FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

C-TECH UNITED CORP.

Bluetooth Headset

Model: BT2011

Trade Name: C-TECH

Prepared for

C-TECH UNITED CORP.
5F, No. 665, Sec. 3, Chung Chen Rd., Hsin Chuang City,
Taipei Hsien, Taiwan, R.O.C.

Prepared by

Compliance Certification Services Inc.
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TABLE OF CONTENTS

1. TEST RESULT CERTIFICATION 3

2. EUT DESCRIPTION 4

3. TEST METHODOLOGY 5

3.1 EUT CONFIGURATION 5
3.2 EUT EXERCISE 5
3.3 GENERAL TEST PROCEDURES 5
3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS 6
3.5 DESCRIPTION OF TEST MODES 6

4. INSTRUMENT CALIBRATION 7

5. FACILITIES AND ACCREDITATIONS 8

5.1 FACILITIES 8
5.2 EQUIPMENT 8
5.3 LABORATORY ACCREDITATIONS AND LISTING 8
5.4 TABLE OF ACCREDITATIONS AND LISTINGS 9

6. SETUP OF EQUIPMENT UNDER TEST 10

6.1 SETUP CONFIGURATION OF EUT 10
6.2 SUPPORT EQUIPMENT 10

7. FCC PART 15.247 REQUIREMENTS 11

7.1 PEAK POWER 11
7.2 PEAK POWER SPECTRAL DENSITY 14
7.3 BAND EDGES MEASUREMENT 17
7.4 FREQUENCY SEPARATION 22
7.5 NUMBER OF HOPPING FREQUENCY 27
7.6 TIME OF OCCUPANCY (DWELL TIME) 29
7.7 RADIO FREQUENCY EXPOSURE 37
7.8 SPURIOUS EMISSIONS 40
7.9 POWERLINE CONDUCTED EMISSIONS 53

APPENDIX 1 PHOTOGRPHS OF TEST SETUP 57

1. TEST RESULT CERTIFICATION

Applicant: C-TECH UNITED CORP.
5F, No. 665, Sec. 3, Chung Chen Rd., Hsin Chuang City,
Taipei Hsien, Taiwan, R.O.C.

Equipment Under Test: Bluetooth Headset

Trade Name: C-TECH

Model: BT2011

Date of Test: March 16 ~ 19, 2004

APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
FCC 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 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.207, 15.209 and 15.247.

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

Approved by:

Harris.W. Lai
Director of Linkou Laboratory
Compliance Certification Services Inc.

Reviewed by:

Devin Chang
Section Manager
Compliance Certification Services Inc.

2. EUT DESCRIPTION

Product	Bluetooth Headset
Trade Name	C-TECH
Model Number	BT2011
Model Discrepancy	N/A
Power Supply	Model: DVR-0520-3512 Input: AC 120V, 60Hz, 60mA Output: DC 5V, 200mA
Frequency Range	2402 – 2480MHz
Transmit Power	0.55dBm
Modulation Technique	GFSK
Transmit Data Rate	1MHz
Number of Channels	79 Channels
Antenna Designation	Chip Antenna
Temperature Range	0 ~ + 55°C

Note: *This submittal(s) (test report) is intended for FCC ID: RJK-BT2011A 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. Radiated testing was performed at an antenna to EUT distance 3 meters.

3.1EUT 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.

3.2EUT 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.

3.3GENERAL 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 max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4.

3.4FCC 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.

3.5DESCRIPTION OF TEST MODES

The EUT (Bluetooth Headset) has been tested under operating condition.

Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel Low (2402MHz)、Mid (2441MHz) and High (2480MHz) with highest data rate (worst case) are chosen for full testing.

(The field strength of spurious radiation emission was measured in the following position: EUT stand-up position (X mode) and laid-down position (Y, Z mode))

The worst case is laid-down position (Y mode), and it also is final measurement mode.

4. 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.

5. FACILITIES AND ACCREDITATIONS

5.1FACILITIES

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

☒ No. 81-1, Lane 210, Bade Rd. 2, Luchu Hsiang, Taoyuan Hsien, Taiwan, R.O.C.

☐ No. 199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.

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

5.2EQUIPMENT

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.”

5.3LABORATORY ACCREDITATIONS AND LISTING

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code: 200600-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (registration no: 93105 and 90471).

5.4TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	NVLAP*	EN 55011, EN 55014-1, AS/NZS 1044, CNS 13783-1, EN 55022, CNS 13438, EN 61000-3-2, EN 61000-3-3, ANSI C63.4, FCC OST/MP-5, AS/NZS CISPR 22, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11	NVLAP 200600-0
USA	FCC	3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements	FC 93105, 90471
Japan	VCCI	4 3/10 meter Open Area Test Sites to perform conducted/radiated measurements	VCCI R-393/1066/725/879 C-402/747/912
Norway	NEMKO	EN 50081-1/2, EN 50082-1/2, IEC 61000-6-1/2, EN 50091-2, EN 50130-4, EN 55011, EN 55013, EN 55014-1/2, EN 55015, EN 55022, EN 55024, EN 61000-3-2/3, EN 61326-1, IEC 61000-4-2/3/4/5/6/8/11, EN 60601-1-2, EN 300 328-2, EN 300 422-2, EN 301 419-1, EN 301 489-01/03/07/08/09/17, EN 301 419-2/3, EN 300 454-2, EN 301 357-2	N ELA 124a ELA 124b ELA 124c
Taiwan	CNLA	EN 300 328-1/2, EN 300 220-1/2/3, EN 300 440-1/2, EN 61000-3-2, EN 61000-3-3, 47 CFR FCC Part 15 Subpart C/D/E, EN 55013, CNS 13439, EN 55014-1, CNS 13783-1, EN 55022, CNS 13438, CISPR 22, AS/NZS 3548, EN 61000-4-2/3/4/5/6/8/11, ENV 50204, IEEE Std 1528, FCC OET Bulletin, 65+Supplement C, EN50360, EN50361, EN50371, RSS102	CNLA 0363 ILAC MRA
Taiwan	BSMI	CNS 13438, CNS 13783-1, CNS 13439, CNS 14115	SL2-IS-E-0014 SL2-IN-E-0014 SL2-A1-E-0014 SL2-R1-E-0014 SL2-R2-E-0014 SL2-L1-E-0014
Canada	Industry Canada	RSS212, Issue 1	Canada IC 3991-3 IC 3991-4

** 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

6.1SETUP CONFIGURATION OF EUT

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

6.2SUPPORT EQUIPMENT

Device Type	Brand	Model	FCC ID	Series No.	Data Cable	Power Cord
N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

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

7.1PEAK POWER

LIMIT

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

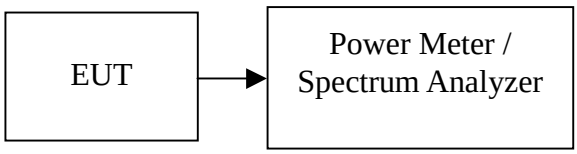
1. For systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 watt.
2. Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
RF Power Meter	BOONTON	4531	130601	01/09/2005
RF Power Sensor	BOONTON	56218	2240	01/09/2005
Spectrum Analyzer	Agilent	E4446A	US42510252	04/27/2004
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/22/2004

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

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the RF Power Meter. The RF Power Meter is set to the peak power detection.

TEST RESULTS

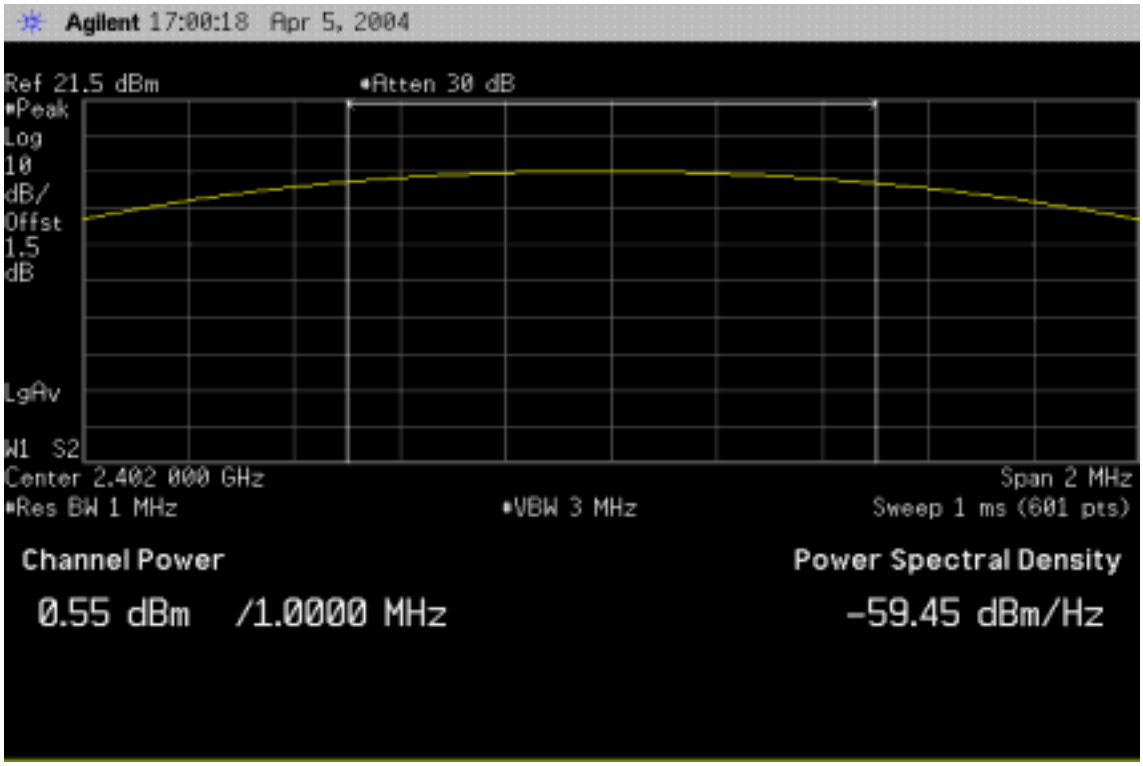
No non-compliance noted

Test Data

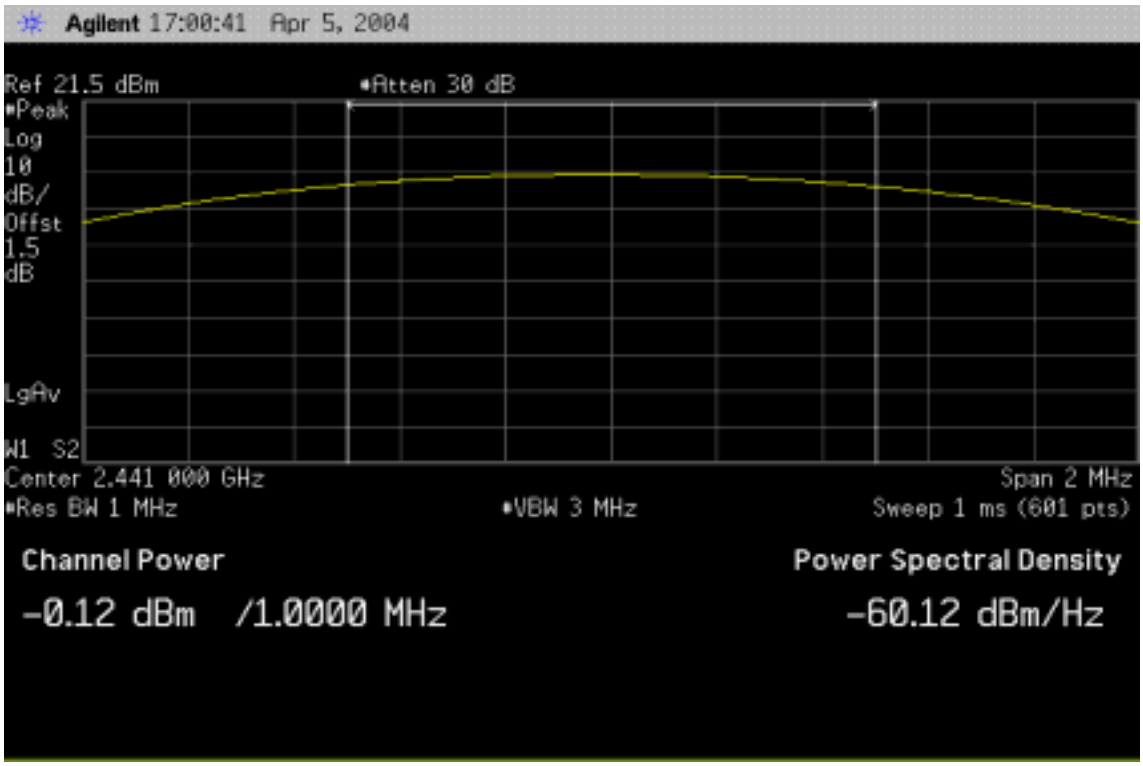
Channel	Frequency (MHz)	Reading Power (dBm)	Factor (dB)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2402	-0.95	1.50	0.55	0.00114	1.00	PASS
Mid	2441	-1.62	1.50	-0.12	0.00097		PASS
High	2480	-2.38	1.50	-0.88	0.00082		PASS

Test Plot

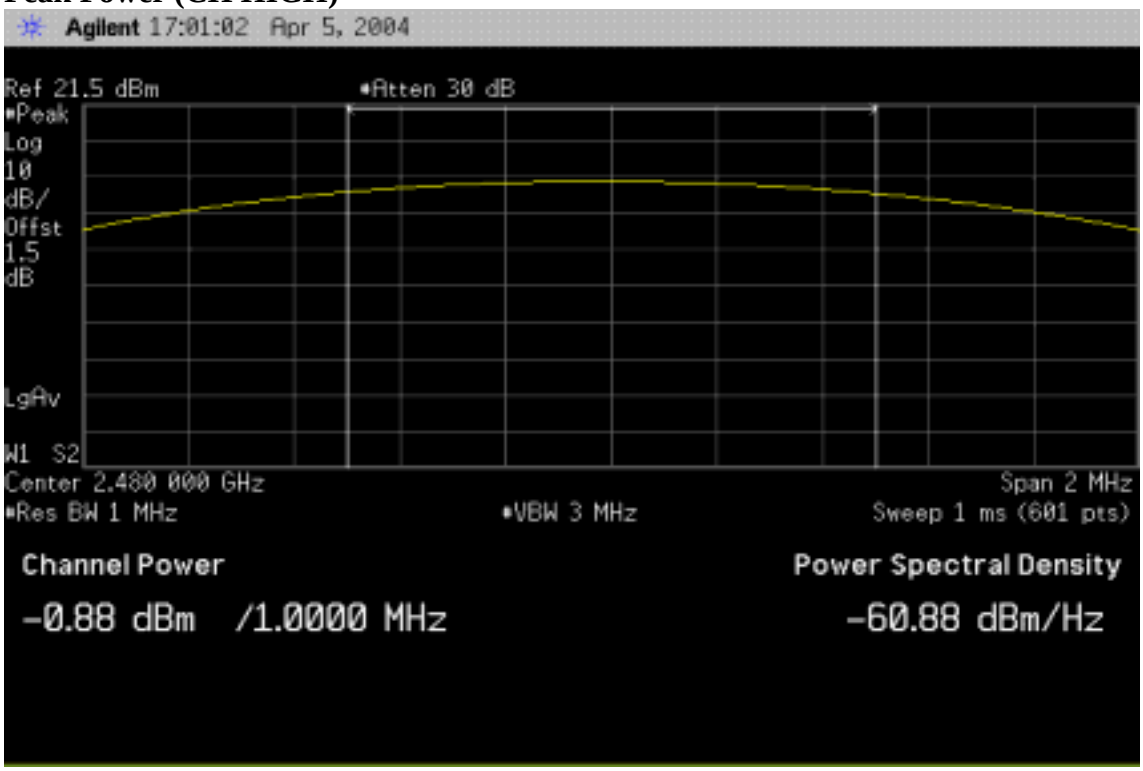
Peak Power (CH Low)



Peak Power (CH MID)



Peak Power (CH HIGH)



7.2PEAK POWER SPECTRAL DENSITY

LIMIT

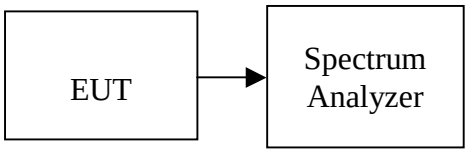
1. For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.
2. The direct sequence operating of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	04/28/2004
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/22/2004

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

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 the spectrum analyzer as RBW = 3kHz, VBW = 10kHz, Span = 300kHz, Sweep=100s
4. Record the max. reading.
5. Repeat the above procedure until the measurements for all frequencies are completed.

