Engineering and Testing for EMC and Safety Compliance

APPLICATION FOR FCC CERTIFICATION

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

ICOM Incorporated
1-6-19 Kamikurazukuri
Hirano-Ku
Osaka, Japan 547

Model: WLan card SL–1105

FCC ID: AFJ SL-1105

December 7, 2000

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

FCC Rules Parts	Frequency Range	Output Power (W)	Freq. Tolerance	Emission Designator
15.247	2413 to 2463 MHz	0.0229		

This report concerns (check one): Original Grant: X **Class II Change:**
Equipment Type: PCMCIA Board

Deferred grant requested per 47 CFR 0.457 (d) (1) (ii) Yes: **No:** X
If yes, defer until: _____

Company name agrees to notify the Commission by: ___(date) of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes: **No:** X
If no, assumed Part 15, subpart B for unintentional radiators - the new 47 CFR. [10-1-90 Edition] provision.

REPORT PREPARED BY:

EMC Engineer: Rachid Sehb Signature: _____

Supervising Engineer: Desmond A. Fraser Signature: _____

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TABLE OF CONTENTS

1 INTRODUCTION

The following Application for FCC Certification for a Direct Sequence Spread Spectrum transmitter is prepared on behalf of Samsung ***ICOM Incorporated*** in accordance with Part 15.247 of the Federal Communications Commissions. The Equipment Under Test (EUT) was the ***Wlan card SL-1105 , FCC ID: AFJ SL-1105***. 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. 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.

All radiated and conducted emissions measurement were performed manually at Rhein Tech, Incorporated. The radiated emissions measurements required by the rules were performed on the three meter, open field, test range maintained by Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. Complete description and site attenuation measurement data have been placed on file with the Federal Communications Commission. The power line conducted emission measurements were performed in a shielded enclosure also located at the Herndon, Virginia facility. Rhein Tech, Labs, Inc. is on the FCC accepted lab list as a Facility available to do measurement work for others on a contract basis.

1.1 RELATED SUBMITTAL (S)/GRANT (S)

This is an original application for certification.

1.2 TEST METHODOLOGY

Both conducted and radiated testing were 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.

1.3 TEST FACILITY

The open area test site and conducted 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).

1.4 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	8546OA	RF Filter Section, (100 KHz to 6.5 GHz)	3330A00107	11/07/01

RTL Asset Number	Manufacturer	Model	Part Type	Serial Number	Calibration due date
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 (9 kHz –3200 MHz)	1947A02956	11/08/01
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	

RTL Asset Number	Manufacturer	Model	Part Type	Serial Number	Calibration due date
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
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

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 2.413GHz, Channel 6 at 2.438GHz and Channel 11 at 2.463GHz 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 a note computer with an internal antenna connected to the antenna port similar to its intended use.

The EUT was investigated with the internal trace antenna. 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. The change in envelope did not cause the EUT to be non-compliant in any of the aforementioned modes.

2.2 EUT EXERCISE SOFTWARE

The EUT was provided with the software to continuously transmit during testing. The carrier was also checked to verify that the information was being transmitted.

2.3 SPECIAL ACCESSORIES

N/A.

