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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C Specifications for an Intentional Radiator on the Intel Corporation Models: WDAP5000, WSAP2000, and WSAP5000

FCC ID:	J3OWDAP5000
GRANTEE:	Intel Corporation 2300 Corporate Center Drive Thousand Oaks, CA 91320
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	April 30, 2002
FINAL TEST DATE:	January 21, 2002

AUTHORIZED SIGNATORY: _____

Juan Martinez
Senior EMC Engineer

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SCOPE

An electromagnetic emissions test has been performed on the Intel Corporation models WDAP5000, WSAP2000, and WSAP5000 pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC 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.

The test results recorded herein are based on a single type test of the Intel Corporation models WDAP5000, WSAP2000, and WSAP5000 and therefore apply only to the tested sample. The sample was selected and prepared by Jim Baer of Intel Corporation

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their 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.

STATEMENT OF COMPLIANCE

The tested sample of Intel Corporation models WDAP5000, WSAP2000, and WSAP5000 complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators.

Maintenance of FCC 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.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Intel Corporation models WDAP5000, WSAP2000, and WSAP5000. The actual test results are contained in an exhibit of this report.

LIMITS OF CONDUCTED INTERFERENCE VOLTAGE

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.207.

The following measurement was extracted from the data recorded during the conducted emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

120V, 60Hz

Frequency MHz	Level dBuV	Power Lead	EN55022 B Limit	EN55022 B Margin	Detector QP/Ave	Comments
0.150	50.4	Line 1	55.7	-5.3	AV	

LIMITS OF ANTENNA CONDUCTED POWER

This is a pre-approved module. Original FCC ID number is J3OM3AWEB56GA. This is the reason that no Antenna Conducted measurements were performed. The only change made was the antenna.

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247 and 15.209 in the case of emissions falling within the frequency bands specified in Section 15.205.

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

Frequency MHz	Level dBuV/m	Pol v/h	15.247 (c) Limit	15.247 (c) Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
2390.0	53.4	h	54.0	-0.6	Avg			Note 1

Note 1: EUT operating on the Lowest available channel in the 2.402 - 2.4835 GHz band. Signal level calculated using the relative measurements (-50.67 dBc for peak and -53.00 dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.

LIMITS OF POWER AND BANDWIDTH

This is a pre-approved module. Original FCC ID number is J3OM3AWEB56GA. This is the reason that no Antenna Conducted measurements were performed. The only change made was the antenna.

MEASUREMENT UNCERTAINTIES

ISO Guide 25 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 NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.2

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Dual Accesspoint contains a 2.4 GHz Mini PCI DSS Radio Module and a 5.15 - 5.35 GHz UNII Mini PCI Radio. There will be three model names that will cover 3 configurations. All will be using the same FCC ID number.

1) WSAP2000 will correspond to the single band 2.4 GHz Mini PCI DSSS module (15.247) in the Accespoint, only.

2) WSAP5000 will correspond to the single band 5 GHz UNII MINI PCI card (Part 15E) in the Accespoint, only.

3) WDAP5000 will correspond to a Dual Band 2.4 GHz (15.247) and the 5 GHz MINI PCI cards (Part 15E) in the Accespoint.

The device provides wireless network capabilities and will be used indoors. FCC has approved the 2.4 GHz Mini PCI as a modular device (FCC ID: J3OM3AWEB56GA). Both cards were transmitting at the same time, in the Accesspoint, to demonstrate that the Mini PCI emissions will still be in compliance. Normally, the EUT would be tabletop during operation. The EUT was treated as tabletop equipment during testing to simulate the end user environment.

The EUT uses a combination of five integral antennas to provide different radiation pattern directions. The 2.4 GHz antenna is embedded in the same PCB antenna used for the 5 GHz UNII transmitter, which has a gain of 6.2 dBi.

The sample was received on January 21, 2002 and tested on January 21, 2002. The EUT consisted of the following component(s):

Manufacturer	Model	Description	S/N	FCC ID
Intel	WDAP5000	Accesspoint w/ 2.4 DSSS & UNII 5 GHz MINI PCI cards	N/A	J30WDAP5000
Intel	WSAP2000	Accesspoint w/ 2.4 GHz MINI PCI card, only.	N/A	J30WDAP5000
Intel	WSAP5000	Accesspoint w/ UNII 5 GHz MINI PCI card, only.	N/A	J30WDAP5000
Yhi	YC-1018-S05-U	Power Supply	176890	N/A

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 25 cm wide by 4 cm deep by 15 cm high.

