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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 Dell Computer Corporation Model: WM3A2100*

FCC ID: E2K24CLNS

GRANTEE: Dell Computer Corporation
One Dell Way
Round Rock, TX 78613

TEST SITE: Elliott Laboratories, Inc.
684 W. Maude Avenue
Sunnyvale, CA 94086

REPORT DATE: January 21, 2003

FINAL TEST DATE: January 15, January 16, and January 17, 2003

AUTHORIZED SIGNATORY: Mark Briggs
Director of Engineering

ACCREDITED

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## *DECLARATIONS OF COMPLIANCE*

Equipment Name and Model:
WM3A2100

Manufacturer:
Dell Computer Corporation
One Dell Way
Round Rock, TX 78613

Tested to applicable standards:
RSS-210, Issue 5, November 2001 (Low Power License-Exempt Radiocommunication Devices)
FCC Part 15 Subpart C (DTS)

Test Report Prepared For:
Jason Limoges
Dell Computer Corporation
One Dell Way
Round Rock, TX 78613
USA

Measurement Facility Description Filed With Department of Industry:

Departmental Acknowledgement Number: IC2845 **SV1** Dated July 30, 2001
Departmental Acknowledgement Number: IC2845 **SV4** Dated July 19, 2001

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above mentioned departmental standards (through the use of ANSI C63.4 as detailed in section 5.3 of RSS-210, Issue 4); and that the equipment performed in accordance with the data submitted in this report.

| | |
|---|---|
| Signature | _____ |
| Name | Mark Briggs |
| Title | Director of Engineering |
| Company | Elliott Laboratories Inc. |
| Address | 684 W. Maude Ave |
| | Sunnyvale, CA 94086 |
| | USA |
| Date: | January 21, 2003 |

Maintenance of compliance with the above standards 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.).

## *SCOPE*

An electromagnetic emissions test has been performed on the Dell Computer Corporation model WM3A2100 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 Dell Computer Corporation model WM3A2100 and therefore apply only to the tested sample. The sample was selected and prepared by Jason Limoges of Dell Computer 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 Dell Computer Corporation model WM3A2100 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.).

## *SUMMARY OF RESULTS*

### *OPERATION IN THE 2400-2483.5MHz BAND*

| FCC Part 15 Section | Description | Measured Value | Comments | Result |
|---|---|---|---|---|
| 15.247(a) | Digital Modulation | Systems uses Direct Sequence Spread Spectrum techniques | System must utilize a digital transmission technology | Complies |
| 15.247 (a) (2) | 6dB Bandwidth | > 12.1 MHz * | Minimum allowed is 500kHz | Complies |
| 15.247 (b) (3)<br>15.247 (b)(4) (i) | Output Power | 16.4 dBm<br>(0.0437 Watts)<br>EIRP = 0.06 W* | Multi-point applications: Maximum permitted is 1Watt, with EIRP limited to 4 Watts. | Complies |
| 15.247(d) | Power Spectral Density | -5.50 dBm / MHz * | Maximum permitted is 8dBm/3kHz | Complies |
| 15.247(c) | Spurious Emissions – Antenna Conducted 30MHz – 25GHz | All spurious emissions < -20dBc | All spurious emissions < -20dBc. Emissions in restricted bands must meet the radiated emissions limits detailed in 15.207 | Complies |
| 15.247(c) / 15.209 | Radiated Spurious Emissions 30MHz – 25GHz | -1.0 dB @ 2483.5MHz * | | Complies |
| 15.207 | AC Conducted Emissions | 56 dBuV @ .215 MHz<br>(-7.0 dB) * | Conducted emissions from the AC power port must meet the limits set forth in 15.207 | Complies |
| 15.247 (b) (5) | RF Exposure Requirements | The user's manual instructs the user to operate the device with a separation distance meeting the rf safety requirements. Refer to MPE report. | | Complies |
| 15.203 | RF Connector | Antenna and connector is integral to the host device | Integral antenna or specialized connector required | Complies |

EIRP calculated using antenna gain of 1.4dBi (1.38) in the 2.4 GHz band

* The worst-case measurements were picked from the two laptops that were tested (each laptop configured with a different antenna). Please refer to test data included in this report.

***MEASUREMENT UNCERTAINTIES***

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with 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 | ± 3.6 |

## *EQUIPMENT UNDER TEST (EUT) DETAILS*

### *GENERAL*

The Dell Computer Corporation model PP05L with the Intel Corporation model WM3A2100 is a wireless 802.11b Mini PCI card installed in the Dell Corporation model PP05L. The 802.11b card is designed to provide wireless networking for home or office environments. Normally, the host laptop model PP05L would be placed on a table top during operation. The system was, therefore, treated as table-top equipment during testing to simulate the end user environment. The electrical rating of the laptop is 120/240 V, 50/60 Hz, 2 Amps.

The WMA3A2100 will be installed in the Dell model number PP05L chassis. This chassis is used for the Dell Inspiron and Dell Latitude series of laptops. The EUT was actually tested in a Dell Inspiron laptop. Based on the common chassis between the two models, the radiated emissions data detailed in this report will be applicable to the Latitude.

The WM3A2100 can use two different antenna systems, a Hitachi Bondi antenna with 0.6dBi of gain in the 2.4GHz band or a Wistron Neweb Bondi antenna with a gain of 1.45dBi in the 2.4GHz band. The antenna gains include the cable loss of the cable between the EUT and the antenna. The antennas are mounted in the display section of the host laptop. Both antennas have a main antenna and an auxiliary antenna to provide spatial diversity. The antenna system is located on the left side of the laptop, in the base towards the back.

Radiated emissions tests were performed on two systems, one configured with the Hitachi antenna and the other with the Wistron Neweb antenna. For both configurations the system was operating with the higher gain main antenna transmitting rather than the lower gain auxiliary antenna.

The host laptops also contain a BlueTooth module (FCC ID: IXMUB22111S). The rf exposure exhibit for this application presents a case for not considering these two devices to be co-located, therefore the modular approval for the BlueTooth module will be used as the basis for FCC authorization of this device.

The sample was received on January 15, 2003 and tested on January 15, January 16 and January 17, 2003. The EUT consisted of the following component(s):

| Manufacturer/Model/Description | FCC ID |
|---|---|
| Dell Inspiron / Latitude Laptop PC | |
| Intel WM3A2100 802.11b Mini PCI Transceiver | |

### *ENCLOSURE*

The EUT has no enclosure. It is designed to be installed within the enclosure of a host computer.

***MODIFICATIONS***

No modifications were made to the EUT during testing.

***SUPPORT EQUIPMENT***

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

| Manufacturer/Model/Description | Serial Number | FCC ID Number |
|---|---|---|
| Dell Inspiron Laptop | TW-034652-12800-2AN-0279 Rev X04 | DoC |
| Dell/AA22850/AC Adapter | - | - |
| US Robotics/Pilot 1000/PDA | 604819965702 | MQ90001 |
| Hewlett Packard/2225C/Printer | 2714540166 | DS16XU2225 |

***EXTERNAL I/O CABLING***

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

| Cable Description | Length (m) | From Unit/Port | To Unit/Port |
|---|---|---|---|
| Serial | 2 | Laptop Serial | PDA |
| Parallel | 1.5 | Laptop interface | Printer |
| AC | 1.8 | AC | Laptop |

***TEST SOFTWARE***

Digital Operation During Emission:

EUT was transmitting continuously to the main antenna on Channel 6 (2437MHz) with the nominal settings for maximum output power (Gain 3, Bias 35, Scale 13). The laptop had scrolling H's on the display.

Radio Operation During Emission:

EUT tested at the low, middle, and high channel. The EUT was configured to transmit at highest output power. The data rate of 1Mb/s was selected as this produced the highest output power and highest output power spectral density.

## *TEST SITE*

### *GENERAL INFORMATION*

Final test measurements were taken on January 15, January 16 and January 17, 2003 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.

### *CONDUCTED EMISSIONS CONSIDERATIONS*

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

### *RADIATED EMISSIONS CONSIDERATIONS*

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. 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 and 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 peak power sensor are used for all 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:

***AC MAINS CONDUCTED EMISSIONS SPECIFICATION LIMITS, RSS 210***

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

***AC MAINS CONDUCTED EMISSIONS SPECIFICATION LIMITS, FCC SECTION 15.207***

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

***RADIATED EMISSIONS SPECIFICATION LIMITS***

Industry Canada and the FCC state that the levels of emissions outside of the allocated band shall be attenuated by at least 20dB form the maximum in-band level as measured in a 100kHz bandwidth. The FCC further require that emissions that fall in restricted bands meet the limits outlined in FCC Part 15.209 as detailed in the table below:

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

***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 - For RSS 210, 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*

1 Page

**Radiated Emissions, 1 - 26.5 GHz, 16-Jan-03**
**Engineer: Chris**

| Manufacturer | Description | Model # | Assett # | Cal interval | Last Calibrated | Cal Due |
|---|---|---|---|---|---|---|
| EMCO | Horn Antenna, D. Ridge 1-18GHz | 3115 | 487 | 12 | 4/22/2002 | 4/22/2003 |
| Hewlett Packard | Spectrum Analyzer 9KHz - 26.5GHz, non programable | 8563E | 284 | 12 | 3/21/2002 | 3/21/2003 |
| Miteq | Preamplifier, 1-18GHz | AFS44 | 1346 | 12 | 1/6/2003 | 1/6/2004 |
| Hewlett Packard | High Pass filter, 3.5GHz | P/N 84300-80038 | 1157 | 12 | 3/1/2002 | 3/1/2003 |

