



FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

Bluetooth Module

Model: AB3C2

Trade Name: AIRcable SMD

Issued to

Wireless Cables Inc.

1414 Soquel Ave, Ste 212, Santa Cruz, CA 95062, USA

Issued by

Compliance Certification Services Inc.

Hsinchu Lab.

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NVLAP LAB CODE 200118-0



Testing Laboratory
0240

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1. TEST RESULT CERTIFICATION

Applicant: 1414 Soquel Ave, Ste 212, Santa Cruz, CA 95062, USA
Equipment Under Test: Bluetooth Module
Trade Name: AIRcable SMD
Model: AB3C2
Date of Test: May 22 ~ 25, 2007

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart C	No non-compliance noted

We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4: 2003 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

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

Approved by:

Reviewed by:


S. B. Lu
Section Manager
Compliance Certification Services Inc.


Jason Chang
Section Manager
Compliance Certification Services Inc.





2. EUT DESCRIPTION

Product	Bluetooth Module
Trade Name	AIRcable SMD
Model Number	AB3C2
Model Discrepancy	All the above models are identical except the model designation.
Power Supply	Powered from host device
Frequency Range	2402 ~ 2480 MHz
Transmit Power	2.5 dBm
Modulation Technique	FHSS (GFSK)
Transmit Data Rate	1Mbps
Modulation Technique	GFSK for 1Mbps
Number of Channels	79 Channels
Antenna Specification	Gain: 0 dBi
Antenna Designation	Chip Antenna

Remark:

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: SQCAB3C2 filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.



3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

3.1 EUT CONFIGURATION

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

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4.



3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

- (a) Except as shown in paragraph (d) of this section, 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 - 5.15
¹ 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 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	(²)
13.36 - 13.41	322 - 335.4		

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

² Above 38.6

- (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.



3.5 DESCRIPTION OF TEST MODES

The EUT (model: AB3C2) had been tested under operating condition.

Test program used to control the EUT for staying in continuous transmitting mode was programmed.

Software used to control the EUT for staying in continuous transmitting mode was programmed. The worst case data rate is determined as the data rate with highest output power.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode only.

Channel Low (2402MHz), Mid (2441MHz) and High (2480MHz) with 1Mbps data rate was chosen for full testing.

The field strength of spurious emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.



4. INSTRUMENT CALIBRATION

4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

4.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

Remark: Each piece of equipment is scheduled for calibration once a year.

Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY46180323	02/22/2008
Single Channel PK Power Meter	Agilent	N1911A	MY45100803	03/11/2008
Wideband Power Sensor	Agilent	N1921A	MY45241299	03/06/2008
DC Power Supply	Agilent	E3641A	MY40002337	02/25/2008

Open Area Test Site 2				
Manufacturer or Type	Manufacturer	Model	Serial Number	Calibration Due
Bilog- Antenna	CHASE	CBL6112B	2817	08/27/2007
Spectrum Analyzer	Rohde&Schwarz	FSEK30	835253/002	10/17/2007
Spectrum Analyzer	Agilent	E4446A	MY433601.32	03/21/2008
EMI Test Receiver	Rohde&Schwarz	ESCS30	835418/008	09/01/2007
OPEN SITE	CCS	-----	No.2	05/06/2008
Horn Antenna	Com-Power	AH-118	10089	08/29/2007
Horn Antenna	Com-Power	AH-840	03077	02/24/2007
Pre-amplifier	Agilent	8449B	3008A01471	12/24/2007
Per-Amplifier	HP	8447D	1937A02748	12/24/2007
High pass filter	HP	84300/80038	002	CAL. ON USE
High pass filter	HP	84300/80039	003	CAL. ON USE
Loop Antenna	ETS-LINDGREN	6502	2356	06/14/2007

Remark: The measurement uncertainty is less than $\pm 3.2\text{dB}$ (30MHz ~ 1GHz), $\pm 3.2\text{dB}$ (Above 1GHz) which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV



Powerline Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
L.I.S.N	EMCO	3810/2	9801-1850	02/25/2008
L.I.S.N	CHASE	NNLK 8129	8129118	01/25/2008
TEST RECEIVER	Rohde&Schwarz	ESHS30	838550/003	01/30/2008
KEENE SHIELDED ROOM	CCS	5983	No.1	N/A
PULSE LIMIT	Rohde&Schwarz	EHS3Z2	357.8810.52	07/10/2007
50Ω TERMINATOR	N/A	-----	-----	07/10/2007

Remark: The measurement uncertainty is less than +/- 2.1dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.



5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

☒ Rm. 258, Bldg. 17, 195 Sec. 4, Chung Hsing Rd., Chutung, Hsinchu Hsien 310, Taiwan

Tel: 886-3-591-0068 / Fax: 886-3-582-5720

☒ Room 423, WiCE Bldg. 48, No.566, Lane 134, Longyuan Rd., Longtan Township, Taoyuan

County 32544, Taiwan

Tel: 886-3-411-7500 / Fax: 886-3-411-7503

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

5.2 EQUIPMENT






Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5.3 TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	NVLAP	EN 55014-1, AS/NZS 1044, CNS 13783-1, IEC/CISPR 14-1, IEC/CISPR 22, EN 55022, EN 61000-3-2, EN 61000-3-3, ANSI C63.4, AS/NZS CISPR 22, AS/NZS 3548, IEC 61000-4-2/3/4/5/6/8/11	 200118-0
USA	FCC	3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements	 90585, 90584
Japan	VCCI	3/10 meter Open Area Test Sites to perform conducted/radiated measurements	VCCI R-1229/1189 C-1250/1294
Taiwan	TAF	FCC Method-47 CFR Part 15 Subpart C,D,E CISPR 11, FCC METHOD-47 CFR Part 18, EN 55011, CNS 13803, CISPR 13, CNS 13439, FCC Method-47 CFR Part 15 Subpart B, CISPR 14-1, EN 55014-1, CNS 13783-1, EN 55015, CNS 14115, CISPR 22, EN 55022, VCCI CNS 13438, EN 61000-4-2/3/4/5/6/8/11	 Testing Laboratory 0240
Taiwan	BSMI	CNS 13803, CNS 13438, CNS 13439, CNS 13783-1, CNS 14115	 SL2-IS-E-0002 SL2-IN-E-0002 SL2-A1-E-0002 SL2-R1-E-0002 SL2-R2-E-0002 SL2-L1-E-0002
Canada	Industry Canada	RSS212, Issue 1	 IC 4417-1

* No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.



6. SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

6.2 SUPPORT EQUIPMENT

No.	Brand	Device Type	Model	Series No.	FCC ID	Data Cable	Power Cord
1	IBM	Notebook PC	X60	LV-R1400	FCC DoC	Shielded, 1.8m with two cores	Unshielded, 1.8m
2	ATEN	USB to RS-232 Adapter	UC-232A	041012109001	FCC DoC	Shielded, 0.3m	N/A

Remark:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.



7. FCC PART 15.247 REQUIREMENTS

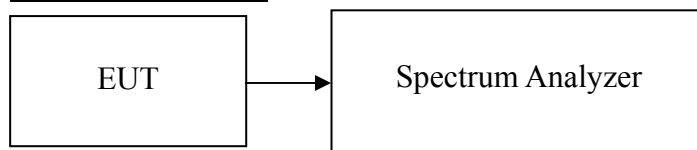
7.1 PEAK POWER

LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

1. According to §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.
2. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.
3. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the peak power detection.

