

FC

Test Report

Product Name	2.4GHz WIRELESS RECEIVER
Model No.	JW-02-R
FCC ID.	VH7-JW02R

Applicant	JETVOX ACOUSTIC CORP.
Address	No.22, Dalin Rd., Taoyuan City, Taoyuan County 330, Taiwan (R.O.C.)

Date of Receipt	Aug. 08, 2007
Issued Date	Sep.10, 2007
Report No.	078150R-RFUSP06V01

The Test Results relate only to the samples tested.
The test report shall not be reproduced except in full without the written approval of QuieTek Corporation.
This report must not be used to claim product endorsement by NVLAP any agency of the U.S. Government

Test Report Certification

Issued Date: Sep.10, 2007

Report No.: 078150R-RFUSP06V01



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Applicant	JETVOX ACOUSTIC CORP.
Address	No.22, Dalin Rd., Taoyuan City, Taoyuan County 330, Taiwan (R.O.C.)
Manufacturer	JETVOX ACOUSTIC CORP.
Model No.	JW-02-R
FCC ID.	VH7-JW02R
Rated Voltage	AC 120V/60Hz
Working Voltage	Battery DC 3.7V
Trade Name	JVOX
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2006 ANSI C63.4: 2003
Test Result	Complied



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(Senior Engineer / Tim Sung)



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TABLE OF CONTENTS

Description	Page
1. GENERAL INFORMATION	5
1.1. EUT Description.....	5
1.2. Operational Description.....	6
1.3. Test System Details	7
1.4. Configuration of Test System	7
1.5. EUT Exercise Software	7
1.6. Test Facility	8
2. CONDUCTED EMISSION	9
2.1. Test Equipment.....	9
2.2. Test Setup	9
2.3. Limits.....	9
2.4. Test Procedure	10
2.5. Uncertainty	10
2.6. Test Result of Conducted Emission	11
3. PEAK POWER OUTPUT	12
3.1. Test Equipment.....	12
3.2. Test Setup	12
3.3. Limit	12
3.4. Uncertainty	12
3.5. Test Result of Peak Power Output	13
4. RADIATED EMISSION	14
4.1. Test Equipment.....	14
4.2. Test Setup	15
4.3. Limits.....	15
4.4. Test Procedure	16
4.5. Uncertainty	16
4.6. Test Result of Radiated Emission	17
5. BAND EDGE	21
5.1. Test Equipment.....	21
5.2. Test Setup	21
5.3. Limit	22
5.4. Test Procedure	22
5.5. Uncertainty	22
5.6. Test Result of Band Edge	23
6. CHANNEL NUMBER.....	27
6.1. Test Equipment.....	27

6.2.	Test Setup	27
6.3.	Limit	27
6.4.	Uncertainty	27
6.5.	Test Result of Channel Number.....	28
7.	CHANNEL SEPARATION.....	29
7.1.	Test Equipment	29
7.2.	Test Setup	29
7.3.	Limit	29
7.4.	Uncertainty	29
7.5.	Test Result of Channel Separation.....	30
8.	DWELL TIME	31
8.1.	Test Equipment	31
8.2.	Test Setup	31
8.3.	Limit	31
8.4.	Uncertainty	31
8.5.	Test Result of Dwell Time	32
9.	OCCUPIED BANDWIDTH	36
9.1.	Test Equipment	36
9.2.	Test Setup	36
9.3.	Limits.....	36
9.4.	Uncertainty	36
9.5.	Test Result of Occupied Bandwidth	37
10.	PSEUDO RANDOM HOPPING ALGORITHM	40
11.	EMI REDUCTION METHOD DURING COMPLIANCE TESTING	42
Attachment 1: EUT Test Photographs		
Attachment 2: EUT Detailed Photographs		

1. GENERAL INFORMATION

1.1. EUT Description

Product Name	2.4GHz WIRELESS RECEIVER
Trade Name	JVOX
FCC ID.	VH7-JW02R
Model No.	JW-02-R
Frequency Range	2404 – 2478MHz
Type of Modulation	FHSS
Channel Number	38
Channel Control	Auto
Antenna Type	Monopole
Antenna Gain	Refer to the table “Antenna List”

Antenna List

No.	Manufacturer	Part No.	Peak Gain
1	JETVOX	N/A	0.73dBi for 2.4 GHz

Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 01:	2404 MHz	Channel 02:	2406 MHz	Channel 03:	2408 MHz	Channel 04:	2410 MHz
Channel 05:	2412 MHz	Channel 06:	2414 MHz	Channel 07:	2416 MHz	Channel 08:	2418 MHz
Channel 09:	2420 MHz	Channel 10:	2422 MHz	Channel 11:	2424 MHz	Channel 12:	2426 MHz
Channel 13:	2428 MHz	Channel 14:	2430 MHz	Channel 15:	2432 MHz	Channel 16:	2434 MHz
Channel 17:	2436 MHz	Channel 18:	2438 MHz	*Channel 19:	2440 MHz	Channel 20:	2442 MHz
Channel 21:	2444 MHz	Channel 22:	2446 MHz	Channel 23:	2448 MHz	Channel 24:	2450 MHz
Channel 25:	2452 MHz	Channel 26:	2454 MHz	Channel 27:	2456 MHz	Channel 28:	2458 MHz
Channel 29:	2460 MHz	Channel 30:	2462 MHz	Channel 31:	2464 MHz	Channel 32:	2466 MHz
Channel 33:	2468 MHz	Channel 34:	2470 MHz	Channel 35:	2472 MHz	Channel 36:	2474 MHz
Channel 37:	2476 MHz	Channel 38:	2478 MHz				

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. The transmitter is presented with a continuous data stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its 38 channels and over the minimum number of hopping channels (15 channels).

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

*What is available is 2441MHz from the RF Engineer sample from the customer, and that does not comply with Channel 19 in this report, which is 2440MHz.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals. The transmitter is presented with a continuous data stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its 38 channels and over the minimum number of hopping channels (15 channels).

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted.

The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

The Frequency Hopping Sequences have the following characteristics:

- Pseudorandomly ordered frequency list
- Predesigned pseudorandom list of 38 frequencies
- Minimum hop distance of 4 channels
- Additional hopping sequences derived by modulo 38 frequency offset
- 38 hopping patterns organized in 2 sets of 19 patterns each.
- Sequences from same set collide 3 times on average, 5 times worst case, over a hopping pattern cycle, including hits and adjacent channel hits.
- Denote frequency as $2404+b[i]$, $b[i]$ is the base sequence in range 0.. 37.
- k-th sequence is formed from the base sequence as $2404+(b[i]+k) \bmod 38$
- Example:
 - Base sequence: 2404, 2452, 2470, 2446, ...
 - 10-th sequence: 2420, 2470, 2412, 2464, .

Note:

1. The EUT is a 2.4GHz WIRELESS RECEIVER with a built-in 2.4GHz transceiver.
2. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15 Subpart C Paragraph 15.247 for spread spectrum devices.
3. Regarding to the operation frequency band, the lowest, middle, and highest frequency are selected to perform the test.
4. Quietek verified constructions and functions, which are shown in the test report, in typical operation.
5. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.

1.2. Operational Description

The EUT is a 2.4GHz WIRELESS RECEIVER with a built-in 2.4GHz transceiver. It supports 38 channels in 2404-2478MHz. The signals are modulated by FHSS. The antenna is a chip antenna. The EUT provides wireless technology that revolutionizes personal connectivity.

Test Mode	Mode 1: Transmitter
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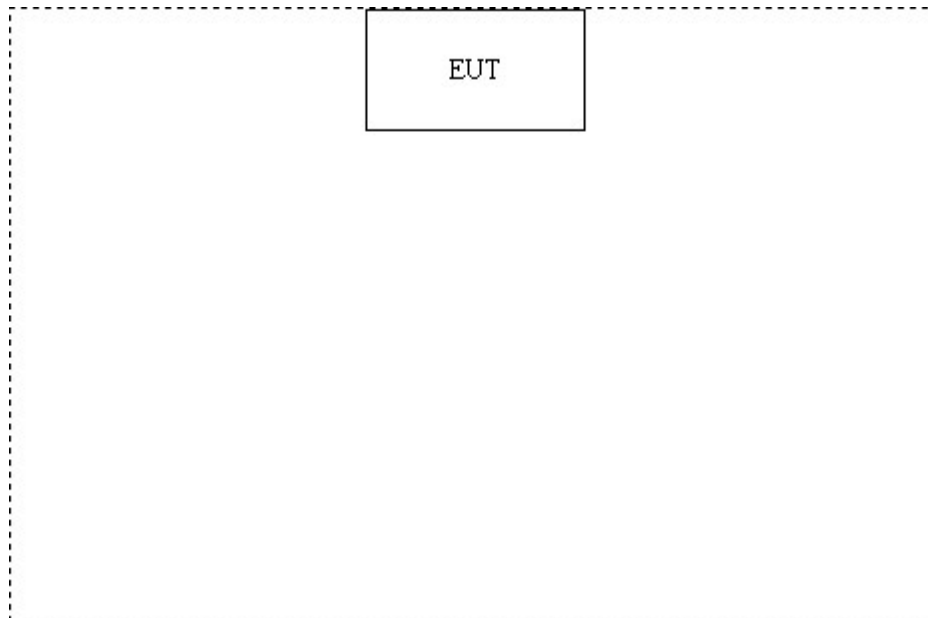
1.3. Test System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