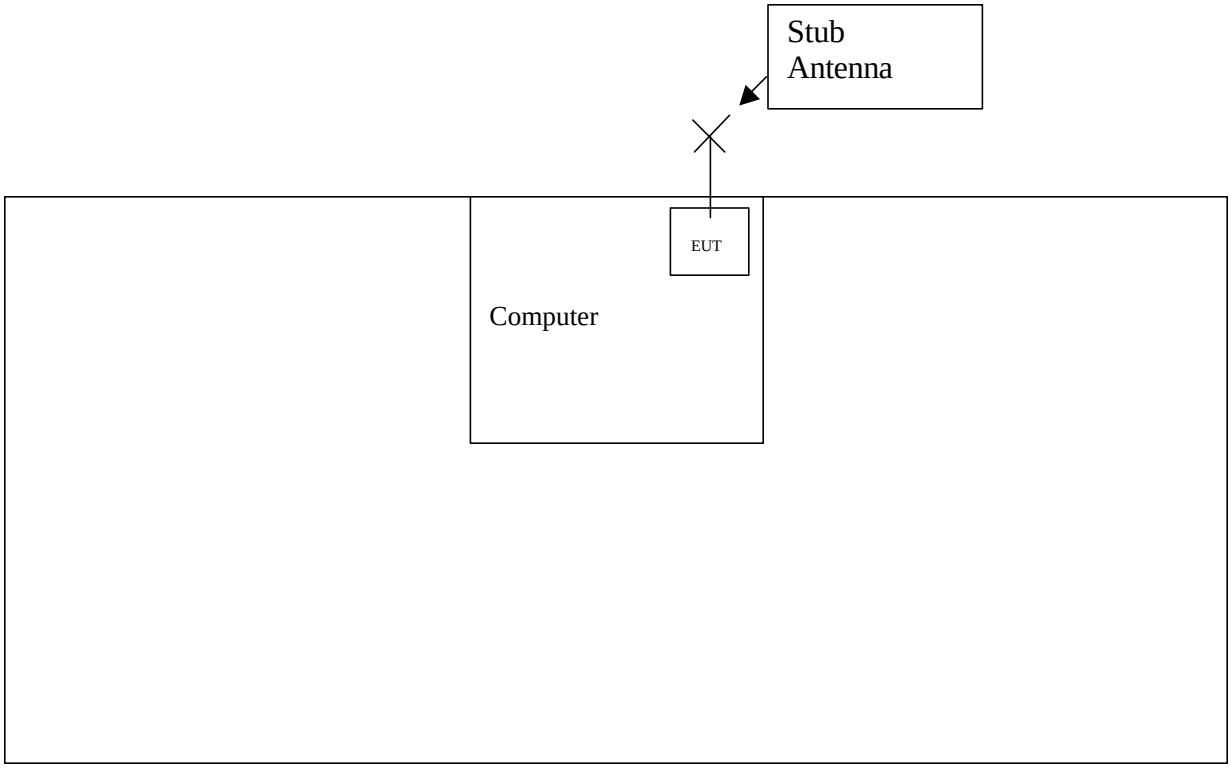
2.4 TEST SYSTEM DETAILS

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

External Components:

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
COMPUTER	FUJITSU	FMV-5120NU2/W	91BJ5004867	DOC	SHIELDED	12431
MODEM	US ROBOTICS	0413	839032B26M4PN	DOC	SHIELDED I/O UNSHIELDED POWER	900407
WIRELESS LAN PCMCIA CARD	ICOM	SL-1105	00001	FCC ID: AFJ SL-1105	N/A	12156
PRINTER	HEWLETT PACKARD	C3990A	JPHG006828	B94C2164X	SHIELDED I/O UNSHIELDED POWER	09905

2.5 CONFIGURATION OF TESTED SYSTEM



3 CONFORMANCE STATEMENT

STANDARDS REFERENCED FOR THIS REPORT	
FCC RULES AND REGULATION	PART 2 SUBPART J
FCC RULES AND REGULATION	PART 15 §15.109
FCC RULES AND REGULATION	PART 15 §15.111
FCC RULES AND REGULATION	PART 15 § 15.121
ANSI	C63.4:1992

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.

Signature: 

Date: December 7, 2000

Typed/Printed Name: Desmond A. Fraser

Position: President
(NVLAP Signatory)

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(dBuV/m) = SAR(dBuV) + SCF(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:

SCF(dB/m) = - PG(dB) + AF(dB/m) + CL(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:

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

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 dBuV - 11.5 dB/m = 37.8 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 CONDUCTED EMISSIONS MEASUREMENTS

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50 ohm / 50 microhenry Line Impedance Stabilization Network (EUT LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 7 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 7 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or average mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. No video filter less than 10 times the resolution bandwidth was used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. 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 have been recorded in this report.

