



Engineering and Testing for EMC and Safety Compliance

CLASS II PERMISSIVE CHANGE FOR A DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

CISCO Systems Inc.
170 West Tasman Drive
San Jose, CA 95134-1706

Model: AIR-LMC350

FCC ID: LDK102040
CANADA: 2461391186A

STANDARDS REFERENCED FOR THIS REPORT	
PART 2: 1999	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
PART 15: 1999	RADIO FREQUENCY DEVICES
FCC 97-114	GUIDANCE ON MEASUREMENTS FOR DIRECT SEQUENCE SPREAD SPECTRUM SYSTEMS
ANSI C63.4-1992	STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS
RSS-139; Issue 1 (Provisional)	LICENSED RADIOCOMMUNICATIONS DEVICES IN THE BAND 2400-2483.5
RSS-102, Issue 1: 1999	EVALUATION PROCEDURE FOR MOBILE AND PORTABLE RADIO TRANSMITTERS

FCC Rules Parts	Frequency Range	EIRP (W)	Freq. Tolerance	Emission Designator
15.247	2412-2462 MHz	0.465	N/A	
Industry Canada Standards	Frequency Range	EIRP (W)	Freq. Tolerance	Emission Designator
RSS-210	2412-2462 MHz	0.465	N/A	

REPORT PREPARED BY:

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Document Number: 2001212 / QRTL01-202

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TABLE OF CONTENTS

1	INTRODUCTION	3
1.1	RELATED SUBMITTAL (S)/GRANT (S)	3
1.2	CHANGE INFORMATION	3
1.3	TEST METHODOLOGY	3
1.4	TEST FACILITY	3
1.5	EMISSIONS EQUIPMENT LIST	4
2	SYSTEM TEST CONFIGURATION	7
2.1	JUSTIFICATION	7
2.2	EUT EXERCISE SOFTWARE	7
2.3	SPECIAL ACCESSORIES	7
2.4	TEST SYSTEM DETAILS	8
2.5	CONFIGURATION OF TESTED SYSTEM	9
3	CONFORMANCE STATEMENT	10
4	FIELD STRENGTH CALCULATION	11
5	RADIATED EMISSIONS MEASUREMENTS	12
6	EFFECTIVE ISOTROPIC RADIATED POWER MEASUREMENTS	12
7	RADIATED SPURIOUS EMISSIONS	13
7.1.1	<i>Radiated Emissions Harmonics/spurious (Channel 1; 2412 MHz)</i>	<i>13</i>
7.1.2	<i>Radiated Emissions Harmonics/spurious (Channel 6; 2437 MHz)</i>	<i>13</i>
7.1.3	<i>Radiated Emissions Harmonics/spurious (Channel 11; 2462 MHz)</i>	<i>14</i>
8	COMPLIANCE WITH THE RESTRICTED BAND EDGE	15
9	BANDEDGE PLOTS	16
9.1	RADIATED MEASUREMENT PHOTOS	18
9.2	ANTENNA PHOTOS	20



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1 INTRODUCTION

The following Application for Class II permissive change for a Direct Sequence Spread Spectrum transmitter is prepared on behalf of **Cisco Systems Inc** in accordance with the Federal Communications Commissions and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was the PCMCIA card, **FCC ID: LDK102040 and CANADA: 2461391186A**. The test results reported in this document relate only to the item that was tested.

All measurements contained in this Application were conducted in accordance with ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 1992, with Federal Communications Commissions Rules and Regulations Part 15.247, 1999, and with Industry Canada RSS210 and RSS102. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Some accessories are used to increase sensitivity and prevent overloading of the measuring instrument. These are explained in the appendix of this report. Calibration checks are performed regularly on the instruments, and all accessories including the high pass filter, preamplifier and cables.

1.1 RELATED SUBMITTAL (S)/GRANT (S)

This is a Class II Permissive Change.

1.2 CHANGE INFORMATION

An antenna was added to this device.