MODIFICATIONS

The EUT required the following modifications in order to comply with the emission specifications:

Mod. #	Test	Date	Modification
1	Radiated Digital	2/6/2002	Added finger to back side of 2.4 GHz MPCI card for better grounding.
2	Radiated Digital	2/7/2002	AP Motherboard ground plane improved. Also the modification above was still used.

SUPPORT EQUIPMENT

No local support equipment was used for emissions testing.

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

Manufacturer	Model	Description	Serial Number	FCC ID
3Com	OfficeConnect	Hub	0100\7P1F036035	-
IBM	Thinkpad	Laptop	-	-

EXTERNAL I/O CABLING

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Ethernet	Remote Hub	RJ-45	Un-shielded	10

EUT OPERATION DURING EMISSIONS

2.4 GHz DSSS radio module was tested at maximum output power. The radio was tested at low, middle, and high channels for the radiated emissions.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on January 21, 2002 at the Elliott Laboratories Open Area Test Site #4 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

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. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 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.

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.

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.

POWER METER

A power meter and thermister mount are used for all direct output power measurements from transmitters as they provide a broadband indication of the power output.

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 biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

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 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 FCC requires 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, 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.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. 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 regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is 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. 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. 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, which have values close to the specification limit, may also be measured with a tuned dipole antenna to determine compliance.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed 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.

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, SECTION 15.207

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209

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

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

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

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

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:

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

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

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

EXHIBIT 1: Test Equipment Calibration Data

Radiated Emissions, 1 - 18GHz, 22-Jan-02
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Hewlett Packard	High Pass filter, 8.2GHz	P/N 84300-80039	1156	12	3/27/01	3/27/02
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	868	12	11/13/01	11/13/02
EMCO	Horn antenna, D. Ridge 1-18GHz (SA40 system antenna)	3115	1142	12	1/29/01	1/29/02
Hewlett Packard	Spectrum Analyzer 9KHz - 26GHz	8563E	284	12	2/22/01	2/22/02

Conducted Emissions, 07-Feb-02
Engineer: Rafael

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	812	12	1/23/02	1/23/03
Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	1316	12	5/9/01	5/9/02
Solar Electronics	LISN	8012-50-R-24-BNC	305	12	7/30/01	7/30/02

Radiated Emissions, 30 - 1000 MHz, 07-Feb-02
Engineer: Rafael

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Biconical Antenna, 30-300 MHz	3110B	1320	12	5/23/01	5/23/02
EMCO	Log Periodic Antenna, 0.2-1 GHz	3146	1294	12	3/27/01	3/27/02
Rohde & Schwarz	Test Receiver, 20-1300 MHz	ESVP	1317	12	5/9/01	5/9/02

Antenna Conducte Emissions, 12-Feb-02
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Hewlett Packard	Microwave EMI test system (SA40, 30Hz - 40GHz)	84125C	1149	12	2/5/01	2/5/02

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T 45966 14 Pages

Elliott

EMC Test Data

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Emissions Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B
Immunity Spec:	N/A	Environment:	-

EMC Test Data

For The

Intel Corporation

Model

WDAP5000, WSAP2000, & WSAP5000

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Emissions Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B
Immunity Spec:	N/A	Environment:	-

EUT INFORMATION

General Description

The EUT Dual Accesspoint. It contains a 2.4 GHz Mini PCI Spread Spectrum Radio Module and a 5.15 - 5.35 GHz UNII Mini PCI Radio. The device provides wireless network capabilities and will be used indoors. The 2.4 GHz Mini PCI has been approved by FCC as Modular devices(FCC ID: J3OM3AWEB56GA). Both cards were transmitting at the same time, in the Accesspoint, to demonstrate that the Mini PCI emissions will still be in compliance.

Normally, the EUT would be placed on a tabletop during operation. The EUT was treated as tabletop equipment during testing to simulate the end-user environment. EUT electrical rating is 120Vac, 60Hz.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Intel	WDAP5000	Accesspoint w/ 2.4 DSSS & UNII 5 GHz MINI PCI cards	-	J30WDAP5000
Intel	WSAP2000	Accesspoint w/ 2.4 GHz MINI PCI card, only.	-	J30WDAP5000
Intel	WSAP5000	Accesspoint w/ UNII 5 GHz MINI PCI card,	-	J30WDAP5000
Yhi	YC-1018-S05-U	Power Supply	176890	N/A

Antenna

The EUT uses a combination of five integral antennas to provide different radiation patterns. The maximum gain of the integral PCB antenna is approximately 1.8 dBi for the OMNI pattern and 5.6 for the Half-Round Front Pattern. This are based on the 5 GHz UNII transmitter. In same PCB antenna is embeded the 2.4 GHz antenna, which has about a 6.2 dBi gain.