TEST RESULTS

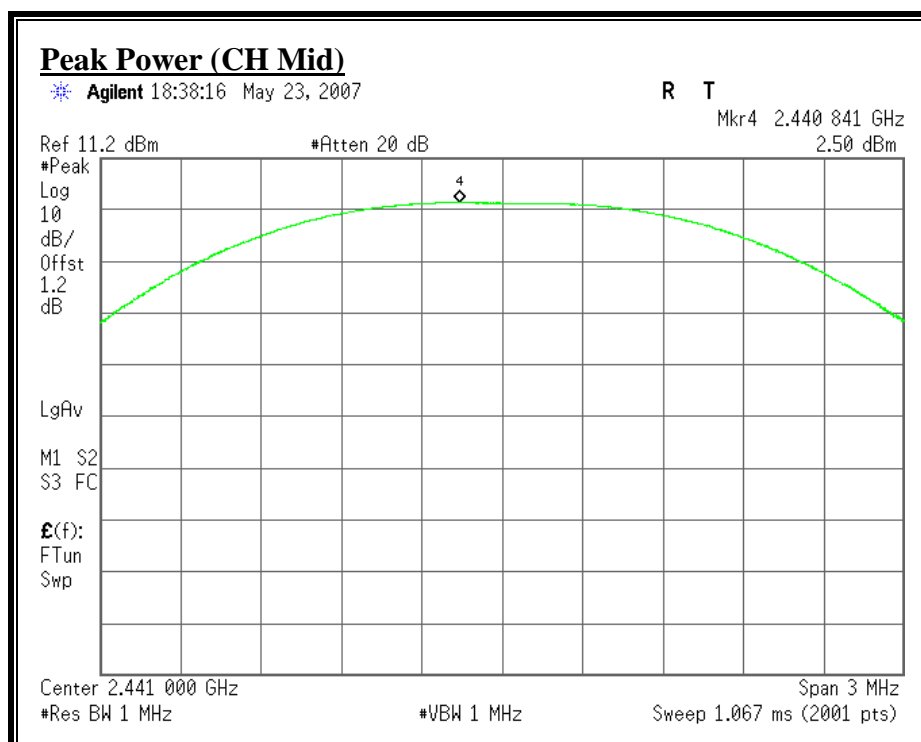
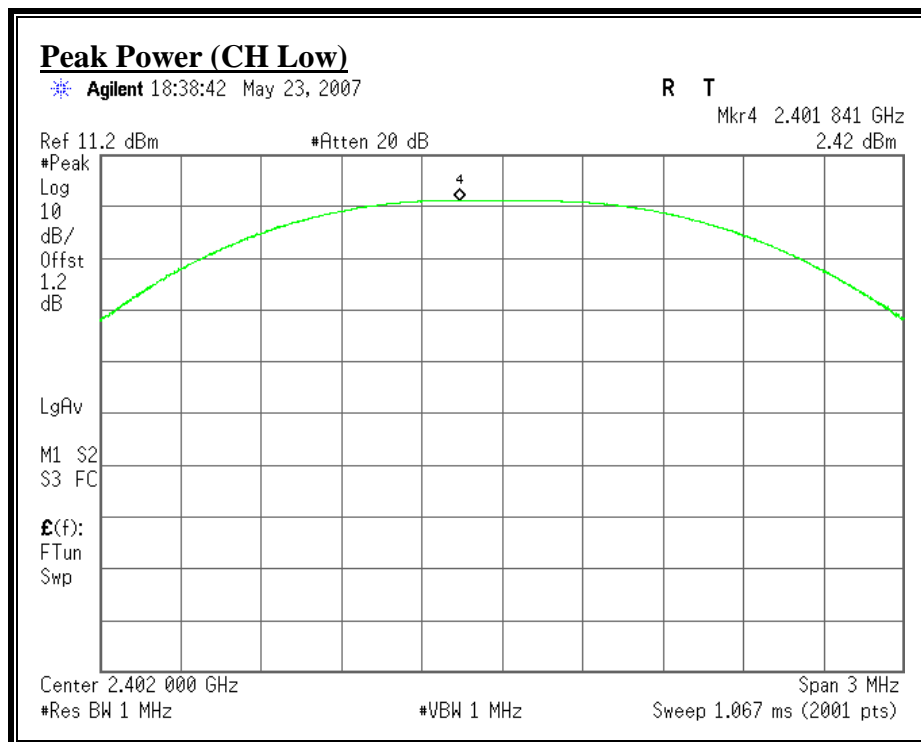
No non-compliance noted

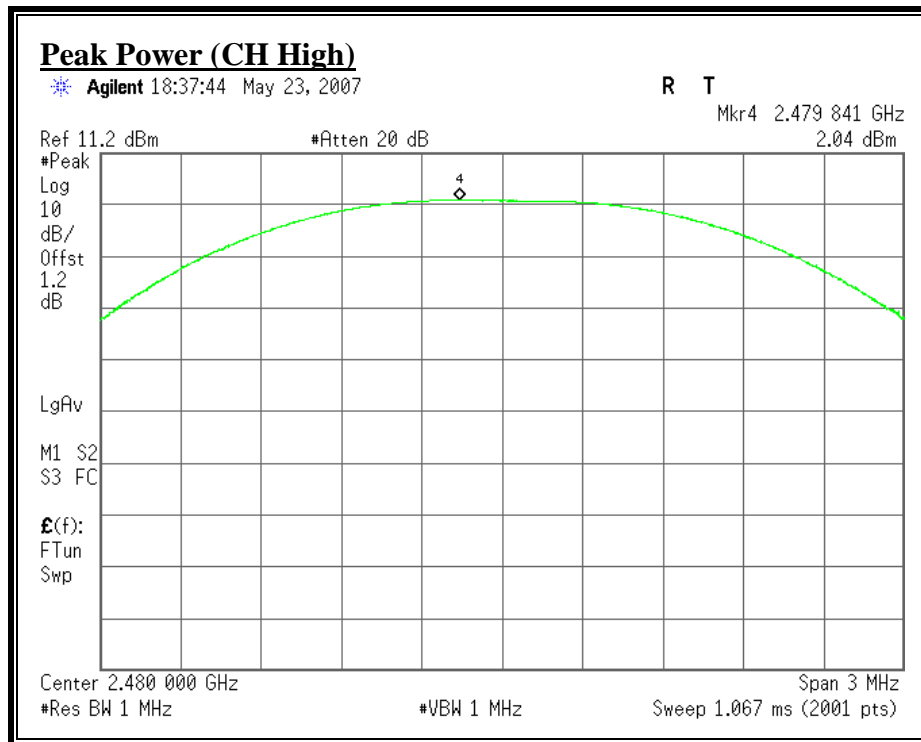
Test Data

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2402	2.42	0.00175	0.125	PASS
Mid	2441	2.50	0.00178		PASS
High	2480	2.04	0.00160		PASS



Test Plot



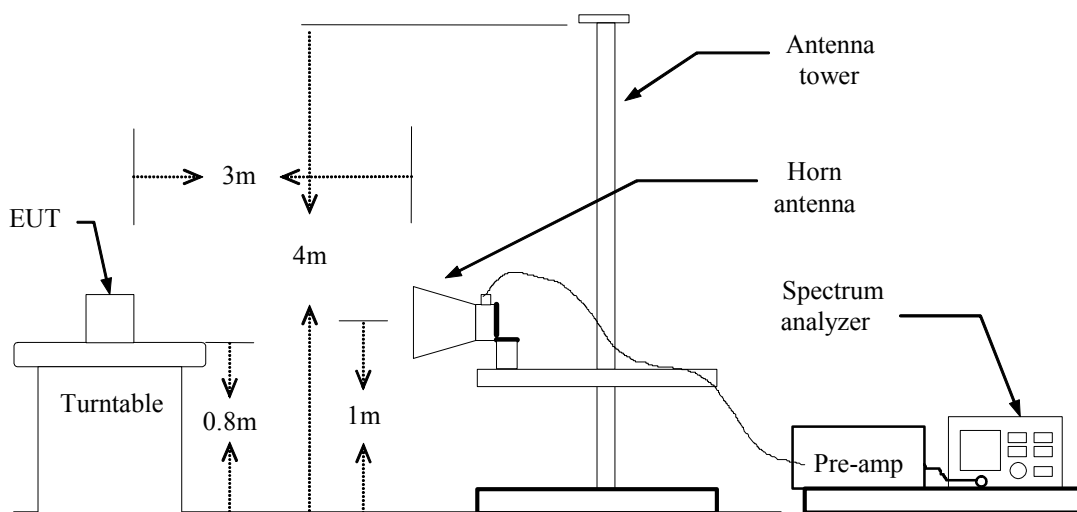


7.2 BAND EDGES MEASUREMENT

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands 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, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

