Engineering and Testing for EMC and Safety Compliance

APPLICATION FOR FCC CERTIFICATION

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

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Model: Magic Wave USB Card SWL-2100U

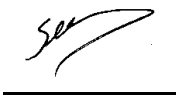
FCC ID: E2XSWL-2100U

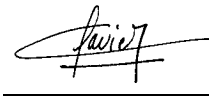
May 30, 2001

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 5: Draft 3	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 - 2462 MHz	0.028		
Industry Canada	**Frequency Range**	**Output Power (W)**	**Freq. Tolerance**	**Emission Designator**
RSS-210	2412 - 2462 MHz	0.028		

REPORT PREPARED BY:

EMC Engineer: Rachid Sehb **Signature:** 

Supervising Engineer: Bruno Clavier **Signature:** 

Document Number: 2001150

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1 INTRODUCTION

The following Application for FCC Certification for a Direct Sequence Spread Spectrum transmitter is prepared on behalf of ***Samsung Electro-Mechanics*** in accordance with the Federal Communications Commissions and Industry Canada standards. The Equipment Under Test (EUT) was the ***Magic Wave USB Card SWL-2100U***, ***FCC ID: E2XSWL-2100U***. 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).

TABLE 1-1: TEST EQUIPMENT LIST

RTL Asset Number	Manufacturer	Model	Part Type	Serial Number
900969	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2412A00414
900929	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2811A01276
900901	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	3145A01599
900339	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2521A00743
900042	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2521A01032
900924	Amplifier Research	75A220	Amplifier (10 kHz – 220 MHz)	
900933	Hewlett Packard	11975A	Power Amplifier (2 - 8 GHz)	2304A00348
901067	Hewlett Packard	8903B	Audio Analyzer	2303A00307
901055	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2545A04102
900718	Voltech	PM3000A	Power Analyzer	6836-002-10
900397	Associated Research, Inc.	6554SA	Electrical Safety Compliance Analyzer	940281
900926	Hewlett Packard	8753D	RF Vector Network Analyzer	3410A09659
901089	Hewlett Packard	HP875ET	Transmission/Reflection Network Analyzer	US39170052
900968	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz – 1.5 GHz)	2602A00160
900903	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz – 1.5 GHz)	2841A00614
900897	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz – 1.5 GHz)	2727A00535
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	3138A07771
900912	Hewlett Packard	8568A	RF Spectrum Analyzer (100 Hz – 1.5 GHz)	2634A02704
900824	Hewlett Packard	8591E	RF Spectrum Analyzer (9 KHz – 1.8 GHz)	3710A06135
900724	ARA	LPB-2520	Log Periodic / Biconical Antenna (25-1000 MHz)	1037
900725	ARA	LPB-2520	Log Periodic / Biconical Antenna (25-1000 MHz)	1036
900967	A.H. Systems	TDS-206/535-1 through TDS-206/535-4	Tuned Dipole set (30 – 1000 MHz)	126, 128, 129, 132
900154	Compliance Design	Roberts Dipole	Adjustable Elements Dipole antenna (30-1000MHz)	N/A
900814	Electro-Metrics	RGA-60	Double Ridges Guide Antenna (1-18 GHz)	2310
900081	EMCO	3146	Log-Periodic Antenna (200-1000 MHz)	1850
900800	EMCO	3301B	Active Monopole (Rod antenna) (30 Hz – 50 MHz)	9809-4071
900151	Rohde@ Schwarz	HFH@-Z2	Loop Antenna (9kHz-30 MHz)	82825/019
900791	Schaffner –Chase	CSL6112	Bilog antenna (30 MHz – 2GHz)	2099
901053	Schaffner –Chase	CBL6112B	Bilog Chase antenna (200 MHz – 2 GHz)	2648
900060	Hewlett Packard	86634B	Auxiliary Section for External Pulse Modulator	1314A02913
901041	ACO Pacific	511E	Sound Level Calibrator	028751
900970	Hewlett Packard	85662A	Spectrum Analyzer Display	254211239
900930	Hewlett Packard	85662A	Spectrum Analyzer Display	3144A20839
900911	Hewlett Packard	85662A	Spectrum Analyzer Display	2542A12739
900902	Hewlett Packard	85662A	Spectrum Analyzer Display	2848A17585
900896	Hewlett Packard	85662A	Spectrum Analyzer Display	2816A16471
900914	Hewlett Packard	8546OA	RF Filter Section, (100 KHz to 6.5 GHz)	3330A00107
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585
900059	Hewlett Packard	8660C	Signal Generator (9 KHz – 3200 MHz)	1947A02956
900960	Hewlett Packard	8444A	Tracking Generator (0.5 –1500MHz)	2325A07827
900917	Hewlett Packard	8648C	Synthesized. Signal Generator (9 KHz – 3200 MHz)	3537A01741
900821	Hewlett Packard	33120A	15 MHz Function / Arbitrary Waveform Generator	US36029992
900059	Hewlett Packard	8660C	Synthesized. Signal Generator (9 kHz –3200 MHz)	1947A02956

