EMC Test Report
Application for Grant of Equipment Authorization
Industry Canada RSS-Gen Issue 3 / RSS 210 Issue 8
FCC Part 15 Subpart C

Intel® Centrino® Wireless-N 2230 Models 2230BNHMW & 2230BNHU

IC CERTIFICATION #:	1000M-2230BNH and 1000M-2230BNHU
FCC ID:	PD92230BNH and PD92230BNHU
APPLICANT:	Intel Corporation 100 Center Point Circle Suite 200 Columbia, SC 29210
TEST SITE(S):	Elliott Laboratories 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-3; 2845B-5
REPORT DATE:	October 24, 2011
FINAL TEST DATES:	October 2, 3 and 4, 2011
TOTAL NUMBER OF PAGES:	72

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A2LA ACCREDITED
Testing Cert #2016.01

Rev#	Date	Comments	Modified By
-	10-24-2011	First release	

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SCOPE

An electromagnetic emissions test has been performed on the Intel Corporation model Intel® Centrino® Wireless-N 2230 Models 2230BNHMW & 2230BNHU, pursuant to the following rules:

Industry Canada RSS-Gen Issue 3
RSS 210 Issue 8 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in Elliott Laboratories test procedures:

ANSI C63.4:2003
FHSS test procedure DA 00-0705A1, March 2000

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Intel Corporation model Intel® Centrino® Wireless-N 2230 Models 2230BNHMW & 2230BNHU complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 3
RSS 210 Issue 8 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Intel Corporation model Intel® Centrino® Wireless-N 2230 Models 2230BNHMW & 2230BNHU and therefore apply only to the tested sample. The sample was selected and prepared by Steve Hackett of Intel Corporation.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

FREQUENCY HOPPING SPREAD SPECTRUM (2400 – 2483.5 MHz, less than 75 channels)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247 (a) (1)	RSS 210 A8.1 (1)	20dB Bandwidth	Basic Rate: 1140 kHz EDR: 1410 kHz	Channel spacing > 2/3rds 20dB BW	Complies
		Channel Separation	1 MHz		Complies
15.247 (a) (1) (ii)	RSS 210 A8.1 (4)	Number of Channels	Min 20 Max 79	15 or more	Complies
15.247 (a) (1) (ii)	RSS 210 A8.1 (4)	Channel Dwell Time (*average time of occupancy)*	0.4 seconds per 31.6 seconds for 79 channels	<0.4 second within a period of 0.4 x number of channels	Complies
15.247 (a) (1)	RSS 210 A8.1 (1)	Channel Utilization	The system uses the Bluetooth algorithm and, therefore, meets all requirements for channel utilization.	All channels shall, on average, be used equally	Complies
15.247 (b) (3)	RSS 210 A8.4 (2)	Output Power	Basic Rate: 6.1 dBm (0.004 W) EDR: 4.6 dBm (0.003 W) EIRP = 0.085 W Note 1	*0.125 Watts (EIRP < ???)*	Complies
15.247(c)	RSS 210 A8.5	Spurious Emissions – 30MHz – 25GHz	All spurious emissions < -20dBc	< -20dBc	Complies
15.247(c) / 15.209	RSS 210 A8.5 Table 2, 3	Radiated Spurious Emissions 30MHz – 25GHz	51.9dBµV/m @ 2483.5MHz (-2.1dB)	15.207 in restricted bands, all others < -20dBc	Complies
15.247 (a) (1)	RSS 210 A8.1(2)	Receiver bandwidth	Refer to operational description	Shall match the channel bandwidth	Complies
Note 1: EIRP calculated using antenna gain of 3.2 dBi					

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	u.FL unique connector	Unique or integral antenna required	Complies
15.207	RSS GEN Table 2	AC Conducted Emissions	32.1dBµV @ 15.520MHz (-17.9dB)	Refer to page 18	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	37.3dBµV/m @ 120.01MHz	Refer to page 19	Complies
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to SAR report, RSS 102 declaration and User Manual statements	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual	Refer to page 11 of the user's manual	Statement required regarding non-interference	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual	Not applicable, antenna is integral to host systems.	Statement for products with detachable antenna	Complies
-	RSP 100 RSS GEN 4.4.1	99% Bandwidth	Basic: 903 kHz EDR: 1.21 MHz	Information only	N/A

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (field strength)	dBµV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dBµV	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Intel® Centrino® Wireless-N 2230 Models 2230BNHMW & 2230BNHU are PCIe Half Mini Card for factor Bluetooth/IEEE 802.11b/g/n wireless network adapters. The cards support MIMO (2x2) for 802.11n modes and MISO (1x2) for 802.11b/g modes. Bluetooth only operation mode is a 1x1. When Bluetooth is operational 802.11b/g/n modes operate as SISO (1x1).
The card is sold under two different FCC/IC ID numbers (see table below). The ID's ending in "U" are intended to allow user install conditions and host systems must be provided with a BIOS locking feature that prevents installation of unauthorized devices.
For radio testing purposes the card was installed in a test fixture that exposed all sides of the card. For digital device testing for certification under equipment code JBP the card was installed inside a laptop PC.

The sample was received on September 21, 2011 and tested on October 2, 3 and 4, 2011. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Intel Corporation	2230BNHMW	PCIe Half Mini Card form factor Bluetooth / IEEE 802.11b/g/n wireless network adapter	001500825023 (JBP) 00150082509B (DSS, DTS)	PD92230BNH PD92230BNHU 1000M-2230BNH
	2230BNHU			1000M-2230BNHU

ANTENNA SYSTEM

The EUT antenna is a two-antenna PIFA antenna system – Shanghai Universe Communication Electron Co., Ltd for both chains (2400-2480MHz, 3.2dBi max gain).

The antenna connects to the EUT via a non-standard u.Fl antenna connector, thereby meeting the requirements of FCC 15.203.

ENCLOSURE

The EUT does not have an enclosure as it is designed to be installed within the enclosure of a host computer or system.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at Elliott.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Intel Corporation	-	Test Fixture	D9164573K0B0	N/A
DELL	Latitude D520	Laptop PC	HM9383J	N/A
Agilent	E3610A	DC Supply	MY4001740	N/A

No remote support equipment was used during testing.

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Laptop USB	Fixture USB	USB cable	Shielded	1.5
Laptop Mini PCI	Fixture PCIe	Ribbon	unshielded	0.7
DC Power	Fixture DC power	2-wire	unshielded	0.7

EUT OPERATION

The EUT was installed into a test fixture that exposed all sides of the card. The test fixture interfaced to a laptop computer and dc power supply. The laptop computer was used to configure the EUT to continuously transmit at a specified output power or continuously receive on the channel specified in the test data. For transmit mode measurements the system was configured to operate in each of the available operating modes – 802.11b, 802.11g, 802.11n (20 MHz channel bandwidth) and 802.11n (40MHz channel bandwidth), Bluetooth Low Energy, Bluetooth 1Mb/s and Bluetooth 3Mb/s. In addition radiated spurious tests were repeated with the device operating in both Bluetooth and 802.11 modes to determine if any spurious emissions due to intermodulation products were created.

The data rates used for all tests were the lowest data rates for each 802.11 mode – 1Mb/s for 802.11b, 6Mb/s for 802.11a and 802.11g, 6.5MB/s for 802.11n (20MHz), and 13 Mb/s for 802.11n (40MHz). The device operates at its maximum output power at the lowest data rate (this was confirmed through separate measurements – refer to test data for actual measurements). Bluetooth operation was evaluated at both 1Mb/s and 3Mb/s data rates. 2Mb/s data rate was found, through preliminary testing, to produce emissions similar to those for 3Mb/s.

Receiver spurious emissions in 802.11 modes were evaluated in single chain and multi-chain modes. Bluetooth receiver spurious were evaluated for single chain only as only SISO is supported for Bluetooth.

The PC was using the Intel test utility DRTU Version 1.5.3.0322 and driver version 15.0.0.61.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
Chamber 3	769238	2845B-3	41039 Boyce Road Fremont, CA 94538-2435
Chamber 5	211948	2845B-5	

ANSI C63.4:2003 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4:2003.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4:2003. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4:2003.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.4:2003 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4:2003, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

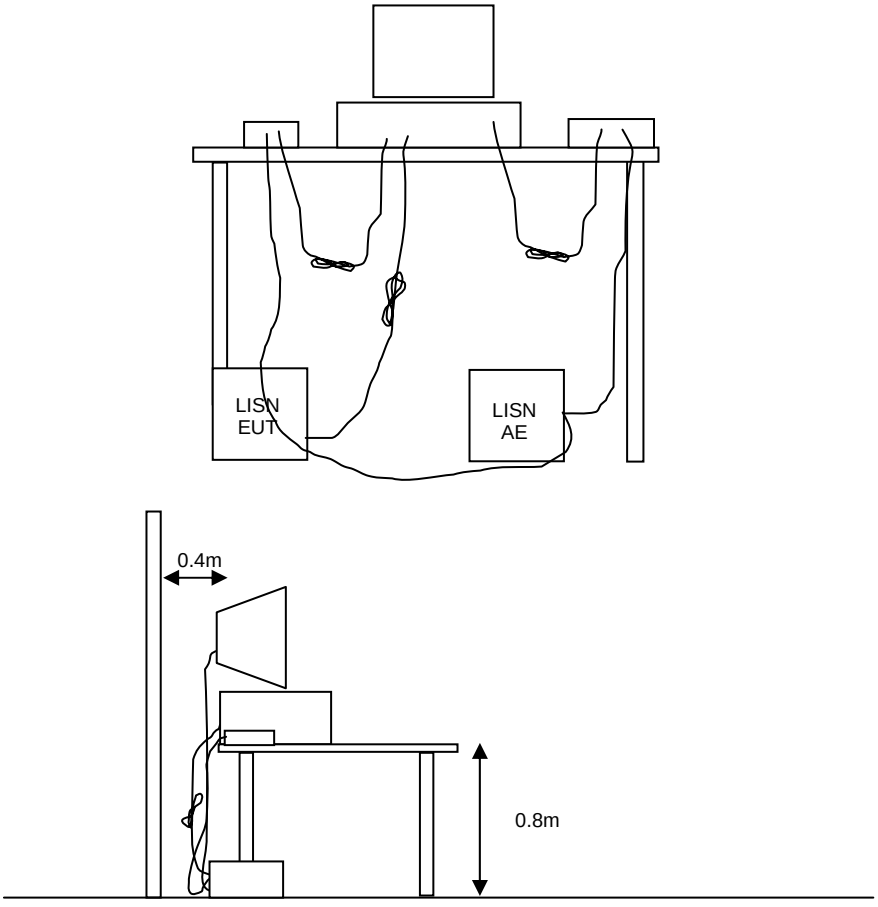


Figure 1 Typical Conducted Emissions Test Configuration

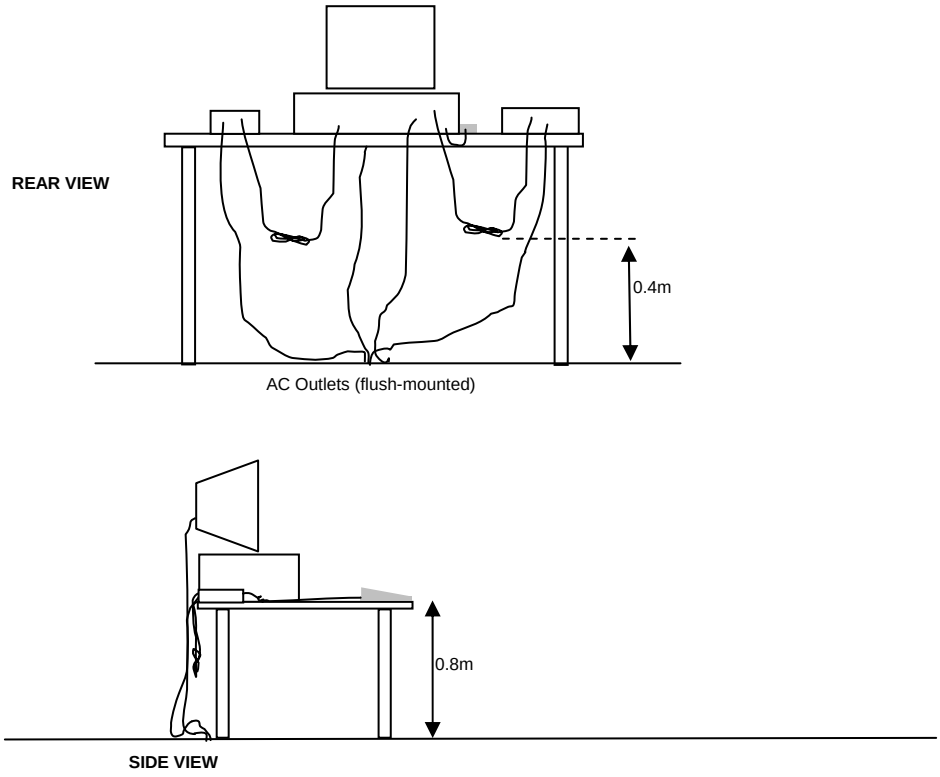
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

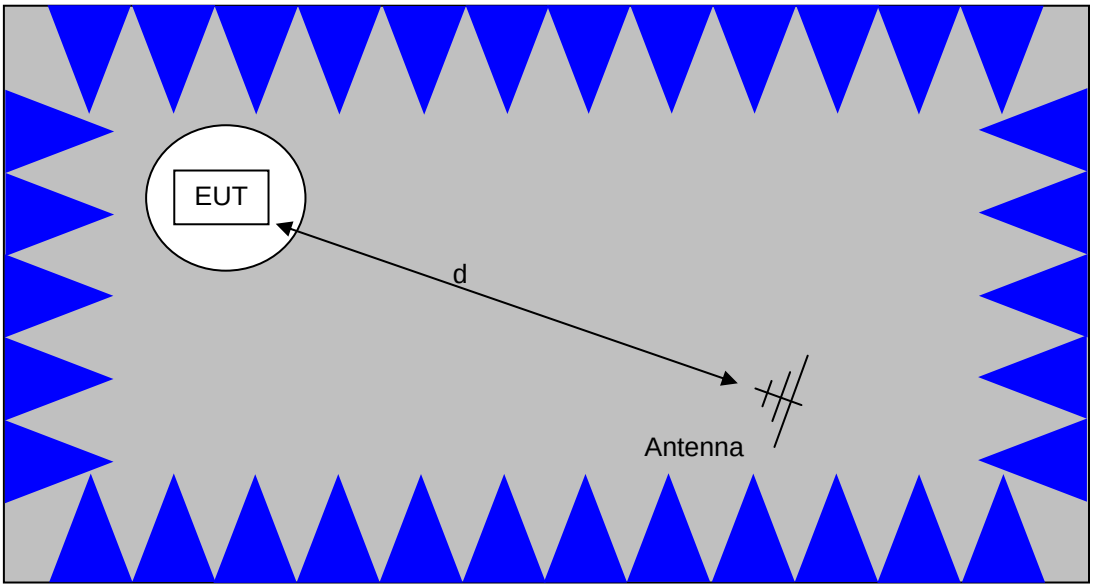
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

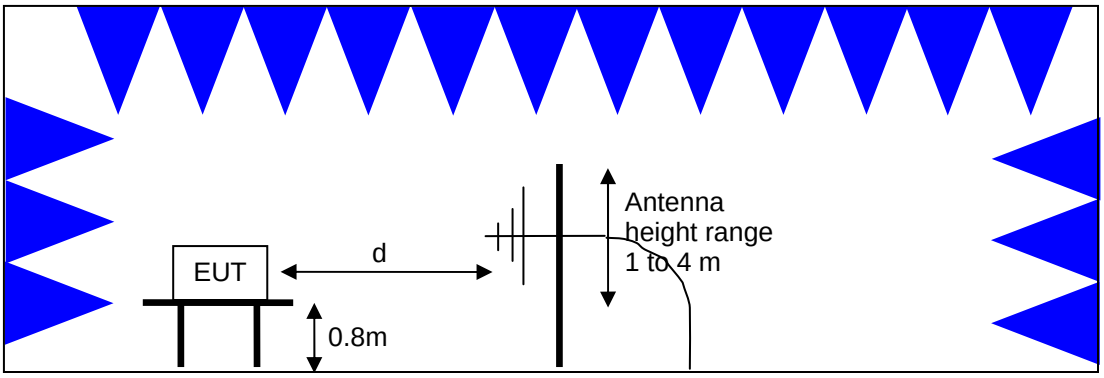


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

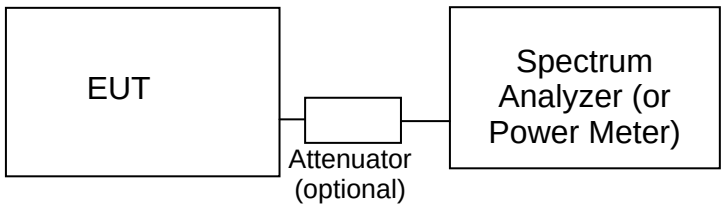
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements of power, bandwidth and power spectral density are performed, where possible, with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.



Test Configuration for Antenna Port Measurements

Measurement bandwidths (video and resolution) are set in accordance with the relevant standards and Elliott's test procedures for the type of radio being tested. When power measurements are made using a resolution bandwidth less than the signal bandwidth the power is calculated by summing the power across the signal bandwidth using either the analyzer channel power function or by capturing the trace data and calculating the power using software. In both cases the summed power is corrected to account for the equivalent noise bandwidth (ENBW) of the resolution bandwidth used.

If power averaging is used (typically for certain digital modulation techniques), the EUT is configured to transmit continuously. Power averaging is performed using either the built-in function of the analyzer or, if the analyzer does not feature power averaging, using external software. In both cases the average power is calculated over a number of sweeps (typically 100). When the EUT cannot be configured to continuously transmit then either the analyzer is configured to perform a gated sweep to ensure that the power is averaged over periods that the device is transmitting or power averaging is disabled and a max-hold feature is used.

If a power meter is used to make output power measurements the sensor head type (peak or average) is stated in the test data table.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(a), RSS GEN

The table below shows the limits for the emissions on the AC power line from an intentional radiator and a receiver.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from receivers as detailed in FCC Part 15.109, RSS 210 Table 2, RSS GEN Table 1 and RSS 310 Table 3. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

[1] The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

OUTPUT POWER LIMITS – FHSS SYSTEMS

The table below shows the limits for output power based on the number of channels available for the hopping system.

Operating Frequency (MHz)	Number of Channels	Output Power
902 – 928	≥ 50	1 Watt (30 dBm)
902 – 928	25 to 49	0.25 Watts (24 dBm)
2400 – 2483.5	≥ 75	1 Watt (30 dBm)
2400 – 2483.5	< 75	0.125 Watts (21 dBm)
5725 – 5850	75	1 Watt (30 dBm)

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_S = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_S)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_S$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_S = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of d (meters) from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{d} \text{ microvolts per meter}$$

where P is the eirp (Watts)

For a measurement at 3m the conversion from a logarithmic value for field strength (dBuV/m) to an eirp power (dBm) is -95.3dB.