Test Configuration



TEST PROCEDURE

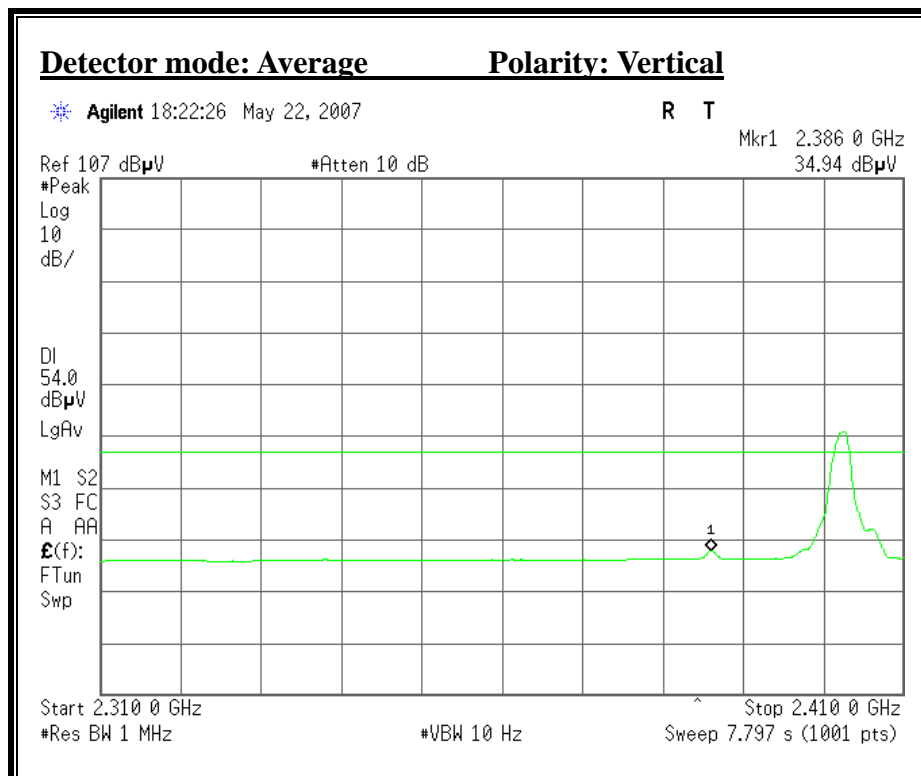
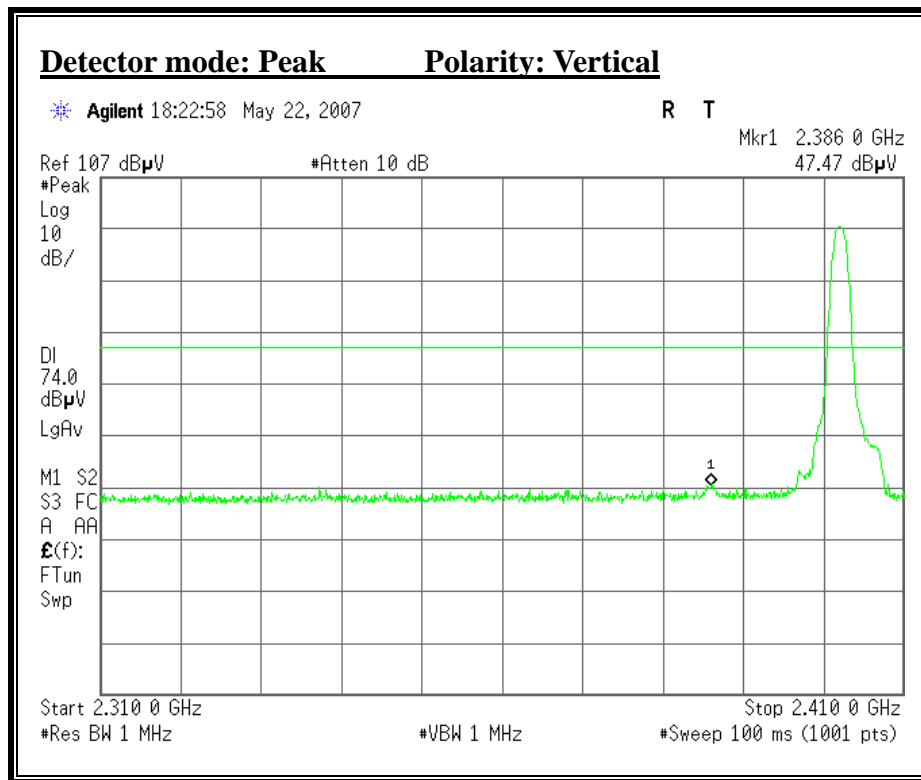
1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
 - (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
 - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

TEST RESULTS

Refer to attach spectrum analyzer data chart.



Band Edges (CH Low)





Detector mode: Peak Polarity: Horizontal

Agilent 18:16:09 May 22, 2007

R T

Mkr1 2.386 1 GHz
47.78 dB μ V

Ref 107 dB μ V

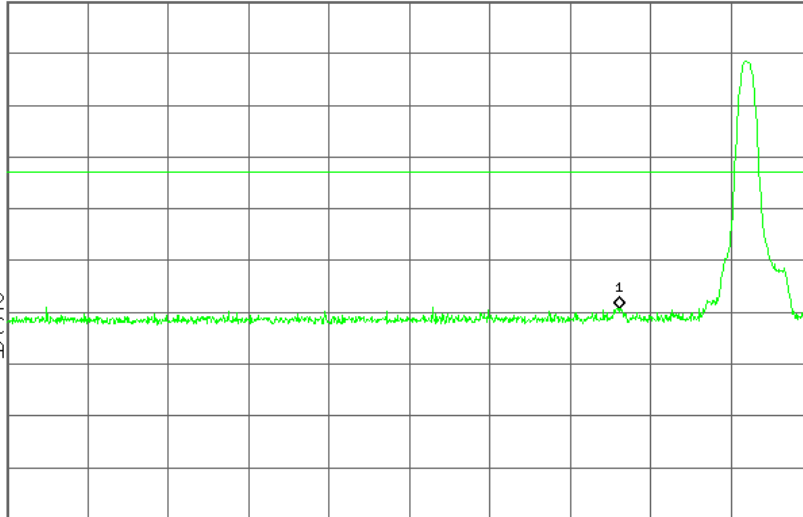
#Atten 10 dB

#Peak
Log
10
dB/

DI
74.0
dB μ V
LgAv

M1 S2
S3 FC
A AA

$\mathcal{E}(f)$:
FTun
Swp



Start 2.310 0 GHz

Stop 2.410 0 GHz

#Res BW 1 MHz

#VBW 1 MHz

#Sweep 100 ms (1001 pts)

