

Intel A nyP oint- wireless-home Network US B... Adapter



Proprietary Information

CONFIDENTIAL INFORMATION

	DESCRIPTION	CONTENTS	FILE NAME
PROTOCOL DESCRIPTION	Duty Cycle Analysis	PROTOCOL	Duty Cycle1.pdf
	Cycle Timing Conditions	PROTOCOL	Duty Cycle1.pdf
	Duty Cycle Plots	PROTOCOL	Duty Cycle1.pdf
THEORY OF OPERATION	RangeLAN2 Description	PROTOCOL	TheoryOpp1.pdf
	RangeLAN2 Description	PROTOCOL	TheoryOpp2.pdf
	RangeLAN2 Description	PROTOCOL	TheoryOpp3.pdf
	RangeLAN2 Description	PROTOCOL	TheoryOpp4.pdf
	Hopping Pattern	PROTOCOL	RL2Fhthop5.pdf

-CONTACT INFORMATION-

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EC LABS, INC.	CHIP MATHENY	408/747-1490	chip@eclabs.com

CONFIDENTIAL INFORMATION





Intel AnyPoint- wireless-home Network US B... Adapter

2.4 GHZ TRANSMITTER

FREQUENCY HOPPING SPREAD SPECTRUM

INTENTIONAL RADIATOR ...

RF DEVICE...



Letters of Interest

LETTER TYPE	WORD FILE	ACROBAT FILE
Intro Letter	SubmittalLET.doc	IntroLET.pdf
Agent Authorization	AgentAuth.doc	Agentautho.pdf
Confidential Request	ConfidLET.doc	Confidential pdf

CONTACT INFORMATION-

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average limits. Peak measurements were made with a RBW and VBW = 1 MHz. Average measurements were made with a RBW = 1 MHz and a VBW = 10 Hz.

15.7 15.207 AC LINE CONDUCTED EMISSIONS

The RF line conducted levels for emissions in the 0.45 - 30 MHz band must not exceed 250 μ V when measured with a LISN. Attached graphs and tabular data show that emissions are below the 250 μ V (48 dB μ V) maximum allowed level. Test Data are in *Appendix B*.

15.8 15.209 RADIATED EMISSIONS

The attached table shows that the Class B radiated limits from 30 - 1000 MHz are not exceeded by the EUT. The EUT was operating normally with a combination of transmission and reception and hopping one of the fifteen pseudorandom sequences during this test. The EUT was placed near one edge of a wooden table resting on a turntable. The wooden table was apIntelately 1 meter above the groundplane of the 3 meter test site. The search antennas were located at 3 meters. Measurements were made in accordance with ANSI C63.4-1994.

Test Data are in Appendix A.

ELECTRONIC COMPLIANCE LABORATORIES, INC.

Oling	12/30/99
Chip Matheny	Date:

Chief Technical Officer Electronic Compliance Laboratories, Inc.



Power = 20.17 dBm (peak reading) +0.3dB cable loss = +20.47 dBm /

111 mW

Limit: +30 dBm / 1 W maximum power

Integral Antenna (part of PCB pattern)

EIRP = +20.47dBm (peak power) +peak antenna gain (2dBii) = +22.47 dBm / 177mW

EIRP Limit: +36 dBm / 4 W maximum EIRP

15.4 15.247(c) OUT OF BAND EMISSIONS

The spectrum analyzer plots titled "Out of Band - Band Edges" show the output spectrum of the EUT while hopping one of the pseudorandom sequences and continuously transmitting packetized data. The analyzer was placed in MAX HOLD mode, and individual sweeps were recorded continually for 10 minutes with the same spectrum analyzer connection as was used for peak output power. The resultant plot shows that the EUT emissions remain inside the 2400 - 2483.5 MHz band when measured in >= 100 kHz bandwidth during operation.

The spectrum analyzer plots labeled "Out of Band 30 to 1000 MHz", " Out of Band 1 to 2.75 GHz", and "Out of Band 2.75 to 26.5 GHz" show that emissions measured in >= 100 kHz bandwidth outside of the 2400 - 2483.5 MHz band are more than 20 dB below the highest level of the desired power Test Plots are shown in *Appendix C*.

