



## Test Certificate

A sample of the following product received on September 21, 2011 and tested on September 28, 2011 complied with the requirements of,

- Subpart B of Part 15 of FCC Rules for Class B digital devices
- Industry Canada Interference Causing Equipment Standard ICES 003, dated February 2004 (Class B)

given the measurement uncertainties detailed in Elliott report R85140.

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

David W. Bare  
Chief Engineer

\_\_\_\_\_  
Intel Corporation

\_\_\_\_\_  
Printed Name



Testing Cert #2016.01

Elliott Laboratories is accredited by the A2LA, certificate number 2016.01, to perform the test(s) listed in this report, except where noted otherwise. This report and the information contained herein represent the results of testing test articles identified and selected by the client performed to specifications and/or procedures selected by the client. National Technical Systems (NTS) makes no representations, expressed or implied, that such testing is adequate (or inadequate) to demonstrate efficiency, performance, reliability, or any other characteristic of the articles being tested, or similar products. This report should not be relied upon as an endorsement or certification by NTS of the equipment tested, nor does it represent any statement whatsoever as to its merchantability or fitness of the test article, or similar products, for a particular purpose. This report shall not be reproduced except in full

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*EMC Test Report*

*Information Technology Equipment  
Class B Digital Device*

*FCC Part 15  
Industry Canada ICES 003*

*Model: Intel® Centrino® Wireless-N 2230 Models 2230BNHMMW &  
2230BNHU*

COMPANY: Intel Corporation  
100 Center Point Circle Suite 200  
Columbia, SC 29210

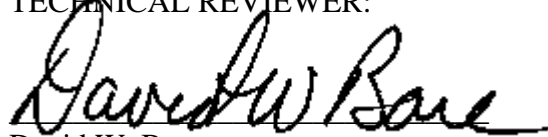
TEST SITE(S): Elliott Laboratories  
41039 Boyce Road  
Fremont, CA. 94538-2435

REPORT DATE: October 24, 2011

FINAL TEST DATES: September 28, 2011

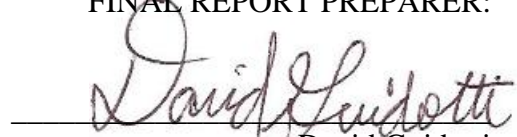
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**REVISION HISTORY**

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

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**SCOPE**

Governments and standards organizations around the world have published requirements regarding the electromagnetic compatibility (EMC) of electronic equipment. Testing has been performed on the Intel Corporation model Intel Centrino Wireless-N 2230 Model 2230BNHMW & 2230BNHU, pursuant to the following standards.

Standard	Title	Standard Date
FCC Part 15, Subpart B	Radio Frequency Devices	October 2010 as Amended
ICES-003, Issue 4	Digital apparatus	2004

All measurements and evaluations have been in accordance with these specifications, test procedures, and measurement guidelines as outlined in Elliott Laboratories test procedures, and in accordance with the standards referenced therein (refer to Appendix E).

**OBJECTIVE**

The objective of Intel Corporation is to verify compliance with FCC requirements for digital devices and Canada's requirements for digital devices;

**STATEMENT OF COMPLIANCE**

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

Standard/Regulation	Equipment Type/Class	Standard Date
Subpart B of Part 15 of the FCC Rules (CFR title 47)	Class B	2010 as amended
ICES-003, Issue 4	Class B	2004

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

Maintenance of compliance is the responsibility of the company. Any modification of the product that could result in increased emissions or susceptibility should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different enclosure, different line filter or power supply, harnessing and/or interface cable changes, etc.).

**DEVIATIONS FROM THE STANDARDS**

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

**INFORMATION TECHNOLOGY EQUIPMENT EMISSIONS TEST RESULTS**

The following emissions tests were performed on the Intel Corporation model Intel Centrino Wireless-N 2230 Model 2230BNHMW & 2230BNHU. The measurements were extracted from the data recorded during testing and represent the highest amplitude emissions relative to the specification limits. The complete test data is provided in the appendices of this report.