1.3 TEST METHODOLOGY

Radiated testing was performed according to the procedures in ANSI C63.4 1992. Radiated testing was performed at an antenna to EUT distance of 3 meters. Emissions above 1 GHz were video averaged.

1.4 TEST FACILITY

The open area test site measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report dated March 3, 1994, submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).



1.5 EMISSIONS EQUIPMENT LIST

RTL Asset Number	Manufacturer	Model	Part Type	Serial Number	Calibration due date
900969	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2412A00414	03/23/01
900929	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2811A01276	03/28/01
900901	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	3145A01599	11/02/01
900339	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2521A00743	03/27/01
900042	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2521A01032	11/05/01
900924	Amplifier Research	75A220	Amplifier (10 kHz – 220 MHz)		N/A
900933	Hewlett Packard	11975A	Power Amplifier (2 - 8 GHz)	2304A00348	11/15/01
901067	Hewlett Packard	8903B	Audio Analyzer	2303A00307	06/28/01
901055	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2545A04102	06/08/01
900718	Voltech	PM3000A	Power Analyzer	6836-002-10	11/08/01
900397	Associated Research, Inc.	6554SA	Electrical Safety Compliance Analyzer	940281	11/08/01
900926	Hewlett Packard	8753D	RF Vector Network Analyzer	3410A09659	03/28/01
901089	Hewlett Packard	HP875ET	Transmission/Reflection Network Analyzer	US39170052	N/A
900968	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz – 1.5 GHz)	2602A00160	03/23/01
900903	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz – 1.5 GHz)	2841A00614	11/02/01
900897	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz – 1.5 GHz)	2727A00535	11/08/01
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	3138A07771	03/27/01
900912	Hewlett Packard	8568A	RF Spectrum Analyzer (100 Hz – 1.5 GHz)	2634A02704	08/02/01
900824	Hewlett Packard	8591E	RF Spectrum Analyzer (9 KHz – 1.8 GHz)	3710A06135	11/14/01
900724	ARA	LPB-2520	Log Periodic / Biconical Antenna (25-1000 MHz)	1037	2/1/01
900725	ARA	LPB-2520	Log Periodic / Biconical Antenna (25-1000 MHz)	1036	07/12/01
900967	A.H. Systems	TDS-206/535-1 through TDS-206/535-4	Tuned Dipole set (30 – 1000 MHz)	126, 128, 129, 132	12/15/00
900154	Compliance Design	Roberts Dipole	Adjustable Elements Dipole antenna (30-1000MHz)	N/A	7/26/01
900814	Electro-Metrics	RGA-60	Double Ridges Guide Antenna (1-18 GHz)	2310	2/26/01
900081	EMCO	3146	Log-Periodic Antenna (200-1000 MHz)	1850	
900800	EMCO	3301B	Active Monopole (Rod antenna) (30 Hz – 50 MHz)	9809-4071	05/02/01
900151	Rohde@Schwarz	HFH@-Z2	Loop Antenna (9kHz-30 MHz)	82825/019	05/26/01
900791	Schaffner –Chase	CSL6112	Bilog antenna (30 MHz – 2GHz)	2099	2/22/01
901053	Schaffner –Chase	CBL6112B	Bilog Chase antenna (200 MHz – 2 GHz)	2648	05/24/01
900060	Hewlett Packard	86634B	Auxiliary Section for External Pulse Modulator	1314A02913	11/08/01
901041	ACO Pacific	511E	Sound Level Calibrator	028751	In calibration
900970	Hewlett Packard	85662A	Spectrum Analyzer Display	254211239	03/23/01
900930	Hewlett Packard	85662A	Spectrum Analyzer Display	3144A20839	03/28/01
900911	Hewlett Packard	85662A	Spectrum Analyzer Display	2542A12739	08/02/01
900902	Hewlett Packard	85662A	Spectrum Analyzer Display	2848A17585	11/02/01
900896	Hewlett Packard	85662A	Spectrum Analyzer Display	2816A16471	11/02/01
900914	Hewlett Packard	85460A	RF Filter Section, (100 KHz to 6.5 GHz)	3330A00107	11/07/01
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	06/21/01
900059	Hewlett Packard	8660C	Signal Generator (9 KHz – 3200 MHz)	1947A02956	11/08/01
900960	Hewlett Packard	8444A	Tracking Generator (0.5 – 1500MHz)	2325A07827	03/08/01
900917	Hewlett Packard	8648C	Synthesized. Signal Generator (9 KHz – 3200 MHz)	3537A01741	03/28/01
900821	Hewlett Packard	33120A	15 MHz Function / Arbitrary Waveform Generator	US36029992	11/14/01
900059	Hewlett Packard	8660C	Synthesized. Signal Generator	1947A02956	11/08/01



