EMCE ENGINEERING, Inc.
Electro Magnetic Controlled Environment

44366 S. Grimmer Boulevard, Fremont, CA 94538

CERTIFICATE OF COMPLIANCE

APPLICABLE SPECIFICATION:

47 CFR PART 2, SUBPART J, PARAGRAPH 2.902

Verification Equipment Authorization

Part 15, Subpart B – Unintentional Radiators

Paragraph 15.101(a) Verification of All Other Devices

Report Number: LAR0005

Date of Report: 2 February 2000

I hereby certify that the measurements shown on this report were made in accordance with the procedures of American National Standards Institute (ANSI) Specification C63.4-1992. The voltages conducted along its power leads and electric fields radiated by the equipment listed below meets the Commissions Limits for a Class A Digital Device. Tests were performed on. 27 January 2000.

Company:	**Larus Corporation**
Street Address:	**1560 Berger Drive**
City, State & ZIP	**San Jose, CA 95112**
Equipment under Test:	**SPREAD SPECTRUM RADIO**
Model Number:	**QUADHOPPER 9000**
Serial Number:	**0001 & 0002**

EMCE Engineering, Inc has been place on the Federal Communications Commission's list of recognized facilities for Parts 15 and 18 DoC approvals. Per the request of EMCE Engineering, the facility has been added to the list of those who perform Measurement Services for the public on a fee basis. This list is published periodically and is also available on the FCC World Wide Web. Additionally, EMCE Engineering has been approved by the National Institute for Science and Technology under the NVLAP program.

EMCE Engineering, assumes no responsibility for the continuing validity of test data when the Equipment under Test is not under the continuous physical control of EMCE. The signature below attests to the fact that all measurements reported herein were performed by myself or were made under my supervision, and are correct to the best of my knowledge and belief as of the date specified. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Tests were conducted by qualified EMCE Engineering personnel utilizing test equipment maintained in a "current" state of calibration with traceability to NIST.

Note

- This report or certificate does not represent endorsement by NVLAP or any agency of the US Government.
- This report or certificate shall not be reproduced except in full without the written approval of the issuer.

Certified by:
EMCE Engineering, Inc.

Stephen A. Sawyer, NCE
President

ELECTROMAGNETIC INTERFERENCE
TEST REPORT

Report Number: **LAR0005**
Report Date: **2 February 2000**
Applicable Specification:
47 CFR Part 15, Subpart B, Verification of a Class A Digital Device

Equipment under Test:	SPREAD SPECTRUM RADIO
Model Number:	QUADHOPPER 9000
Serial Number:	0001 & 0002

Prepared for: **Larus Corporation**
1560 Berger Drive
San Jose, CA 95112

Prepared by: **Stephen A. Sawyer, NCE**
EMCE Engineering, Inc.
44366 S. Grimmer Blvd.
Fremont, CA 95032
Phone: 510-490-4307
Fax: 510-490-3441

Note

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 SCOPE

This test report describes the equipment setup, test methods employed and results obtained during EMI testing of a Class A device of the "All Other Devices" category as defined in Part 15, Subpart A, paragraph 15.3 (h). The tests described herein measured the RF radiated (RFI Field Strength) emissions of two Spread Spectrum Radios as installed and operated in a typical setup. The tests conformed to the measurement and test site requirements of ANSI C63.4-1992. This report does not address the technical requirements for Spread Spectrum Radios, paragraph 15.247.

1.1 Objective

The tests described herein were performed to establish that the EUT is capable of compliance with the EMI Verification requirements of Part 15, Subpart B, paragraph 15.101 for Unintentional Radiators (all other devices).

1.2 Description of EUT

The EUT is a SPREAD SPECTRUM RADIO**,** Model Number: QUADHOPPER 9000**,** Serial Numbers: 0001 & 0002, manufactured by Larus Corporation. The EUT contained the following options: No Options.

1.3 Results/Modifications

The EUT passed FCC Class A radiated emissions tests. Conducted tests were not performed because the EUT was Battery Powered. No modifications were necessary. The manufacturer may declare the EUT as complying with the FCC interference requirements. FCC labeling and user information is found in Appendix F herein.

