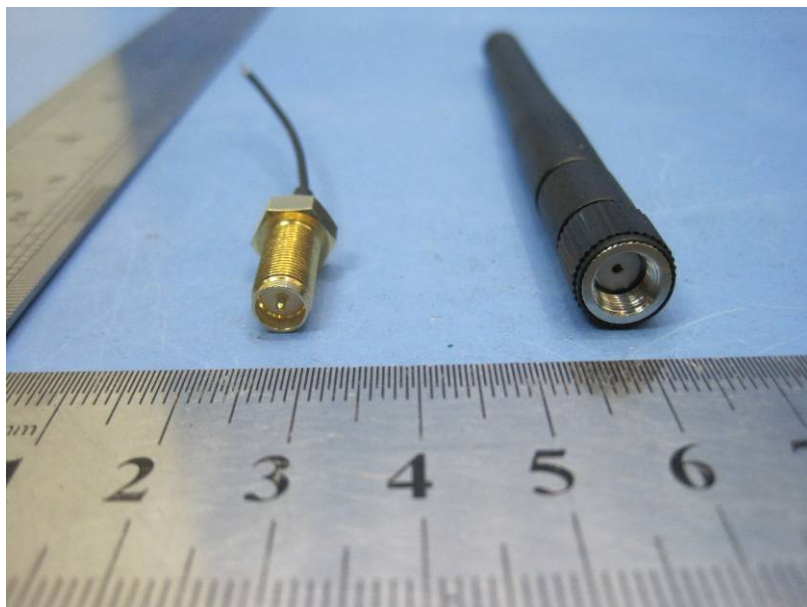


16.4 Module - PCB View



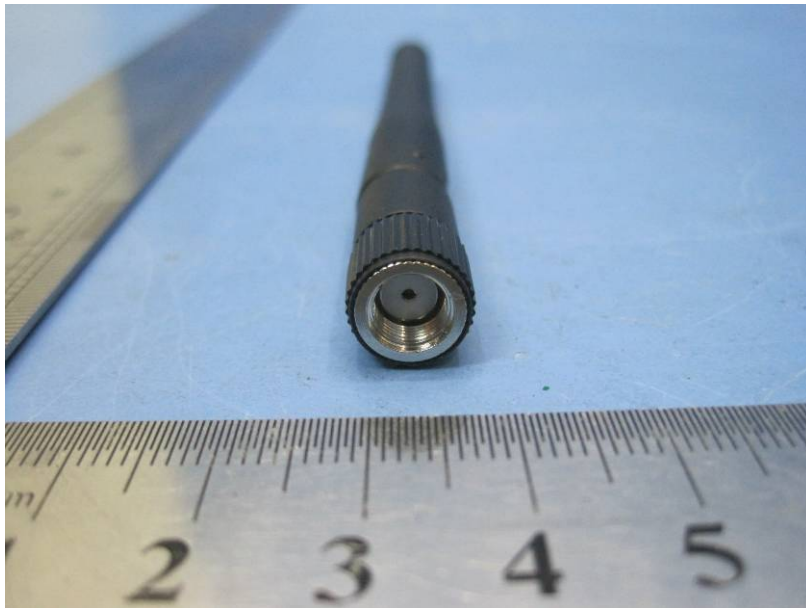
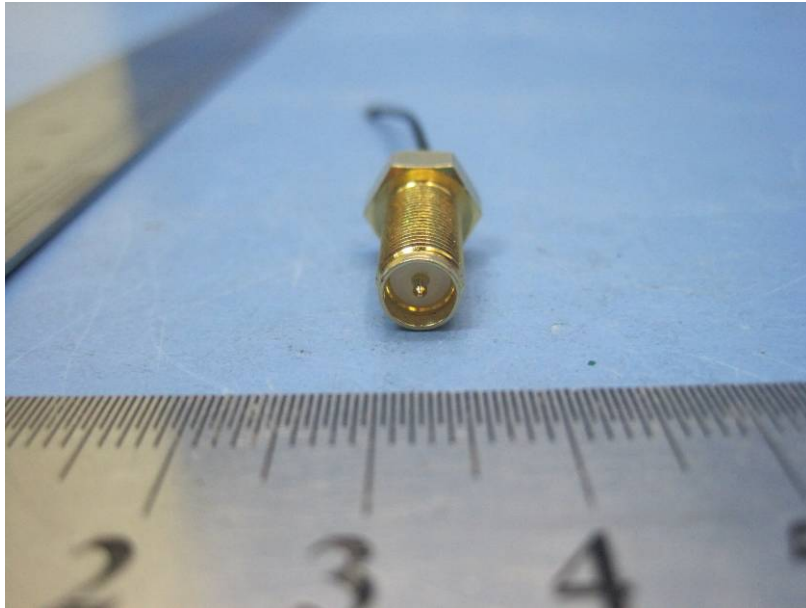


16.5 Antenna View



JSW Pacific Corporation

FCC ID: LE2RFB02



WALTEK SERVICES

Reference No.: WT11116044-D-E-F

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