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Emissions Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B
Immunity Spec:	N/A	Environment:	-

EUT Enclosure

The EUT enclosure is primarily constructed of plastic. It measures approximately 25 cm wide by 4 cm deep by 15 cm high.

Modification History

Mod. #	Test	Date	Modification
1	Radiated Digital	2/6/02	Added finger to back side of 2.4 GHz MPCI card for better grounding.
2	Radiated Digital	2/6/02	AP Motherboard ground plane improved. Also the modification above was still used.

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Emissions Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B
Immunity Spec:	N/A	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None	-	-	-	-

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
3Com	OfficeConnect	Hub	0100\7P1F036035	-
IBM	Thinkpad	Laptop	-	-

Interface Ports

		Cable(s)		
Port	Connected To	Description	Shielded or Unshielded	Length(m)
Ethernet	Remote Hub	RJ-45	Un-shielded	10

EUT Operation During Emissions Testing (Digital and Radio)

The radio was transmitting at full power on the specified channels 5.18, 5.26, and 5.32GHz (maximum allowed) and at a data rate of 6 Mb/s. The channels were selected since they are at the top, center and bottom of the allocated bands.

The radio was transmitting at full power on the specified channels (center channel for radiated emissions measurements below 1GHz). The channels were selected since they are at the top, center, and bottom of the allocated bands. The RF data rate was 6 Mb/s in normal mode and 12 Mb/s in turbo mode. A data link was established between the remote PC and the EUT via the hub at 100Mb/s.

The Ethernet data rate of 100 Mb/s was selected over 10 Mb/s as preliminary testing identified this as being the worst-case Ethernet data rate. Preliminary testing also showed that an RF data rate of 6 Mb/s produced the highest power spectral density in normal mode and 12 Mb/s produced the highest output power spectral density in turbo mode.

For Intentional Radiated Emission the EUT was test in to separate modes. The EUT has the ability to change the pattern of the antenna per software means. One of the modes was the OMNI pattern, tested for both Normal and Turbo mode. The Second mode was the Half-Round Front pattern, tested for both Normal mode, only. The same antenna can be program to radiate on either pattern.

2.4 GHz DSSS radio module was tested at maximum output power. The radio was tested at low, middle, and high channels.

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B

Radiated Emissions

Test Specifics

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

Date of Test: 2/7/02
Test Engineer: Rafael
Test Location: SVOATS #2

Config. Used: See runs below
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT was located on the turntable for radiated emissions testing. Remote support equipment was located approximately 30 meters from the test area with all I/O connections routed overhead.
On the OATS, the measurement antenna was located 10 meters from the EUT for the measurement range 30 - 1000 MHz.

Ambient Conditions:

Temperature: 10.6°C
Rel. Humidity: 82%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	RE, Maximized Emissions	EN55022B	Pass	-3.9dB @ 362.998MHz

Modifications Made During Testing:

Modifications are detailed under each run description.

Deviations From The Standard

No deviations were made from the requirements of the standard.

Elliott

EMC Test Data

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B

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

New motherboard on AP, **2.4 & 5GHz Card w/ the finger contacts**

Both Cards active (2.4 & 5GHz)

Frequency	Level	Pol	EN55022 B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
362.998	33.1	h	37.0	-3.9	QP	20	2.6	
890.990	32.7	v	37.0	-4.3	QP	20	1.8	
890.990	32.2	h	37.0	-4.8	QP	215	1.0	
362.998	28.8	v	37.0	-8.2	QP	250	1.0	
824.995	25.9	h	37.0	-11.1	QP	170	1.1	
791.995	22.5	h	37.0	-14.5	QP	200	1.0	
824.995	20.3	v	37.0	-16.7	QP	40	1.5	
791.995	18.8	v	37.0	-18.2	QP	40	1.0	

Run #2: Maximized Emissions from Run #1

New motherboard on AP, **2.4 & 5GHz Card w/ the finger contacts**

Both Cards active (2.4 & 5GHz)

Frequency	Level	Pol	EN55022 B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
362.998	33.1	h	37.0	-3.9	QP	25	2.5	
890.990	32.7	v	37.0	-4.3	QP	30	1.8	
890.990	32.2	h	37.0	-4.8	QP	225	1.1	
362.998	28.8	v	37.0	-8.2	QP	265	1.0	
824.995	25.9	h	37.0	-11.1	QP	180	1.1	
791.995	22.5	h	37.0	-14.5	QP	195	1.0	

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B

Conducted Emissions - Power Ports

Test Specifics

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: 2/7/02
Test Engineer: Rafael
Test Location: SVOATS #2

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

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN.

