CONFORMANCE TEST REPORT
FOR
FCC 47 CFR, Part 15 Subpart C
and
Canada RSS-210

Report No.: 09-08-MAS-205

Client:	Helicomm Inc.
Product:	Embedded Wireless Module
Model:	IP-Link 1221-2264
FCC ID:	RF2IPLINK2264
IC ID:	8576A-IPLINK2264
Manufacturer/supplier:	Helicomm Inc.

Date test item received:	2009/08/26
Date test campaign completed:	2009/09/15
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Total number of pages of this test report: 43 pages
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Internal photos 2 pages
Setup photos 3 pages

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Client	: Helicomm Inc.
Address	: 6540 Lusk Blvd. Suite C155 San Diego, CA 92121
Manufacturer	: Helicomm Inc.
Address	: 6540 Lusk Blvd. Suite C155 San Diego, CA 92121
EUT	: Embedded Wireless Module
Trade name	: Helicomm
Model No.	: IP-Link 1221-2264
Power Source	: 3.6Vdc
Regulations applied	: FCC 47 CFR, Part 15 Subpart C (2008)
	Canada RSS-210 Issue 7 (2007) / RSS-Gen Issue 2 (2007)

The testing described in this report has been carried out to the best of our knowledge and ability, and our responsibility is limited to the exercise of reasonable care. This certification is not intended to believe the sellers from their legal and/or contractual obligations.

The compliance test is only certified for the test equipment and the results of the testing report relate only to the item tested. The compliance test of this report was conducted in accordance with the appropriate standards. It's not intention to assure the quality and performance of the product. This report shall not be reproduced except in full, without the approval of ETC. This report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

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② ISO/IEC 17025: BSMI, CNLA, NCC, NVLAP, CCIBLAC, UL, Compliance

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④ MRA: Australia, Hong Kong, New Zealand, Singapore, USA, Japan, Korea, China, APLAC through TAF

⑤ FCC Registration Number: 90588, 91094, 91095

NVLAP Lab Code 200133-0

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1 GENERAL INFORMATION

1.1 Product Description

a) Type of EUT : Embedded Wireless Module

b) Trade Name : Helicomm

c) Model No. : IP-Link 1221-2264

1.2 Characteristics of Device

The EUT is a Embedded Wireless Module. Frequency range is 2405 ~ 2480 MHz at interval of 5 MHz. Modulation Type is DSSS. Each IP-Link embedded module includes an IEEE 802.15.4-compliant radio, an 8051-based microcontroller, programmable I/O and our ZigBee-Compliant IP-Net networking firmware. IP-Link Modules support mesh, star and hybrid networking topologies and come with Helicomm's ZigBee-Compliant IP-Net firmware.

Channel	Frequency (MHz)
Low	2405
Mid	2440
High	2480

1.3 Test Methodology

All testing were performed according to the procedures in ANSI C63.4 (2003) and FCC CFR 47 Part 2 and Part 15.

1.4 Test Facility

The semi-anechoic chamber and conducted measurement facility used to collect the radiated and conducted data are located inside the Building at No.8, Lane 29, Wen-ming Road, Lo-shan Tsun, Kweishan Hsiang, Taoyuan, Taiwan, R.O.C.

This site has been accreditation as a FCC filing site.

1.5 Test Summary

Requirement	FCC Paragraph #	IC Paragraph #	Test Pass
Antenna Requirement	15.203	RSS-Gen_7.1.4	☒
Conducted Emission	15.207	RSS-Gen_7.2.2	☒
Emission Bandwidth	15.247 (a)(2)	RSS-210_A8.2 (a)	☒
Output Power Requirement	15.247 (b)	RSS-210_A8.4 (4)	☒
Power Density Requirement	15.247 (e)	RSS-210_A8.2 (b)	☒
Spurious Emissions	15.247 (d)	RSS-210_A8.5	☒
Radiated Emission	15.247 (d)	RSS-210_2.2	☒

2 PROVISIONS APPLICABLE

2.1 Definition

Unintentional radiator:
A device that intentionally generates and radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction.

Class A Digital Device:
A digital device which is marketed for use in commercial or business environment; exclusive of a device which is market for use by the general public, or which is intended to be used in the home.

Class B Digital Device :
A digital device which is marketed for use in a residential environment notwithstanding use in a commercial, business of industrial environment. Example of such devices that are marketed for the general public.

Note : A manufacturer may also qualify a device intended to be marketed in a commercial, business, or industrial environment as a Class B digital device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B Digital Device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B Digital Device, Regardless of its intended use.

Intentional radiator:
A device that intentionally generates and emits radio frequency energy by radiation or induction.

2.2 Requirement for Compliance

(1) Conducted Emission Requirement

For unintentional device, according to §15.107(a) Line Conducted Emission Limits is as following:

Frequency MHz	Quasi Peak dB μV	Average dB μV
0.15 - 0.5	66-56*	56-46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

*Decreases with the logarithm of the frequency.

For intentional device, according to §15.207(a) Line Conducted Emission Limits is same as above table.

(2) Radiated Emission Requirement

For unintentional device, according to §15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency MHz	Distance Meters	Radiated dB μV/m	Radiated μV/m
30 - 88	3	40.0	100
88 - 216	3	43.5	150
216 - 960	3	46.0	200
above 960	3	54.0	500

For intentional device, according to §15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

(3) Antenna Requirement

For intentional device, according to §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.

(4) Bandwidth Requirement

According to 15.247 (a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

(5) Output Power Requirement

For systems using digital modulation , according to 15.247(b), the maximum peak output power of the intentional radiator shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(6) Spurious Emissions Measurement

According to 15.247 (c) , 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. Attenuation below the general limits specified in Section 15.209(a) is not required. 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)).

(7) Power Density Requirement

According to 15.247 (d) , for digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission..

2.3 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.25
0.495 - 0.505 **	16.69475 - 16.69525	608-614	5.35-5.46
2.1735 - 2.1905	16.80425 - 16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475 - 156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

** : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

2.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device :

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

2.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual.

The Federal Communications Commission Radio Frequency Interference Statement includes the following paragraph.

This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio / TV technician for help.

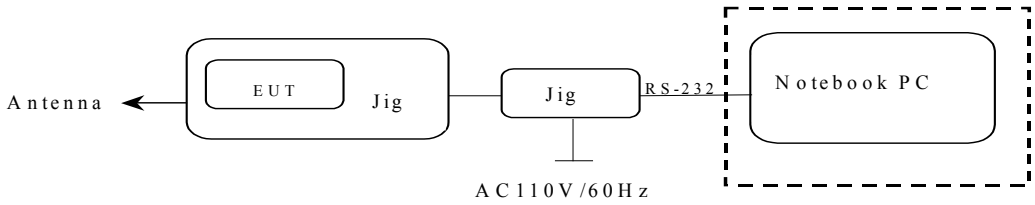
3. SYSTEM TEST CONFIGURATION

3.1 Devices for Tested System

3.1.1 H/W

Device	Manufacture	Model No.	Cable Description
Embedded Wireless Module*	Helicomm Inc.	IP-Link 1221-2264	0.3m Unshielded Line/Antenna
Notebook PC	HP	nx6320	1.8m Unshielded RS-232 Cable
Jig	N/A	N/A	8cm Unshielded Signal Line 1.8m Unshielded Power Line
Jig	N/A	N/A	----

Remark: "*" means equipment under test.



Note: A HP notebook performs the control test mode. The notebook removes away after the control command is ready.

3.1.2 S/W

Test Software:	macTools.exe
Parameter setting:	0x1F 0dBm

4 CONDUCTED EMISSION MEASUREMENT

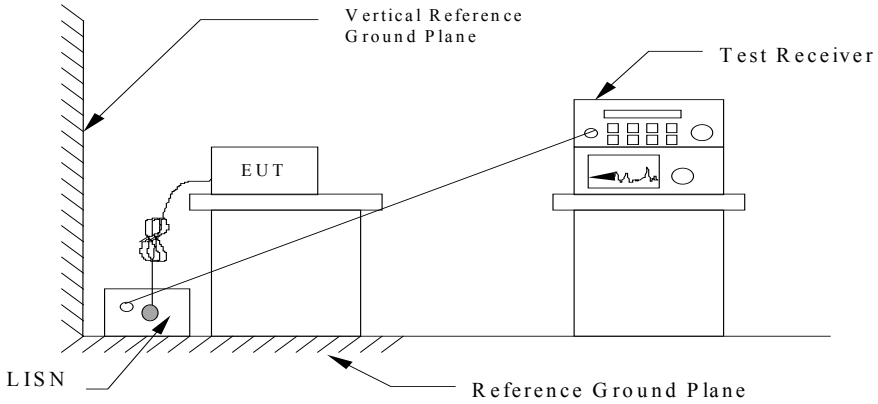
4.1 Standard Applicable

For unintentional and intentional device, Line Conducted Emission Limits are in accordance to § 15.107(a) and §15.207(a) respectively. Both Limits are identical specification.

4.2 Measurement Procedure

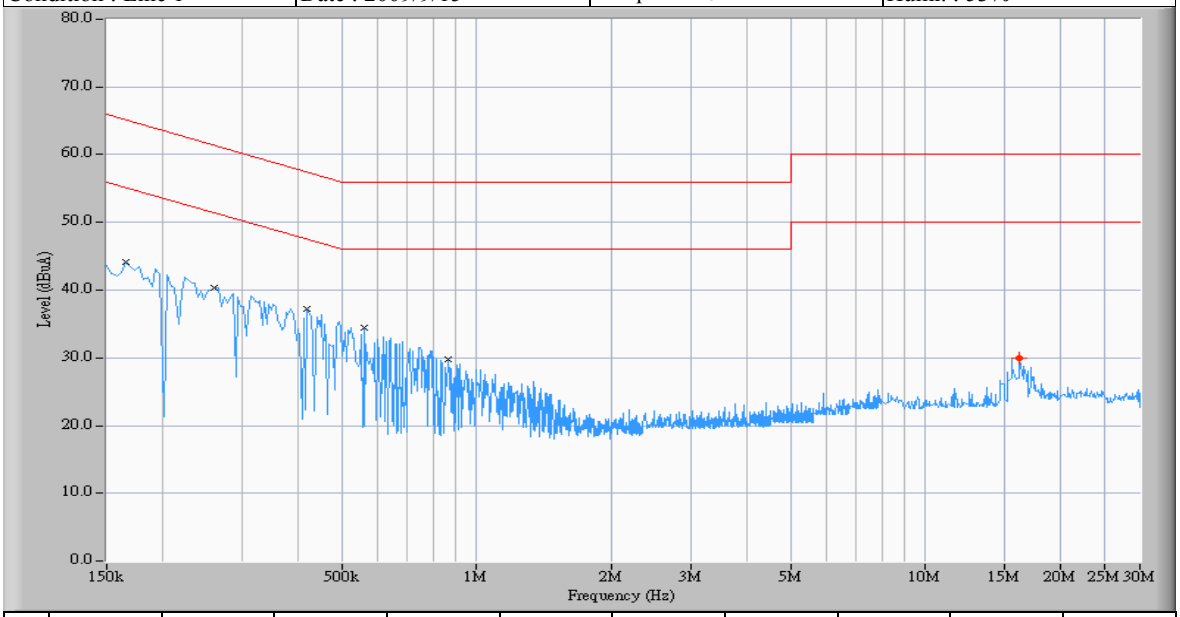
1. Setup the configuration per figure 1.
2. A preliminary scan with a spectrum monitor is performed to identify the frequency of emission that has the highest amplitude relative to the limit by operating the EUT in selected modes of operation, typical cable positions, and with a typical system configuration.
3. Record the 6 highest emissions relative to the limit.
4. Measure each frequency obtained from step 3 by a test receiver set on quasi peak detector function, and then record the accuracy frequency and emission level. If all emissions measured in the specified band are attenuated more than 20 dB from the limit, this step would be ignored, and the peak detector function would be used.
5. Confirm the highest three emissions with variation of the EUT cable configuration and record the final data.
6. Repeat all above procedures on measuring each operation mode of EUT.