	Product	Manufacturer	Model No.	Serial No.	FCC ID	Power Cord
(1)	N/A	N/A	N/A	N/A	N/A	N/A

	Signal Cable Type	Signal cable Description
A.	N/A	N/A

1.4. Configuration of Test System



1.5. EUT Exercise Software

(1)	EUT into a RF test mode.
(2)	Selection test mode via DIP SW
(3)	Configure the test channel and the packet type.
(4)	Press to start the continuous transmission/receiving.
(5)	Setup the EUT as shown in section 1.3.
(6)	Verify that the EUT works correctly.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	30-65
Barometric pressure (mbar)	860-1060	950-1000

Site Description: Federal Communications Commission
FCC Engineering Laboratory
7435 Oakland Mills Road
Columbia, MD 21046
Reference 31040/SIT1300F2



Accreditation on NVLAP
NVLAP Lab Code: 200533-0



Site Name: Quietek Corporation
Site Address: No. 5-22, Ruei-Shu Valley, Ruei-Ping Tsuen,
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Taiwan, R.O.C.
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E-Mail : service@quietek.com



FCC Accreditation Number: TW1014

2. Conducted Emission

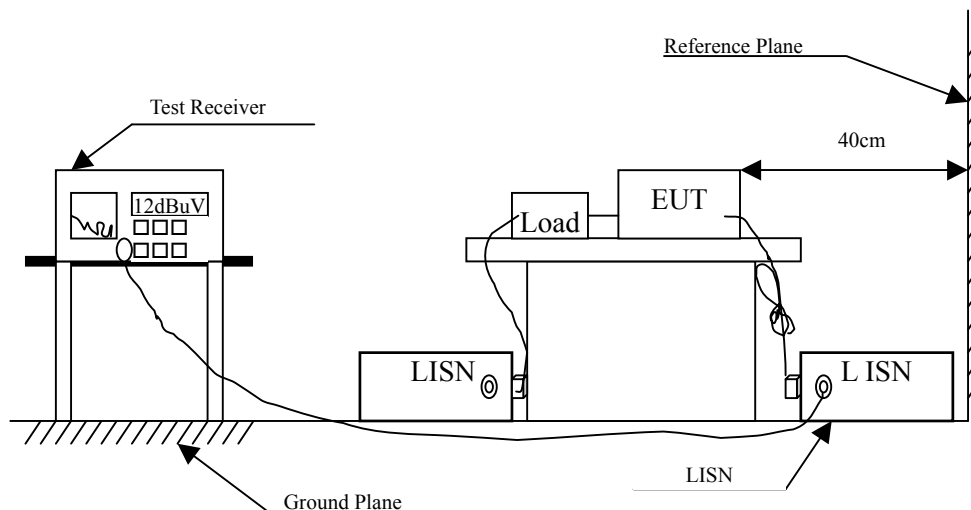
2.1. Test Equipment

The following test equipment are used during the conducted emission test:

Item	Instrument	Manufacturer	Type No./Serial No	Last Cal.	Remark
1	EMI Test Receiver	R&S	ESCS 30/100367	Aug., 2007	
2	LISN	R&S	ESH3-Z5/836679/023	July, 2007	EUT
3	LISN	R&S	ESH3-Z5/836679/017	Feb., 2007	Peripherals
4	Pulse Limiter	R&S	ESH3-Z2/357.8810.52	Sep., 2007	
5	No.7 Shielded Room			N/A	

Note: All equipments are calibrated every one year.

2.2. Test Setup



2.3. Limits

FCC Part 15 Subpart B Paragraph 15.107 (dBuV) Limit		
Frequency MHz	Limits	
	QP	AV
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.

2.4. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2003 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

2.5. Uncertainty

± 2.26 dB

2.6. Test Result of Conducted Emission

Owing to the DC operation of EUT, this test item is not performed.

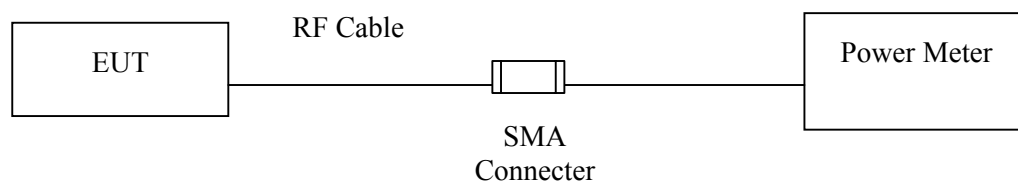
3. Peak Power Output

3.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Power Meter	Anritsu	ML2495A/6K00003357	May, 2007
X	Power Sensor	Anritsu	MA2491A/034457	May, 2007

Note: 1. All equipments are calibrated every one year.
2. Test instruments marked by “X” are used to measure the final test results.

3.2. Test Setup



3.3. Limit

All other Frequency hopping system in the 2400-2483.5MHz band: 0.125W

3.4. Uncertainty

± 1.27 dB

3.5. Test Result of Peak Power Output

Product : 2.4GHz WIRELESS RECEIVER
Test Item : Peak Power Output
Test Site : CTR1
Test Mode : Mode 1: Transmitter

Channel No.	Frequency (MHz)	Measurement	Required Limit	Result
Channel 01	2404.00	12.85dBm	0.125Watt= 20.97dBm	Pass
Channel 19	2440.00	13.21dBm	0.125Watt= 20.97dBm	Pass
Channel 38	2478.00	13.64dBm	0.125Watt= 20.97dBm	Pass

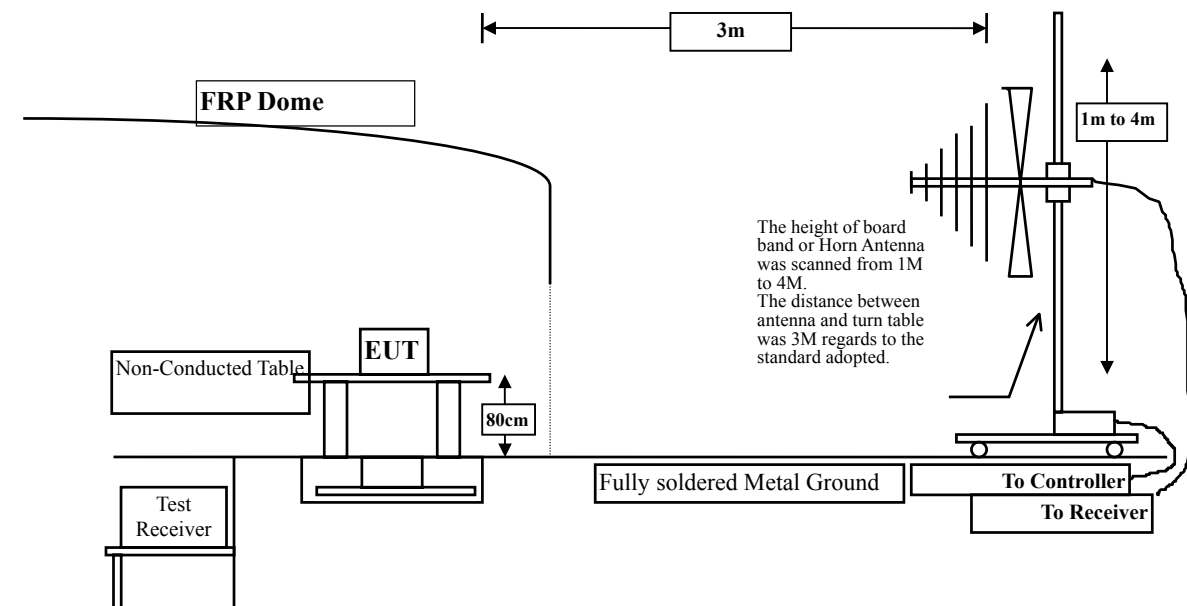
4. Radiated Emission

4.1. Test Equipment

Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.
<input type="checkbox"/> Site # 1		Test Receiver	R & S	ESVS 10 / 834468/003	May, 2007
		Spectrum Analyzer	Advantest	R3162/ 00803480	May, 2007
		Pre-Amplifier	Advantest	BB525C/ 3307A01812	May, 2007
		Bilog Antenna	SCHAFFNER	CBL6112B / 2697	Sep., 2007
<input type="checkbox"/> Site # 2		Test Receiver	R & S	ESCS 30 / 836858 / 022	May, 2007
		Spectrum Analyzer	Advantest	R3162 / 100803466	May, 2007
		Pre-Amplifier	Advantest	BB525C/3307A01814	May, 2007
		Bilog Antenna	SCHAFFNER	CBL6112B / 2705	May, 2007
		Horn Antenna	ETS	3115 / 0005-6160	Sep., 2007
		Pre-Amplifier	QTK	QTK-AMP-01/ 0001	May, 2007
<input checked="" type="checkbox"/> Site # 3	X	Test Receiver	R & S	ESI 26 / 838786/004	May, 2007
	X	Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2007
	X	Bilog Antenna	SCHAFFNER	CBL6112B / 2697	May, 2007
	X	Horn Antenna	Schwarzbeck	BBHA9120D / 305, 306	July, 2007
	X	Horn Antenna	Schwarzbeck	BBHA9170 / 208, 209	July, 2007
	X	Pre-Amplifier	QTK	QTK-AMP-01 / 0001	July, 2007
	X	Pre-Amplifier	QTK	QTK-AMP-03 / 0003	May, 2007
	X	Pre-Amplifier	HP	8449B / 3008A01123	July, 2007

- Note: 1. All equipments are calibrated every one year.
2. Test equipments marked by "X" are used to measure the final test results.