**CONDUCTED EMISSIONS (MAINS PORT)**

Frequency Range Operating Voltage	Standard/Section	Requirement	Measurement	Margin	Status
0.15-30 MHz, 120V, 60Hz	FCC § 15.107(a) (Class B)	0.15-0.5 MHz: 66-56 dB $\mu$ V QP 56-46 dB $\mu$ V Av 0.5-5.0 MHz: 56 dB $\mu$ V QP 46 dB $\mu$ V Av 5.0-30.0 MHz: 60 dB $\mu$ V QP 50 dB $\mu$ V Av	28.6dB $\mu$ V @ 0.208MHz	-24.7dB	Complied

**RADIATED EMISSIONS**

Frequency Range	Standard/Section	Requirement	Measurement	Margin	Status
30-1000 MHz	FCC §15.109(g) Class B	30 – 230, 30 dB $\mu$ V/m 230 – 1000, 37 dB $\mu$ V/m (10m limit)	41.9dB $\mu$ V/m @399.38 MHz	-4.1dB	Complied
1000-40000 MHz Note 1	FCC §15.109(a) Class B	54.0 dB $\mu$ V/m Av 74.0 dB $\mu$ V/m Pk (3m limit)	N/A – Note 1		
Note 1 Testing above 1GHz against FCC 15.109(a) requirements was not required because the highest frequency generated in the EUT was declared to be less than 108 MHz.					

**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 were calculated using the approach described in CISPR 16-4-2:2003 using a coverage factor of k=2, which gives a level of confidence of approximately 95%. The levels were found to be below levels of  $U_{cispr}$  and therefore no adjustment of the data for measurement uncertainty is required.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
Conducted Emissions	dBuV or dBuA	150kHz – 30MHz	$\pm$ 2.2 dB
Radiated Electric Field	dBuV/m	30 – 1000 MHz	$\pm$ 3.6 dB
		1000 – 40,000 MHz	$\pm$ 6.0 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 September 28, 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)	PD92230BNH 1000M-2230BNH PD92230BNHU
	2230BNHU		00150082509B (DSS, DTS)	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 local support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
Dell	Latitude	Laptop	162-047-551-87	-
HP	5650	Printer	MY3883K42P	-
The EUT was installed inside the Laptop				

The following equipment was used as remote support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
Netgear	GS108	Hub	GS16152CB035 447	-

**EUT INTERFACE PORTS**

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

Port		Description	Cable(s) Shielded/Unshielded	Length(m)
From	To			
USB	Printer	USB	Shielded	2
Ethernet	Hub	CAT 5	Unshielded	10
Laptop	AC Adapter	Two wire	Unshielded	1.5
AC Adapter	AC Mains	Three wire	Unshielded	2

**EUT OPERATION**

During emissions testing the digital interface to the EUT was active seeking a network, the laptop was showing a scrolling H pattern and the peripheral interfaces were enabled and active.



**EMISSIONS TESTING****RADIATED AND CONDUCTED EMISSIONS**

Final test measurements were taken at the Elliott Laboratories Anechoic Chambers listed below. The test sites contain separate areas for radiated and conducted emissions testing. The sites conform to the requirements of ANSI C63.4: 2003 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2007 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are registered with the VCCI and are on file with the FCC and Industry Canada.

Site	Registration Numbers			Location
	VCCI	FCC	Canada	
Chamber 3	R-1683 G-58 C-1795 T-1639	769238	IC 2845B-3	41039 Boyce Road Fremont, CA 94538-2435

**RADIATED EMISSIONS CONSIDERATIONS**

Radiated emissions measurements were made with the EUT powered from a supply voltage within the expected tolerances of each nominal operating voltage/frequency for each geographical regions covered by the scope of the standards referenced in this report.

**CONDUCTED EMISSIONS CONSIDERATIONS**

Conducted emissions testing is performed in conformance with ANSI C63.4 and CISPR 22.

Mains port 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.

## **EMISSIONS MEASUREMENT INSTRUMENTATION**

### **RECEIVER SYSTEM**

An EMI receiver as specified in CISPR 16-1-1:2006 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7 GHz. 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.

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 1000 MHz 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.

### **INSTRUMENT CONTROL COMPUTER**

Measurements are converted to the field strength at an antenna or voltage developed at the LISN (or ISN) measurement port, which is then compared directly with the appropriate specification limit under software control of the test receivers and spectrum analyzers. 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 emission measurements utilize a fifty micro-Henry 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.

### **IMPEDANCE STABILIZATION NETWORK (ISN)**

Telecommunication port conducted emission measurements utilize an Impedance Stabilization Network with a 150-ohm termination impedance and specific longitudinal conversion loss as the voltage monitoring point. This network provides for calibrated radio-frequency noise measurements by the design of the internal circuitry on the EUT and measurement ports, respectively. For current measurements, a current probe with a uniform frequency response and less than 1-ohm insertion impedance is used.