TEST RESULTS

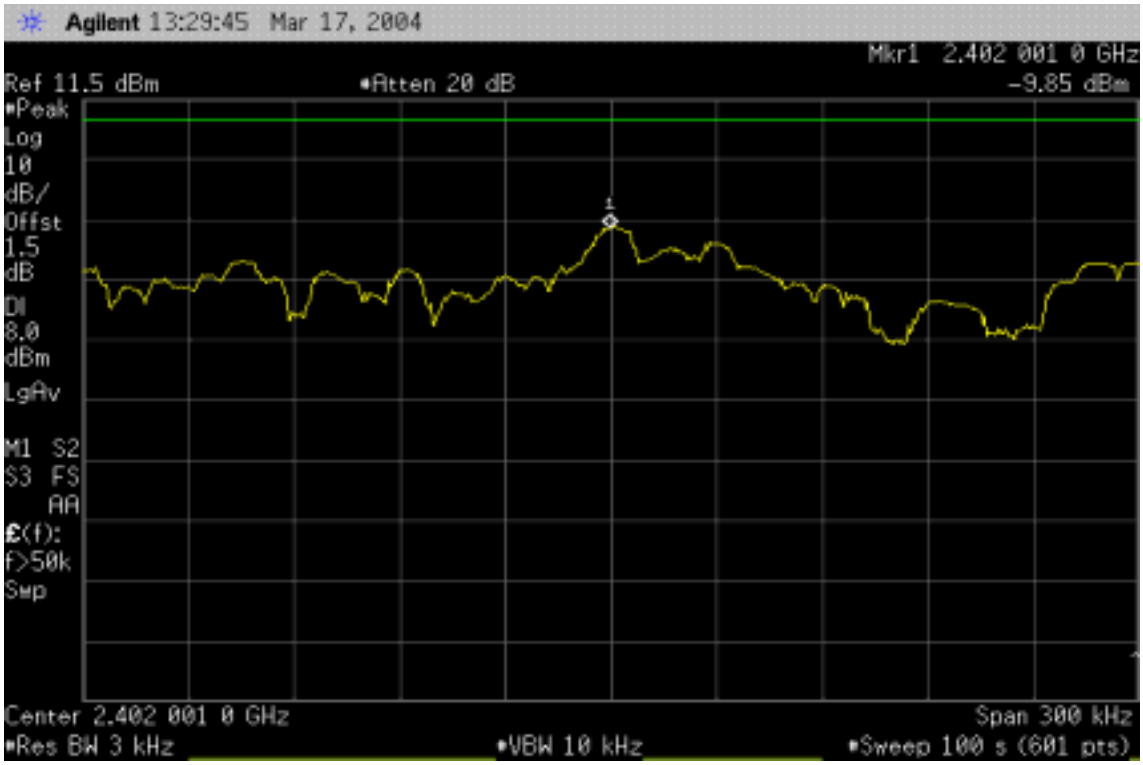
No non-compliance noted

Test Data

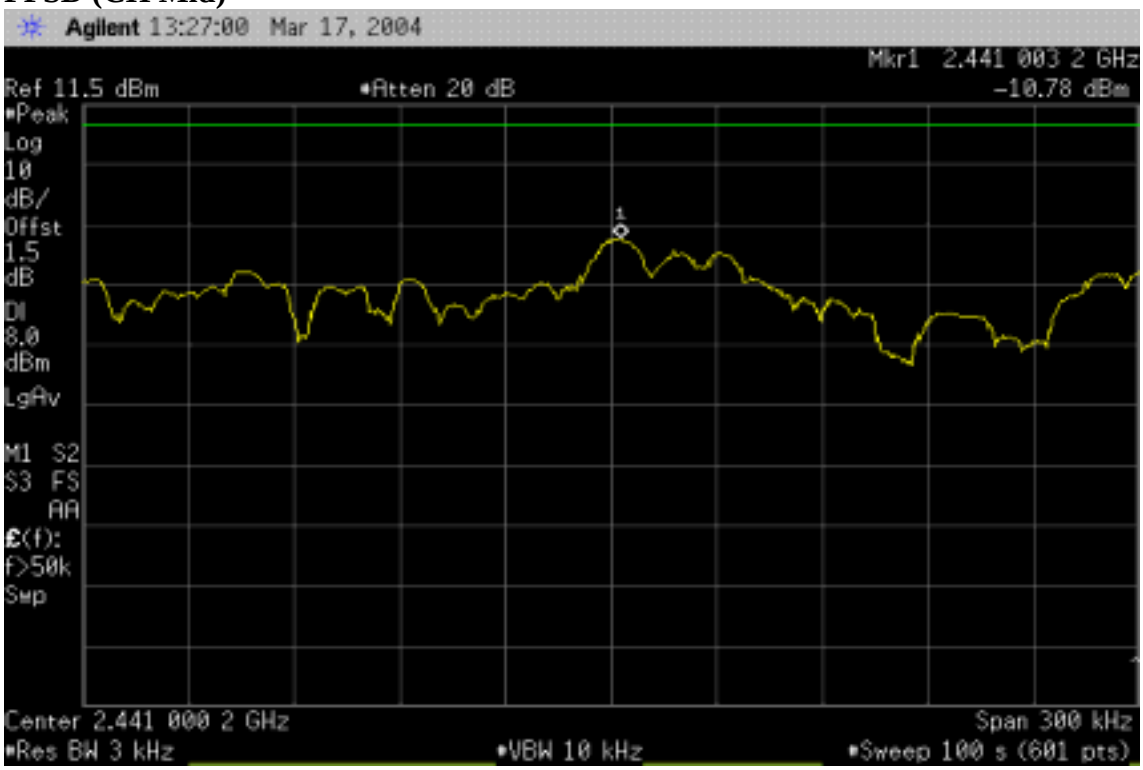
Channel	Frequency (MHz)	Reading (dBm)	Factor (dB)	PPSD (dBm)	Limit (dBm)	Result
Low	2402	-11.35	1.50	-9.85	8.00	PASS
Mid	2441	-12.28	1.50	-10.78		PASS
High	2480	-13.95	1.50	-12.45		PASS

Test Plot

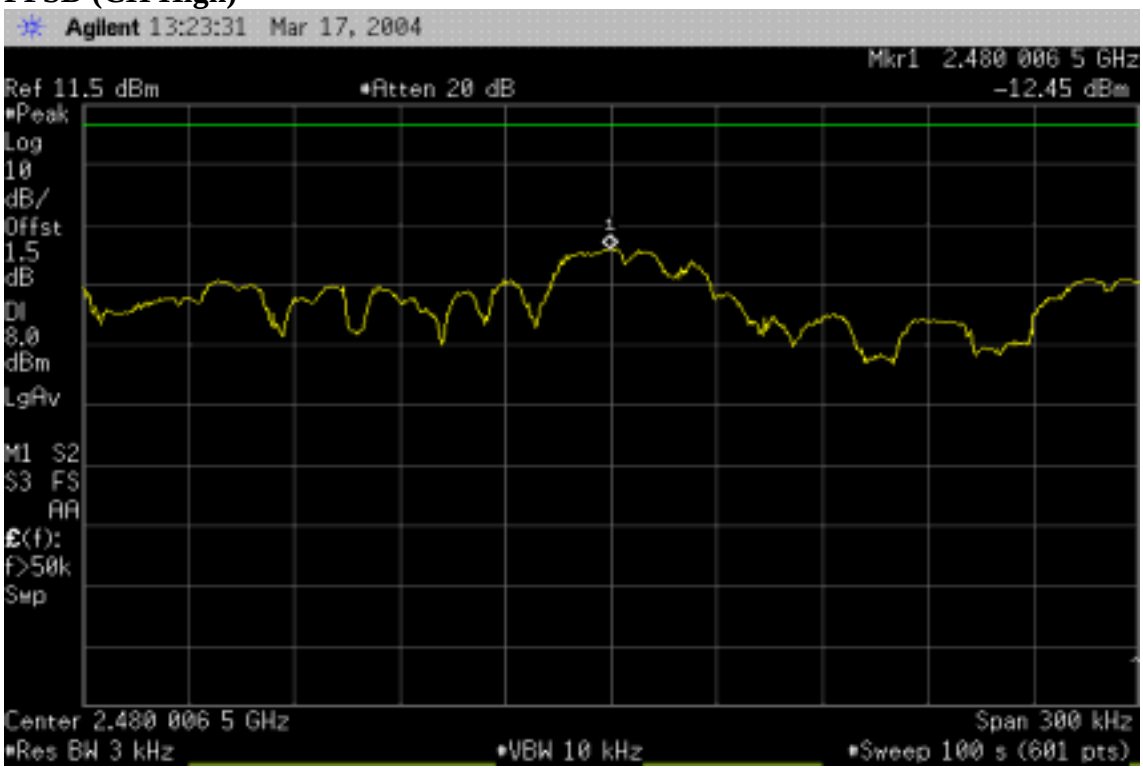
PPSD (CH Low)



PPSD (CH Mid)



PPSD (CH High)


Agilent 13:23:31 Mar 17, 2004
Mkr1 2.480 006 5 GHz
Ref 11.5 dBm
Atten 20 dB
-12.45 dBm
Peak
Log
10
dB/
Offst
1.5
dB
DI
8.0
dBm
LgAv
M1 S2
S3 FS
AA
£(f):
f>50k
Swp
Center 2.480 006 5 GHz
Span 300 kHz
Res BW 3 kHz
VBW 10 kHz
Sweep 100 s (601 pts)

7.3BAND EDGES MEASUREMENT

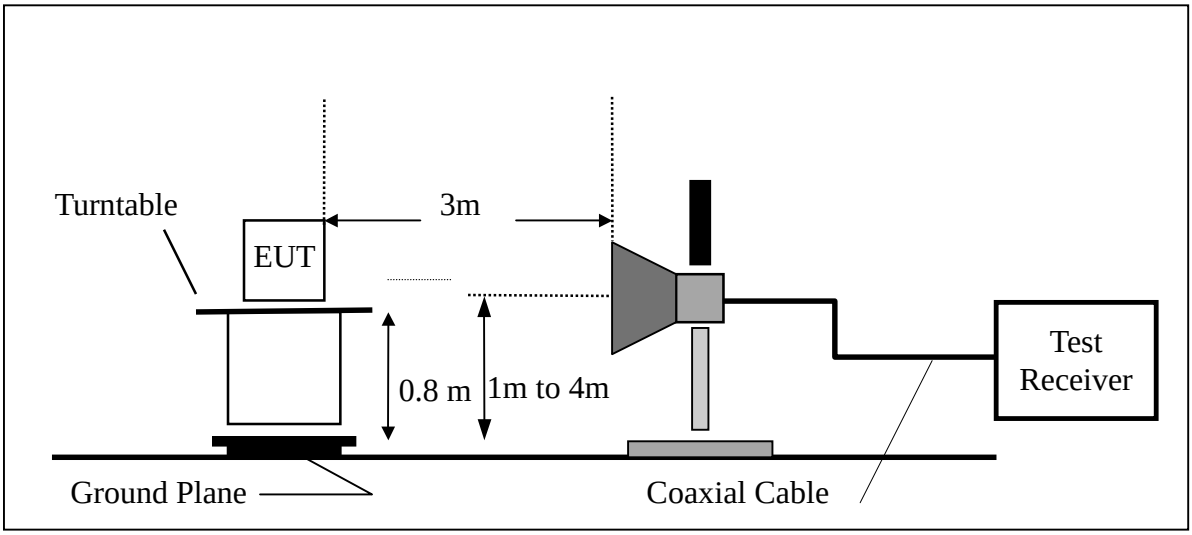
LIMIT

According to §15.247(c), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, 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 in15.209(a).

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	04/27/2004
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/22/2004
Horn Antenna	EMCO	3115	N/A	02/24/2005

TEST CONFIGURATION



TEST PROCEDURE

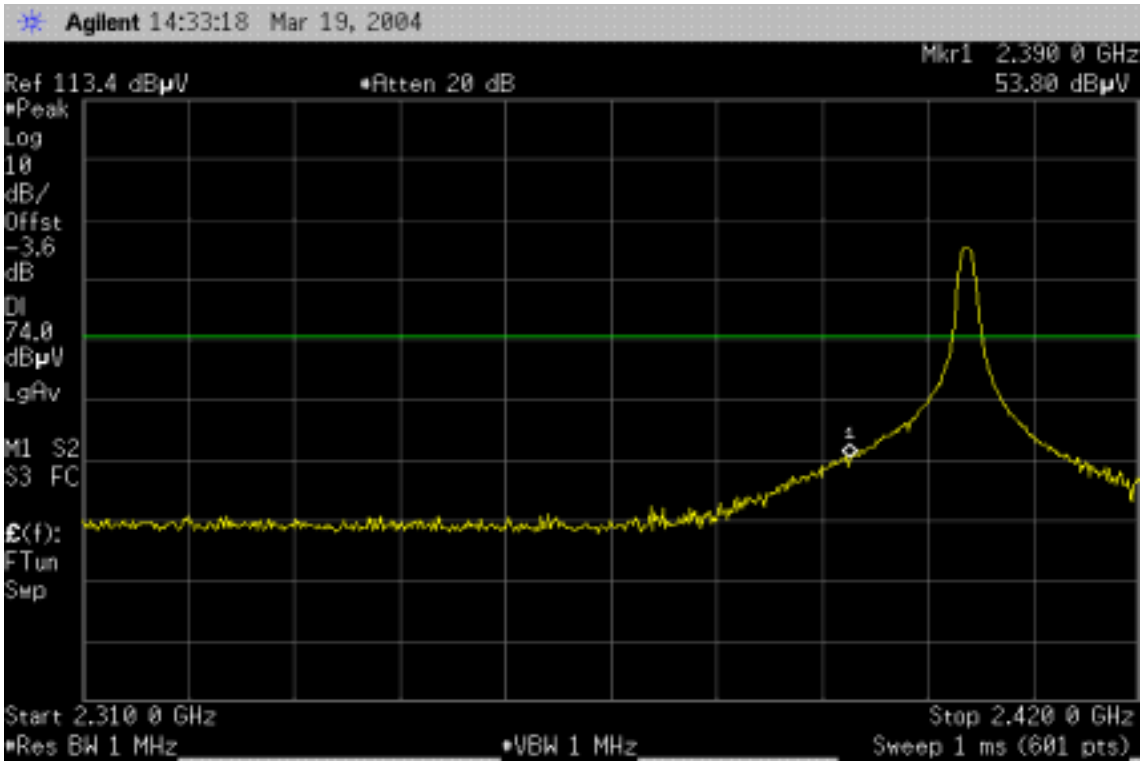
1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the 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

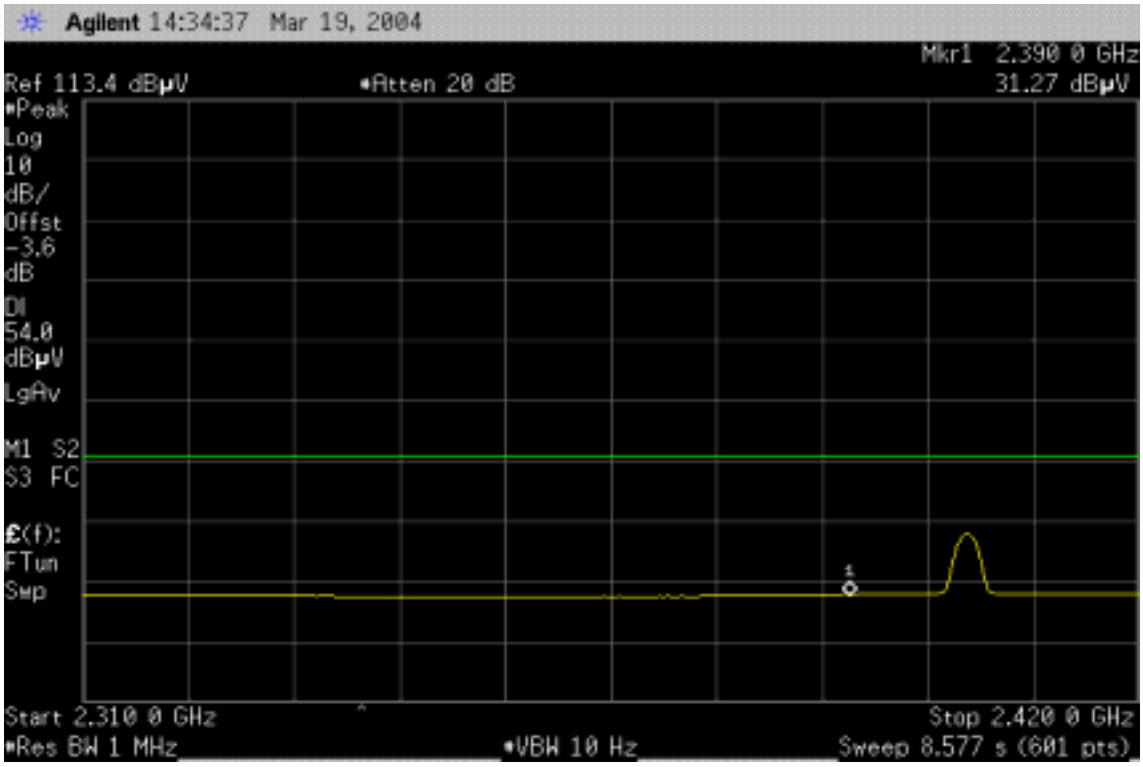
Refer to attach spectrum analyzer data chart.

