Engineering and Testing for EMC and Safety Compliance

APPLICATION FOR FCC CERTIFICATION

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

Samsung Electro-Mechanics
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Kyunggi-Do, Korea, 442-743
+82-331-210-6662

Model: Magic Wave PCMCIA Card SWL-2000E

FCC ID: E2XSWL-2000E

September 23, 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
RSS-210, Issue 3: 2000	LOW POWER LICENCE-EXEMPT RADIOCOMMUNICATION DEVICES (ALL FREQUENCY BANDS)
RSS-102, Issue 1: 1999	EVALUATION PROCEDURE FOR MOBILE AND PORTABLE RADIO TRANSMITTERS

FCC Rules Parts	Frequency Range	Output Power (W)	Freq. Tolerance	Emission Designator
15.247	2412-2460	0.0275		

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

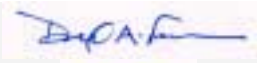
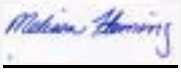
Deferred grant requested per 47 CFR 0.457 (d) (1) (ii)? Yes: **No**: X
If yes, defer until: _____

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.

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described above. No modifications were 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.

REPORT PREPARED BY:

Supervising Engineer:	**Desmond A. Fraser**	
EMC Engineer:	**Rachid Sehb**	
Administrative Writer:	**Melissa Fleming**	

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1 GENERAL INFORMATION

The following Application for Certification for a Direct Sequence Spread Spectrum transmitter is prepared on behalf of ***Samsung Electro-Mechanics*** in accordance with Federal Communications Commissions Rules and Regulations and with Industry Canada. The Equipment Under Test (EUT) was the ***Magic Wave PCMCIA Card SWL-2000E***, ***FCC ID: E2XSWL-2000E***. 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.

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 and with Industry Canada. 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 and Industry Canada 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 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.

1.3 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, 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 equipment for emission testing					
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	11/09/00
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	11/09/00
900933	Hewlett Packard	11975A	Power Amplifier (2 - 8 GHz)	2304A00348	11/10/00
901067	Hewlett Packard	8903B	Audio Analyzer	2303A00307	06/28/01
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	11/09/00
900897	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz - 1.5 GHz)	2727A00535	11/09/00
901089	Hewlett Packard	HP875ET	Transmission/Reflection Network Analyzer	US39170052	N/A
901055	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2545A04102	06/08/01
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	03/06/01
901016	Hewlett Packard	8565E	Portable Spectrum Analyzer (30 Hz-50 GHz)	3846A01069	02/28/01
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	03/27/01
900926	Hewlett Packard	8753D	RF Vector Network Analyzer	3410A09659	03/28/01
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	11/10/00
901088	Hewlett Packard	HP8954A	Transceiver Interface	2146A00139	07/28/01
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	06/21/01
900151	Rohde@Schwarz	HFH2-Z2	Loop Antenna (9 kHz - 30 MHz)	827525/019	05/26/01
900800	EMCO	3301B	Active Monopole	9809-4071	05/02/01
900154	Compliance Design Inc,	Roberts Dipole	Adjustable Elements Dipole Antenna (30-1000MHz)	-	07/266/01
900725	Antenna Research Associates, Inc.	LPB-2520	LOG Periodic /Biconical Antenna (25-1000MHz)	1036	07/12/01
900724	Antenna Research Associates, Inc.	LPB-2520	LOG Periodic /Biconical Antenna (25-1000MHz)	1037	02/01/01
901053	Schaffner	CBL6112B	Bi-Log Chase Antenna (200 MHz – 2 GHz)	2648	07/24/01
900713	ATM	WR05	Horn Antennas (140-220 GHz)	05-443-6	N/A
900826	ATM	WR08,	Horn Antennas (50-220 GHz)	8041904-1	N/A
900711	ATM	WR10	Horn Antennas (75-110 GHz)	8051905-1	N/A
900712	ATM	WR15	Horn Antennas (50-75 GHz)	8051805-1	N/A
900814	Electro-Metrics	RGA-60	Double Ridges Guide Antenna (1-18 GHz)	2310	02/26/01
900791	Schaffner - Chase	CBL6112	Antenna (25 MHz - 2 GHz)	2099	02/22/01
900321	EMCO	3161-03	Horn Antennas (4-8,2GHz)	9508-1020	N/A
900323	EMCO	3160-7	Horn Antennas (8,2-12,4 GHz)	9605-1054	N/A
900325	EMCO	3160-9	Horn Antennas (18 - 26.5 GHz)	9605-1051	N/A
900338	EMCO	3160-10	Horn Antennas (26.5 - 40 GHz)	9606-1033	N/A
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