### **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 bilog antenna or combination of biconnical and log periodic antennas are used to cover the range from 30 MHz to 1000 MHz. Narrowband tuned dipole antennas may be used over the entire 30 to 1000 MHz frequency range for precision measurements of field strength. Above 1000 MHz, horn antennas are used. The antenna calibration factors are included in site factors that are programmed into the test receivers or data collection 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.

ANSI C63.4, CISPR 22 and KN22 specify 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 up to 12-mm thick 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 company's specifications. An appendix of this report contains the list of test equipment used and calibration information.

## ***EMISSIONS TEST PROCEDURES***

### ***EUT AND CABLE PLACEMENT***

The standards 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, CISPR 22 and KN22, and the worst-case orientation is used for final measurements.

### ***CONDUCTED EMISSIONS (MAINS)***

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. Emissions that have peak values close to the specification limit are also measured in the quasi-peak and average detection modes to determine compliance except when the amplitude of the emission when measured with the quasi-peak detector is more than 10 dB below the specification limit for average measurements. In this case only quasi-peak measurements are performed.

**RADIATED EMISSIONS (SEMI-ANECHOIC and/or OATS TEST ENVIRONMENT)**

Radiated emissions measurements in a semi-anechoic environment are performed in two phases (preliminary scan and final maximization). Final maximization may be performed on an OATS.

**Preliminary Scan**

A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulations specified on page 1. One or more of these are performed with the antenna polarized vertically and one or more of these are performed with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions if required. 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**

During final maximization, 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 that results in the highest emission is then maintained while varying the antenna height from one to four meters. 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. Emissions that have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

For measurements above 1GHz every effort is made to ensure the EUT remains within the cone of radiation of the measurement antenna (i.e. 3dB beam-width of the antenna). This may include rotating the product and/or angling the measurement antenna.

When Testing above 18 GHz, the receive antenna is located at 1 meter from the EUT and the antenna height is restricted to a maximum of 2.5m. Maximum emissions are found within this restricted range because emission levels decrease over distance and as the antenna is raised above 2.5m, the distance from the EUT increases. As a result of the increased measurement distance, at antenna heights above 2.5m, lower emission levels are measured as compared to emissions levels measured at antenna heights at 2.5m and below.

**SAMPLE CALCULATIONS****SAMPLE CALCULATIONS - CONDUCTED EMISSIONS**

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

$$R_r - S = M$$

where:

$$\begin{aligned} R_r &= \text{Receiver Reading in dBuV} \\ S &= \text{Specification Limit in dBuV} \\ M &= \text{Margin to Specification in +/- dB} \end{aligned}$$

**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, is calculated by using the following formula:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

$$\begin{aligned} F_d &= \text{Distance Factor in dB} \\ D_m &= \text{Measurement Distance in meters} \\ D_s &= \text{Specification Distance in meters} \end{aligned}$$

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:

$$\begin{aligned} R_r &= \text{Receiver Reading in dBuV/m} \\ F_d &= \text{Distance Factor in dB} \\ R_c &= \text{Corrected Reading in dBuV/m} \\ L_s &= \text{Specification Limit in dBuV/m} \\ M &= \text{Margin in dB Relative to Spec} \end{aligned}$$

**Appendix A Test Equipment Calibration Data****Radiated and Conducted Emissions - AC Power Ports, 28-Sep-11**

<b><u>Manufacturer</u></b>	<b><u>Description</u></b>	<b><u>Model</u></b>	<b><u>Asset #</u></b>	<b><u>Cal Due</u></b>
EMCO	LISN, 10 kHz-100 MHz, 25A	3825/2	1292	3/1/2012
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1401	4/21/2012
Fischer Custom Comm.	LISN, 50uH, 25 Amps, Dual Line	FCC-LISN-50/250- 25-2-01	1575	4/21/2012
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

## *Appendix B Test Data*

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## EMC Test Data

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
Contact:	Steve Hackett	Account Manager:	Christine Krebill
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: 9/28/2011  
 Test Engineer: Vishal Narayan  
 Test Location: Fremont Chamber #3

Config. Used: 2  
 Config Change: None  
 EUT Voltage: 230V/50Hz

### General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. Any remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

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: 21 °C  
 Rel. Humidity: 40 %

### Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Radiated Emissions 30 - 1000 MHz, Preliminary	Class B	Pass	40.1dBµV/m @ 398.45MHz (-5.9dB)
2	Radiated Emissions 30 - 1000 MHz, Maximized	Class B	Pass	41.9dBµV/m @ 399.38MHz (-4.1dB)