**Antenna Conducted Emissions, 18-Jan-03**
**Engineer: jmartinez**

| Manufacturer | Description | Model # | Assett # | Cal interval | Last Calibrated | Cal Due |
|---|---|---|---|---|---|---|
| Rohde & Schwarz | Peak Power Sensor 100uW - 2 Watts | NRV-Z32 | 1423 | 12 | 9/6/2002 | 9/6/2003 |
| Rohde & Schwarz | Power Meter | NRVS | 1422 | 12 | 9/6/2002 | 9/6/2003 |
| Hewlett Packard | Spectrum Analyzer, 9KHz - 26.5GHz | 8563E | F1202LB | 12 | 9/27/2002 | 9/27/2003 |

**Radiated Emissions, 1 - 26.5 GHz, 16-Jan-03**
**Engineer: Chris**

| Manufacturer | Description | Model # | Assett # | Cal interval | Last Calibrated | Cal Due |
|---|---|---|---|---|---|---|
| EMCO | Horn Antenna, D. Ridge 1-18GHz | 3115 | 487 | 12 | 4/22/2002 | 4/22/2003 |
| Hewlett Packard | Spectrum Analyzer 9KHz - 26.5GHz, non programable | 8563E | 284 | 12 | 3/21/2002 | 3/21/2003 |
| Miteq | Preamplifier, 1-18GHz | AFS44 | 1346 | 12 | 1/6/2003 | 1/6/2004 |
| Hewlett Packard | High Pass filter, 3.5GHz | P/N 84300-80038 | 1157 | 12 | 3/1/2002 | 3/1/2003 |

**Antenna Conducted Emissions, 18-Jan-03**
**Engineer: jmartinez**

| Manufacturer | Description | Model # | Assett # | Cal interval | Last Calibrated | Cal Due |
|---|---|---|---|---|---|---|
| Hewlett Packard | Spectrum Analyzer 9KHz - 26.5GHz, non programable | 8563E | 284 | 12 | 3/21/2002 | 3/21/2003 |

**Antenna Conducted Emissions, 18-Jan-03**
**Engineer: jmartinez**

| Manufacturer | Description | Model # | Assett # | Cal interval | Last Calibrated | Cal Due |
|---|---|---|---|---|---|---|
| Rohde & Schwarz | Attenuator, 20dB , 50 ohms, 10W, DC-18 GHz | 20dB, 10W, Type N | 1241 | 12 | 8/15/2002 | 8/15/2003 |
| Rohde & Schwarz | Peak Power Sensor 100uW - 2 Watts | NRV-Z32 | 1423 | 12 | 9/6/2002 | 9/6/2003 |
| Rohde & Schwarz | Power Meter | NRVS | 1422 | 12 | 9/6/2002 | 9/6/2003 |

**Conducted and Radiated Emissions, 20-Jan-03**
**Engineer: rwong**

| Manufacturer | Description | Model # | Assett # | Cal interval | Last Calibrated | Cal Due |
|---|---|---|---|---|---|---|
| Elliott Laboratories | Biconical Antenna, 30-300 MHz | EL30.300 | 773 | 12 | 3/5/2002 | 3/5/2003 |
| EMCO | LISN, 10kHz-100MHz | 3825/2 | 1293 | 12 | 6/2/2002 | 6/2/2003 |
| Rohde& Schwarz | Pulse Limiter | ESH3 Z2 | 1398 | 12 | 1/10/2003 | 1/10/2004 |
| Rohde & Schwarz | Test Receiver, 9kHz-2750MHz | ESCS 30 | 1337 | 12 | 12/27/2002 | 12/27/2003 |

**Conducted Emissions, 20-Jan-03**
**Engineer: rwong**

| Manufacturer | Description | Model # | Assett # | Cal interval | Last Calibrated | Cal Due |
|---|---|---|---|---|---|---|
| Fischer Custom Comm. | LISN, Freq. 0.9 -30 MHz,16 Amp | FCC-LISN-50/250-16-2 | 1079 | 12 | 7/2/2002 | 7/2/2003 |

# *EXHIBIT 2: Test Data Log Sheets*

**ELECTROMAGNETIC EMISSIONS**

**TEST LOG SHEETS**

**AND**

**MEASUREMENT DATA**

T 49892 20 Pages
T 49893 14 Pages

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Emissions Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | B / DSSS |
| Immunity Spec: | N/A | Environment: | - |

# EMC Test Data

For The

## Intel

Model

**WM3A2100 inside Dell PP05L with Neweb antenna**

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Emissions Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | B / DSSS |
| Immunity Spec: | N/A | Environment: | - |

# EUT INFORMATION

## General Description

The EUT is a Dell laptop (Chassis PP05L) containing a mini PCI 802.11b transceiver operating in the 2400-2483.5MHz band. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end user environment.

## Equipment Under Test

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| Intel Corporation | WM3A2100 | 802.11b Mini PCI card | N/A | TBD |
| Dell | Inspiron | Laptop | TW-034652-12800-2AN-0279 Rev X04 | DoC |
| Dell | AA22850 | AC Adapter | - | - |

## EUT Enclosure

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

## Modification History

| Mod. # | Test | Date | Modification |
|---|---|---|---|
| 1 | - | - | None |

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Emissions Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | B / DSSS |
| Immunity Spec: | N/A | Environment: | - |

# Test Configuration #1

## Local Support Equipment

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| Dell | Inspiron | Laptop | TW-034652-12800-2AN-0279 Rev X04 | DoC |
| Dell | AA22850 | AC Adapter | - | - |

## Remote Support Equipment

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

## Interface Cabling and Ports

| | | Cable(s) | | |
|---|---|---|---|---|
| Port | Connected To | Description | Shielded or Unshielded | Length(m) |
| AC | Laptop | 3 wire | Unshielded | 1.8 |

Note: No ports were connected during the Radio test.

## Radio Operation During Emissions

EUT tested at the low, middle, and high channel. The highest output power was tested. All settings were adjusted to produce worst case mode. During radiated emissions testing the EUT was transmitting into the main antenna rather than the auxiliary antenna as the main antenna has the highest gain.

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

# Radiated Emissions

## 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: 1/15&16/2003
Test Engineer: Rafael / Chris
Test Location: SVOATS #4

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

## General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.
For radiated emissions testing the measurement antenna was located 3 meters from the EUT.
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 used.

## Ambient Conditions:

Temperature: 7°C / 13°C
Rel. Humidity: 82% / 72%

## Summary of Results

| Run # | Test Performed | Limit | Result | Margin |
|---|---|---|---|---|
| 1 | RE, 30 - 25000 MHz - Spurious Emissions | FCC Part 15.209 / 15.247( c) | Pass | See runs below |
| 2 | RE, 30 - 25000 MHz - Spurious Emissions | FCC Part 15.209 / 15.247( c) | Pass | See runs below |
| 3 | RE, 30 - 25000 MHz - Spurious Emissions | FCC Part 15.209 / 15.247( c) | Pass | See runs below |

## 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.

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

**Run #1a: Radiated Spurious Emissions. Low Channel @ 2412 MHz**

Neweb Antenna, Rate=1, Gain=4, Bias=35, Scale=13, Output measured power=16.25dBm

Main antenna tested

| Frequency | Level | Pol | 15.209 / 15.247 | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | v/h | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 2412.999 | 105.0 | H | - | - | Pk | 200 | 1.8 | |
| 2412.809 | 101.3 | H | - | - | Avg | 200 | 1.8 | |
| 2413.066 | 106.8 | V | - | - | Pk | 160 | 1.0 | |
| 2412.801 | 103.4 | V | - | - | Avg | 160 | 1.0 | |
| 2390.000 | 52.8 | V | 54.0 | -1.2 | Avg | 160 | 1.0 | |
| 2390.000 | 52.2 | H | 54.0 | -1.8 | Avg | 200 | 1.8 | |
| 7232.792 | 47.7 | V | 54.0 | -6.3 | Avg | 90 | 1.2 | |
| 7232.762 | 47.0 | H | 54.0 | -7.0 | Avg | 325 | 2.0 | |
| 4824.014 | 45.3 | V | 54.0 | -8.7 | Avg | 165 | 1.2 | |
| 2390.000 | 64.1 | V | 74.0 | -9.9 | Pk | 160 | 1.0 | |
| 2390.000 | 63.4 | H | 74.0 | -10.6 | Pk | 200 | 1.8 | |
| 4823.998 | 42.3 | H | 54.0 | -11.7 | Avg | 20 | 1.7 | |
| 7232.680 | 54.4 | H | 74.0 | -19.6 | Pk | 325 | 2.0 | |
| 7232.442 | 53.9 | V | 74.0 | -20.1 | Pk | 90 | 1.2 | |
| 4823.913 | 50.7 | V | 74.0 | -23.3 | Pk | 165 | 1.2 | |
| 4823.794 | 50.2 | H | 74.0 | -23.8 | Pk | 20 | 1.7 | |

| | |
|---|---|
| Note 1: | For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental. |

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

**Run #1b: Radiated Spurious Emissions. Center Channel @ 2437 MHz**

Neweb Antenna, Rate=1, Gain=3, Bias=35, Scale=13, Output measured power=16.3dBm

Main antenna tested

| Frequency | Level | Pol | 15.209 / 15.247 | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | v/h | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 2436.897 | 106.8 | V | - | - | Pk | 180 | 1.8 | |
| 2437.901 | 103.1 | V | - | - | Avg | 180 | 1.8 | |
| 2436.847 | 104.0 | H | - | - | Pk | 280 | 1.9 | |
| 2437.929 | 100.2 | H | - | - | Avg | 280 | 1.9 | |
| 7307.763 | 41.1 | V | 54.0 | -12.9 | Avg | 100 | 1.2 | |
| 4874.033 | 40.6 | V | 54.0 | -13.4 | Avg | 150 | 1.6 | |
| 7307.679 | 39.4 | H | 54.0 | -14.6 | Avg | 110 | 2.0 | |
| 4874.017 | 39.2 | H | 54.0 | -14.8 | Avg | 100 | 1.2 | |
| 7307.255 | 49.4 | V | 74.0 | -24.6 | Pk | 100 | 1.2 | |
| 7307.474 | 48.6 | H | 74.0 | -25.4 | Pk | 110 | 2.0 | |
| 4873.796 | 48.6 | V | 74.0 | -25.4 | Pk | 150 | 1.6 | |
| 4874.017 | 48.2 | H | 74.0 | -25.8 | Pk | 100 | 1.2 | |

| | |
|---|---|
| Note 1: | For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental. |