Detector mode: Average Polarity: Horizontal

Agilent 18:16:54 May 22, 2007

R T

Mkr1 2.386 1 GHz
34.51 dB μ V

Ref 107 dB μ V

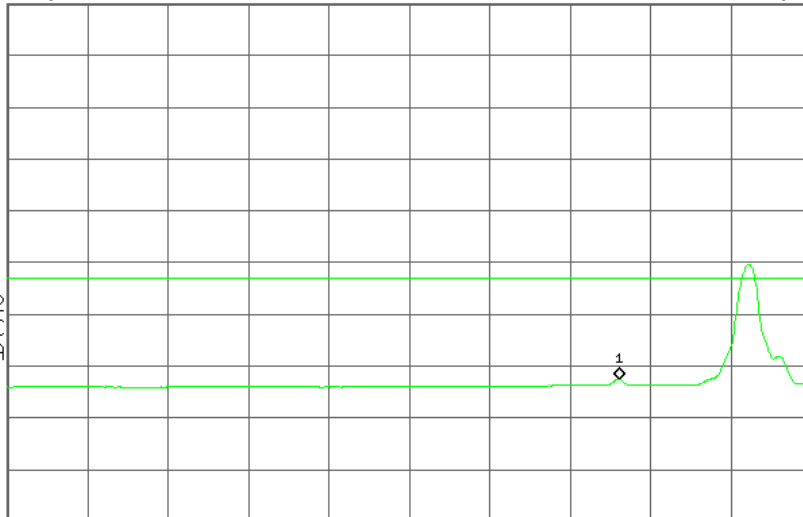
#Atten 10 dB

#Peak
Log
10
dB/

DI
54.0
dB μ V
LgAv

M1 S2
S3 FC
A AA

$\mathcal{E}(f)$:
FTun
Swp



Start 2.310 0 GHz

Stop 2.410 0 GHz

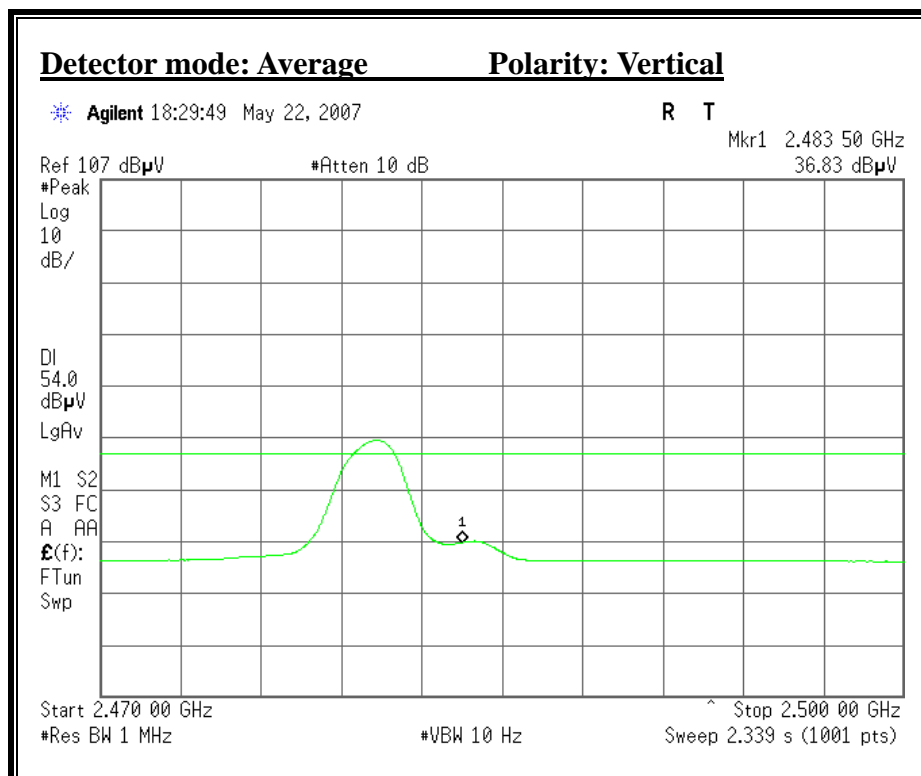
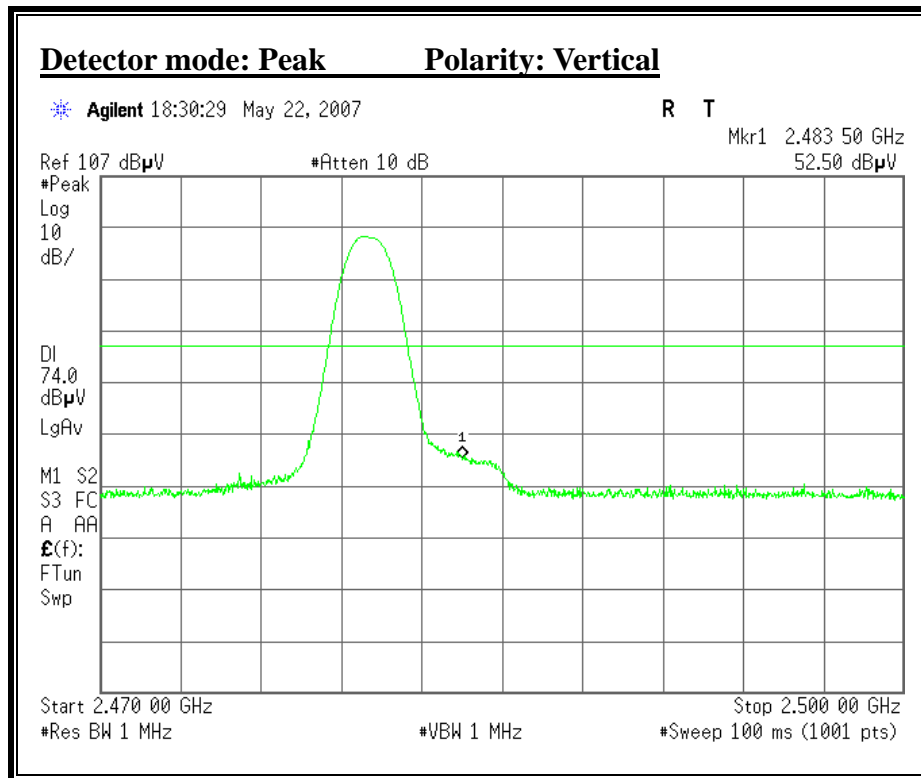
#Res BW 1 MHz

#VBW 10 Hz

Sweep 7.797 s (1001 pts)



Band Edges (CH High)





Detector mode: Peak **Polarity: Horizontal**

Agilent 18:40:38 May 22, 2007

R T

Mkr1 2.484 01 GHz
52.53 dB μ V

Ref 107 dB μ V

#Atten 10 dB

*Peak

Log

10

dB/

DI

74.0

dB μ V

LgAv

M1 S2

S3 FC

A AA

$\mathcal{E}(f)$:

FTun

Swp

Start 2.470 00 GHz

*Res BW 1 MHz

#VBW 1 MHz

Stop 2.500 00 GHz

#Sweep 100 ms (1001 pts)

Detector mode: Peak **Polarity: Horizontal**

Agilent 18:40:02 May 22, 2007

R T

Mkr1 2.484 01 GHz
37.23 dB μ V

Ref 107 dB μ V

#Atten 10 dB

*Peak

Log

10

dB/

DI

54.0

dB μ V

LgAv

M1 S2

S3 FC

A AA

$\mathcal{E}(f)$:

FTun

Swp

Start 2.470 00 GHz

*Res BW 1 MHz

#VBW 10 Hz

Stop 2.500 00 GHz

Sweep 2.339 s (1001 pts)

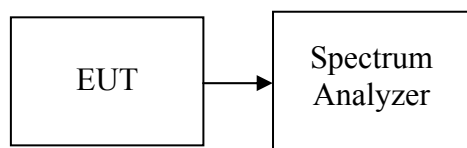


7.3 FREQUENCY SEPARATION

LIMIT

According to §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 Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW = 30kHz, VBW = 100kHz, Span = 3MHz, Sweep = auto.
5. Max hold, mark 3 peaks of hopping channel and record the 3 peaks frequency.

TEST RESULTS

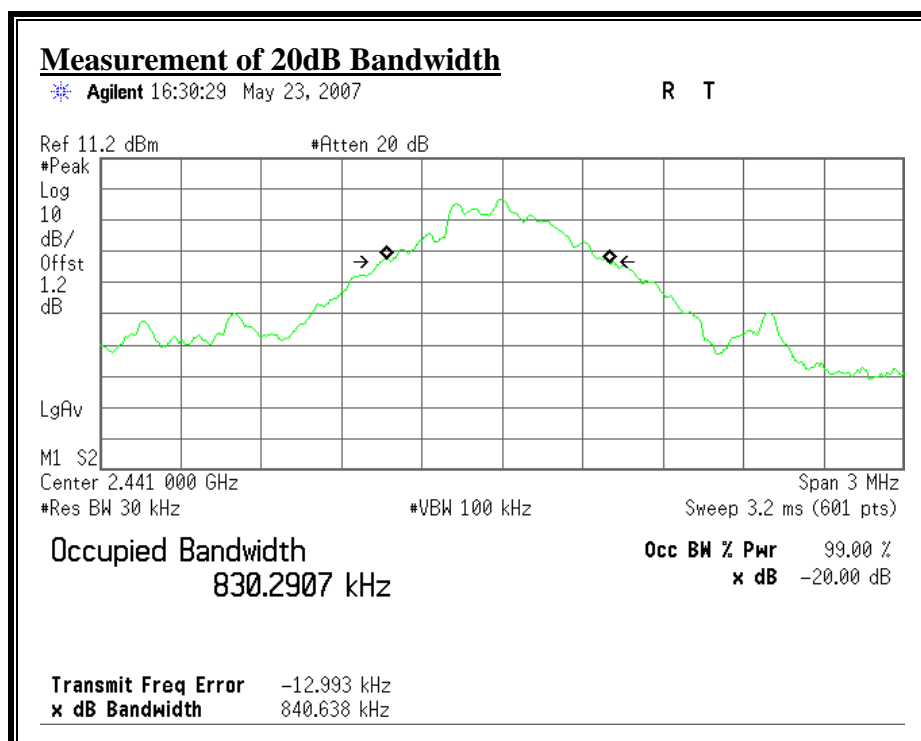
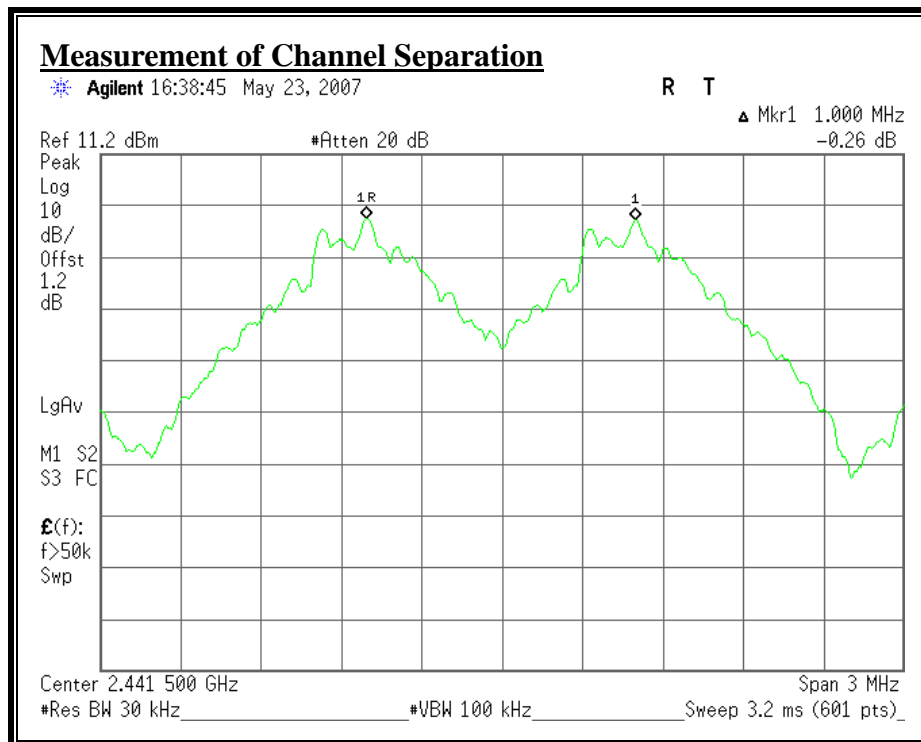
No non-compliance noted

Test Data

Channel Separation (MHz)	20dB Bandwidth (kHz)	Channel Separation Limit	Result
1.00	840.638	> 25kHz or two-thirds of the 20 dB bandwidth	Pass



Test Plot



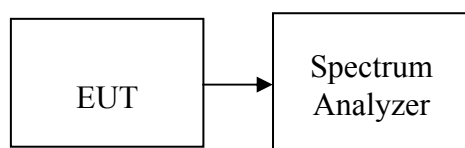


7.4 NUMBER OF HOPPING FREQUENCY

LIMIT

§15.247(a)(1)(iii) For frequency hopping system operating in the 2400-2483.5MHz bands shall use at least 15 hopping frequencies

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2441.5MHz, Sweep = auto and Start=2441.5MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW=100kHz, VBW=300kHz.
5. Max hold, view and count how many channel in the band.