15.5 15.203 ANTENNA REQUIREMENT

The antenna is an integral part of the EUT. It is part of the printed circuit pattern on the circuit board inside the plastic case of the EUT.

15.6 15.205 RESTRICTED BAND RADIATION LIMITS

The EUT was placed on a wooden table resting on a turntable. The wooden table was apIntelately 1 meter above the groundplane of the 3 meter test site. The search antenna was moved in to 1 meter when necessary to improve the noise floor, and the appropriate range factor was applied. While the EUT was transmitting uninterrupted random data on each of the low/mid/high channels and with the spectrum analyzer on MAX HOLD, the turntable was rotated, and the search antenna raised and lowered in an attempt to maximize the received radiated emission level. Test results are attached in *Appendix D* in tabular form showing that no spurious signals were detected above the 74 dBuV/m peak/54dBuV/m



15.0 Summary of Measurements

The EUT is a USB Cordless LAN Adapter with a low power frequency hopping spread spectrum (FHSS) radio operating in the 2400-2483.5 MHz ISM band. Tests were performed with the integral antenna. An internal test connector was fitted for the conducted measurements. Test firmware resident in the EUT and was used for the test.

15.1 15.247(a)(1) FREQUENCY HOPPING SYSTEMS

The EUT uses 79 channels, each 1 MHz wide. The system hops over one of 15 pseudorandom sequences. On average, each channel is used equally. Please refer to "RangeLAN2 Frequency Hopping Theory of Operation" (confidentiality requested) in *Exhibit B* for more details.

15.2 15.247(a)(1)(ii) CHANNEL UTILIZATION

A spectrum analyzer plots labeled "Channel Utilization". The total number of channels is 79. The channels used have nominal center frequencies of 2402 through 2480 MHz. Three spectrum analyzer MAX HOLD plots labeled "20 dB Bandwidth" show the 20 dB bandwidth of the hopping channel to be < 1 MHz (965 / 955 / 860 kHz) at the low/midband/high frequencies of 2.402 / 2.44 / 2.48 GHz. Test Plots are shown in *Appendix C*.

Zero span spectrum analyzer plot labeled "Channel Occupancy" shows worstcase transmission time on a given channel:

Occupancy interval: 390ms, <100 % duty

Maximum allowed: 400 msec

Test Data in Appendix C.

15.3 15.247(b) MAXIMUM PEAK OUTPUT POWER

The three spectrum analyzer plots labeled "Power Out" show the maximum measured power of the hopping channel to be **20.17 dBm** or **104 mW**. The EUT was made to transmit uninterrupted random data on each of the low/mid/high channels.

Test Plots are shown in Appendix C.

The output was taken from an internal MMS test connector, through 1 foot of RG 142 cable, to Spectrum Analyzer set on Max Hold with no additional attenuation.



Grounding was in accordance with the manufacturers requirements and conditions for intended use.





Frequency = Frequency of emission in MHz

Raw dBm = Reading at Spectrum Analyzer(uncorrected)

Site CF = Correction Factor for cable loss Corr'd dBuV = Corrected emission level in dBuV

FCC Limit A / B = Conducted Emission level limit in $dB\mu V$ EUT Level 1* = Emission relative to the FCC Class A Limit EUT Level 2* = Emission relative to the FCC Class B Limit

Note: L1 is AC-Hot, L2 is AC-Neutral

QP is a Quasi-Peak value AV is an Average value

*A negative value indicates that the emission is below (or meets) the limit and a positive value indicates that the emission is above (or exceeds) the limit.

12.0 Equipment Under Test

The USB is a point to point, point to multipoint *Wireless Home Network Adapter* operating in the 2.4- 2.5 GHz ISM Band. The unit has an integrated antenna, which operates in a full duplex mode.