1.4 Test Limits

FCC Class A conduction and radiation limits are as follows:

Conducted Emission Limits (Quasi-peak)		**Radiated Emission Limits (@10-meters**	
0.450 – 1.705 MHz	60 dBuV	30 – 88 MHz	39.1 dBuV/m
1.705-30 MHz	69.5 dBuV	88 – 216 MHz	43.5 dBuV/m
		216 – 960 MHz	46.4 dBuV/m
		960 – 1000 MHz	49.5 dBuV/m

2.0 APPLICABLE DOCUMENTS

2.1 FCC Documents

Document	**Title**
Title 47 CFR	TELECOMMUNICATION
Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations .
Part 15	Radio Frequency Devices.

2.2 Other Documents

ANSI C63.4-1992	American National Standards for Methods of Measurement of Radio-Noise Emissions From Low-Voltage Electrical and Electronic Equipment In the Range of 9kHz to 40GHz.
ANSI C63.5-1988	American National Standards for Calibration of Antennas Used for Radiated Emissions Measurement.
CISPR 22: 1997	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement. By the International Electrotechnical Commission (IEC).

3.0 GENERAL SETUP AND TEST CONDITIONS

3.1 Test Facility

The tests described herein were performed at:

EMCE Engineering, Inc.
44366 S. Grimmer Blvd.
Fremont, CA 94538

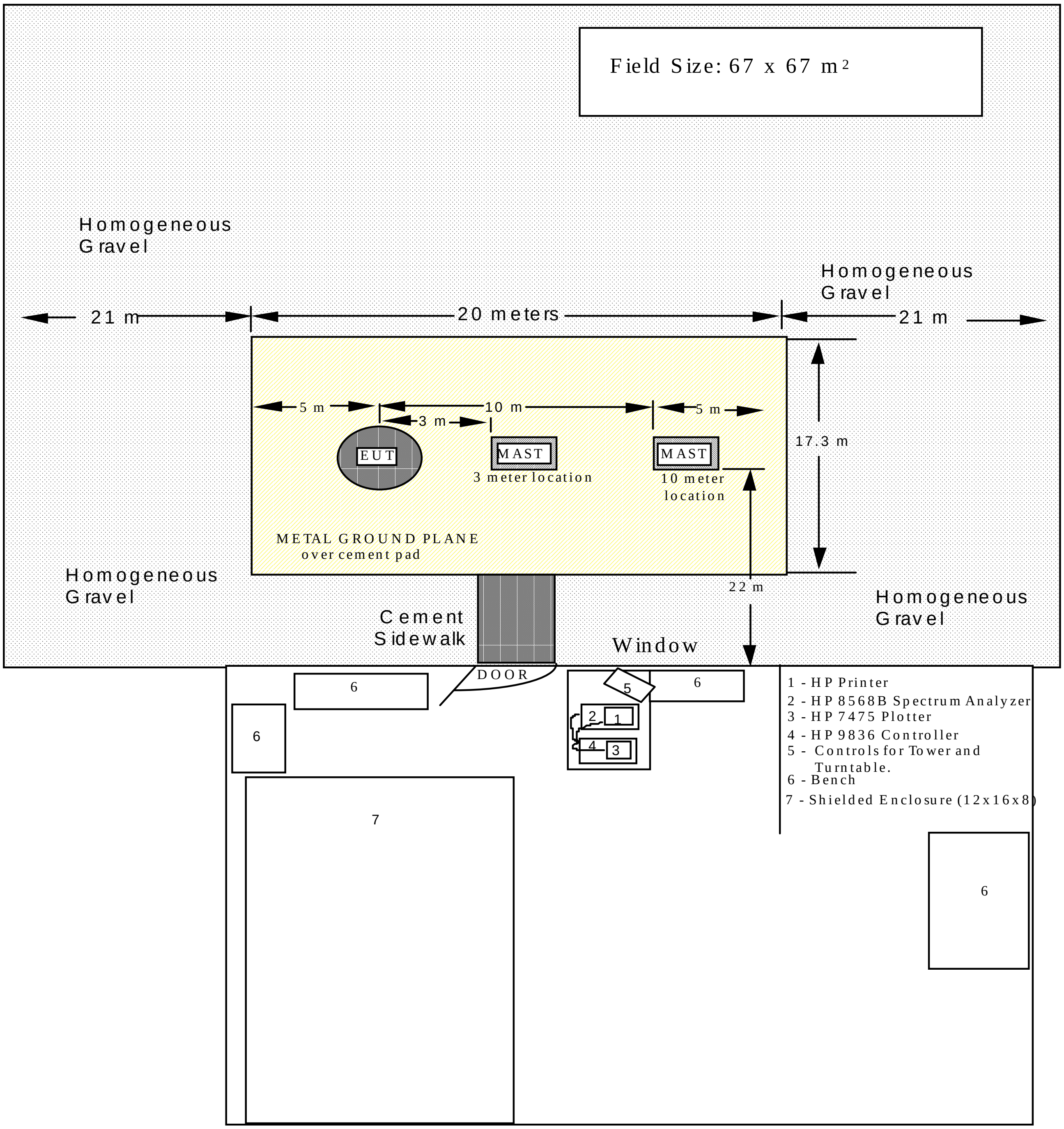

FIGURE 1. TEST SITE LAYOUT.

3.1 Test facility (Cont'd)

This laboratory has one electromagnetic shielded enclosure and a 3-meter and 10 meter Open Area Test Site (OATS). The shielded room is available for preliminary determination of radiated emission frequencies and formal conducted emission measurements, or for other investigative work. A computer controlled spectrum analyzer with quasi-peak adapter, plotter and printer were used for gathering and recording test data. Figure 1 shows the test site layout for conducted and radiated.

3.2 Description of Open Area Test Site (OATS)

The 3 and 10 meter site is located out-of-doors in an open field whose size is 212 feet long by 206 feet wide. The dimensions of the test area are 66 feet wide by 59 feet long (20m x 18m). The description of the 3 and 10 meter site is on file with the FCC according to the requirements of Part 2.948.

3.3 Site Attenuation