RTL Asset Number	Manufacturer	Model	Part Type	Serial Number
900560	Haefely	PESD 1600	ESD Generator	H 703146
900099	Marconi	52022-910E	Signal Generator (10 kHz – 1 GHz)	119044-189
900195	Tektronix	CFG280	Function Generator (0.1 Hz – 11 MHz)	TW12167
900927	Tektronix	ASG 100	Audio Signal Generator	B03274 V2.3
900935	Wavetek	3510B	Signal Generator	5372160
900660	Philips	PM5418TDS	TV Generator	LO 604891
900369	Philips	PM5418TDS	TV Generator	LR81436C
900268	Taylor	5565	Hygrometer / Thermometer	N/A
901056	Hewlett Packard	8954A, Opt.H03	Transceiver Interface	2924A00830
901088	Hewlett Packard	8954A	Transceiver Interface	2146A00139
901082	AFJ International	AFJ LS16	LISN (9 kHz – 30 MHz)	16010020081
901083	AFJ International	AFJ LS16	LISN (9 kHz – 30 MHz)	16010020082
901084	AFJ International	AFJ LS16	LISN (9 kHz – 30 MHz)	16010020080
901090	Bajog electronic	4V-100/200	LISN (150 kHz – 30 MHz)	00-44-007
900726	Solar	7225-1	LISN	N/A
900727	Solar	7225-1	LISN	N/A
900078	Solar	7225-1	LISN	N/A
900077	Solar	7225-1	LISN	N/A
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892
900770	Hewlett Packard	437B	Power Meter	2949A02966
900793	Hewlett Packard	432A	Thermistor Power Meter	1848a22632
900126	Hewlett Packard	11970A	Harmonic Mixer (26-40 GHz)	2332A01199
900396	Hewlett Packard	11970K	Harmonic Mixer (18-26 GHz)	2332A00563
900921	Haefely	IP 6.2	Coupling Network	083-334-13
900918	Voltech	IEC Standard 555	Reference Impedance Network (rented)	7701
900061	Hewlett Packard	86603A	RF Plug-in (1 to 2600 MHz)	2221A02967
900160	Pacific	112-AMX	AC Power Source (rented)	0187
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1-26.5 GHz)	3008A00505
900045	Hewlett Packard	8447F	Preamplifier	2944A03783
901040	Industrial	SMX100	Wide Band Preamplifier (0.01-1000 MHz)	1736-0696
900721	Hewlett Packard	8447D	Preamplifier (0.1-1300 MHz)	2727A05397
900889	Hewlett Packard	85685A	RF Preselector for HP 8566B or 8568B (20Hz-2GHz)	3146A01309
900566	Amplifier Research	FP 2000	Isotropic Field Probe	20760
900174	FCC	F-120-9A	RF Injection Probe (10 kHz – 300 MHz)	N/A
901044	FCC	F-120-5	Bulk Current Injection Probe (10 kHz – 150 MHz)	17
901042	FCC	F-72-1	RF Current Probe (10 Hz – 100 MHz)	44
900704	FCC	F-14-1	Current Probe (10 Hz – 500 kHz)	33
900894	FCC	F-33-1	RF Current Probe (10 kHz – 250 MHz)	303
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
900769	Hewlett Packard	8481B	Power Sensor	2702A05059
900937	Hewlett Packard	8482H	3-watt Power Sensor (100 KHz to 4.2 GHz)	3318A08961
900928	Hewlett Packard	83752A	Synthesized Sweeper, 0.01 to 20 GHz	3610A00866
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380
900111	Omega Engineering	DP41-TC-DSS	Temperature Monitor	2060123
901043	FCC		Terminator for RF Current Probe F-72-1	

RTL Asset Number	Manufacturer	Model	Part Type	Serial Number
900731	Haefely	PEFT.1	Burst Tester with Coupling Network	082 106-29
900402	BAPCO Electro-Com	IEC 601 L	Safety Tester	000028
900720	Haefely	Psurge 4.1	Surge Tester	083-342-02
900839	Bird	43P	Peak Reading Wattmeter	3110

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 a note computer with an internal 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.

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:

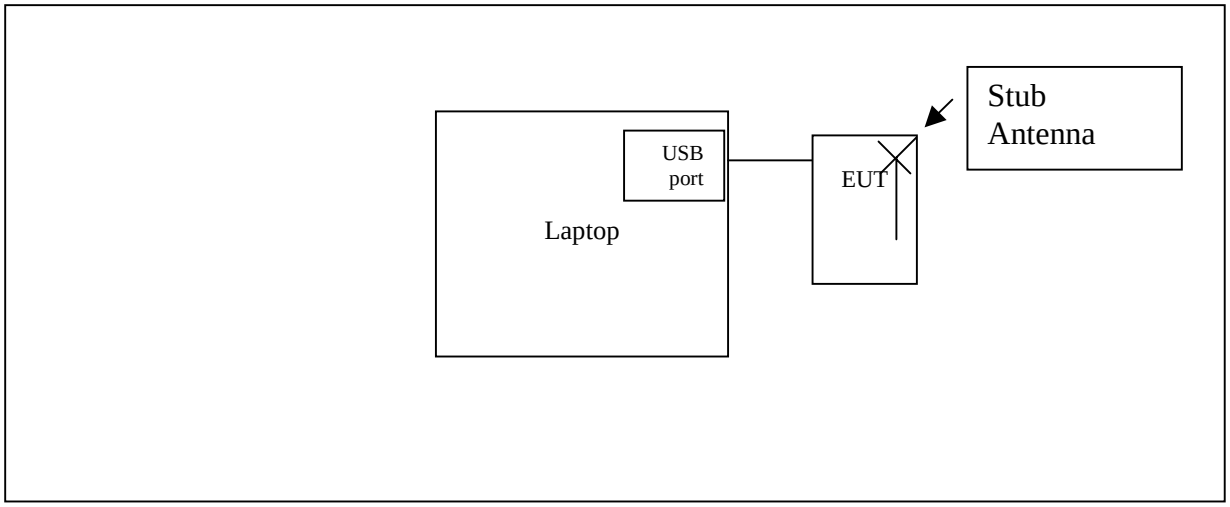
TABLE 2-1: EQUIPMENT UNDER TEST

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
WIRELESS LAN USB CARD	SAMSUNG	SWL-2100U	N/A	FCC ID: E2XSWL-2100U	N/A	13334

TABLE 2-2: EXTERNAL EQUIPMENT USED IN TEST CONFIGURATION

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
COMPUTER	IBM	THINKPAD	5509CY7	A3LS590		

FIGURE 2-1: CONFIGURATION OF TESTED SYSTEM



3 CONFORMANCE STATEMENT

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 5: Draft 3	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	Average Conducted Output Power (W)	Freq. Tolerance	Emission Designator
15.247	2412 - 2462 MHz	0.028		
Industry Canada	**Frequency Range**	**Average Conducted Output Power (W)**	**Freq. Tolerance**	**Emission Designator**
RSS-210	2412 - 2462 MHz	0.028		

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: June 26, 2001

Typed/Printed Name: Bruno Clavier

Position: Vice President of Operations
(NVLAP Signatory)

NVLAP *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.

5.2 CONDUCTED EMISSIONS TEST DATA

TABLE 5-1: CONDUCTED EMISSIONS (CHANNEL 6) NEUTRAL SIDE (LINE 1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC B Limit (dBuV)	FCC B Margin (dBuV)
2.608	Pk	25.1	1.3	26.4	48.0	-21.6
3.480	Pk	23.8	1.5	25.3	48.0	-22.7
5.235	Pk	21.4	1.8	23.2	48.0	-24.8
6.545	Pk	23.0	2.0	25.0	48.0	-23.0
8.295	Pk	27.4	2.2	29.6	48.0	-18.4
9.605	Pk	28.0	1.8	29.8	48.0	-18.2
10.470	Pk	27.8	2.0	29.8	48.0	-18.2
11.340	Pk	25.1	2.5	27.6	48.0	-20.4

TABLE 5-2: CONDUCTED EMISSIONS (CHANNEL 6) HOT SIDE (LINE 2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	FCC B Limit (dBuV)	FCC B Margin (dBuV)
2.608	Pk	25.4	1.3	26.7	48.0	-21.3
6.545	Pk	21.9	2.0	23.9	48.0	-24.1
8.290	Pk	28.0	2.2	30.2	48.0	-17.8
9.605	Pk	28.1	2.3	30.4	48.0	-17.6
10.470	Pk	27.9	2.3	30.2	48.0	-17.8
11.340	Pk	25.5	2.5	28.0	48.0	-20.0
13.520	Pk	22.5	2.8	25.3	48.0	-22.7

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

TEST PERSONNEL:

RACHID SEHB — TEST TECHNICIAN/ENGINEER — SIGNATURE — MAY 30, 2001 — DATE OF TEST

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 DATA

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

TABLE 6-1: RADIATED EMISSION DIGITAL NOISE (CHANNEL 1)

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)
132.000	Qp	H	180	1.8	51.6	-16.1	35.5	43.5	-8.0
144.000	Qp	H	180	1.0	48.4	-16.9	31.5	43.5	-12.0
156.000	Qp	H	225	1.0	41.4	-17.3	24.1	43.5	-19.4
216.000	Qp	H	90	1.3	45.5	-17.3	28.2	43.5	-15.3
251.995	Qp	H	180	1.3	43.8	-14.4	29.4	46.0	-16.6
336.000	Qp	H	145	1.7	51.6	-11.9	39.7	46.0	-6.3
432.015	Qp	H	145	1.2	40.8	-8.8	32.0	46.0	-14.0

QUASI PEAK =120 KHZ

TEST PERSONNEL:

RACHID SEHB		MAY 30, 2001
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

7 MODULATED BANDWIDTH TEST DATA

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 300 kHz. The Minimum 6 dB modulated bandwidths are the following:

TABLE 7-1: MODULATED BANDWIDTH

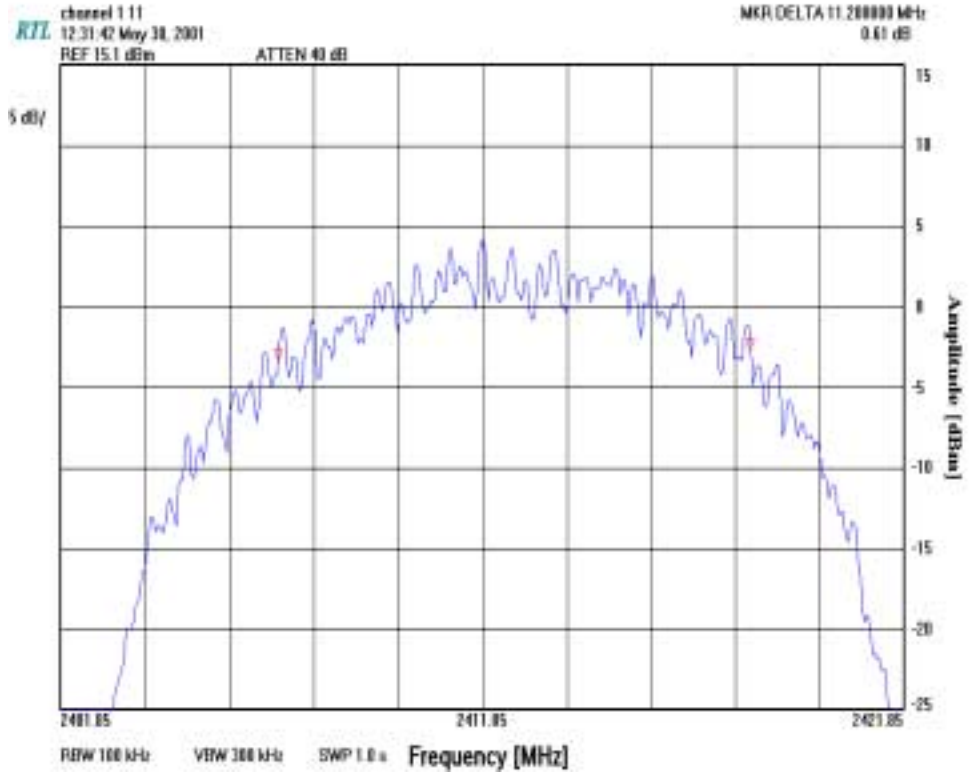
Channel	6(dB) Bandwidth (MHz)
1	11.2
6	11.5
11	11.1

The 26dB bandwidth is listed in figures part 26.

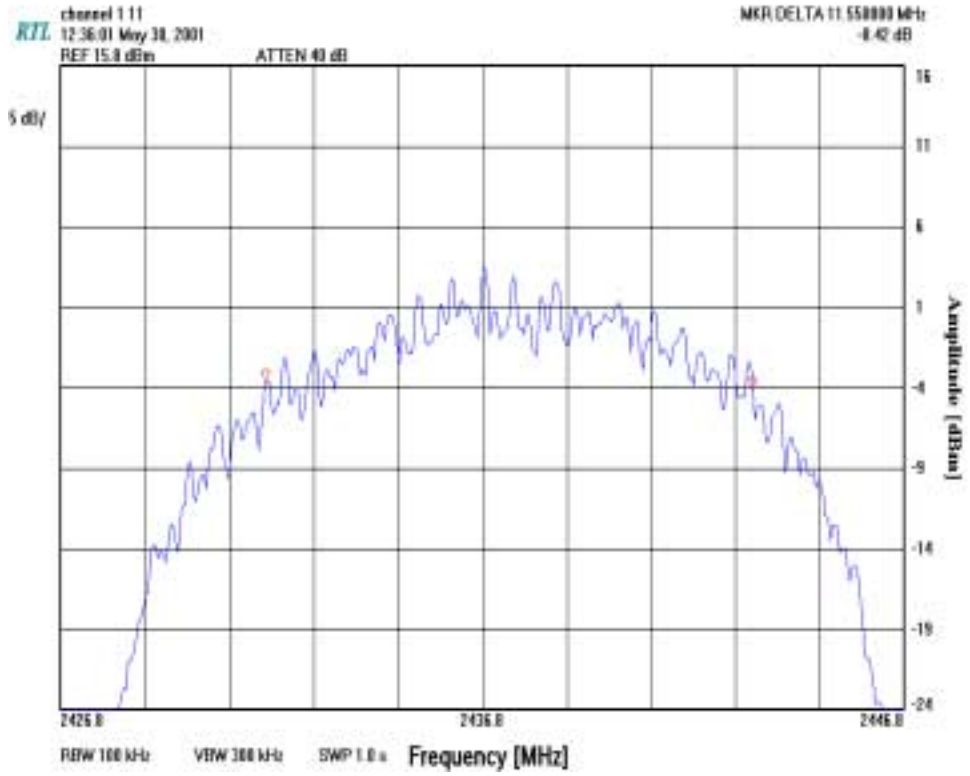
TEST PERSONNEL:

RACHID SEHB		MAY 30, 2001
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

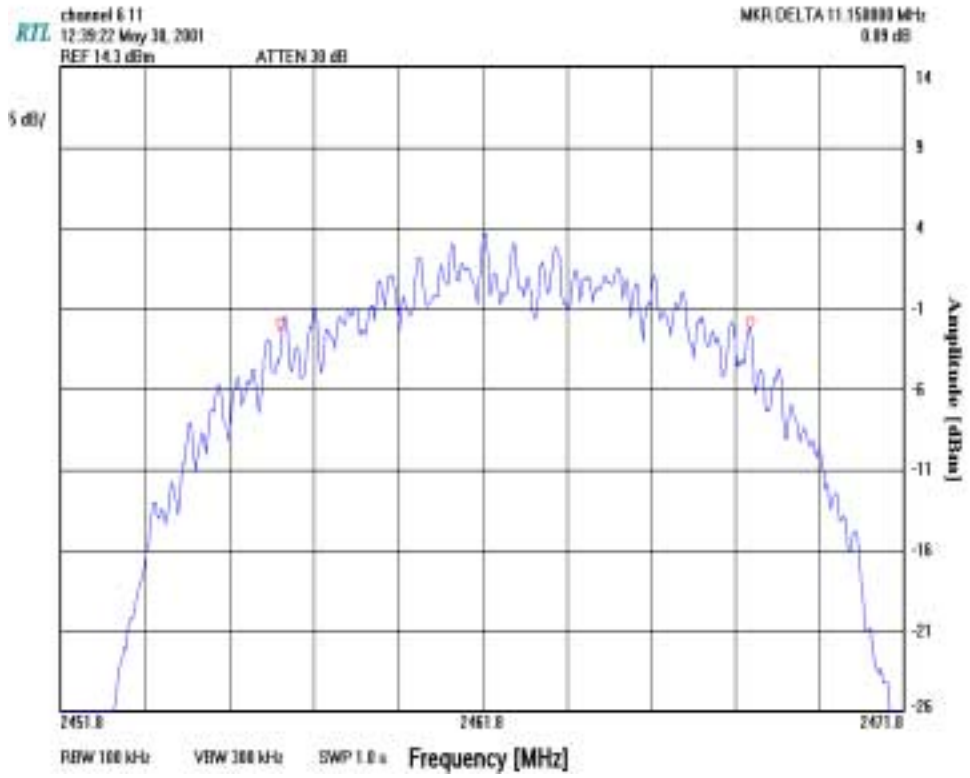
PLOT 7-1: 6dB BANDWIDTH (CHANNEL 1)



PLOT 7-2: 6dB BANDWIDTH (CHANNEL 6)



PLOT 7-3: 6dB BANDWIDTH (CHANNEL 11)



8 POWER OUTPUT TEST DATA

The power output per FCC 15.247(b) was measured on the EUT using an HP peak power meter.The EIRP was calculated trough the maximum gain of the antenna and the power output at the port.

TABLE 8-1: CONDUCTED POWER OUTPUT

Channel	EIRP (dBm)	Power conducted output (dBm)
1	19.2	13.9
6	19.8	14.5
11	18.2	12.9

TEST PERSONNEL:

RACHID SEHB — TEST TECHNICIAN/ENGINEER | SIGNATURE | MAY 30, 2001 — DATE OF TEST

9 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST DATA

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 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.

TABLE 9-1: ANTENNA CONDUCTED SPURIOUS EMISSIONS (CHANNEL 1)

Channel = 1		
Frequency (MHz)	**Spurious level (dBm)**	**FCC Margin (dB)**
2301.99	-50.0	-34.3
2786.90	-55.3	-39.6
4825.00	-54.4	-38.7
7242.00	-53.7	-38.0
9647.70	-75.0	-59.3
12059.70	-74.0	-58.3
14471.70	-71.0	-55.3

TABLE 9-2: ANTENNA CONDUCTED SPURIOUS EMISSIONS (CHANNEL 6)

Channel = 6		
Frequency (GHz)	**Spurious level (dBm)**	**FCC Margin (dB)**
2282.97	-71.0	-55.3
2326.99	-61.0	-45.3
4878.00	-49.2	-33.5
7312.00	-33.4	-17.7
9778.00	-75.0	-59.3
12185.00	-74.0	-58.3
14622.00	-69.0	-53.3

TABLE 9-3: ANTENNA CONDUCTED SPURIOUS EMISSIONS (CHANNEL 11)

Channel = 11		
Frequency (GHz)	**Spurious level (dBm)**	**FCC Margin (dB)**
2352.30	-51.5	-36.0
2395.99	-63.7	-48.2
2419.99	-62.0	-46.5
4922.80	-54.0	-38.5
7391.14	-56.5	-41.0
9848.00	-74.0	-58.5
12310.00	-75.0	-59.5
14772.00	-69.0	-53.5

TEST PERSONNEL:

RACHID SEHB		MAY 30, 2001
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

10 RADIATED SPURIOUS EMISSIONS

Radiated Spurious Emissions applies to harmonics and the spurious emissions that fall in the 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.
The EUT was tested in all three orthogonal planes in order to determine worst-case emission

TABLE 10-1: RADIATED EMISSIONS HARMONICS/SPURIOUS (CHANNEL 1)