Ambient Conditions:

Temperature: 10.6°C
Rel. Humidity: 82%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power 120V/60Hz	EN55022 B	Pass	-5.3dB @ .15MHz

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:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B

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

Frequency	Level	Power	EN55022B		Detector	Comments
MHz	dBuV	Lead	Limit	Margin	Function	
0.150	50.4	Line 1	55.7	-5.3	AV	
0.150	50.4	Neutral	55.7	-5.3	AV	
2.743	36.9	Neutral	46.0	-9.1	AV	
0.150	56.0	Neutral	65.7	-9.7	QP	
0.150	55.4	Line 1	65.7	-10.3	QP	
1.846	32.0	Line 1	46.0	-14.0	AV	
0.199	36.3	Neutral	53.6	-17.3	AV	
0.200	36.2	Line 1	53.6	-17.4	AV	
2.743	38.4	Neutral	56.0	-17.6	QP	
0.199	44.9	Neutral	63.6	-18.7	QP	
0.200	44.8	Line 1	63.6	-18.8	QP	
1.846	34.7	Line 1	56.0	-21.3	QP	

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B

FCC Part 15.247 Subpart C Test

Test Specifics

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:	1/21/02	Config. Used:	1
Test Engineer:	Jmartinez	Config Change:	None
Test Location:	SVOATS# 4	Host Unit Voltage	120Vac, 60Hz

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing.
For radiated emissions testing the measurement antenna was located 3 meters from the EUT unless stated otherwise.
When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators and cables used.

Ambient Conditions:

Temperature: 11°C
Rel. Humidity: 80%

Summary of Results

Run #	Test Performed	Limit	Result	Comments
1	RE, 1000 - 24,000 MHz - Spurious Emissions	15.247/15.205	Pass	Refer to individual runs

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.

2.4GHz antenna Gain: 6.2 dBi

Elliott

EMC Test Data

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B

Run #1a: Radiated Spurious Emissions, 1000 - 40000 MHz
Testing the 802.11b card. 802.11a card off.

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
EUT On Channel Available (High Channel 2.480GHz)								
4824.0	48.6	h	74.0	-25.4	Pk	108	1.0	Note 2
4824.0	36.1	h	54.0	-17.9	Avg	108	1.0	Note 2
2483.7	58.1	h	74.0	-15.9	Pk	5	1.6	Note 2; Spurious emission
2483.7	53.0	h	54.0	-1.0	Avg	5	1.6	Note 2' Spurious emission
2489.0	38.3	h	54.0	-15.7	Pk	167	1.2	Note 2; Spurious emission
2494.0	47.0	h	54.0	-7.0	Pk	160	1.2	Note 2' Spurious emission
2483.7	47.9	v	54.0	-6.1	Pk	70	1.4	Note 2; Spurious emission
2489.0	45.1	v	54.0	-8.9	Pk	70	1.4	Note 2; Spurious emission
2494.0	50.1	v	54.0	-3.9	Pk	70	1.4	Note 2' Spurious emission
EUT on Middle Channel 2.437 MHz								
4874.0	47.8	V	54.0	-6.2	Pk	138	1.4	Peak reading, average limit
7310.2	50.6	V	74.0	-23.4	Pk	70	1.2	Restricted
7310.2	38.4	V	54.0	-15.6	Avg	70	1.2	Restricted
9747.8	50.7	V	74.0	-23.3	Pk	0	0.0	Non-Restricted
4874.0	49.9	H	74.0	-24.1	Pk	133	1.3	Restricted
4874.0	44.0	H	54.0	-10.0	Avg	133	1.3	Restricted
7310.2	50.2	H	74.0	-23.8	Pk	0	1.4	Restricted
7310.2	38.0	H	54.0	-16.0	Avg	0	1.4	Restricted
9747.8	51.9	H	74.0	-22.1	Pk	23	1.3	Non-Restricted
EUT On Low Channel (2.412 GHz)								
2433.7	58.4	h	93.0	-34.6	Pk	90	1.4	Note 3; Spurious emission
2455.7	52.0	h	93.0	-41.1	Pk	90	1.4	Note 3; Spurious emission
2433.7	53.8	v	93.0	-39.2	Pk	90	1.4	Note 3; Spurious emission
2455.7	46.9	v	93.0	-46.1	Pk	245	1.5	Note 3; Spurious emission