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

**Run #1c: Radiated Spurious Emissions. High Channel @ 2462 MHz**

Neweb Antenna, Rate=1, Gain=3, Bias=35, Scale=13, Output measured power=16.4dBm

Main antenna tested

| Frequency | Level | Pol | 15.209 / 15.247 | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | v/h | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 2462.982 | 104.1 | H | - | - | Pk | 280 | 1.9 | |
| 2462.821 | 100.4 | H | - | - | Avg | 280 | 1.9 | |
| 2461.931 | 107.3 | V | - | - | Pk | 220 | 1.9 | |
| 2462.793 | 103.5 | V | - | - | Avg | 220 | 1.9 | |
| 2483.527 | 53.0 | V | 54.0 | -1.0 | Avg | 220 | 1.9 | |
| 2483.500 | 52.5 | H | 54.0 | -1.5 | Avg | 280 | 1.9 | |
| 2483.527 | 65.0 | V | 74.0 | -9.0 | Pk | 220 | 1.9 | |
| 4924.012 | 45.0 | V | 54.0 | -9.0 | Avg | 215 | 1.8 | |
| 2483.500 | 63.8 | H | 74.0 | -10.2 | Pk | 280 | 1.9 | |
| 4924.012 | 43.1 | H | 54.0 | -10.9 | Avg | 190 | 1.8 | |
| 7381.547 | 34.3 | V | 54.0 | -19.7 | Avg | 170 | 1.2 | |
| 7381.821 | 33.6 | H | 54.0 | -20.4 | Avg | 120 | 1.5 | |
| 4923.989 | 50.8 | V | 74.0 | -23.2 | Pk | 215 | 1.8 | |
| 4923.986 | 50.4 | H | 74.0 | -23.6 | Pk | 190 | 1.8 | |
| 7382.983 | 45.9 | V | 74.0 | -28.1 | Pk | 170 | 1.2 | |
| 7381.927 | 45.3 | H | 74.0 | -28.7 | Pk | 120 | 1.5 | |

| | |
|---|---|
| Note 1: | For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental. |

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

# Radiated Emissions

## 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: | 1/17/2003 | Config. Used: | 1 |
| Test Engineer: | jmartinez | Config Change: | None |
| Test Location: | SVOATS #4 | Host Unit Voltage | Host provides power to EUT |

## General Test Configuration

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 used.

## Ambient Conditions:

Temperature: 14°C

Rel. Humidity: 45%

## Summary of Results

| Run # | Test Performed | Limit | Result | Margin |
|---|---|---|---|---|
| 1 | 6dB Bandwidth | 15.247(a) | Pass | Refer to run |
| 2 | Output Power | 15.247(b) | Pass | Refer to run |
| 3 | Power Spectral Density (PSD) | 15.247(d) | Pass | Refer to run |
| 4 | Out of Band | 15.247(c) | Pass | Refer to run |

## Modifications Made During Testing:

No modifications were made to the EUT during testing

## Deviations From The Standard

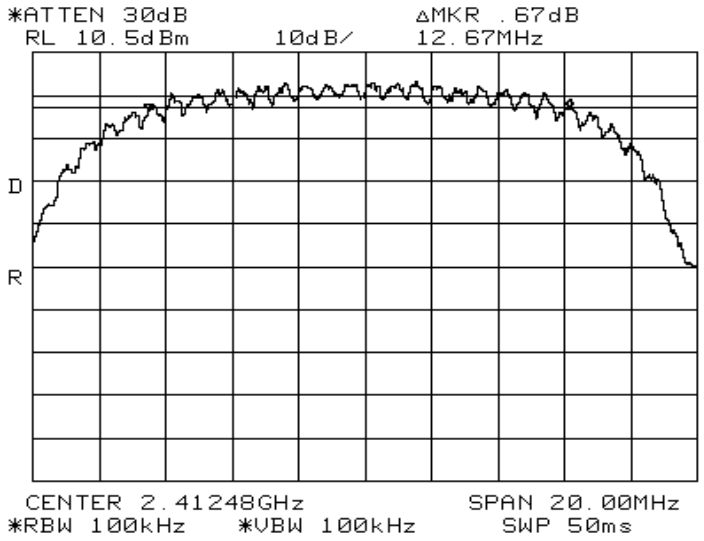
No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

**Run #1: Signal Bandwidth**

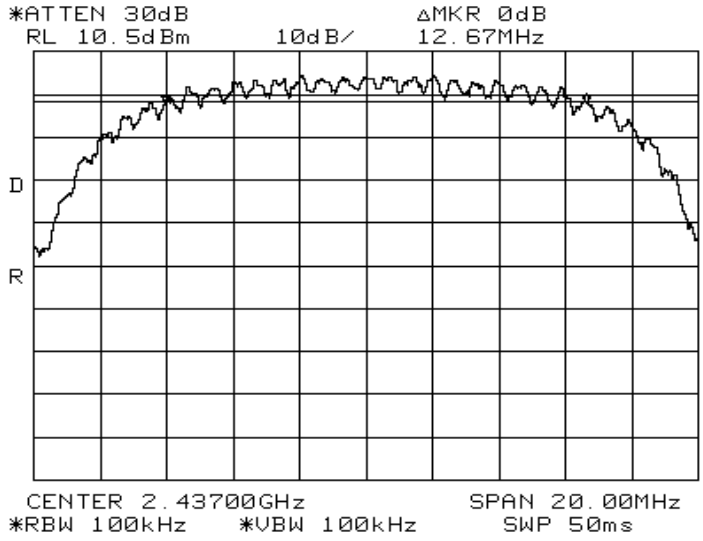
| Channel | Frequency (MHz) | Resolution Bandwidth | 6dB Signal Bandwidth | Graph reference # |
|---|---|---|---|---|
| 1 | 2412 | 100 kHz | 12.67 MHz | Refer to plots below |
| 6 | 2437 | 100 kHz | 12.67 MHz | Refer to plots below |
| 11 | 2462 | 100 kHz | 13.10 MHz | Refer to plots below |

**2412 MHz**

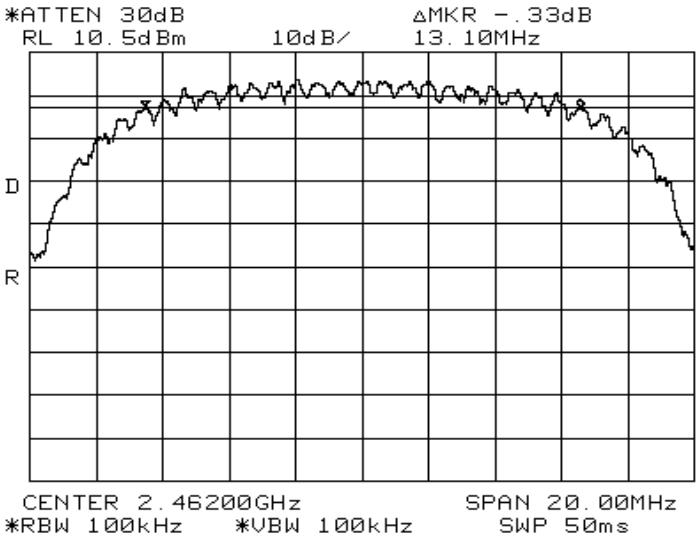


| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

**2437 MHz**




**2462 MHz**



| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

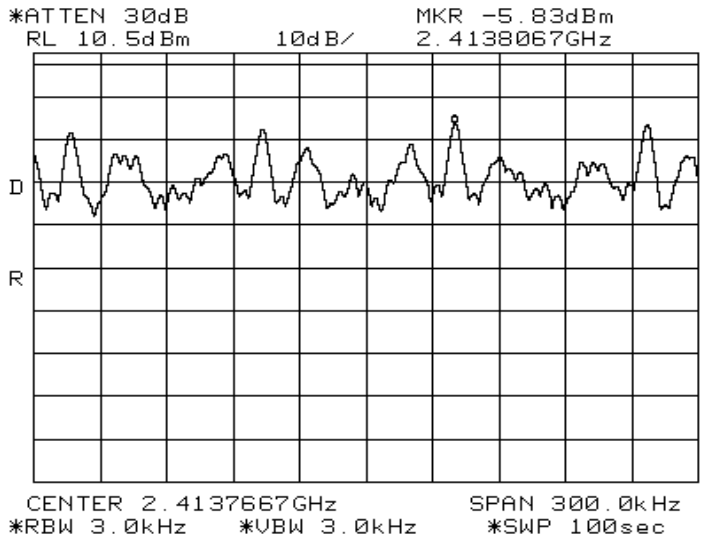
**Run #2: Peak Output Power**

| Channel | Frequency | Power | Rate | Antenna | Step | Gain | Bias | scale |
|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBm) | (Mb/s) | | | | | |
| 1 | 2412 | 16.3 | 11 | 1 | 0 | 4 | 35 | 13 |
| 6 | 2437 | 16.3 | 11 | 1 | 0 | 3 | 35 | 13 |
| 11 | 2462 | 16.4 | 11 | 1 | 0 | 3 | 35 | 13 |