Figure 1 : Conducted emissions measurement configuration



4.3 Conducted Emission Data

EUT :	Model : IP-Link 1221-2264	Status :	
Condition : Line 1	Date : 2009/9/15	Temp. : 22℃	Humi. : 53%

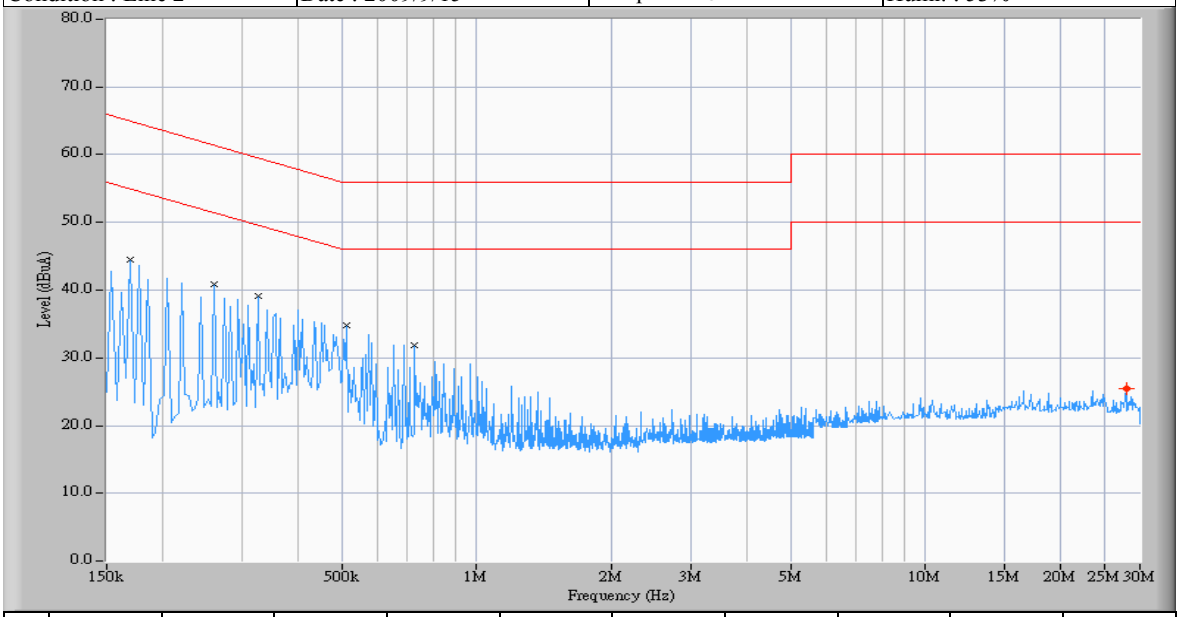


	Freq (MHz)	QP Level (dBuA)	AVG Level (dBuA)	Factor (dB)	QP Result (dBuA)	AVG Result (dBuA)	QP Limit (dBuA)	AVG Limit (dBuA)	QP Margin (dB)	AVG Margin (dB)
1	0.166	44.2	----	0.3	44.5	----	65.2	55.2	-20.7	----
2	0.259	40.4	----	0.2	40.6	----	61.5	51.5	-20.9	----
3	0.420	37.2	----	0.2	37.4	----	57.5	47.5	-20.1	----
4	0.560	34.5	----	0.2	34.7	----	56.0	46.0	-21.3	----
5	0.861	29.9	----	0.2	30.1	----	56.0	46.0	-25.9	----
6	16.212	29.9	----	0.4	30.3	----	60.0	50.0	-29.7	----

Note:

1. Place of measurement: EMC LAB. of the ETC.
2. "***" means the value was too low to be measured.
3. If the data table appeared symbol of "----" means the Q.P. value is under the limit of AVG. so, the AVG. value doesn't need to be measured.
4. "#" means the noise was too low, so record the peak value.
5. The estimated measurement uncertainty of the result measurement is ±2.5dB.

EUT :	Model : IP-Link 1221-2264	Status :	
Condition : Line 2	Date : 2009/9/15	Temp. : 22℃	Humi. : 53%



	Freq (MHz)	QP Level (dBuA)	AVG Level (dBuA)	Factor (dB)	QP Result (dBuA)	AVG Result (dBuA)	QP Limit (dBuA)	AVG Limit (dBuA)	QP Margin (dB)	AVG Margin (dB)
1	0.170	44.5	----	0.3	44.8	----	65.0	55.0	-20.2	----
2	0.259	40.9	----	0.2	41.1	----	61.5	51.5	-20.4	----
3	0.326	39.1	----	0.2	39.3	----	59.6	49.6	-20.3	----
4	0.513	34.8	----	0.2	35.0	----	56.0	46.0	-21.0	----
5	0.728	31.8	----	0.2	32.0	----	56.0	46.0	-24.0	----
6	27.935	25.4	----	0.5	25.9	----	60.0	50.0	-34.1	----

Note:

1. Place of measurement: EMC LAB. of the ETC.
2. "***" means the value was too low to be measured.
3. If the data table appeared symbol of "----" means the Q.P. value is under the limit of AVG. so, the AVG. value doesn't need to be measured.
4. "#" means the noise was too low, so record the peak value.
5. The estimated measurement uncertainty of the result measurement is ±2.5dB.

4.4 Result Data Calculation

The result data is calculated by adding the LISN Factor to the measured reading. The basic equation with a sample calculation is as follows:

RESULT = READING + LISN FACTOR (Included Cable Loss)

4.5 Conducted Measurement Equipment

The following test equipment are used during the conducted test.

Equipment	Manufacturer	Model No.	Next Cal. Due
RF Test Receiver	Rohde and Schwarz	ESCS30	08/22/2010
LISN	EMCO	37100/2M	02/11/2010

5 ANTENNA REQUIREMENT

5.1 Standard Applicable

For intentional device, according to §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 §15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2 Antenna Construction and Directional Gain

Antenna type: Dipole Antenna.
Antenna gain: 3 dBi.

6 EMISSION BANDWIDTH MEASUREMENT

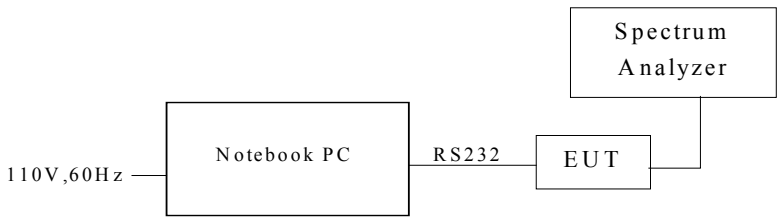
6.1 Standard Applicable

According to 15.247(a)(2), system using digital modulation techniques, the minimum 6dB bandwidth shall be at least 500 kHz.

6.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 2. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Figure 2: Emission bandwidth measurement configuration.



6.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Agilent	E4446A	09/30/2009

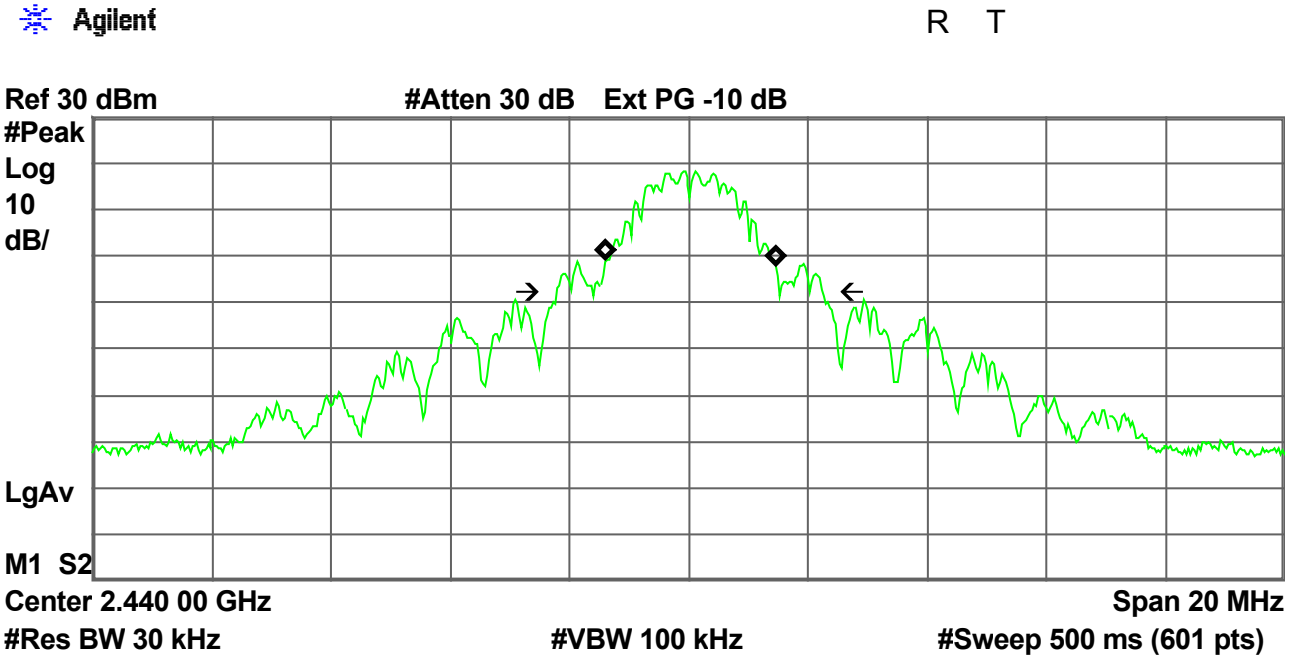
6.4 Measurement Data

Test Date: Aug. 27, 2009 Temperature: 28℃ Humidity: 56 %

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	FCC Limit (kHz)	Chart
Low	2405	1.75	500	Page 19
Mid	2440	1.75	500	Page 20
High	2480	1.75	500	Page 21

Note:

1.Please refer to page 18 to page 21 for chart
2. The estimated measurement uncertainty of the result measurement is 8.25×10^{-7} *(1GHz≦f≦ 18GHz)*