13.0 Support Equipment

Equipment Type: Compaq Presario Laptop Computer

Model Number: 1275

Serial Number: 1V99CLR792YF

Manufacturer: Compaq Computer Corporation

Comments:

Equipment Type:
Model Number:
Serial Number:
Manufacturer:
Comments:

14.0 Equipment Configuration

All of the equipment and cables were placed in worstcase positions to maximize emissions.

Interconnecting cables were of the type and length specified in the individual equipment requirements.

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Corr'd dBuV = Corrected emission level in dBuV FCC Limit A / B = Limit as stated in Part-15, Subpart B

EUT Level A* = Emission relative to the FCC Class A Limit. EUT Level B* = Emission relative to the FCC Class B Limit.

Note: V/H is the antenna polarization (Vertical or Horizontal) QP indicates the Quasi-Peak value.

*A negative value indicates that the emission is below (or meets) the limit and a positive value indicates that the emission is above (or exceeds) the limit.

11.3 Line Conducted Emissions Test Procedure

- EUT and any other equipment and cables were placed on a nonconductive table one meter above a ground screen.
- 2. The EUT's Input Power line cord was connected to a Line Impedance Stabilization Network (LISN).
- 3. All other (Non-EUT) equipment received power from a separate AC Power Source. The LISN assembly has two monitoring points: Line 1 (AC-Hot) and Line 2 (AC-Neutral). Each monitoring point was scanned by the measuring equipment (the other point was terminated in 50 ohms) over the frequency range of 450kHz to 30MHz for conducted emissions
- 4. When an emission is found, the following takes place:
 - The emission levels are maximized by equipment/cable placement.
 - b. Frequency and emission level data are entered into computer in dBm.
 - c. The monitoring point (Line 1 or 2) is entered into the computer.
 - d. The computer converts dBm to micro volts and uses a lookup table to find cable losses (in dB) at that frequency, calculates a corrected emission level, and compares the corrected emission level to the appropriate limit. The data is then printed out in tabular form.

An example of the printout and definitions follows:

11.4 Line Conducted Emissions Test Example

FREQ		SITE		FCC	Limit	EUT Le	vel (L1)
MHz	Raw (dBm)	CF (dB)	Corr'd	Class A (dBµV)	Class B (dBµV)	<u>A</u> (dB)	(dB)
1.85	-57	15.0	65.0	69.5	48.0	-4.5	+17



11.0 Test Methods

11.1 Radiated Emissions Test Procedure

- (1) EUT and any other equipment and cables used with the EUT are placed on a non-conductive table 1-meter above a ground plane.
- (2) The EUT receives the normal AC Power at the base of the table.
- (3) All equipment and cables are placed in a manner, which tends to maximize their emission characteristics in a typical application.
- (4) The table is rotated 360 degrees to determine the maximum radial emissions.
- The antenna height is varied between 1 meter and 4 meters above the ground plane to determine the maximum emissions.
 Appropriate antennas are used during the test in both the vertical and horizontal polarization.
- (6) The Spectrum Analyzer is scanned from 30 MHz to 1000 MHz for emissions. The applicable spectrum analyzer settings are:
 - a). Resolution Bandwidth = 100 kHz,
 - b). Normal Detector Mode = Peak (The Quasi-Peak is used when the emissions are near, or over the limit).
- (7) When an emission is found and maximized, the following actions are performed:
 - a). The emission frequency is entered into the computer.
 - b). The emission level is read from the spectrum analyzer in dBm and entered into the computer.
 - c). The antenna polarization is entered into the computer.
 - d). The computer converts the level in dBm to dB μ V and uses lookup tables to determine the coax cable loss, antenna factor, and pre-amp gain. A site correction factor is calculated for that particular frequency, and the data is printed out in tabular form.

11.2 Radiated Emissions Test Example

FREQ		SITE		FCC	Limit	EUT Le	vel (L1)
MHz	Raw (dBm)	CF (dB)	Corr'd (dBµV)	Class A (dBµV)	Class B (dBµV)	(dB)	(dB)
65.4	-58	-14.5	34.5	39.1	40.0	-4.6	-5.5

Frequency Raw dBm Site CF = Frequency of emission in MHz

= Reading at Spectrum Analyzer(uncorrected)

= Correction Factor for coax/antenna/preamp for that frequency. Note that a negative CF is the result of the gain of the preamp.