5.1 CONDUCTED EMISSIONS TEST

The following table lists worst-case conducted emission date. Specifically: Emission Frequency, Test Detector, Analyzer Reading, Site Correction Factor, corrected Emission Level, Quasi Peak Limit and Margin, and the Average Limit and Margin.

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. If the conducted emissions exceed the limit with the instrument set to the quasi-peak mode, then measurements are made in the average mode.

The conducted test was performed with the EUT exercise program loaded, and the emissions were scanned between 150 kHz to 30 MHz on the NEUTRAL SIDE and HOT SIDE, herein referred to as L1 and L2, respectively.

5.1.1 CONDUCTED EMISSIONS (CHANNEL 1 WITH THE INTERNAL ANTENNA)

NEUTRAL SIDE (Line 1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC B QP Limit (dBuV)	FCC B QP Margin (dBuV)	FCC B AV Limit (dBuV)	FCC B AV Margin (dBuV)
1.770	Pk	39.1	0.9	40.0	48.0	-8.0	48.0	-8.0
2.088	Pk	42.7	1.0	43.7	48.0	-4.3	48.0	-4.3
4.431	Pk	42.3	1.4	43.7	48.0	-4.3	48.0	-4.3
5.110	Pk	28.9	1.6	30.5	48.0	-17.5	48.0	-17.5
13.160	Pk	30.5	2.3	32.8	48.0	-15.2	48.0	-15.2
25.460	Pk	18.7	3.3	22.0	48.0	-26.0	48.0	-26.0

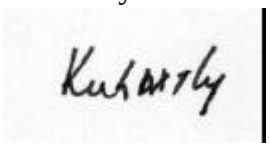
HOT SIDE (Line 2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC B QP Limit (dBuV)	FCC B QP Margin (dBuV)	FCC B AV Limit (dBuV)	FCC B AV Margin (dBuV)
0.450	Pk	34.3	0.4	34.7	48.0	-13.3	48.0	-13.3
2.088	Pk	40.5	1.0	41.5	48.0	-6.5	48.0	-6.5
4.440	Pk	33.5	1.4	34.9	48.0	-13.1	48.0	-13.1
12.870	Pk	29.5	2.3	31.8	48.0	-16.2	48.0	-16.2
13.065	Pk	31.1	2.3	33.4	48.0	-14.6	48.0	-14.6
15.190	Pk	23.7	2.7	26.4	48.0	-21.6	48.0	-21.6

[(1)]Pk = Peak; QP = Quasi-Peak; Av = Average

TEST PERSONNEL:

Typed/Printed Name: Kinh Ly **Date:** December 7, 2000



5.1.2 CONDUCTED EMISSIONS (CHANNEL 6 WITH THE INTERNAL ANTENNA)

NEUTRAL SIDE (Line 1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC B QP Limit (dBuV)	FCC B QP Margin (dBuV)	FCC B AV Limit (dBuV)	FCC B AV Margin (dBuV)
0.450	Pk	34.7	0.5	35.2	48.0	-12.8	48.0	-12.8
1.765	Pk	36.4	0.9	37.3	48.0	-10.7	48.0	-10.7
4.431	Pk	42.3	1.4	43.7	48.0	-4.3	48.0	-4.3
5.105	Pk	29.7	1.6	31.3	48.0	-16.7	48.0	-16.7
12.870	Pk	30.3	2.3	32.6	48.0	-15.4	48.0	-15.4
15.235	Pk	24.1	2.8	26.9	48.0	-21.1	48.0	-21.1

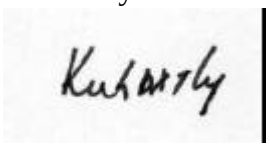
HOT SIDE (Line 2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC B QP Limit (dBuV)	FCC B QP Margin (dBuV)	FCC B AV Limit (dBuV)	FCC B AV Margin (dBuV)
0.450	Pk	32.8	0.4	33.2	48.0	-14.8	48.0	-14.8
2.088	Pk	42.5	1.0	43.5	48.0	-4.5	48.0	-4.5
3.699	Pk	37.3	1.2	38.5	48.0	-9.5	48.0	-9.5
5.065	Pk	28.6	1.6	30.2	48.0	-17.8	48.0	-17.8
12.915	Pk	31.0	2.3	33.3	48.0	-14.7	48.0	-14.7
15.190	Pk	23.9	2.7	26.6	48.0	-21.4	48.0	-21.4