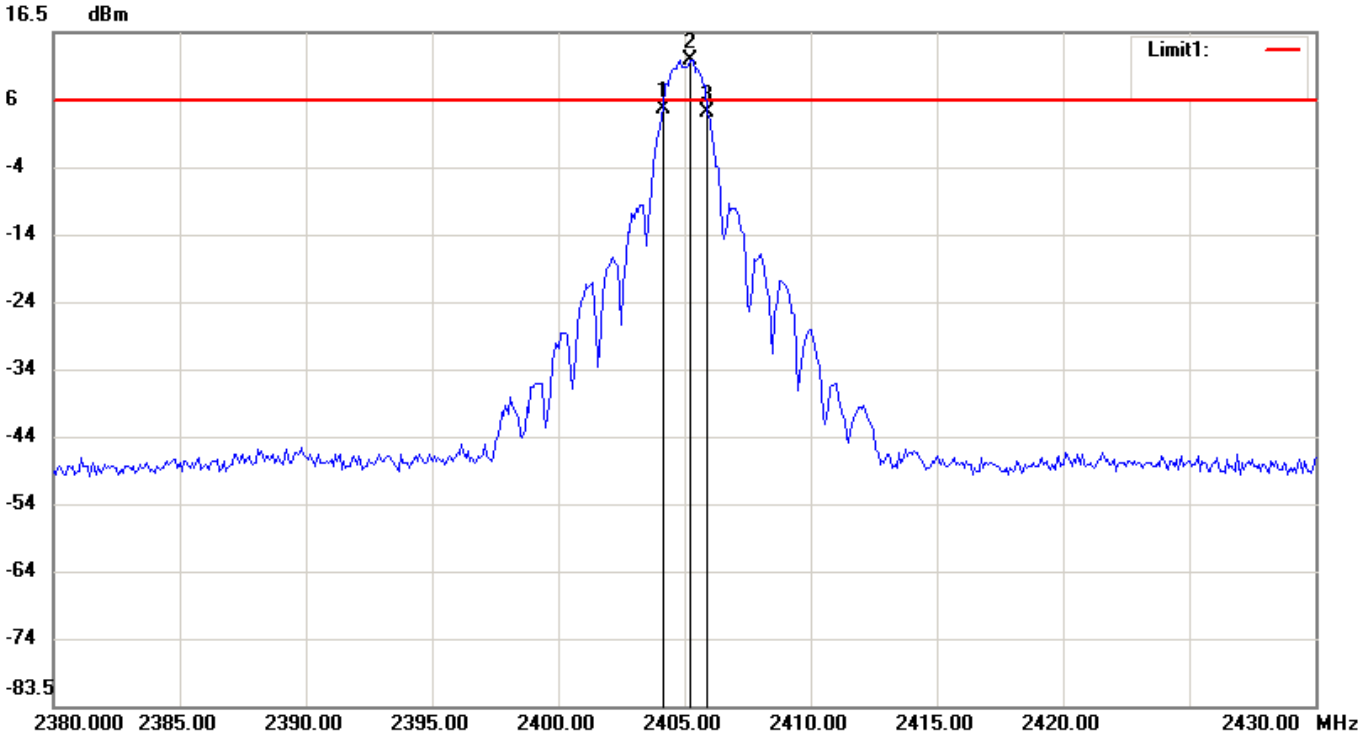
Occupied Bandwidth
2.8636 MHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error 36.417 kHz
x dB Bandwidth 4.448 MHz

File: ZIGBEE **Data: #36** **Date: 2009/8/27** **Temperature: 28 ℃**

Time: PM 02:54:00 **Humidity: 56 %**



Condition: **6.46dBm** **Horizontal**

EUT: **Sweep Time: 500ms** **Att.: 20dB**

Model: **RBW: 100 KHz** **VBW: 300 KHz**

Test Mode:

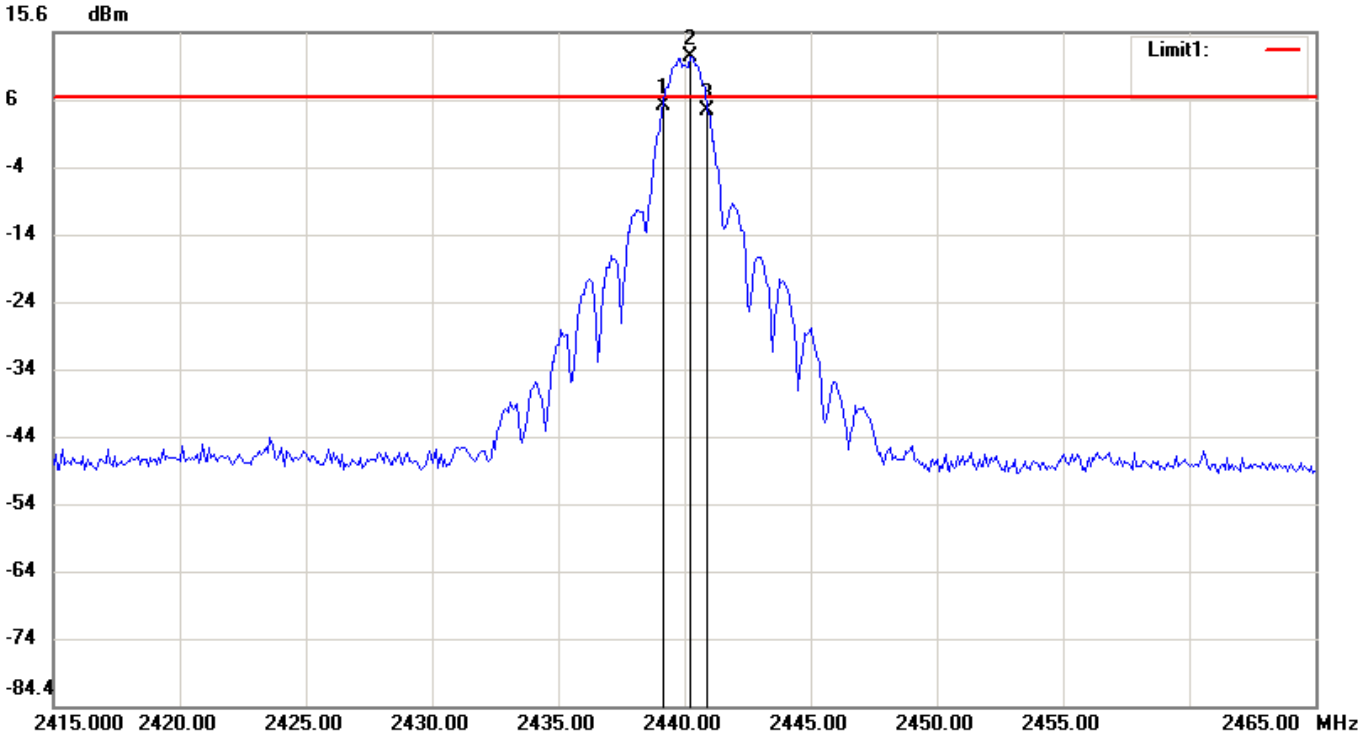
Note: **FCC-6dB EBW**

No.	Frequency(MHz)	Level(dBm)
1	2404.1667	5.18
2	2405.2500	12.46
3	2405.9167	4.57

No.		△Frequency(MHz)	△Level(dB)
1	mk3-mk1	1.75	-0.61

File: ZIGBEE **Data: #35** **Date: 2009/8/27** **Temperature: 28 ℃**

Time: PM 02:52:06 **Humidity: 56 %**



Condition: **5.87dBm** **Horizontal**

EUT: **Sweep Time: 500ms** **Att.: 20dB**

Model: **RBW: 100 KHz** **VBW: 300 KHz**

Test Mode:

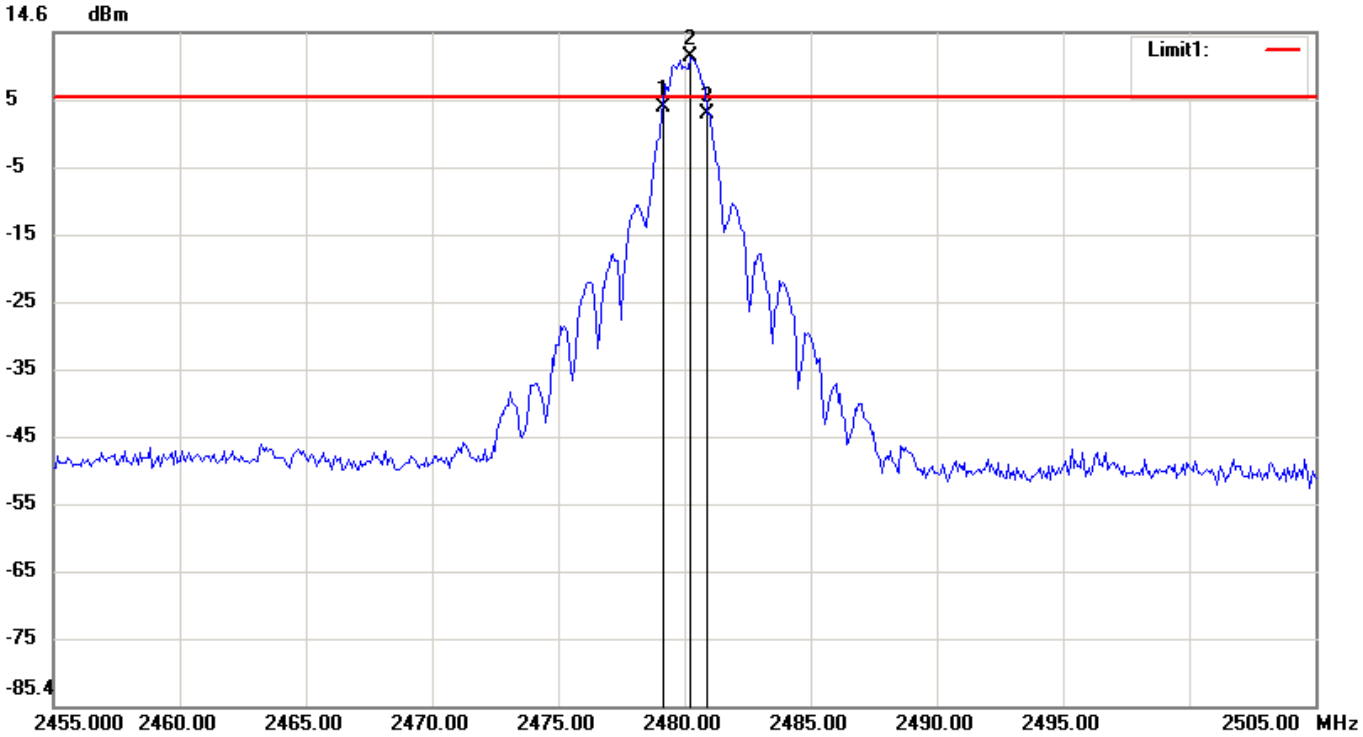
Note: **FCC-6dB EBW**

No.	Frequency(MHz)	Level(dBm)
1	2439.1667	4.71
2	2440.2500	11.87
3	2440.9167	3.95

No.		△Frequency(MHz)	△Level(dB)
1	mk3-mk1	1.75	-0.76

File: ZIGBEE **Data: #30** **Date: 2009/8/27** **Temperature: 28 ℃**

Time: PM 02:43:24 **Humidity: 56 %**



Condition: **5dBm** **Horizontal**

EUT: **Sweep Time: 500ms** **Att.: 20dB**

Model: **RBW: 100 KHz** **VBW: 300 KHz**

Test Mode:

Note: **FCC-6dB EBW**

No.	Frequency(MHz)	Level(dBm)
1	2479.1667	3.58
2	2480.2500	11.00
3	2480.9167	2.54

No.		△Frequency(MHz)	△Level(dB)
1	mk3-mk1	1.75	-1.04

7 OUTPUT POWER MEASUREMENT

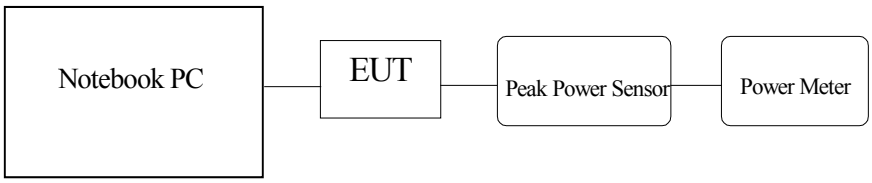
7.1 Standard Applicable

For direct sequence system, according to 15.247(b), the maximum peak output power of the transmitter shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 3. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range.
3. Measure the highest value appearing on power meter and record the level to calculate result data.
4. Repeat above procedures until all frequencies measured were complete.