Band Edges Test Data (CH-Low)

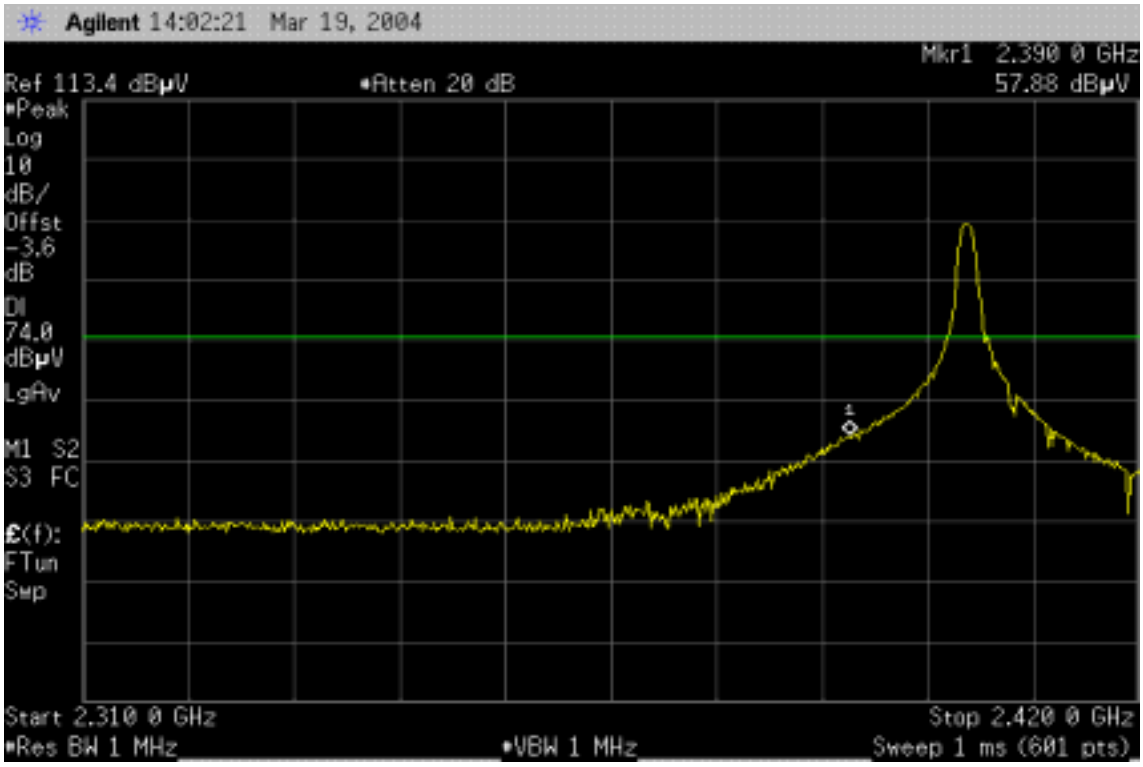
Detector mode: Peak **Polarity: Vertical**



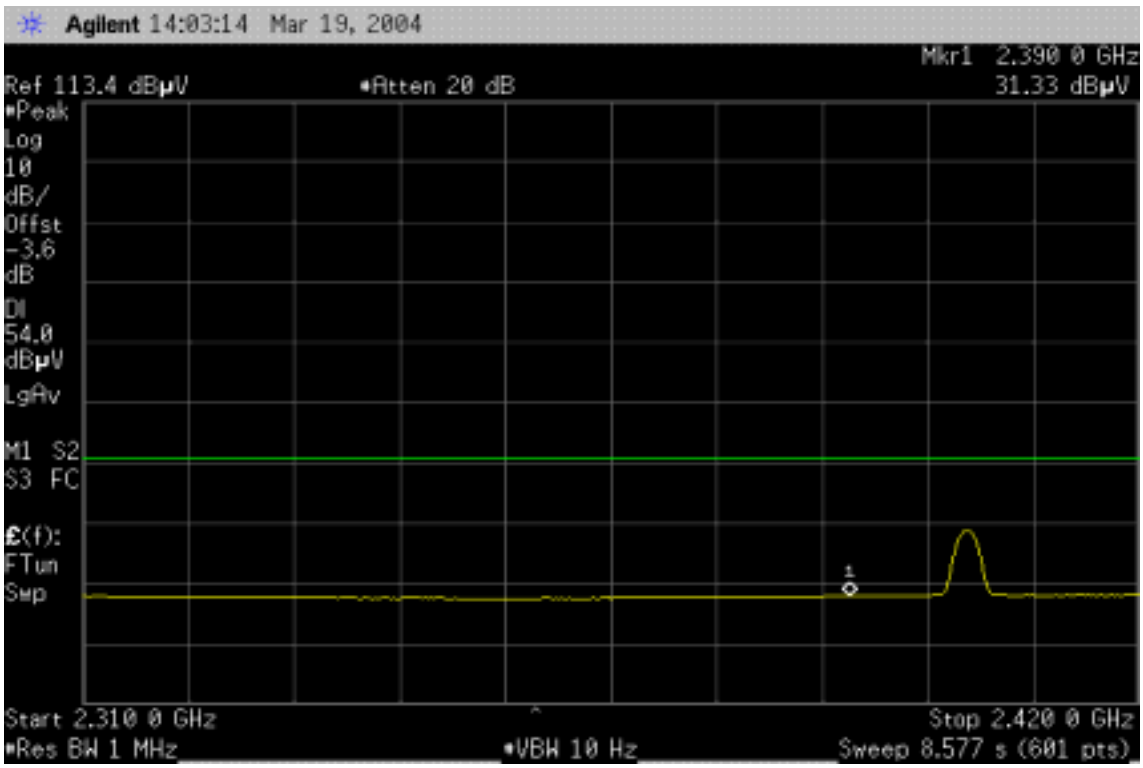
Detector mode: Average **Polarity: Vertical**



Detector mode: Peak **Polarity: Horizontal**

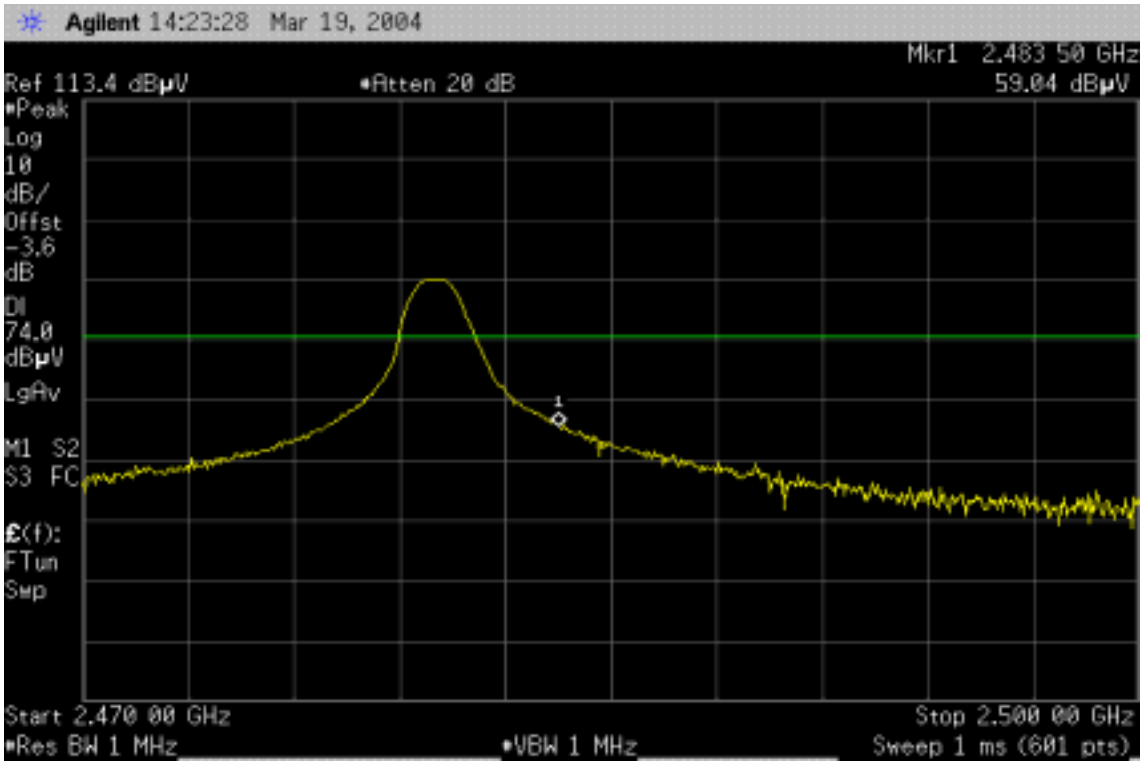


Detector mode: Average **Polarity: Horizontal**

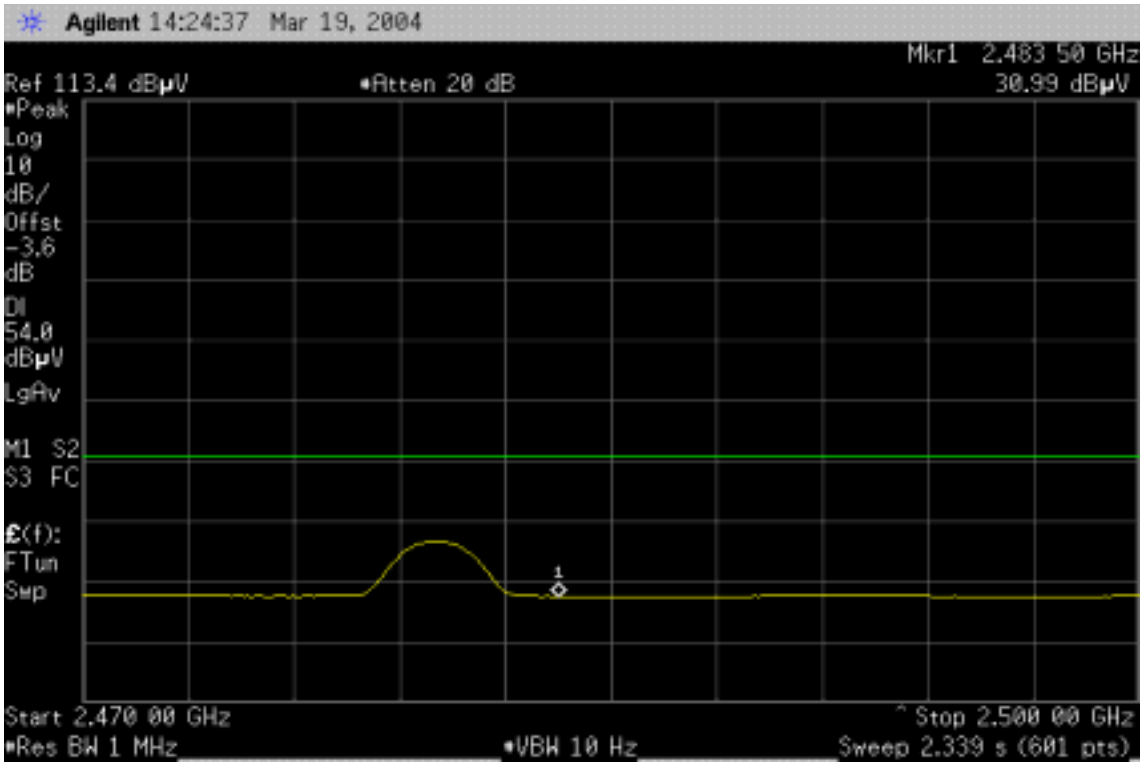


Band Edges Test Data (CH-High)

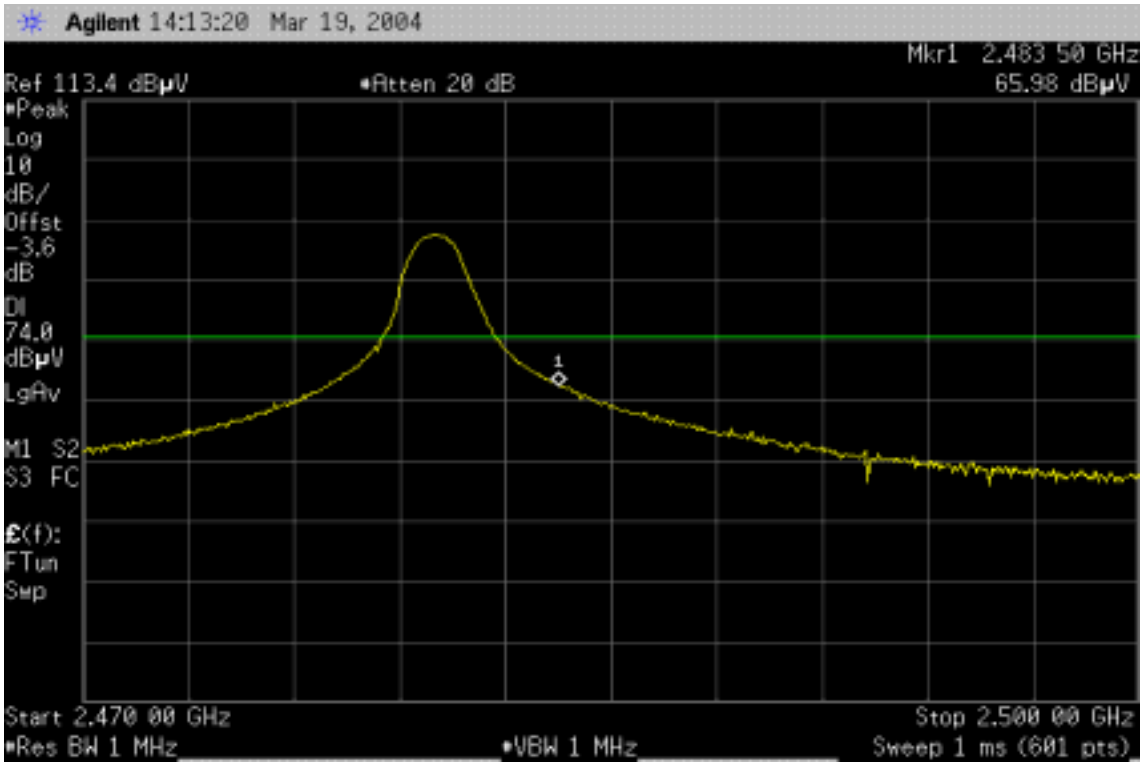
Detector mode: Peak **Polarity: Vertical**



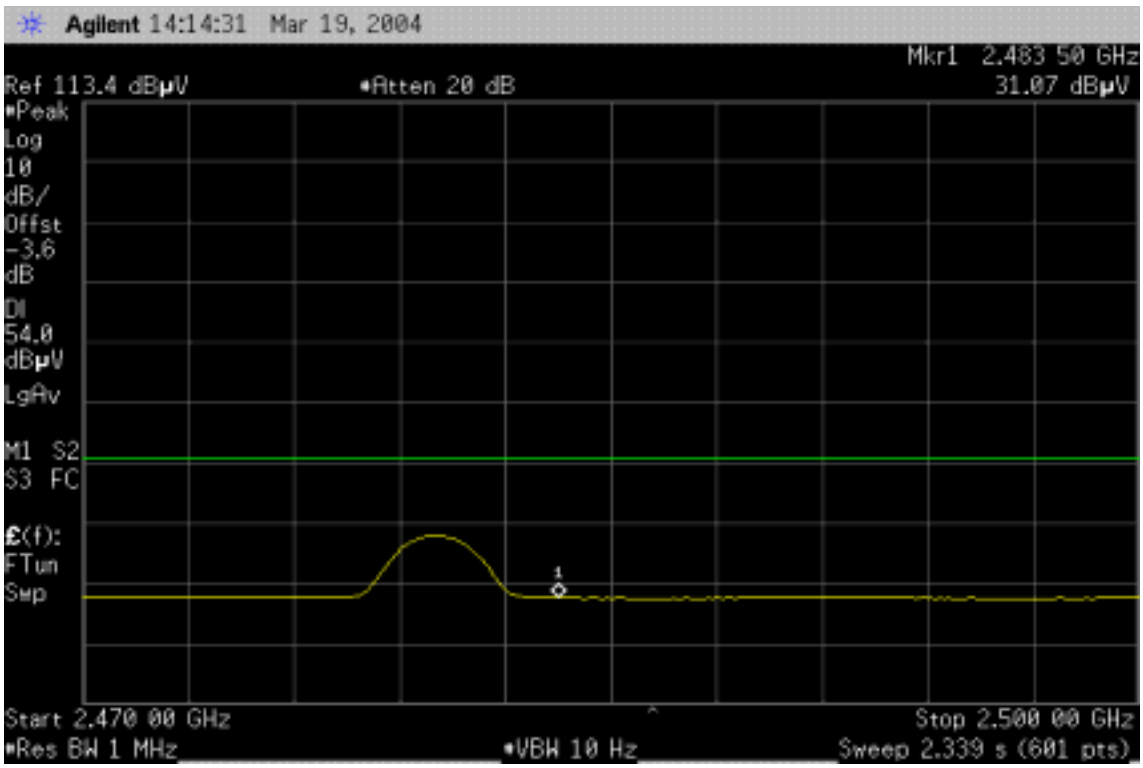
Detector mode: Average **Polarity: Vertical**



Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**



7.4FREQUENCY SEPARATION

LIMIT

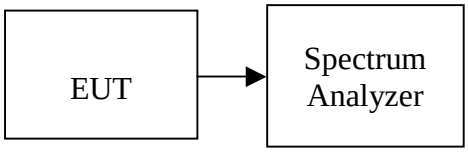
According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	04/28/2004

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

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, VBW=30kHz, Adjust Span to 3 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