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RTL Asset Number	Manufacturer	Model	Part Type	Serial Number	Calibration due date
			(9 kHz – 3200 MHz)		
900560	Haefely	PESD 1600	ESD Generator	H 703146	10/05/01
900099	Marconi	52022-910E	Signal Generator (10 kHz – 1 GHz)	119044-189	11/14/01
900195	Tektronix	CFG280	Function Generator (0.1 Hz – 11 MHz)	TW12167	N/A
900927	Tektronix	ASG 100	Audio Signal Generator	B03274 V2.3	N/A
900935	Wavetek	3510B	Signal Generator	5372160	03/28/00
900660	Philips	PM5418TDS	TV Generator	LO 604891	11/21/01
900369	Philips	PM5418TDS	TV Generator	LR81436C	N/A
900268	Taylor	5565	Hygrometer / Thermometer	N/A	09/05/01
901056	Hewlett Packard	8954A, Opt.H03	Transceiver Interface	2924A00830	06/02/01
901088	Hewlett Packard	8954A	Transceiver Interface	2146A00139	07/28/01
901082	AFJ International	AFJ LS16	LISN (9 kHz – 30 MHz)	16010020081	06/16/01
901083	AFJ International	AFJ LS16	LISN (9 kHz – 30 MHz)	16010020082	06/16/01
901084	AFJ International	AFJ LS16	LISN (9 kHz – 30 MHz)	16010020080	06/16/01
901090	Bajog electronic	4V-100/200	LISN (150 kHz – 30 MHz)	00-44-007	08/03/01
900726	Solar	7225-1	LISN	N/A	03/29/01
900727	Solar	7225-1	LISN	N/A	03/29/01
900078	Solar	7225-1	LISN	N/A	03/29/01
900077	Solar	7225-1	LISN	N/A	03/29/01
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892	06/08/01
900770	Hewlett Packard	437B	Power Meter	2949A02966	In cal.
900793	Hewlett Packard	432A	Thermistor Power Meter	1848a22632	N/A
900126	Hewlett Packard	11970A	Harmonic Mixer (26-40 GHz)	2332A01199	11/10/02
900396	Hewlett Packard	11970K	Harmonic Mixer (18-26 GHz)	2332A00563	11/00/02
900921	Haefely	IP 6.2	Coupling Network	083-334-13	11/10/01
900918	Voltech	IEC Standard 555	Reference Impedance Network (rented)	7701	11/08/01
900061	Hewlett Packard	86603A	RF Plug-in (1 to 2600 MHz)	2221A02967	11/08/01
900160	Pacific	112-AMX	AC Power Source (rented)	0187	11/15/01
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1-26.5 GHz)	3008A00505	09/15/01
900045	Hewlett Packard	8447F	Preamplifier	2944A03783	N/A
901040	Industrial	SMX100	Wide Band Preamplifier (0.01-1000 MHz)	1736-0696	11/17/01
900721	Hewlett Packard	8447D	Preamplifier (0.1-1300 MHz)	2727A05397	N/A
900889	Hewlett Packard	85685A	RF Preselector for HP 8566B or 8568B (20Hz-2GHz)	3146A01309	11/14/01
900566	Amplifier Research	FP 2000	Isotropic Field Probe	20760	08/29/01
900174	FCC	F-120-9A	RF Injection Probe (10 kHz – 300 MHz)	N/A	05/31/01
901044	FCC	F-120-5	Bulk Current Injection Probe (10 kHz – 150 MHz)	17	05/12/01
901042	FCC	F-72-1	RF Current Probe (10 Hz – 100 MHz)	44	05/11/01
900704	FCC	F-14-1	Current Probe (10 Hz – 500 kHz)	33	05/12/01
900894	FCC	F-33-1	RF Current Probe (10 kHz – 250 MHz)	303	05/30/01
900854	Solar Electronics Co	9119-IN	RF Current Probe	972501	
900849	Solar Electronics Co	9121-IN	Injection Probe (10 MHz – 1 GHz)	953501	
900848	Solar Electronics Co	9320-IN	RF Current Probe	990521	
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 KHz – 6.5 GHz)	3325A00159	03/29/01
900769	Hewlett Packard	8481B	Power Sensor	2702A05059	In cal.
900937	Hewlett Packard	8482H	3-watt Power Sensor (100 KHz to 4.2 GHz)	3318A08961	12/02/01
900928	Hewlett Packard	83752A	Synthesized Sweeper, 0.01 to 20 GHz	3610A00866	03/28/01
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	11/07/01