Figure 3: Output power measurement configuration.



7.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Agilent	E4446A	09/30/2009
Power Meter	Boonton	4532-0102	05/13/2010
Peak Power Sensor	Boonton	57518	10/26/2009

7.4 Measurement Data

Test Date: Aug. 27, 2009 Temperature: 28℃ Humidity: 56 %

Channel	Frequency (MHz)	Maximum Peak Output Power (dBm)	Maximum Peak Output Power (mW)	FCC Limit (mW)	Chart
Low	2405	17.54	56.754	1000	-
Mid	2440	17.45	55.590	1000	-
High	2480	17.36	54.450	1000	-

Note:
The estimated measurement uncertainty of the result measurement is ±1.5dB(1GHz≦f≦18GHz)

8 POWER DENSITY MEASUREMENT

8.1 Standard Applicable

According to 15.247(d), for direct sequence systems, the transmitted power density averaged over any 1 second interval shall not be greater than 8 dBm in any 3 kHz bandwidth within these bands.

8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 2. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set EUT to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of spectrum analyzer on highest level appearing on spectral display within a 300 kHz frequency span.
4. Set the spectrum analyzer on a 3 kHz resolution bandwidth and 10 kHz video bandwidth as well as max. hold function, then record the measurement result.
5. Repeat above procedures until all measured frequencies were complete.

8.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Agilent	E4446A	09/30/2009

8.4 Measurement Data

Test Date: Aug. 27, 2009 Temperature: 28℃ Humidity: 56 %

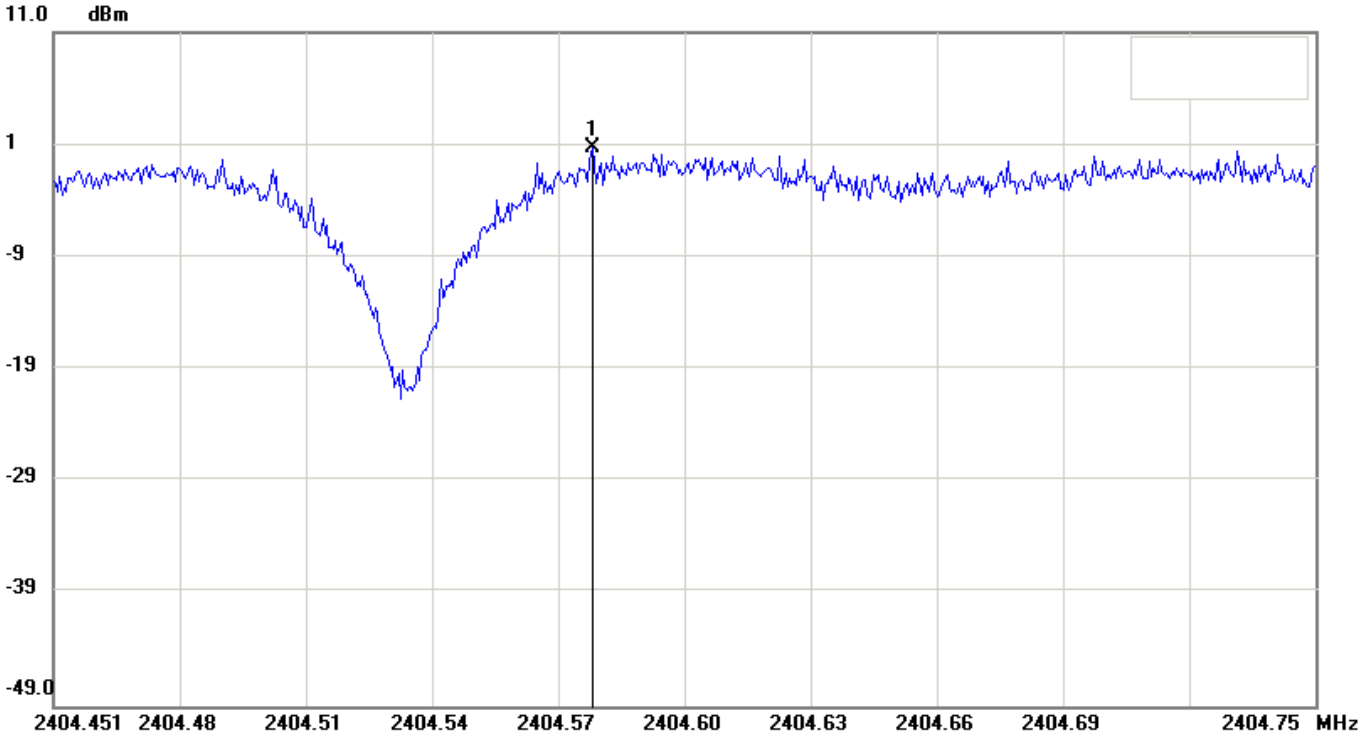
Channel	Frequency (MHz)	Peak Power Spectral Density (dBm)	FCC Limit (dBm)	Chart
Low	2405	0.65	8	Page 26
Mid	2440	-0.30	8	Page 27
High	2480	-0.91	8	Page 28

Note:

1. *Please refer to page 26 to page 28 for chart*
2. *The estimated measurement uncertainty of the result measurement is ±1.5dB(1GHz≦f≦ 18GHz)*

File: ZIGBEE **Data: #39** **Date: 2009/8/27** **Temperature: 28 ℃**

Time: PM 02:59:10 **Humidity: 56 %**



Condition: **Horizontal**

EUT: **Sweep Time: 100000ms Att.: 20dB**

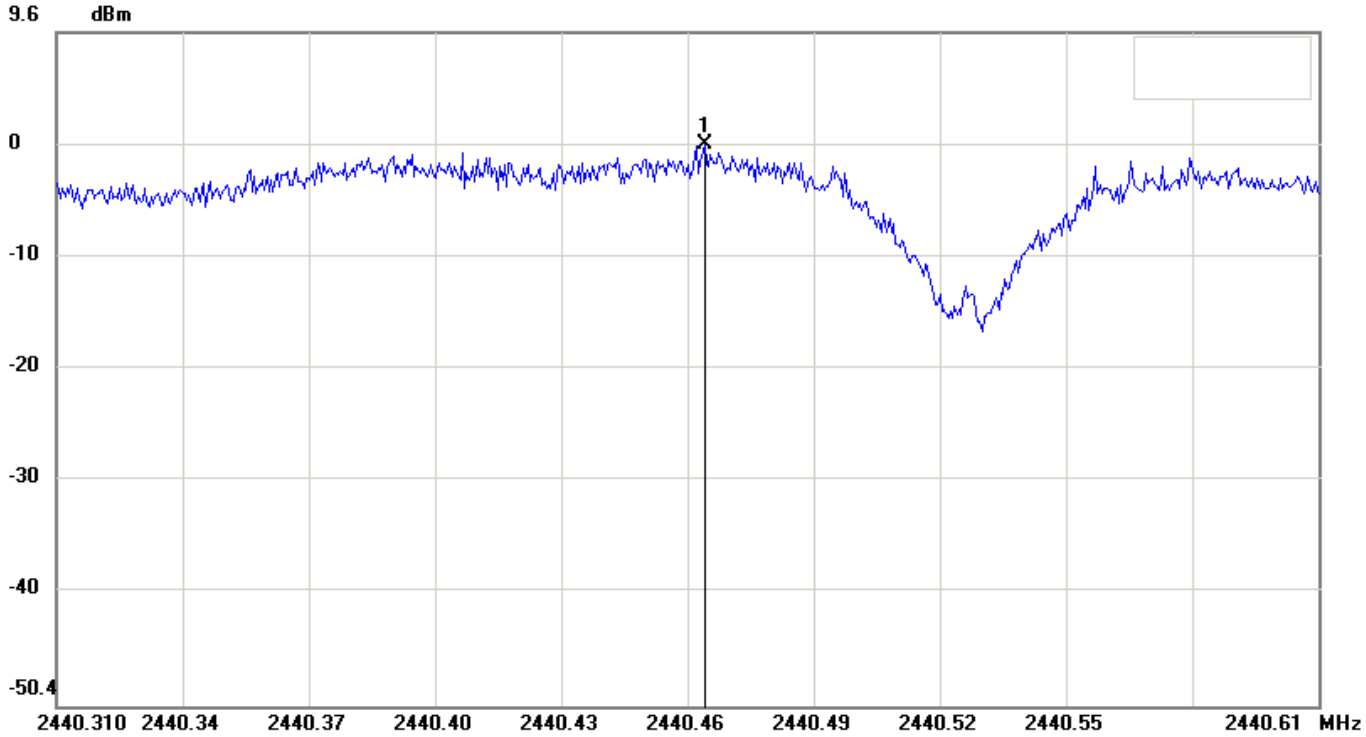
Model: **RBW: 3 KHz VBW: 10 KHz**

Test Mode:

Note: **FCC-Power Density (PK)**

No.	Frequency(MHz)	Level(dBm)
1	2404.5793	0.65

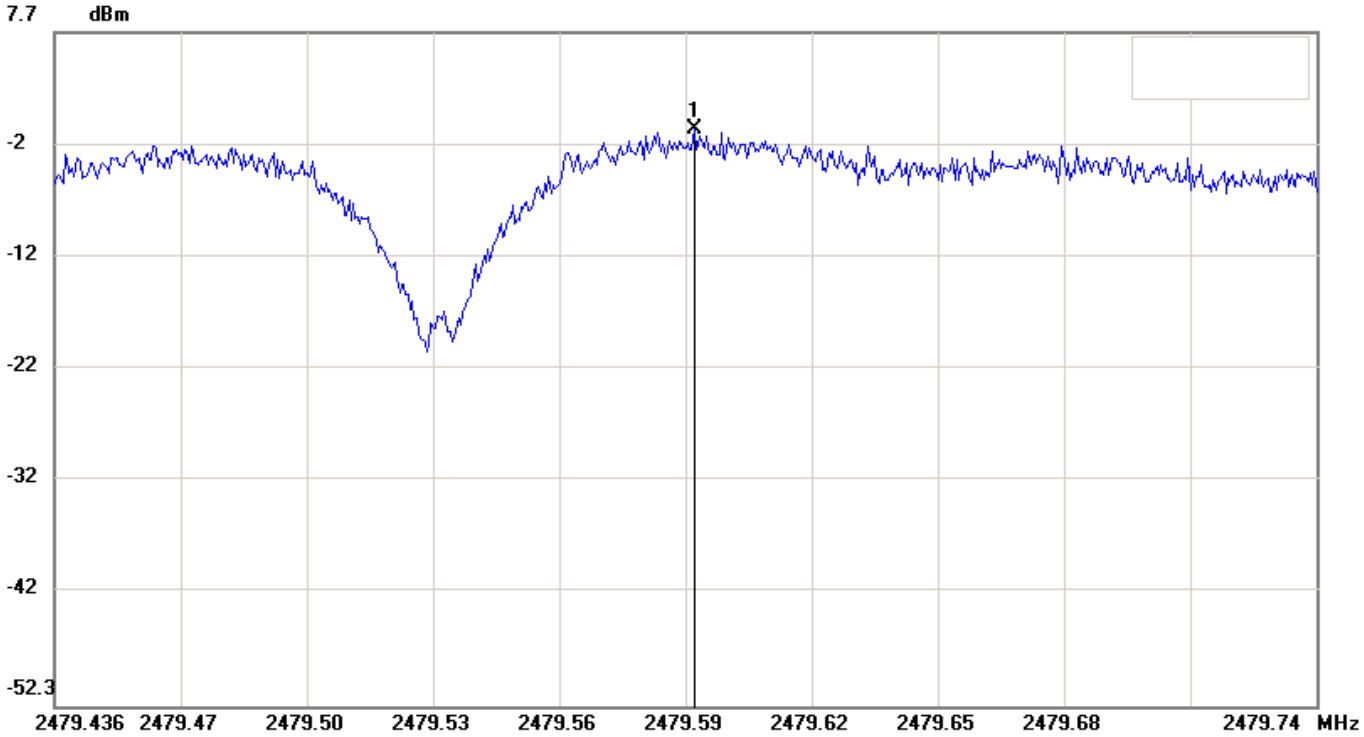
File: ZIGBEE **Data: #59** **Date: 2009/9/8** **Temperature: 28 ℃**
Time: AM 11:18:50 **Humidity: 49 %**



Condition: **RF Conducted**
EUT: **Sweep Time: 100000ms Att.: 10dB**
Model: **RBW: 3 KHz VBW: 10 KHz**
Test Mode:
Note: **FCC-802.11B Channel 07-Power Density (PK)**

No.	Frequency(MHz)	Level(dBm)
1	2440.4642	-0.30

File: ZIGBEE **Data: #63** **Date: 2009/9/8** **Temperature: 28 ℃**
Time: AM 11:25:31 **Humidity: 49 %**



Condition: **RF Conducted**
EUT: **Sweep Time: 100000ms Att.: 10dB**
Model: **RBW: 3 KHz VBW: 10 KHz**
Test Mode:
Note: **FCC-802.11B Channel 11-Power Density (PK)**

No.	Frequency(MHz)	Level(dBm)
1	2479.5885	-0.91

9 SPURIOUS EMISSION - RF CONDUCTED MEASUREMENT

9.1 Standard Applicable

According to 12.247 (c) , 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. Attenuation below the general limits specified in Section 15.209(a) is not required. 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)).

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 2. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

9.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Next Cal. Due
Spectrum Analyzer	Agilent	E4446A	09/30/2009

9.4 Measurement Data

Test Date: Sep. 08, 2009 Temperature: 28℃ Humidity: 49 %

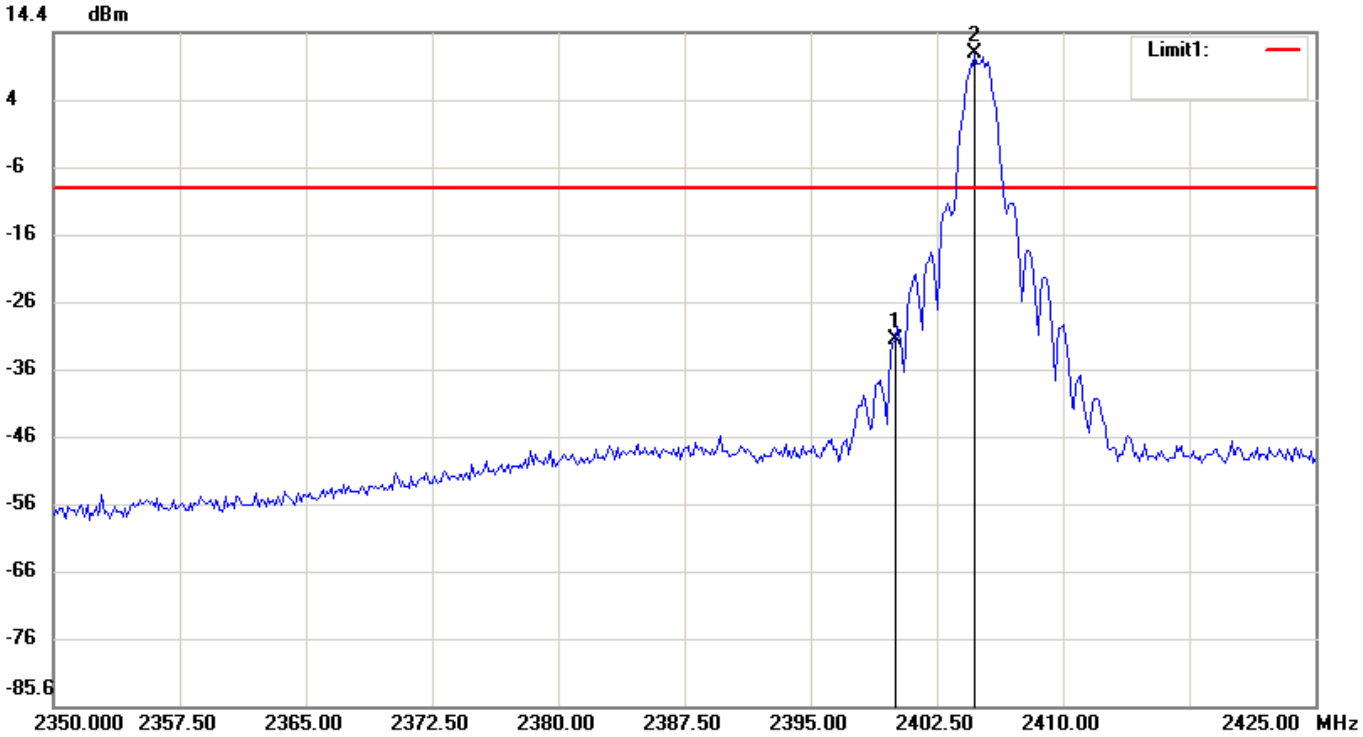
Channel	Frequency(MHz)	Chart
Low	2405	Page 31, Page 33
Mid	2440	Page 34
High	2480	Page 32 Page 35

All out-of –band conducted emissions were more than 20dB below the carrier.

Note: Please refer to page 31 to page 35 for chart

File: ZIGBEE **Data: #55** **Date: 2009/9/8** **Temperature: 28 ℃**

Time: AM 11:12:37 **Humidity: 49 %**



Condition: **-8.77dBm** **RF Conducted**

EUT: **Sweep Time: 500ms** **Att.: 20dB**

Model: **RBW: 100 KHz** **VBW: 300 KHz**

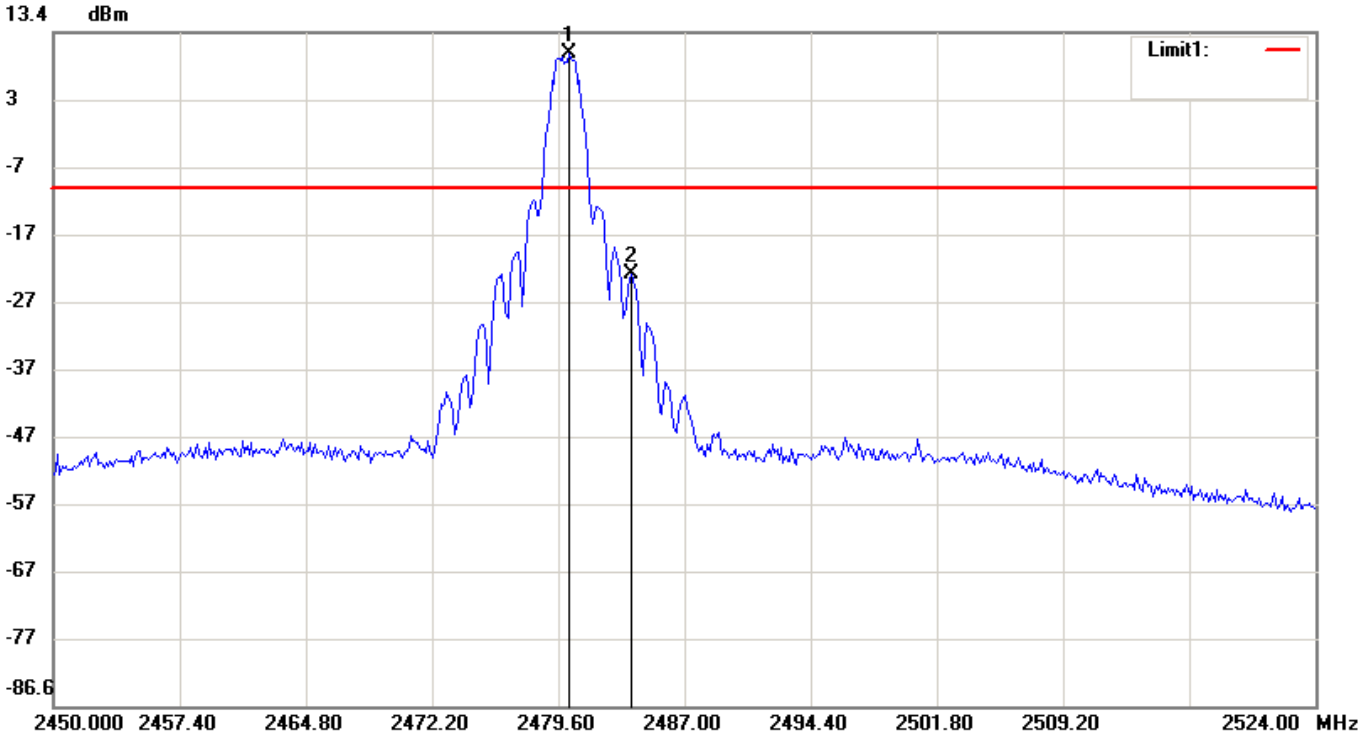
Test Mode:

Note: **FCC-802.11B Channel 01-Bandedge**

No.	Frequency(MHz)	Level(dBm)
1	2400.0000	-31.16
2	2404.7500	11.23

File: ZIGBEE **Data: #64** **Date: 2009/9/8** **Temperature: 28 ℃**

Time: AM 11:26:05 **Humidity: 49 %**



Condition: **-9.72dBm** **RF Conducted**

EUT: **Sweep Time: 500ms** **Att.: 20dB**

Model: **RBW: 100 KHz** **VBW: 300 KHz**

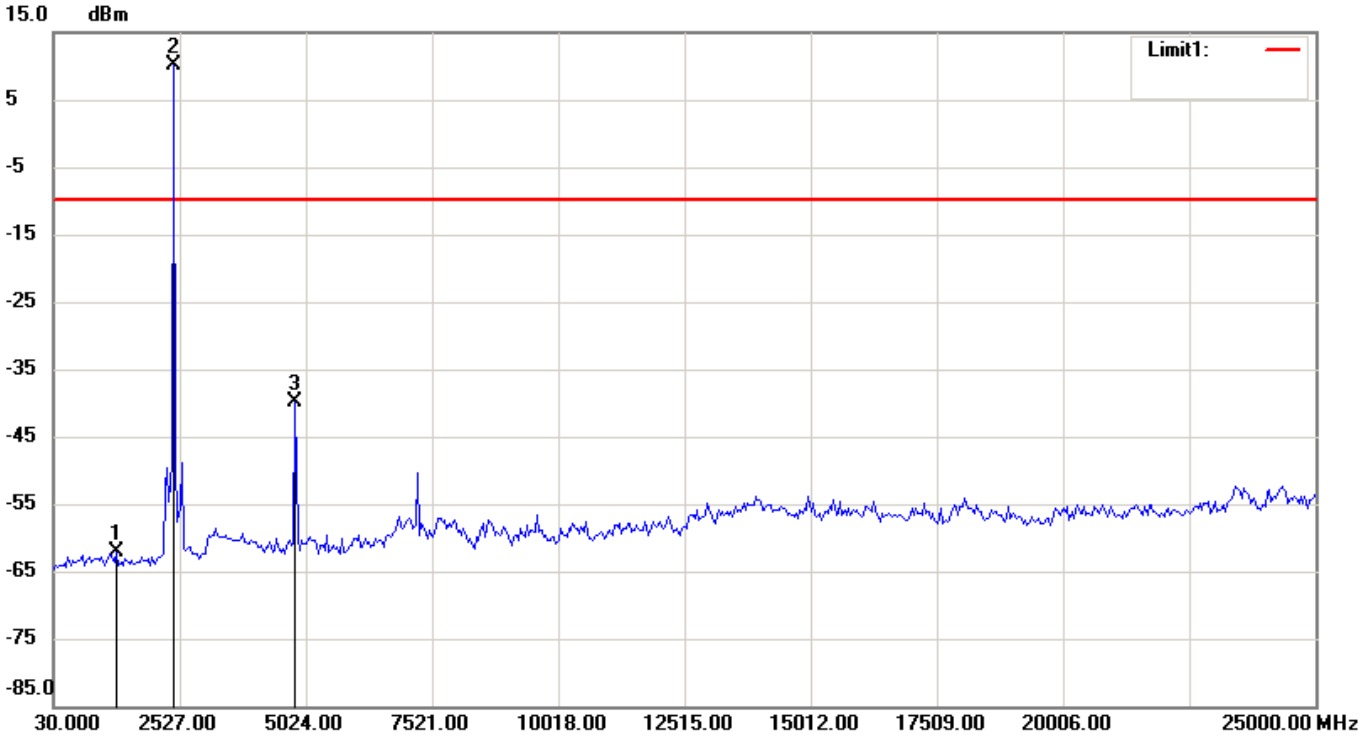
Test Mode:

Note: **FCC-802.11B Channel 11-Bandedge**

No.	Frequency(MHz)	Level(dBm)
1	2480.2167	10.28
2	2483.9167	-22.63

File: ZIGBEE **Data: #51** **Date: 2009/9/8** **Temperature: 28 ℃**

Time: AM 11:06:47 **Humidity: 49 %**



Condition: **-9.91dBm** **RF Conducted**

EUT: **Sweep Time: 2386.4ms Att.: 20dB**

Model: **RBW: 100 KHz VBW: 300 KHz**

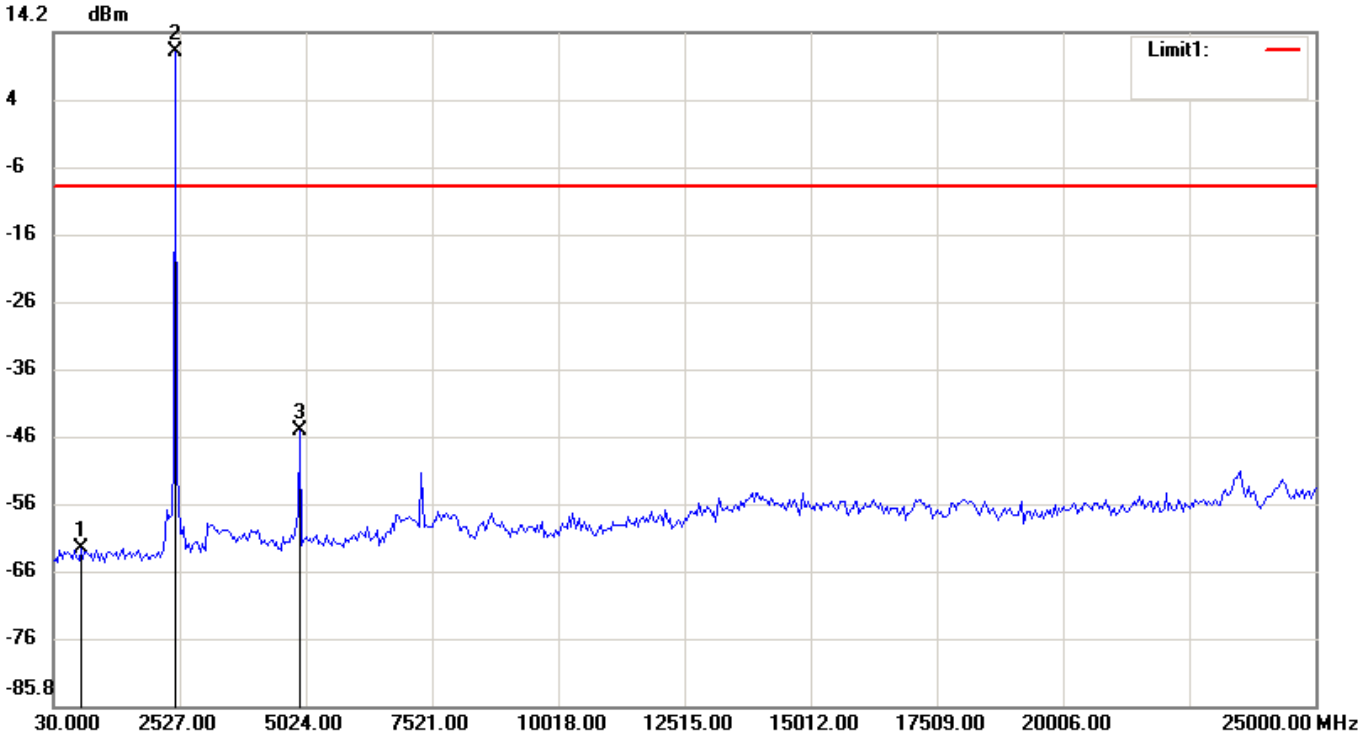
Test Mode:

Note: **FCC-802.11B Channel 01-Conducted Spurious**

No.	Frequency(MHz)	Level(dBm)
1	1278.5000	-62.03
2	2402.1500	10.09
3	4815.9167	-39.73

File: ZIGBEE **Data: #56** **Date: 2009/9/8** **Temperature: 28 ℃**

Time: AM 11:13:39 **Humidity: 49 %**



Condition: **-8.73dBm** **RF Conducted**

EUT: **Sweep Time: 2386.4ms Att.: 20dB**

Model: **RBW: 100 KHz VBW: 300 KHz**

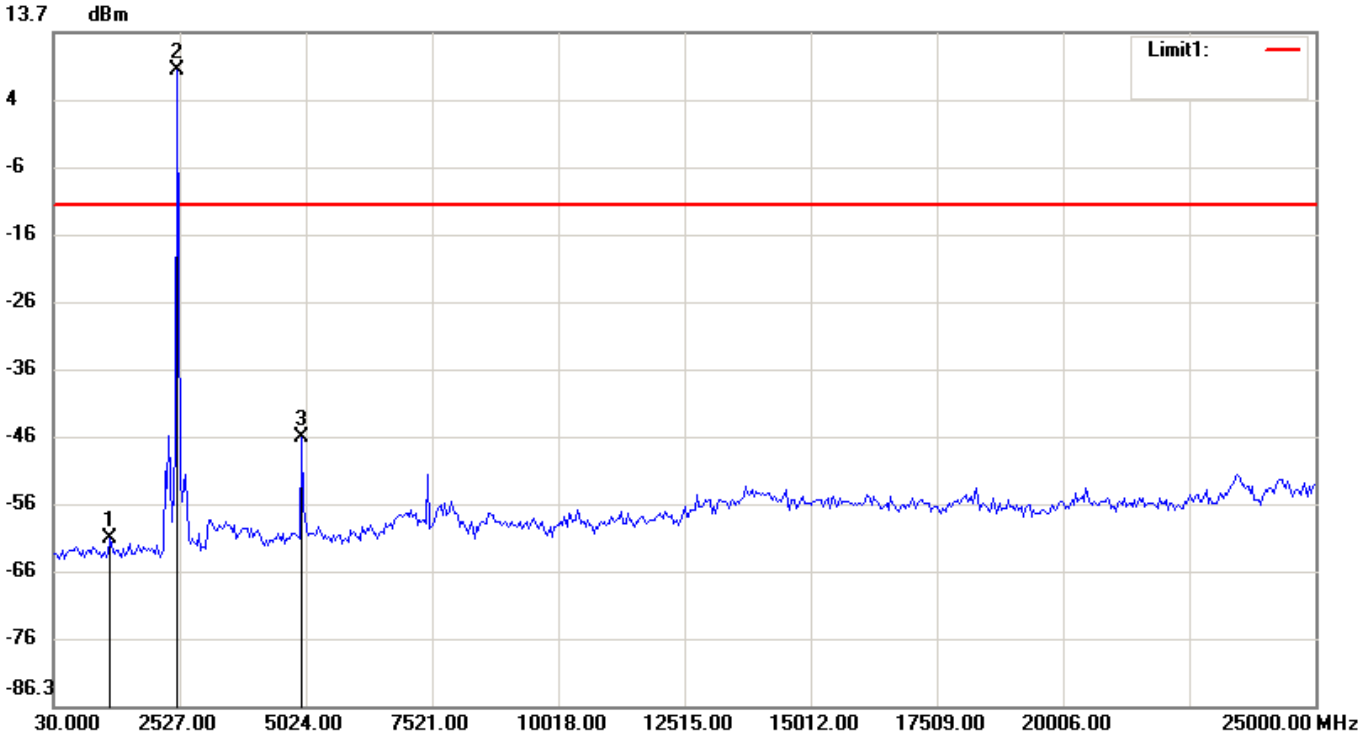
Test Mode:

Note: **FCC-802.11B Channel 07-Conducted Spurious**

No.	Frequency(MHz)	Level(dBm)
1	571.0167	-62.35
2	2443.7667	11.27
3	4899.1500	-44.91

File: ZIGBEE **Data: #61** **Date: 2009/9/8** **Temperature: 28 ℃**

Time: AM 11:21:36 **Humidity: 49 %**



Condition: **-12.03dBm** **RF Conducted**

EUT: **Sweep Time: 2386.4ms Att.: 20dB**

Model: **RBW: 100 KHz VBW: 300 KHz**

Test Mode:

Note: **FCC-802.11B Channel 11-Conducted Spurious**

No.	Frequency(MHz)	Level(dBm)
1	1153.6500	-61.52
2	2485.3833	7.97
3	4940.7667	-46.49

10 RADIATED EMISSION MEASUREMENT

10.1 Standard Applicable

For unintentional radiator, the radiated emission shall comply with §15.109(a).