4.2. Test Setup



4.3. Limits

➤ General Radiated Emission Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209 Limits		
Frequency MHz	uV/m @3m	dBuV/m@3m
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

- Remarks:
1. RF Voltage (dBuV) = 20 log RF Voltage (uV)
 2. In the Above Table, the tighter limit applies at the band edges.
 3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

4.4. Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.4: 2003 on radiated measurement.

The additional latch filter below 1GHz was used to measure the level of harmonics radiated emission during field strength of harmonics measurement.

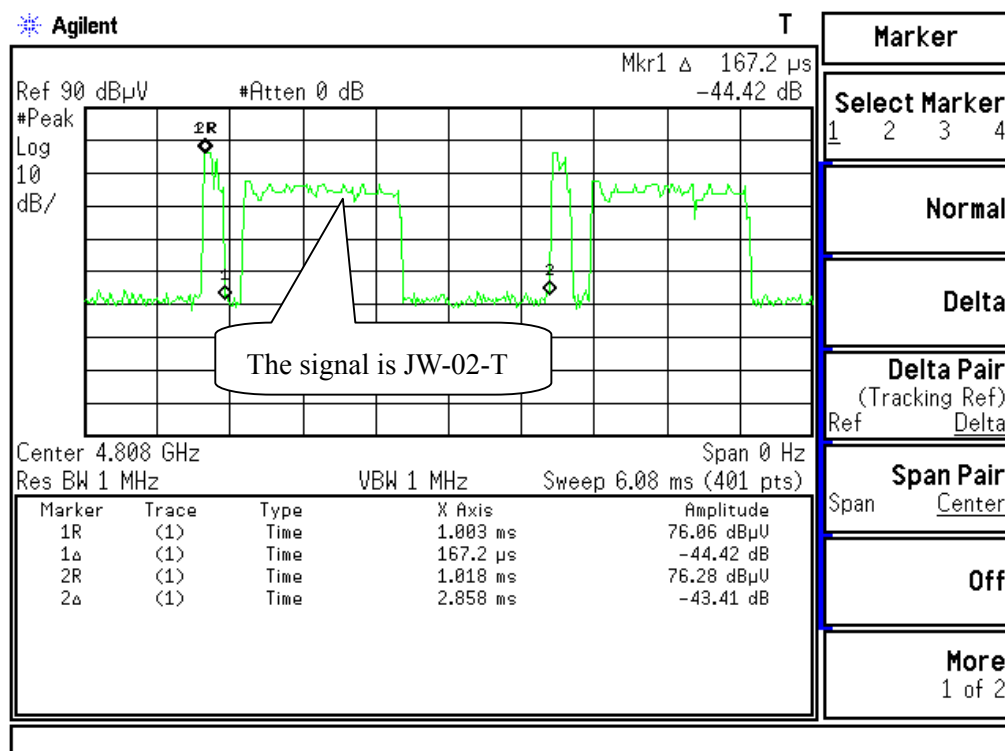
The bandwidth below 1GHz setting on the field strength meter is 120 kHz, above 1GHz are 1 MHz.

The frequency range from 30MHz to 10th harmonics is checked.

The average value of the radiated emission is calculated according to the following table from FCC15.35(c).

Average Value= PK+20*log(duty cycle)

20*log(duty cycle)=20*log(0.1672ms/2.858ms)= -24.656dB



4.5. Uncertainty

± 3.9 dB above 1GHz

± 3.8 dB below 1GHz

4.6. Test Result of Radiated Emission

Product : 2.4GHz WIRELESS RECEIVER
Test Item : Harmonic Radiated Emission
Test Site : No.3 OATS
Test Mode : Mode 1: Transmitter (Channel 01)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4807.975	3.675	52.095	55.769	-18.231	74.000
7211.975	9.373	37.717	47.089	-26.911	74.000
9615.975	11.836	37.263	49.099	-24.901	74.000
Average Value:					
4807.975			31.112	-22.887	54.000
Vertical					
Peak Detector:					
4807.875	3.675	53.048	56.722	-17.278	74.000
7212.000	9.373	38.386	47.758	-26.242	74.000
9616.000	11.836	36.871	48.707	-25.293	74.000
Average Value:					
4807.875			32.066	-21.934	54.000

Note:

1. The reading levels below 1GHz and above 1GHz are quasi-peak values and peak/average values, respectively.
2. Receiver setting (Peak Detector) : RBW:1MHz; VBW:1MHz; Span:100MHz ◦
3. Receiver setting (Average Value) : PK+20*log(duty cycle)=PK-24.656dB ◦
4. Emission Level = Reading Level + Correct Factor.
5. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Harmonic Radiated Emission
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (Channel 19)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4882.000	3.921	51.567	55.488	-18.512	74.000
7323.000	9.657	37.208	46.865	-27.135	74.000
9764.000	11.798	36.570	48.368	-25.632	74.000
Average Value:					
4882.000			30.832	-23.168	54.000
Vertical					
Peak Detector:					
4882.000	3.921	53.580	57.501	-16.499	74.000
7323.000	9.657	36.062	45.719	-28.281	74.000
9764.000	11.798	36.030	47.828	-26.172	74.000
Average Value:					
4882.000			32.854	-21.155	54.000

Note:

1. The reading levels below 1GHz and above 1GHz are quasi-peak values and peak/average values, respectively.
2. Receiver setting (Peak Detector) : RBW:1MHz; VBW:1MHz; Span:100MHz ◦
3. Receiver setting (Average Value) : PK+20*log(duty cycle)=PK-24.656dB ◦
4. Emission Level = Reading Level + Correct Factor.
5. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Product : 2.4GHz WIRELESS RECEIVER
Test Item : Harmonic Radiated Emission
Test Site : No.3 OATS
Test Mode : Mode 1: Transmitter (Channel 38)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4956.000	4.182	49.936	54.118	-19.882	74.000
7434.000	9.939	37.365	47.304	-26.696	74.000
9912.000	11.853	36.456	48.309	-25.691	74.000
Average Value:					
4956.000			29.462	-24.538	54.000
Vertical					
Peak Detector:					
4956.000	4.182	54.458	58.640	-15.360	74.000
7434.000	9.939	36.915	46.854	-27.146	74.000
9912.000	11.853	36.393	48.246	-25.754	74.000
Average Value:					
4956.000			33.984	-20.016	54.000

Note:

1. Reading levels below 1GHz and above 1GHz are quasi-peak values and peak/average values, respectively.
2. Receiver setting (Peak Detector) : RBW:1MHz; VBW:1MHz; Span:100MHz °
3. Receiver setting (Average Value) : PK+20*log(duty cycle)=PK-24.656dB °
4. Emission Level = Reading Level + Correct Factor.
5. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : General Radiated Emission
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (Channel 19)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
515.000	18.950	8.897	27.847	-18.153	46.000
544.100	19.945	10.859	30.804	-15.196	46.000
575.625	19.517	10.210	29.727	-16.273	46.000
607.150	20.225	10.018	30.243	-15.757	46.000
827.825	21.884	11.026	32.910	-13.090	46.000
852.075	22.567	10.223	32.790	-13.210	46.000
Vertical					
257.950	14.277	4.989	19.266	-26.734	46.000
381.625	16.688	6.003	22.691	-23.309	46.000
461.650	18.489	3.222	21.711	-24.289	46.000
544.100	20.532	6.039	26.571	-19.429	46.000
687.175	20.372	6.817	27.189	-18.811	46.000
755.075	23.113	5.390	28.503	-17.497	46.000

Note:

1. The reading levels below 1GHz are quasi-peak values.
2. “ ” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor
4. The radiated emissions below 1GHz of the lowest, middle, highest frequency are pretested. Only the worst case is shown on the report.