RTL equipment for emission testing

RTL Asset Number	Manufacturer	Model	Part Type	Serial Number	Calibration due date
900902	Hewlett Packard	85662A	Spectrum Analyzer Display	2848A17585	11/09/00
900896	Hewlett Packard	85662A	Spectrum Analyzer Display	2816A16471	11/09/00
900914	Hewlett Packard	8546OA	RF Filter Section, (100 KHz to 6.5 GHz)	3330A00107	05/10/00
900059	Hewlett Packard	8660C	Synthesized Signal Generator (9KHz to 3200 MHz)	1947A02956	11/09/00
900960	Hewlett Packard	8444A	Tracking Generator (0.5 -1500MHz)	2325A07827	03/08/01
900917	Hewlett Packard	8648C	Synthesized. Signal Generator (9 KHz to 3200 MHz)	3537A01741	03/28/00
900660	Philips	PM-5418TDS	TV Generator	LO 604891	11/10/00
901083	AFJ International	LS16/110VAC	LISN, 16A	16010020080	06/16/01
901082	AFJ International	LS16/110VAC	LISN, 16A	16010020081	06/16/01
901084	AFJ International	LS16/110VAC	LISN, 16A	16010020082	06/16/01
900726	Solar	7225-1	LISN	-	03/29/01
900727	Solar	7225-1	LISN	-	03/29/01
901090	Bajog electronic GmbH	4V-100/200	LISN (150 kHz – 30 MHz)	00-44-007	08/03/00
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892	06/08/01
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
900717	Hewlett Packard	11970U	Harmonic Mixer (40-60 GHz)	2332A01110	06/18/01
900715	Hewlett Packard	11970V	Harmonic Mixer (50-75 GHz)	2521A00512	06/18/01
900716	Hewlett Packard	11970W	Harmonic Mixer (75-110 GHz)	2521A00710	06/12/01
900752	Oleson Microwave Lab.	M05HW	Mixer (140-700 GHz)	G80814-1	08/14/01
900751	Oleson Microwave Lab.	M08HW	Mixer (90-140 GHz)	F80814-1	08/14/01
900770	Hewlett Packard	437B	Power Meter	2949A02966	11/09/00
900769	Hewlett Packard	8481B	Power Sensor	2702A05059	11/09/00
900061	Hewlett Packard	86603A	RF Plug-in (1 to 2600 MHz)	2221A02967	11/09/00
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1-26.5 GHz)	3008A00505	11/10/00
900889	Hewlett Packard	85685A	RF Preselector for HP 8566B or 8568B (20Hz-2GHz)	3146A01309	11/10/00
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 KHz – 6.5 GHz)	3325A00159	03/29/01
900937	Hewlett Packard	8482H	3-watt Power Sensor (100 KHz to 4.2 GHz)	3318A08961	07/18/00
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	09/22/00

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 2.412GHz, Channel 6 at 2.434GHz and Channel 11 at 2.460GHz 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 external antenna connected to the antenna port similar to its intended use.

The EUT was investigated with the external 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.

Note: The EUT was tested as a digital device as well as a receiver. A DOC report is on file for the device as a digital interface and a receiver device. The emission data is a part of the radiated emission data.

2.2 EUT EXERCISE SOFTWARE

The EUT was enabled to continuously transmit, which was verified by a receiving unit during testing. The carrier was also checked to verify that the information was being transmitted.

2.3 SPECIAL ACCESSORIES

N/A.