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RTL Asset Number	Manufacturer	Model	Part Type	Serial Number	Calibration due date
900111	Omega Engineering	DP41-TC-DSS	Temperature Monitor	2060123	In cal.
901043	FCC		Terminator for RF Current Probe F-72-1		05/12/01
900731	Haefely	PEFT.1	Burst Tester with Coupling Network	082 106-29	11/10/01
900402	BAPCO Electro-Com	IEC 601 L	Safety Tester	000028	11/10/01
900720	Haefely	Psurge 4.1	Surge Tester	083-342-02	11/10/01
900839	Bird	43P	Peak Reading Wattmeter	3110	11/10/01



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2 SYSTEM TEST CONFIGURATION

2.1 JUSTIFICATION

The EUT was tested in all three orthogonal planes in order to determine worst-case emission. Channel 1 at 2.412 GHz, Channel 6 at 2.437 GHz and Channel 11 at 2.462 GHz were tested and investigated from 9kHz to 24GHz. All three channels were investigated and tested. Data for all three channels are presented in this report.

To complete the configuration required by the FCC, the transmitter was tested in the notebook computer with the integral antenna connected to the antenna port as it is intended to be used.

The worst-case data taken in this report represents the highest data rate at 11 MBPS. Data rates of 5.5MBPS, 2 MBPS and 1 MBPS were investigated and found to be in compliance.

2.2 EUT EXERCISE SOFTWARE

The EUT was provided with software, which provides for continuous transmission during testing. The carrier was also checked to verify that the information was being transmitted.

2.3 SPECIAL ACCESSORIES

N/A.