Appendix A Test Equipment Calibration Data

Radio Antenna Port , 2-Oct-11

Manufacturer	Description	Model	Asset #	Cal Due
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	12/1/2011
Rohde & Schwarz	Power Sensor 100 uW - 10 Watts	NRV-Z53	1555	2/2/2012
Rohde & Schwarz	Attenuator, 20 dB , 50 ohm, 10W, DC-18 GHz	20dB, 10W, Type N	1556	2/2/2012
Agilent	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	1/26/2012

Radiated Emissions, 30 - 40,000 MHz, 03-Oct-11

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263	12/8/2011
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/6/2012
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	8/15/2012
Hewlett Packard	High Pass filter, 3.5 GHz (Blu System)	P/N 84300-80038 (84125C)	1391	6/23/2012
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2249	10/11/2011

Radiated Emissions, 1000 - 10,000 MHz, 05-Oct-11

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263	12/8/2011
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/6/2012
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	8/15/2012
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2249	10/11/2011

Radiated Emissions, 30 - 1,000 MHz, 04-Oct-11

Manufacturer	Description	Model	Asset #	Cal Due
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	4/13/2012
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	2237	7/14/2012
Com-Power Corp.	Preamplifier, 30-1000 MHz	PAM-103	2380	4/13/2012

Conducted Emissions - AC Power Ports, 04-Oct-11

Manufacturer	Description	Model	Asset #	Cal Due
EMCO	LISN, 10 kHz-100 MHz, 25A	3825/2	1292	3/1/2012
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1401	4/21/2012
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	4/13/2012
Fischer Custom Comm	LISN, 25A, 150kHz to 30MHz, 25 Amp,	FCC-LISN-50-25-2-09	2001	9/15/2012

Appendix B Test Data

T84599 Pages 24 - 71

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		-
Emissions Standard(s):	FCC 15.247	Class:	B
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Intel Corporation

Model

Intel® Centrino® Wireless-N 2230

Date of Last Test: 10/18/2011

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

RSS-210 and FCC 15.247 FHSS Antenna Port Measurements

Power, Bandwidth and Conducted Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 18-25 °C

Rel. Humidity: 30-50 %

Summary of Results

MAC Address: 00150082509B DRTU Tool Version 1.5.3.0322 Driver version 15.0.0.61

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Output Power	15.247(b)	Pass	Basic Rate: 6.1 dBm (0.004 W) EDR: 4.6 dBm (0.003 W)
2	20dB Bandwidth	15.247(a)	Pass	Basic Rate: 1140 kHz EDR: 1410 kHz
2	99% bandwidth	15.247(a)	Pass	Basic Rate: 903 kHz EDR: 1208 kHz
3	Channel Spacing	15.247(a)	Pass	1 MHz
3	Channel Occupancy	15.247(a)	Pass	Device complies with the Bluetooth 2 specifications with a minimum of 20 hopping channels
3	Number of Channels	15.247(a)	Pass	
5	Conducted Spurious	15.247(a)	Pass	All emissions more than 20dB below the highest in-band signal level.

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

Run #1: Output Power

Date of Test: 10/2/2011 Test Location: FT Chamber #5

Test Engineer: Rafael Varelas

For frequency hopping systems in the 2400-2483.5 MHz band employing less than 75 channels the maximum allowed output power is 0.125 watts.

Maximum antenna gain: 3.2 dBi

Mode	Channel	Frequency (MHz)	Res BW	Output Power (dBm)	Output Power (W)	EIRP (W)
Basic Rate	Low	2402		5.4	0.0035	0.0072
	Mid	2441		6.1	0.0041	0.0085
	High	2480		5.3	0.0034	0.0071
EDR	Low	2402		3.6	0.0023	0.0048
	Mid	2441		4.6	0.0029	0.0060
	High	2480		3.5	0.0022	0.0047

Run #2: Bandwidth, Channel Occupancy, Spacing and Number of Channels

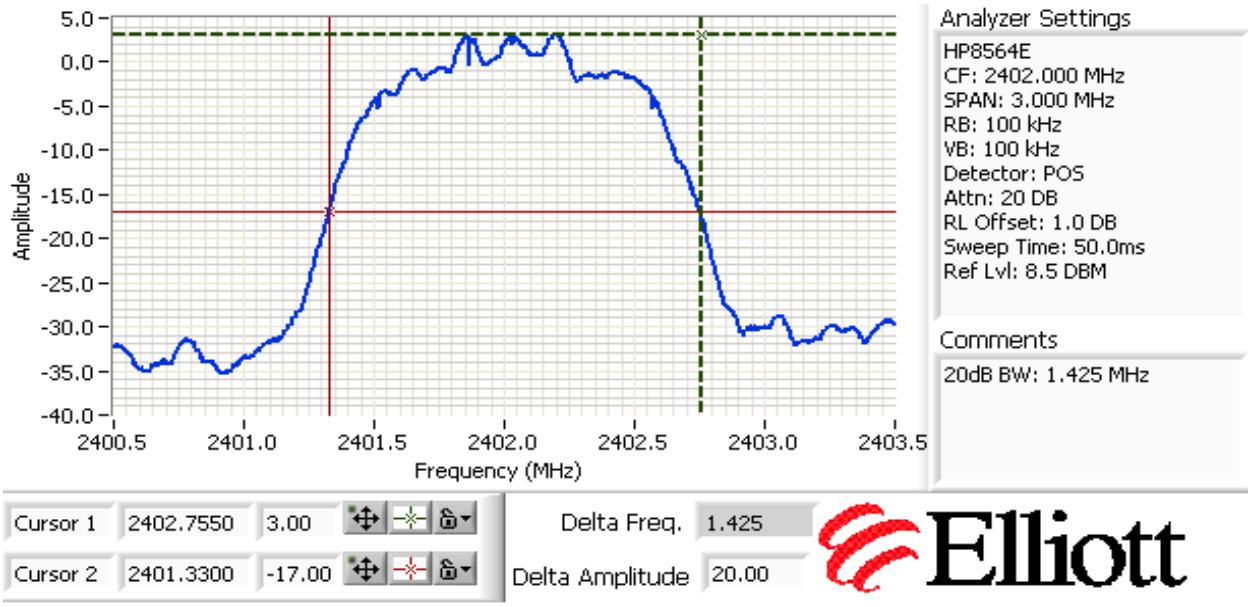
Date of Test: 10/2/2011 Test Location: FT Chamber #5

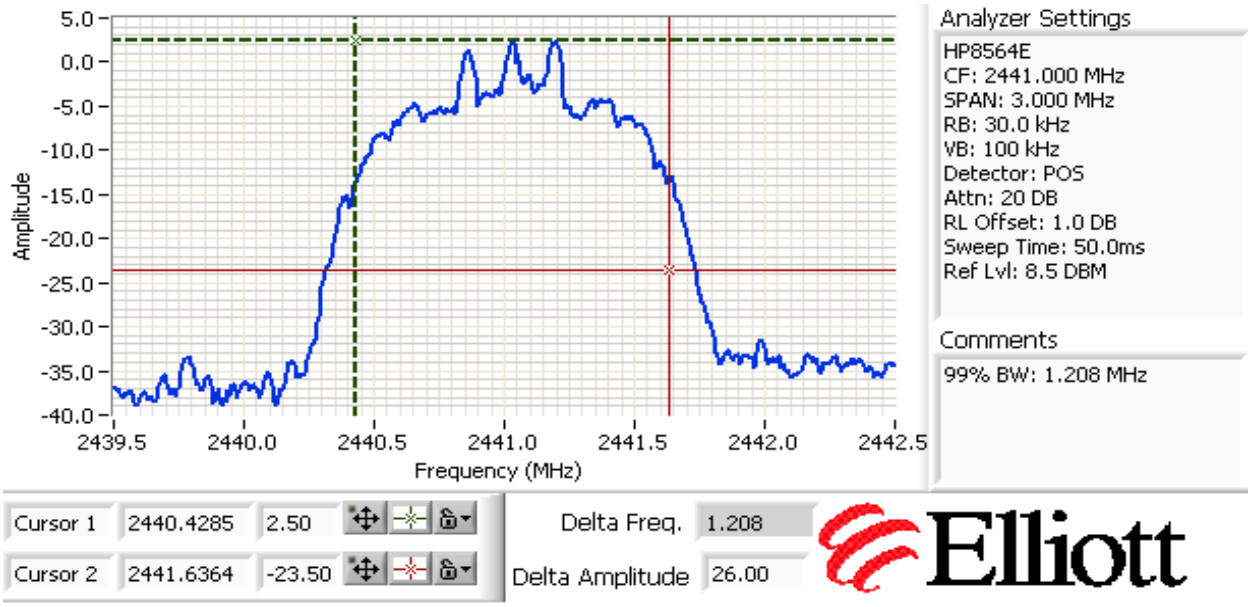
Test Engineer: Rafael Varelas

Mode	Channel	Frequency (MHz)	Resolution Bandwidth	20dB Bandwidth (kHz)	Resolution Bandwidth	99% Bandwidth (kHz)
Basic Rate	Low	2402	100kHz	1140	30kHz	899
	Mid	2441	100kHz	1140	30kHz	903
	High	2480	100kHz	1140	30kHz	903
EDR	Low	2402	100kHz	1425	30kHz	1208
	Mid	2441	100kHz	1415	30kHz	1208
	High	2480	100kHz	1410	30kHz	1203

Note 1:	20dB bandwidth measured using RB = 100kHz, VB = 100kHz (VB > RB)
Note 2:	99% bandwidth measured using RB = 30kHz, VB = 100kHz (VB >=3RB)

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A





Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

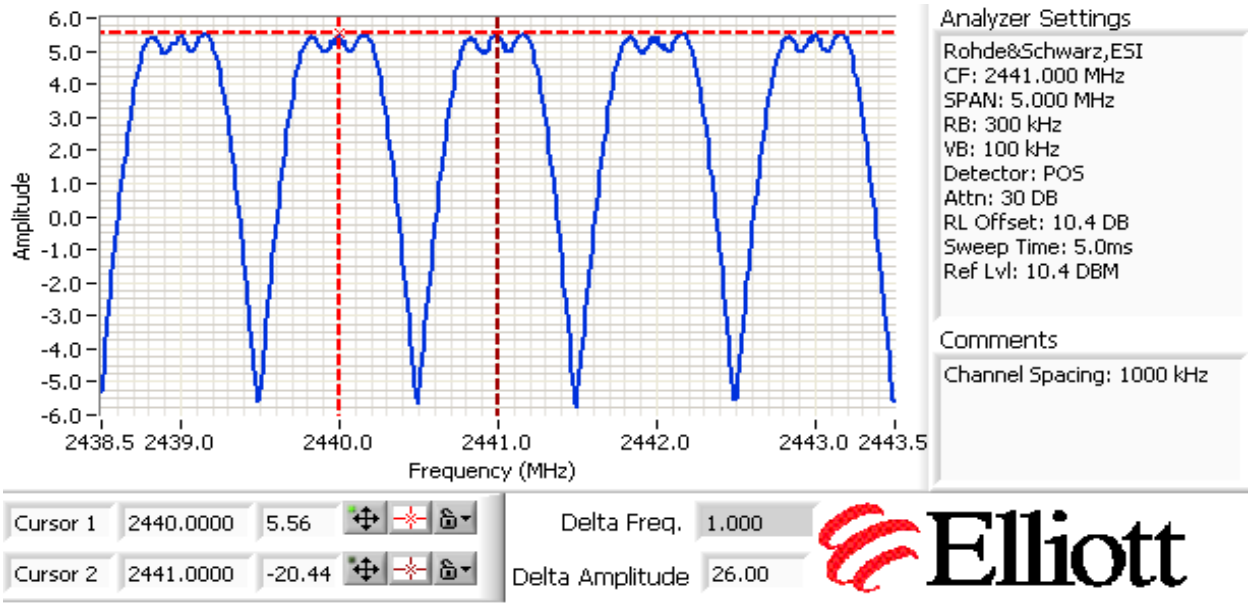
Channel Spacing

Channel Spacing: 1000.0 kHz

20dB Bandwidth: 1425 kHz

The channel spacing was measured in Basic rate mode with hopping enabled - see plot below showing channel spacing:

The channel spacing shall be greater than 2/3 Times the widest 20dB bandwidth as the ouput power is <0.125W.



Number of channels: 79 Max 20 Min (AFF enabled)

The number of channels was measured in Basic rate mode with hopping enabled with both the maximum (all) channels enabled and with the minimum number of channels enabled. The system shall employ a minimum of 15 hopping channels.

Run #3: Channel Occupancy and Number of Channels

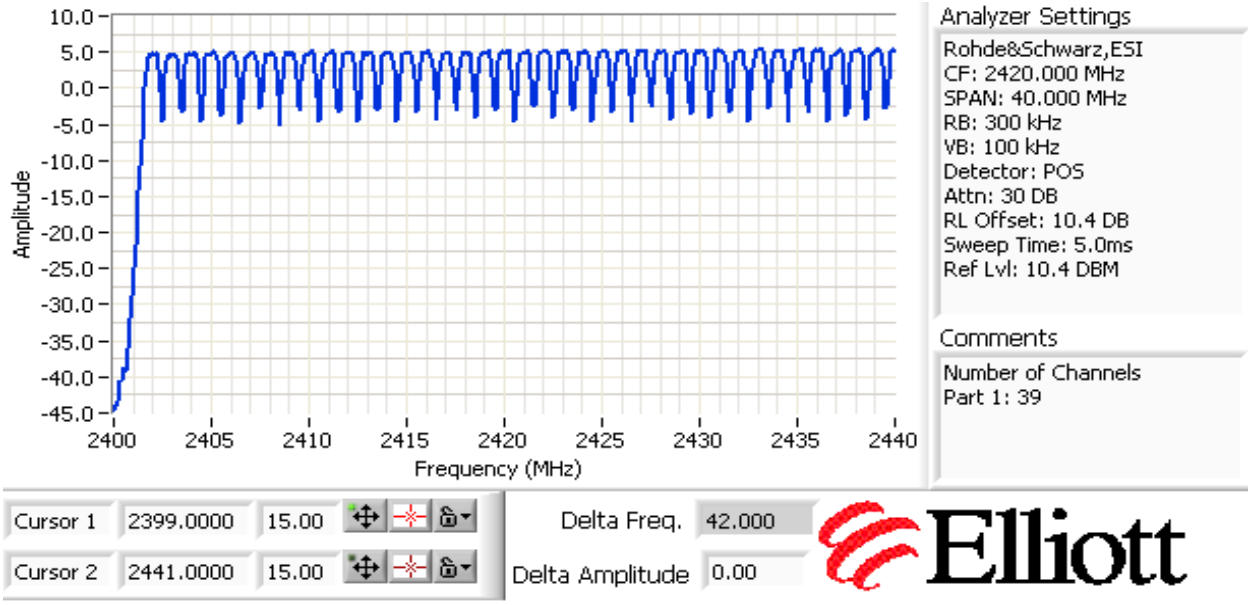
Requirement: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

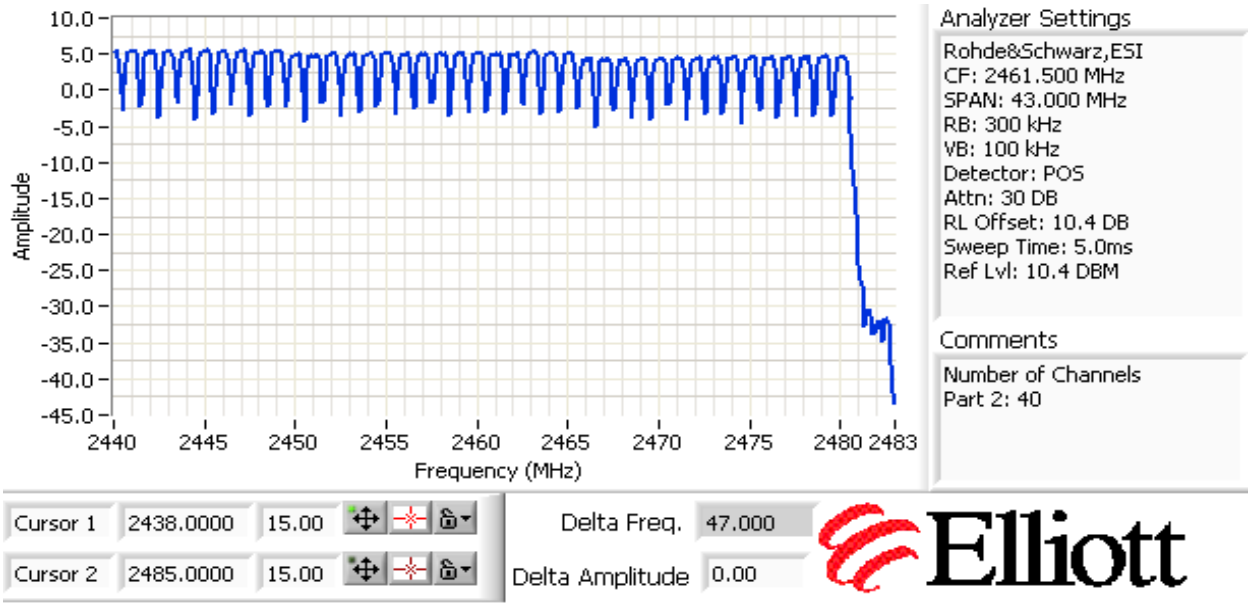
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. (Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.)

The device complies with the Bluetooth protocol and employs a minimum of 20 of the available 79 hopping channels when employing adaptove frequency hopping and all 79 channels when not. Channels are selected in a speudo random manner to ensure, on average, all channels are used equally.

The hopping rate is 1600 hops per second although any new channel may be used for a single hop slot, 3 hop slots or 5 hop slots. The dwell time per channel is, therefore either 0.625ms (single slot), 1.875ms (three slot) or 3.125ms (five slot). The average time of occupancy will not exceed 0.4s in any time interval of 0.4s mutliplied by the number of channels being used.

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A





Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

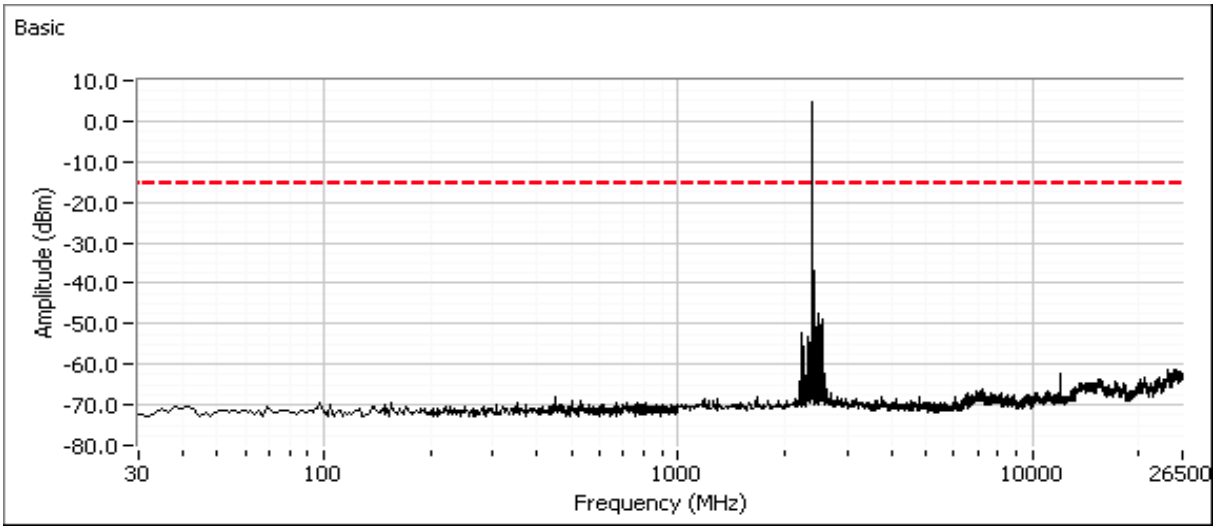
Run #4: Antenna Conducted Spurious Emissions, 30 - 26,500 MHz.

Date of Test: 10/3/2011 Test Location: FT Chamber #3

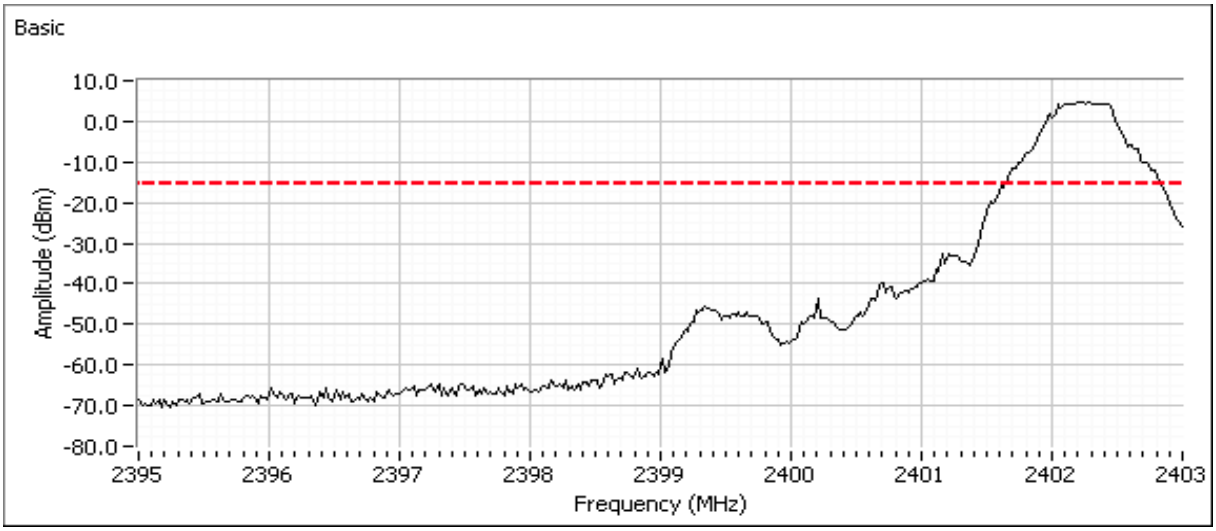
Test Engineer: M. Birgani

Refer to plots below. Scans made using RBW=VB=100 KHz with the limit line set at 20dB below the highest in-band signal level with the hopping feature disabled. Addiitonal plots with hopping enabled at the band edges.