### Modifications Made During Testing

No modifications were made to the EUT during testing

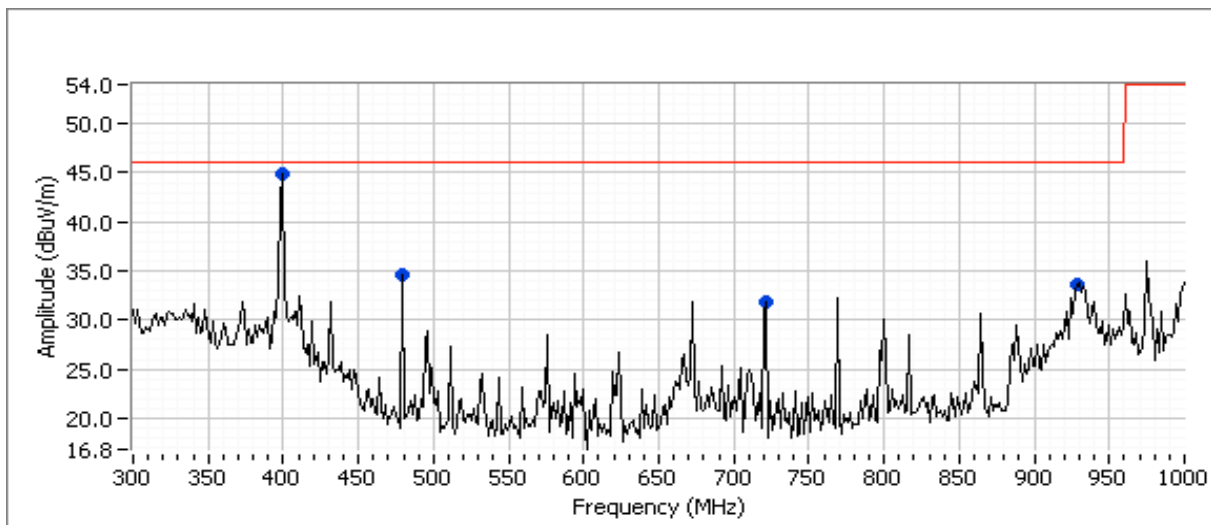
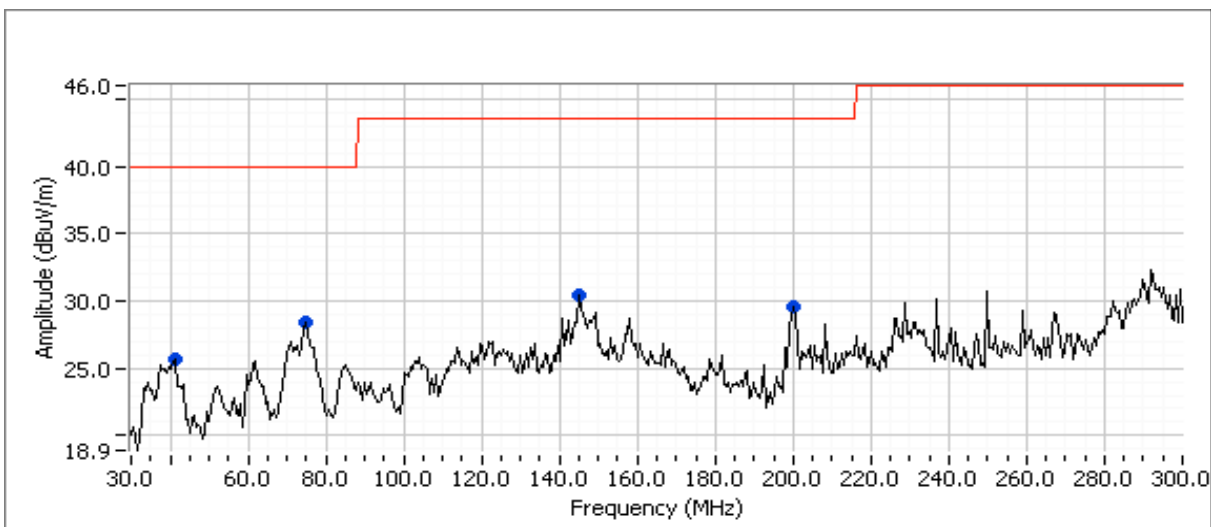
### Deviations From The Standard

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
Contact:	Steve Hackett	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	B