For intentional radiators, according to §15.247 (a), operation under this provision is limited to frequency hopping and direct sequence spread spectrum, and the out band emission shall be comply with §15.247 (c)

10.2 Measurement Procedure

A.Preliminary Measurement For Portable Devices.

For portable devices, the following procedure was performed to determine the maximum emission axis of EUT (X and Y axis):

1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antennna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. The axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.
4. The position in which the maximum noise occurred was “Y axis”. (Please see the test setup photos)

B. Final Measurement

1. Setup the configuration per figure 4 and 5 for frequencies measured below and above 1 GHz respectively.
2. For emission frequencies measured below 1 GHz, it is performed in a semi-anechoic chamber to determine the accurate frequencies of higher emissions. For emission frequencies measured above 1 GHz, a pre-scan be performed with a 1 meter measuring distance before final test.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 120 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0 ° to 360 ° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.

   Note : A filter was used to avoid pre-amplifier saturated when measure TX operation mode.
5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the datarate, placement of ANT. cables associated with EUT to obtain the worse case and record the result.

Figure 4 : Frequencies measured below 1 GHz configuration

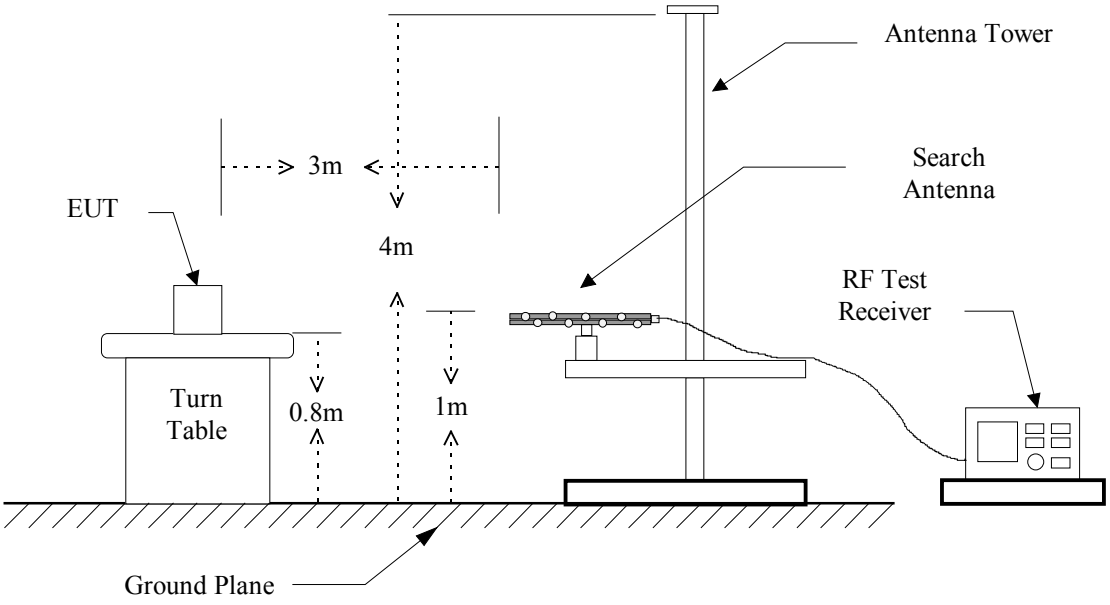
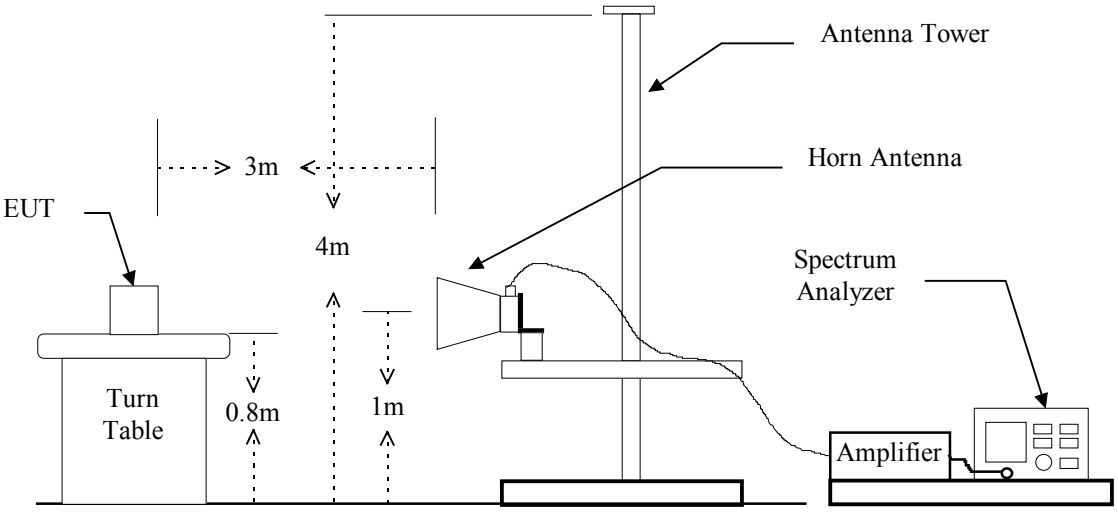


Figure 5 : Frequencies measured above 1 GHz configuration



10.3 Measuring Instrument

The following instrument are used for radiated emissions measurement :

Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
EMI Receiver	R&S	ESIB 7	100328	07/19/2010
BiLog Antenna	Schaffner	CBL 6112B	2927	08/18/2010
Horn Antenna	EMCO	3115	9107-3729	12/07/2009
PRE-Amplifier	Agilent	8449B	3008A01648	10/08/2009
Spectrum Analyzer	R&S	FSU46	13040904-001	11/24/2009
Spectrum Analyzer	Agilent	8564EC	4123A00585	10/13/2009

Measuring instrument setup in measured frequency band when specified detector function is used :

Frequency Band (MHz)	Instrument	Function	Resolution Bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	300 kHz
	Spectrum Analyzer	Peak	120 kHz	300 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10 Hz

10.4 Radiated Emission Data

10.4.1 Harmonic

Operation Mode: TX
Test Date: Aug. 28, 2009 Temperature: 26℃ Humidity: 61 %

a) Channel Low
Fundamental Frequency: 2405 MHz

Frequency	Reading (dBuV)				Factor	Result @3m		Limit @3m	
	H		V		(dB)	(dBuV/m)		(dBuV/m)	
(MHz)	Peak	Ave	Peak	Ave	Corr.	Peak	Ave	Peak	Ave.
4810.000	56.8	47.4	65.9	54.6	-2.3	63.6	52.3	74.0	54.0
7215.000	---	---	---	---	-0.3	---	---	74.0	54.0
9620.000	---	---	---	---	2.0	---	---	74.0	54.0
12025.000	---	---	---	---	4.2	---	---	74.0	54.0

b) Channel Mid
Fundamental Frequency: 2440 MHz

Frequency	Reading (dBuV)				Factor	Result @3m		Limit @3m	
	H		V		(dB)	(dBuV/m)		(dBuV/m)	
(MHz)	Peak	Ave	Peak	Ave	Corr.	Peak	Ave	Peak	Ave.
4880.000	54.0	---	62.8	52.8	-2.3	60.5	50.5	74.0	54.0
7320.000	---	---	56.0	45.9	0.9	56.9	46.8	74.0	54.0
12200.000	---	---	---	---	4.2	---	---	74.0	54.0
19520.000	---	---	---	---	-4.8	---	---	74.0	54.0

c) Channel High
Fundamental Frequency: 2480 MHz

Frequency	Reading (dBuV)				Factor	Result @3m		Limit @3m	
	H		V		(dB)	(dBuV/m)		(dBuV/m)	
(MHz)	Peak	Ave	Peak	Ave	Corr.	Peak	Ave	Peak	Ave.
4960.000	54.5	---	65.6	54.6	-2.3	63.3	52.6	74.0	54.0
7440.000	---	---	55.7	43.9	0.9	56.6	44.8	74.0	54.0
12400.000	---	---	---	---	4.4	---	---	74.0	54.0
19840.000	---	---	---	---	-4.8	---	---	74.0	54.0
22320.000	---	---	---	---	-3.4	---	---	74.0	54.0