Note 1:	No harmonic emission detected beyond 2nd harmonic within 20-dB of the limit.
Note 2:	Restricted emissions
Note 3:	Non-Restricted emissions

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EMC Test Data

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B

Run #1b: Radiated Spurious Emissions, 1000 - 40000 MHz
Still testing 802.11b card, but with 802.11a MINI PCI transmitting also.

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
EUT on the High Channel 2.480GHz. With 802.11a on at full power.								
2483.7	58.2	h	74.0	-15.8	Pk	5	1.6	Note 2
2483.7	53.2	h	54.0	-0.8	Avg	5	1.6	Note 2
2489.0	45.1	h	54.0	-8.9	Pk	223	1.5	Note 2; Spurious emission
2494.0	50.1	h	54.0	-3.9	Pk	85	1.2	Note 2' Spurious emission
2351.7	52.2	h	54.0	-1.8	Pk	0	1.4	Note 2; Spurious emission
2505.0	50.1	h	54.0	-3.9	Pk	155	1.6	Note 2' Spurious emission
2483.7	51.7	v	54.0	-2.3	Pk	266	1.3	Note 2; Spurious emission
2489.0	41.7	v	54.0	-12.3	Pk	266	1.3	Note 2; Spurious emission
2494.0	43.4	v	54.0	-10.6	Pk	266	1.3	Note 2' Spurious emission
EUT on Middle Channel 2.437 MHz								
4874.0	49.5	V	74.0	-24.5	Pk	116	1.1	Restricted
4873.9	38.9	V	54.0	-15.1	Avg	116	1.1	Restricted
7311.5	56.3	V	74.0	-17.7	Pk	200	1.2	Restricted
7311.2	42.3	V	54.0	-11.7	Avg	200	1.2	Restricted
9747.8	56.7	V	74.0	-17.3	Pk	42	1.4	Non-Restriced
9747.8	54.4	H	74.0	-19.6	Pk	6	1.2	Non-Restriced
7310.2	52.3	H	74.0	-21.7	Pk	325	1.4	Restricted
7310.2	41.5	H	54.0	-12.5	Avg	325	1.4	Restricted
4874.0	51.3	H	74.0	-22.7	Pk	113	1.3	Restricted
4874.0	45.5	H	54.0	-8.5	Avg	113	1.3	Restricted
EUT On Low Channel (2.412 GHz) w/ 802.11a on at full power								
4824.0	46.9	h	74.0	-27.1	Pk	176	1.5	Note 1; Note: 2
4824.0	28.7	h	54.0	-25.3	Avg	176	1.5	Note 1; Note: 2
2433.7	57.7	h	92.0	-34.3	Pk	176	1.5	Note 3; Spurious emission
2455.7	47.8	h	92.0	-44.2	Pk	309	1.7	Note 3; Spurious emission
2433.7	52.9	v	92.0	-39.1	Pk	85	1.0	Note 3; Spurious emission
2455.7	43.8	v	92.0	-48.2	Pk	85	1.0	Note 3; Spurious emission
2367.7	45.4	v	54.0	-8.6	Pk	264	1.4	Note 3; Spurious emission
2367.7	48.2	h	54.0	-5.8	Pk	162	1.6	Note 3; Spurious emission

Note 1:	No harmonic emission detected beyond 2nd harmonic within 20-dB of the limit.
Note 2:	Restricted emissions
Note 3:	Non-Restricted emissions