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)
2387.200	Av	H	90	1.2	41.3	0.0	41.3	54.0
2387.200	PK	H	90	1.2	50.8	0.0	50.8	
2390.00	Av	H	95	1.0	40.6	0.0	40.6	54.0
2390.00	PK	H	95	1.0	52.8	0.0	52.8	
2413.250	Av	H	270	1.0	95.8	0.0	95.8	Fundamental
2413.250	PK	H	270	1.0	103.1	0.0	103.1	Fundamental
2787.000	Av	H	90	1.3	46.7	0.0	46.7	54.0
2787.000	PK	H	90	1.3	54.3	0.0	54.3	
4828.000	Av	H	90	1.4	28.0	14.3	42.3	54.0
4228.000	PK	H	90	1.4	39.0	14.3	53.3	
7241.000	Av	H	90	1.0	31.0	20.3	51.3	54.0
7241.000	PK	H	90	1.0	40.7	20.3	61.0	
9655.000	Av	H	135	1.0	NF			
12069.000	Av	H	90	1.0	NF			
14483.000	Av	H	90	1.0	NF			

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

TEST PERSONNEL:

RACHID SEHB		MAY 31, 2001
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

TABLE 10-2: RADIATED EMISSIONS HARMONICS/SPURIOUS (CHANNEL 6)

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)
2327.00	AV	H	90	1.0	43.4	0.0	43.4	54.0
2327.00	PK	H	90	1.0	50.7	0.0	50.7	
2437.75	AV	H	90	1.0	97.1	0.0	97.1	Fundamental
2437.75	PK	H	90	1.0	105.9	0.0	105.9	Fundamental
4875.60	AV	H	270	1.0	28.7	14.3	43.0	54.0
4875.60	PK	H	270	1.0	40.2	14.3	54.5	
73132.40	AV	H	90	1.0	28.6	20.3	48.9	54.0
73132.40	PK	H	90	1.0	40.0	20.3	60.3	
9751.20	Av	H	90	1.0	NF			
12189.00	Av	H	90	1.0	NF			
14626.80	Av	H	135	1.0	NF			

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

TEST PERSONNEL:

RACHID SEHB
TEST TECHNICIAN/ENGINEER

SIGNATURE

MAY 31, 2001
DATE OF TEST

TABLE 10-3: RADIATED EMISSIONS HARMONICS/SPURIOUS (CHANNEL 11)

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)
2351.60	Av	H	90	1.2	41.7	0.0	41.7	54.0
2351.60	PK	H	90	1.2	50.7	0.0	50.7	
2462.25	Av	H	270	1.0	93.3	0.0	93.3	FUNDAMENTAL
2462.25	PK	H	270	1.0	101.4	0.0	101.4	FUNDAMENTAL
2483.5	Av	H	90	1.0	40.5	0.0	40.5	54.0
2483.5	PK	H	90	1.0	52.2	0.0	52.2	
4929.37	Av	H	90	2.0	29.2	14.3	43.5	54.0
4929.37	PK	H	90	2.0	38.8	14.3	53.1	
7394.07	Av	H	90	1.4	30.9	20.3	51.2	54.0
7394.07	PK	H	90	1.4	43.2	20.3	63.5	
9858.77	Av	H	90	2.0	NF			
12323.47	Av	H	135	1.5	NF			
14788.17	Av	H	90	1.2	NF			

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

TEST PERSONNEL:

RACHID SEHB
TEST TECHNICIAN/ENGINEER

SIGNATURE

MAY 31, 2001
DATE OF TEST

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.