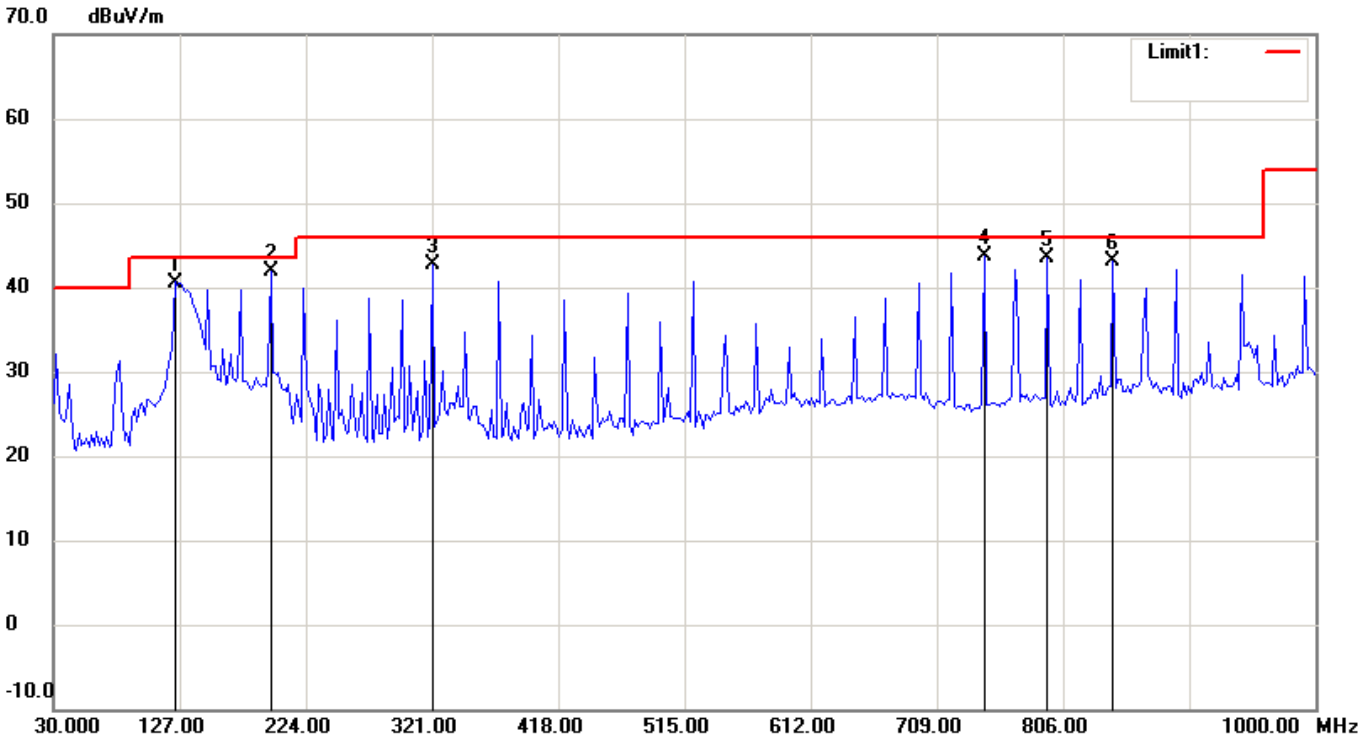
Note :
1. Item of margin shown in above table refer to average limit.
2. Remark "---" means that the emissions level is too low to be measured.

10.4.2 Spurious Emission

10.4.2.1 Operation Mode: TX

10.4.2.1.1 Emission frequencies below 1 GHz

File: ZIGBEE **Data:** #31 **Date:** 2009/8/28 **Time:** PM 02:45:32 **Temperature:** 26 ℃ **Humidity:** 61 %

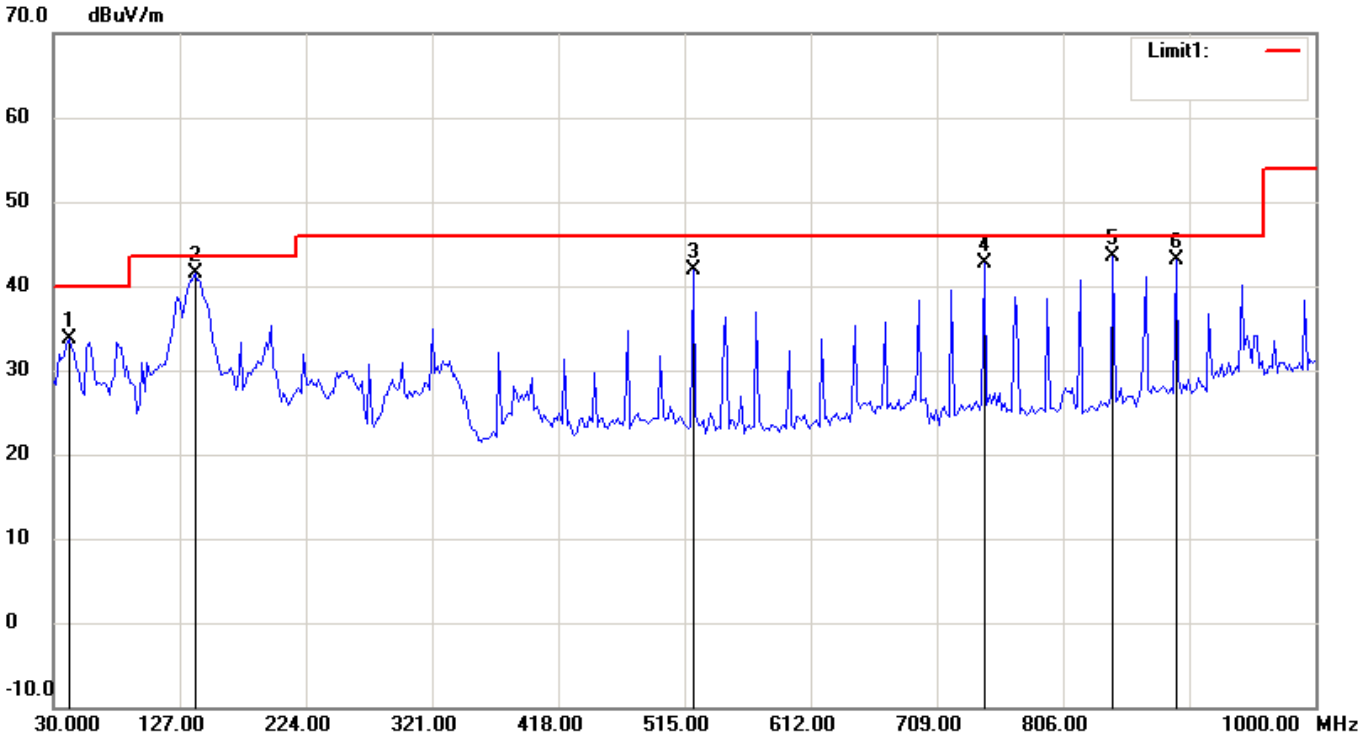


Condition: NCC_LP0002_30-1000MHz **Polarization:** Horizontal
EUT: **Distance:** 3m
Model: KDR515
Test Mode: TX

No.	Frequency (MHz)	Reading (dBuV/m)	Detector	Corrected Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	123.3066	23.06	peak	17.54	40.60	43.50	-2.90
2	197.1743	27.04	peak	14.82	41.86	43.50	-1.64
3	321.5832	23.69	peak	19.00	42.69	46.00	-3.31
4	745.3507	17.44	peak	26.17	43.61	46.00	-2.39
5	793.9479	17.11	peak	26.48	43.59	46.00	-2.41
6	844.4890	15.94	peak	27.16	43.10	46.00	-2.90

File: **ZIGBEE** **Data:** **#29** **Date:** **2009/8/28** **Temperature:** **26 ℃**

Time: **PM 02:42:46** **Humidity:** **61 %**



Condition: **NCC_LP0002_30-1000MHz** **Polarization:** **Vertical**

EUT: **Distance:** **3m**

Model: **KDR515**

Test Mode: **TX**

No.	Frequency (MHz)	Reading (dBuV/m)	Detector	Corrected Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	41.6632	15.28	peak	18.38	33.66	40.00	-6.34
2	138.8576	24.19	peak	17.37	41.56	43.50	-1.94
3	521.8035	18.33	peak	23.66	41.99	46.00	-4.01
4	745.3506	16.52	peak	26.17	42.69	46.00	-3.31
5	844.4890	16.28	peak	27.16	43.44	46.00	-2.56
6	893.0861	16.01	peak	27.19	43.20	46.00	-2.80

10.4.2.1.2 Emission frequencies above 1 GHz

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)
Radiated emission frequencies above 1 GHz to 25 GHz were too low to be measured.						

Note:

1. Place of Measurement: Measuring site of the ETC.
2. The estimated measurement uncertainty of the result measurement is
   ±4.6dB (30MHz≦f<300MHz).
   ±4.4dB (300MHz≦f<1000MHz).
   ±4.1dB (1GHz≦f<18GHz).
   ±4.4dB (18GHz<f≦40GHz).
3. Remark "---" means that the emissions level is too low to be measured.

10.4.2.2 Operation Mode: RX

10.4.2.2.1 Emission frequencies below 1 GHz

File: ZIGBEE Date: 2009/8/28 Humidity: 61 % Temperature: 26 ℃

Condition: 30-1000MHz Polarization: Horizontal

Model: KDR515 Distance: 3m

Test Mode: RX

No.	Frequency (MHz)	Reading (dBuV/m)	Detector	Corrected Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	123.3066	23.06	peak	17.54	40.60	43.50	-2.90
2	197.1743	27.04	peak	14.82	41.86	43.50	-1.64
3	321.5832	23.69	peak	19.00	42.69	46.00	-3.31
4	745.3507	17.44	peak	26.17	43.61	46.00	-2.39
5	793.9479	17.11	peak	26.48	43.59	46.00	-2.41
6	844.4890	15.94	peak	27.16	43.10	46.00	-2.90

File: ZIGBEE Date: 2009/8/28 Humidity: 61 % Temperature: 26 ℃

Condition: 30-1000MHz Polarization: Vertical

Model: KDR515 Distance: 3m

Test Mode: RX

No.	Frequency (MHz)	Reading (dBuV/m)	Detector	Corrected Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	41.6632	15.28	peak	18.38	33.66	40.00	-6.34
2	138.8576	24.19	peak	17.37	41.56	43.50	-1.94
3	521.8035	18.33	peak	23.66	41.99	46.00	-4.01
4	745.3506	16.52	peak	26.17	42.69	46.00	-3.31
5	844.4890	16.28	peak	27.16	43.44	46.00	-2.56
6	893.0861	16.01	peak	27.19	43.20	46.00	-2.80

10.4.2.1.2 Emission frequencies above 1 GHz

Frequency (MHz)	Ant-Pol H/V	Meter Reading (dBuV)	Corrected Factor (dB)	Result @3m (dBuV/m)	Limit @3m (dBuV/m)	Margin (dB)
Radiated emission frequencies above 1 GHz to 25 GHz were too low to be measured.						

Note:

1. Place of Measurement: Measuring site of the ETC.
2. The estimated measurement uncertainty of the result measurement is
   ±4.6dB (30MHz≦f<300MHz).
   ±4.4dB (300MHz≦f<1000MHz).
   ±4.1dB (1GHz≦f<18GHz).
   ±4.4dB (18GHz<f≦40GHz).
3. Remark "---" means that the emissions level is too low to be measured.

10.4.3 Radiated Measurement at Bandedge with Fundamental Frequencies

Test Date: Aug. 28, 2009 Temperature: 26℃ Humidity: 61 %

Operation Mode: TX

Operation Channel	Test Frequency (MHz)	Reading (dBuV) H Peak	H Ave	V Peak	V Ave	Factor (dB) Corr.	Result @3m (dBuV/m) Peak	Result @3m (dBuV/m) Ave	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.
Low	2390.000	29.37	19.20	32.91	20.00	30.3	63.21	50.30	74.0	54.0
High	2483.500	28.36	19.52	33.44	21.41	30.3	63.74	51.71	74.0	54.0

Note :

1. Remark "---" means that the emissions level is too low to be measured.
2. The result is the highest value of radiated emission from restrict band of 2310 ~ 2390 MHz and 2483.5 ~ 2500 MHz.

10.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, High Pass Filter Loss(if used) and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation calculation is as follows:

Result = Reading + Corrected Factor

where

Corrected Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Amplifier Gain