3 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)

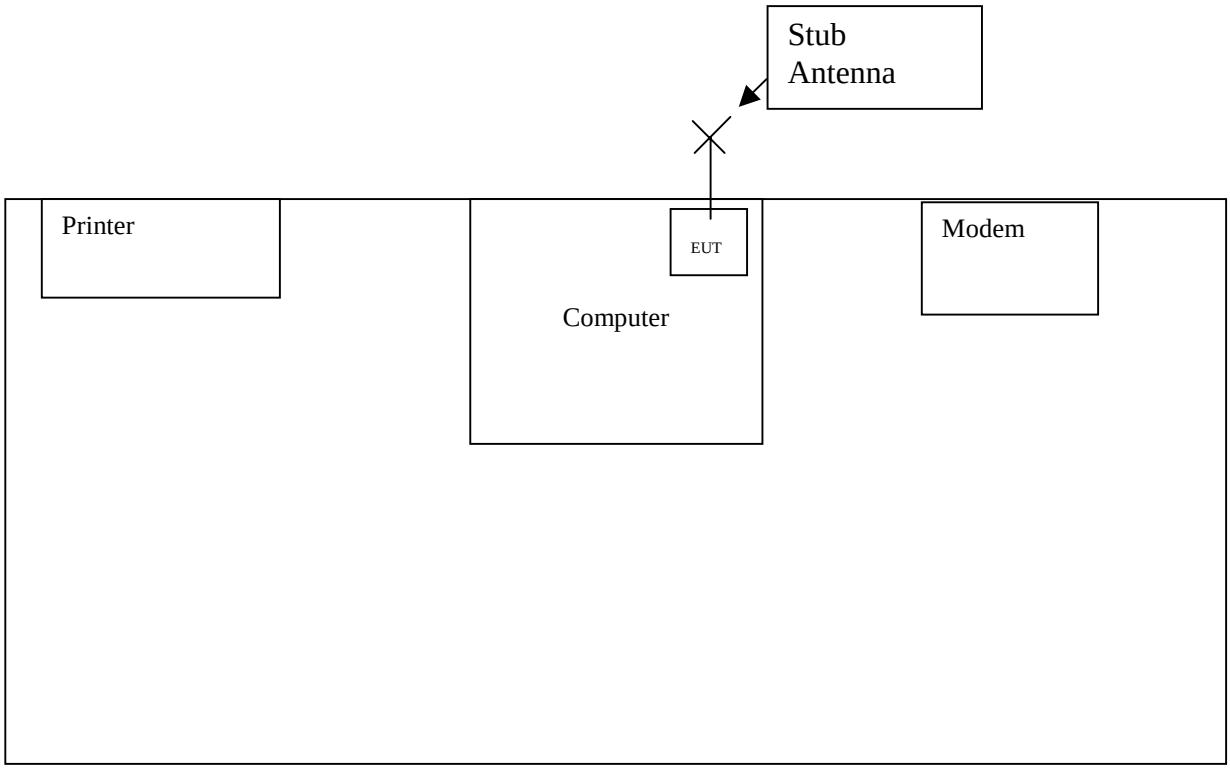
4 TEST SYSTEM DETAILS

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	IBM THINKPAD		5509CY7	A3LS590	SHIELDED	
MODEM	US ROBOTICS	0413	839032B26M4PN	DOC	SHIELDED I/O UNSHIELDED POWER	900407
WIRELESS LAN PCMCIA CARD	**SAMSUNG**	**SWL-2100E**		**E2XSWL-2000E**	**N/A**	**12156**
PRINTER	HEWLETT PACKARD	LASERJET 6L	JHPG006828		SHIELDED I/O UNSHIELDED POWER	9905

4.1 CONFIGURATION OF TESTED SYSTEM



5 CONDUCTED EMISSIONS

5.1 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.

5.2 CONDUCTED EMISSIONS TEST RESULTS

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.

Pk = Peak; QP = Quasi-Peak; Av = Average

5.2.1.1 Neutral Side (Line 1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.480	Pk	40.8	0.8	41.6	48.0	-6.4	48.0	-6.4
0.584	Pk	38.6	0.9	39.5	48.0	-8.5	48.0	-8.5
1.396	Pk	40.5	1.2	41.7	48.0	-6.3	48.0	-6.3
2.314	Pk	36.2	1.5	37.7	48.0	-10.3	48.0	-10.3
14.730	Pk	35.2	2.9	38.1	48.0	-9.9	48.0	-9.9
18.360	Pk	24.8	3.1	27.9	48.0	-20.1	48.0	-20.1

5.2.1.2 Hot Side (Line 2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.475	Pk	38.9	0.7	39.6	48.0	-8.4	48.0	-8.4
0.579	Pk	37.5	0.7	38.2	48.0	-9.8	48.0	-9.8
1.252	Pk	33.1	1.0	34.1	48.0	-13.9	48.0	-13.9
1.342	Pk	33.3	1.0	34.3	48.0	-13.7	48.0	-13.7
15.050	Pk	34.5	2.9	37.4	48.0	-10.6	48.0	-10.6
20.310	Pk	24.0	3.4	27.4	48.0	-20.6	48.0	-20.6