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10.0 FCC Limits

10.1 Radiated Emission Limits

The field strength of radiated emissions for a Class A Digital Device, when measured at a distance of 10 meters, shall not exceed the limits given in the table below. The lower limit applies at the band edge.

The field strength of radiated emissions for a Class B Digital Device, when measured at a distance of 3 meters, shall not exceed the limits given in the table below. The lower limit applies at the band edge.

Frequency (MHz)	Class A (3m) Limit (µV/m)	Class A (3m) Limit (dBµV/m)	Class A (10m) Limit (µV/m)	Class A (10m) Limit (dBµV/m)	Class B (3m) Limit (µV/m)	Class B (3m) Limit (dBµV/m)
30-88	300	49.6	90	39.1	100	40.0
88-216	500	54.0	150	43.5	150	43.5
216-960	700	56.0	210	46.4	200	46.0
Above 960	1000	60.0	300	49.5	500	54.0

10.2 Conducted Emission Limits

For a digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back into the AC power line on any frequency or frequencies within the band 450kHz to 30MHz shall not exceed the limits in the following table for the appropriate class. Compliance shall be based on the measurement of the Radio Frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

Frequency	Class A Limit	Class A Limit	Class B Limit	Class B Limit
(MHz)	<u>(μV)</u>	(dBµV)	<u>(μV)</u>	<u>(dBμV)</u>
0.45 to 1.705	1000	60.0	250	48.0
1.705 to 30.0	3000	69.5	250	48.0



9.0 FCC Class Types

9.1 CLASS A DIGITAL DEVICE

A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

9.2 CLASS B DIGITAL DEVICE

A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

Note: The responsible party may also qualify a device intended to be marketed in a commercial, business, or industrial environment as a Class B device, and in fact is encouraged to do so, provided that the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

(Code of Federal Regulations, Part 15, Subpart A, Sect. H&I) (CFR 47, Parts 0 to 19, Revised as of October 1, 1990)



8.0 Detector Functions

On any frequency or frequencies below or equal to 1000 MHz, the limits shown below are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths.

On any frequency or frequencies above 1000 MHz, the radiated limits shown below are based on the use of measuring equipment employing an average detector function.

EC Laboratories uses the Peak detection mode for normal testing and initial screening of the EUT. The Peak detection mode will produce a measurement value that is always greater than, or equal to, the quasi-peak or average detection mode. Whenever the measurement value is 6 dB below the applicable limit or greater, the appropriate detector function will be employed and recorded.

8.1 Frequency Range of Investigation

The spectrum was investigated up to the frequency specified in the following table according to the highest clock frequency generated in the device.

Highest Frequency Used (Clock)	Upper Limit of Range Measured
Below 1.705 MHz	30 MHz
1.705 to 108 MHz	1000 MHz
108 to 500 MHz	2000 MHz
500 to 1000 MHz	5000 MHz
Above 1000 MHz	10th Harmonic or 40 GHz (Whichever is Lower)









7.0 Data Reporting Format

The measurement results are expressed in accordance with FCC Part 15 Subpart B Class B limits, where applicable, are presented in tabular or graphical form.

7.1 Operating Conditions

The EUT was operated at the specified load conditions (mechanical and/or electrical) for which it was designed.

7.2 Conditions of the EUT

The EUT was operated for a sufficient period of time to apIntelate normal operating conditions.

7.3 Test Configuration

The equipment under test was configured and operated in a manner that tends to maximize its emission characteristics in a typical application. Power and signal distribution, ground, interconnecting cabling and physical placement of equipment were simulating the typical application and usage in so far as practicable. The EUT was furnished with rated voltage as specified by the manufacturer in the individual equipment's power requirements.