The site attenuation for radiated measurements has been determined for this test site using the method described in ANSI C63.4 Paragraph 5.4.6 and sub paragraphs. This method measures how closely the test site approximates free space transmission for plane waves (far field conditions) as modified by the influence of ground plane reflections. The site attenuation is measured annually. Site attenuation was last measured and reported to the FCC on 7 June 1999.

3.4 Ground Plane (Ground Screen)

The site has a 3900 square foot (20m x 18m) floor area of poured reinforced concrete, 6 to 8 inches thick. A 20m x 18m (66ft x 59ft) solid 24 gauge galvanized sheet steel ground plane is centered on the test area with its long dimension along the major axis of the test site. It is made up of 4-foot wide sheets overlapped one inch on each other and MIG welded at 18-inch intervals. The antenna mast and turntable are located 3 meters apart on the centerline of the major axis so that each is greater than 3 meters from the edges of the ground plane. The ground plane is connected to a nine-foot long earth ground rod at each corner of the ground plane.

3.5 Input Power for EUT

Electricity for the EUT is provided by buried power lines in metallic conduit with an outlet box placed near the EUT. Power for the EUT is taken from the outlet box of either of two “shielded enclosure” quality power line filters located on the ground plane near the EUT. The filters are electrically bonded to the ground plane.

3.6 Accessory Equipment Precautions

Care was taken that accessory equipment or adjacent equipment did not produce unacceptable interference so as to contaminate the final test data. The EMI receiver and its associated computer, printer and plotter were located greater than 15 meters away from the EUT during testing and were powered from a separately filtered power source.

3.7 Ambient Interference

Ambient interference from radio and television stations, vehicles, mobile radio, etc. were present at the open test site during testing. Care was taken to assure that ambient interference did not overload the measurement receiver or mask emissions from the EUT. The method of measurement used to deal with ambient noise during radiated emission testing is described in Paragraph 5.2.1.

3.8 Personnel

All testing was performed by EMCE Engineering personnel who are properly trained for the instruments and procedures used. The test data sheets have been signed-off by the attending EMCE Test Engineer.