**Run #3: Power Spectral Density**

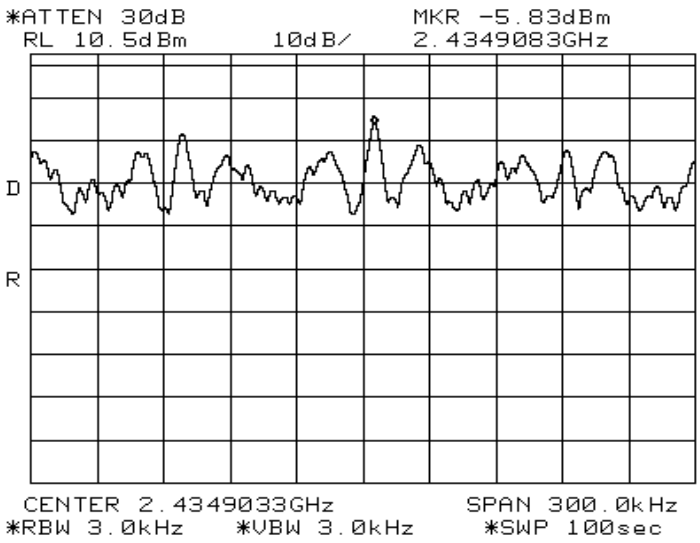
| Channel | Frequency (MHz) | Res BW | P.S.D. (averaged over 1 second in a 3kHz bandwidth) | Graph reference # |
|---|---|---|---|---|
| 1 | 2412 | 3 kHz | -5.83 dBm | refer to plot below |
| 6 | 2437 | 3 kHz | -5.83 dBm | refer to plot below |
| 11 | 2462 | 3 kHz | -6.50 dBm | refer to plot below |

**2412 MHz**

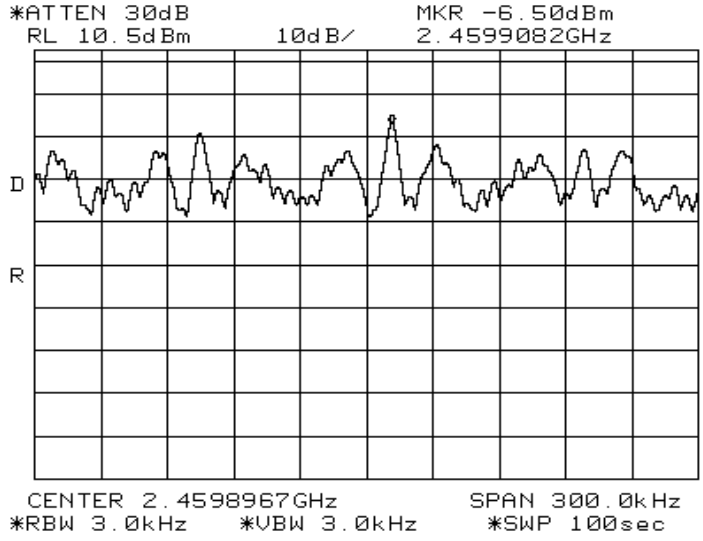


| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

**2437 MHz**



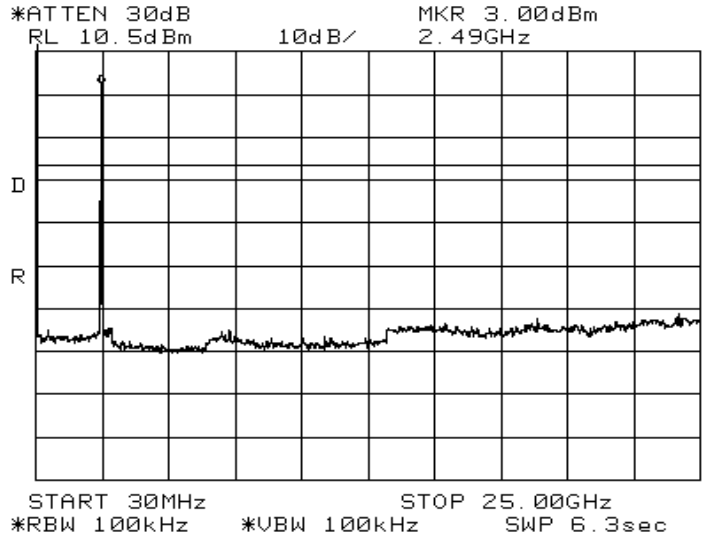

**2462 MHz**



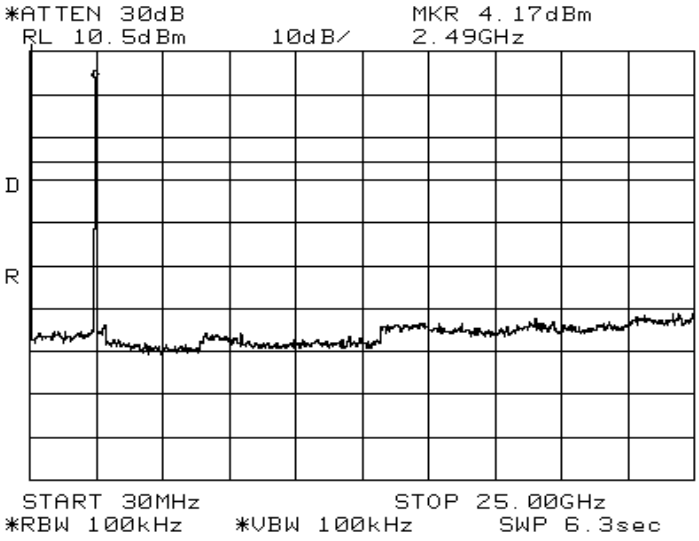
| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

**Run #4: Out of Band**

**2412 MHz**

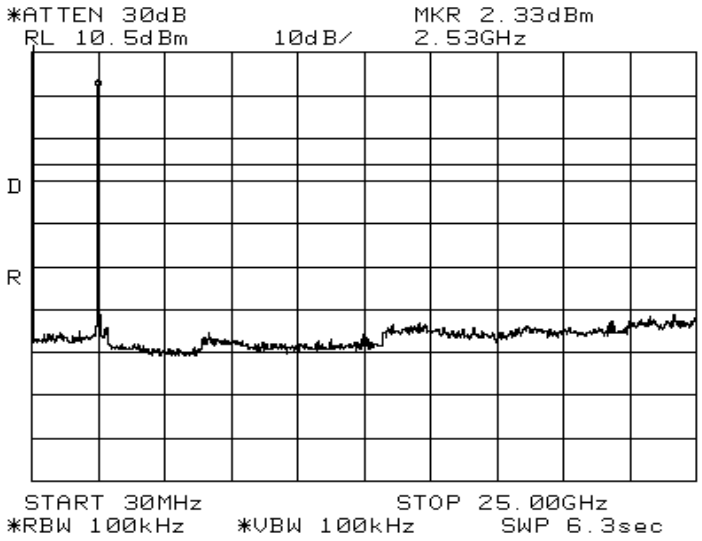



**2437 MHz**



| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | N/A |

**2462 MHz**



| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | B / DSSS |

# 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: 1/20/2003
Test Engineer: Rod Wong
Test Location: SVOATS #1

Config. Used: #2
Config Change: None
EUT Voltage: Refer to individual run

## 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. A second LISN was used for all local support equipment.

## Ambient Conditions:

Temperature: 10°C
Rel. Humidity: 87%

## Summary of Results

| Run # | Test Performed | Limit | Result | Margin |
|---|---|---|---|---|
| 1 | CE, AC Power 230V/50Hz | EN55022 B / 15.109 | Pass | -11.1dB @ 0.215MHz |
| 2 | CE, AC Power 120V/60Hz | EN55022 B / 15.110 | Pass | -7.0dB @ 0.215MHz |

## 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.

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell PP05L with Neweb antenna | T-Log Number: | T49892 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC, 15.247, RSS-210 issue 5 | Class: | B / DSSS |

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

| Frequency | Level | AC | EN55022 B | | Detector | Comments |
|---|---|---|---|---|---|---|
| MHz | dBµV | Line | Limit | Margin | QP/Ave | |
| 0.2150 | 51.9 | Line | 63.0 | -11.1 | QP | |
| 8.3400 | 37.9 | Line | 50.0 | -12.1 | Average | |
| 28.1350 | 36.5 | Line | 50.0 | -13.5 | Average | |
| 0.2100 | 48.9 | Neutral | 63.2 | -14.3 | QP | |
| 0.2150 | 37.2 | Line | 53.0 | -15.8 | Average | |
| 0.1600 | 47.7 | Neutral | 65.5 | -17.8 | QP | |
| 0.2100 | 34.2 | Neutral | 53.2 | -19.0 | Average | |
| 28.1350 | 40.5 | Line | 60.0 | -19.5 | QP | |
| 8.3400 | 40.2 | Line | 60.0 | -19.8 | QP | |
| 0.1600 | 26.6 | Neutral | 55.5 | -28.9 | Average | |
| 6.9300 | 11.9 | Neutral | 50.0 | -38.1 | Average | |
| 6.9300 | 21.0 | Neutral | 60.0 | -39.0 | QP | |