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

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





# EMC Test Data

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

## Continuation of Run #1

### Preliminary peak readings captured during pre-scan

Frequency MHz	Level dB $\mu$ V/m	Pol v/h	FCC Class B		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
145.571	30.4	V	43.5	-13.1	Peak	350	1.0	
72.670	28.4	V	40.0	-11.6	Peak	123	1.5	
39.253	25.7	V	40.0	-14.3	Peak	259	1.0	
201.080	29.5	H	43.5	-14.0	Peak	260	2.0	
398.449	44.8	H	46.0	-1.2	Peak	191	2.0	
479.980	34.6	V	46.0	-11.4	Peak	40	1.0	
927.138	33.6	H	46.0	-12.4	Peak	134	1.5	
719.972	31.9	V	46.0	-14.1	Peak	301	1.0	

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

Frequency MHz	Level dB $\mu$ V/m	Pol v/h	FCC Class B		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
398.449	40.1	H	46.0	-5.9	QP	192	2.0	QP (1.00s)
479.980	35.3	V	46.0	-10.7	QP	41	1.0	QP (1.00s)
719.972	32.8	V	46.0	-13.2	QP	301	1.0	QP (1.00s)
927.138	30.5	H	46.0	-15.5	QP	136	1.5	QP (1.00s)
145.571	27.1	V	43.5	-16.4	QP	351	1.0	QP (1.00s)
39.253	23.0	V	40.0	-17.0	QP	260	1.0	QP (1.00s)
72.670	22.5	V	40.0	-17.5	QP	125	1.5	QP (1.00s)
201.080	21.6	H	43.5	-21.9	QP	260	2.0	QP (1.00s)

## Run #2: Maximized Readings From Run #1

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

Frequency MHz	Level dB $\mu$ V/m	Pol v/h	FCC Class B		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
399.375	41.9	H	46.0	-4.1	QP	192	2.0	QP (1.00s)
479.980	35.3	V	46.0	-10.7	QP	41	1.0	QP (1.00s)
719.972	32.8	V	46.0	-13.2	QP	301	1.0	QP (1.00s)
927.138	30.5	H	46.0	-15.5	QP	136	1.5	QP (1.00s)
145.571	27.1	V	43.5	-16.4	QP	351	1.0	QP (1.00s)
39.253	23.0	V	40.0	-17.0	QP	260	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: 9/28/2011  
 Test Engineer: Vishal Narayan  
 Test Location: Fremont Chamber #3

Config. Used: 2  
 Config Change: None  
 EUT Voltage: 230V/50Hz and 120V/60Hz

### General Test Configuration

For tabletop equipment, the EUT 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 were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

**Ambient Conditions:**  
 Temperature: 21 °C  
 Rel. Humidity: 40 %

### Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power, 230V/50Hz	Class B	Pass	28.5dBµV @ 0.210MHz (-24.7dB)
2	CE, AC Power, 120V/60Hz	Class B	Pass	28.6dBµV @ 0.208MHz (-24.7dB)

### Modifications Made During Testing

No modifications were made to the EUT during testing

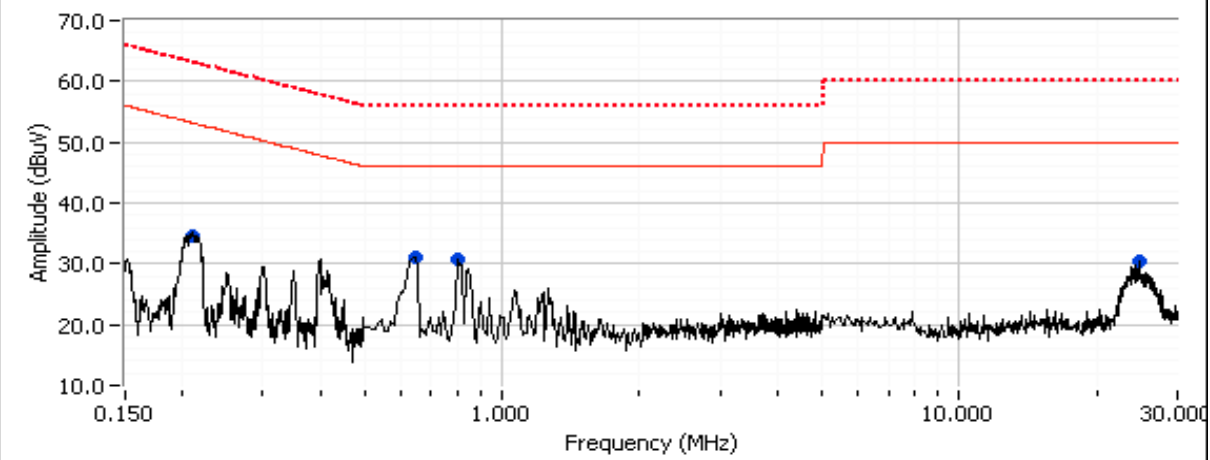
### Deviations From The Standard

No deviations were made from the requirements of the standard.