Low channel -Basic Rate

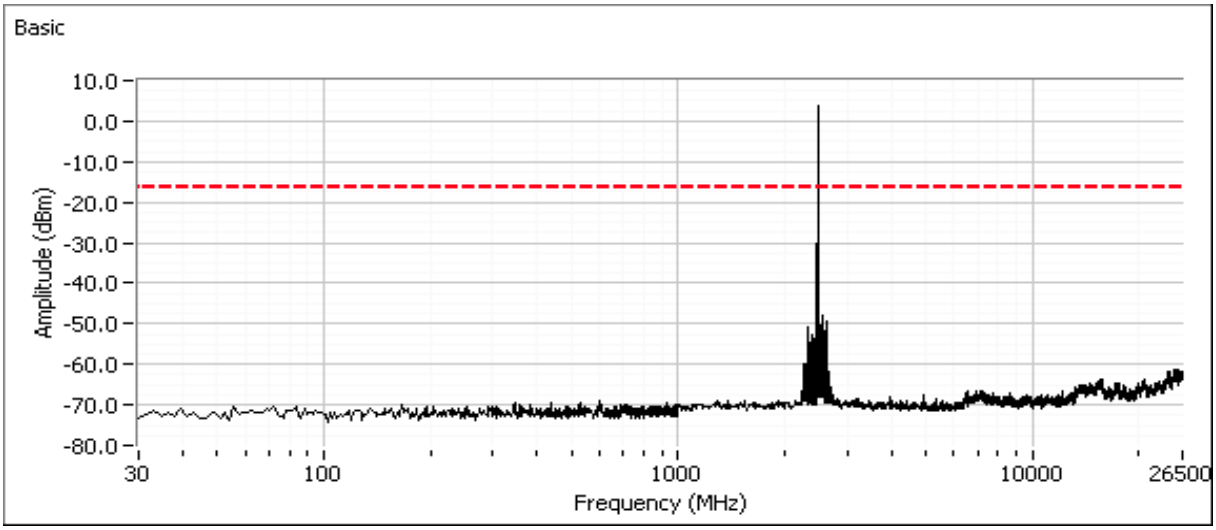


Plot showing -20dBc at the lower band edge

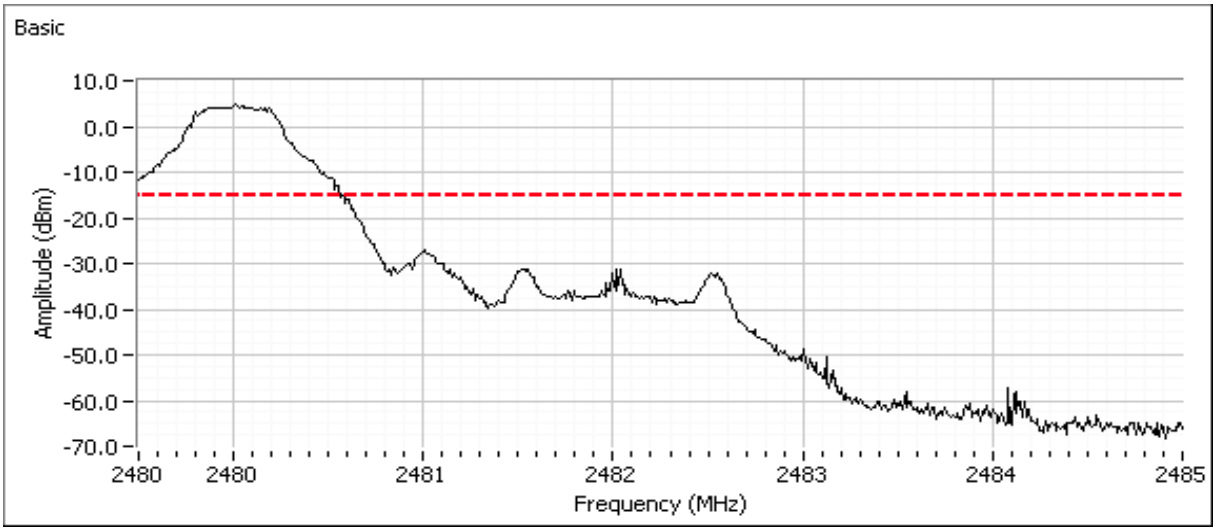


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

High channel - Basic Rate

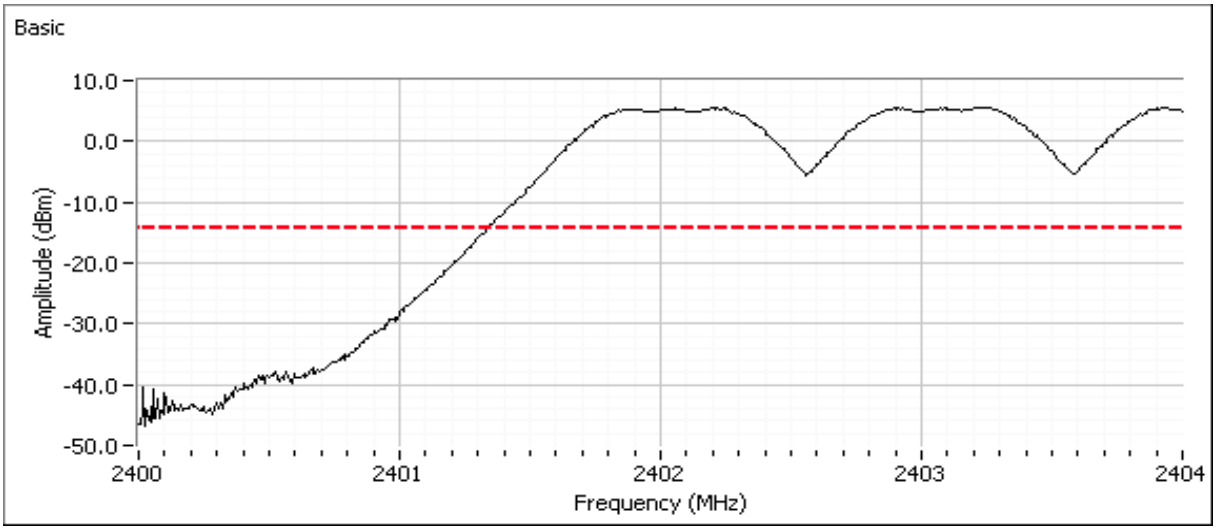


Plot showing -20dBc at the upper band edge

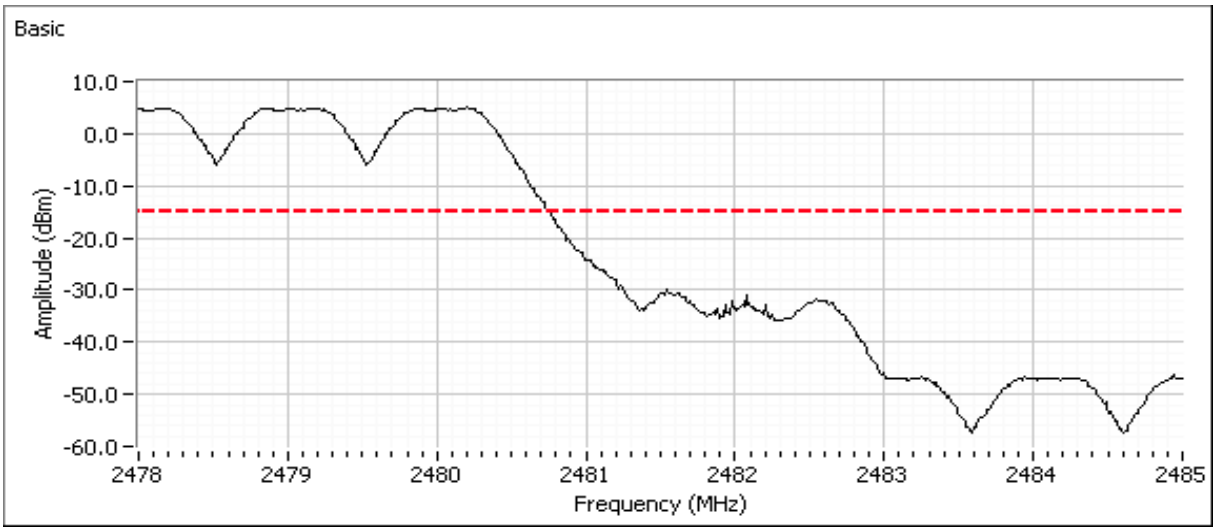


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

Low channel, hopping enabled - Basic Rate

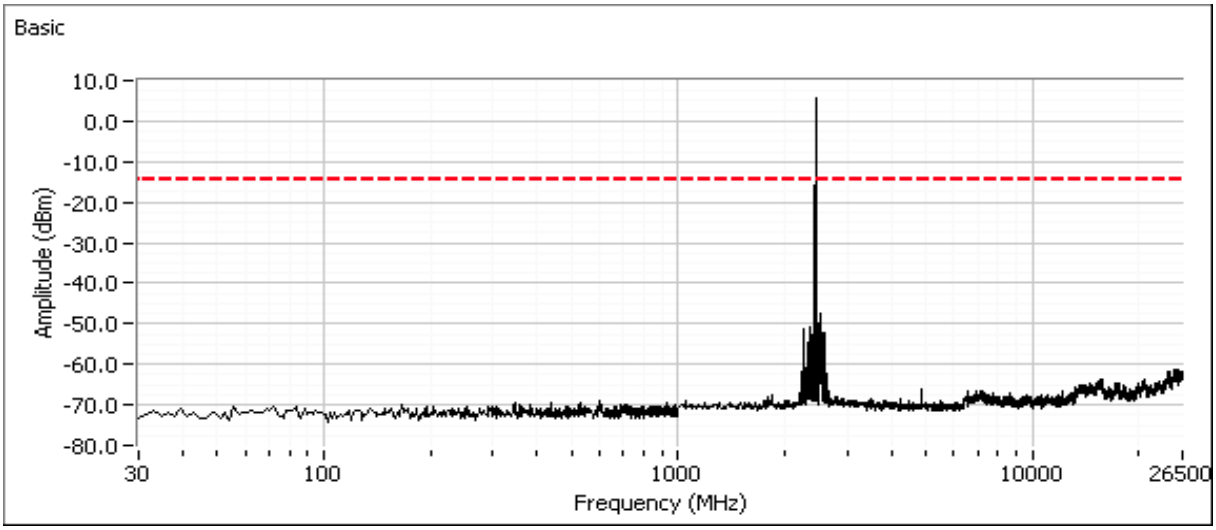


High channel, hopping enabled - Basic Rate

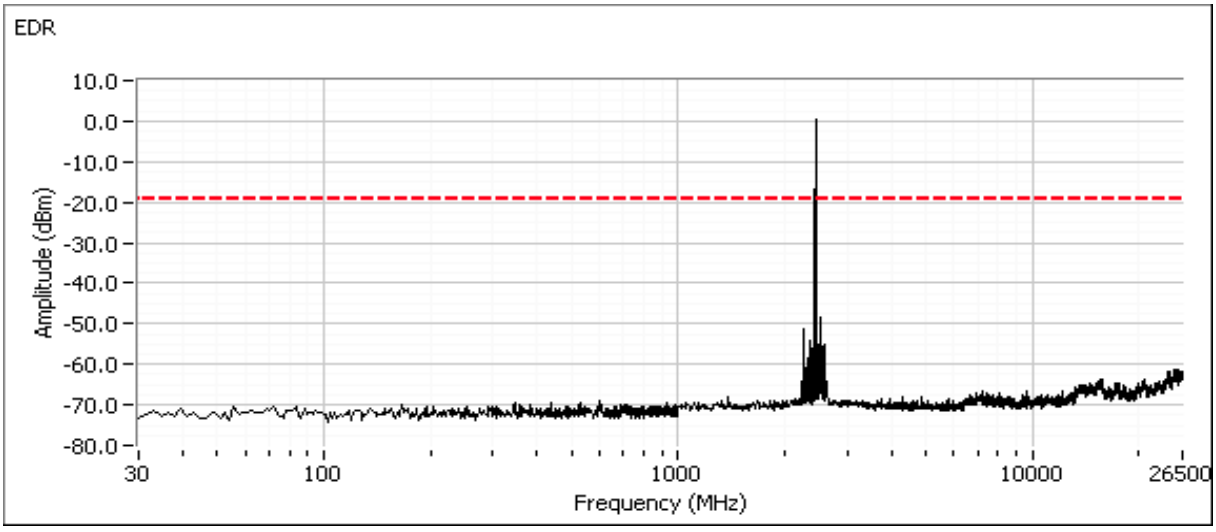


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

Center channel - Basic Rate

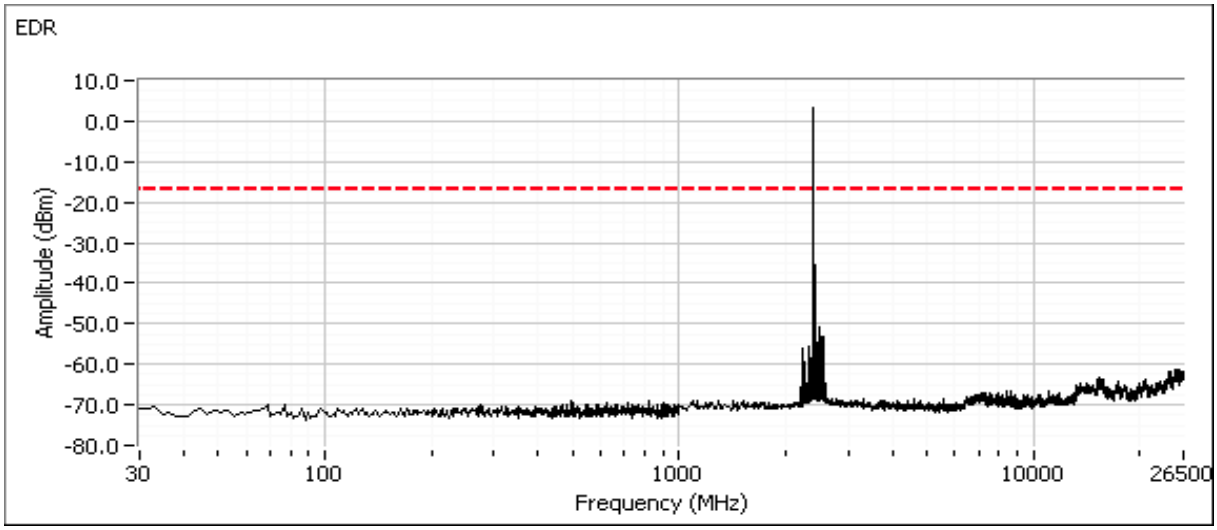


Center channel - EDR (3Mb/s)

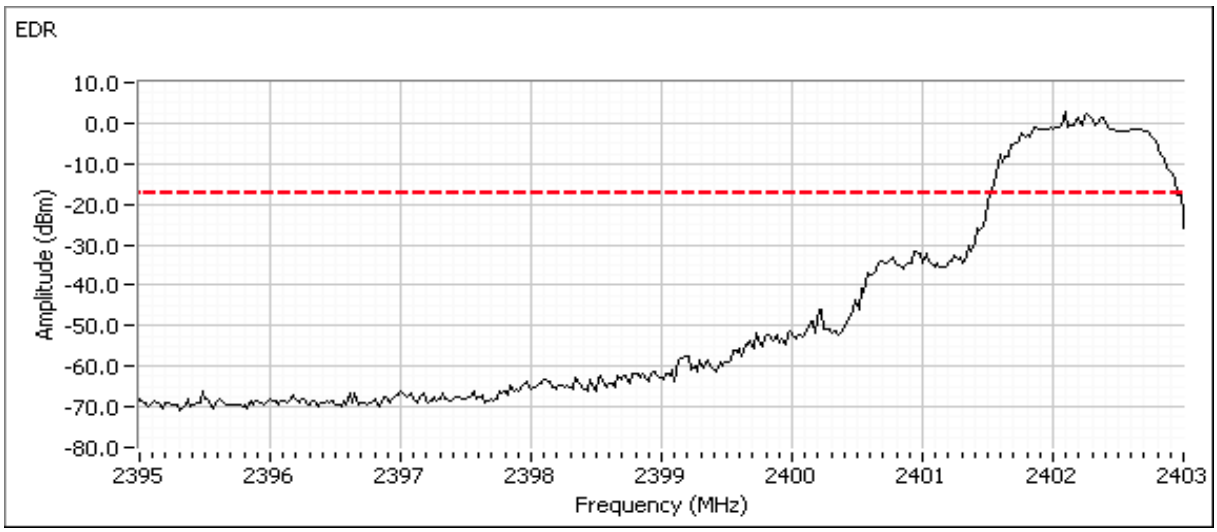


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

Low channel -EDR (3Mb/s)

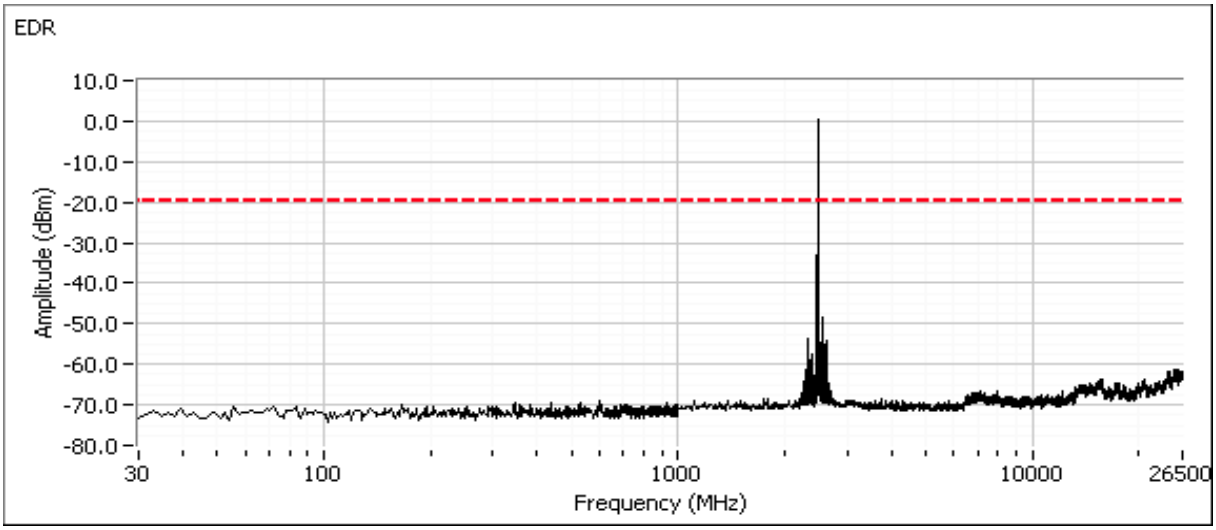


Plot showing -20dBc at the lower band edge

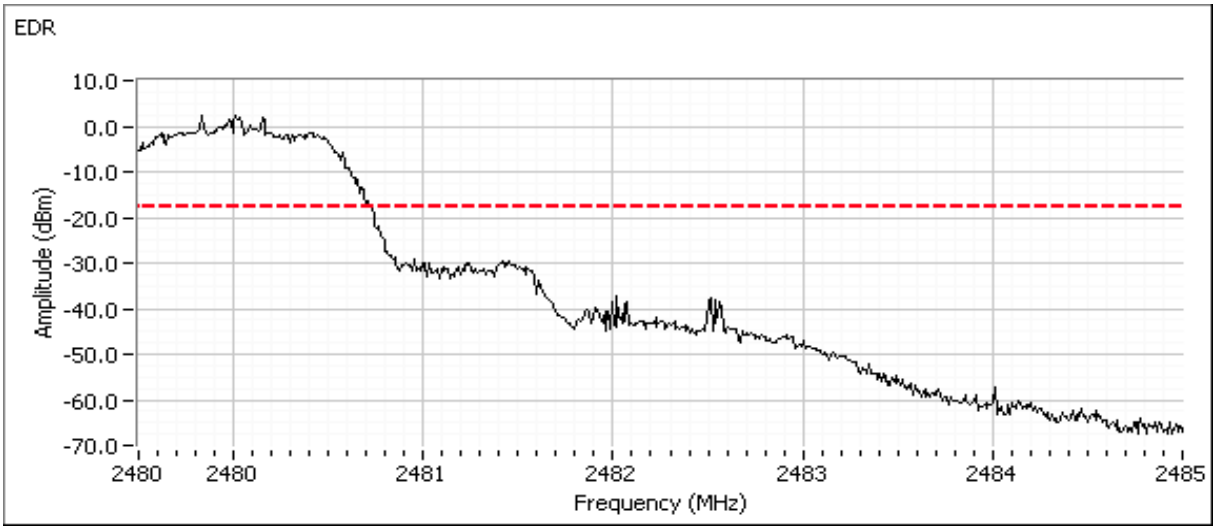


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

High channel - EDR (3Mb/s)