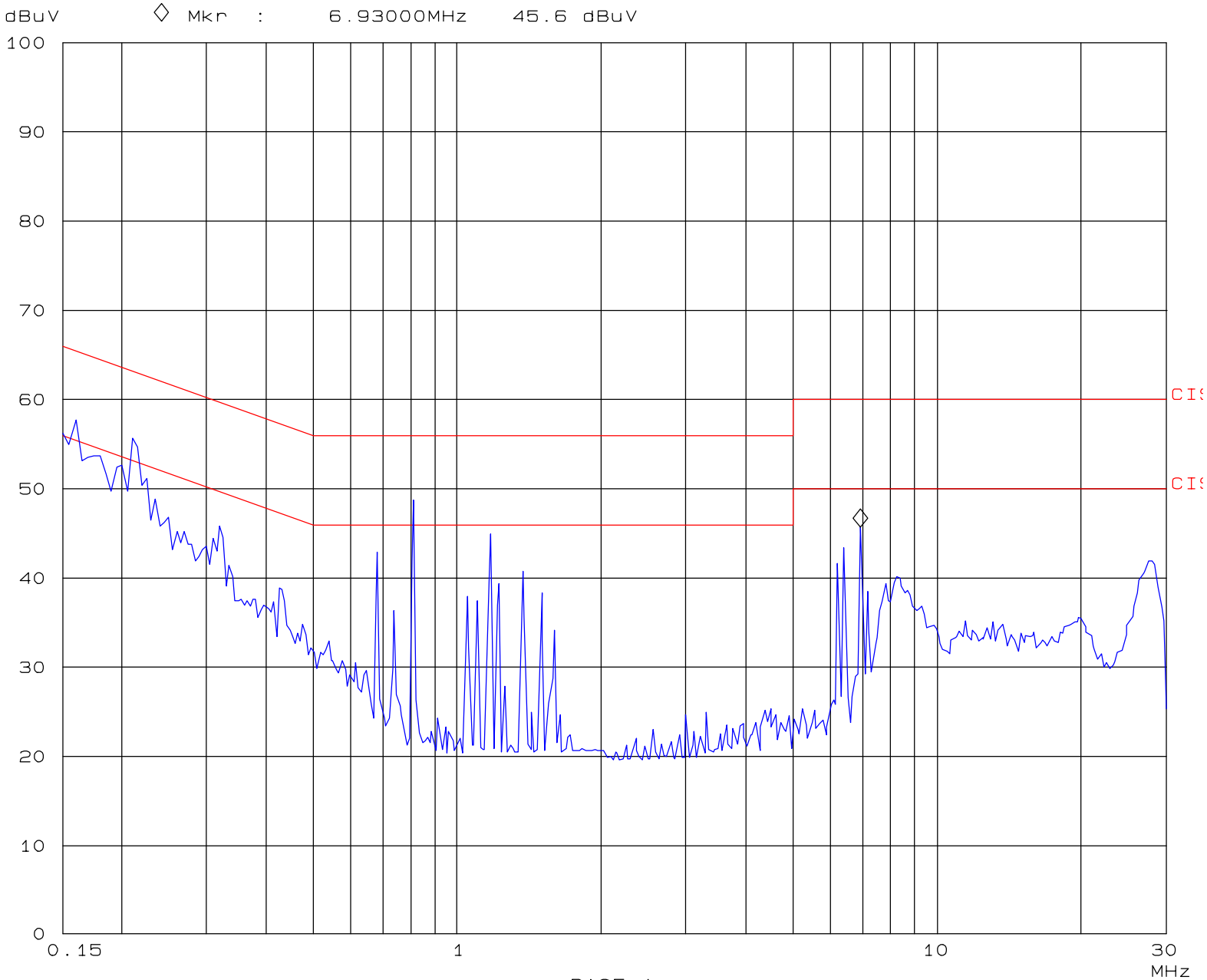
**Run #2: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz**

| Frequency | Level | AC | EN55022 B | | Detector | Comments |
|---|---|---|---|---|---|---|
| MHz | dBµV | Line | Limit | Margin | QP/Ave | |
| 0.2150 | 56.0 | Line | 63.0 | -7.0 | QP | |
| 0.2150 | 55.9 | Netural | 63.0 | -7.1 | QP | |
| 0.2150 | 41.5 | Line | 53.0 | -11.5 | Average | |
| 0.2150 | 41.3 | Netural | 53.0 | -11.7 | Average | |
| 8.4450 | 37.7 | Line | 50.0 | -12.3 | Average | |
| 28.0150 | 37.7 | Line | 50.0 | -12.3 | Average | |
| 8.0200 | 34.2 | Netural | 50.0 | -15.8 | Average | |
| 8.4450 | 42.6 | Line | 60.0 | -17.4 | QP | |
| 27.7000 | 31.9 | Netural | 50.0 | -18.1 | Average | |
| 28.0150 | 41.2 | Line | 60.0 | -18.8 | QP | |
| 8.0200 | 40.2 | Netural | 60.0 | -19.8 | QP | |
| 27.7000 | 38.8 | Netural | 60.0 | -21.2 | QP | |

# Intel WM3A2100
# Conducted Emissions

20. Jan 03 16:20

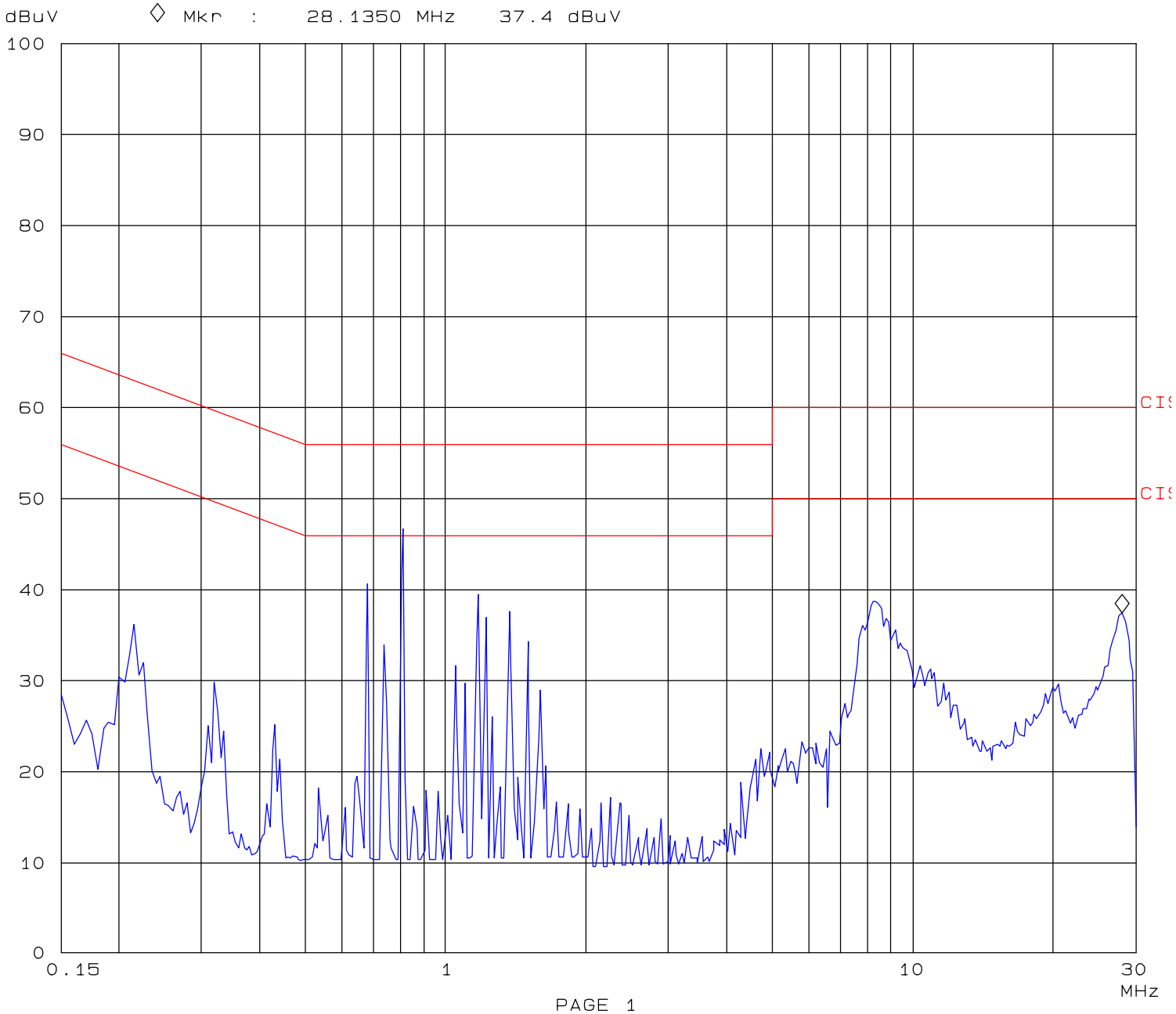
EUT: Intel WM3A2100
Manuf: Intel
Op Cond: Run 1 230V/50Hz Neu
Operator: Rod Wong
Test Spec: EN 55022 B
Comment: J49891/T49892



# Intel WM3A2100
## Conducted Emissions

20. Jan 03 16:35

| | |
|---|---|
| EUT: | Intel WM3A2100 |
| Manuf: | Intel |
| Op Cond: | Run 1 230V/50Hz Line |
| Operator: | Rod Wong |
| Test Spec: | EN 55022 B |
| Comment: | J49891/T49892 |