5. Band Edge

5.1. Test Equipment

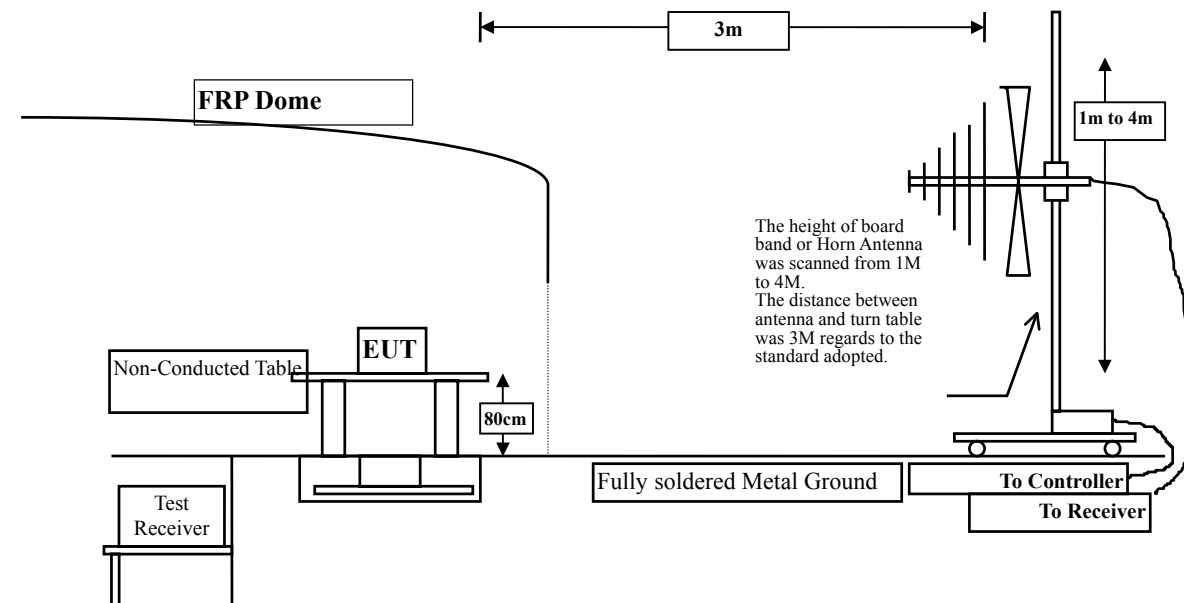
OATS No.3

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Test Receiver	R & S	ESI 26 / 838786/004	May, 2007
X	Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2007
X	Bilog Antenna	SCHAFFNER	CBL6112B / 2697	May, 2007
X	Horn Antenna	Schwarzbeck	BBHA9120D / 305, 306	July, 2007
X	Horn Antenna	Schwarzbeck	BBHA9170 / 208, 209	July, 2007
X	Pre-Amplifier	QTK	QTK-AMP-01 / 0001	July, 2007
X	Pre-Amplifier	QTK	QTK-AMP-03 / 0003	May, 2007
X	Pre-Amplifier	HP	8449B / 3008A01123	July, 2007

Note: 1. All equipments are calibrated every one year.
2. The test equipments marked by "X" are used to measure the final test results.

5.2. Test Setup

RF Radiated Measurement:



5.3. Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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)).

5.4. Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.4:2003 on radiated measurement.

The bandwidth below 1GHz setting on the field strength meter is 120 kHz, above 1GHz are 1 MHz.

5.5. Uncertainty

± 3.9 dB above 1GHz

± 3.8 dB below 1GHz

5.6. Test Result of Band Edge

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (Channel 01)

RF Radiated Measurement:

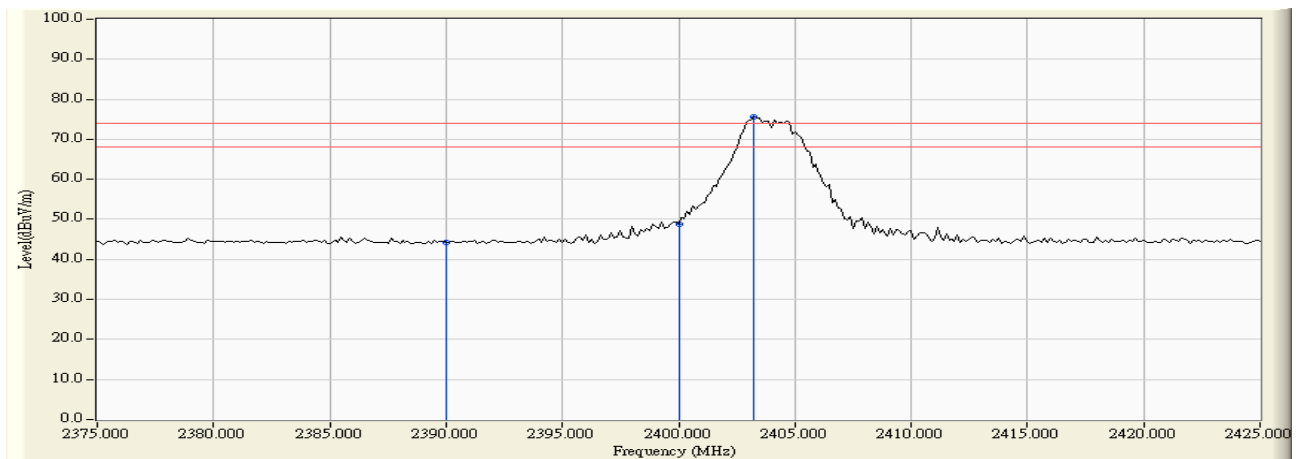
Channel No.	Frequency (MHz)	Required Limit (dBc)	Result
01	<2400	>20	Pass

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
01(Peak)	2390.000	-2.378	46.580	44.203	74.00	54.00	Pass
01(Peak)	2400.000	-2.328	51.176	48.848	74.00	54.00	Pass
01(Peak)	2403.250	-2.311	77.969	75.657	74.00	54.00	Pass

Figure Channel 01:

Horizontal (Peak)



Note:

RBW=1MHz, VBW=1MHz, Sweep Time=500ms.

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (Channel 01)

RF Radiated Measurement:

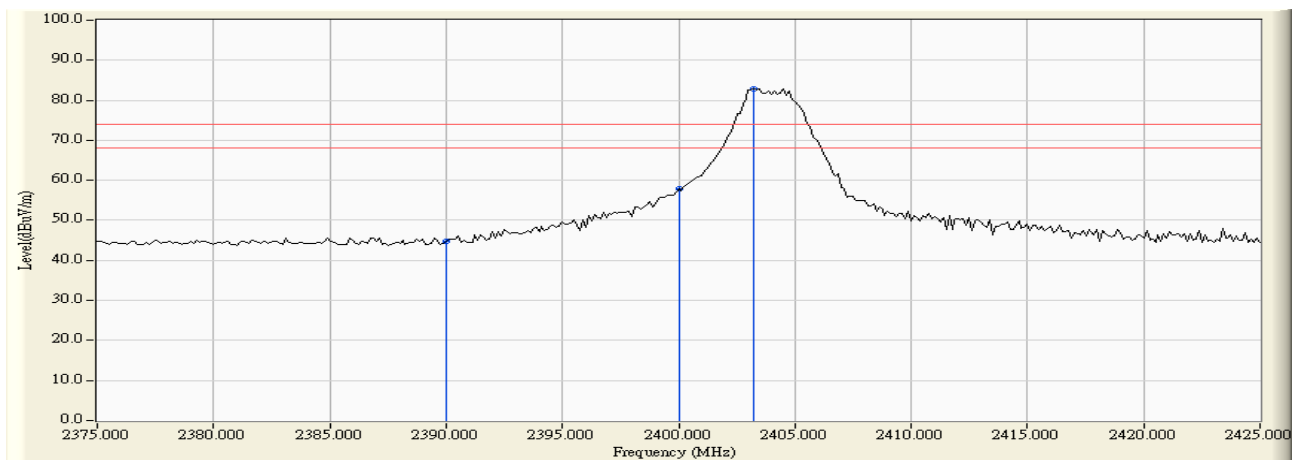
Channel No.	Frequency (MHz)	Required Limit (dBc)	Result
01	<2400	>20	Pass

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
01(Peak)	2390.000	-2.378	47.215	44.838	74.00	54.00	Pass
01(Peak)	2400.000	-2.328	60.307	57.979	74.00	54.00	Pass
01(Peak)	2403.250	-2.311	85.277	82.965	74.00	54.00	Pass

Figure Channel 01:

Vertical (Peak)



Note:

RBW=1MHz, VBW=1MHz, Sweep Time=500ms.