TEST PERSONNEL:

Typed/Printed Name: Rachid Sehb  **Date:** August 28, 2000

5.2.2.1 NEUTRAL SIDE (Line 1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.479	Pk	40.5	0.8	41.3	48.0	-6.7	48.0	-6.7
0.584	Pk	39.1	0.9	40.0	48.0	-8.0	48.0	-8.0
1.027	Pk	36.5	1.0	37.5	48.0	-10.5	48.0	-10.5
2.602	Pk	34.3	1.5	35.8	48.0	-12.2	48.0	-12.2
14.560	Pk	36.1	2.9	39.0	48.0	-9.0	48.0	-9.0
21.430	Pk	22.6	3.4	26.0	48.0	-22.0	48.0	-22.0

5.2.2.2 HOT SIDE (Line 2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.481	Pk	40.8	0.7	41.5	48.0	-6.5	48.0	-6.5
0.584	Pk	39.8	0.7	40.5	48.0	-7.5	48.0	-7.5
1.027	Pk	34.7	0.9	35.6	48.0	-12.4	48.0	-12.4
2.602	Pk	33.7	1.4	35.1	48.0	-12.9	48.0	-12.9
14.500	Pk	36.0	2.8	38.8	48.0	-9.2	48.0	-9.2
20.500	Pk	24.6	3.4	28.0	48.0	-20.0	48.0	-20.0

TEST PERSONNEL:

Typed/Printed Name: Rachid Sehb  **Date:** August 28, 2000

5.2.3.1 NEUTRAL SIDE (Line 1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.472	Pk	40.9	0.8	41.7	48.0	-6.3	48.0	-6.3
0.691	Pk	38.7	0.8	39.5	48.0	-8.5	48.0	-8.5
1.126	Pk	33.7	1.0	34.7	48.0	-13.3	48.0	-13.3
2.683	Pk	33.1	1.5	34.6	48.0	-13.4	48.0	-13.4
14.530	Pk	35.0	2.8	37.8	48.0	-10.2	48.0	-10.2
20.160	Pk	22.8	3.4	26.2	48.0	-21.8	48.0	-21.8

5.2.3.2 HOT SIDE (Line 2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.473	Pk	40.6	0.7	41.3	48.0	-6.7	48.0	-6.7
0.585	Pk	39.0	0.7	39.7	48.0	-8.3	48.0	-8.3
1.018	Pk	35.0	0.9	35.9	48.0	-12.1	48.0	-12.1
2.602	Pk	33.8	1.4	35.2	48.0	-12.8	48.0	-12.8
14.370	Pk	35.5	2.8	38.3	48.0	-9.7	48.0	-9.7
20.260	Pk	25.2	3.4	28.6	48.0	-19.4	48.0	-19.4

TEST PERSONNEL:

Typed/Printed Name: Rachid Sehb  **Date:** August 28, 2000

6 RADIATED EMISSIONS

6.1 RADIATED EMISSIONS MEASUREMENTS

Before final measurements of radiated emissions were made on the open-field three/ten meter range; the EUT was scanned indoors 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.

6.2 RADIATED EMISSIONS TEST RESULTS

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

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV/m)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
195.98	Qp	H	180	1.8	50.2	-18	32.2	43.5	-11.3	Pass	
199.849	Qp	V	90	1	35.9	-17.6	18.3	43.5	-25.2	Pass	
204.859	Qp	H	90	1	45.6	-17.2	28.4	43.5	-15.1	Pass	
208.998	Qp	H	280	1	43.5	-17	26.5	43.5	-17	Pass	
209.277	Qp	H	300	1.2	47.3	-17	30.3	43.5	-13.2	Pass	
2412.7	Av	H	180	1	76.6	3.3	79.9				Fundamental
4825.4	Av	H	85	1	32.7						Noise Floor
7238.1	Av	H	95	1	33.5						Noise Floor
9650.8	Av	H	85	1	30.6						Noise Floor
12063.5	Av	H	90	1	30.3						Noise Floor
14476.2	Av	H	90	1	33.6						Noise Floor
16888.9	Av	H	90	1	32.8						Noise Floor