7.4 Test Platform

The EUT was placed on a non-conductive table having a height of 1 meter above the test site ground.

7.5 Maximization of Emissions

The test platform was rotated 360 degrees along with the moving of cabling and/or equipment in order to determine the maximum level of emissions.

7.6 Temperature

The ambient temperature of the testing location was within the range of 10 to 40 degrees Centigrade (50 to 104 Degrees Fahrenheit).









6.0 Test Equipment

The following list contains equipment used at EC Laboratories, Inc. for compliance testing. The equipment conforms to the American National Standard Specifications for Electromagnetic Interference and Field Strength Instrumentation from 10 kHz to 1000 MHz.

6.1 Test Equipment Table

Description	Manufacturer	Serial No.	Model No.
EMI Receiver	HP	3325A00137	8456A
Power Meter	HP	3125U13399	437B
Power Sensor	HP	3318A16275	8481
Spectrum Analyzer	HP	3137A01183	8563A
Pre-amp	HP	3113A05849	8447F
Pre-amp	HP	3008A00527	8449B
LISN	EM	2532	ANS-25/2
Biconical Antenna	EM	677	EM-6912
Log-Periodic Antenna	EM	858	EM-6950
Double Ridge Horn	EM	6231	EM 6961
Filter BP 1.2-4 GHz	FSY	001	HM1160-11SS
Filter BP 4-10 GHz	FSY	001	HM2950-15SS
Filter BP 10-18 GHz	FSY	001	HP8601-7SS

HP = Hewlett Packard EM = Electro Metrics FSY = FSY Microwave

Antennas used at the time the data was taken is indicated on each data page. Antenna height and polarization are also noted on the data pages.

Calibration of the measuring instruments, including any accessories that may effect such calibration, are checked frequently to assure their accuracy. Adjustments are made and correction factors applied in accordance with instructions contained in the manual for the measuring instrument. All equipment is calibrated per EC Labs' Test Equipment Calibration Schedule as required per EN 45001 and NVLAP Accredidations.

4.0 Test Equipment Settings

4.1 Test Equipment Settings

Parameter	Line Conducted Emissions	Radiated Emissions
Bandwidth	9 kHz	120kHz
*Detector Mode	Peak	Peak

^{*}Unless otherwise specified

Units of Measurement

Measurements of radiated emissions are reported in terms of microvolts per meter or in dBuV/m at a specified distance. The indicated readings on the spectrum analyzer are converted to microvolts per meter or to dBuV/m by the use of appropriate confversion factors. Measurements of conducted interference

are reported in units of microvolts or dBuV.

5.0 Antennas

5.1 Antenna Table

Antenna Type	Frequency Range	
Biconical	25 to 300 MHz	
Log Periodic	300 to 1000MHz	
Horn Double Ridge	1 to 18GHz	
Horn Parabolic	4.9 to 10GHz	
Horn Polarad	4.7 to 7.74GHz	
Horn Polarad	8.3 to 10GHz	

Correction Factors: Programmed into the software

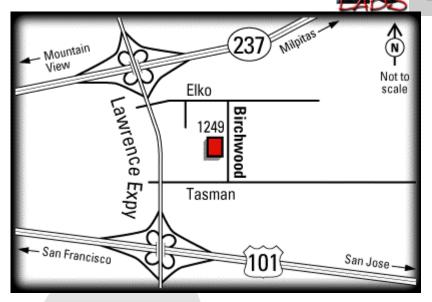
Antenna Height: Varied from 1 to 4 meters above the

ground plane

Polarization: Vertical/Horizontal

Note: The antenna used at the time that the data was taken is indicated on each data page in the apppendices. The correction factors and antenna polarization are also noted on each data page.





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peripherals and support equipment were connected to a separate power source. All emissions observed were below the FCC Class B limit. Test results are in **Appendix B.**

2.3 15.247 Operation within the 2400-2483.5 MHz band: The *Intel AnyPoint tm Cordless USB Adapter* met all the requirements. See data and plots in Appendices.