TEST RESULTS

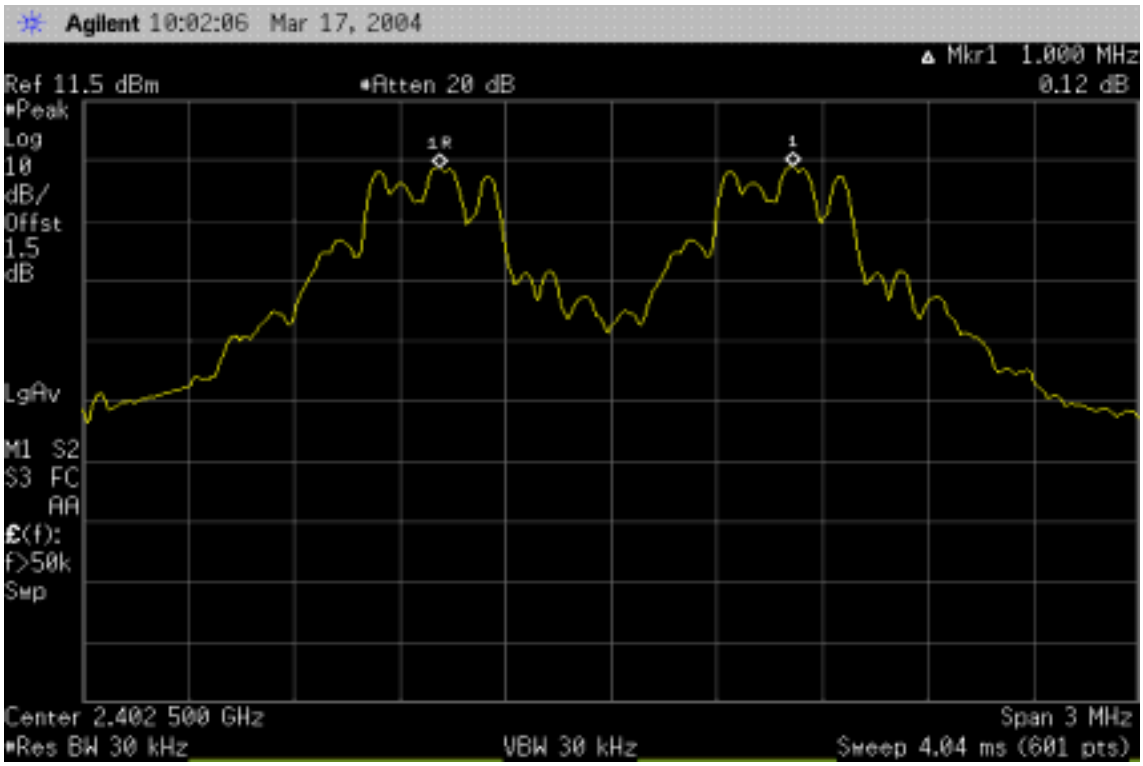
No non-compliance noted

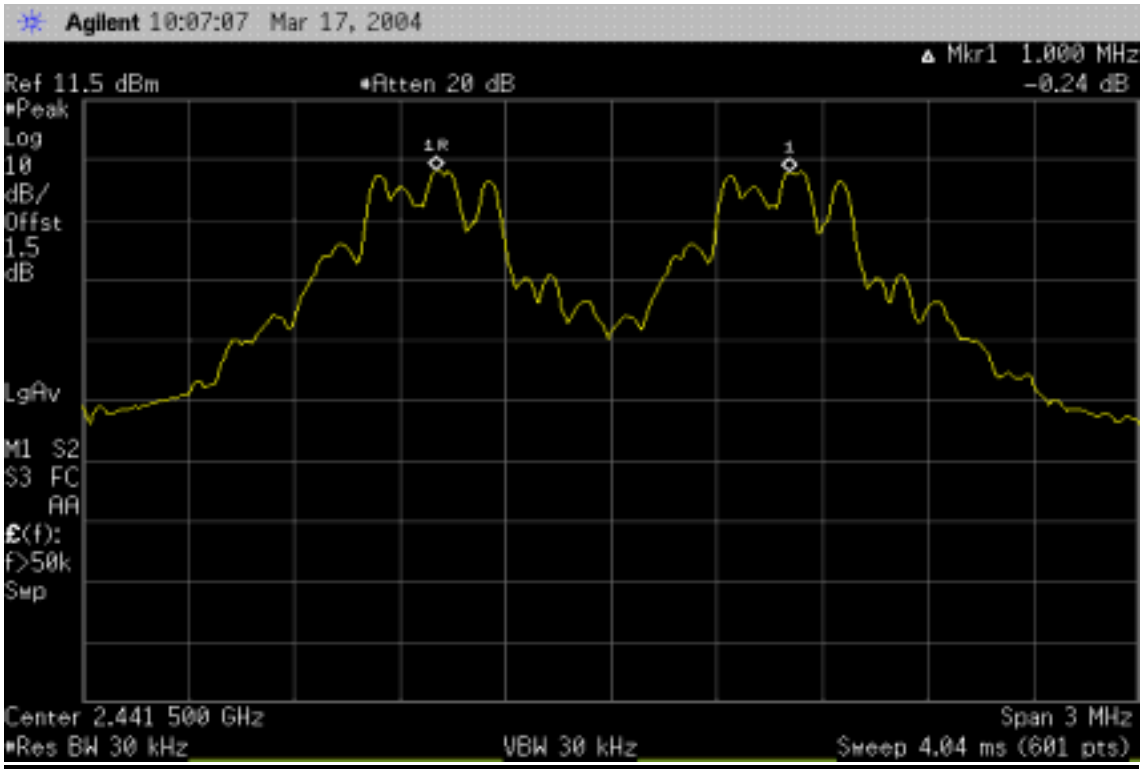
Test Data

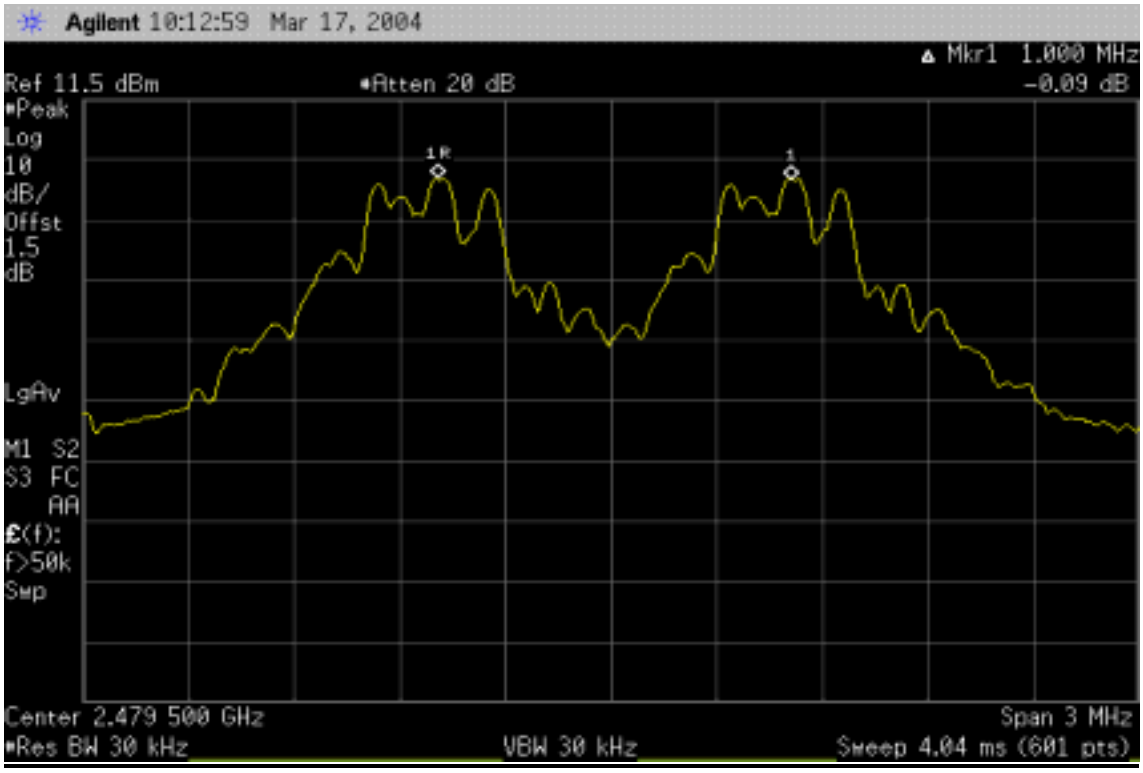
Channel	Frequency (MHz)	Channel Separation (MHz)	20dB Bandwith (kHz)	Limit (kHz)	Result
Low	2402	1.00	670.00	>25	Pass
Mid	2441		673.00		
High	2480		673.00		

Test Plot

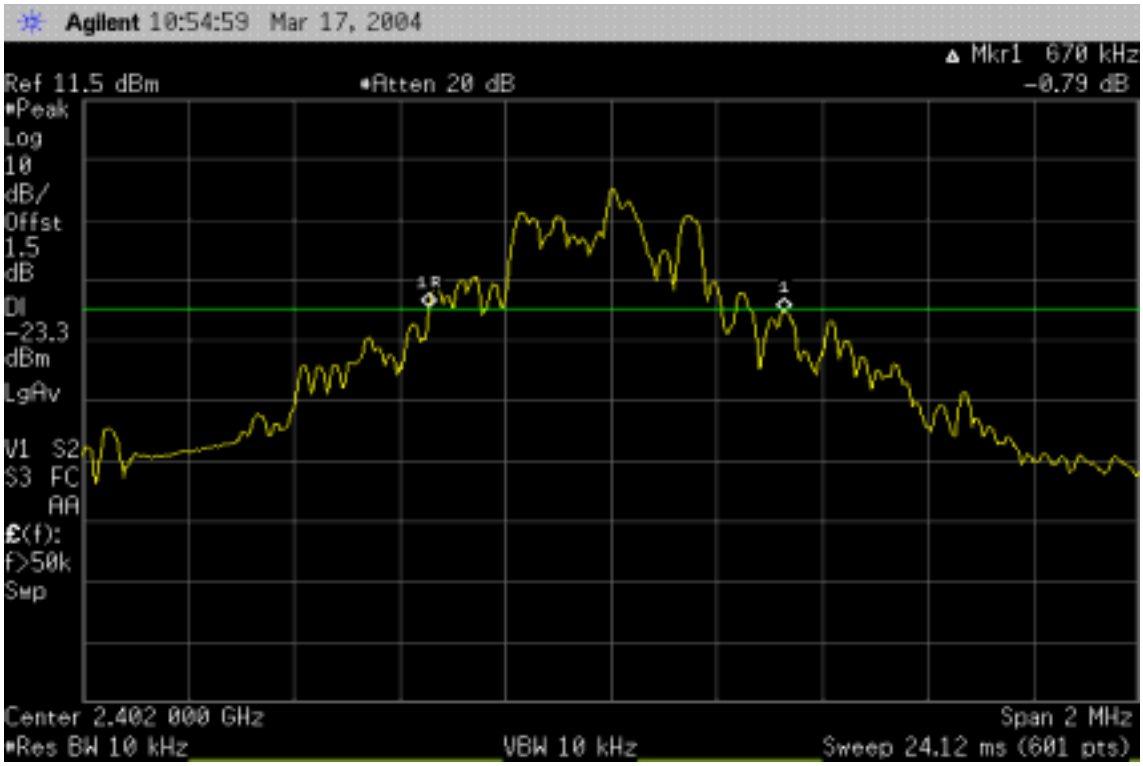
Measurement of Channel Separation

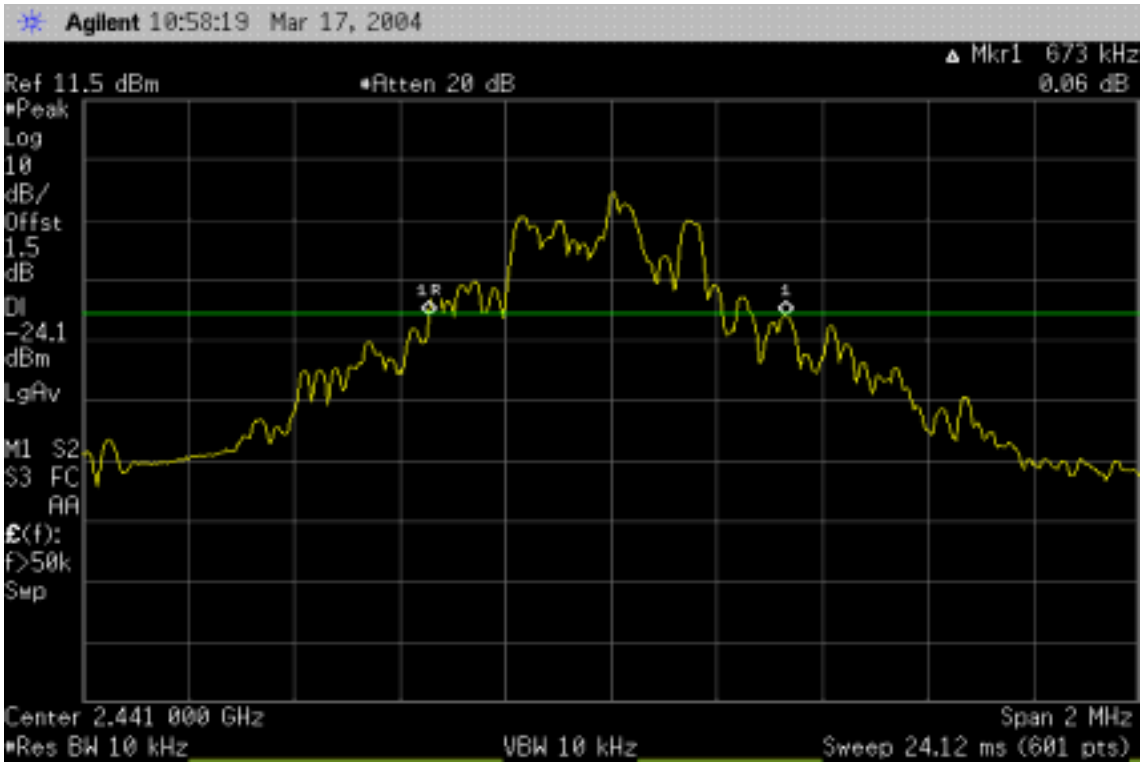


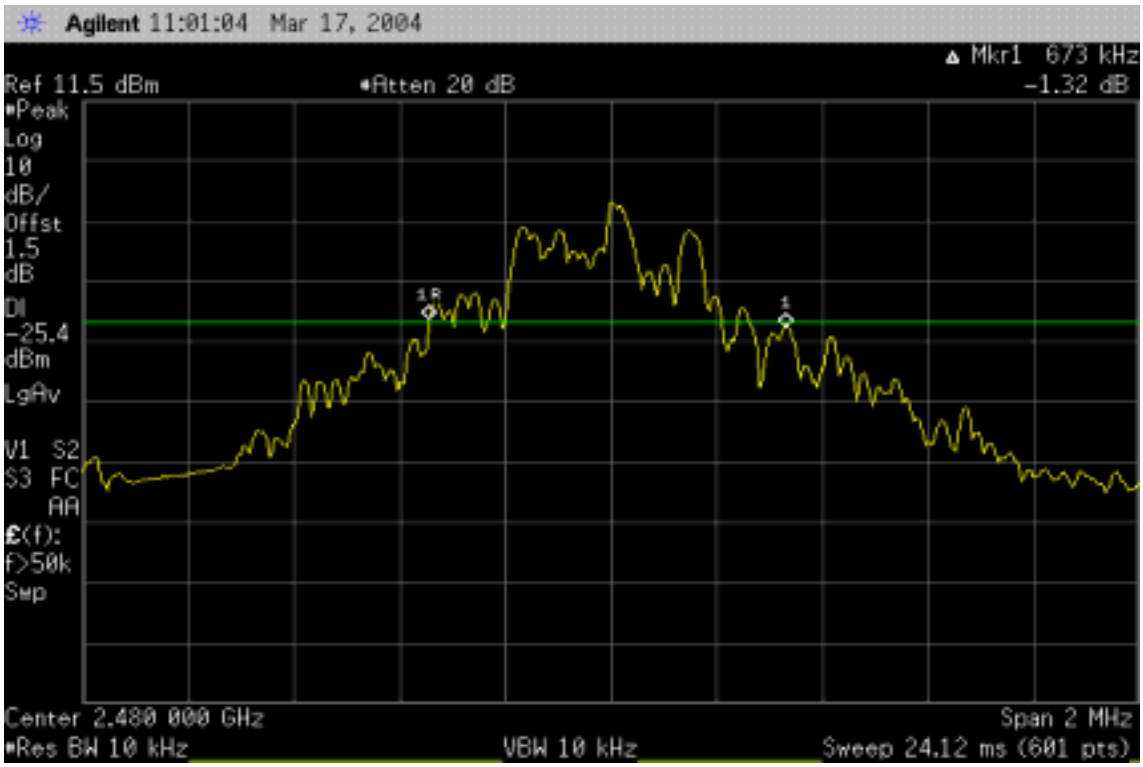



Agilent 10:12:59 Mar 17, 2004
Mkr1 1.000 MHz
Ref 11.5 dBm
Atten 20 dB
-0.09 dB
Peak
Log
10
dB/
Offst
1.5
dB
1R
1
LgAv
M1 S2
S3 FC
AA
£(f):
f>50k
Swp
Center 2.479 500 GHz
Span 3 MHz
Res BW 30 kHz
VBW 30 kHz
Sweep 4.04 ms (601 pts)

Measurement of 20dB Bandwidth






Agilent 11:01:04 Mar 17, 2004
Mkr1 673 kHz
Ref 11.5 dBm
Atten 20 dB
-1.32 dB
Peak
Log
10
dB/
Offst
1.5
dB
D1
-25.4
dBm
LgAv
V1 S2
S3 FC
AA
£(f):
f>50k
Swp
Center 2.480 000 GHz
Span 2 MHz
Res BW 10 kHz
VBW 10 kHz
Sweep 24.12 ms (601 pts)

7.5NUMBER OF HOPPING FREQUENCY

LIMIT

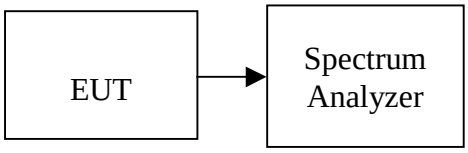
According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 75 hopping frequencies.

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	04/28/2004
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/22/2004

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

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, VBW=1MHz,
5. Max hold, view and count how many channel in the band.