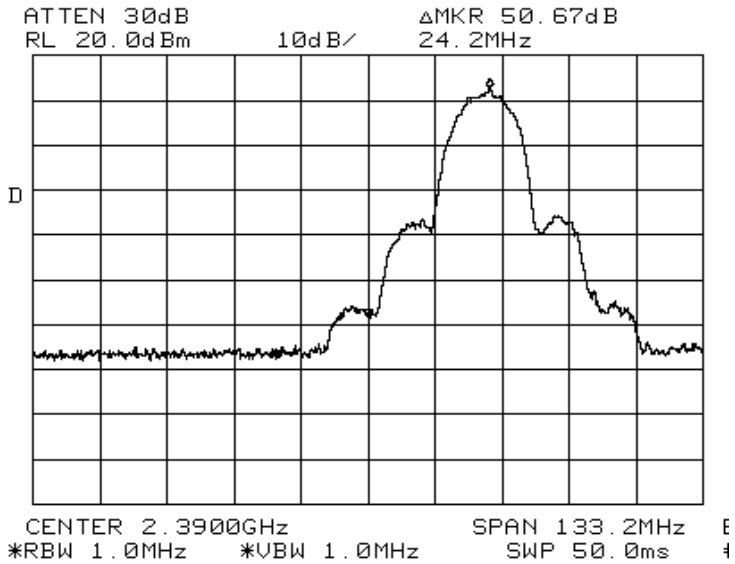
Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B

Fundamental Bandedge Low Channel								
2413.249	108.8	V	-	-	Pk	78	1.2	Peak reading, peak limit
2412.352	101.6	V	-	-	Avg	78	1.2	Average reading, average limit
2413.389	113.5	H	-	-	Pk	89	1.8	Peak reading, peak limit
2412.394	106.4	H	-	-	Avg	89	1.8	Average reading, average limit

Band Edge Field Strength Calculations

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2390.0	58.3	v	74.0	-15.7	Pk			Note 1
2390.0	48.6	v	54.0	-5.4	Avg			Note 1
2390.0	63.0	h	74.0	-11.0	Pk			Note 1
2390.0	53.4	h	54.0	-0.6	Avg			Note 1

Note 1:	EUT operating on the Lowest available channel in the 2.402 - 2.4835 GHz band. Signal level calculated using the relative measurements (-50.67 dBc for peak and -53.00 dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.



Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
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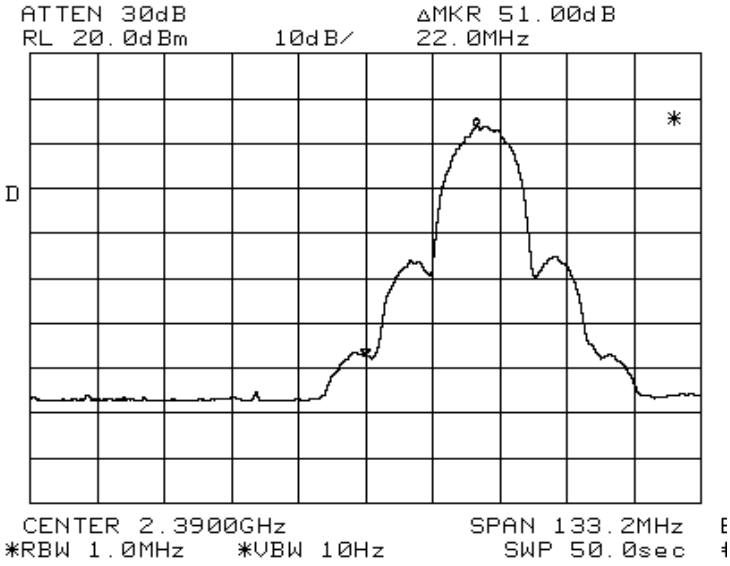

EMC Test Data

Client:	Intel Corporation	Job Number:	J45759
Model:	WDAP5000, WSAP2000, & WSAP5000	T-Log Number:	T45966
		Proj Eng:	Mark Briggs
Contact:	Robert Paxman		
Spec:	FCC Part 15 B and E, RSS-210, EN55022	Class:	B

Fundamental Bandedge (High Channel)

2409.163	105.7	V	-	-	Pk	277	1.8	Peak reading, peak limit
2409.273	98.8	V	-	-	Avg	277	1.8	Average reading, average limit
2411.792	112.3	h	-	-	Pk	7	1.8	Peak reading, peak limit
2411.072	106.3	h	-	-	Avg	7	1.8	Average reading, average limit

Band Edge Field Strength Calculations

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.5	55.2	v	74.0	-18.8	Pk			Note 1
2483.5	45.5	v	54.0	-8.5	Avg			Note 1
2483.5	61.8	h	74.0	-12.2	Pk			Note 1
2483.5	53.0	h	54.0	-1.0	Avg			Note 1

Note 1:	EUT operating on the Highest available channel in the 2.402 - 2.4835 GHz band. Signal level calculated using the relative measurements (-50.50 dBc for peak and -53.34 dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.