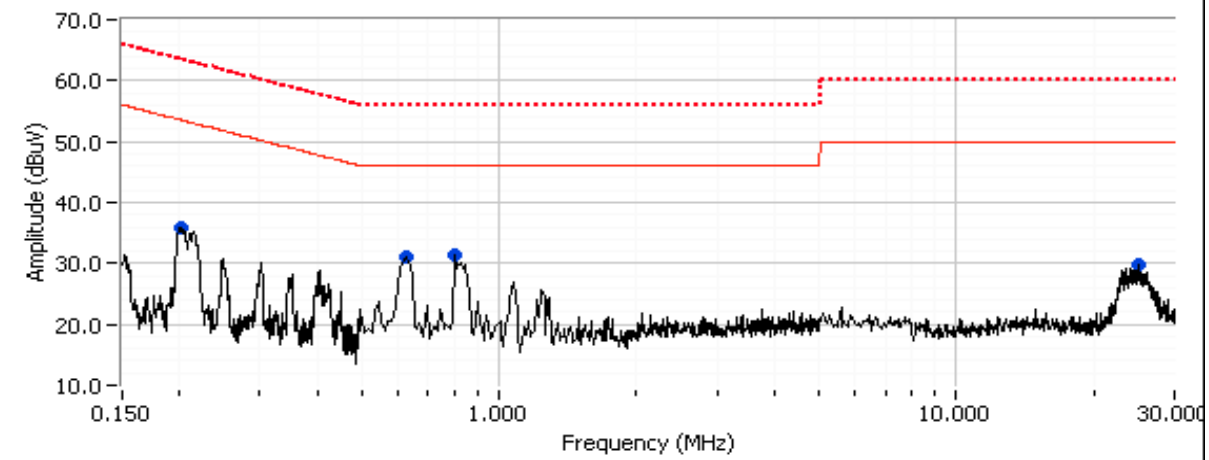
Client:	Intel Corporation	Job Number:	J84364
Model:	Intel® Centrino® Wireless-N 2230	T-Log Number:	T84599
Contact:	Steve Hackett	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 230V/50Hz