TEST RESULTS

No non-compliance noted

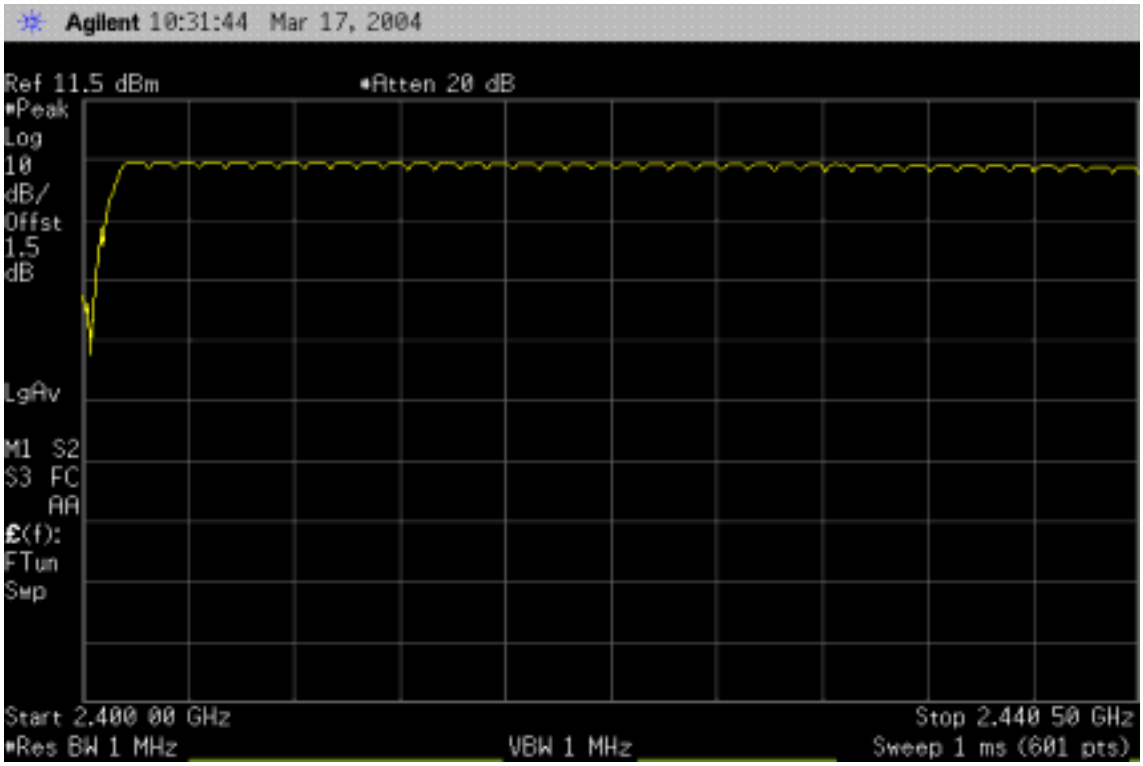
Test Data

Result (No. of CH)	Limit (No. of CH)	Result
79	>75	PASS

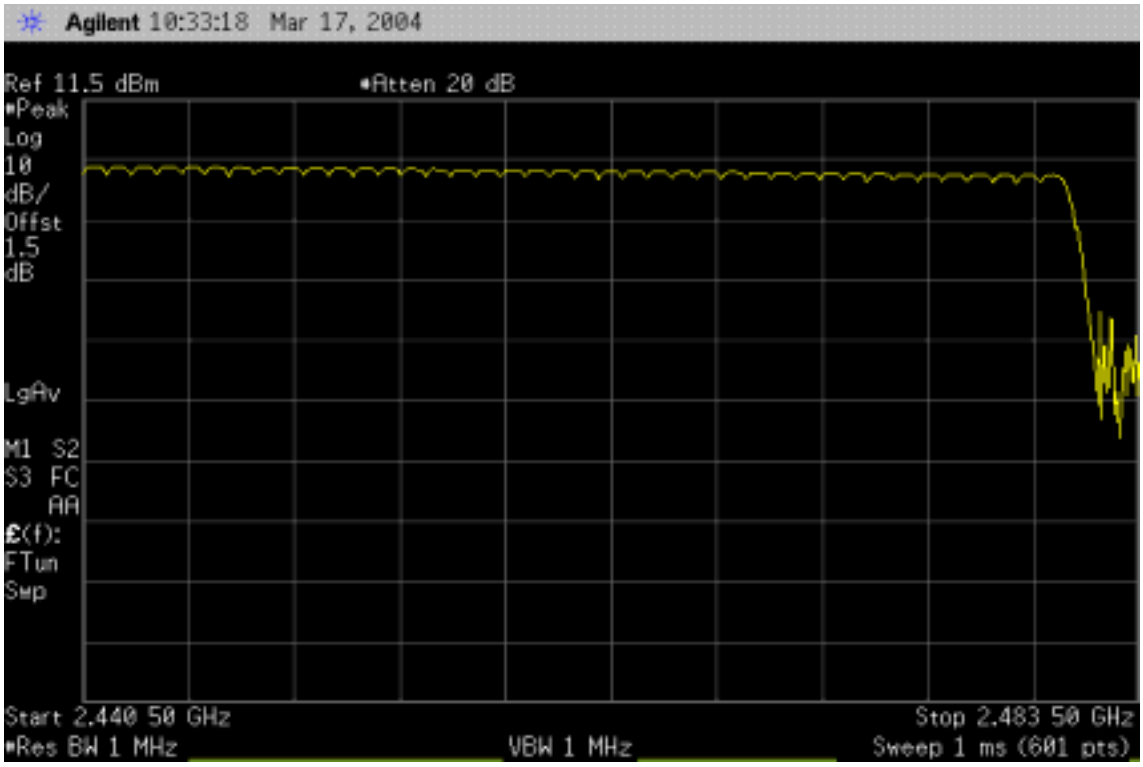
Test Plot

Channel Number

2.4 GHz – 2.441 GHz



2.441 GHz – 2.4835 GHz



7.6TIME OF OCCUPANCY (DWELL TIME)

LIMIT

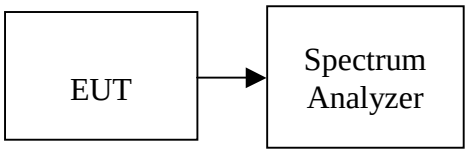
According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	04/28/2004
Spectrum Analyzer	R&S	FSP30	1093.4495.30	07/22/2004

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

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, Adjust Sweep = 10ms.
5. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

No non-compliance noted

Test Data

DH 1

CH Low: 0.250 * (1600/2)/79 * 30 = 75.95 (ms)
CH Mid: 0.250 * (1600/2)/79 * 30 = 75.95 (ms)
CH High: 0.250 * (1600/2)/79 * 30 = 75.95 (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	0.250	75.95	30	400.00	PASS
Mid	0.250	75.95	30		PASS
High	0.250	75.95	30		PASS

DH 3

CH Low: 1.683 * (1600/4)/79 * 30 = 511.29 (ms)
CH Mid: 1.717 * (1600/4)/79 * 30 = 521.62 (ms)
CH High: 1.700 * (1600/4)/79 * 30 = 516.46 (ms)

CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	1.683	511.29	30	400.00	PASS
Mid	1.717	521.62	30		PASS
High	1.700	516.46	30		PASS

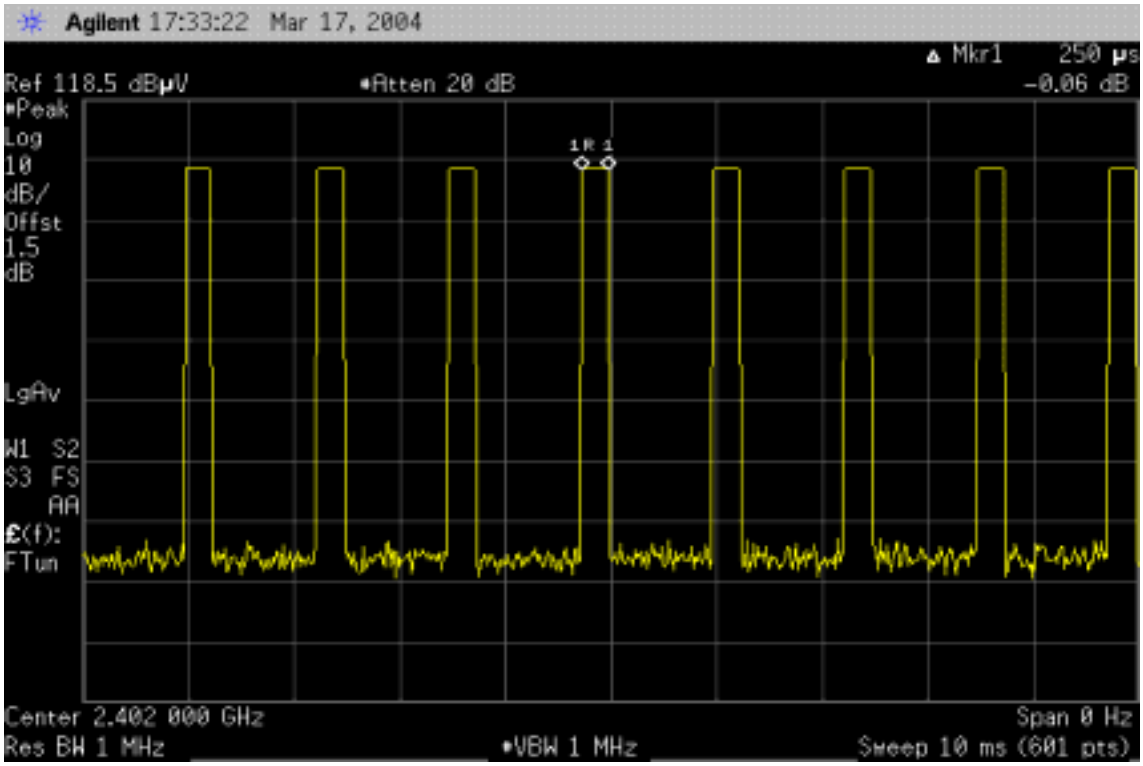
DH 5

CH Low: 2.417 * (1600/6)/79 * 30 = 734.28 (ms)
CH Mid: 2.433 * (1600/6)/79 * 30 = 739.14 (ms)
CH High: 2.417 * (1600/6)/79 * 30 = 734.28 (ms)

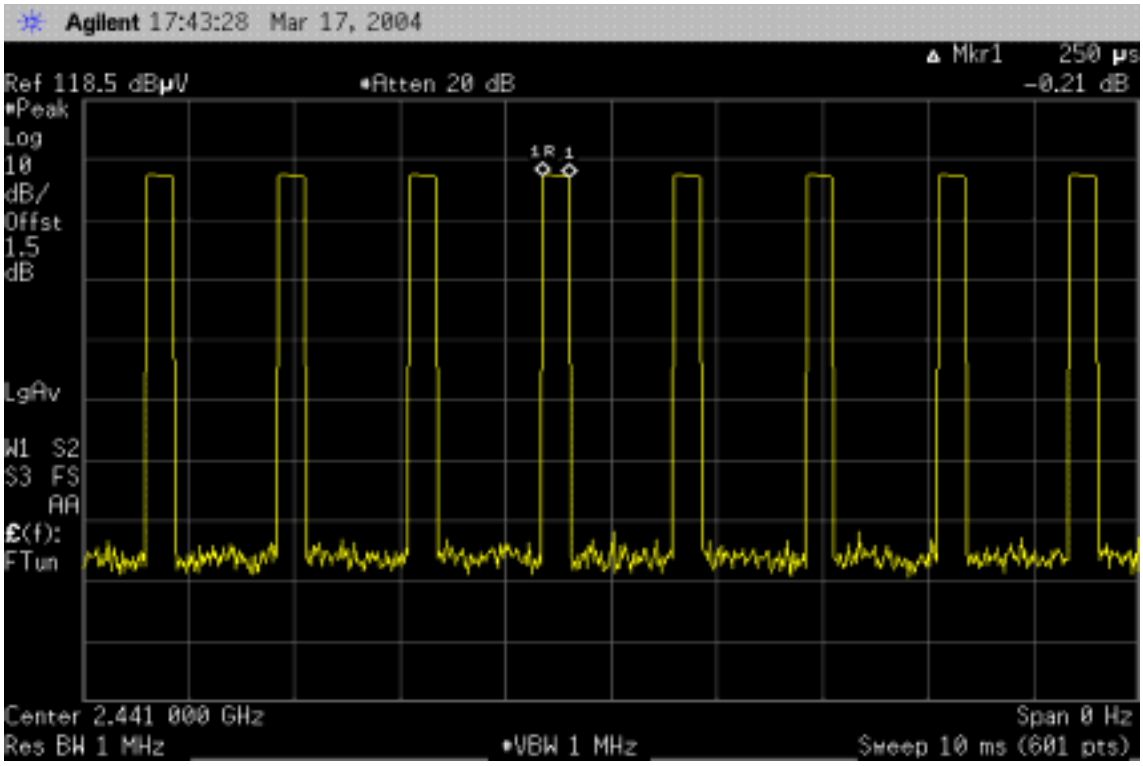
CH	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
Low	2.417	734.28	30	400.00	PASS
Mid	2.433	739.14	30		PASS
High	2.417	734.28	30		PASS