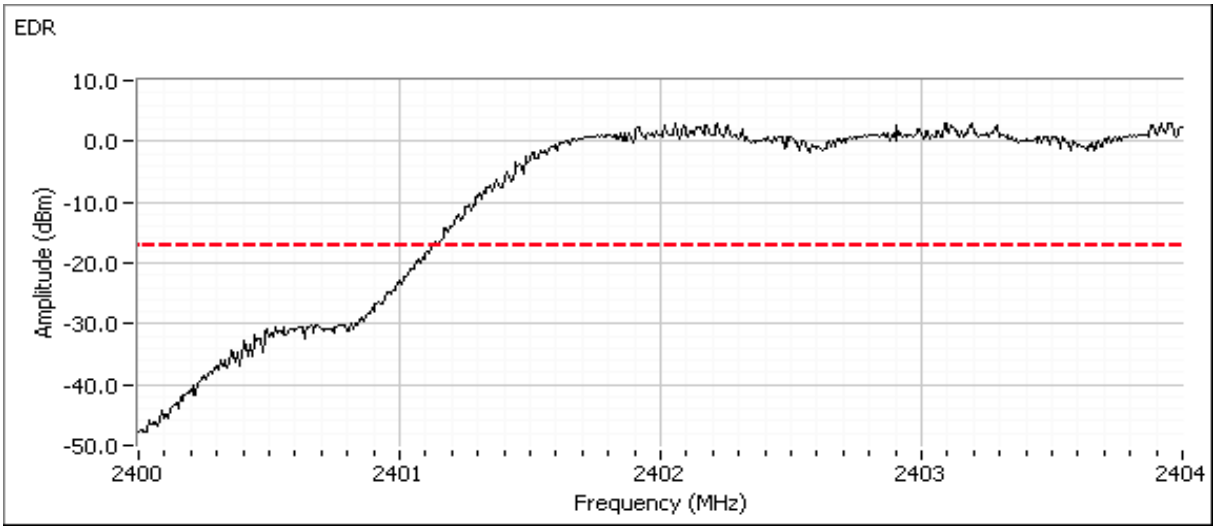


Plot showing -20dBc at the upper band edge

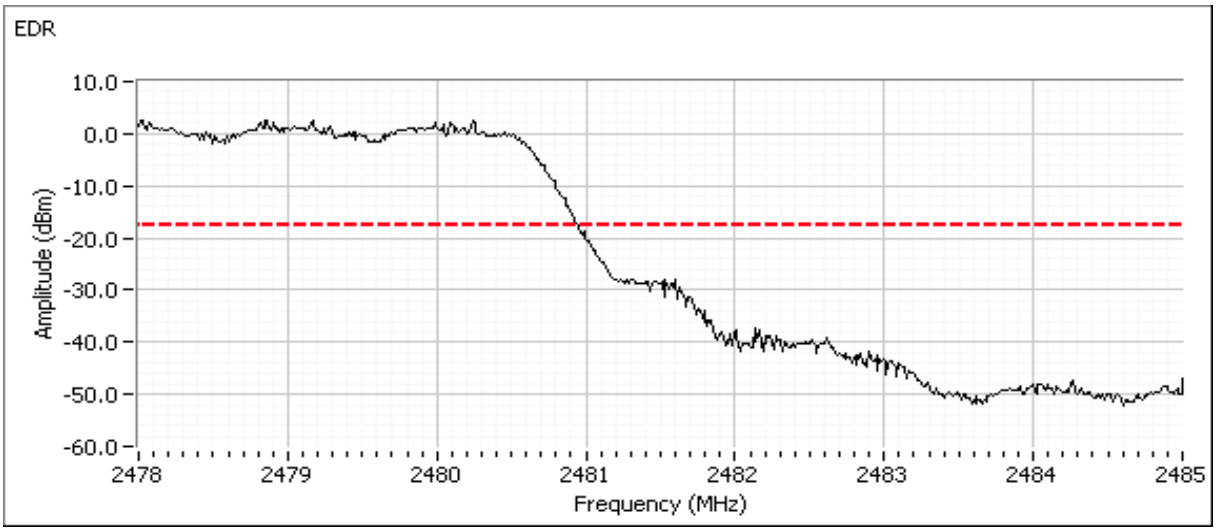


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	N/A

Low channel, hopping enabled - EDR (3Mb/s)



High channel, hopping enabled - EDR (3Mb/s)



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

RSS 210 and FCC 15.247 (FHSS) Radiated Spurious Emissions (Bluetooth FHSS)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

MAC Address: 00150082509B DRTU Tool Version 1.5.3.0322 Driver version 15.0.0.61

Target power for Bluetooth is max power without exceeding 7dBm for both integral and PIFA antennas

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a	Basic rate 1Mb/s	2402	8		Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	41.3dBµV/m @ 2362.1MHz (-12.7dB)
			8		Radiated Emissions 1 -40 GHz	FCC Part 15.209 / 15.247(c)	
1b		2441	8		Radiated Emissions 1 -40 GHz	FCC Part 15.209 / 15.247(c)	40.2dBµV/m @ 1594.1MHz (-13.8dB)
1c		2480	8		Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	51.9dBµV/m @ 2483.5MHz (-2.1dB)
			8		Radiated Emissions 1 -40 GHz	FCC Part 15.209 / 15.247(c)	
2a	EDR 3Mb/s	2402	8		Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	39.3dBµV/m @ 2362.5MHz (-14.7dB)
			8		Radiated Emissions 1 -40 GHz	FCC Part 15.209 / 15.247(c)	37.2dBµV/m @ 1594.1MHz (-16.8dB)
2b		2441	8		Radiated Emissions 1 -40 GHz	FCC Part 15.209 / 15.247(c)	40.8dBµV/m @ 1594.1MHz (-13.2dB)
2c		2480	8		Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	48.7dBµV/m @ 2483.5MHz (-5.3dB)
			8		Radiated Emissions 1 -40 GHz	FCC Part 15.209 / 15.247(c)	41.2dBµV/m @ 1594.1MHz (-12.8dB)

Ambient Conditions:

Temperature: 18 - 25 °C

Rel. Humidity: 30 - 45 %

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Note:	Scans made between 10 - 40GHz with the measurement antenna moved around the card and its antennas 10-20cm from the device indicated there were no signifcant emissions in this frequency range. 19.696GHz was visable at 10cm but not above the noise floor of the measurment system 1 meter away. This emission does not change with Tx frequency.

Run #1: Radiated Spurious Emissions, 1000 - 40,000 MHz. Operating Mode:Basic rate, 1Mb/s

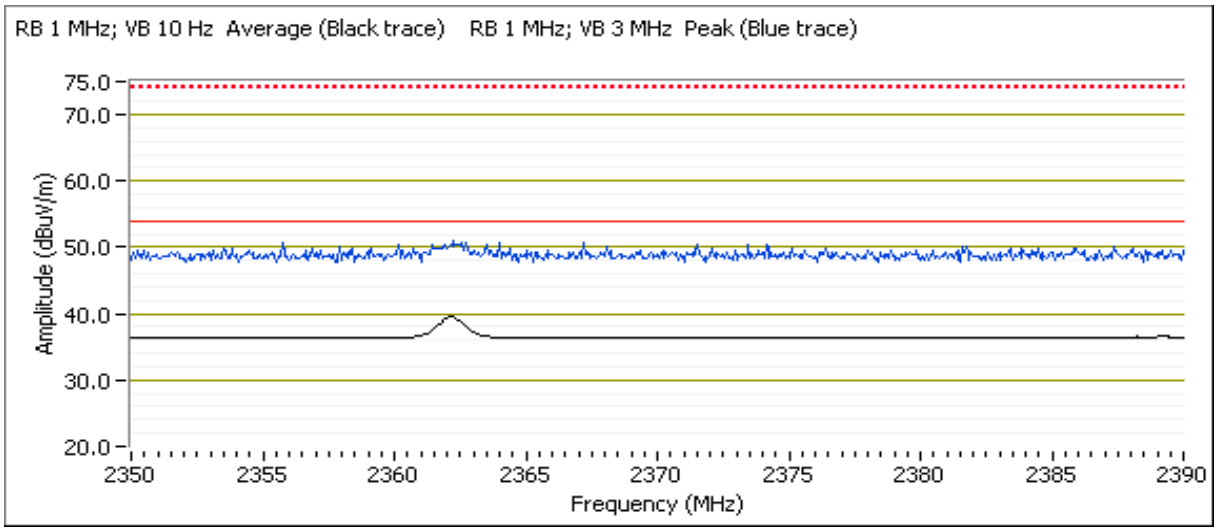
Date of Test: 10/3/2011 Test Location: FT Chamber #3

Test Engineer: M. Birgani

Run #1a: Low Channel @ 2402 MHz

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2362.070	41.3	H	54.0	-12.7	AVG	40	1.1	RB 1 MHz;VB 10 Hz;Pk
2362.130	40.6	V	54.0	-13.4	AVG	86	1.0	RB 1 MHz;VB 10 Hz;Pk
2361.930	50.4	H	74.0	-23.6	PK	40	1.1	RB 1 MHz;VB 3 MHz;Pk
2375.870	50.2	V	74.0	-23.8	PK	86	1.0	RB 1 MHz;VB 3 MHz;Pk



Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	

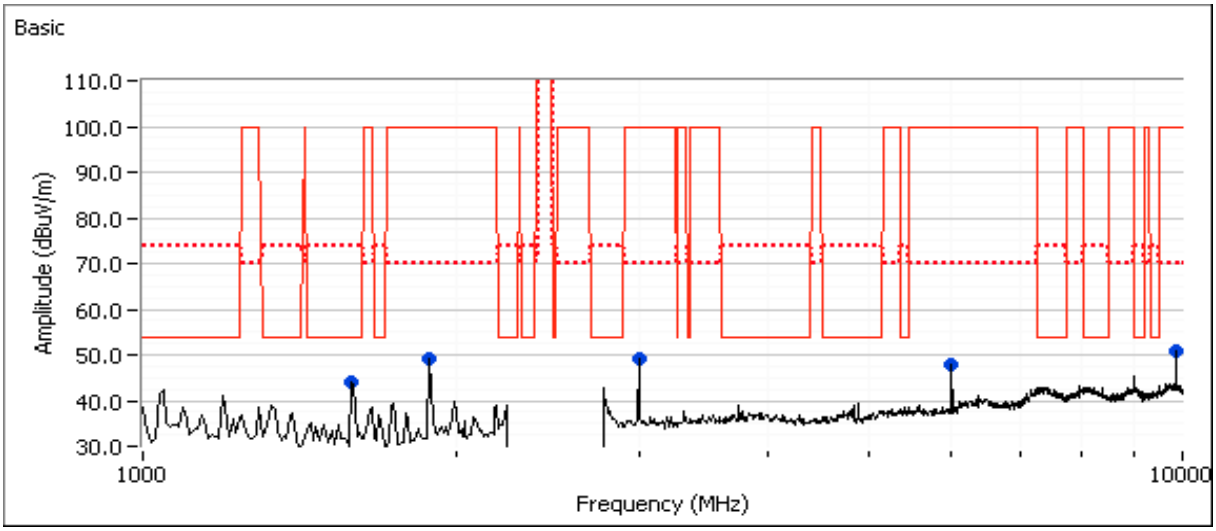
Note 1:	For emissions in restricted bands, the limit of 15.209 was used.
Note 2:	Emissions not in restricted bands are measured as antenna conducted and compared to the out of band power limit.

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #1b: Center Channel @ 2441 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2441.070	100.5	-	-	-	PK	86	1.0	Fundamental RB=VB 100 kHz;Pk
1594.090	40.2	V	54.0	-13.8	AVG	190	1.0	RB 1 MHz;VB 10 Hz;Pk
1593.920	52.1	V	74.0	-21.9	PK	190	1.0	RB 1 MHz;VB 3 MHz;Pk
9848.330	50.9	V	80.5	-29.6	PK	73	1.1	RB 1 MHz;VB 3 MHz;Pk
1889.170	49.2	V	80.5	-31.3	PK	340	1.7	RB 1 MHz;VB 3 MHz;Pk
2998.330	49.1	H	80.5	-31.4	PK	195	1.0	RB 1 MHz;VB 3 MHz;Pk
5995.830	48.0	V	80.5	-32.5	PK	159	1.1	RB 1 MHz;VB 3 MHz;Pk

Note 1:	For emissions in restricted bands, the limit of 15.209 was used.
Note 2:	Emissions not in restricted bands are measured as antenna conducted and compared to the out of band power limit.

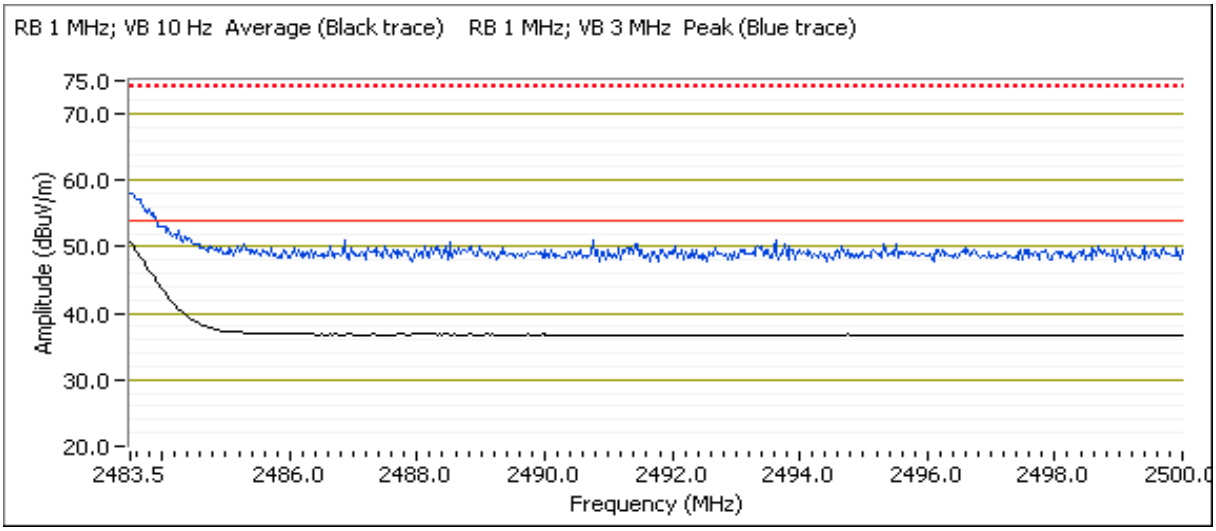


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #1c: High Channel @ 2480 MHz

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.500	51.9	H	54.0	-2.1	AVG	10	1.0	RB 1 MHz;VB 10 Hz;Pk
2483.500	47.5	V	54.0	-6.5	AVG	40	1.0	RB 1 MHz;VB 10 Hz;Pk
2483.530	57.7	H	74.0	-16.3	PK	10	1.0	RB 1 MHz;VB 3 MHz;Pk
2483.500	54.4	V	74.0	-19.6	PK	40	1.0	RB 1 MHz;VB 3 MHz;Pk



Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	

Note 1:	For emissions in restricted bands, the limit of 15.209 was used.
Note 2:	Emissions not in restricted bands are measured as antenna conducted and compared to the out of band power limit.

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #2: Radiated Spurious Emissions, 1000 - 40,000 MHz. Operating Mode: EDR, 3Mb/s

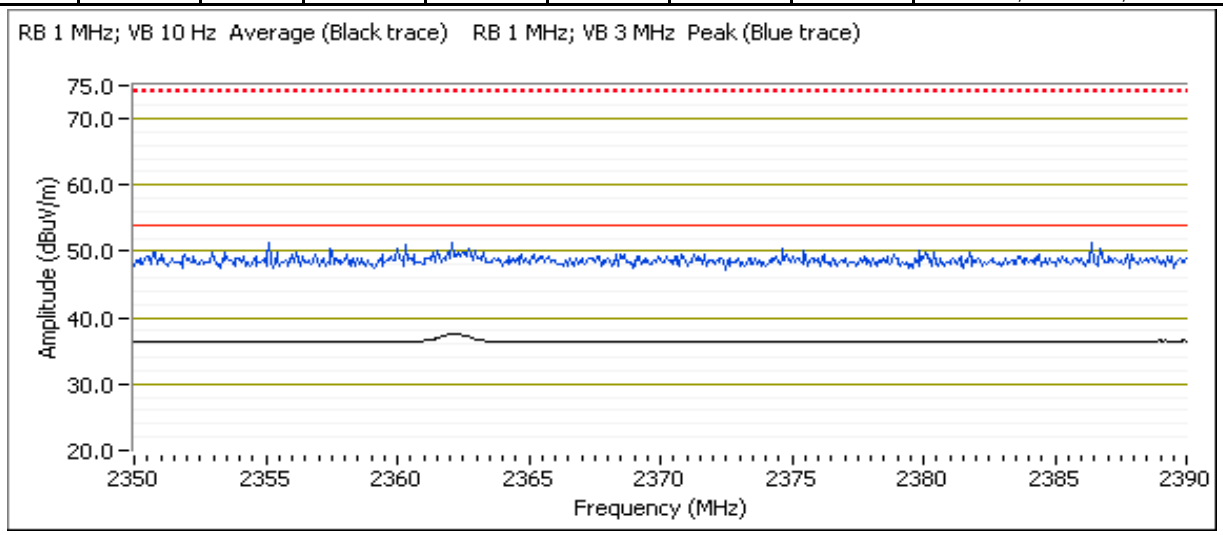
Date of Test: 10/3/2011 Test Location: FT Chamber #3

Test Engineer: M. Birgani

Run #2a: Low Channel @ 2402 MHz

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2362.530	39.3	H	54.0	-14.7	AVG	35	1.0	RB 1 MHz;VB 10 Hz;Pk
2362.270	38.6	V	54.0	-15.4	AVG	84	1.0	RB 1 MHz;VB 10 Hz;Pk
2374.270	49.8	H	74.0	-24.2	PK	35	1.0	RB 1 MHz;VB 3 MHz;Pk
2383.200	49.4	V	74.0	-24.6	PK	84	1.0	RB 1 MHz;VB 3 MHz;Pk

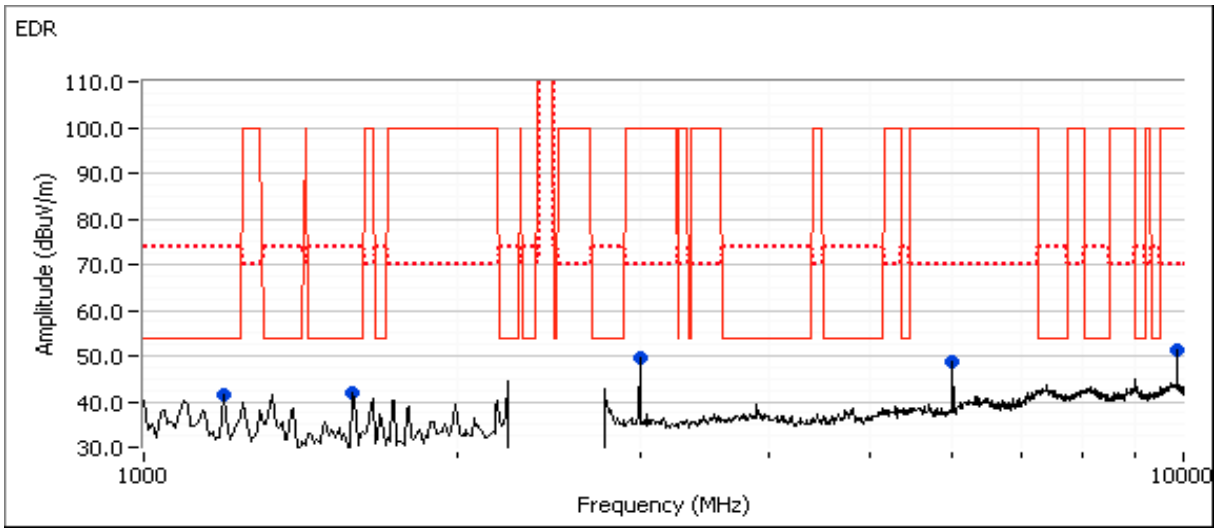


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2441.170	96.5	-	-	-	-	35	1.0	Fundamental RB=VB 100 kHz;Pk
1594.090	37.2	V	54.0	-16.8	AVG	195	1.3	RB 1 MHz;VB 10 Hz;Pk
1196.450	31.9	V	54.0	-22.1	AVG	196	1.3	RB 1 MHz;VB 10 Hz;Pk
1593.920	50.1	V	74.0	-23.9	PK	195	1.3	RB 1 MHz;VB 3 MHz;Pk
9848.330	51.1	V	76.5	-25.4	PK	81	1.1	RB 1 MHz;VB 3 MHz;Pk
2998.330	49.6	V	76.5	-26.9	PK	201	1.0	RB 1 MHz;VB 3 MHz;Pk
5995.830	48.8	V	76.5	-27.7	PK	208	1.0	RB 1 MHz;VB 3 MHz;Pk
1196.530	43.8	V	74.0	-30.2	PK	196	1.3	RB 1 MHz;VB 3 MHz;Pk

Note 1:	For emissions in restricted bands, the limit of 15.209 was used.
Note 2:	Emissions not in restricted bands are measured as antenna conducted and compared to the out of band power limit.