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (Channel 38)

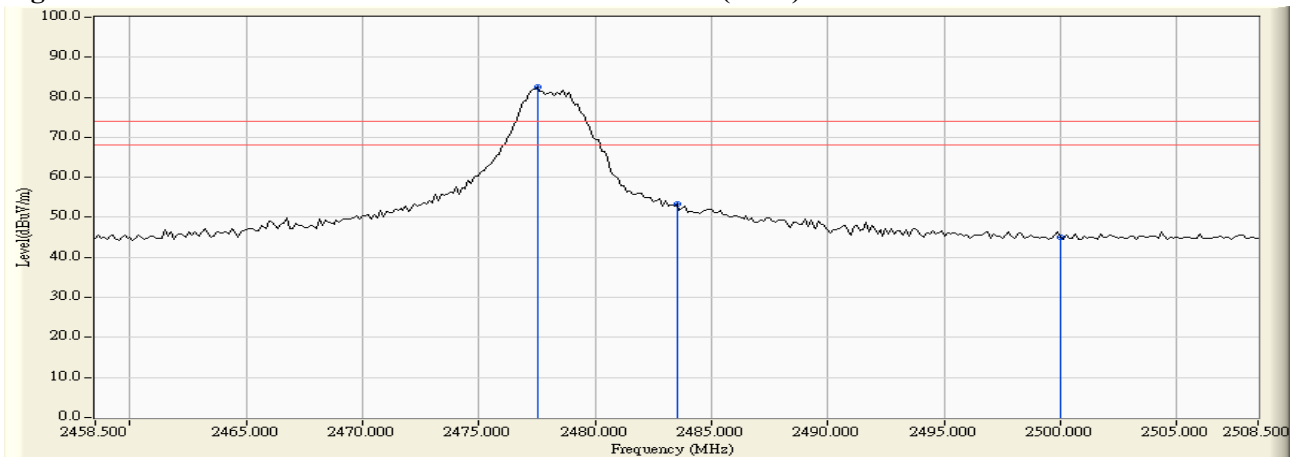
RF Radiated Measurement:

Channel No.	Frequency (MHz)	Required Limit (dBc)	Result
38	>2483.5	>20	Pass

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
38(Peak)	2477.500	-1.963	84.624	82.661	74.00	54.00	Pass
38(Peak)	2483.500	-1.937	55.181	53.244	74.00	54.00	Pass
38(Peak)	2500.000	-1.886	46.819	44.933	74.00	54.00	Pass

Figure Channel 38: Horizontal (Peak)



Note:

RBW=1MHz, VBW=1MHz, Sweep Time=500ms

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (2478MHz)

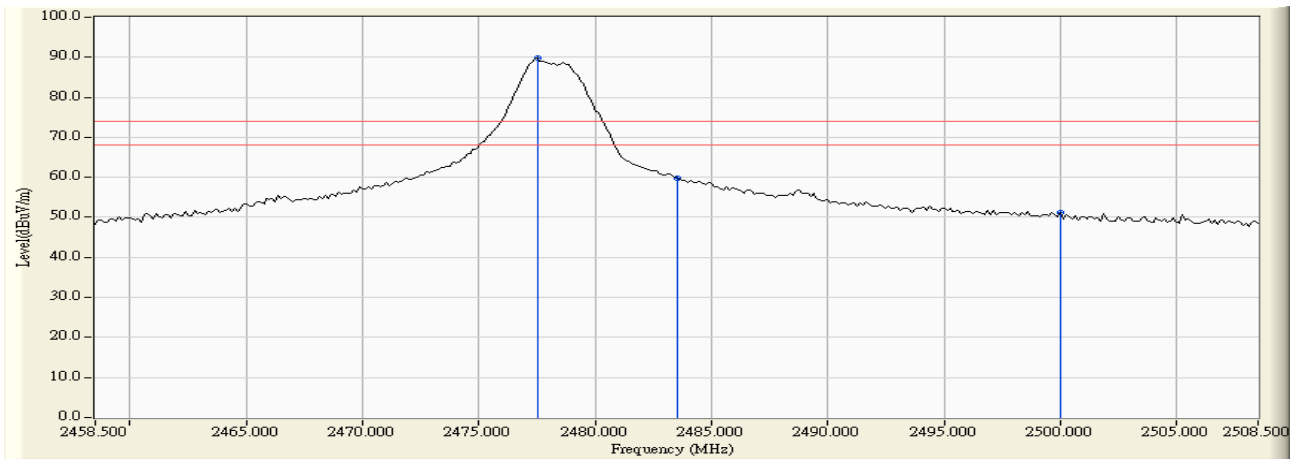
RF Radiated Measurement:

Channel No.	Frequency (MHz)	Required Limit (dBc)	Result
38	>2483.5	>20	Pass

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBUV)	Emission Level (dBUV/m)	Peak Limit (dBUV/m)	Average Limit (dBUV/m)	Result
38(Peak)	2477.500	-1.963	91.823	89.860	74.00	54.00	Pass
38(Peak)	2483.500	-1.937	61.821	59.884	74.00	54.00	Pass
38(Peak)	2500.000	-1.886	53.138	51.252	74.00	54.00	Pass
38(Average)	2483.500	-1.937	40.017	38.080	74.00	54.00	Pass

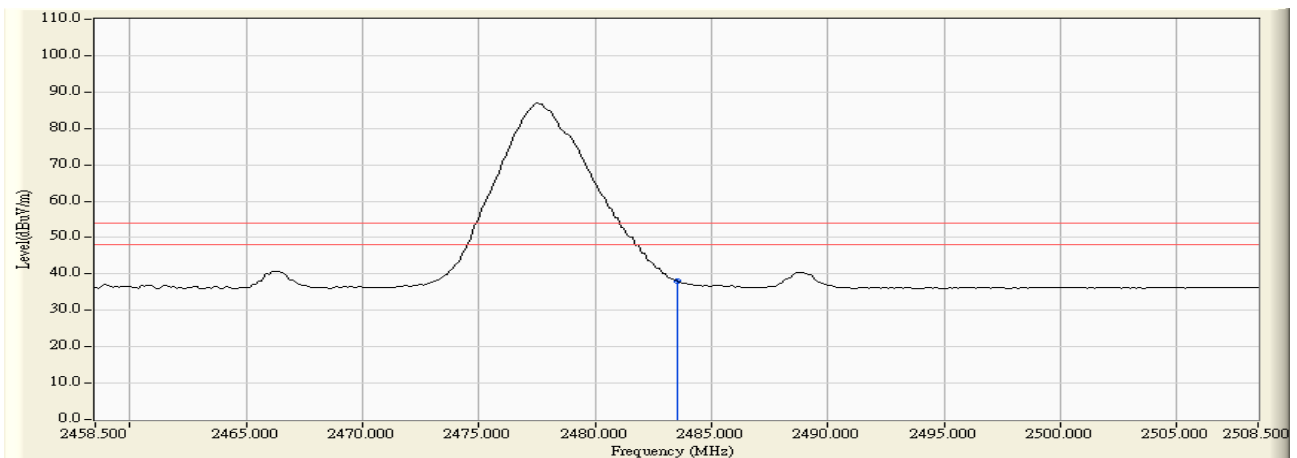
Figure Channel 38: Vertical (Peak)



Note:

RBW=1MHz, VBW=1MHz, Sweep Time=500ms.

Figure Channel 38: Vertical (Average)



Note:

RBW=1MHz, VBW=300Hz, Sweep Time=500ms.

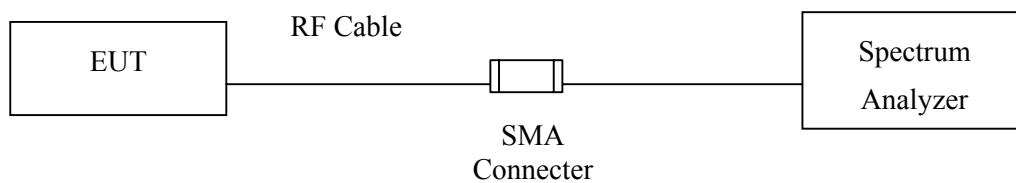
6. Channel Number

6.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Spectrum Analyzer	R & S	FSP40 / 100170	Nov., 2006

Note: 1. All equipments are calibrated every one year.
2. The test equipments marked by "X" are used to measure the final test results.

6.2. Test Setup



6.3. Limit

Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels.