Test Plot

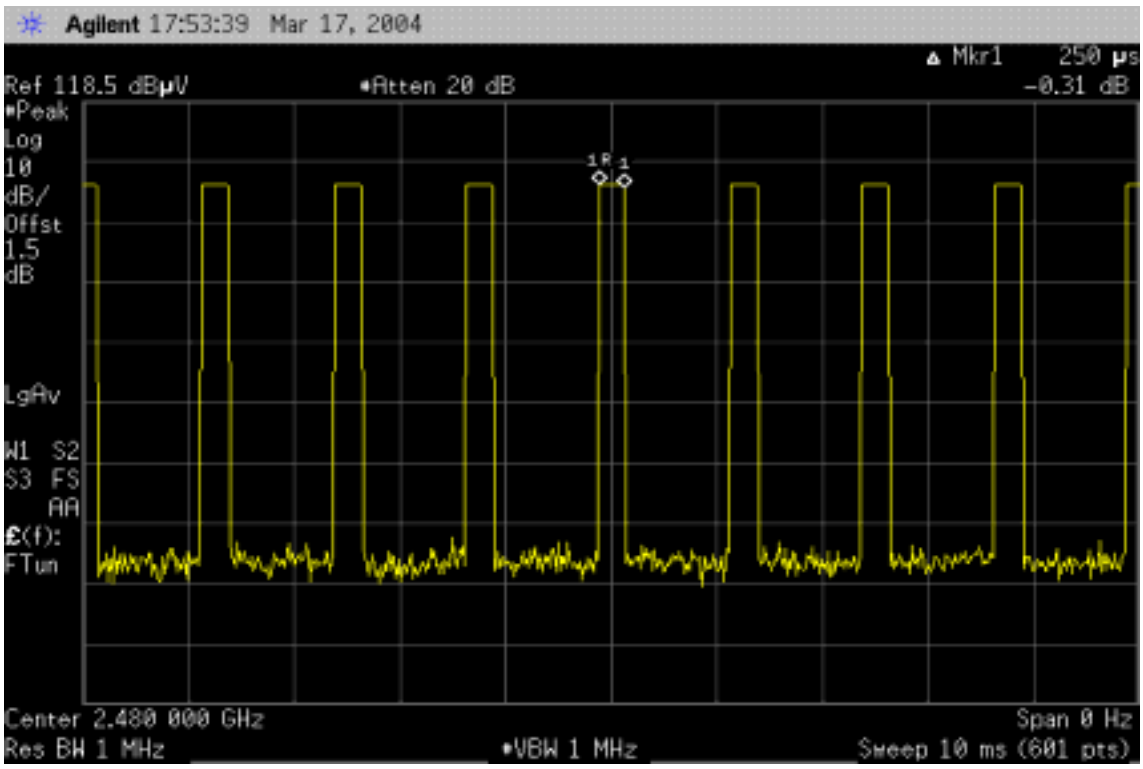
CH Low



CH Mid

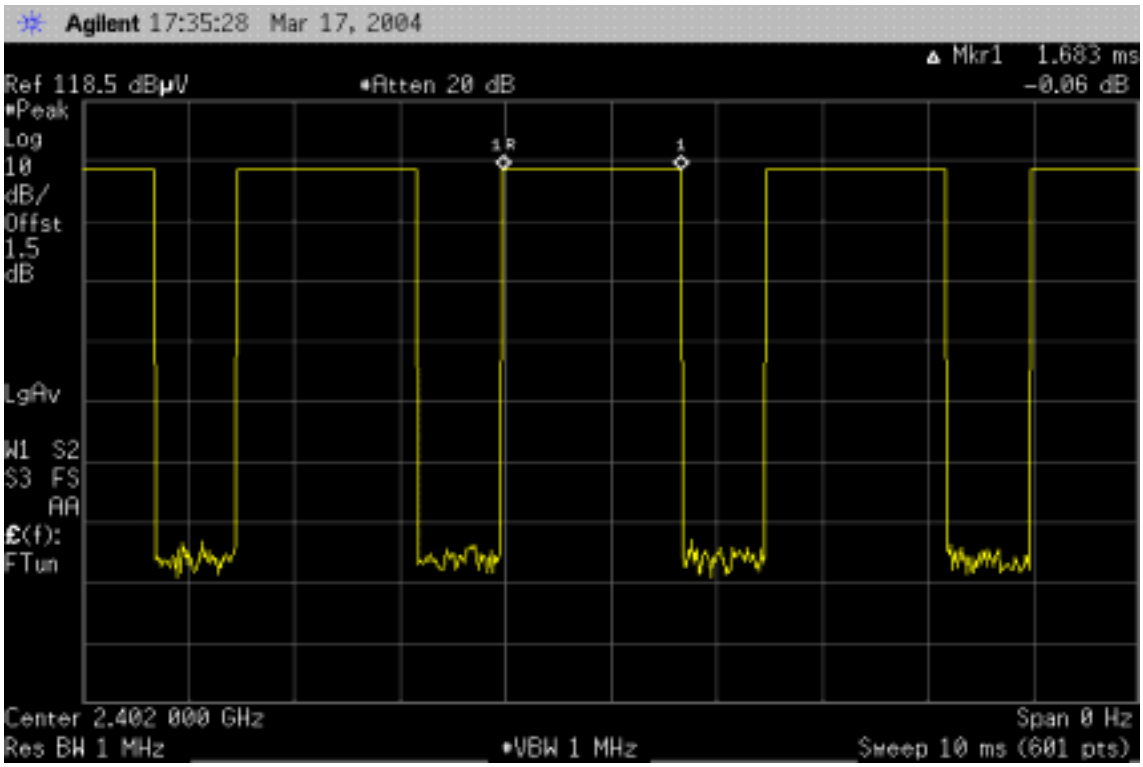


CH High

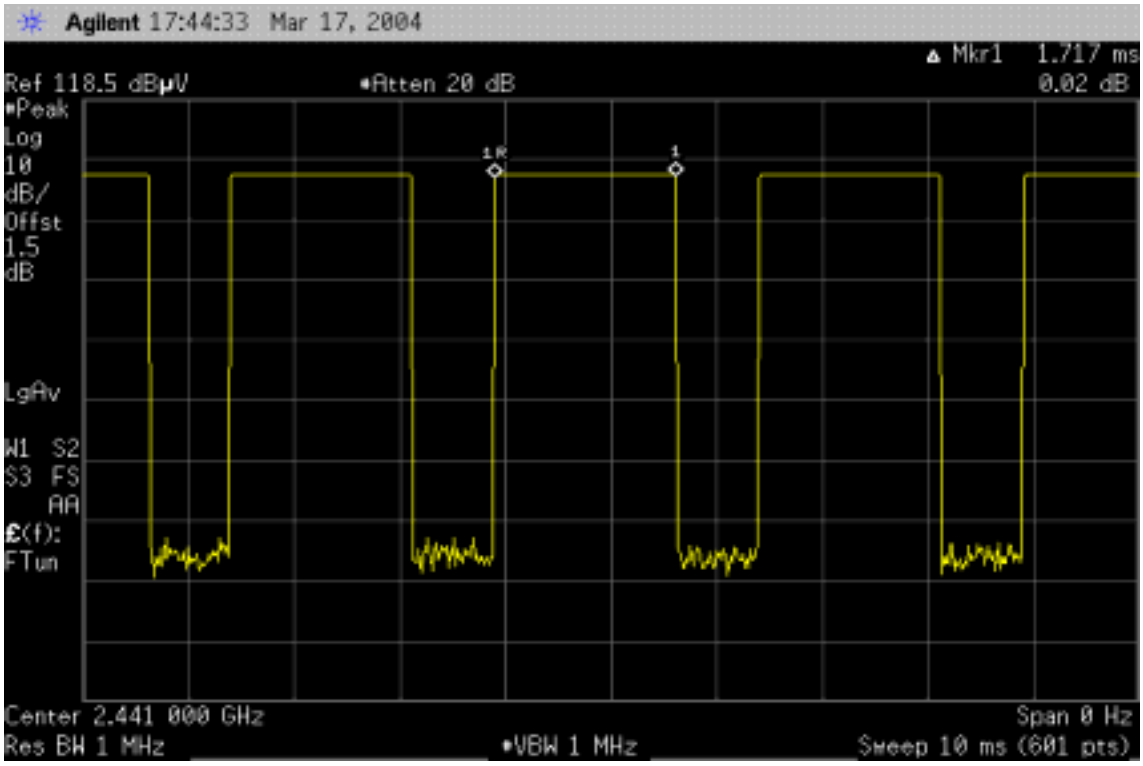

Agilent 17:53:39 Mar 17, 2004
Mkr1 250 µs
Ref 118.5 dBµV
Atten 20 dB
-0.31 dB
Peak
Log
10
dB/
Offst
1.5
dB
LgAv
W1 S2
S3 FS
AA
£(f):
FTun
Center 2.480 000 GHz
Span 0 Hz
Res BW 1 MHz
VBW 1 MHz
Sweep 10 ms (601 pts)

DH 3

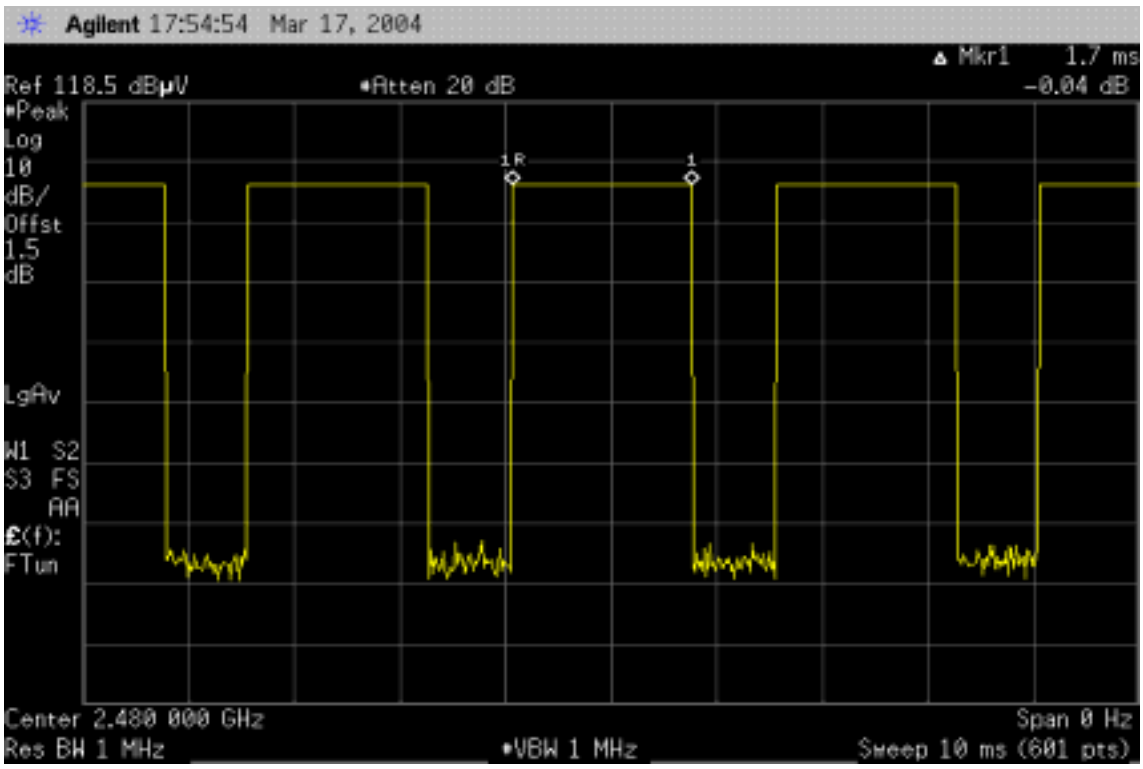
CH Low



CH Mid

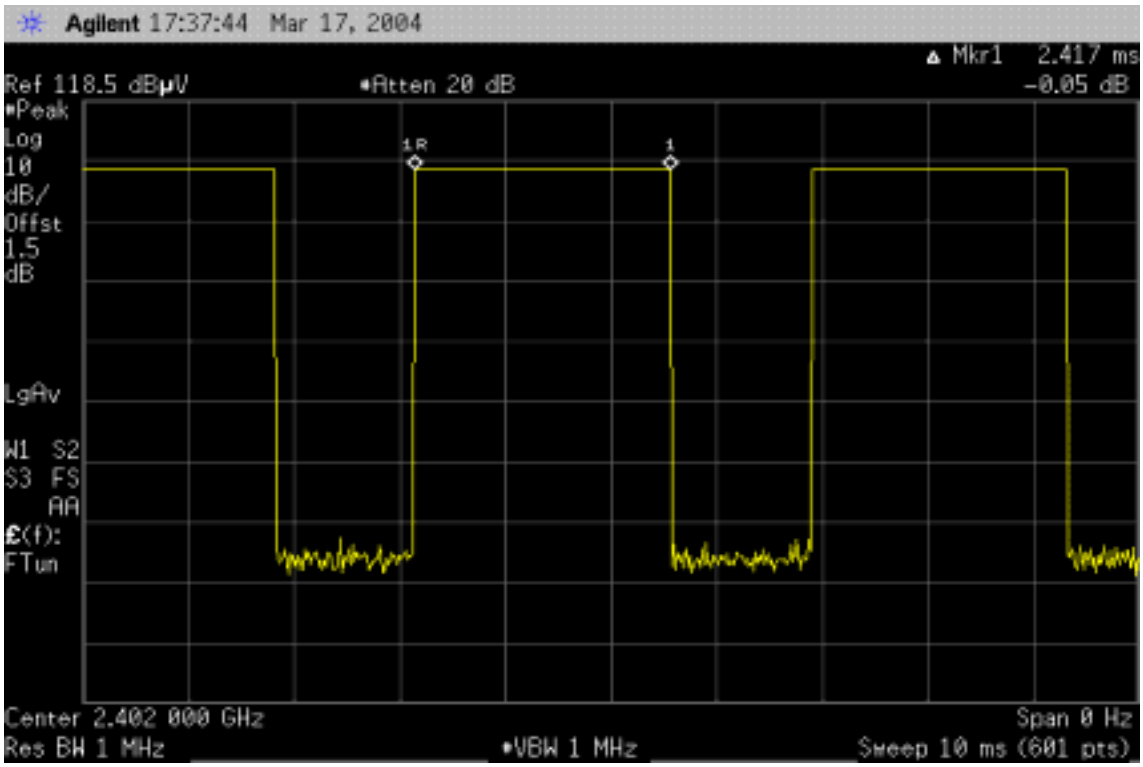


CH High

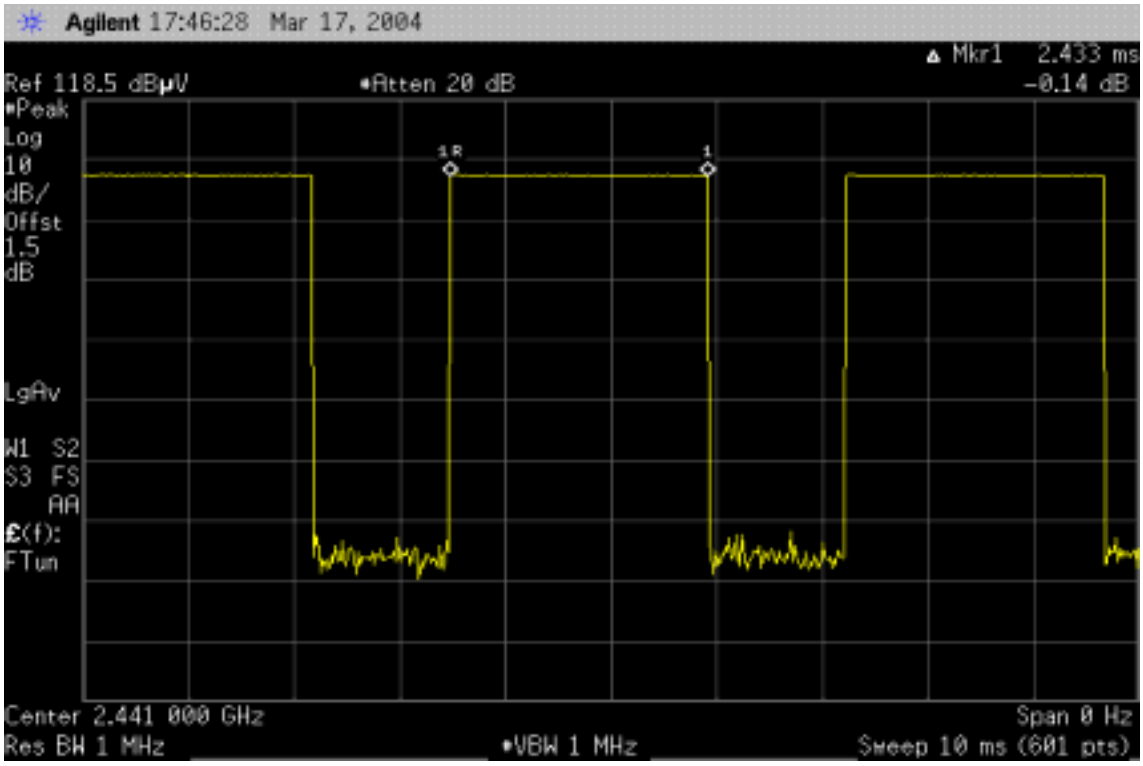

Agilent 17:54:54 Mar 17, 2004
Mkr1 1.7 ms
Ref 118.5 dBµV
Atten 20 dB
-0.04 dB
Peak
Log
10
dB/
Offst
1.5
dB
1R
1
LgAv
W1 S2
S3 FS
AA
£(f):
FTun
Center 2.480 000 GHz
Span 0 Hz
Res BW 1 MHz
VBW 1 MHz
Sweep 10 ms (601 pts)

DH 5

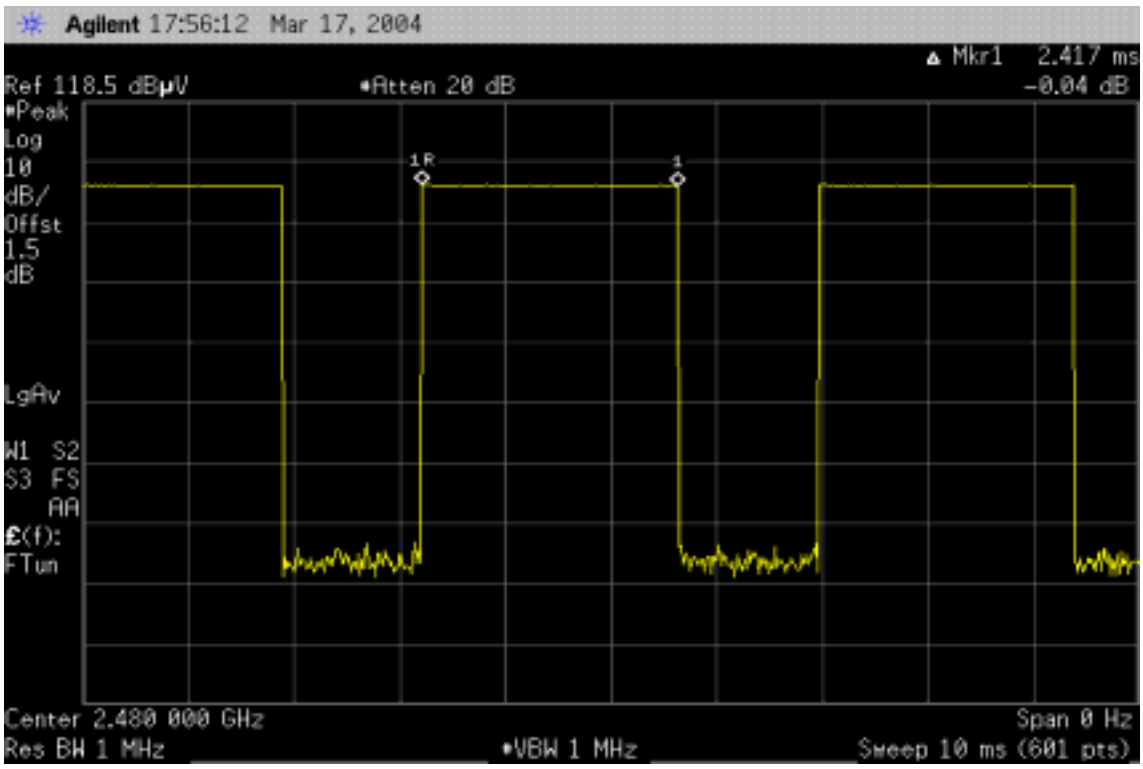
CH Low



CH Mid



CH High


Agilent 17:56:12 Mar 17, 2004
Mkr1 2.417 ms
-0.04 dB
Ref 118.5 dBµV
Atten 20 dB
Peak
Log
10
dB/
Offst
1.5
dB
1R
1
LgAv
W1 S2
S3 FS
AA
ε(f):
FTun
Center 2.480 000 GHz
Span 0 Hz
Res BW 1 MHz
VBW 1 MHz
Sweep 10 ms (601 pts)

7.7RADIO FREQUENCY EXPOSURE

LIMIT

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 §15.247(b)(4) and §1.1307(b)(1) of this chapter.

EUT Specification

EUT	Bluetooth Headset
Frequency band (Operating)	☐ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz ☐ WLAN: 5.745GHz ~ 5825GHz ☒ Others Bluetooth: 2402GHz ~ 2480GHz
Device category	☒ Portable (<20cm separation) ☐ Mobile (>20cm separation) ☐ Others _____
Exposure classification	☐ Occupational/Controlled exposure *(S = 5mW/cm^2)* ☒ General Population/Uncontrolled exposure *(S=1mW/cm^2)*
Antenna diversity	☒ Single antenna ☐ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☐ Tx/Rx diversity
Max. output power	0.27dBm (1.064mW)
Antenna gain (Max)	2 dBi (Numeric gain: 1.584)
Evaluation applied	☒ MPE Evaluation ☐ SAR Evaluation

Note:

1. *The maximum output power is 0.27dBm (1.064mW) at 2402MHz (with 1.584 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 minimum separation generally be used is at least 20 cm, even if the calculations indicate that the MPE distance would be lesser.*

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: $60/f_{(GHz)}=60/2.402=29.383mW$)

MPE evaluation

Not applicable.

Calculation

Given $E = \sqrt{\frac{30 \times P \times G}{d}}$ & $S = \frac{E^2}{3770}$

Where *E = Field Strength in Volts / meter*
P = Power in Watts
G=Numeric antenna gain
d=Distance in meters
S=Power Density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$d = \sqrt{\frac{30 \times P \times G}{3770 \times S}}$$

Changing to units of mW and cm, using:

P (mW) = P (W) / 1000 and

*d (cm) =100 * d (m)*

Yields

$$d = 100 \times \sqrt{\frac{30 \times (P/1000) \times G}{3770 \times S}} = 0.282 \times \sqrt{\frac{P \times G}{S}}$$

Where *d = distance in cm*
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW / cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and

G (numeric) = 10 ^ (G (dBi) / 10)

Yields

$$d = 0.282 \times \frac{10^{(P+G)/20}}{\sqrt{20}}$$

Equation 1

Where *d = MPE safe distance in cm*
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW / cm^2

Maximum Permissible Exposure

EUT output power = 1.064 mW

Antenna Gain = 1.584 (Numeric gain)

S = 1.0 mW / cm^2 from 1.1310 Table 1

Substituting these parameters into the above Equation 1:

→ MPE Safe Distance = 0.085534 cm

(For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.)