[(1)]Pk = Peak; QP = Quasi-Peak; Av = Average

TEST PERSONNEL:

Typed/Printed Name: Kinh Ly **Date:** December 7, 2000



5.1.3 CONDUCTED EMISSIONS (CHANNEL 11 WITH THE INTERNAL ANTENNA)

NEUTRAL SIDE (Line 1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC B QP Limit (dBuV)	FCC B QP Margin (dBuV)	FCC B AV Limit (dBuV)	FCC B AV Margin (dBuV)
0.450	Pk	33.6	0.5	34.1	48.0	-13.9	48.0	-13.9
2.484	Pk	30.3	1.1	31.4	48.0	-16.6	48.0	-16.6
4.290	Pk	32.1	1.4	33.5	48.0	-14.5	48.0	-14.5
5.200	Pk	28.3	1.6	29.9	48.0	-18.1	48.0	-18.1
13.065	Pk	30.0	2.3	32.3	48.0	-15.7	48.0	-15.7
15.230	Pk	24.2	2.8	27.0	48.0	-21.0	48.0	-21.0

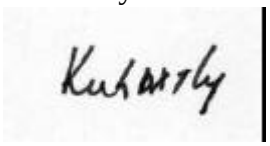
HOT SIDE (Line 2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC B QP Limit (dBuV)	FCC B QP Margin (dBuV)	FCC B AV Limit (dBuV)	FCC B AV Margin (dBuV)
0.450	Pk	32.7	0.4	33.1	48.0	-14.9	48.0	-14.9
3.903	Pk	32.3	1.3	33.6	48.0	-14.4	48.0	-14.4
5.110	Pk	29.5	1.6	31.1	48.0	-16.9	48.0	-16.9
12.720	Pk	29.2	2.3	31.5	48.0	-16.5	48.0	-16.5
13.255	Pk	29.6	2.3	31.9	48.0	-16.1	48.0	-16.1
27.845	Pk	18.4	3.4	21.8	48.0	-26.2	48.0	-26.2

[(1)]Pk = Peak; QP = Quasi-Peak; Av = Average

TEST PERSONNEL:

Typed/Printed Name: Kinh Ly **Date:** December 7, 2000



6 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. The spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. 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.

6.1 RADIATED EMISSIONS TEST

The following data lists the significant emission frequencies, measured levels, correction factor (includes cable and antenna corrections), the corrected reading, plus the limit.

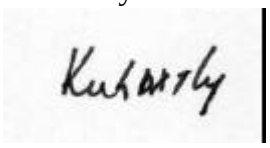
6.1.1 RADIATED EMISSION DIGITAL NOISE (CHANNEL 1 WITH THE INTERNAL ANTENNA)

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
224.993	Qp	H	270	2.0	37.4	-17.1	20.3	46.0	-25.7
250.005	Qp	H	215	1.4	37.7	-14.6	23.1	46.0	-22.9
254.479	Qp	V	45	1.0	35.0	-14.8	20.2	46.0	-25.8
374.220	Qp	H	135	1.4	35.9	-10.8	25.1	46.0	-20.9
381.460	Qp	V	180	1.0	34.8	-10.9	23.9	46.0	-22.1
450.023	Qp	H	225	1.0	38.7	-9.0	29.7	46.0	-16.3

QUASI PEAK =120 KHZ
AVERAGE: RES. =1 MHZ, VID= 10HZ; NF = NOISE FLOOR

TEST PERSONNEL:

Typed/Printed Name: Kinh Ly **Date:** December 7, 2000



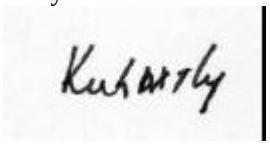
6.1.2 RADIATED EMISSION DIGITAL NOISE (CHANNEL 6 WITH THE INTERNAL ANTENNA)

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
124.999	Qp	V	215	1.0	39.3	-15.4	23.9	43.5	-19.6
310.012	Qp	H	145	1.0	40.2	-13.0	27.2	46.0	-18.8
316.532	Qp	V	180	1.8	36.2	-13.0	23.2	46.0	-22.8
367.514	Qp	V	175	1.4	35.7	-10.8	24.9	46.0	-21.1
374.712	Qp	H	165	1.0	36.5	-10.8	25.7	46.0	-20.3
528.012	Qp	H	155	2.0	34.9	-7.7	27.2	46.0	-18.8

QUASI PEAK =120 KHZ
AVERAGE: RES. =1 MHZ, VID= 10HZ; NF = NOISE FLOOR

TEST PERSONNEL:

Typed/Printed Name: Kinh Ly **Date:** December 7, 2000



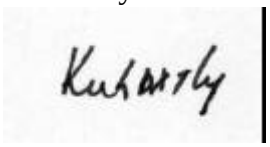
6.1.3 RADIATED EMISSIONS DIGITAL NOISE (CHANNEL 11 WITH THE INTERNAL ANTENNA)

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
125.000	Qp	V	225	1.0	40.2	-15.4	24.8	43.5	-18.7
224.987	Qp	H	315	2.0	38.4	-17.1	21.3	46.0	-24.7
249.999	Qp	H	230	1.4	37.4	-15.3	22.1	46.0	-23.9
310.012	Qp	H	145	1.0	39.9	-13.9	26.0	46.0	-20.0
378.569	Qp	H	35	1.0	35.5	-11.7	23.8	46.0	-22.2
528.000	Qp	H	165	2.0	35.1	-7.7	27.4	46.0	-18.6

QUASI PEAK =120 KHZ
AVERAGE: RES. =1 MHZ, VID= 10HZ; NF = NOISE FLOOR

TEST PERSONNEL:

Typed/Printed Name: Kinh Ly **Date:** December 7, 2000



7 Modulated Bandwidth

The minimum 6 dB bandwidth per FCC 15.247(a)(2) was measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 100 kHz. The Minimum 6 dB modulated bandwidths are the following:

Channel	6(dB) Bandwidth (MHz)
1	11.20
6	11.10
11	11.05

The 6dB bandwidth is listed in figures part 26.

8 Power Output

The power output per FCC 15.247(b) was measured on the EUT using an HP peak power meter.

Channel	EIRP (dBm)*	Power conducted output (dBm)
1	15.2	13.0
6	14.8	12.3
11	10.8	11.8

*Measurement accuracy is +/- 1.5 dB

9 Antenna Conducted Spurious Emissions

Antenna spurious emission per FCC 15.247(c) was measured from the EUT antenna port using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. The modulated carrier was identified at 2.413GHz for Channel 1, 2.438GHz for Channel 6 and 2.463GHz for Channel 11. No other harmonics or spurs were found within 20 dB of the carrier level, and from 9kHz to the carriers 10^{th} harmonic. See antenna conducted spurious noise table and plots.
Channels 1, 6, and 11 were investigated and tested, only worst-case plot for channel 11 is presented in this report.

Channel = 1		
Frequency (GHz)	**Spurious level (dBm)**	**FCC Margin (dB)**
2.4534	-38	17,9
2.4451	-47	26,9
2.4851	-45	24,9
4.8130	-49	28,9

Channel = 6		
Frequency (GHz)	**Spurious level (dBm)**	**FCC Margin (dB)**
2.4808	-49	27,7
2.4822	-50	28,7
2.4917	-48	26,7
4.8760	-53	31,7

Channel = 11		
Frequency (GHz)	**Spurious level (dBm)**	**FCC Margin (dB)**
2.4030	-40	18,7
2.4952	-51	29,7
2.5063	-51	29,7
4.9110	-52	30,6

10 RADIATED SPURIOUS EMISSIONS

Radiated Spurious Emissions applies to harmonics and spurious emissions that fall in the restricted and non-restricted bands. 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.