TEST RESULTS

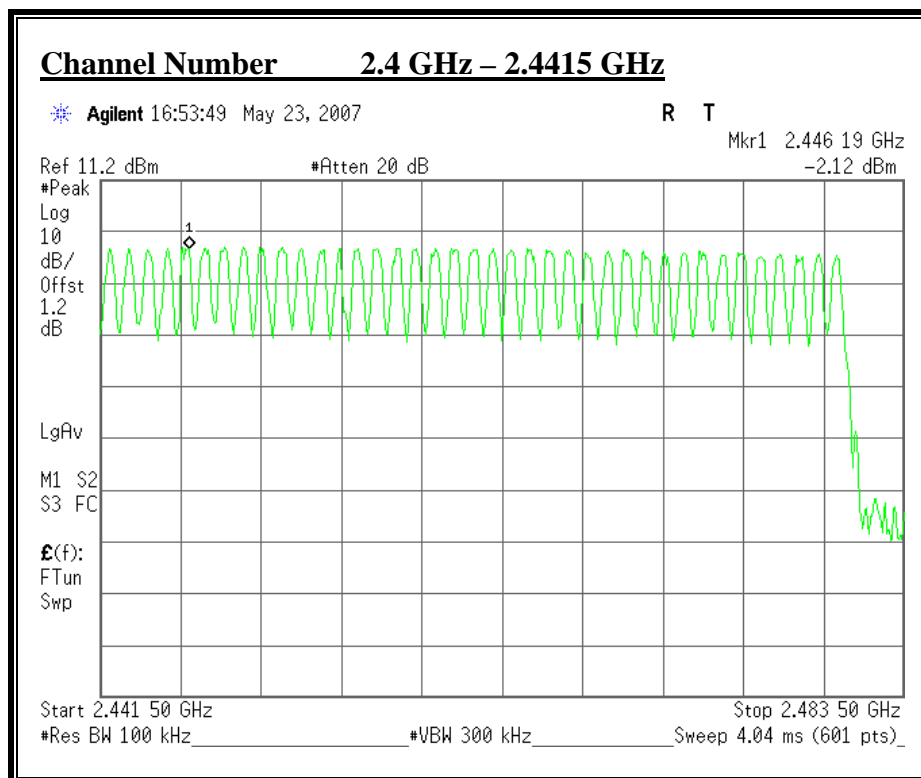
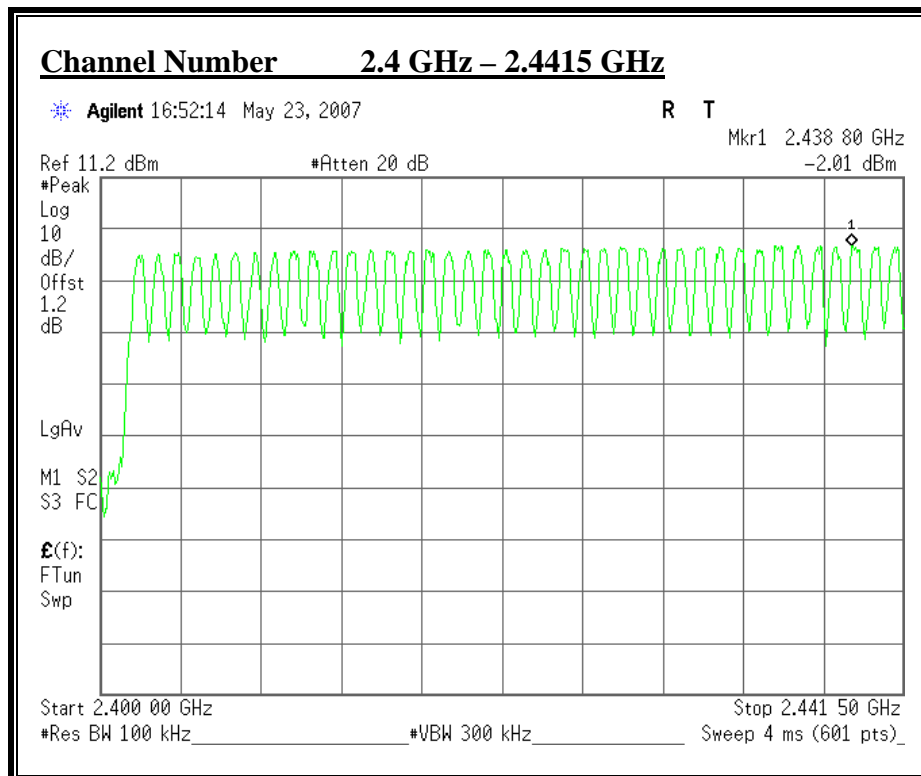
No non-compliance noted

Test Data

Result (No. of CH)	Limit (No. of CH)	Result
79	>15	PASS



Test Plot



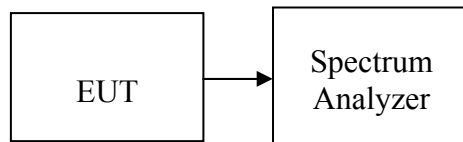


7.5 TIME OF OCCUPANCY (DWELL TIME)

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

Test Configuration

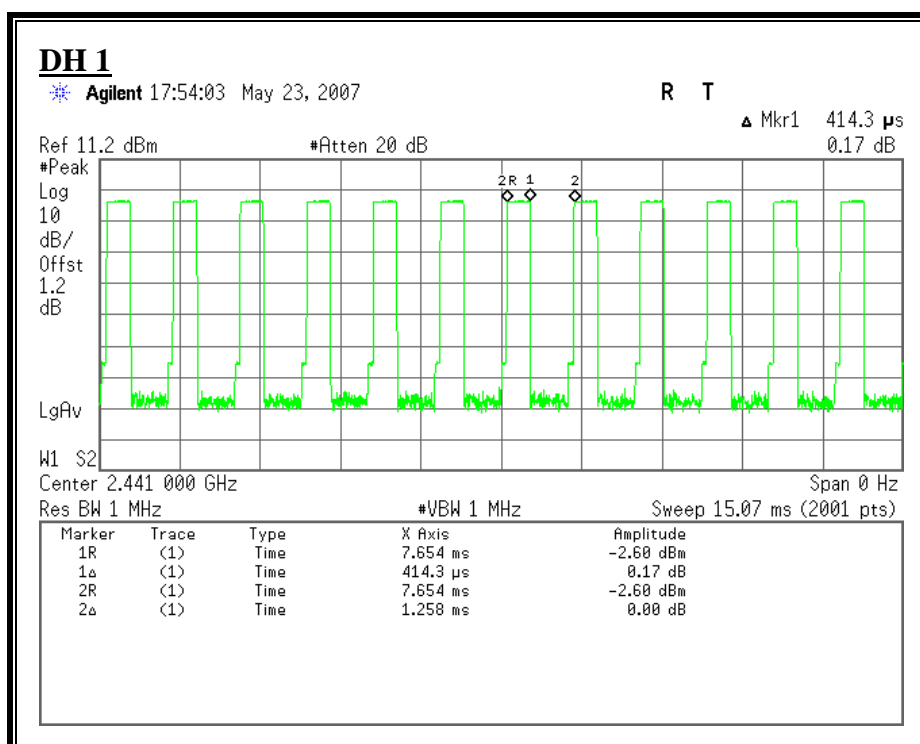


TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=1MHz, Span = 0Hz, Sweep = auto.
5. Repeat above procedures until all frequency measured were complete.