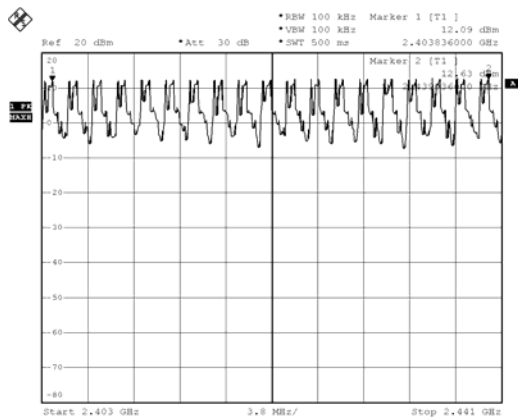
6.4. Uncertainty

N/A

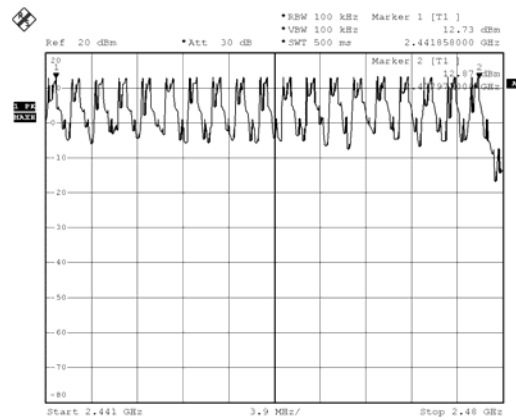
6.5. Test Result of Channel Number

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Channel Number
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter

Frequency Range (MHz)	Measurement (Hopping Channel)	Required Limit (Hopping Channel)	Result
2404 - 2478	38	>15	Pass



PN1
 Date: 5.SEP.2007 21:18:20



PN1
 Date: 5.SEP.2007 21:19:32

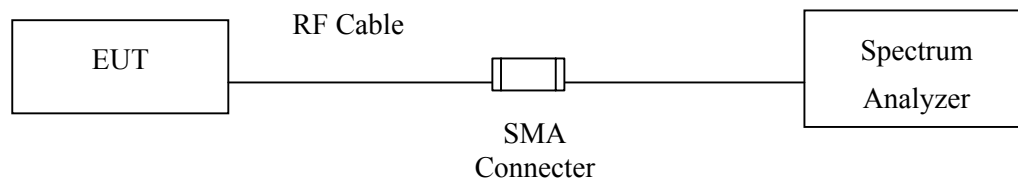
7. Channel Separation

7.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Spectrum Analyzer	R & S	FSP40 / 100170	Nov., 2006

Note: 1. All equipments are calibrated every one year.
2. The test instruments marked by “X” are used to measure the final test results.

7.2. Test Setup



7.3. Limit

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.

7.4. Uncertainty

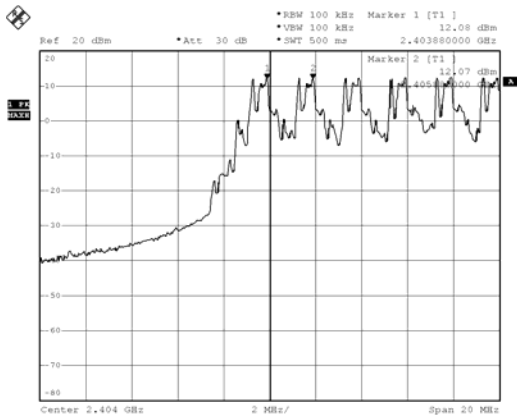
$\pm 150\text{Hz}$

7.5. Test Result of Channel Separation

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Channel Separation
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter

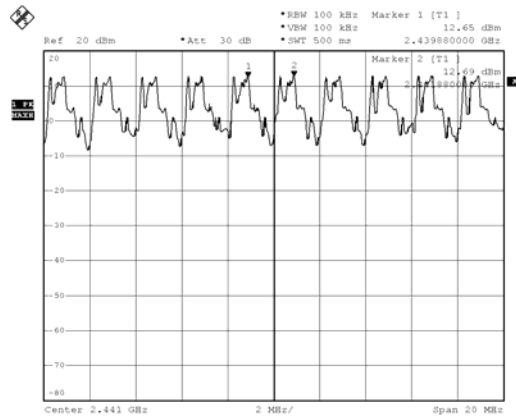
Frequency (MHz)	Measurement Level (MHz)	Required Limit	Result
2404	2.00	>25 kHz or 2/3 * 20 dB BW	Pass
2440	2.00	>25 kHz or 2/3 * 20 dB BW	Pass
2478	2.00	>25 kHz or 2/3 * 20 dB BW	Pass

Channel 01-02



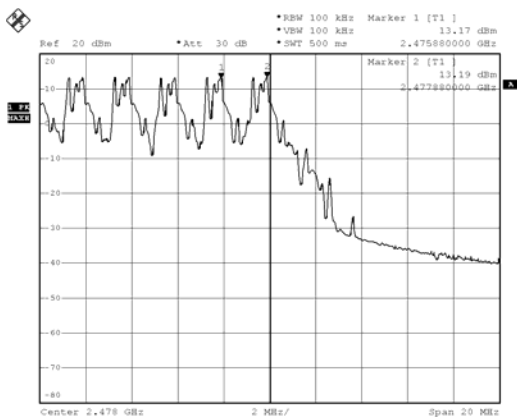
PN1
 Date: 5.SEP.2007 21:13:52

Channel 19-20



PN1
 Date: 5.SEP.2007 21:15:10

Channel 37-38



PN1
 Date: 5.SEP.2007 21:16:31

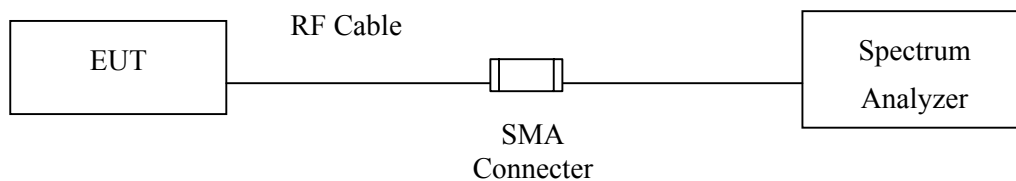
8. Dwell Time

8.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Spectrum Analyzer	R & S	FSP40 / 100170	Nov., 2006

Note: 1. All equipments are calibrated every one year.
2. The test equipments marked “X” are used to measure the final test results.

8.2. Test Setup



8.3. Limit

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.

8.4. Uncertainty

± 25msec

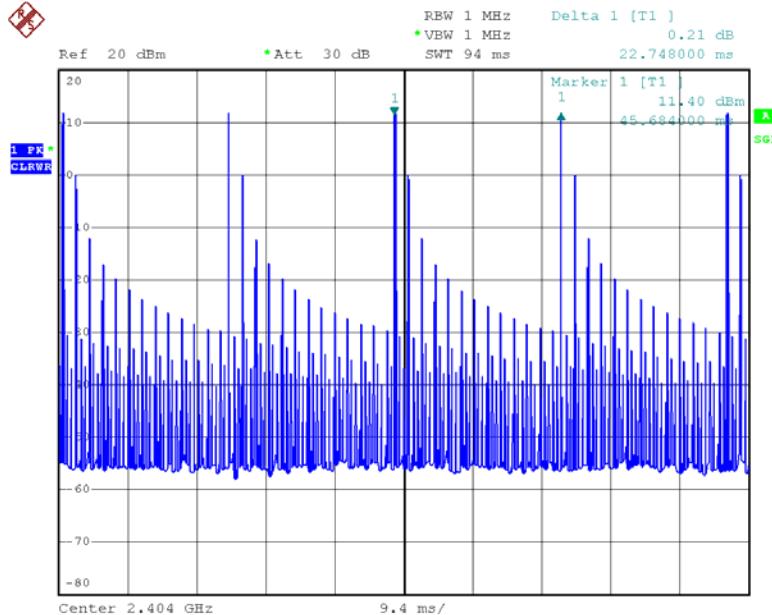
8.5. Test Result of Dwell Time

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Dwell Time
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (Channel 10,19,38)

Channel No.	Frequency (MHz)	Time Interval between hops (ms)	Transmission Time (us)	Dwell Time (ms)	Limit (ms)	Result
01	2404	22.74	159.8	106.814	400	Pass
19	2440	22.56	164.0	110.496	400	Pass
38	2478	22.56	165.2	111.304	400	Pass

Note: Dwell Time = $38 * 400\text{ms} / \text{Time Interval Between Hops} * \text{Transmission Time} / 1000$