7.8SPURIOUS EMISSIONS

7.8.1 Conducted Measurement

LIMIT

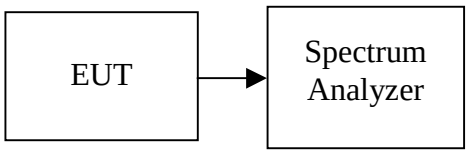
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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)).

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	04/28/2004

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

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 100 kHz.

Measurements are made over the 30MHz to 26GHzrange with the transmitter set to the lowest, middle, and highest channels.

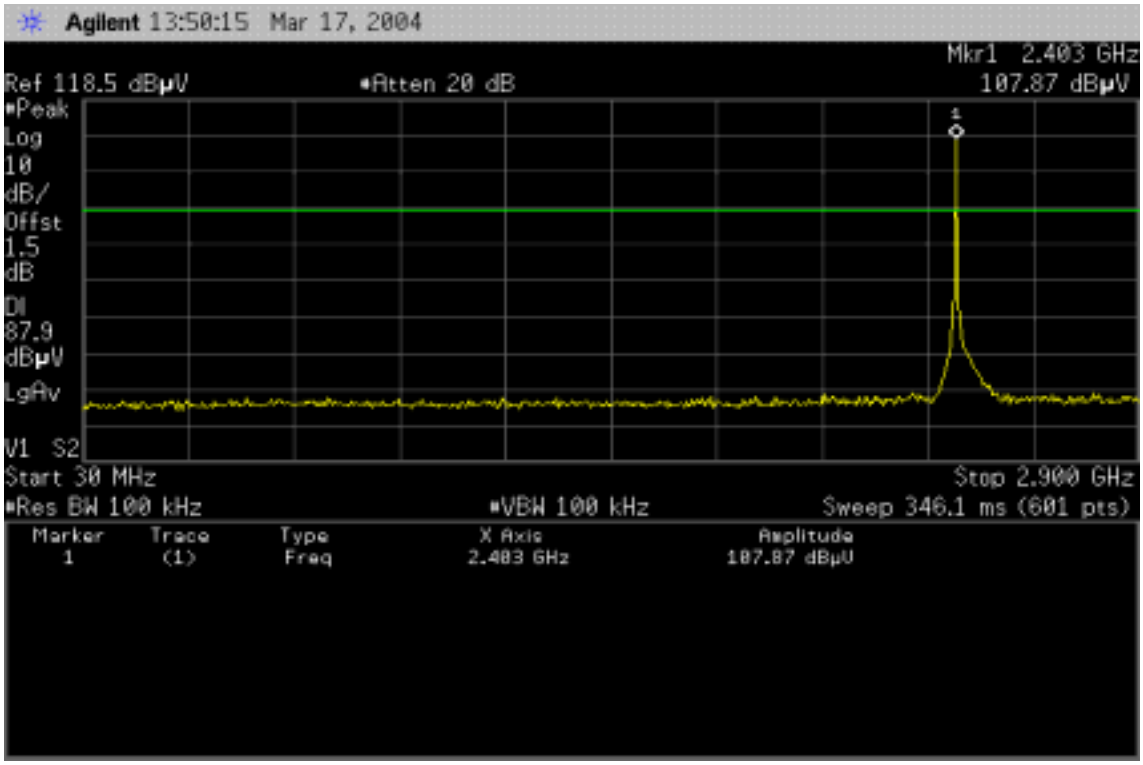
TEST RESULTS

No non-compliance noted

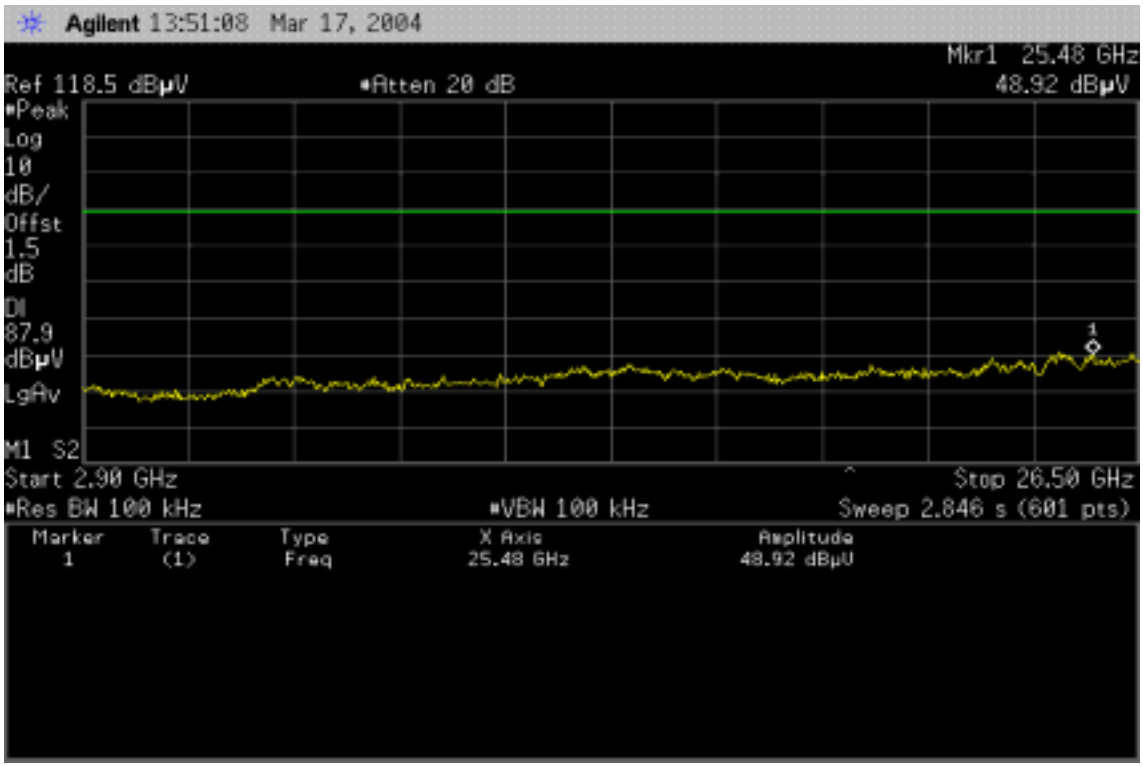
Test Plot

CH Low

30MHz – 2.9GHz

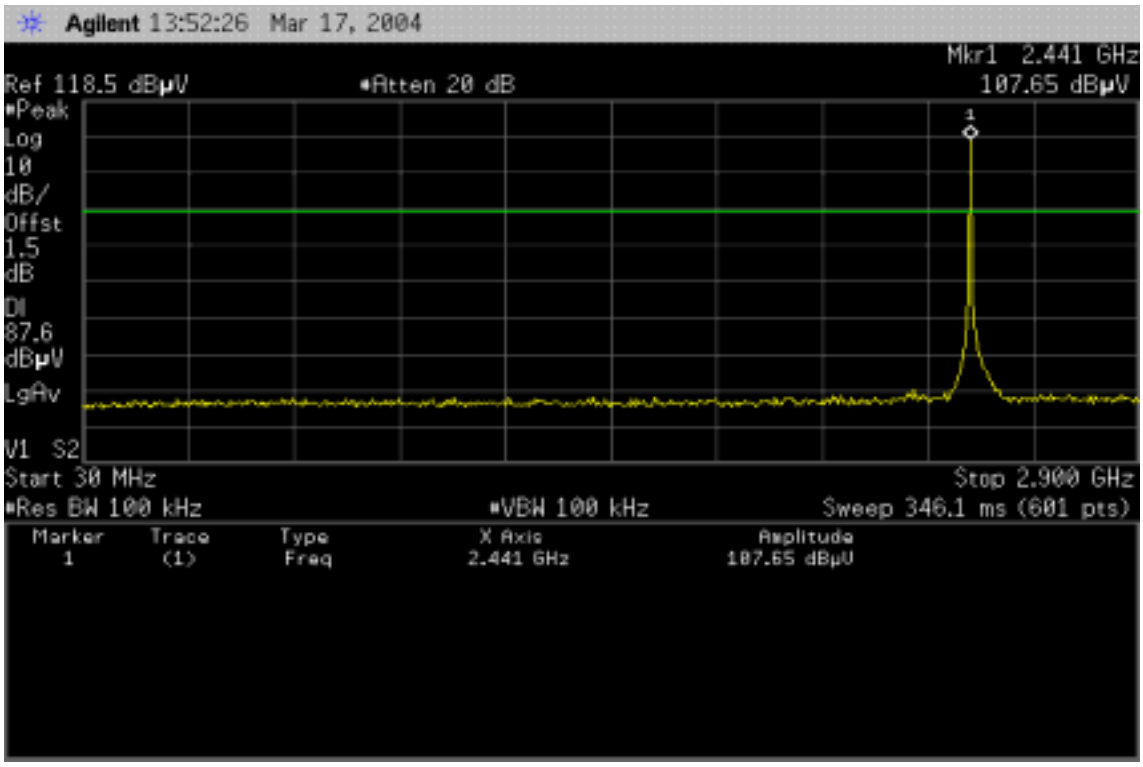


2.9GHz – 26.5GHz

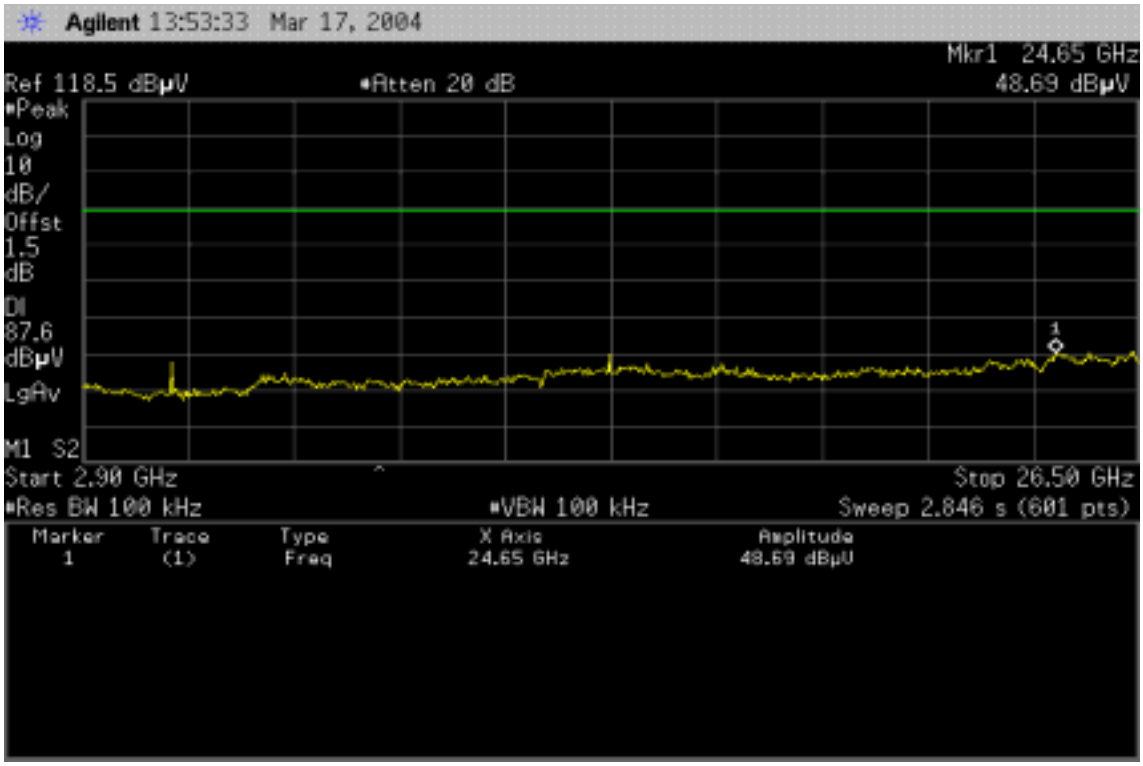


CH Mid

30MHz – 2.9GHz

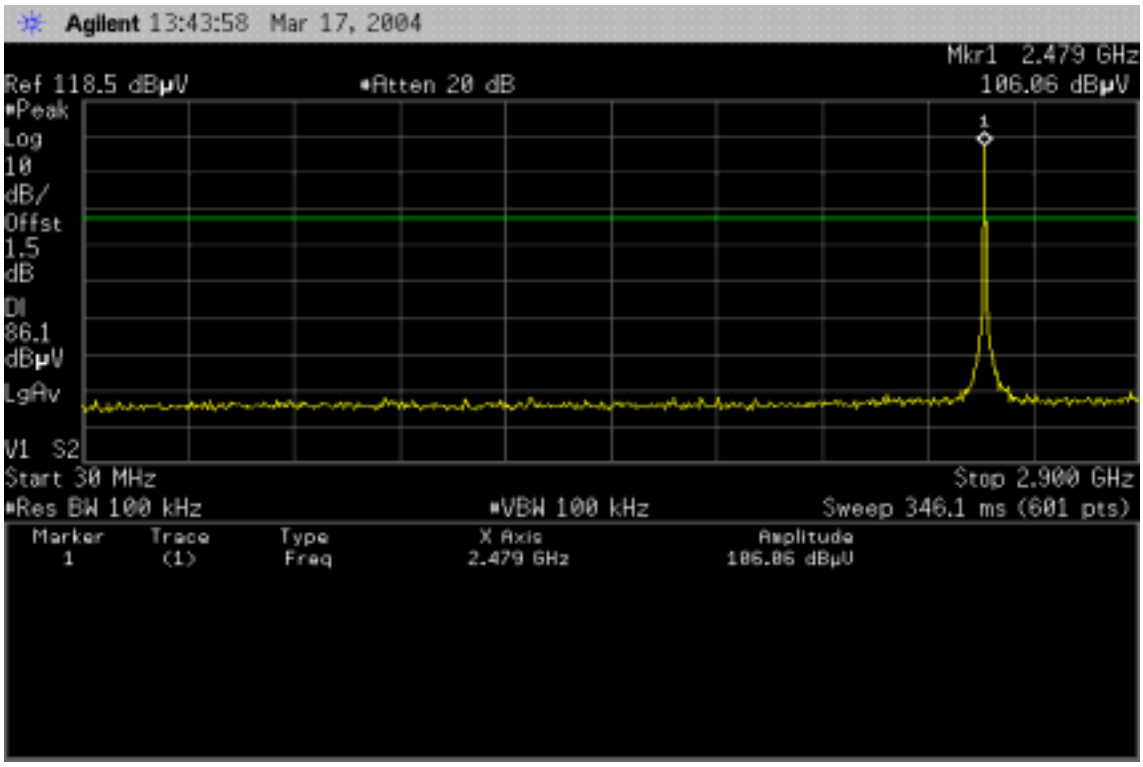


2.9GHz – 26.5GHz

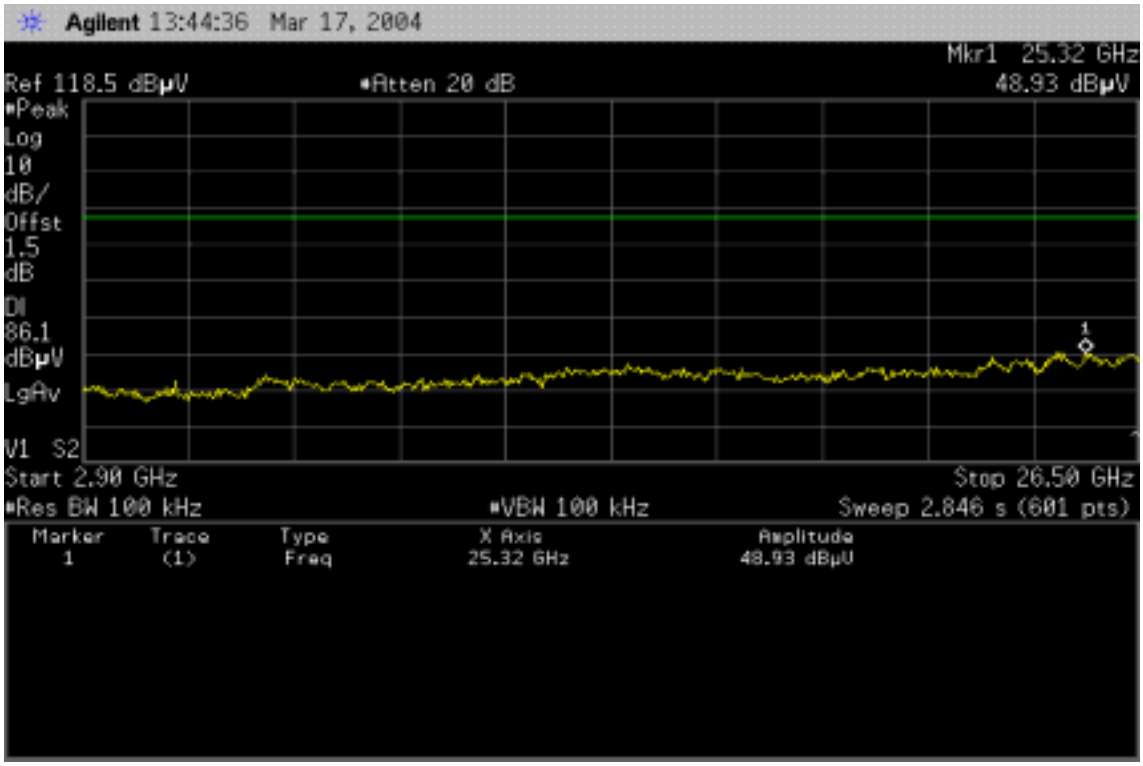


CH High

30MHz – 2.9GHz



2.9GHz – 26.5GHz



7.6.2 Radiated Emissions

LIMIT

1. 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 (mV/m)	Measurement Distance (m)
30-88	100*	3
88-216	150*	3
216-960	200*	3
Above 960	500	3

Note: *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 above emission table, the tighter limit applies at the band edges.