Run #1 230V/50Hz Line



Run #1 230V/50Hz Neutral



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

**Continuation of Run #1**
**Preliminary peak readings captured during pre-scan (peak readings vs. average limit)**

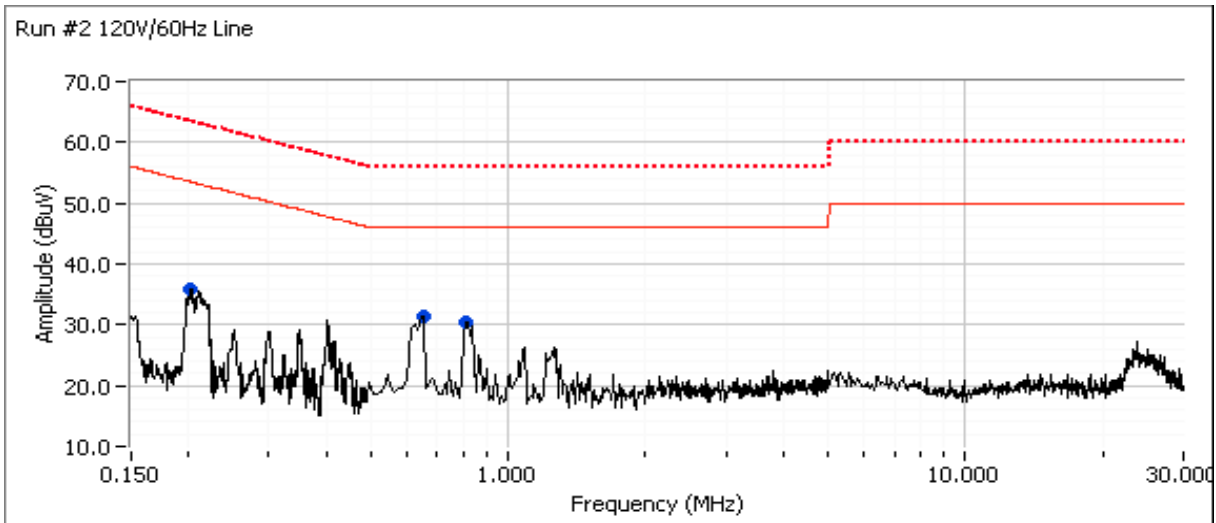
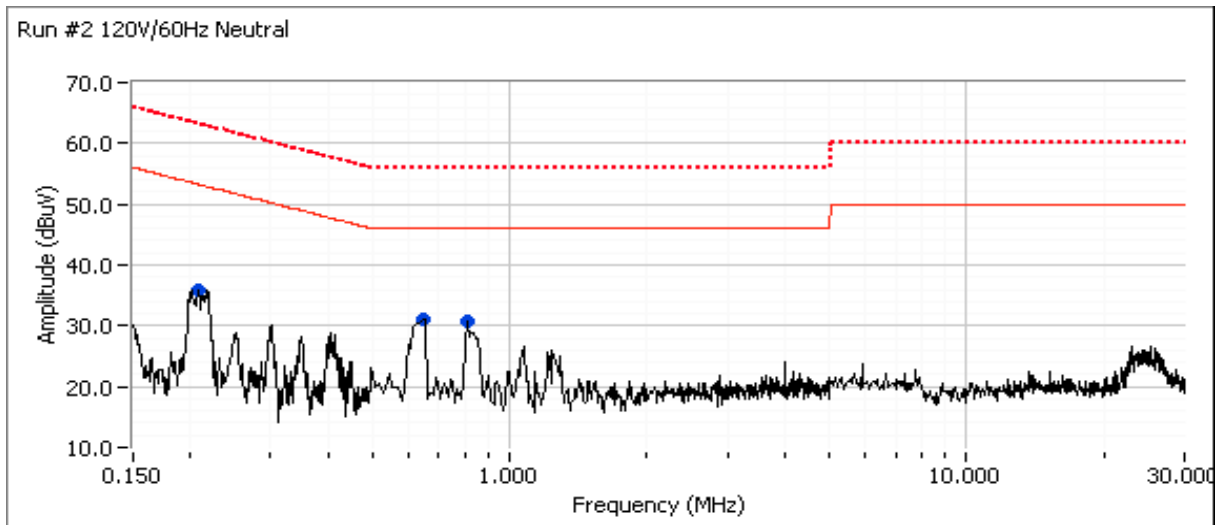
Frequency MHz	Level dB $\mu$ V	AC Line	Class B		Detector QP/Ave	Comments
			Limit	Margin		
0.813	31.3	Neutral	46.0	-14.7	Peak	
0.655	31.1	Neutral	46.0	-14.9	Peak	
0.649	31.0	Line	46.0	-15.0	Peak	
0.798	30.6	Line	46.0	-15.4	Peak	
0.202	35.8	Neutral	53.6	-17.8	Peak	
<i>0.210</i>	<i>34.7</i>	Line	<i>53.2</i>	<i>-18.5</i>	<i>Peak</i>	
24.672	30.3	Line	50.0	-19.7	Peak	
24.955	29.7	Neutral	50.0	-20.3	Peak	

**Final quasi-peak and average readings**

Frequency MHz	Level dB $\mu$ V	AC Line	Class B		Detector QP/Ave	Comments
			Limit	Margin		
0.210	28.5	Line	53.2	-24.7	AVG	AVG (0.10s)
0.202	28.8	Neutral	53.5	-24.7	AVG	AVG (0.10s)
0.649	30.8	Line	56.0	-25.2	QP	QP (1.00s)
0.649	19.3	Line	46.0	-26.7	AVG	AVG (0.10s)
0.813	28.8	Neutral	56.0	-27.2	QP	QP (1.00s)
0.202	35.9	Neutral	63.5	-27.6	QP	QP (1.00s)
0.798	27.6	Line	56.0	-28.4	QP	QP (1.00s)
0.798	17.0	Line	46.0	-29.0	AVG	AVG (0.10s)
0.813	16.9	Neutral	46.0	-29.1	AVG	AVG (0.10s)
0.210	33.8	Line	63.2	-29.4	QP	QP (1.00s)
0.655	26.4	Neutral	56.0	-29.6	QP	QP (1.00s)
0.655	14.5	Neutral	46.0	-31.5	AVG	AVG (0.10s)
24.955	18.5	Neutral	50.0	-31.5	AVG	AVG (0.10s)
24.672	18.4	Line	50.0	-31.6	AVG	AVG (0.10s)
24.955	24.8	Neutral	60.0	-35.2	QP	QP (1.00s)
24.672	24.6	Line	60.0	-35.4	QP	QP (1.00s)