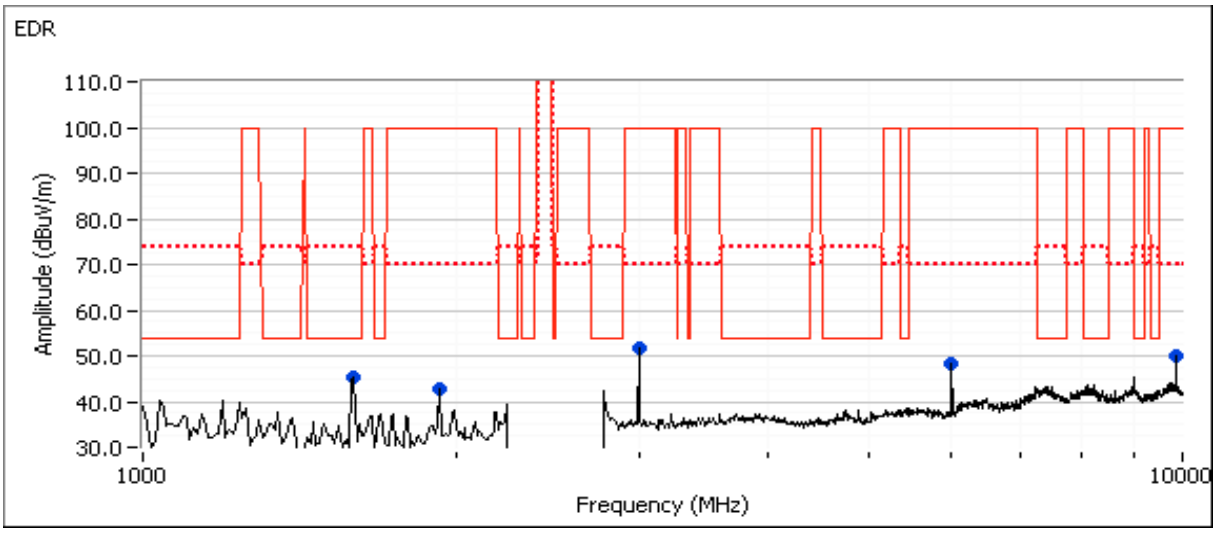


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #2b: Center Channel @ 2441 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2480.180	98.3	-	-	-	-	11	1.0	Fundamental RB=VB 100 kHz;Pk
1594.090	40.8	V	54.0	-13.2	AVG	195	1.2	RB 1 MHz;VB 10 Hz;Pk
1593.920	51.9	V	74.0	-22.1	PK	195	1.2	RB 1 MHz;VB 3 MHz;Pk
2998.330	51.7	H	78.3	-26.6	Peak	192	1.0	Peak reading with average limit
9848.330	50.1	V	78.3	-28.2	Peak	74	1.1	Peak reading with average limit
5995.830	48.5	V	78.3	-29.8	Peak	159	1.0	Peak reading with average limit
1925.830	42.8	H	78.3	-35.5	Peak	328	2.0	Peak reading with average limit

Note 1:	For emissions in restricted bands, the limit of 15.209 was used.
Note 2:	Emissions not in restricted bands are measured as antenna conducted and compared to the out of band power limit.

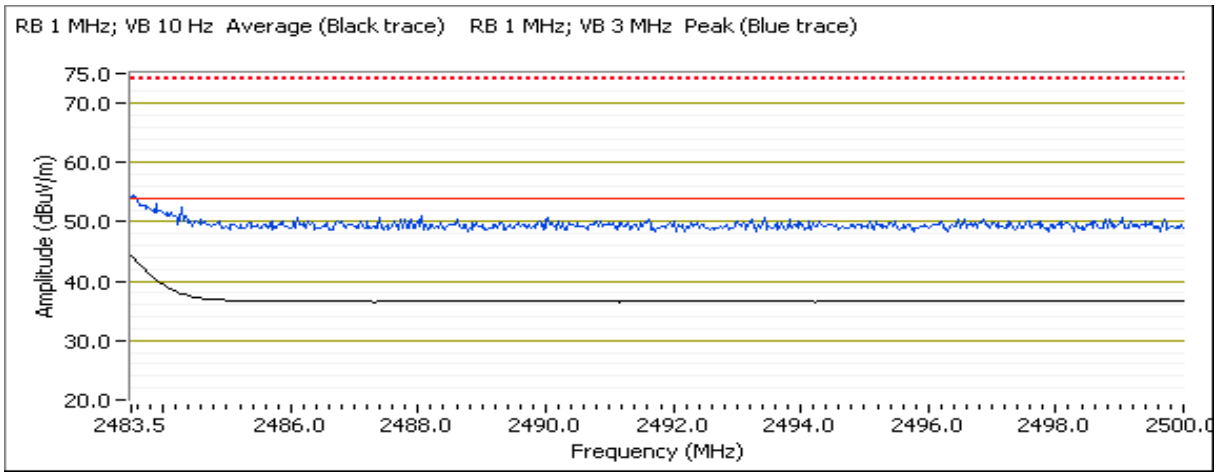


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #2c: High Channel @ 2480 MHz

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.500	48.7	H	54.0	-5.3	AVG	10	1.0	RB 1 MHz;VB 10 Hz;Pk
2483.500	44.8	V	54.0	-9.2	AVG	42	1.0	RB 1 MHz;VB 10 Hz;Pk
2483.500	56.7	H	74.0	-17.3	PK	10	1.0	RB 1 MHz;VB 3 MHz;Pk
2483.530	54.2	V	74.0	-19.8	PK	42	1.0	RB 1 MHz;VB 3 MHz;Pk

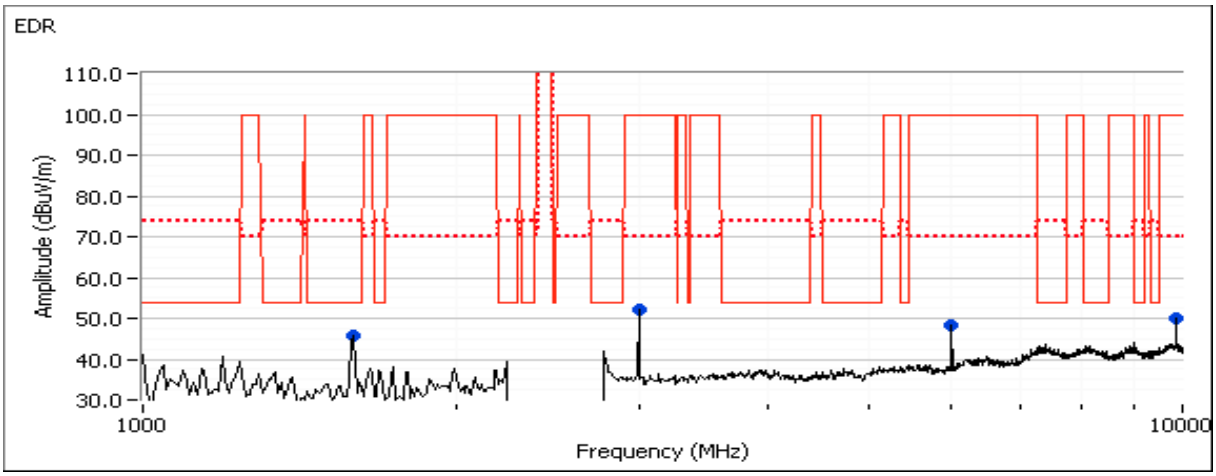


Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2480.180	97.9	-	-	-	-	10	1.0	Fundamental RB=VB 100 kHz;Pk
1594.090	41.2	V	54.0	-12.8	AVG	190	1.0	RB 1 MHz;VB 10 Hz;Pk
1593.920	52.1	V	74.0	-21.9	PK	190	1.0	RB 1 MHz;VB 3 MHz;Pk
2998.330	52.1	H	77.9	-25.8	PK	192	1.0	RB 1 MHz;VB 3 MHz;Pk
9848.330	50.2	V	77.9	-27.7	PK	77	1.1	RB 1 MHz;VB 3 MHz;Pk
5995.830	48.5	V	77.9	-29.4	PK	213	1.0	RB 1 MHz;VB 3 MHz;Pk

Note 1:	For emissions in restricted bands, the limit of 15.209 was used.
Note 2:	Emissions not in restricted bands are measured as antenna conducted and compared to the out of band power limit.



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

RSS 210 and FCC 15.247 Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 17-22 °C

Rel. Humidity: 40-50 %

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Summary of Results

MAC Address: 00150082509B DRTU Tool Version 1.5.3.0322 Driver version 15.0.0.61

For Wi-Fi, only Chain A is used for Tx. For Bluetooth only chain B is used for Tx. Both chains are used for Rx for Wi-Fi and Bluetooth

Note - the target and measured power are average powers (measured with average power sensor) and are used for reference purposes only. Power is set using " GAIN CONTROL" mode in the DRTU tool.

Use the Gain Control mode of adjusting power. Set power to within ±0.2dB of target (dial in closer to the target value within ± 0.2dB if possible and not just a passing value above the target).

MAC Address: DRTU Tool Version Driver version

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1	BT Basic 802.11b	2402MHz 2412MHz	7dBm 16.5dBm	4.8 16.7	Radiated Emissions, 1 - 10 GHz	FCC Part 15.209 / 15.247(c)	47.9dBµV/m @ 2489.3MHz (-6.1dB)
2	BT Basic 802.11b	2480MHz 2462MHz	7dBm 16.5dBm	4.6 16.7		FCC Part 15.209 / 15.247(c)	49.4dBµV/m @ 2320.0MHz (-4.6dB)
3	BT Basic 802.11g	2402MHz 2412MHz	7dBm 16.5dBm	4.8 16.7		FCC Part 15.209 / 15.247(c)	47.9dBµV/m @ 2486.3MHz (-6.1dB)
4	BT Basic 802.11g	2480MHz 2462MHz	7dBm 16.5dBm	4.6 16.6		FCC Part 15.209 / 15.247(c)	49.2dBµV/m @ 2488.1MHz (-4.8dB)
Wi-Fi mode for the following runs based on the worst case mode from runs 1 through 4							
5	BT Basic 802.11b	2402MHz 2437MHz	7dBm 16.5dBm	4.8 16.6	Radiated Emissions, 1 - 10 GHz	FCC Part 15.209 / 15.247(c)	47.9dBµV/m @ 2485.7MHz (-6.1dB)
6	BT Basic 802.11b	2440MHz 2412MHz	7dBm 16.5dBm	5.4 16.7		FCC Part 15.209 / 15.247(c)	48.0dBµV/m @ 2360.1MHz (-6.0dB)
7	BT Basic 802.11b	2440MHz 2462MHz	7dBm 16.5dBm	5.4 16.7		FCC Part 15.209 / 15.247(c)	48.2dBµV/m @ 2279.8MHz (-5.8dB)
8	BT Basic 802.11b	2480MHz 2437MHz	7dBm 16.5dBm	4.6 16.6		FCC Part 15.209 / 15.247(c)	48.5dBµV/m @ 2320.0MHz (-5.5dB)
Wi-Fi mode and channel and Bluetooth channel for the following run based on the worst case mode from runs 1 through 8							
9	BT EDR 802.1b	2480MHz 2462MHz	7dBm 16.5dBm	1.1 16.7	Radiated Emissions, 1 - 10 GHz	FCC Part 15.209 / 15.247(c)	46.8dBµV/m @ 2320.0MHz (-7.2dB)

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #1: Radiated Spurious Emissions, 1-10GHz. Operating Mode: 802.11b @ 2412, BT Basic @ 2402 MHz

Date of Test: 10/4/2011 Test Location: FT Chamber #3

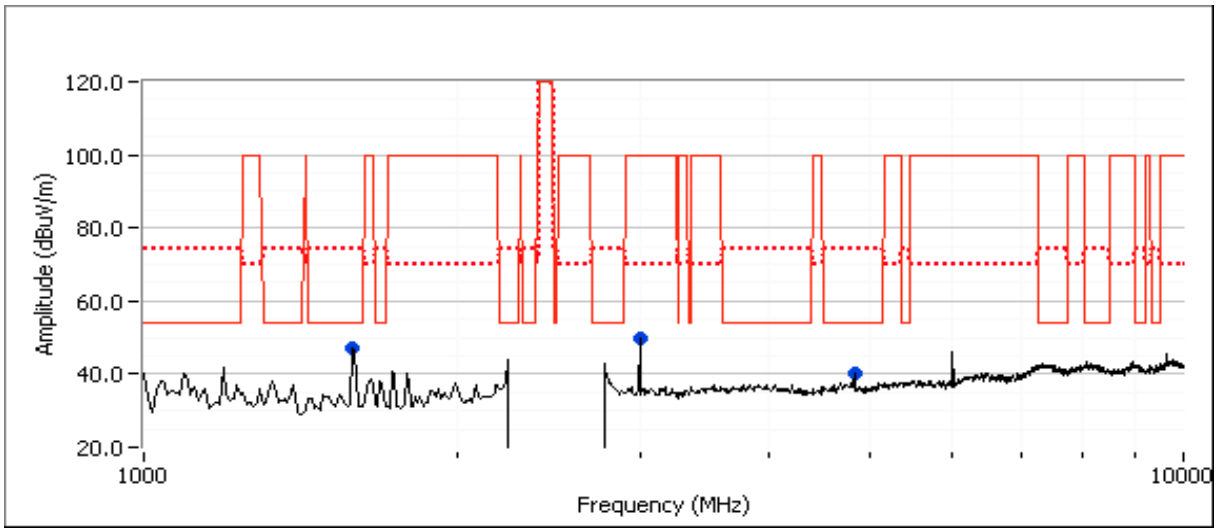
Test Engineer: Rafael Varelas

Preliminary Spurious Emissions excluding allocated band (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1594.630	47.0	V	54.0	-7.0	Peak	195	1.3	
3000.160	49.7	V	70.0	-20.3	Peak	195	1.3	
4824.150	40.0	V	54.0	-14.0	Peak	354	1.9	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1594.230	38.9	V	54.0	-15.1	AVG	196	1.0	RB 1 MHz;VB 10 Hz;Pk
1593.870	51.2	V	74.0	-22.8	PK	196	1.0	RB 1 MHz;VB 3 MHz;Pk
4823.930	33.4	V	54.0	-20.6	AVG	307	1.0	RB 1 MHz;VB 10 Hz;Pk
4821.520	44.1	V	74.0	-29.9	PK	307	1.0	RB 1 MHz;VB 3 MHz;Pk



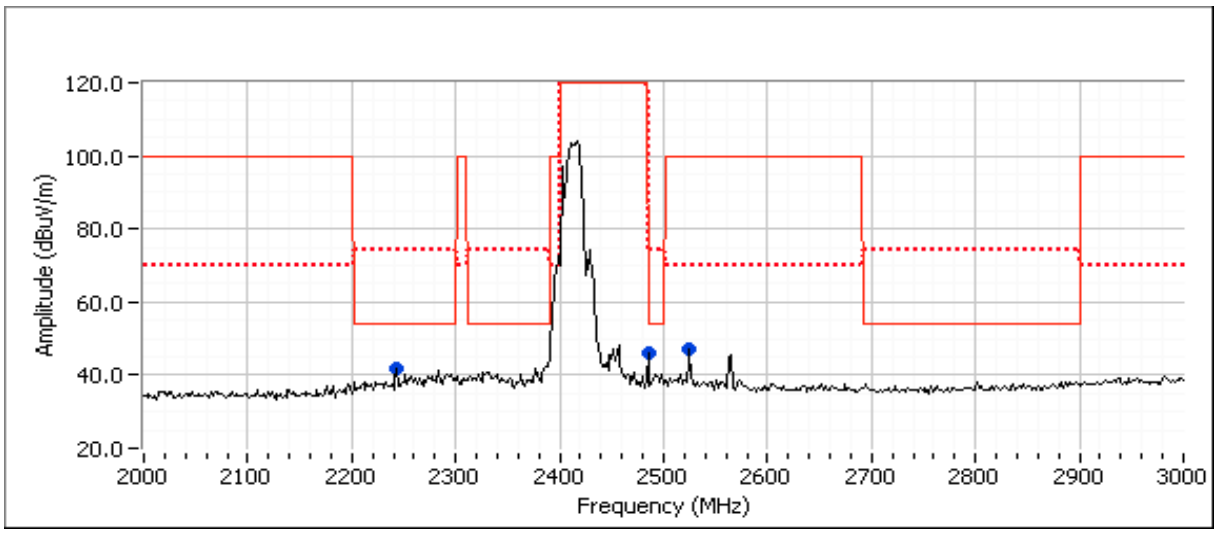
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary Spurious Emissions at 20cm from 2-3 GHz (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2485.000	46.3	V	54.0	-7.7	Peak	181	1.0	
2525.000	47.0	V	70.0	-23.0	Peak	181	1.0	
2243.330	41.9	V	54.0	-12.1	Peak	181	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2489.330	47.9	V	54.0	-6.1	AVG	189	1.0	RB 1 MHz;VB 10 Hz;Pk
2485.530	59.0	V	74.0	-15.0	PK	189	1.0	RB 1 MHz;VB 3 MHz;Pk
2241.980	47.4	V	54.0	-6.6	AVG	95	1.0	RB 1 MHz;VB 10 Hz;Pk
2240.960	58.1	V	74.0	-15.9	PK	95	1.0	RB 1 MHz;VB 3 MHz;Pk



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #2: Radiated Spurious Emissions, 1-10GHz. Operating Mode: 802.11b @ 2462, BT Basic @ 2480 MHz