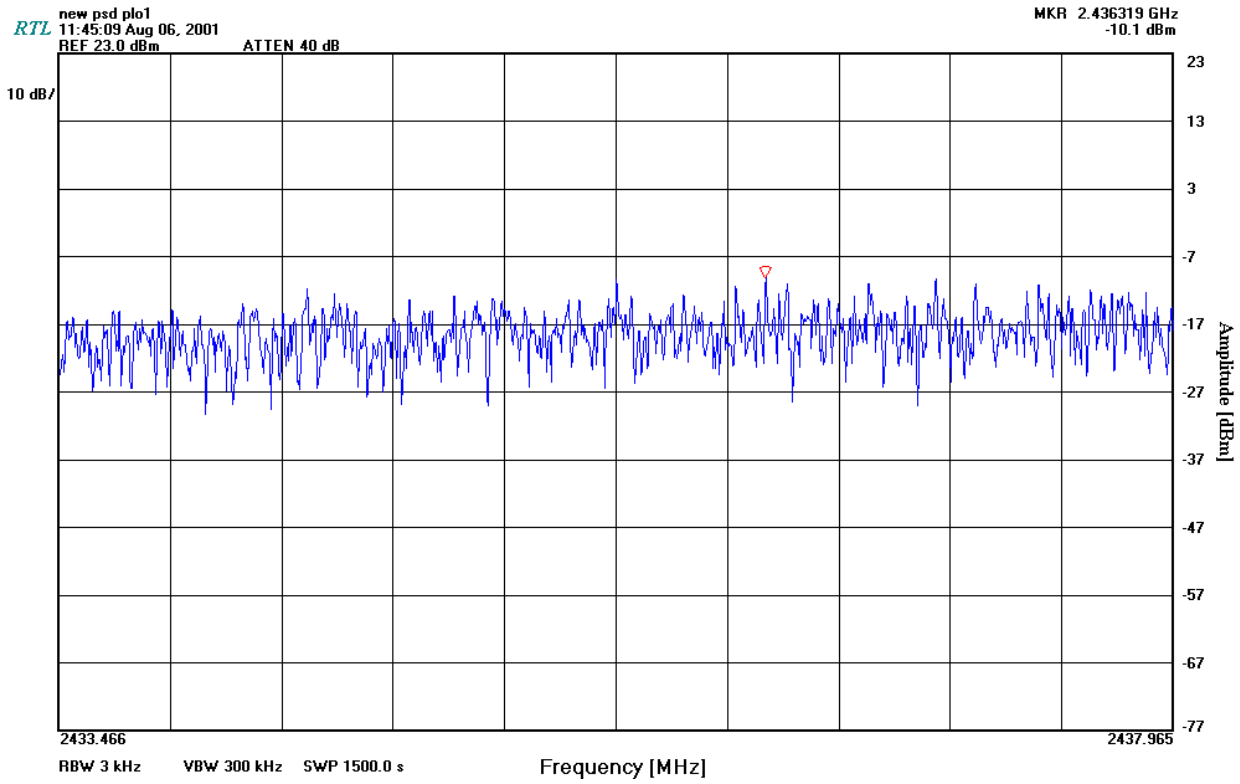
TABLE 11-1: POWER SPECTRAL DENSITY

Channel	Power Spectral Density limit = +8dBm
1	-8.5
6	-10.1
11	-9.3

TEST PERSONNEL:

RACHID SEHB — TEST TECHNICIAN/ENGINEER — SIGNATURE — MAY 31, 2001 — DATE OF TEST

PLOT 11-1: SPECTRAL DENSITY (CHANNEL 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.

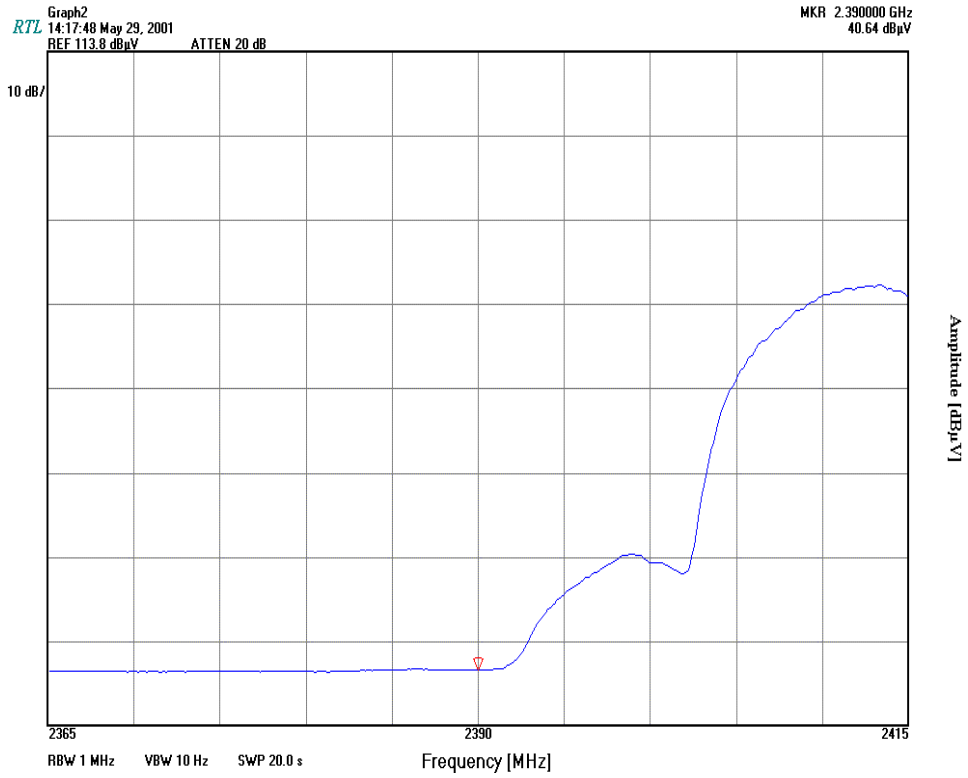
TABLE 12-1: RESTRICTED BAND EDGE

Channel Set to	Frequency tested MHz	Detector	Field Strength Level (dBµV/m)	FCC Limit (dBµV/m)	FCC Margin (dB)
1	2390.0	AV	40.6	54.0	-13.4
1	2390.0	PK	52.8		
11	2483.5	AV	40.5	54.0	-13.5
11	2483.5	PK	52.2		