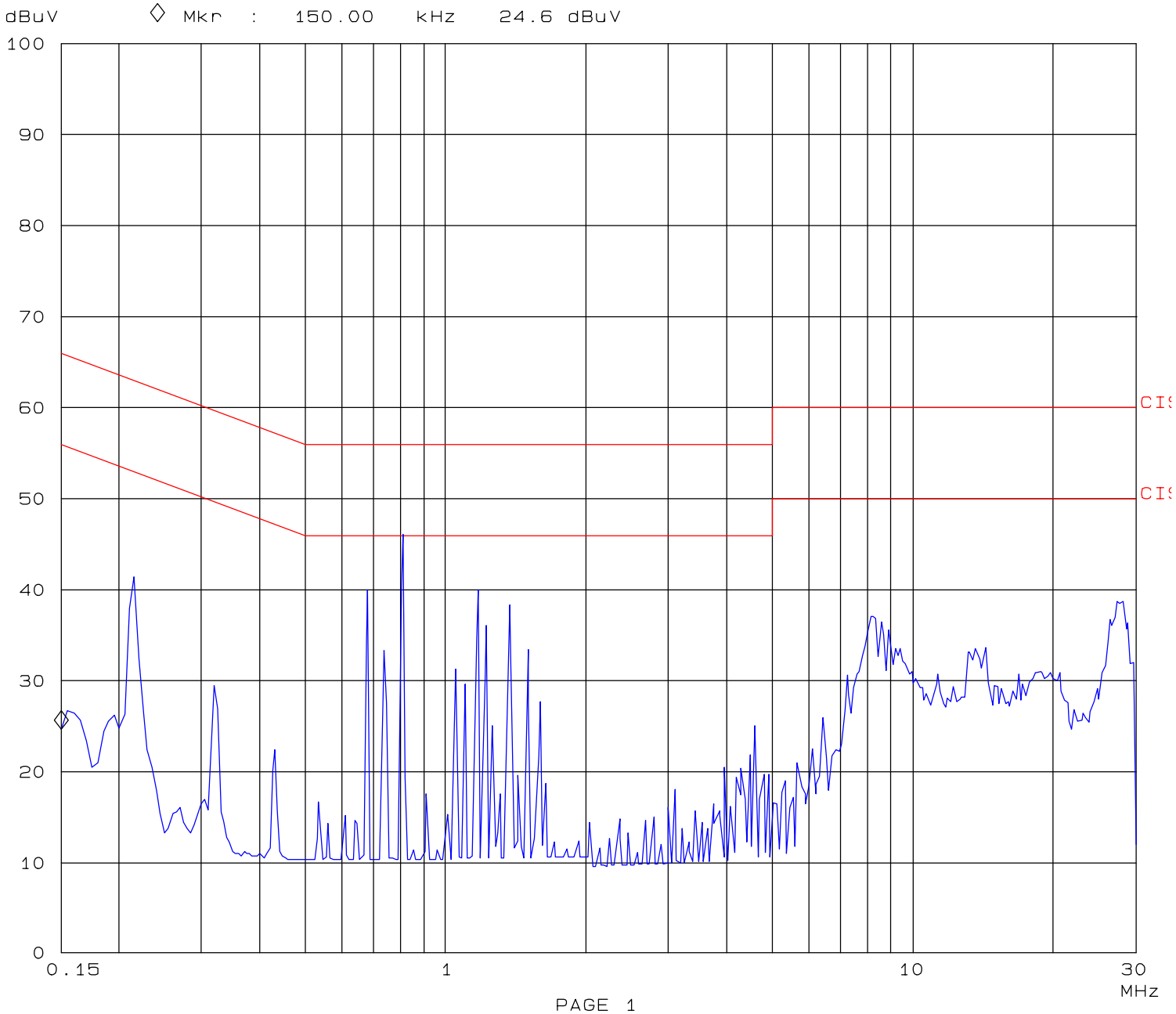


# Intel WM3A2100

20. Jan 03 17:16

## Conducted Emissions

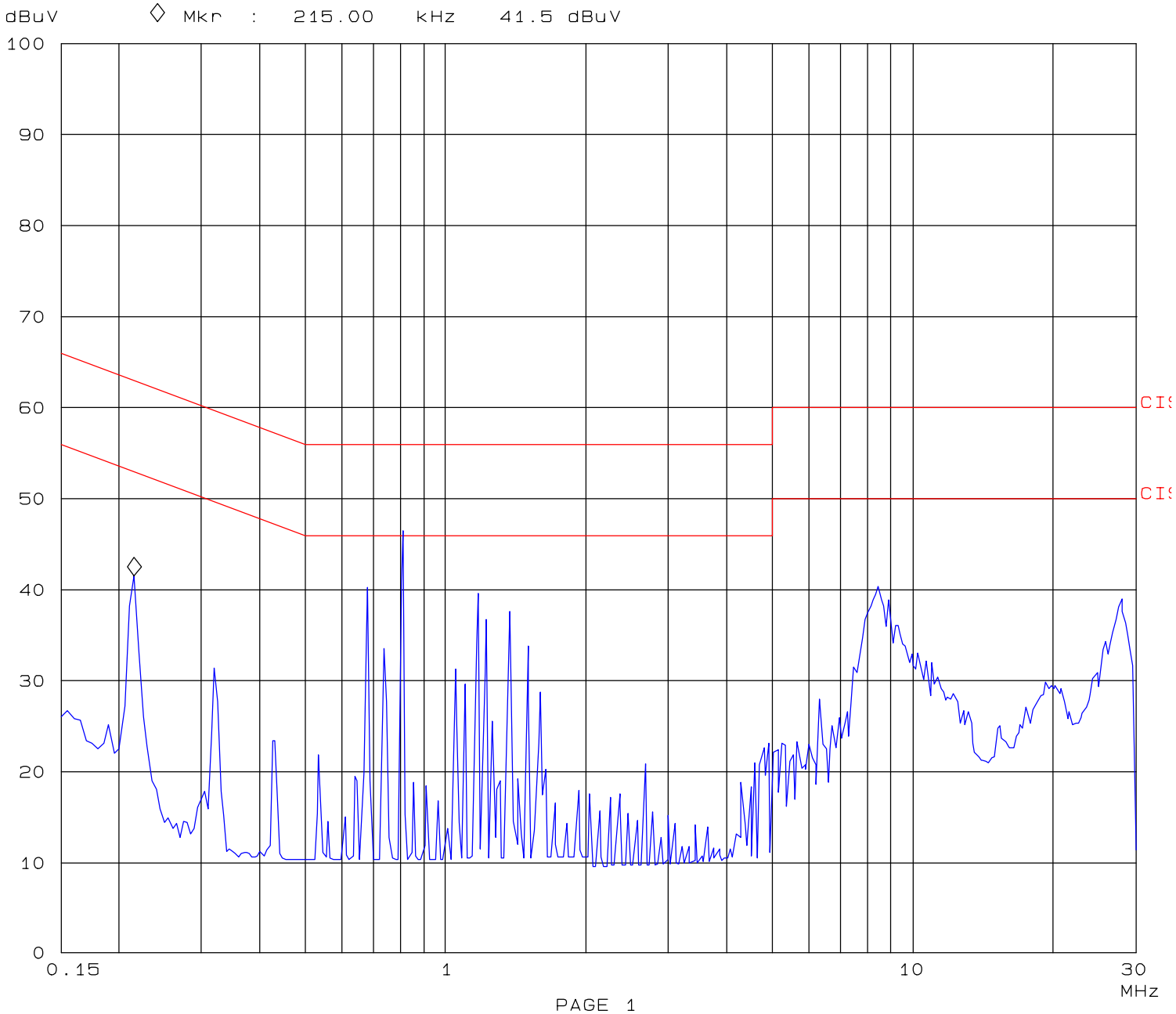
| | |
|---|---|
| EUT: | Intel WM3A2100 |
| Manuf: | Intel |
| Op Cond: | Run 2 120V/60Hz Neutral |
| Operator: | Rod Wong |
| Test Spec: | EN 55022 B |
| Comment: | J49891/T49892 |



# Intel WM3A2100
## Conducted Emissions

20. Jan 03 17:04

| | |
|---|---|
| EUT: | Intel WM3A2100 |
| Manuf: | Intel |
| Op Cond: | Run 2 120V/60Hz Line |
| Operator: | Rod Wong |
| Test Spec: | EN 55022 B |
| Comment: | J49891/T49892 |



Elliott

*EMC Test Data*

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Emissions Spec: | FCC / Canada | Class: | B |
| Immunity Spec: | N/A | Environment: | - |

# EMC Test Data

For The

## Intel

Model

**WM3A2100 inside Dell Inspiron with Hitachi antenna**

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Emissions Spec: | FCC / Canada | Class: | B |
| Immunity Spec: | N/A | Environment: | - |

# EUT INFORMATION

## General Description

The EUT is a Dell laptop (Chassis PP05L) containing a mini PCI 802.11b transceiver operating in the 2400-2483.5MHz band. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end user environment.

## Equipment Under Test

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| Intel | WM3A2100 | 802.11b Mini PCI card | N/A | TBD |
| Dell | Inspiron | Laptop | TW-034652-12800-2AN-0285 Rev X04 | DoC |
| Dell | AA22850 | AC Adapter | | |

## EUT Enclosure

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

## Modification History

| Mod. # | Test | Date | Modification |
|---|---|---|---|
| 1 | - | - | None |

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Emissions Spec: | FCC / Canada | Class: | B |
| Immunity Spec: | N/A | Environment: | - |

# Test Configuration #1 - Radio Testing per 15.247/RSS 210

## Local Support Equipment

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| Dell | Inspiron | Laptop | TW-034652-12800-2AN-0285 Rev X04 | DoC |
| Dell | AA22850 | AC Adapter | | |

## Remote Support Equipment

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| none | | | | |

## Interface Cabling and Ports

| Port | Connected To | Cable(s) | | |
|---|---|---|---|---|
| | | Description | Shielded or Unshielded | Length(m) |
| AC | Laptop | 3 wire | Unshielded | 1.8 |

Note: No ports were connected during the Radio test.

## Radio Operation During Emissions

EUT tested at the low, middle, and high channel. The highest output power was tested. All settings were adjusted to produce worst case mode.

| | | | |
|---|---|---|---|
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| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

# Radiated Emissions

## 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: 1/15 &16/2003
Test Engineer: Rafael / Chris
Test Location: SVOATS #4

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

## General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.
For radiated emissions testing the measurement antenna was located 3 meters from the EUT.
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 used.