Date of Test: 10/4/2011 Test Location: FT Chamber #3

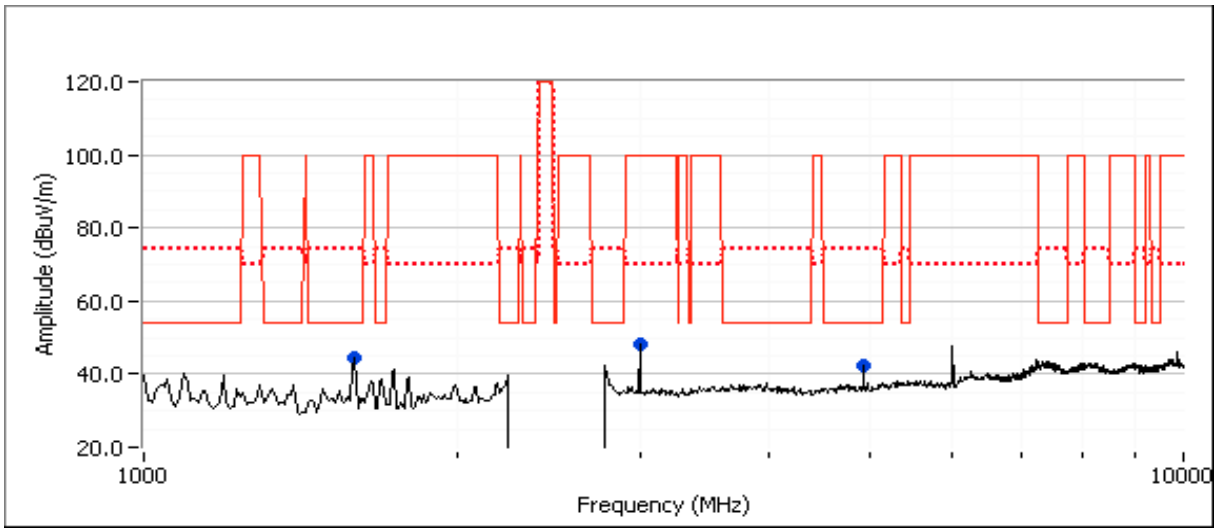
Test Engineer: Rafael Varelas

Preliminary Spurious Emissions excluding allocated band (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1592.900	44.3	V	54.0	-9.7	Peak	148	1.0	
3000.070	48.4	H	70.0	-21.6	Peak	192	1.3	
4923.970	42.3	V	54.0	-11.7	Peak	154	1.6	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4924.040	41.2	V	54.0	-12.8	AVG	144	1.0	RB 1 MHz;VB 10 Hz;Pk
4923.980	47.0	V	74.0	-27.0	PK	144	1.0	RB 1 MHz;VB 3 MHz;Pk
1594.080	37.9	V	54.0	-16.1	AVG	155	1.0	RB 1 MHz;VB 10 Hz;Pk
1594.040	51.0	V	74.0	-23.0	PK	155	1.0	RB 1 MHz;VB 3 MHz;Pk



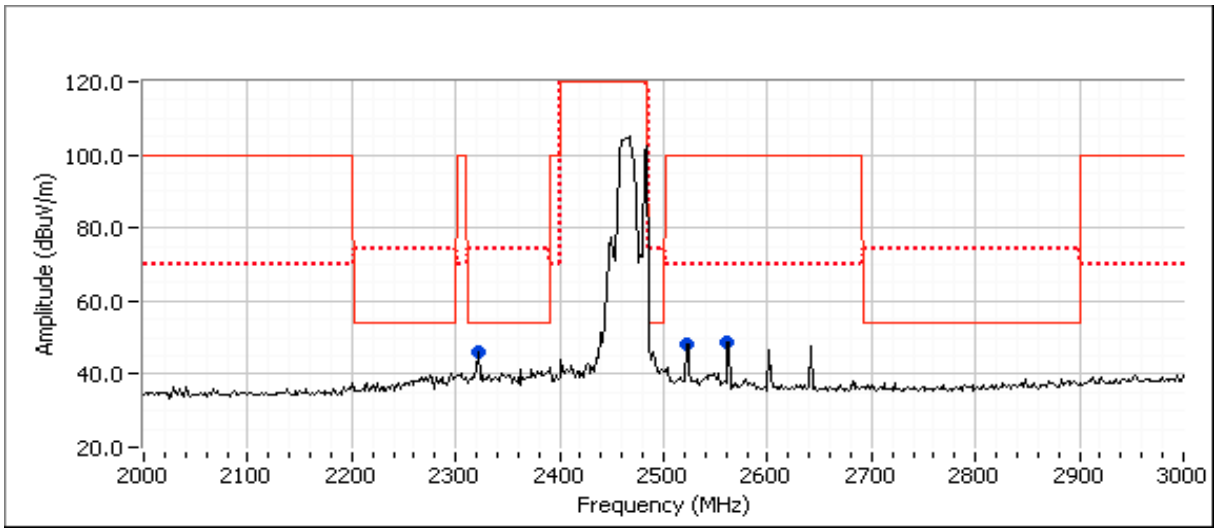
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary Spurious Emissions at 20cm from 2-3 GHz (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2321.670	46.0	V	54.0	-8.0	Peak	180	1.0	
2521.670	48.3	V	70.0	-21.7	Peak	180	1.0	
2561.670	48.8	V	70.0	-21.2	Peak	180	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2320.000	49.4	H	54.0	-4.6	AVG	110	1.4	RB 1 MHz;VB 10 Hz;Pk
2319.670	58.5	H	74.0	-15.5	PK	110	1.4	RB 1 MHz;VB 3 MHz;Pk
2320.040	48.1	V	54.0	-5.9	AVG	98	1.0	RB 1 MHz;VB 10 Hz;Pk
2320.270	58.1	V	74.0	-15.9	PK	98	1.0	RB 1 MHz;VB 3 MHz;Pk



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #3: Radiated Spurious Emissions, 1-10GHz. Operating Mode: 802.11g @ 2412, BT Basic @ 2402 MHz

Date of Test: 10/4/2011 Test Location: FT Chamber #3

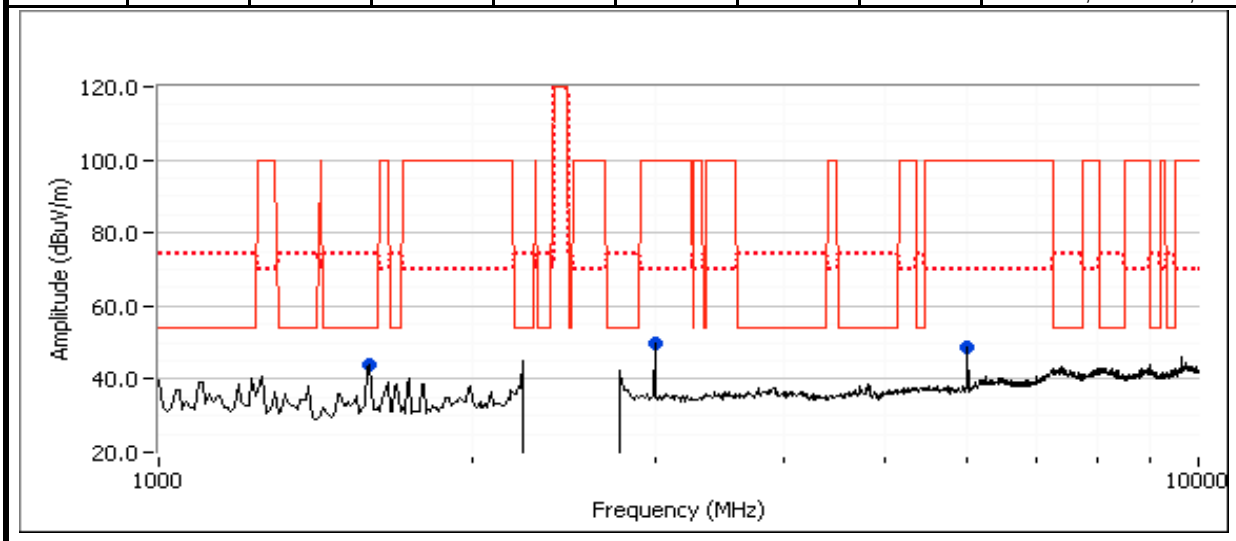
Test Engineer: Rafael Varelas

Preliminary Spurious Emissions excluding allocated band (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1600.130	44.2	V	54.0	-9.8	Peak	198	1.3	
3000.160	49.7	V	70.0	-20.3	Peak	198	1.3	
6000.960	48.8	V	70.0	-21.2	Peak	161	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1598.800	40.1	V	54.0	-13.9	AVG	199	1.0	RB 1 MHz;VB 10 Hz;Pk
1600.020	53.1	V	74.0	-20.9	PK	199	1.0	RB 1 MHz;VB 3 MHz;Pk



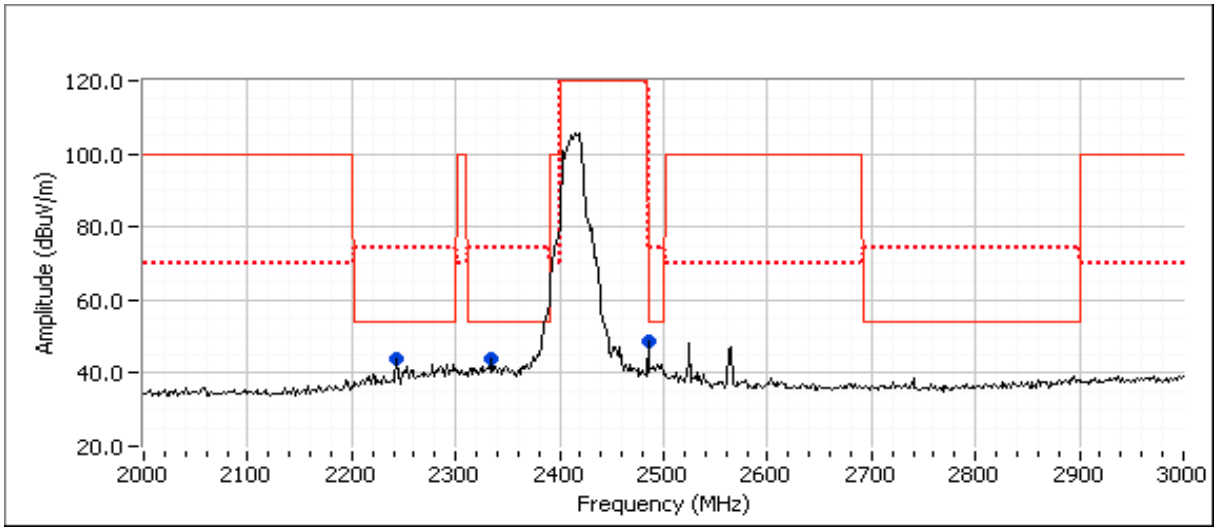
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary Spurious Emissions at 20cm from 2-3 GHz (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2485.000	48.7	V	54.0	-5.3	Peak	181	1.0	
2335.000	43.9	V	54.0	-10.1	Peak	181	1.0	
2243.330	43.7	V	54.0	-10.3	Peak	181	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2486.290	47.9	H	54.0	-6.1	AVG	9	1.2	RB 1 MHz;VB 10 Hz;Pk
2485.480	59.2	H	74.0	-14.8	PK	9	1.2	RB 1 MHz;VB 3 MHz;Pk
2486.230	47.8	V	54.0	-6.2	AVG	76	1.8	RB 1 MHz;VB 10 Hz;Pk
2486.140	59.9	V	74.0	-14.1	PK	76	1.8	RB 1 MHz;VB 3 MHz;Pk
2333.250	46.6	V	54.0	-7.4	AVG	314	1.0	RB 1 MHz;VB 10 Hz;Pk
2334.870	57.5	V	74.0	-16.5	PK	314	1.0	RB 1 MHz;VB 3 MHz;Pk
2241.910	47.4	V	54.0	-6.6	AVG	95	1.0	RB 1 MHz;VB 10 Hz;Pk
2241.760	58.4	V	74.0	-15.6	PK	95	1.0	RB 1 MHz;VB 3 MHz;Pk



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #4: Radiated Spurious Emissions, 1-10GHz. Operating Mode: 802.11g @ 2462, BT Basic @ 2480 MHz

Date of Test: 10/4/2011 Test Location: FT Chamber #3

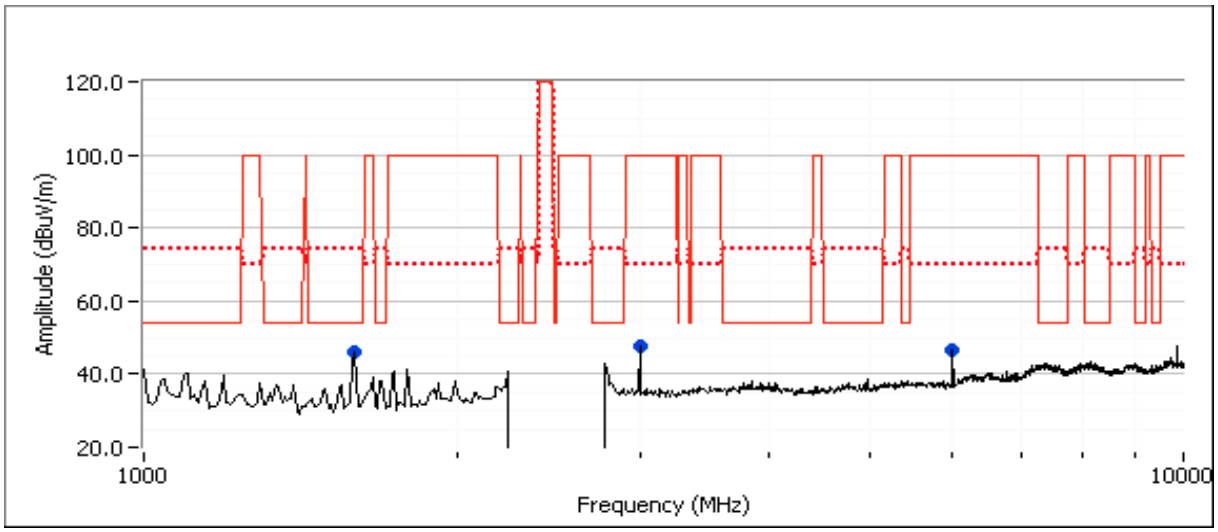
Test Engineer: Rafael Varelas

Preliminary Spurious Emissions excluding allocated band (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1595.740	45.8	V	54.0	-8.2	Peak	191	1.3	
3000.160	47.7	V	70.0	-22.3	Peak	198	1.0	
6001.050	46.8	V	70.0	-23.2	Peak	177	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1594.790	40.6	V	54.0	-13.4	AVG	197	1.0	RB 1 MHz;VB 10 Hz;Pk
1594.710	53.8	V	74.0	-20.2	PK	197	1.0	RB 1 MHz;VB 3 MHz;Pk



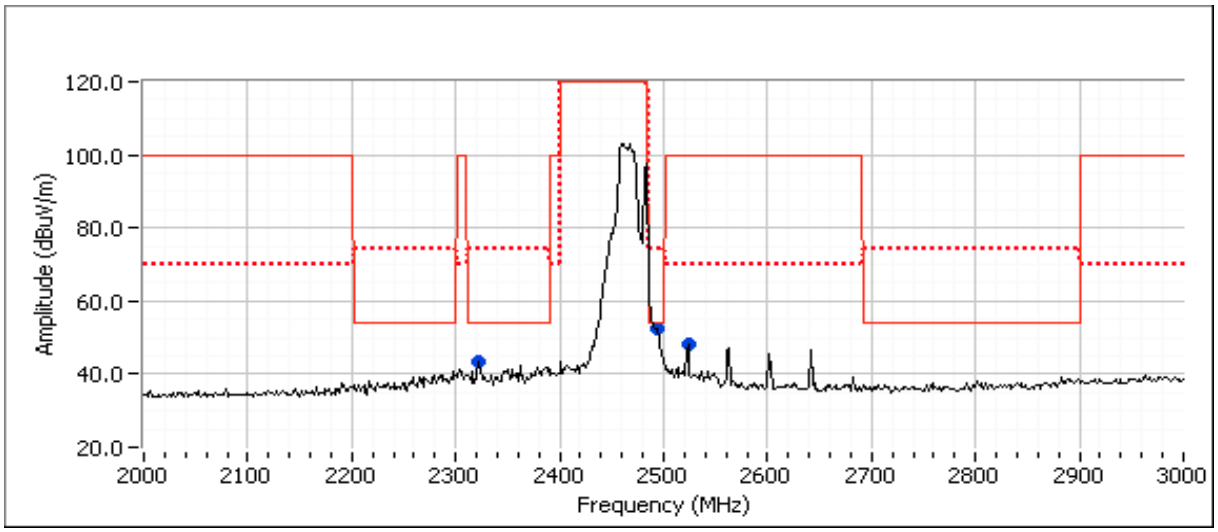
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary Spurious Emissions at 20cm from 2-3 GHz (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2493.330	52.6	V	54.0	-1.4	Peak	180	1.0	
2523.330	48.0	V	70.0	-22.0	Peak	180	1.0	
2321.670	43.3	V	54.0	-10.7	Peak	180	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2488.050	49.2	H	54.0	-4.8	AVG	353	1.0	RB 1 MHz;VB 10 Hz;Pk
2488.080	64.5	H	74.0	-9.5	PK	353	1.0	RB 1 MHz;VB 3 MHz;Pk
2488.000	49.1	V	54.0	-4.9	AVG	184	1.1	RB 1 MHz;VB 10 Hz;Pk
2488.300	63.0	V	74.0	-11.0	PK	184	1.1	RB 1 MHz;VB 3 MHz;Pk
2319.970	47.3	V	54.0	-6.7	AVG	191	1.0	RB 1 MHz;VB 10 Hz;Pk
2320.170	57.8	V	74.0	-16.2	PK	191	1.0	RB 1 MHz;VB 3 MHz;Pk



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #5: Radiated Spurious Emissions, 1-10GHz. Operating Mode: 802.11b @ 2437, BT Basic @ 2402 MHz

Date of Test: 10/4/2011 Test Location: FT Chamber #3

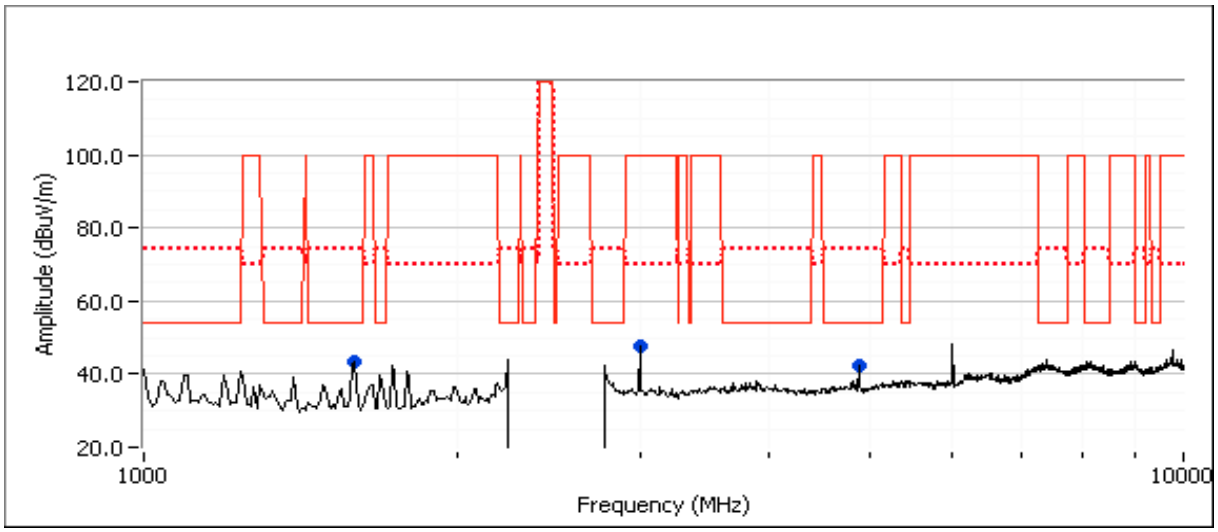
Test Engineer: Rafael Varelas

Preliminary Spurious Emissions excluding allocated band (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1592.720	43.5	V	54.0	-10.5	Peak	139	1.0	
3000.250	47.4	H	70.0	-22.6	Peak	123	1.9	
4874.100	42.5	V	54.0	-11.5	Peak	124	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1597.830	39.4	V	54.0	-14.6	AVG	148	1.0	RB 1 MHz;VB 10 Hz;Pk
1593.820	52.5	V	74.0	-21.5	PK	148	1.0	RB 1 MHz;VB 3 MHz;Pk
4874.000	41.9	V	54.0	-12.1	AVG	122	1.0	RB 1 MHz;VB 10 Hz;Pk
4873.840	47.7	V	74.0	-26.3	PK	122	1.0	RB 1 MHz;VB 3 MHz;Pk