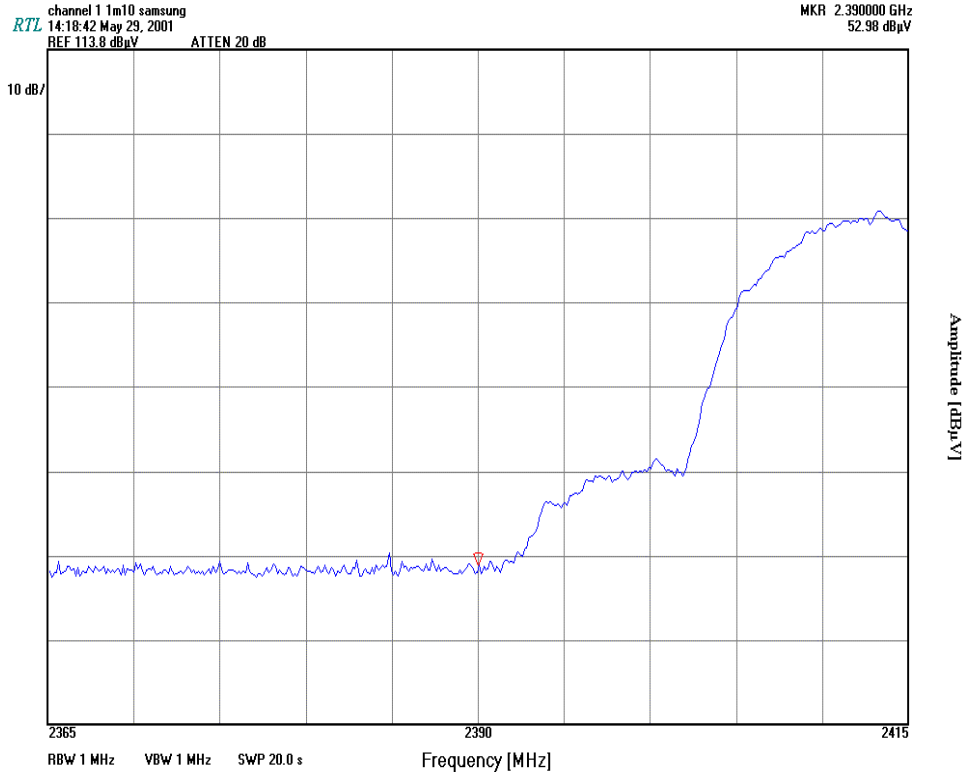
TEST PERSONNEL:

RACHID SEHB — TEST TECHNICIAN/ENGINEER — SIGNATURE — MAY 31, 2001 — DATE OF TEST

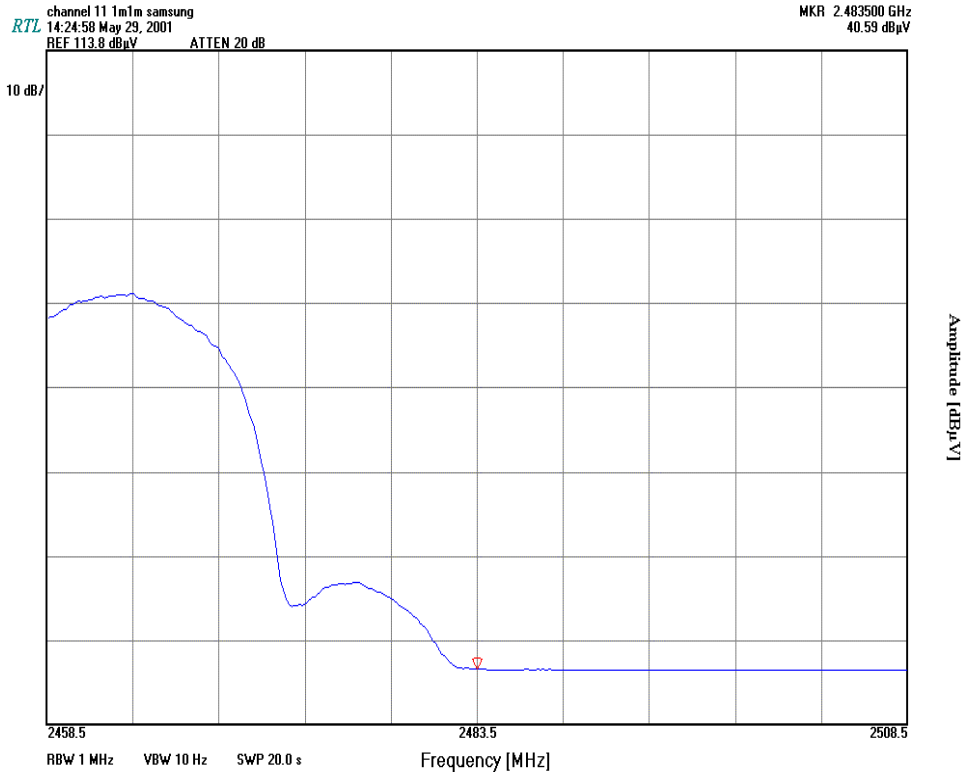
PLOT 12-1: BAND-EDGE: CHANNEL 1; AVERAGE MEASUREMENT (RBW 1MHZ/VBW 10HZ)



PLOT 12-2: BAND-EDGE: CHANNEL 1; PEAK MEASUREMENT (RBW 1MHZ/VBW 1MHZ)



PLOT 12-3: BAND-EDGE: CHANNEL 11; AVERAGE MEASUREMENT (RBW 1MHZ/VBW 10HZ)



PLOT 12-4: BAND-EDGE: CHANNEL 11; PEAK MEASUREMENT (RBW 1MHZ/VBW 1MHZ)