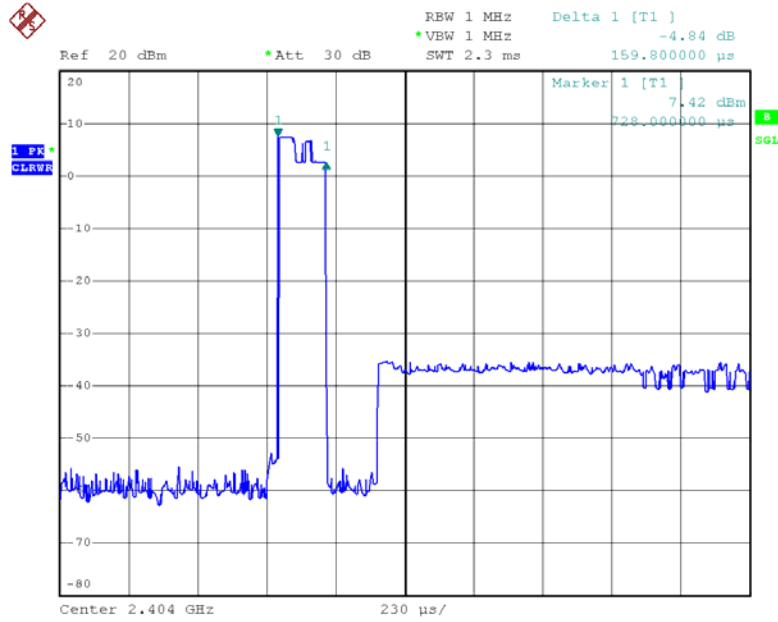
CH 1 2404MHz Time Interval between hops



PN1

Date: 13.SEP.2007 13:17:11

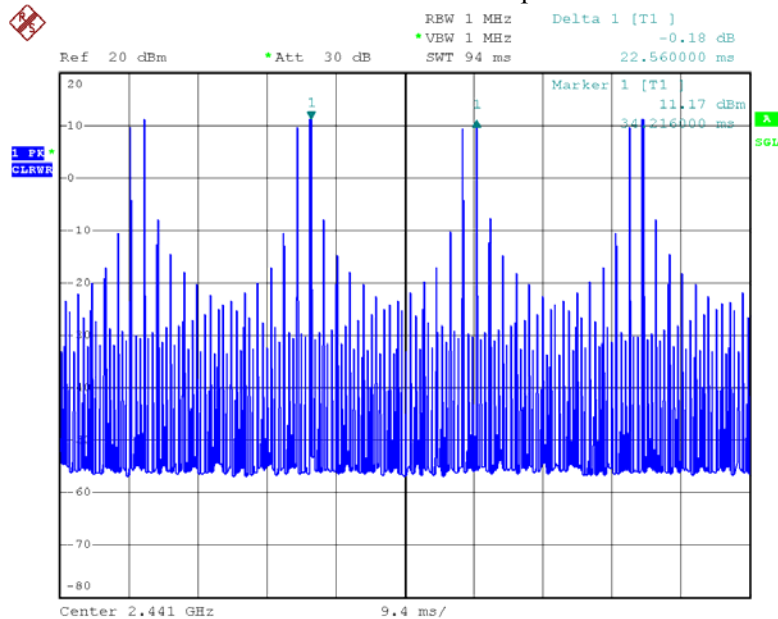
CH 1 2404MHz Transmission Time



PN1

Date: 6.SEP.2007 17:44:34

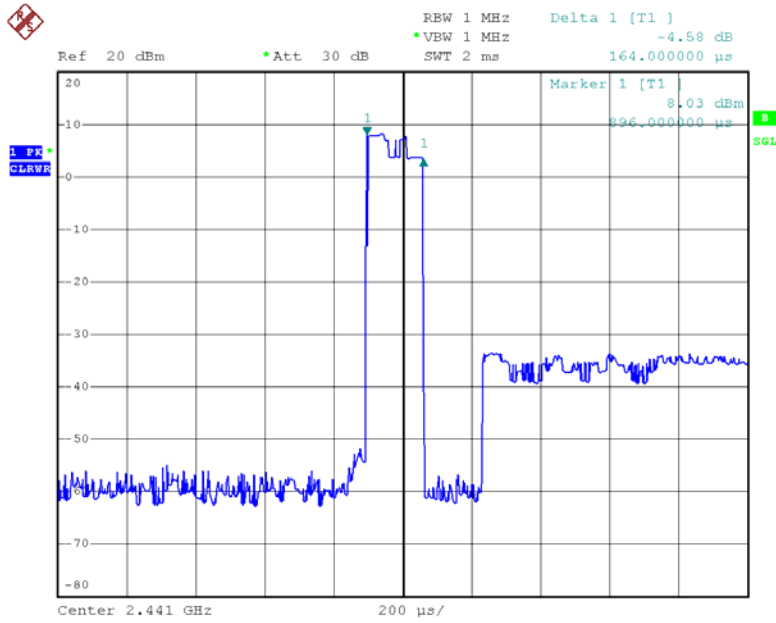
CH 19 2440MHz Time Interval between hops



PN1

Date: 13.SEP.2007 13:17:37

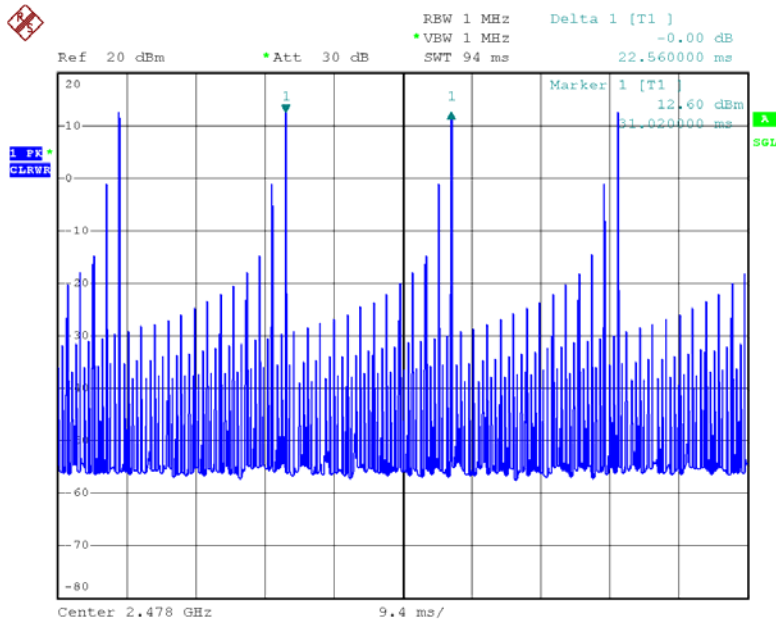
CH 19 2440MHz Transmission Time



PN1

Date: 6.SEP.2007 17:46:21

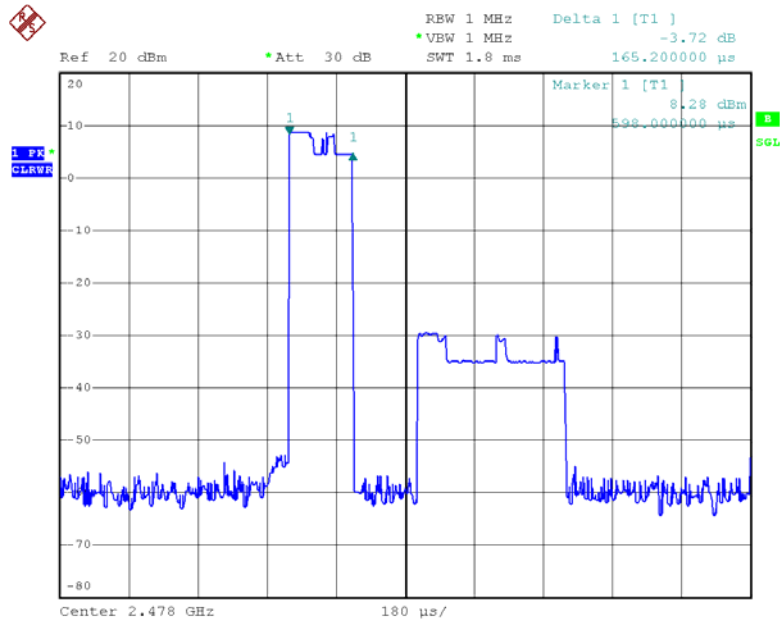
CH 38 2478MHz Time Interval between hops



PN1

Date: 13.SEP.2007 13:18:27

CH 38 2478MHz Transmission Time



PN1

Date: 6.SEP.2007 17:48:10

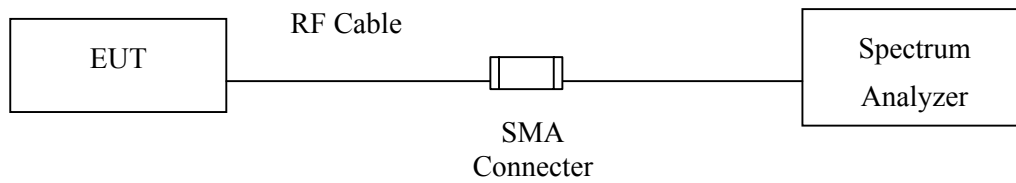
9. Occupied Bandwidth

9.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Spectrum Analyzer	R & S	FSP40 / 100170	Nov., 2006

Note: 1. All equipments are calibrated every one year.
 2. The test instruments Marked “X” are used to measure the final test results.