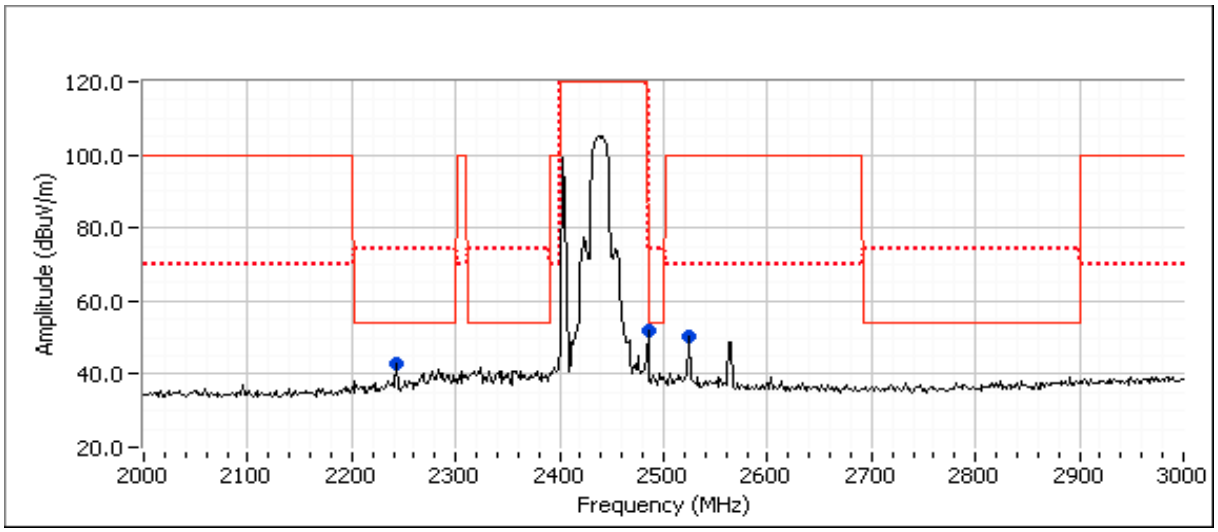
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary Spurious Emissions at 20cm from 2-3 GHz (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2243.330	43.1	V	54.0	-10.9	Peak	179	1.0	
2485.000	51.8	V	54.0	-2.2	Peak	179	1.0	
2525.000	50.5	V	70.0	-19.5	Peak	179	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2485.670	47.9	V	54.0	-6.1	AVG	199	1.7	RB 1 MHz;VB 10 Hz;Pk
2488.500	59.8	V	74.0	-14.2	PK	199	1.7	RB 1 MHz;VB 3 MHz;Pk
2483.580	47.6	H	54.0	-6.4	AVG	88	1.2	RB 1 MHz;VB 10 Hz;Pk
2485.570	58.7	H	74.0	-15.3	PK	88	1.2	RB 1 MHz;VB 3 MHz;Pk
2242.110	47.7	V	54.0	-6.3	AVG	90	1.0	RB 1 MHz;VB 10 Hz;Pk
2246.530	58.9	V	74.0	-15.1	PK	90	1.0	RB 1 MHz;VB 3 MHz;Pk



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #6: Radiated Spurious Emissions, 1-10GHz. Operating Mode: 802.11b @ 2412, BT Basic @ 2440 MHz

Date of Test: 10/4/2011 Test Location: FT Chamber #3

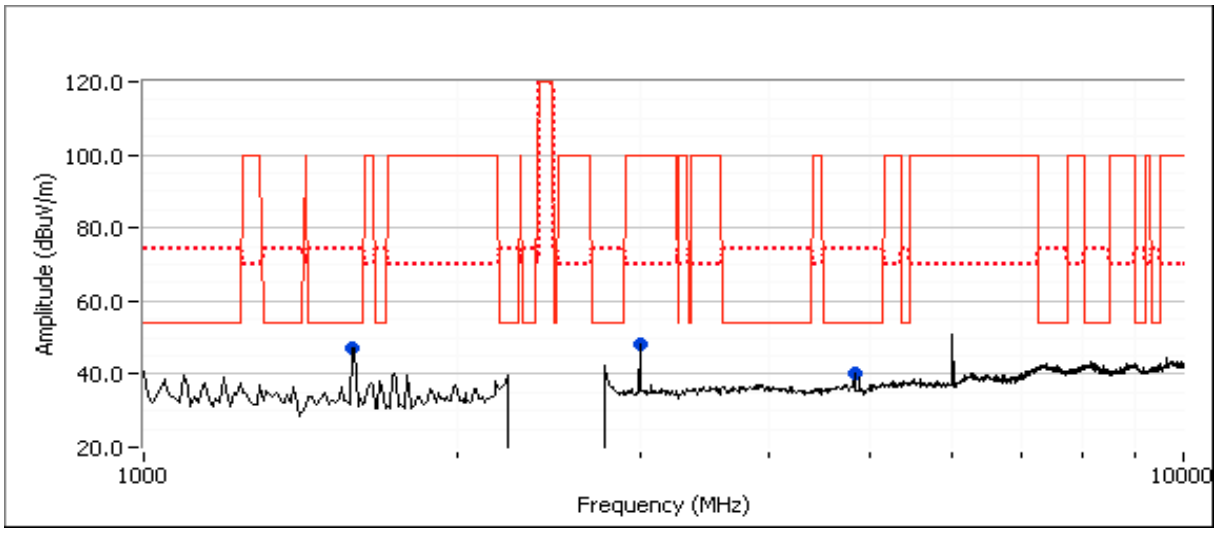
Test Engineer: Rafael Varelas

Preliminary Spurious Emissions excluding allocated band (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1593.990	47.1	V	54.0	-6.9	Peak	209	1.3	
3000.160	48.2	H	70.0	-21.8	Peak	191	1.3	
4824.060	40.1	V	54.0	-13.9	Peak	204	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1595.310	41.0	V	54.0	-13.0	AVG	204	1.0	RB 1 MHz;VB 10 Hz;Pk
1594.270	52.5	V	74.0	-21.5	PK	204	1.0	RB 1 MHz;VB 3 MHz;Pk
4823.950	38.7	V	54.0	-15.3	AVG	230	1.0	RB 1 MHz;VB 10 Hz;Pk
4824.120	46.7	V	74.0	-27.3	PK	230	1.0	RB 1 MHz;VB 3 MHz;Pk



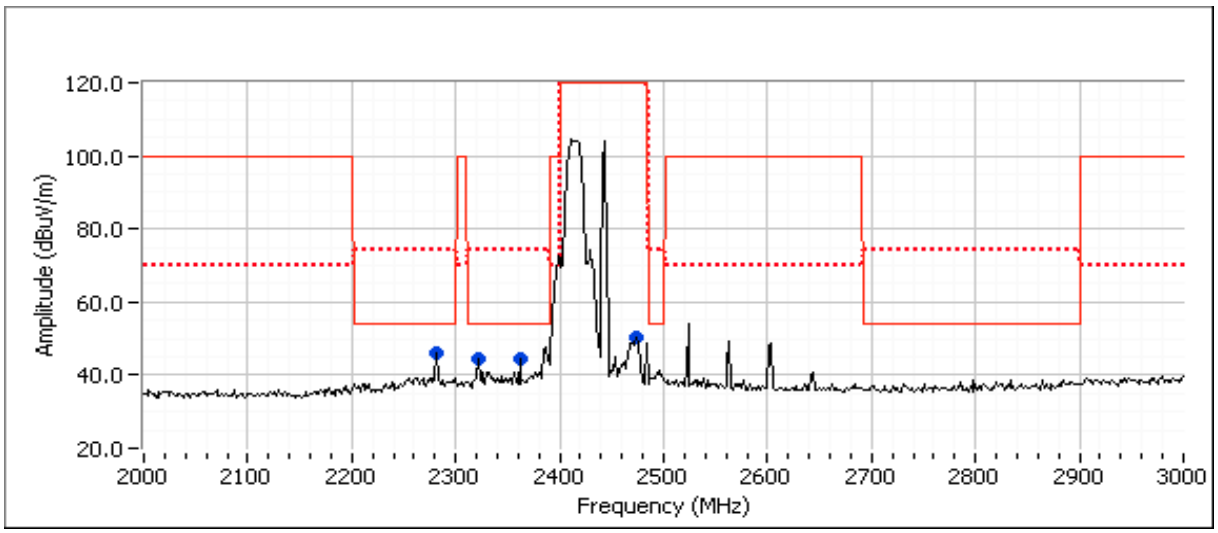
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary Spurious Emissions at 20cm from 2-3 GHz (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2281.670	46.1	V	54.0	-7.9	Peak	179	1.0	
2321.670	44.5	V	54.0	-9.5	Peak	179	1.0	
2361.670	44.3	V	54.0	-9.7	Peak	179	1.0	
2473.330	50.3	V	120.0	-69.7	Peak	179	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2360.050	48.0	V	54.0	-6.0	AVG	100	1.0	RB 1 MHz;VB 10 Hz;Pk
2359.540	58.7	V	74.0	-15.3	PK	100	1.0	RB 1 MHz;VB 3 MHz;Pk
2280.020	47.8	V	54.0	-6.2	AVG	92	1.0	RB 1 MHz;VB 10 Hz;Pk
2279.940	58.0	V	74.0	-16.0	PK	92	1.0	RB 1 MHz;VB 3 MHz;Pk
2320.050	47.1	V	54.0	-6.9	AVG	95	1.0	RB 1 MHz;VB 10 Hz;Pk
2324.650	57.5	V	74.0	-16.5	PK	95	1.0	RB 1 MHz;VB 3 MHz;Pk
2360.070	47.3	H	54.0	-6.7	AVG	253	1.0	RB 1 MHz;VB 10 Hz;Pk
2363.700	58.9	H	74.0	-15.1	PK	253	1.0	RB 1 MHz;VB 3 MHz;Pk



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #7: Radiated Spurious Emissions, 1-10GHz. Operating Mode: 802.11b @ 2462, BT Basic @ 2440 MHz

Date of Test: 10/4/2011 Test Location: FT Chamber #3

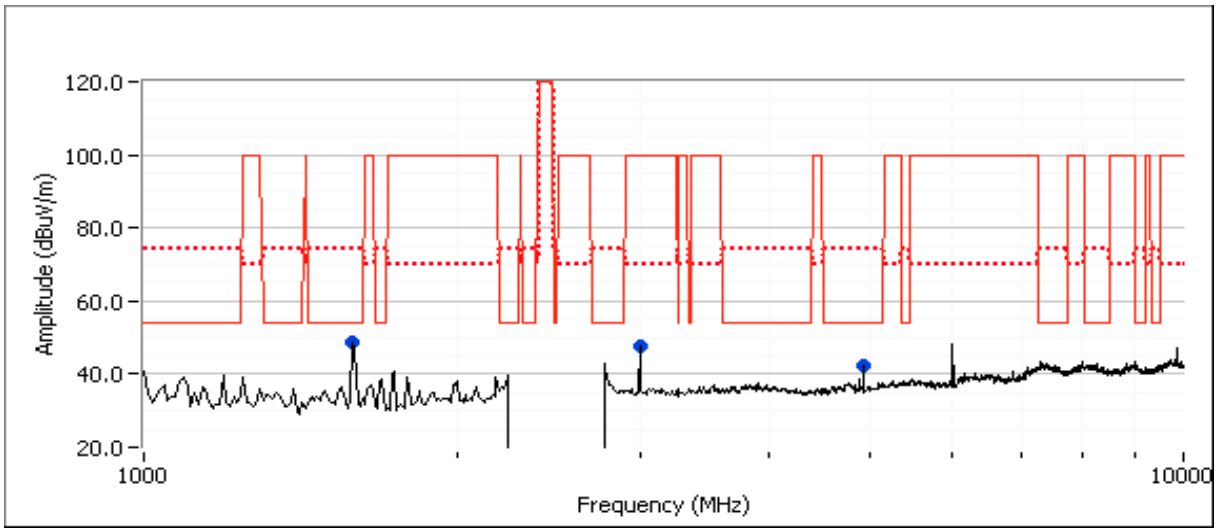
Test Engineer: Rafael Varelas

Preliminary Spurious Emissions excluding allocated band (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1592.530	48.5	V	54.0	-5.5	Peak	192	1.3	
3000.160	47.9	H	70.0	-22.1	Peak	201	1.3	
4923.970	42.3	V	54.0	-11.7	Peak	146	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4924.020	40.8	V	54.0	-13.2	AVG	144	1.0	RB 1 MHz;VB 10 Hz;Pk
4924.060	46.4	V	74.0	-27.6	PK	144	1.0	RB 1 MHz;VB 3 MHz;Pk
1593.580	39.3	V	54.0	-14.7	AVG	202	1.0	RB 1 MHz;VB 10 Hz;Pk
1593.650	52.0	V	74.0	-22.0	PK	202	1.0	RB 1 MHz;VB 3 MHz;Pk



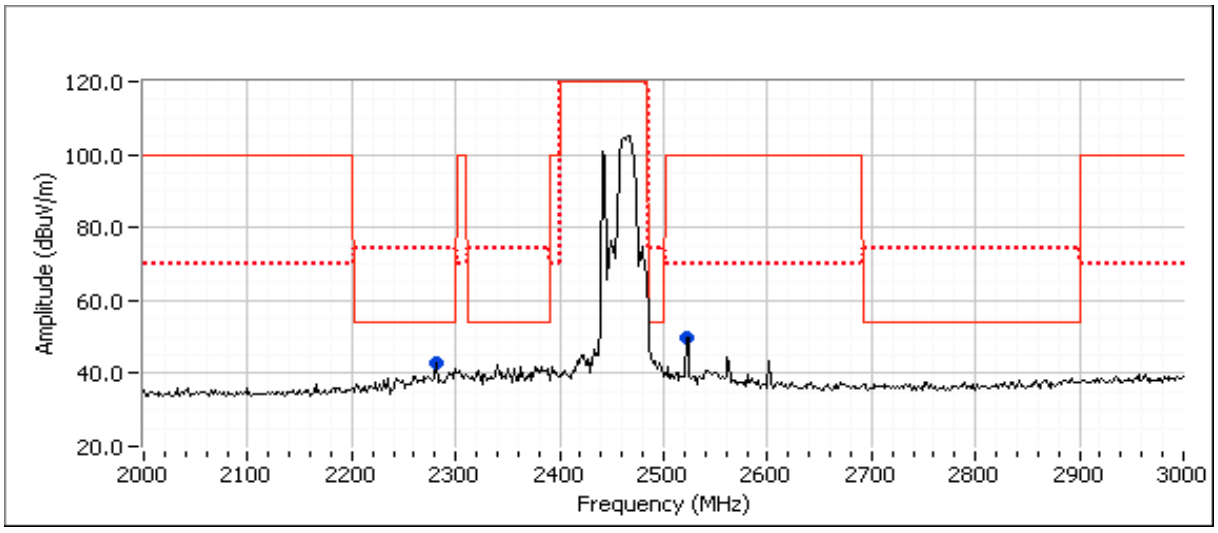
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary Spurious Emissions at 20cm from 2-3 GHz (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2281.670	43.1	V	54.0	-10.9	Peak	181	1.0	
2521.670	49.7	V	70.0	-20.3	Peak	181	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2279.820	48.2	H	54.0	-5.8	AVG	120	1.0	RB 1 MHz;VB 10 Hz;Pk
2280.320	58.3	H	74.0	-15.7	PK	120	1.0	RB 1 MHz;VB 3 MHz;Pk
2280.020	47.9	V	54.0	-6.1	AVG	94	1.0	RB 1 MHz;VB 10 Hz;Pk
2280.450	58.3	V	74.0	-15.7	PK	94	1.0	RB 1 MHz;VB 3 MHz;Pk



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #8: Radiated Spurious Emissions, 1-10GHz. Operating Mode: 802.11b @ 2437, BT Basic @ 2480 MHz

Date of Test: 10/4/2011 Test Location: FT Chamber #3

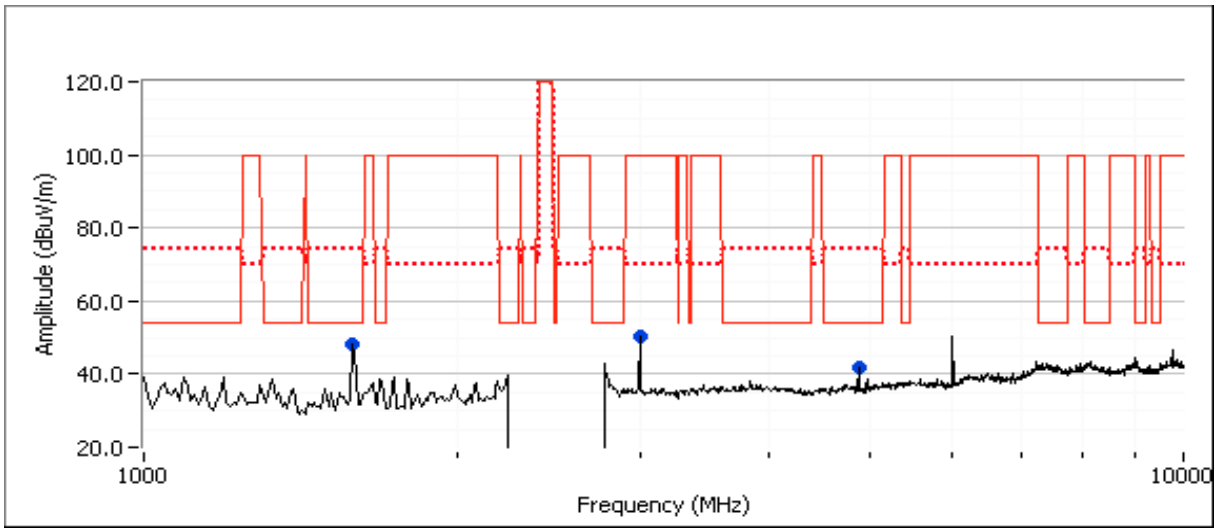
Test Engineer: Rafael Varelas

Preliminary Spurious Emissions excluding allocated band (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1598.660	48.1	V	54.0	-5.9	Peak	206	1.3	
3000.070	50.4	H	70.0	-19.6	Peak	191	1.3	
4874.000	41.8	V	54.0	-12.2	Peak	101	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1597.720	40.4	V	54.0	-13.6	AVG	204	1.0	RB 1 MHz;VB 10 Hz;Pk
1598.640	53.1	V	74.0	-20.9	PK	204	1.0	RB 1 MHz;VB 3 MHz;Pk
4873.990	40.7	V	54.0	-13.3	AVG	102	1.0	RB 1 MHz;VB 10 Hz;Pk
4873.890	47.4	V	74.0	-26.6	PK	102	1.0	RB 1 MHz;VB 3 MHz;Pk