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

Run #2: 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
Contact:	Steve Hackett	Account Manager:	Christine Krebill
Standard:	FCC 15.247	Class:	B

**Continuation of Run #2**

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

Frequency MHz	Level dB $\mu$ V	AC Line	Class B		Detector QP/Ave	Comments
			Limit	Margin		
0.650	31.5	Line	46.0	-14.5	Peak	
0.652	31.2	Neutral	46.0	-14.8	Peak	
0.808	30.8	Neutral	46.0	-15.2	Peak	
0.812	30.3	Line	46.0	-15.7	Peak	
<i>0.208</i>	<i>35.7</i>	Neutral	<i>53.3</i>	<i>-17.6</i>	<i>Peak</i>	
0.204	35.7	Line	53.5	-17.8	Peak	

**Final quasi-peak and average readings**

Frequency MHz	Level dB $\mu$ V	AC Line	Class B		Detector QP/Ave	Comments
			Limit	Margin		
0.208	28.6	Neutral	53.3	-24.7	AVG	AVG (0.10s)
0.204	28.7	Line	53.4	-24.7	AVG	AVG (0.10s)
0.650	30.8	Line	56.0	-25.2	QP	QP (1.00s)
0.652	30.2	Neutral	56.0	-25.8	QP	QP (1.00s)
0.808	29.0	Neutral	56.0	-27.0	QP	QP (1.00s)
0.650	18.9	Line	46.0	-27.1	AVG	AVG (0.10s)
0.812	28.8	Line	56.0	-27.2	QP	QP (1.00s)
0.652	18.2	Neutral	46.0	-27.8	AVG	AVG (0.10s)
0.808	17.0	Neutral	46.0	-29.0	AVG	AVG (0.10s)
0.812	17.0	Line	46.0	-29.0	AVG	AVG (0.10s)
0.204	34.2	Line	63.4	-29.2	QP	QP (1.00s)
0.208	33.8	Neutral	63.3	-29.5	QP	QP (1.00s)

### Appendix C Product Labeling Requirements

The following information has been provided to clarify notification, equipment labeling requirements and information that must be included in the operator's manual. These requirements may be found in the standards/regulations listed in the scope of this report.

#### Label Location

The required label(s) must be in a *conspicuous location* on the product, which is defined as any location readily visible to the user of the device without the use of tools.

#### Label Attachment

The label(s) must be *permanently attached* to the product, which is defined as attached such that it can normally be expected to remain fastened to the equipment during the equipment's expected useful life. A paper gum label will generally not meet this condition.

#### United States Class B Label

FCC ID: ABC1234567

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

The FCC Identifier is comprised of the grantee code (in the example above **ABC**) that was assigned by the FCC plus a unique alpha-numeric specific to the product being certified. The ID must appear on the device.

If the device is too small or for such use that it is not practicable to place the US label statement on it, the statement shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed

#### Industry Canada

For ICES-003 (digital apparatus), the product must be labeled with a notice indicating compliance e.g.

This Class B digital apparatus complies with Canadian ICES-003

Cet appareil numérique de la classe B est conforme à la norme NMB-003  
du Canada

If there is limited space on the product then the text may be placed in the manual:

## *Appendix D User Manual Regulatory Statements*

Where special accessories, such as shielded cables, are required in order to meet the emission limits, appropriate instructions regarding the need to use such accessories must be contained on the first page of text concerned with the installation of the device in the operator's manual.

A requirement by FCC regulations, and recommended for all regulatory markets, is a cautionary statement to the end user that changes or modifications to the device not expressly approved by you, the manufacturer, could void their right to operate the equipment.

### *United States Class B Manual Statement*

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Note: Additional information about corrective measures may also be provided to the user at the company's option.

The FCC has indicated that the radio interference statement be bound in the same manner as the operator's manual. Thus, a loose-leaf insert page in a bound or center-spine and stapled manual would not meet this condition.

## ***Appendix E Basic and Reference Standards***

*Subpart B of Part 15 of FCC Rules for digital devices.*

FCC Part 15 Subpart B references the use of ANSI C63.4–2003: “*Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*” for the purposes of evaluating the radiated and conducted emissions from digital devices.

*End of Report*

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