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2.4 TEST SYSTEM DETAILS

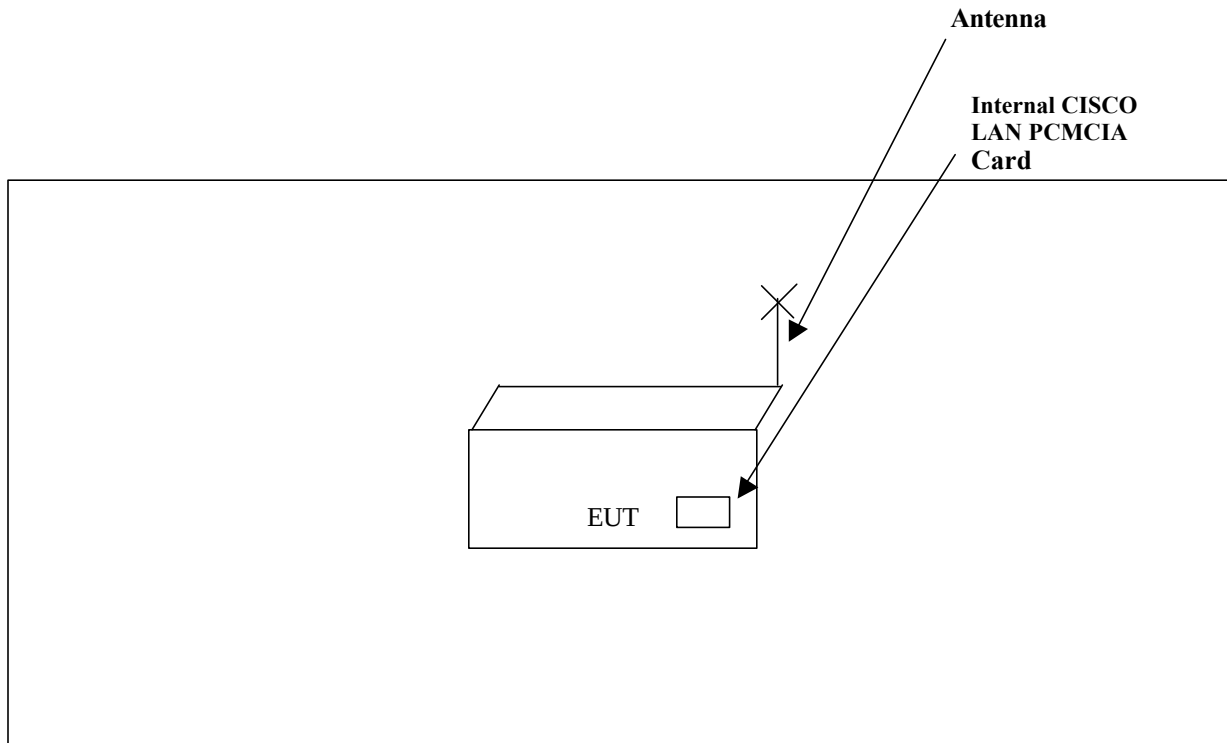
The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system (including inserted cards, which have grants) are:

PART	MANUFACTURER	MODEL	SERIAL NUMBER	FCC ID	CABLE DESCRIPTION	RTL BAR CODE
NOTEBOOK COMPUTER	ITRONIX	IX250	ZZGEG1129ZZ5957	LNQUSA40064-M6-E	UNSHIELDED POWER CORD WITH AC/DC CONVERTER	13537
WIRELESS LAN PCMCIA CARD (EUT)	CISCO SYSTEMS, INC.	AIR-LMC352	SPL051002YW	LDK102040	N/A	13540
19V AC ADAPTER	DELTA ELECTRONICS	ADP-60DB	NPD0037027994	DoC	UNSHIELDED	13538



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2.5 CONFIGURATION OF TESTED SYSTEM





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3 CONFORMANCE STATEMENT

STANDARDS REFERENCED FOR THIS REPORT	
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PART 15: 1999	RADIO FREQUENCY DEVICES
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FCC Rules Parts	Frequency Range	EIRP	Freq. Tolerance	Emission Designator
15.247	2412-2462 MHz	0.465	N/A	
Industry Canada Standards	Frequency Range	EIRP	Freq. Tolerance	Emission Designator
RSS-210	2412-2462 MHz	0.465	N/A	

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described above. Modifications were not made during testing to the equipment in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the ANSI C63.4 test methodology.

EMC Engineer: Daniel Baltzell

Date: July 18, 2001

Signature:

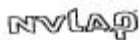
Supervising Engineer: Desmond A. Fraser

Date: July 18, 2001

Position: President

(NVLAP Signatory)

Signature:



Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 20061-0.

Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.