**Test Plot****TEST RESULTS***No non-compliance noted***Test Data**

Transmitting Frequency	Packet type	Dwell time (ms)	Total of Dwell (ms)	Limit (ms)	Results
2441MHz	DH1	0.414	132.48	400	PASS
2441MHz	DH3	1.672	267.52	400	PASS
2441MHz	DH5	2.923	311.79	400	PASS

DH1 Dwell time = $0.414 \text{ ms} \times (1600 \div 2) \div 79 \times 31.6 = 132.48 \text{ (ms)}$ DH3 Dwell time = $1.672 \text{ ms} \times (1600 \div 4) \div 79 \times 31.6 = 267.52 \text{ (ms)}$ DH5 Dwell time = $2.923 \text{ ms} \times (1600 \div 6) \div 79 \times 31.6 = 311.79 \text{ (ms)}$ **Test Plot**



DH 3

Agilent 17:55:22 May 23, 2007

R T

Δ Mkr2 2.501 ms
-0.01 dB

Ref 11.2 dBm

#Atten 20 dB

#Peak

Log

10

dB/

Offst

1.2

dB

LgAv

W1 S2

Center 2.441 000 GHz

Span 0 Hz

Res BW 1 MHz

#VBW 1 MHz

Sweep 15.07 ms (2001 pts)

Marker	Trace	Type	X Axis	Amplitude
1R	(1)	Time	2.87 ms	-1.84 dBm
1a	(1)	Time	1.672 ms	-0.59 dB
2R	(1)	Time	2.87 ms	-1.84 dBm
2a	(1)	Time	2.501 ms	-0.01 dB

DH 5

Agilent 17:52:37 May 23, 2007

R T

Δ Mkr2 3.752 ms
0.19 dB

Ref 11.2 dBm

#Atten 20 dB

#Peak

Log

10

dB/

Offst

1.2

dB

LgAv

W1 S2

Center 2.441 000 GHz

Span 0 Hz

Res BW 1 MHz

#VBW 1 MHz

Sweep 15.07 ms (2001 pts)

Marker	Trace	Type	X Axis	Amplitude
1R	(1)	Time	4.708 ms	-2.88 dBm
1a	(1)	Time	2.923 ms	0.27 dB
2R	(1)	Time	4.708 ms	-2.88 dBm
2a	(1)	Time	3.752 ms	0.19 dB



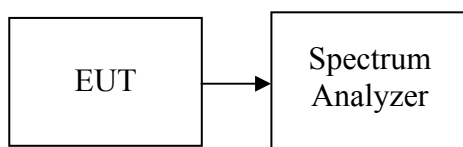
7.6 SPURIOUS EMISSIONS

7.6.1 Conducted Measurement

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands 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, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

Test Configuration



TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

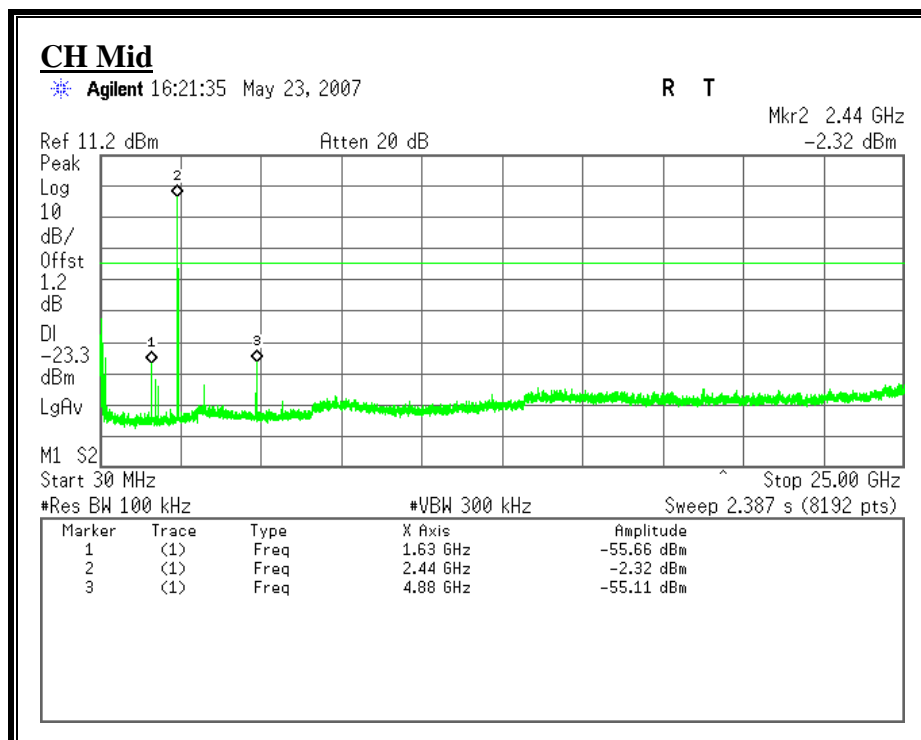
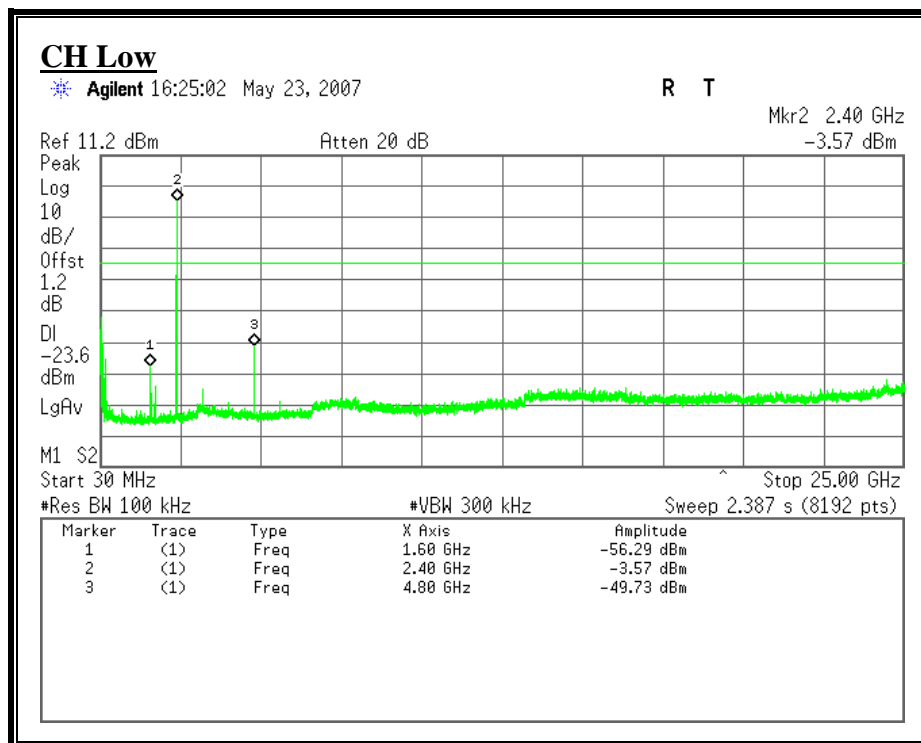
Measurements are made over the 30MHz to 25GHz range with the transmitter set to the lowest, middle, and highest channels.

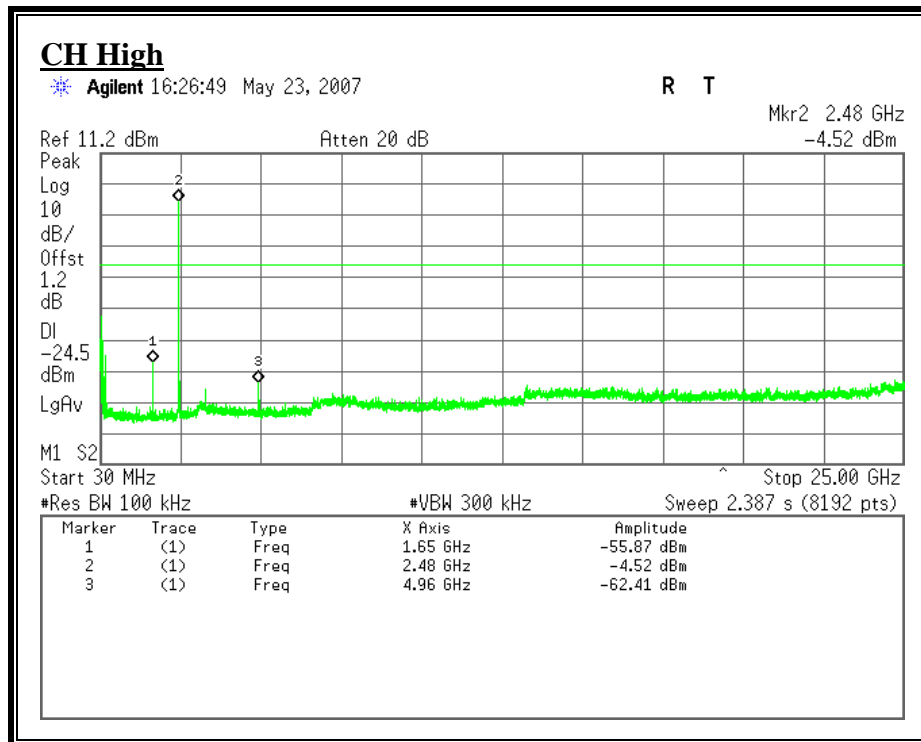
TEST RESULTS

No non-compliance noted



Test Plot







7.6.2 Radiated Emissions

LIMIT

1. According to §15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (m)
30-88	100*	3
88-216	150*	3
216-960	200*	3
Above 960	500	3