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

TEST PERSONNEL:

Typed/Printed Name: Rachid Sehb **Date:** August 28, 2000

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV/m)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
170.948	Qp	V	180	1	36.7	-17.1	19.6	43.5	-23.9	Pass	
200.161	Qp	H	1	1	37.6	-17.8	19.8	43.5	-23.7	Pass	
210.828	Qp	V	10	1	42.5	-17.3	25.2	43.5	-18.3	Pass	
313.738	Qp	H	0	1	42.9	-12.9	30	46	-16	Pass	
2434.2	Av	H	90	1	79.6	3.3	82.9				Fundamental
4868.4	Av	H	85	1	32.8						Noise Floor
7302.6	Av	H	95	1	33.5						Noise Floor
9736.8	Av	H	85	1	31						Noise Floor
12171	Av	H	90	1	28.6						Noise Floor
14605.2	Av	H	90	1	33.6						Noise Floor
17039.4	Av	H	90	1	33						Noise Floor

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

TEST PERSONNEL:

Typed/Printed Name: Rachid Sehb **Date:** August, 2000

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV/m)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail	Comments
204.862	Qp	V	180	1	44.4	-17.2	27.2	43.5	-16.3	Pass	
208.99	Qp	H	270	1	43	-17	26	43.5	-17.5	Pass	
349.556	Qp	H	90	1	38.6	-11.2	27.4	46	-18.6	Pass	
656	Qp	V	145	1	35.5	-5.7	29.8	46	-16.2	Pass	
2460	Av	H	90	1	79.7	3.3	83.0				Fundamental
4900	Av	H	95	1	33.1						Noise Floor
7350	Av	H	85	1	31.0						Noise Floor
9800	Av	H	90	1	28.03						Noise Floor
12250	Av	H	90	1	33.3						Noise Floor
14700	Av	H	90	1	33						Noise Floor

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

TEST PERSONNEL:

Typed/Printed Name: Rachid Sehb **Date:** August, 1999

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	11.1
6	11.4
11	11.5

The 6dB bandwidth is listed in figures ---,--- and ---.

7.1 POWER OUTPUT

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

Channel	Conducted Power (mW)	EIRP (dBm)	EIRP (mW)
1	25.1	13.5	22.3
6	26.3	14.2	26.3
11	27.5	13.5	22.1

7.2 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 2.412GHz for Channel 1, 2.434GHz for Channel 6 and 2.460GHz for Channel 11. No other harmonics or spurs were found within 20 dB of the carrier level, and from 9kHz to the carriers 10th 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	**Carrier power = 3.5 dBm**	
Frequency (GHz)	**Spurious level (dBm)**	**FCC limit (dBm)**
0.011	-47.5	-16.5
0.018	-45.3	-16.5
1.600	-57	-16.5
1.600	-57	-16.5
4.839	-54	-16.5
9.655	-49	-16.5

Channel = 6	**Carrier Power = 5.3 dBm**	
Frequency (GHz)	**Spurious level (dBm)**	**FCC limit (dBm)**
0.018	-45.3	-14.7
1.689	-56.1	-14.7
4.884	-54.6	-14.7
9.760	-51.7	-14.7
12.183	-57.67	-14.7
17.066	-72	-14.7

Channel = 11	**Carrier Power = 4.8**	
Frequency (GHz)	**Spurious level (dBm)**	**FCC limit (dBm)**
0.018	-45.3	-15.2
1.719	-55	-15.2
4.929	-56	-15.2
9.865	-55	-15.2
12.300	-59.1	-15.2
14.775	-63	-15.2

7.3 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.

7.4 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, 2.434GHz and 2.460GHz respectively. These levels are well below the +8 dBm limit. See power spectral density table and plots.

Channel	Power Spectral Density limit = +8dBm
1	-8.97
6	-8.57
11	-8.70

8 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.

Bandedge Measurement						
Antenna	**Channel**	**Delta dB**	**Field Strength Level (dBuV)**	**Corrected level (dBuV)**	**FCC Limit (dBuV)**	**FCC Margin (dB)30**
External	1	30.5	79.9	49.4	54	4.6
External	11	30.0	83	53.0	54	1.0

9 ANTENNA SPECIFICATIONS

External stub antenna

Electrical Specifications:

Model No.	Samsung External Antenna
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	-30C – 60C