10.1.1 RADIATED EMISSIONS HARMONICS/SPURIOUS (CHANNEL 1)

Frequency in Ghz	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Level in dBuV/m	Limit in dBuV/m	Margin in dB
2.0382	AV	H	10	1.5	42.67	55.9	82.4	-26.5
2.4130	AV	H	10	1.5	89.1	102.4	Fundamental	
2.4530	AV	H	15	1.5	37.1	50.4	82.4	-32
4.8250	AV	H	15	1.5	NF			

AVERAGE: RES. =1 MHZ, VID= 10HZ; NF = NOISE FLOOR

TEST PERSONNEL:

Typed/Printed Name: Rachid SEHB **Date:** December 7, 2000

10.1.2 RADIATED EMISSIONS HARMONICS/SPURIOUS (CHANNEL 6)

Frequency in Ghz	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Level in dBuV/m	Limit in dBuV/m	Margin in dB
2.0628	AV	H	10	1,5	38,8	52,03	77,2	-25,17
2.4380	AV	H	10	1,5	83,9	97,2	Fundamental	
2.9939	AV	H	15	1,5	36,1	49,4	77,2	-27,8
4.,8760	AV	H	15	1,5	NF			

Average: Res. =1 MHz, VID= 10Hz; NF = noise floor

TEST PERSONNEL:

Typed/Printed Name: Rachid SEHB **Date:** December 7, 2000

10.1.3 RADIATED EMISSIONS HARMONICS/SPURIOUS (CHANNEL 11)

Frequency in Ghz	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Level in dBuV/m	Limit in dBuV/m	Margin in dB
2,088	AV	H	10	1,5	43,8	57,03	75,2	-18,17
2,403	AV	H	10	1,5	40,1	53,4	75,2	-27,8
2,463	AV	H	15	1,5	81,9	95,2	Fundamental	
4,926	AV	H	15	1,5	NF			

QUASI PEAK =120 KHZ
AVERAGE: RES. =1 MHZ, VID= 10HZ; NF = NOISE FLOOR

TEST PERSONNEL:

Typed/Printed Name: Rachid SEHB **Date:** December 7, 2000

11 POWER SPECTRAL DENSITY

The Power spectral density per FCC 15.247(d) was measured from the antenna port of the EUT using a 50 ohm spectrum analyzer with the resolution bandwidth set at 3kHz, the video bandwidth set at 3kHz, and the sweep time set at 17 second. The spectral lines were resolved for the modulated carriers at 2.412GHz, 2.437GHz and 2.462GHz respectively. These levels are well below the +8 dBm limit. See power spectral density table and plots.

Channel	Power Spectral Density limit = +8dBm
1	-9.6
6	-10.4
11	-10.6

12 COMPLIANCE WITH THE RESTRICTED BAND EDGE

Compliance with the band edges was performed using the FCC's "Radiated Measurement at a Band Edge" guidance 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.

Band edge Measurement						
Antenna	**Channel**	**Delta dB**	**Field Strength Level (dBuV)**	**Corrected level (dBuV)**	**FCC Limit (dBuV)**	**FCC Margin**
Internal	1	-53.5	100.9	47.4	54	-6.6
Internal	11	-52.5	93.7	41.3	54	-12.8

13 ANTENNA SPECIFICATIONS

Internal trace antenna

Electrical Specifications:

Model No.	Dual pattern antenna with diversity support
Frequency Range	2.4-2.5GHz
Bandwidth	100MHz
Gain	2.15dBi
V.S.W.R	<1.9
Radiation Pattern	Omni-Directional
Polarization	Horizontal
Impedance	50ohms
Operating Temperature	

Electrical Specifications:

Dimension	N/A
Pulling Strength	N/A
Swivel Torque	N/A
Input Connector	Directly etched on PCB board