3.0 Test Facility

Name: Electronic Compliance Laboratories,

Inc.

Location: 1249 Birchwood Drive

Sunnyvale, CA 94089

Site Filing: A site description is on file at the;

Federal Communications Commission

P.O. Box 429

Columbia, MD 21045

Types of Sites: Open Field Radiated and Indoor (Screen Room).

Line Conducted: All sites are constructed and calibrated to meet ANSI C63.4-1994 requirements. Test facility is recognized by the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part

285 Code of Federal Regulations.

NVLAP Code: 20089 effective through: March 31, 2000

Location of the Sunnyval e Test Facility



2.0 General Information

Applicant: INTEL CORPORATION

Applicant Address: AL4-52

3585 S.W. 198 Ave.

Aloha, OR. 97007-1299

Contact Name: Ken Aakre
Contact Telephone: 503/642-8013
Contact Fax: 530/642-0605

EUT Description: AnyPoint™ HRF Cordless USB Adapter is a wireless point to point

home networking transmitter adapter which is easily installed in the

home environment

Model Number: APRW1USB Serial Number: A30589437 Report Number: 9120202B FCC ID Number: EJM-HRFUSB Date of Test: 11/12-20/99

Manufacturer: Intel Corporation

Type of Test: FCC Part 15 Class B ITE Certification Radiated /Conducted Emissions

FCC Part 15.247 Radiated/Conducted Measurements

Frequency Range: Conducted Emissions-450 kHz to 30 MHz – Radiated Emissions 30

MHz to 1000 MHz - Radiated Emissions 1000 MHz to 24.8 GHz - Part

15.247

Summary

Pass/Fail: PASSED

2.1 Radiated Emission Test:

The *Intel AnyPoint tm Cordless USB Adapter* was placed on a 3-meter open field test site. All emissions observed were below the applicable limit. All emissions observed were below the FCC Class B limit. Test results are in *Appendix A*.

2.2 AC Line Conducted Test:

The *Intel AnyPoint* tm *Cordless USB Adapter* was placed in a screen room and connected to AC power through a LISN. All other associated

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1.0 Verification of Compliance

EUT Description: AnyPoint™ HRF Cordless USB Adapter is a wireless point to point

home networking transmitter which is easily adaptable in the USB Port

on any computer.

Model Number: APRW1USB Serial Number: A30589437 Applicant: Intel Corporation

Type of Test: FCC Part 15 Class B ITE Certification Radiated /Conducted Emissions

FCC Part 15.247 Intentional Radiator

FCC ID Number: EJM-HRFUSB

Registration: NVLAP Code: 200089

Date of Test: 11/12-20/99

Tested By: Jook Lee, Suresh Kondapolli

The above equipment was tested by Electronic Compliance Laboratories, Inc. and found to be in compliance with the requirements set forth in the CFR 47, FCC Rules and Regulations applicable to Radio Frequency Devices and Information Technology Equipment. The equipment, in the configuration described in this report, shows that the maximum emission levels emanating from this equipment are within the compliance requirements.

Olive	Date : 12/20/99
Chip Matheny	Dato. 12/20/00
Technical Officer	
	Date: 12/30/99
Ken Aakre Quality Assurance Supervis	sor



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LABORATORIES,

INC.

ALOHA, OR. 97007-1299

Testing Date

Report Number

NOVEMBER 12-20 1999

9120202B

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FEDERAL COMMUNICATIONS COMMISSION



CERTIFICATIO

2400-2483.5 MHz FHSS

TRANSMITTER FREQUENCY HOPPING SPREAD SPECTRUM RADIO FREQUENCY DEVICE

CERTIFICATION COMPLIANCE REPORT

AnyPoint wireless-home Cordless US B Adapter

MODEL APRW1USB

CFR 47, FCC PART 15, SUBPART C, INTENTIONAL RADIATORS CFR 47, FCC PART 15, SUBPART C, CLASS B, DIGITAL DEVICES

PREPARED FOR:

TESTING PERFORMED BY:

Intel Corp.

El ectronic

Compliance

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