4 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FI(\text{dBuV/m}) = \text{SAR}(\text{dBuV}) + \text{SCF}(\text{dB/m})$$

FI = Field Intensity

SAR = Spectrum Analyzer Reading

SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

$$\text{SCF}(\text{dB/m}) = -\text{PG}(\text{dB}) + \text{AF}(\text{dB/m}) + \text{CL}(\text{dB})$$

SCF = Site Correction Factor

PG = Pre-amplifier Gain

AF = Antenna Factor

CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(\text{uV/m}) = 10^{\text{FI}(\text{dBuV/m})/20}$$

For example, assume a signal at a frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is -11.5 dB/m. The actual radiated field strength is calculated as follows:

$$49.3 \text{ dBuV} - 11.5 \text{ dB/m} = 37.8 \text{ dBuV/m}$$

$$10^{37.8/20} = 10^{1.89} = 77.6 \text{ uV/m}$$

EIRP calculation: Power from power meter in (dBm) + antenna gain in (dBi)



5 RADIATED EMISSIONS MEASUREMENTS

Before final measurements of radiated emissions were made on the open-field three/ten meter range; the EUT was scanned indoor at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations. No video filter less than 10 times the resolution bandwidth was used. The range of the frequency spectrum to be investigated is specified in FCC Part 15. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report. For radiated measurements above 1 GHz, a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz are used.

Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

6 EFFECTIVE ISOTROPIC RADIATED POWER MEASUREMENTS

THE CALCULATION OF THE EIRP IS:

$$\text{WATT} = (\text{V/M} \times 3)^2 / 30$$

THE ELECTRIC FIELD STRENGTH OF CHANNELS 1, 6, AND 11 WERE TAKEN PEAK WITH A RESOLUTION BANDWIDTH OF 1 MHZ AND VIDEO BANDWIDTH OF 1 MHZ AND FOUND AS FOLLOWS:

Frequency (MHz)	Peak Analyzer Reading (dBi V)	Site Correction Factor (dB/m)	Corrected Level (dBi V/m)	EIRP (mW)
2412	78.7	32.1	110.8	36.3
2437	78.5	32.0	110.5	33.8
2462	78.8	32.3	111.1	38.4



7 RADIATED SPURIOUS EMISSIONS

Radiated Spurious Emissions applies to harmonics and spurious emissions that fall in the restricted. The restricted bands are listed in Section 15.205. The maximum permitted average field strength for the restricted band is listed in Section 15.209.

The test was performed at 1 MHz RBW and 10 Hz(average measurement) and at 1 MHz RBW and 1 MHz (peak measurement).

7.1.1 Radiated Emissions Harmonics/spurious (Channel 1; 2412 MHz)

Frequency (MHz)	Peak Analyzer Reading (dB _i V)	Average Analyzer Reading (dB _i V)	Site Correction Factor (dB/m)	Corrected Level dB _i V/m)	Limit (dB _i V/m)	Margin (dB)
2038.475	27.2	23.2	30.6	53.8	88.4	-34.6
2412.000	101.67	94.2	14.2	108.4		Fundamental
2443.480	28.3	27.5	33.2	60.7	88.4	-27.7
4824.000	16.2	11.3	30.3	41.6	54.0	-12.4
7236.000	NF					
9648.000	NF					
12060.000	NF					
14472.000	NF					
16884.000	NF					
19296.000	NF					
21708.000	NF					
24120.000	NF					

7.1.2 Radiated Emissions Harmonics/spurious (Channel 6; 2437 MHz)

Frequency (MHz)	Peak Analyzer Reading (dB _i V)	Average Analyzer Reading (dB _i V)	Site Correction Factor (dB/m)	Corrected Level dB _i V/m)	Limit (dB _i V/m)	Margin (dB)
2063.474	27.4	23.2	30.6	53.8	89.0	-35.2
2437.000	102.5	94.8	14.2	109.0		Fundamental
2518.968	29.5	24.7	33.2	57.9	89.0	-31.1
4874.000	16.5	11.3	30.3	41.6	54.0	-12.4
7311.000	NF					
9748.000	NF					
12185.000	NF					
14622.000	NF					
17059.000	NF					
19496.000	NF					
21933.000	NF					
24370.000	NF					



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7.1.3 Radiated Emissions Harmonics/spurious (Channel 11; 2462 MHz)