9.2. Test Setup



9.3. Limits

N/A

9.4. Uncertainty

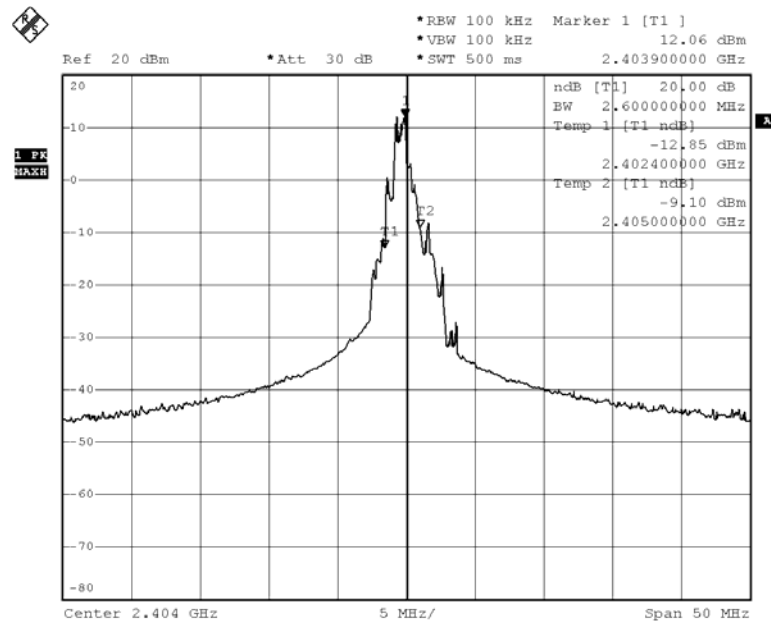
$\pm 150\text{Hz}$

9.5. Test Result of Occupied Bandwidth

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Occupied Bandwidth Data
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (Channel 01)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
01	2404	2600	--	N/A

Figure Channel 01:



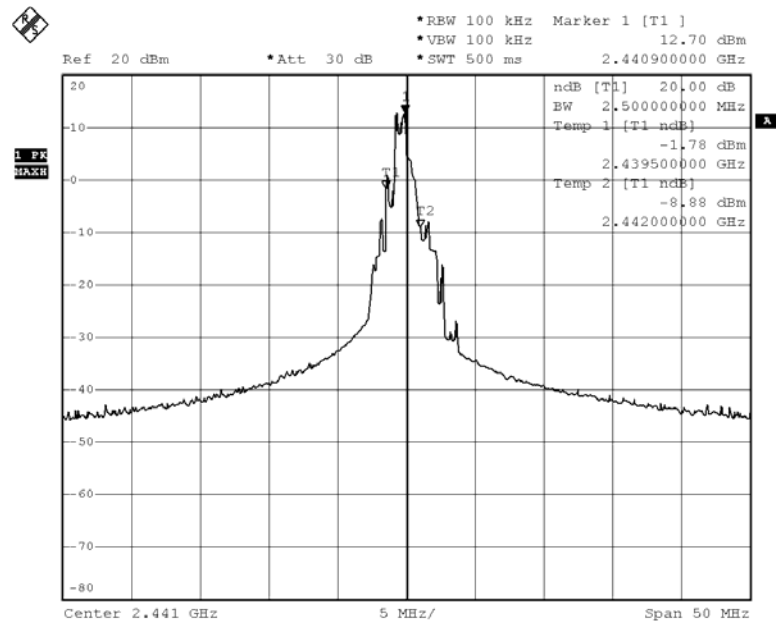
PN1

Date: 5.SEP.2007 21:10:27

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Occupied Bandwidth Data
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (Channel 19)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
19	2441	2500	--	N/A

Figure Channel 19:



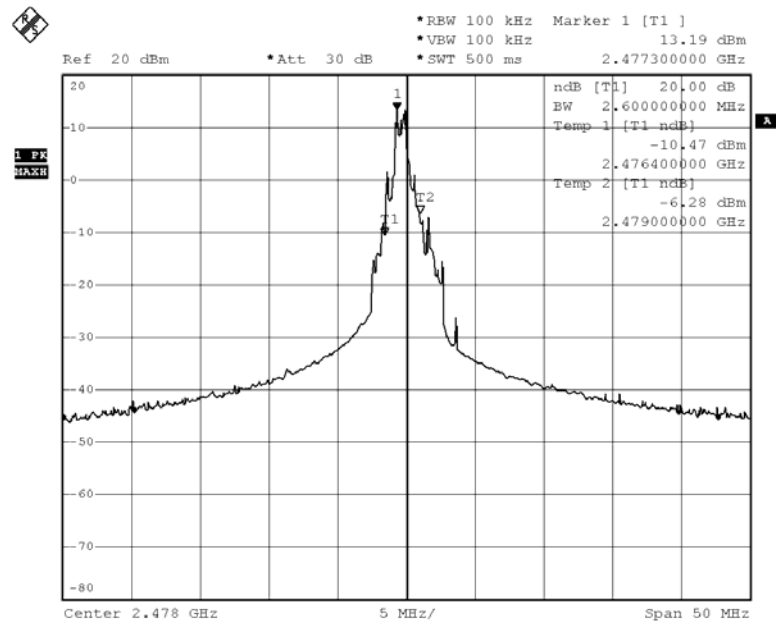
PN1

Date: 5.SEP.2007 21:11:36

Product : 2.4GHz WIRELESS RECEIVER
 Test Item : Occupied Bandwidth Data
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmitter (Channel 38)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
38	2478	2600	--	N/A

Figure Channel 38:



PN1

Date: 5.SEP.2007 21:12:03

10. Pseudo Random Hopping Algorithm

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies.

Each frequency must be used equally by the transmitter.

Base Table Hopping Sequence

The hopping sequence is described below.

Pseudo random properties of the embedded FHSS engine

The embedded FHSS engine uses 38 hopping locations, out of which 18 are non-overlapping channels.

The hopping sequence is contained in a table with the 38 frequency location entries staggered in a pseudorandom order. A single data frame is transmitted on each frequency location before skipping to the next hopping frequency in the list. Upon completion of the list, the hopping sequence is repeated on a cyclic basis.

Upon reception of faulty/no data, the frequency(ies) resulting in loss of data is temporarily removed from the hopping list. The hopping sequence cycle is thus correspondingly shortened. The frequency locations resulting in loss of data are added to a list of banned frequencies containing the frequency locations unsuitable for use.

This list is limited to a maximum number (NBCH), set to 0x12 in this application.

The duration of the ban is given by the equation $(BCHD+1) * NBCH * t_p$

The BCHD parameter is set to 0x0A and t_p is 2.91ms for the 44.1KHz sampling setting.

In normal operation, the initial pseudorandom list of frequency hopping locations is volatile in terms of the number of hopping frequencies in use and the sequence of which they occur.

These elements combined result in an unpredictable hopping sequence with pseudorandom properties.

Base sequence hopping frequency locations

Hopping frequency location	Frequency / UDC* [GHz]	Hopping frequency location	Frequency / UDC* [GHz]	Hopping frequency location	Frequency / UDC* [GHz]
1:	2.406	14:	2.412	27:	2.422
2:	2.428	15:	2.436	28:	2.446
3:	2.452	16:	2.460	29:	2.470
4:	2.476	17:	2.408	30:	2.418
5:	2.424	18:	2.432	31:	2.442
6:	2.448	19:	2.456	32:	2.466
7:	2.472	20:	2.404	33:	2.414
8:	2.420	21:	2.430	34:	2.438
9:	2.444	22:	2.454	35:	2.462
10:	2.468	23:	2.478	36:	2.410
11:	2.416	24:	2.426	37:	2.434
12:	2.440	25:	2.450	38:	2.458
13:	2.464	26:	2.474		

* UDC = User Defined Channel centre frequency defined for the nRF24Z1 Headphone Reference Design 1. See table on below table.

UDC 01:	2404 MHz	UDC 02:	2406 MHz	UDC 03:	2408 MHz	UDC 04:	2410 MHz
UDC 05:	2412 MHz	UDC 06:	2414 MHz	UDC 07:	2416 MHz	UDC 08:	2418 MHz
UDC 09:	2420 MHz	UDC 10:	2422 MHz	UDC 11:	2424 MHz	UDC 12:	2426 MHz
UDC 13:	2428 MHz	UDC 14:	2430 MHz	UDC 15:	2432 MHz	UDC 16:	2434 MHz
UDC 17:	2436 MHz	UDC 18:	2438 MHz	UDC 19:	2440 MHz	UDC 20:	2442 MHz
UDC 21:	2444 MHz	UDC 22:	2446 MHz	UDC 23:	2448 MHz	UDC 24:	2450 MHz
UDC 25:	2452 MHz	UDC 26:	2454 MHz	UDC 27:	2456 MHz	UDC 28:	2458 MHz
UDC 29:	2460 MHz	UDC 30:	2462 MHz	UDC 31:	2464 MHz	UDC 32:	2466 MHz
UDC 33:	2468 MHz	UDC 34:	2470 MHz	UDC 35:	2472 MHz	UDC 36:	2474 MHz
UDC 37:	2476 MHz	UDC 38:	2478 MHz				

11. EMI Reduction Method During Compliance Testing

No modification was made during testing.