## Ambient Conditions:

Temperature: 7°C / 13°C
Rel. Humidity: 82% / 72%

## Summary of Results

| Run # | Test Performed | Limit | Result | Margin |
|---|---|---|---|---|
| 1 | RE, 30 - 25000 MHz - Spurious Emissions | FCC Part 15.209 / 15.247( c) | Pass | -1.7dB @ 2483.5 MHz |

## 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.

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

**Run #1a: Radiated Spurious Emissions. Low Channel @ 2412 MHz**

Hitachi Antenna, Rate=1, Gain=4, Bias=35, Scale=13, Output measured power=16.4dBm

| Frequency | Level | Pol | 15.209 / 15.247 | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | v/h | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 2411.086 | 99.2 | H | - | - | Pk | 200 | 1.8 | |
| 2411.222 | 95.6 | H | - | - | Avg | 200 | 1.8 | |
| 2413.026 | 105.0 | V | - | - | Pk | 190 | 1.0 | |
| 2412.903 | 101.3 | V | - | - | Avg | 190 | 1.0 | |
| 2390.000 | 52.2 | V | 54.0 | -1.8 | Avg | 190 | 1.0 | |
| 2389.733 | 51.7 | H | 54.0 | -2.3 | Avg | 200 | 1.8 | |
| 4823.972 | 47.1 | H | 54.0 | -6.9 | Avg | 110 | 1.5 | |
| 7232.668 | 44.1 | H | 54.0 | -9.9 | Avg | 130 | 2.0 | |
| 2390.000 | 64.1 | V | 74.0 | -9.9 | Pk | 190 | 1.0 | |
| 2389.733 | 63.8 | H | 74.0 | -10.2 | Pk | 200 | 1.8 | |
| 7238.622 | 42.4 | V | 54.0 | -11.6 | Avg | 145 | 1.0 | |
| 4824.048 | 41.5 | V | 54.0 | -12.5 | Avg | 120 | 1.0 | |
| 4823.947 | 51.9 | H | 74.0 | -22.1 | Pk | 110 | 1.5 | |
| 7232.577 | 51.7 | H | 74.0 | -22.3 | Pk | 130 | 2.0 | |
| 7239.358 | 50.6 | V | 74.0 | -23.4 | Pk | 145 | 1.0 | |
| 4824.132 | 48.9 | V | 74.0 | -25.1 | Pk | 120 | 1.0 | |

| | |
|---|---|
| Note 1: | For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental. |

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

**Run #1b: Radiated Spurious Emissions. Center Channel @ 2437 MHz**

Hitachi Antenna, Rate=1, Gain=3, Bias=35, Scale=13, Output measured power=16.4dBm

| Frequency | Level | Pol | 15.209 / 15.247 | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | v/h | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 2435.994 | 105.9 | V | - | - | Pk | 280 | 1.0 | |
| 2436.199 | 103.1 | V | - | - | Avg | 280 | 1.0 | |
| 2436.044 | 102.5 | H | - | - | Pk | 290 | 2.4 | |
| 2436.019 | 98.8 | H | - | - | Avg | 290 | 2.4 | |
| 4874.010 | 42.8 | H | 54.0 | -11.2 | Avg | 130 | 1.5 | |
| 4873.988 | 39.3 | V | 54.0 | -14.7 | Avg | 160 | 1.0 | |
| 7313.745 | 37.1 | V | 54.0 | -16.9 | Avg | 185 | 1.2 | |
| 7306.646 | 36.0 | H | 54.0 | -18.0 | Avg | 160 | 1.8 | |
| 4873.929 | 49.7 | H | 74.0 | -24.3 | Pk | 130 | 1.5 | |
| 7314.592 | 48.0 | V | 74.0 | -26.0 | Pk | 185 | 1.2 | |
| 4874.049 | 47.8 | V | 74.0 | -26.2 | Pk | 160 | 1.0 | |
| 7307.530 | 47.2 | H | 74.0 | -26.8 | Pk | 160 | 1.8 | |

| | |
|---|---|
| Note 1: | For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental. |

Elliott

# EMC Test Data

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

**Run #1c: Radiated Spurious Emissions. High Channel @ 2462 MHz**

Hitachi Antenna, Rate=1, Gain=3, Bias=35, Scale=13, Output measured power=16.2dBm

| Frequency | Level | Pol | 15.209 / 15.247 | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | v/h | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 2460.986 | 103.2 | V | - | - | Pk | 280 | 1.0 | |
| 2460.967 | 99.8 | V | - | - | Avg | 280 | 1.0 | |
| 2463.081 | 102.9 | H | - | - | Pk | 240 | 1.8 | |
| 2462.762 | 99.3 | H | - | - | Avg | 240 | 1.8 | |
| 2483.500 | 52.3 | V | 54.0 | -1.7 | Avg | 280 | 1.0 | |
| 2483.500 | 52.3 | H | 54.0 | -1.7 | Avg | 240 | 1.8 | |
| 2483.983 | 63.9 | H | 74.0 | -10.1 | Pk | 240 | 1.8 | |
| 2483.433 | 62.4 | V | 74.0 | -11.6 | Pk | 280 | 1.0 | |
| 4923.968 | 40.1 | H | 54.0 | -13.9 | Avg | 350 | 1.8 | |
| 4923.947 | 39.7 | V | 54.0 | -14.3 | Avg | 115 | 1.3 | |
| 7385.114 | 32.9 | H | 54.0 | -21.1 | Avg | 0 | 1.8 | Noise Floor |
| 7385.411 | 32.9 | V | 54.0 | -21.1 | Avg | 0 | 1.3 | Noise Floor |
| 4924.033 | 49.1 | V | 74.0 | -24.9 | Pk | 115 | 1.3 | |
| 4924.053 | 48.7 | H | 74.0 | -25.3 | Pk | 350 | 1.8 | |
| 7386.071 | 45.1 | V | 74.0 | -28.9 | Pk | 0 | 1.3 | Noise Floor |
| 7385.291 | 44.8 | H | 74.0 | -29.2 | Pk | 0 | 1.8 | Noise Floor |

| | |
|---|---|
| Note 1: | For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental. |

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

# DSSS Antenna Conducted Emissions

## 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: | 1/17/2003 | Config. Used: | 1 |
| Test Engineer: | jmartinez | Config Change: | None |
| Test Location: | SVOATS #4 | Host Unit Voltage | Host provides power to EUT |

## General Test Configuration

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 used.

## Ambient Conditions:

Temperature: 14°C

Rel. Humidity: 45%

## Summary of Results

| Run # | Test Performed | Limit | Result | Margin |
|---|---|---|---|---|
| 1 | 6dB Bandwidth | 15.247(a) | Pass | Refer to run |
| 2 | Output Power | 15.247(b) | Pass | Refer to run |
| 3 | Power Spectral Density (PSD) | 15.247(d) | Pass | Refer to run |
| 4 | Out of Band | 15.247(c) | Pass | Refer to run |

## Modifications Made During Testing:

No modifications were made to the EUT during testing

## Deviations From The Standard

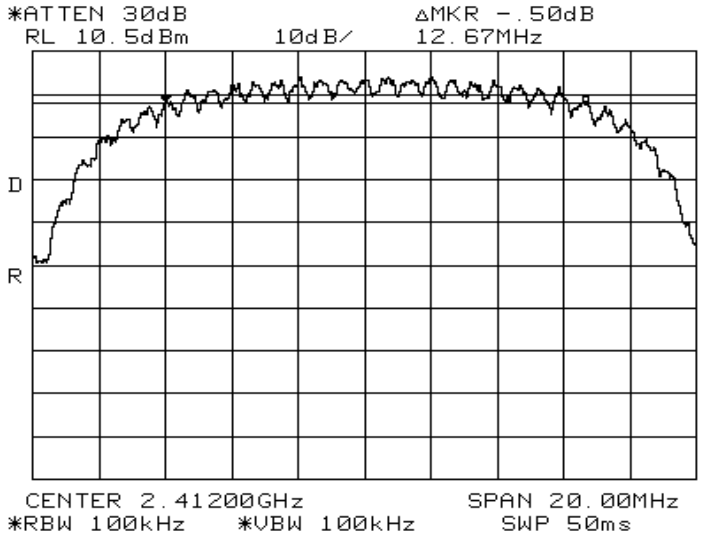
No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

**Run #1: Signal Bandwidth**

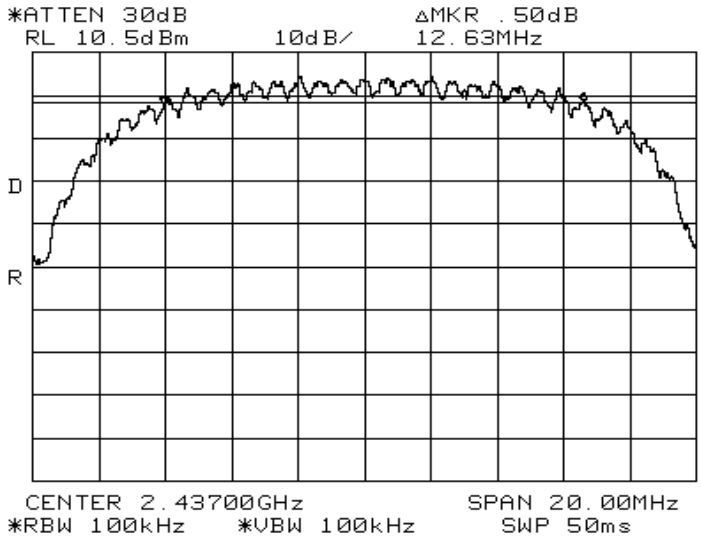
| Channel | Frequency (MHz) | Resolution Bandwidth | 6dB Signal Bandwidth | Graph reference # |
|---|---|---|---|---|
| 1 | 2412 | 100 kHz | 12.67 MHz | Refer to plots below |
| 6 | 2437 | 100 kHz | 12.63 MHz | Refer to plots below |
| 11 | 2462 | 100 kHz | 12.10 MHz | Refer to plots below |