Frequency (MHz)	Peak Analyzer Reading (dB μ V)	Average Analyzer Reading (dB μ V)	Site Correction Factor (dB/m)	Corrected Level dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2088.473	24.3	20.3	30.6	50.9	86.9	-36.0
2462.000	100.2	92.7	14.2	106.9		Fundamental
2585.966	19.2	15.0	33.2	48.2	86.9	-38.7
4924.000	24.6	22.7	30.3	53.0	54.0	-1.0
7386.000	NF					
9848.000	NF					
12310.000	NF					
14772.000	NF					
17234.000	NF					
19696.000	NF					
22158.000	NF					
24620.000	NF					

NF = noise floor

TEST PERSONNEL:

Typed/Printed Name: Daniel Baltzell

Date: July 18, 2001

Signature:



8 COMPLIANCE WITH THE RESTRICTED BAND EDGE

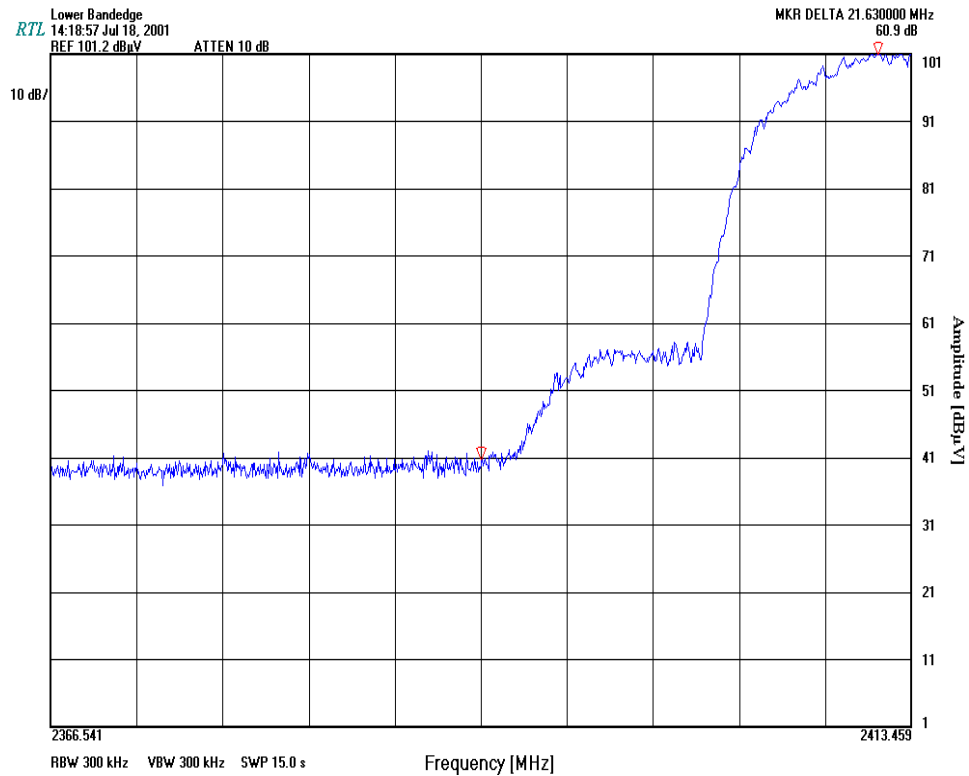
Compliance with the band edges was performed using the procedure described in FCC's Direct Sequence Spread Spectrum Document. The final data derived below were from radiated measurements only. The data taken in this report represents the worst case at 11 MBPS. Data rates of 5.5MBPS, 2 MBPS and 1 MBPS were investigated and found to be in compliance.

Channel Set to	Frequency tested MHz	Detector	Field Strength Level (dBμV/m)	Delta Factor (dB)	Corrected Field Strength (dBμV/m)	FCC Limit (dBμV/m)	FCC Margin (dB)
1	2390.0	AV	108.4	60.9	47.5	54.0	-6.5
		PK	118.9				
11	2483.5	AV	106.9	56.0	50.9	54.0	-3.1
		PK	114.4				



9 BANDEDGE PLOTS

CHANNEL 1



LOWER BAND EDGE (Ä 60.9 DB)