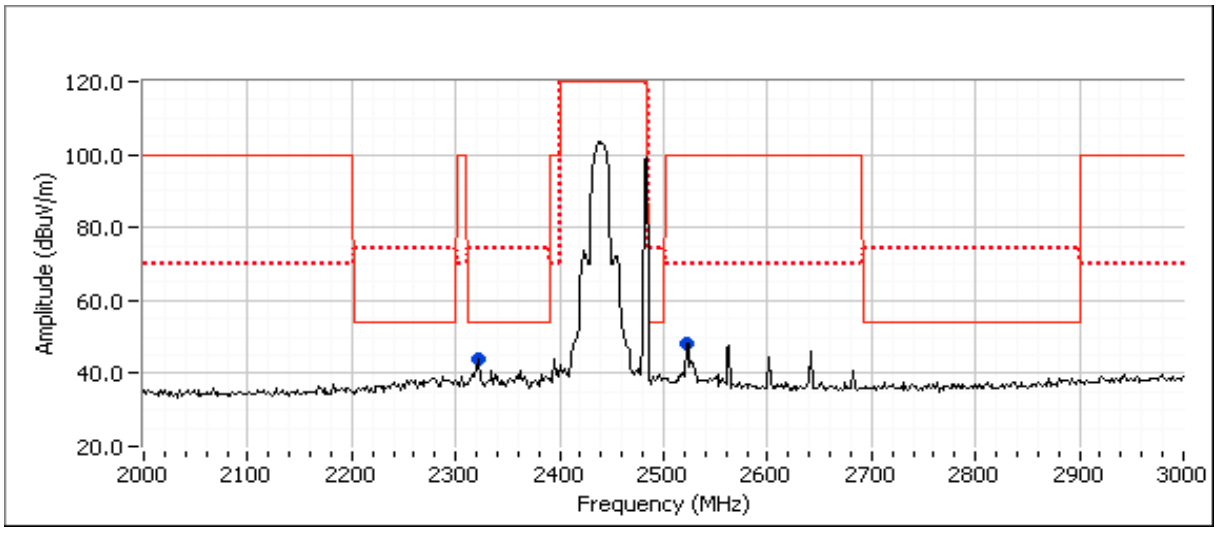
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary Spurious Emissions at 20cm from 2-3 GHz (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2321.670	43.8	V	54.0	-10.2	Peak	181	1.0	
2521.670	48.2	V	70.0	-21.8	Peak	181	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2319.950	48.5	H	54.0	-5.5	AVG	337	1.1	RB 1 MHz;VB 10 Hz;Pk
2317.150	58.1	H	74.0	-15.9	PK	337	1.1	RB 1 MHz;VB 3 MHz;Pk
2320.090	48.0	V	54.0	-6.0	AVG	100	1.0	RB 1 MHz;VB 10 Hz;Pk
2319.140	58.9	V	74.0	-15.1	PK	100	1.0	RB 1 MHz;VB 3 MHz;Pk



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #9: Radiated Spurious Emissions, 1-10GHz. Operating Mode: 802.11b @ 2462, EDR @ 2480 MHz

Date of Test: 10/4/2011 Test Location: FT Chamber #3

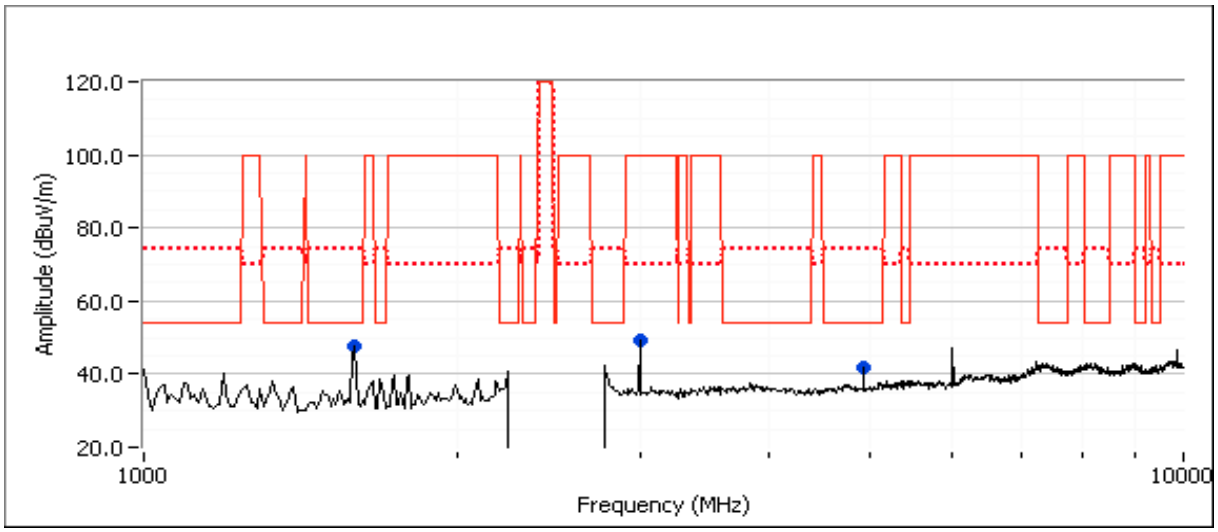
Test Engineer: Rafael Varelas

Preliminary Spurious Emissions excluding allocated band (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1599.950	47.7	V	54.0	-6.3	Peak	203	1.3	
3000.250	49.4	H	70.0	-20.6	Peak	190	1.3	
4923.970	41.6	V	54.0	-12.4	Peak	136	1.6	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1599.560	39.3	V	54.0	-14.7	AVG	201	1.0	RB 1 MHz;VB 10 Hz;Pk
1599.610	52.9	V	74.0	-21.1	PK	201	1.0	RB 1 MHz;VB 3 MHz;Pk



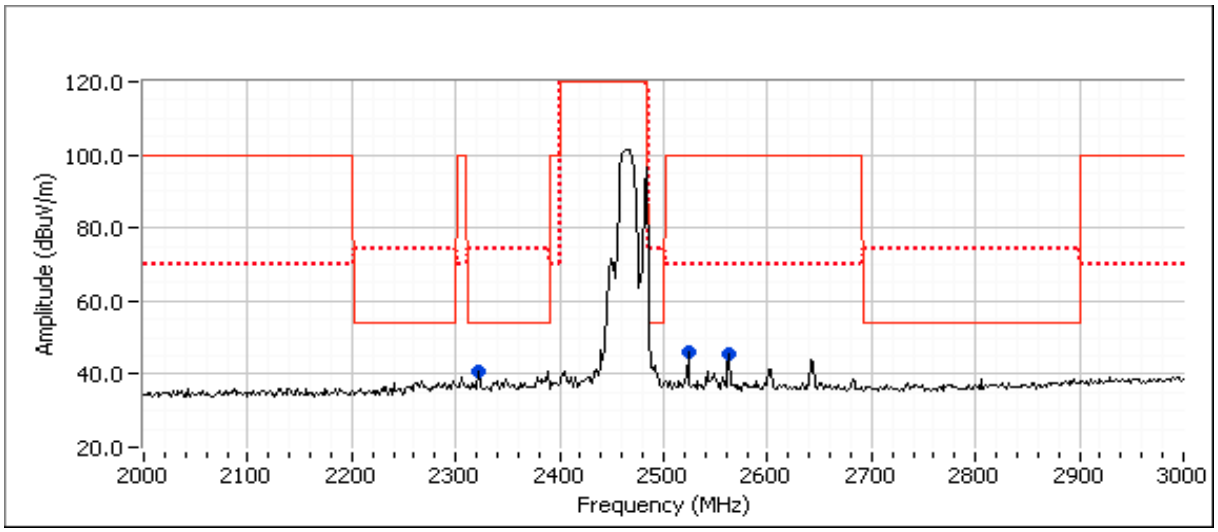
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary Spurious Emissions at 20cm from 2-3 GHz (Peak versus average limit)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2321.670	40.6	V	54.0	-13.4	Peak	180	1.0	
2523.330	45.8	V	70.0	-24.2	Peak	180	1.0	
2563.330	45.3	V	70.0	-24.7	Peak	180	1.0	

Final measurements at 3m

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2320.020	46.8	H	54.0	-7.2	AVG	250	1.0	RB 1 MHz;VB 10 Hz;Pk
2323.840	57.7	H	74.0	-16.3	PK	250	1.0	RB 1 MHz;VB 3 MHz;Pk
2319.800	46.8	V	54.0	-7.2	AVG	154	1.4	RB 1 MHz;VB 10 Hz;Pk
2317.590	57.5	V	74.0	-16.5	PK	154	1.4	RB 1 MHz;VB 3 MHz;Pk



Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Radiated Emissions

(Elliott Laboratories Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 10/4/2011
Test Engineer: Rafael Varelas
Test Location: FT Chamber #3

Config. Used: 1
Config Change: None
Host Unit Voltage 120V/60Hz

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 20.8 °C
Rel. Humidity: 36 %

Summary of Results

MAC Address: 00150082509B DRTU Tool Version 1.5.3.0322 Driver version 15.0.0.61

Run #	Test Performed	Limit	Result	Margin
2	Radiated Emissions 30 - 1000 MHz	FCC 15.209 / RSS 210	Pass	37.3dBµV/m @ 120.01MHz (-6.2dB)

Note - preliminary measurements indicated that the radiated emissions from the combination of test fixture and EUT were not affected by the modules operating frequency or mode (transmit versus receive mode). The system was therefore evaluated with the device operating at max power (16.5dBm) on Chain A at 2437MHz, 802.11b mode and max power (setting 8) on the top channel in Bluetooth mode (1Mb/s data rate).

Modifications Made During Testing

No modifications were made to the EUT during testing

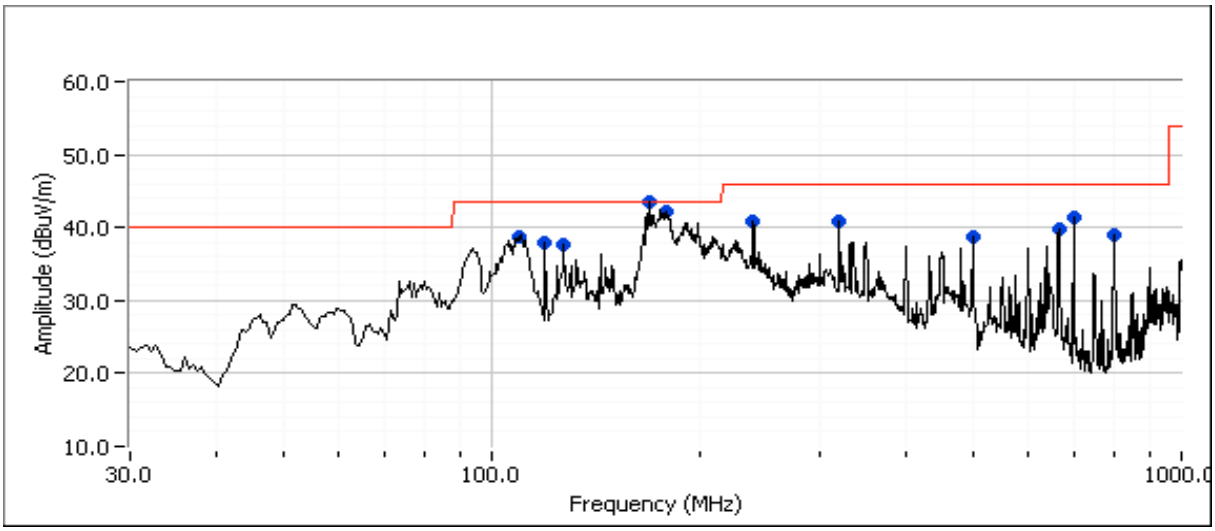
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz
Configured to TX , 802.11b 16.5dBm on chain A (setting 23.5) on channel 6, Bluetooth, 1Mb/s (setting 8.0)

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
30 - 1000 MHz	3	3	0.0



Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
109.992	38.8	V	43.5	-4.7	Peak	45	1.0	
120.005	38.0	V	43.5	-5.5	Peak	311	1.0	
127.340	37.7	H	43.5	-5.8	Peak	106	1.5	
170.221	43.4	H	43.5	-0.1	Peak	115	1.5	
179.812	42.1	H	43.5	-1.4	Peak	149	1.0	
240.002	40.9	H	46.0	-5.1	Peak	10	1.5	
320.051	40.9	H	46.0	-5.1	Peak	77	1.0	
498.377	38.8	V	46.0	-7.2	Peak	17	1.0	
664.945	39.7	V	46.0	-6.3	Peak	31	1.0	
697.272	41.4	H	46.0	-4.6	Peak	206	2.5	
798.470	39.1	H	46.0	-6.9	Peak	207	1.0	

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary quasi-peak readings (no manipulation of EUT interface cables)

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
240.002	39.2	H	46.0	-6.8	QP	11	1.4	QP (1.00s)
109.992	34.4	V	43.5	-9.1	QP	45	1.0	QP (1.00s)
320.051	35.3	H	46.0	-10.7	QP	87	1.0	QP (1.00s)
127.340	27.6	H	43.5	-15.9	QP	120	1.8	QP (1.00s)
170.221	34.8	H	43.5	-8.7	QP	114	1.5	QP (1.00s)
179.812	37.2	H	43.5	-6.3	QP	149	1.2	QP (1.00s)
697.272	36.4	H	46.0	-9.6	QP	191	1.0	QP (1.00s)
120.005	37.3	V	43.5	-6.2	QP	309	1.0	QP (1.00s)

Run #2: Maximized Readings From Run #1

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
30 - 1000 MHz	3	3	0.0

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
120.005	37.3	V	43.5	-6.2	QP	309	1.0	QP (1.00s)
179.812	37.2	H	43.5	-6.3	QP	149	1.2	QP (1.00s)
240.002	39.2	H	46.0	-6.8	QP	11	1.4	QP (1.00s)
170.221	34.8	H	43.5	-8.7	QP	114	1.5	QP (1.00s)
109.992	34.4	V	43.5	-9.1	QP	45	1.0	QP (1.00s)
697.272	36.4	H	46.0	-9.6	QP	191	1.0	QP (1.00s)

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Conducted Emissions

(Elliott Laboratories Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 10/4/2011
Test Engineer: Rafael Varelas
Test Location: FT Chamber #3

Config. Used: 1
Config Change: None
Host Unit Voltage 120V/60Hz

General Test Configuration

The host laptop was located on a wooden table inside the semi-anechoic chamber, 40 cm from a vertical coupling plane and 80cm from the LISN. A second LISN was used for all local support equipment. Remote support equipment was located outside of the semi-anechoic chamber. Any cables running to remote support equipment where routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Ambient Conditions:

Temperature: 20.8 °C
Rel. Humidity: 36 %

Summary of Results

MAC Address: 00150082509B DRTU Tool Version 1.5.3.0322 Driver version 15.0.0.61

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,120V/60Hz	RSS 210 / 15.207	Pass	32.1dBµV @ 15.520MHz (-17.9dB)

Modifications Made During Testing

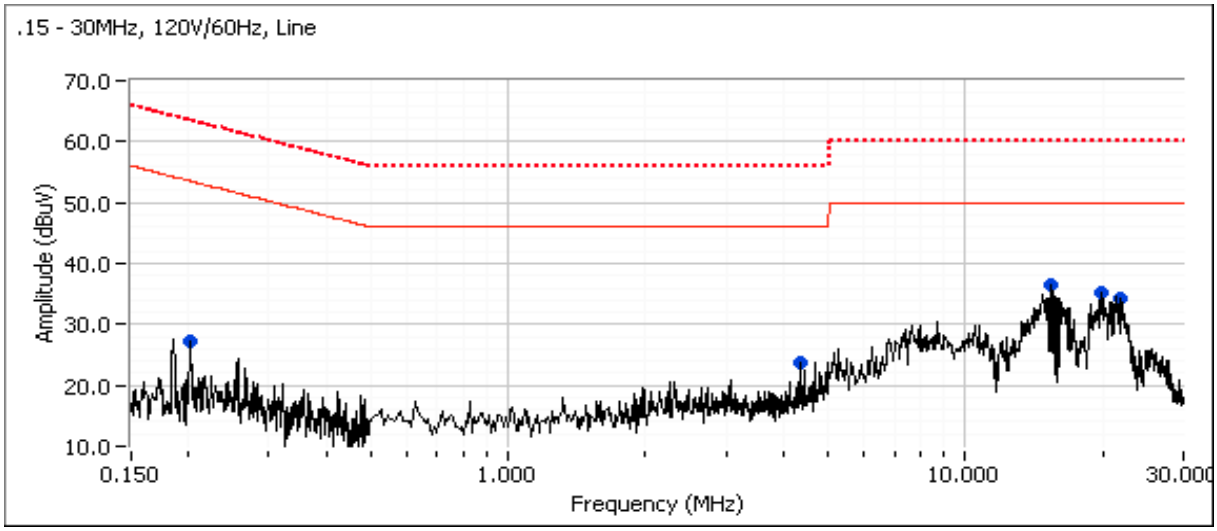
No modifications were made to the EUT during testing

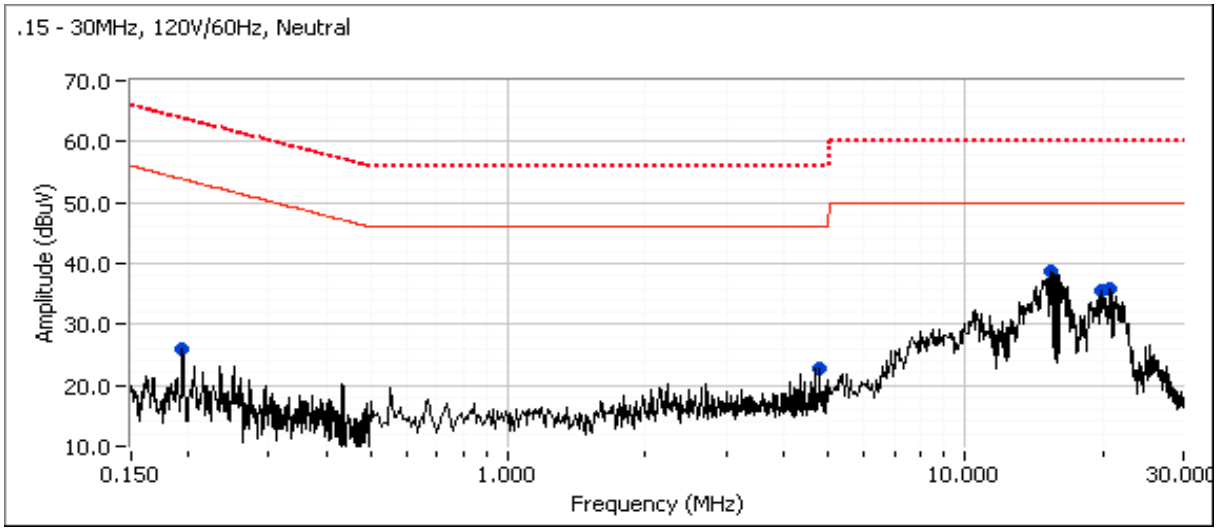
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz





Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
		Account Manager:	Christine Krebill
Contact:	Steve Hackett		
Standard:	FCC 15.247	Class:	B

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	AC	RSS 210 / 15.207		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.204	27.3	Line 1	53.5	-26.2	Peak	
4.369	23.6	Line 1	46.0	-22.4	Peak	
15.514	36.4	Line 1	50.0	-13.6	Peak	
19.804	35.1	Line 1	50.0	-14.9	Peak	
21.840	34.3	Line 1	50.0	-15.7	Peak	
0.194	26.0	Neutral	53.9	-27.9	Peak	
4.789	22.9	Neutral	46.0	-23.1	Peak	
15.520	38.6	Neutral	50.0	-11.4	Peak	
19.806	35.4	Neutral	50.0	-14.6	Peak	
20.781	35.7	Neutral	50.0	-14.3	Peak	

Final quasi-peak and average readings

Frequency	Level	AC	RSS 210 / 15.207		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
15.520	32.1	Neutral	50.0	-17.9	AVG	AVG (0.10s)
15.514	31.5	Line 1	50.0	-18.5	AVG	AVG (0.10s)
19.806	28.4	Neutral	50.0	-21.6	AVG	AVG (0.10s)
15.520	37.9	Neutral	60.0	-22.1	QP	QP (1.00s)
19.804	26.8	Line 1	50.0	-23.2	AVG	AVG (0.10s)
20.781	26.6	Neutral	50.0	-23.4	AVG	AVG (0.10s)
19.806	34.8	Neutral	60.0	-25.2	QP	QP (1.00s)
15.514	34.7	Line 1	60.0	-25.3	QP	QP (1.00s)
21.840	23.4	Line 1	50.0	-26.6	AVG	AVG (0.10s)
20.781	32.8	Neutral	60.0	-27.2	QP	QP (1.00s)
19.804	32.7	Line 1	60.0	-27.3	QP	QP (1.00s)
21.840	29.2	Line 1	60.0	-30.8	QP	QP (1.00s)

End of Report

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