**2412 MHz**

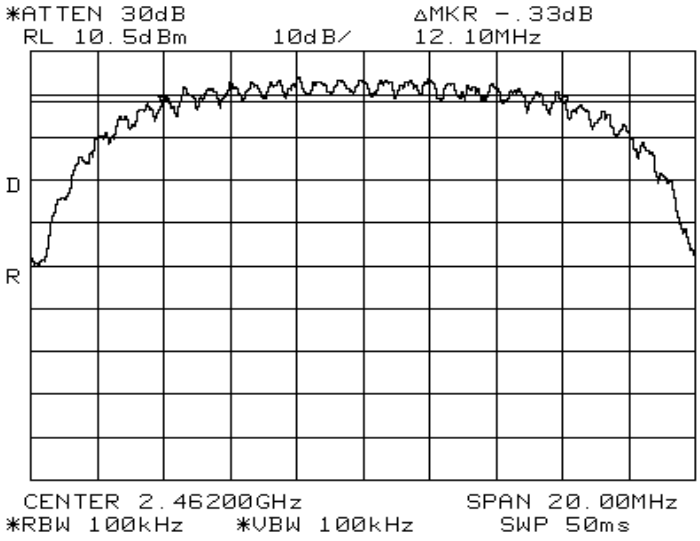


| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

**2437 MHz**




**2462 MHz**



| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

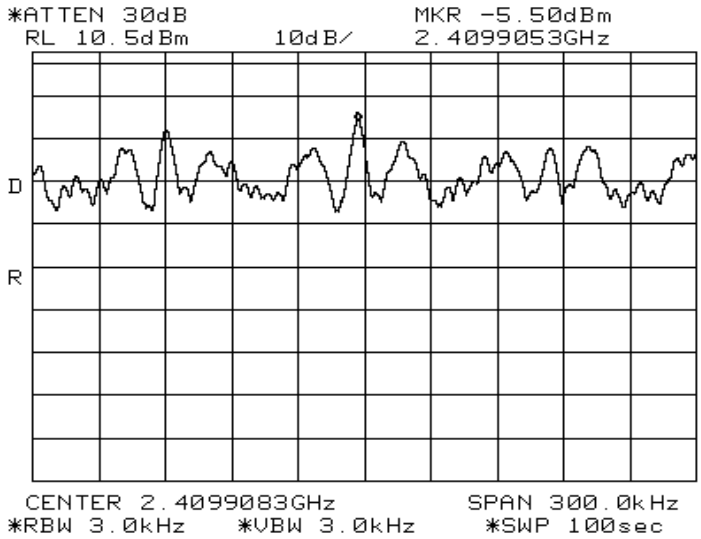
**Run #2: Peak Output Power**

| Channel | Frequency | Power | Rate | Antenna | Step | Gain | Bias | scale |
|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBm) | (Mb/s) | | | | | |
| 1 | 2412 | 16.4 | 11 | 1 | 0 | 4 | 35 | 13 |
| 6 | 2437 | 16.4 | 11 | 1 | 0 | 3 | 35 | 13 |
| 11 | 2462 | 16.2 | 11 | 1 | 0 | 3 | 35 | 13 |

**Run #3: Power Spectral Density**

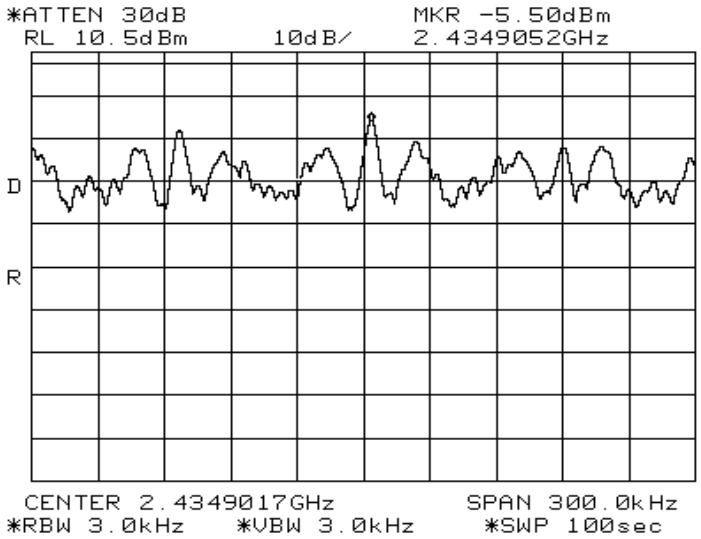
| Channel | Frequency (MHz) | Res BW | P.S.D. (averaged over 1 second in a 3kHz bandwidth) | Graph reference # |
|---|---|---|---|---|
| 1 | 2412 | 3 kHz | -5.50 dBm | refer to plot below |
| 6 | 2437 | 3 kHz | -5.50 dBm | refer to plot below |
| 11 | 2462 | 3 kHz | -5.67 dBm | refer to plot below |

**2412 MHz**

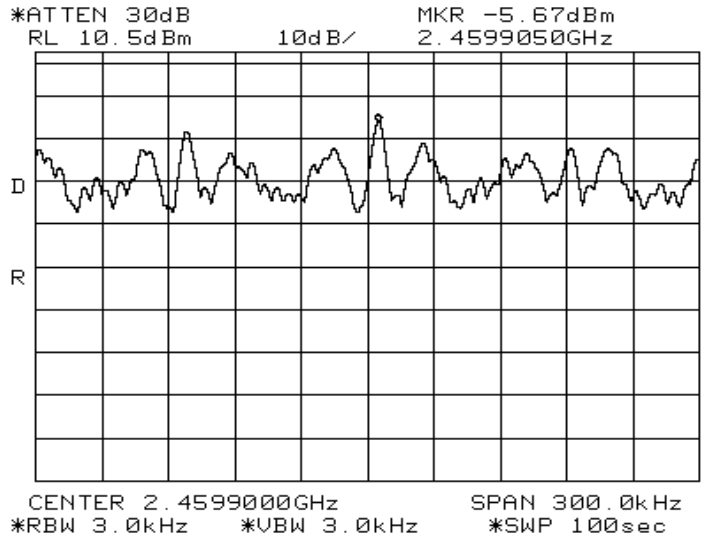


| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

**2437 MHz**



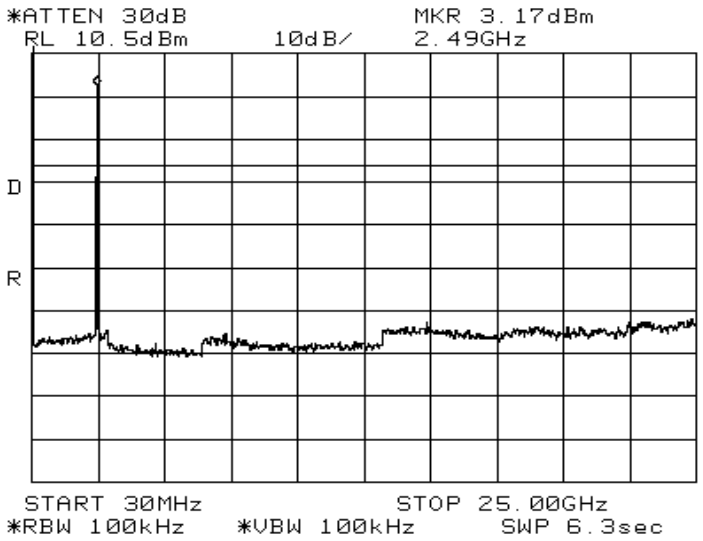

**2462 MHz**



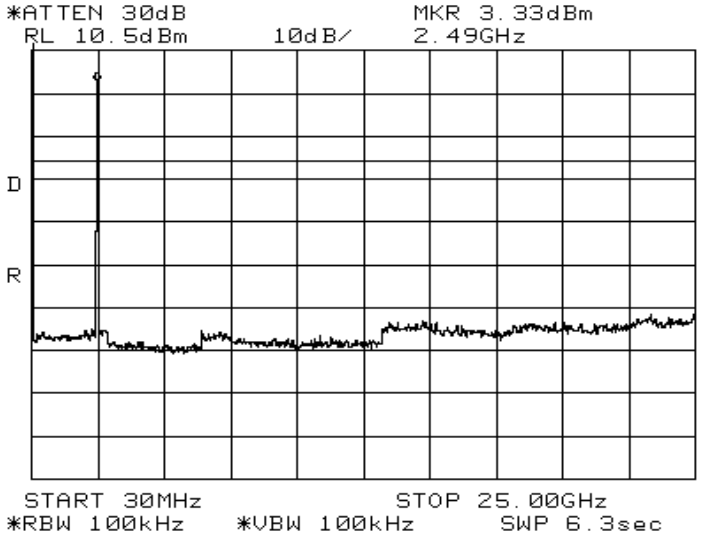
| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

**Run #4: Out of Band**

**2412 MHz**




**2437 MHz**



| | | | |
|---|---|---|---|
| Client: | Intel | Job Number: | J49891 |
| Model: | WM3A2100 inside Dell Inspiron with Hitachi antenna | T-Log Number: | T49893 |
| | | Proj Eng: | Juan Martinez |
| Contact: | Robert Paxman | | |
| Spec: | FCC / Canada | Class: | N/A |

**2462 MHz**