Frequency (Hz)	Field Strength (µV/m at 3-meter)	Field Strength (dBµV/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

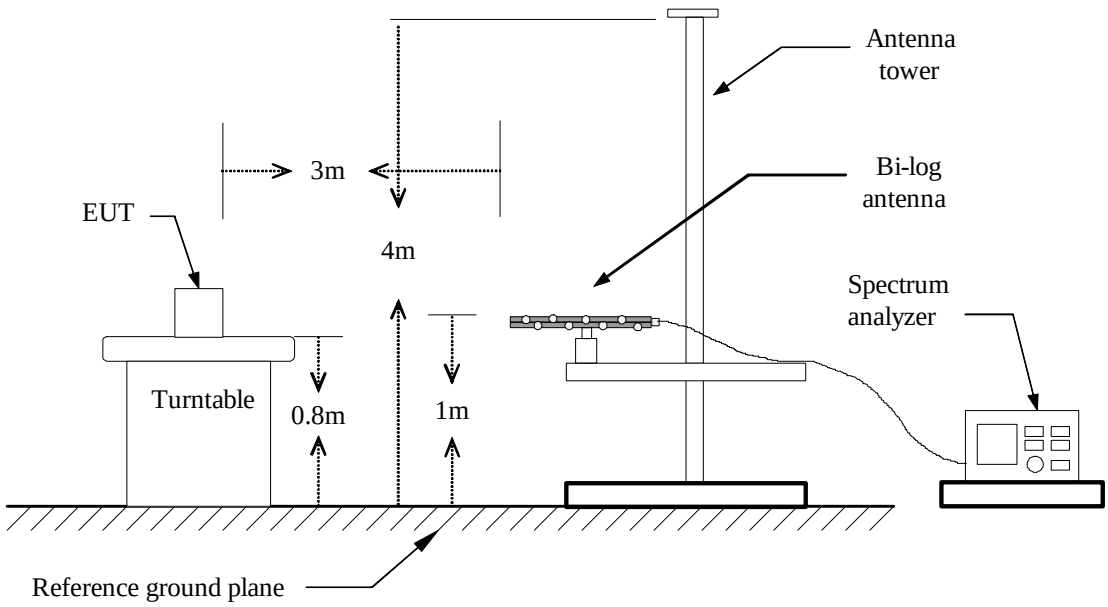
MEASUREMENT EQUIPMENT USED

Open Area Test Site # 3				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	ADVANTEST	R3261A	N/A	03/15/2005
EMI Test Receiver	R&S	ESVS20	838804/004	01/04/2005
Pre-Amplifier	HP	8447D	2944A09173	03/03/2005
Bilog Antenna	SCHWAZBECK	VULB9163	145	07/05/2004
Turn Table	EMCO	2081-1.21	9709-1885	N.C.R
Antenna Tower	EMCO	2075-2	9707-2060	N.C.R
Controller	EMCO	2090	9709-1256	N.C.R
RF Switch	ANRITSU	MP59B	M53867	N.C.R
Site NSA	C&C	N/A	N/A	09/06/2004
Horn antenna	Schwarzbeck	BBHA 9120	D210	02/23/2005
Loop Antenna	EMCO	6502	2356	07/10/2004
Pre-Amplifier	HP	8449B	3008B00965	10/02/2004

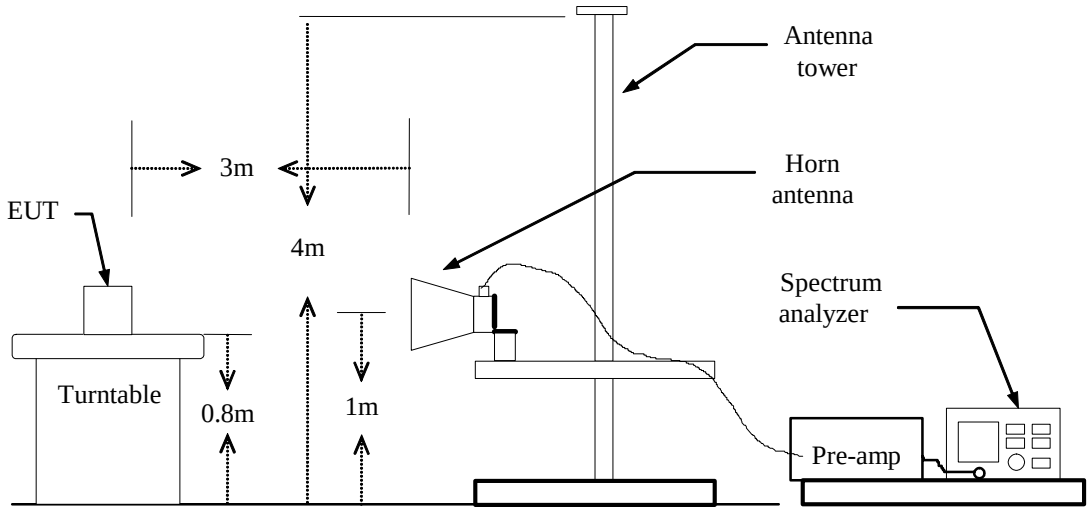
Remark: *Each piece of equipment is scheduled for calibration once a year.*

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. Repeat above procedures until the measurements for all frequencies are complete.

TEST RESULTS

Below 1 GHz

Operation Mode: TX / IEEE 802.11b / CH Low **Test Date:** March 19, 2004

Temperature: 20°C **Tested by:** Max Yan

Humidity: 70 % RH **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit 3m (dBuV/m)	Safe Margin (dB)
34.95	V	Peak	12.78	12.63	25.41	40.00	-14.59
86.25	V	Peak	3.32	11.12	14.44	40.00	-25.56
114.60	V	Peak	1.19	12.26	13.45	43.50	-30.05
352.50	V	Peak	-0.13	18.16	18.03	46.00	-27.97
911.33	V	Peak	0.24	28.31	28.55	46.00	-17.45
N/A							
48.35	H	Peak	6.92	15.42	22.34	40.00	-17.66
86.25	H	Peak	1.82	11.12	12.94	40.00	-27.06
114.60	H	Peak	-1.11	12.26	11.15	43.50	-32.35
610.33	H	Peak	-3.53	25.27	21.74	46.00	-24.26
846.00	H	Peak	-3.98	27.19	23.21	46.00	-22.79
N/A							

Notes:

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 detector mode.*
3. *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.*
4. *The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.*

Operation Mode: TX / IEEE 802.11b / CH Mid **Test Date:** March 19, 2004

Temperature: 20°C **Tested by:** Max Yan

Humidity: 70 % RH **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit 3m (dBuV/m)	Safe Margin (dB)
34.95	V	Peak	13.28	12.63	25.91	40.00	-14.09
86.25	V	Peak	2.48	11.12	13.60	40.00	-26.40
115.05	V	Peak	1.08	12.20	13.28	43.50	-30.22
375.83	V	Peak	-1.43	19.42	17.99	46.00	-28.01
816.83	V	Peak	-2.68	2.52	-0.16	46.00	-46.16
N/A							
34.95	H	Peak	13.94	12.63	26.57	40.00	-13.43
86.25	H	Peak	1.32	11.12	12.44	40.00	-27.56
115.05	H	Peak	-2.25	12.20	9.95	43.50	-33.55
534.50	H	Peak	-2.44	23.73	21.29	46.00	-24.71
928.83	H	Peak	-3.89	28.56	24.67	46.00	-21.33
N/A							

Notes:

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 detector mode.*
3. *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.*
4. *The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.*

Operation Mode: TX / IEEE 802.11b / CH Hight **Test Date:** March 19, 2004

Temperature: 20°C **Tested by:** Max Yan

Humidity: 70 % RH **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limit 3m (dBuV/m)	Safe Margin (dB)
34.95	V	Peak	13.28	12.63	25.91	40.00	-14.09
86.25	V	Peak	2.48	11.12	13.60	40.00	-26.40
115.05	V	Peak	1.08	12.20	13.28	43.50	-30.22
375.83	V	Peak	-1.43	19.42	17.99	46.00	-28.01
816.83	V	Peak	-2.68	2.52	-0.16	46.00	-46.16
N/A							
34.95	H	Peak	13.94	12.63	26.57	40.00	-13.43
86.25	H	Peak	1.32	11.12	12.44	40.00	-27.56
115.05	H	Peak	-2.25	12.20	9.95	43.50	-33.55
534.50	H	Peak	-2.44	23.73	21.29	46.00	-24.71
928.83	H	Peak	-3.89	28.56	24.67	46.00	-21.33
N/A							

Notes:

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 detector mode.*
3. *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.*
4. *The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.*

Above 1 GHz

Operation Mode: TX / CH Low **Test Date:** March 19, 2004

Temperature: 20°C **Tested by:** Max Yan

Humidity: 70 % RH **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
4800.00	V	47.00	---	3.24	50.24	---	74.00	54.00	-3.76	P
N/A										
N/A										
N/A										
N/A										
N/A										
4800.00	H	51.00	36.17	3.24	54.24	39.41	74.00	54.00	-14.59	A
N/A										
N/A										
N/A										
N/A										
N/A										

Notes:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Measurements above show only up to 6 maximum emissions noted, or would be lesser 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.*
3. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.*
4. *Spectrum setting:*
   a. *Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.*
   b. *AV Setting 1GH z- 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms.*

Operation Mode: TX / CH Mid **Test Date:** March 19, 2004

Temperature: 20°C **Tested by:** Max Yan

Humidity: 70 % RH **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
4800.00	V	47.84	---	3.24	51.08	---	74.00	54.00	-2.92	P
N/A										
N/A										
N/A										
N/A										
N/A										
4800.00	H	49.34	---	3.24	52.58	---	74.00	54.00	-1.42	P
N/A										
N/A										
N/A										
N/A										
N/A										

Notes:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Measurements above show only up to 6 maximum emissions noted, or would be lesser 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.*
3. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.*
4. *Spectrum setting:*
   a. *Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.*
   b. *AV Setting 1GH z- 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms.*

Operation Mode: TX / CH High **Test Date:** March 19, 2004

Temperature: 20°C **Tested by:** Max Yan

Humidity: 70 % RH **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
4800.00	V	42.34	---	3.24	45.58	---	74.00	54.00	-8.42	P
4950.00	V	43.84	---	3.56	47.40	---	74.00	54.00	-6.60	P
N/A										
N/A										
N/A										
N/A										
4800.00	H	44.67	---	3.24	47.91	---	74.00	54.00	-6.09	P
4950.00	H	47.17	---	3.56	50.73	---	74.00	54.00	-3.27	P
N/A										
N/A										
N/A										
N/A										

Notes:

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*
2. *Measurements above show only up to 6 maximum emissions noted, or would be lesser 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.*
3. *Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.*
4. *Spectrum setting:*
   a. *Peak Setting 1GHz - 26GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = 200 ms.*
   b. *AV Setting 1GH z- 26GHz, RBW = 1MHz, VBW = 10Hz, Sweep time = 200 ms.*

7.9POWERLINE CONDUCTED EMISSIONS

LIMIT

For an intentional radiator which 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 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	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

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

MEASUREMENT EQUIPMENT USED

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver	R&S	ESCS30	847793/012	12/20/2004
LISN	R&S	ESH2-Z5	843285/010	12/15/2004
LISN	EMCO	3825/2	9003-1628	07/25/2004

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

Test Configuration

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4.
2. The EUT was plug-in the host PC via USB port. The host PC system was placed on the center of the back edge on the test table. The peripherals like modem, monitor printer, K/B, and mouse were placed on the side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The keyboard was placed directly in the front of the monitor, flushed with the front tabletop. The mouse was placed next to the Keyboard, flushed with the back of keyboard.
4. The spacing between the peripherals was 10 centimeters.
5. External I/O cables were draped along the edge of the test table and bundle when necessary.
6. The host PC system was connected with 110Vac/60Hz power source.

The EUT is set to transmit in a continuous mode.

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.

Operation Mode:	TX + RX mode	**Test Date:**	March 16, 2004
Temperature:	25°C	**Humidity:**	65% RH
Tested by:	Chris		

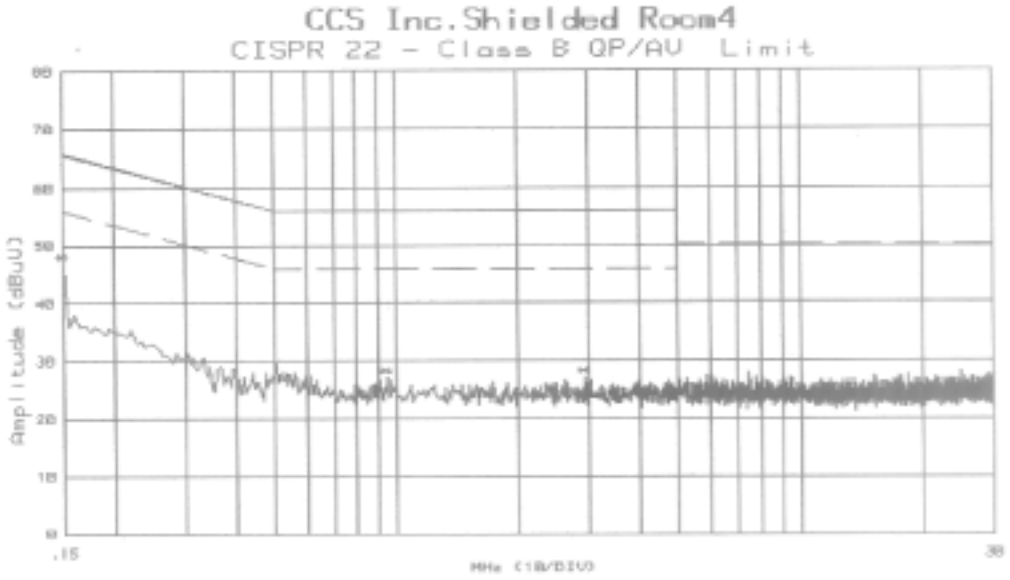
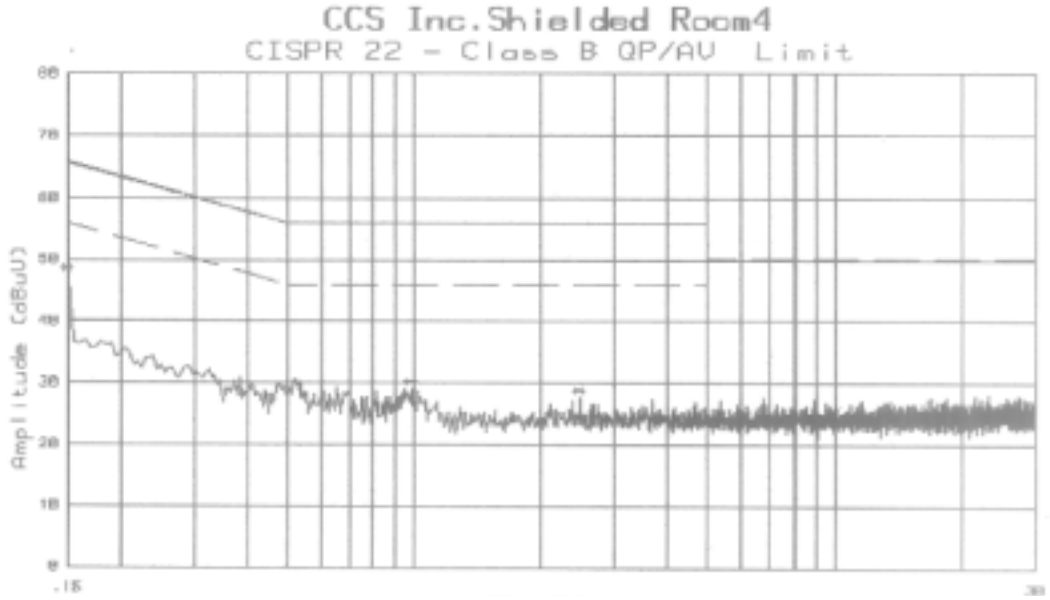
Freq. (MHz)	Q.P. Raw (dBuV)	AVG Raw (dBuV)	Q.P. Limit (dBuV)	AVG Limit (dBuV)	Q.P. Margin (dB)	AVG Margin (dB)	Note
0.150	47.40	---	66.00	---	-18.60	---	L1
0.990	29.00	---	56.00	---	-27.00	---	L1
2.490	27.60	---	56.00	---	-28.40	---	L1
N/A							
N/A							
N/A							
0.150	46.80	---	66.00	---	-19.20	---	L2
0.950	27.10	---	56.00	---	-28.90	---	L2
2.930	27.10	---	56.00	---	-28.90	---	L2
N/A							
N/A							
N/A							

Note:

1. *The measuring frequencies range between 0.15 MHz and 30 MHz.*
2. *The emissions measured in the frequency range between 0.15 MHz and 30MHz were made with an instrument using Quasi-peak detector and Average detector.*
3. *"---" denotes the emission level was or more than 2dB below the Average limit, and no re-check was made.*
4. *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.*
5. *L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)*

Test Data Plots

Conducted emissions (Line 1)



Conducted emissions (Line 2)