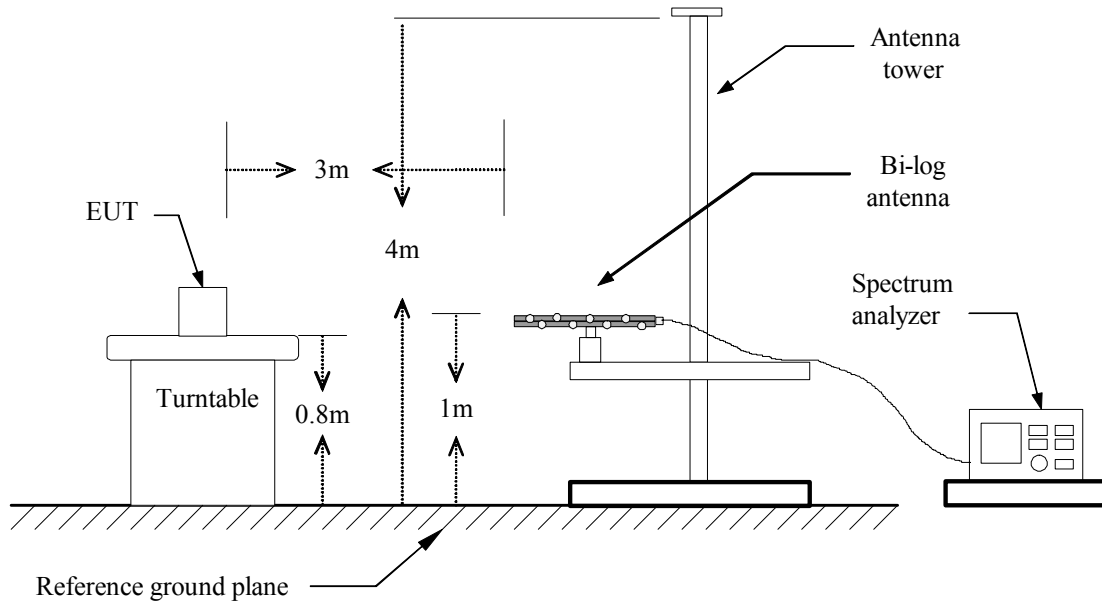
Remark: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

2. In the emission table above, the tighter limit applies at the band edges.

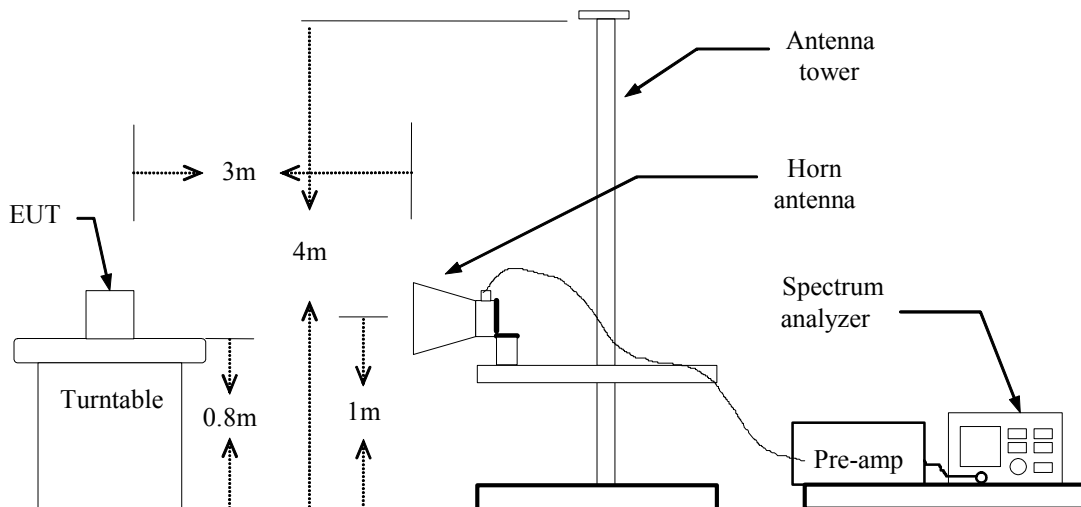
Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3-meter)	Field Strength (dB $\mu\text{V/m}$ at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

Test Configuration

Below 1 GHz



Above 1 GHz





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 varied from 1m to 4m to find out the highest 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. Set the spectrum analyzer in the following setting as:
Below 1GHz:
RBW=100kHz / VBW=300kHz / Sweep=AUTO
Above 1GHz:
(a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
(b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.

**TEST RESULTS****Below 1 GHz****Operation Mode:** Normal Link**Test Date:** 2007/5/22**Temperature:** 20°C**Tested by:** Jason Chang**Humidity:** 55 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (dBuV)	Correction Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
33.88	V	46.00	-15.34	30.66	40.00	-9.34	QP
49.40	V	48.00	-14.90	33.10	40.00	-6.90	QP
312.27	V	30.65	-12.72	17.94	46.00	-28.06	Peak
363.68	V	31.18	-11.89	19.29	46.00	-26.71	Peak
472.32	V	31.32	-10.26	21.06	46.00	-24.94	Peak
731.31	V	29.14	-5.28	23.86	46.00	-22.14	Peak
50.37	H	47.43	-14.93	32.51	40.00	-7.49	Peak
143.49	H	32.35	-13.63	18.72	43.50	-24.78	Peak
304.51	H	30.58	-12.91	17.66	46.00	-28.34	Peak
358.83	H	31.42	-11.94	19.49	46.00	-26.51	Peak
597.45	H	29.11	-7.86	21.25	46.00	-24.75	Peak
745.86	H	28.65	-5.18	23.48	46.00	-22.52	Peak

Remark:

- 1. Measuring frequencies from 30 MHz to the 1GHz.*
- 2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.*
- 3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.*
- 4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
- 5. Measurements above show only up to 6 maximum emissions noted, or would be lesser; with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
- 6. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).*

**Above 1 GHz****Operation Mode:** TX / CH Low**Test Date:** 2007/5/22**Temperature:** 20°C**Tested by:** Jason Chang**Humidity:** 55 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1496.00	V	48.51	---	-1.13	47.38	---	74.00	54.00	-6.62	Peak
1602.00	V	49.72	---	-0.17	49.54	---	74.00	54.00	-4.46	Peak
1660.00	V	48.44	---	0.36	48.80	---	74.00	54.00	-5.20	Peak
2402.00	V	95.13	54.98	4.02	99.15	59.00	---	---	---	Fundamental
2402.00	H	92.06	53.22	4.02	96.08	57.24	---	---	---	Fundamental
4807.50	H	41.10	---	8.98	50.08	---	74.00	54.00	-3.92	Peak

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / CH Mid**Test Date:** 2007/5/22**Temperature:** 20°C**Tested by:** Jason Chang**Humidity:** 55 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1628.00	V	48.71	---	0.06	48.77	---	74.00	54.00	-5.23	Peak
2441.00	V	89.75	---	4.07	93.82	---	---	---	---	Fundamental
4882.50	V	53.33	33.41	8.92	62.25	42.33	74.00	54.00	-11.67	Peak
2441.00	H	90.36	---	4.07	94.44	---	---	---	---	Fundamental

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser; with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / CH High**Test Date:** 2007/5/22**Temperature:** 20°C**Tested by:** Jason Chang**Humidity:** 55 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1654.00	V	48.62	---	0.30	48.92	---	74.00	54.00	-5.08	Peak
2480.00	V	89.87	---	4.13	93.99	---	---	---	---	Fundamental
4957.50	V	54.67	34.01	8.86	63.53	42.87	74.00	54.00	-11.13	Peak
2480.00	H	90.45	---	4.13	94.57	---	---	---	---	Fundamental
4957.50	H	40.62	---	8.86	49.48	---	74.00	54.00	-4.52	Peak

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



7.7 POWERLINE CONDUCTED EMISSIONS

LIMIT

According to §15.207(a), except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

* Decreases with the logarithm of the frequency.

Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

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

**TEST RESULTS**

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Test Data**Operation Mode:** Normal Link**Test Date:** September 10, 2006**Temperature:** 25°C**Tested by:** Roy Cheng**Humidity:** 68% RH

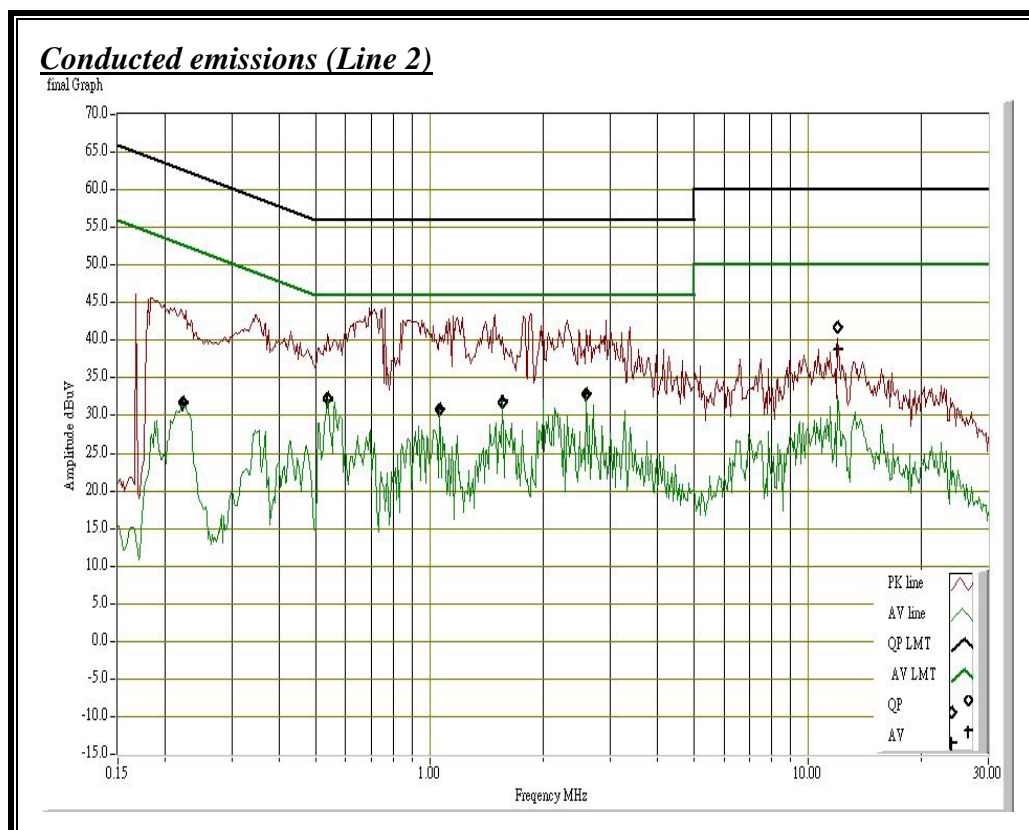
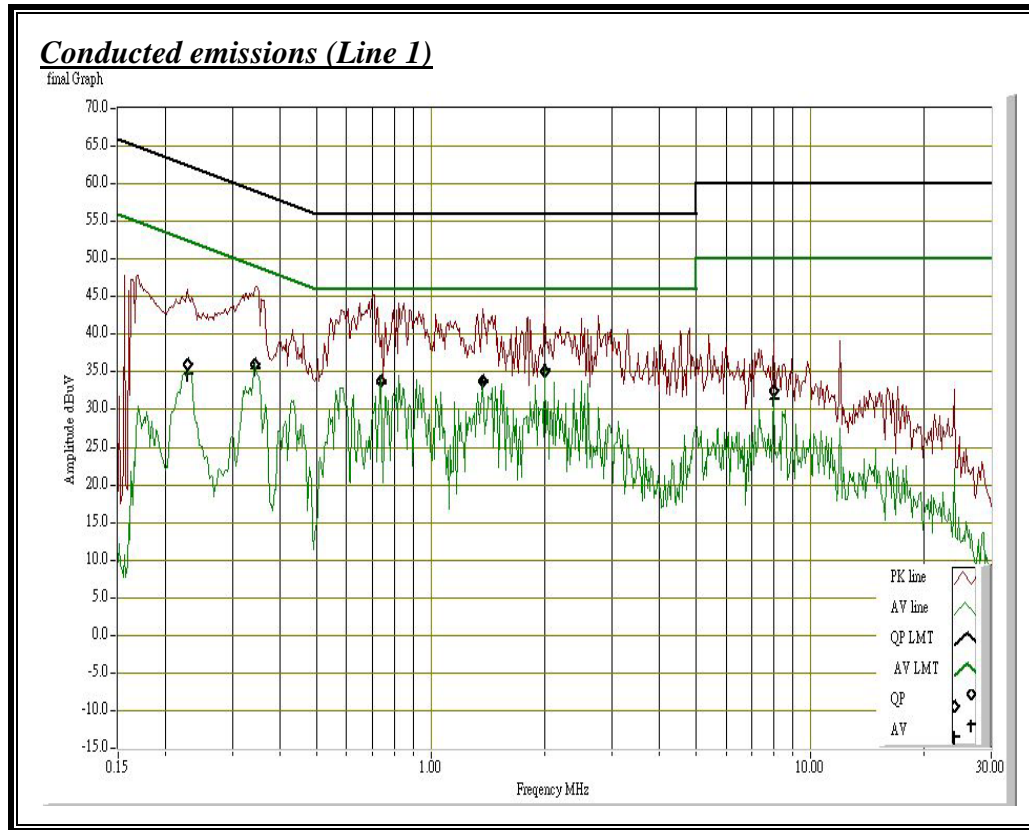
Freq. (MHz)	QP Reading (dBuV)	AV Reading (dBuV)	Corr. factor (dB)	QP Result (dBuV)	AV Result (dBuV)	QP Limit (dBuV)	AV Limit (dBuV)	QP Margin (dB)	AV Margin (dB)	Note
0.229	35.910	34.790	0.100	36.010	34.890	62.486	52.486	-26.476	-17.596	L1
0.344	36.030	35.430	0.100	36.130	35.530	59.106	49.106	-22.976	-13.576	L1
0.738	33.790	33.420	0.100	33.890	33.520	56.000	46.000	-22.110	-12.480	L1
1.374	33.700	33.550	0.100	33.800	33.650	56.000	46.000	-22.200	-12.350	L1
1.999	35.130	35.290	0.100	35.230	35.390	56.000	46.000	-20.770	-10.610	L1
7.996	32.430	31.300	0.500	32.930	31.800	60.000	50.000	-27.070	-18.200	L1
0.223	31.660	31.650	0.100	31.760	31.750	62.706	52.706	-30.946	-20.956	L2
0.537	32.300	31.900	0.100	32.400	32.000	56.000	46.000	-23.600	-14.000	L2
1.065	30.840	30.850	0.100	30.940	30.950	56.000	46.000	-25.060	-15.050	L2
1.561	31.750	31.850	0.100	31.850	31.950	56.000	46.000	-24.150	-14.050	L2
2.594	32.860	32.790	0.100	32.960	32.890	56.000	46.000	-23.040	-13.110	L2
12.000	41.690	38.820	0.740	42.430	39.560	60.000	50.000	-17.570	-10.440	L2

Remark:

1. Measuring frequencies from 0.15 MHz to 30MHz.
2. The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.
3. The IF bandwidth of SPA between 0.15MHz and 30MHz was 10kHz; the IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9kHz;
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)



Test Plots





APPENDIX I RADIO FREQUENCY EXPOSURE

LIMIT

According to §15.247(i), 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 of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

EUT Specification

EUT	Bluetooth Module
Frequency band (Operating)	<input type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz <input type="checkbox"/> WLAN: 5.745GHz ~ 5.825GHz <input checked="" type="checkbox"/> Others: <u>Bluetooth: 2.402GHz ~ 2.480GHz</u>
Device category	<input checked="" type="checkbox"/> Portable (<20cm separation) <input type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others _____
Exposure classification	<input type="checkbox"/> Occupational/Controlled exposure ($S = 5mW/cm^2$) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure ($S = 1mW/cm^2$)
Antenna diversity	<input checked="" type="checkbox"/> Single antenna <input type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input type="checkbox"/> Tx/Rx diversity
Max. output power	2.50dBm (1.78mW)
Antenna gain (Max)	0 dBi (Numeric gain: 1.0)
Evaluation applied	<input type="checkbox"/> MPE Evaluation <input type="checkbox"/> SAR Evaluation <input checked="" type="checkbox"/> N/A*

Remark:

1. The maximum output power is 2.50dBm (1.78mW) at 2441MHz (with 1.0 numeric antenna gain.)
2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.
3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is $1.0 mW/cm^2$ even if the calculation indicates that the power density would be larger.

TEST RESULTS

No non-compliance noted.

(SAR evaluation is not required for the PORTABLE device while its maximum output power is lower than the general population low threshold: $60/f_{(GHz)} = 60/2.441 = 24.58mW$)