3.9 Use of Interference Measurement Equipment

All of the emission measurements and field strength measurements were performed with a Hewlett-Packard 8568B Spectrum Analyzer System. The Spectrum Analyzer System utilizes the following basic instruments:

1. HP-9836 Desktop Computer/Controller
2. HP-2673A Printer
3. HP-7475A Plotter
4. HP-85650A Quasi Peak Adapter

3.9 Use of Interference Measurement Equipment (Cont'd)

Details of the operation of these instruments are given in Appendix A (EMI Measurement with the Automatic Spectrum Analyzer). Specific details are given in the separate sections of emission testing. Antenna factors and cable loss characteristics, though programmed into the computer, are listed in Appendix B.

Test results are recorded on both tabular data sheets and graphical plotter charts and show final corrected values compared to the specification limit. Sample calculations show how the antenna factors, cable losses, amplifier gain, etc. are combined in the automatic analyzer program to produce the final corrected values shown on the graphs and data sheets.

3.10 Calibration of Measuring Equipment

The EMI Receiver (spectrum analyzer) is calibrated by an outside calibration laboratory on a 12 month basis. The laboratory provides certification with traceability to NIST. Antenna factors are measured at 1-year interval by EMCE Engineering, Inc. using the reference antenna method of ANSI C63.5-1988. Cable losses as well as amplifier gains are swept at least every month to verify accurate values.

4.0 PREPARATION OF EUT FOR TEST

4.1 Identification of EUT

Equipment under Test: SPREAD SPECTRUM RADIO
Model Number: QUADHOPPER 9000 Comprised of an RF Transmitter Unit plus a Control unit for each Radio.
Serial Number: 0001& 0002

4.2 Setup of EUT

Power to EUT: **24 VDC Batteries.**
Grounding of EUT: **Not Grounded**
Special Software: **None**

4.3 Interfaces & Cabling

The following cables were connected during test:

Interface	Source Port	Load Port	Length Cable	Conductors Number	Connector Type	Connector Material
RF	EUT TX	Antenna	0.5m	2	Coaxial	Metal
Serial	EUT	Terminal	1m	9	Shld	Plastic
Power	Batteries	**EUT**	2m	2	UnShld	Wire

4.4 Peripherals

The following peripherals were attached and operating during the tests:

Nomenclature	**Mfgr & Model**	**Serial No**
Terminal	HewlettPackard Model 700/92	None
Terminal	Wyse	None
Keyboard	Hewlett Packard	
Keyboard	Wyse	

5.0 TEST PROCEDURES

5.1 Conducted Emissions, Power Leads, 450 kHz to 30 MHz

Conducted emissions were not measured because of the battery power source.

5.1.1 Test Results

The EUT was not tested for conducted emissions because it was powered by Batteries.

5.1.3 Recommendations

Recommendations are not in order here..

5.2 Radiated Emissions Test, 30 MHz to 1000 MHz

Radiated emissions were measured from 30 MHz to 1000 MHz. The measurement bandwidth was 120 kHz according to the methods defined in ANSI C63.4 Section 8.0. The EUT was placed on a nonmetallic stand in the open-field site, 0.8 meters above the ground plane, as shown in Figure 3.

The EUT was operated as described in Paragraph 4.0, in a mode, which was intended to produce maximum emissions. Preliminary scans of the frequency range were used to determine the cable configurations and equipment positions, which produce maximum emissions. These configurations were then kept intact while both angle of rotation of the EUT with respect to the antenna and antenna height were scanned for maximum readings. The angles and antenna polarization are shown on the data sheets in Appendix D.

5.2.1 Vertical Polarization Measurements

Radiated emission measurements were started with the antenna in a vertical orientation at 1.5 meter in height and 1.0 meters from the EUT and with the front of the EUT facing the antenna. The measurement antenna was connected to the preamplifier and spectrum analyzer through 75 feet of RG-214 coaxial cable.

The automatic spectrum analyzer scanning procedure used for radiated measurements is a two-pass process, described in detail in Appendix A. Readings were made at this point using Signal-Sampling techniques. The first pass accumulates and stores both EUT and background ambient emissions received by the measurement antenna for 1000 samples per frequency segment. The second pass was performed with the EUT turned off, thus accumulating only background ambient emissions for 1000 samples per frequency segment. The computer was programmed to subtract the second pass data from the first pass on a point by point basis per frequency segment, thus removing steady state ambient and leaving only EUT emissions. This culling process reduces the total number of emissions that must be examined manually.

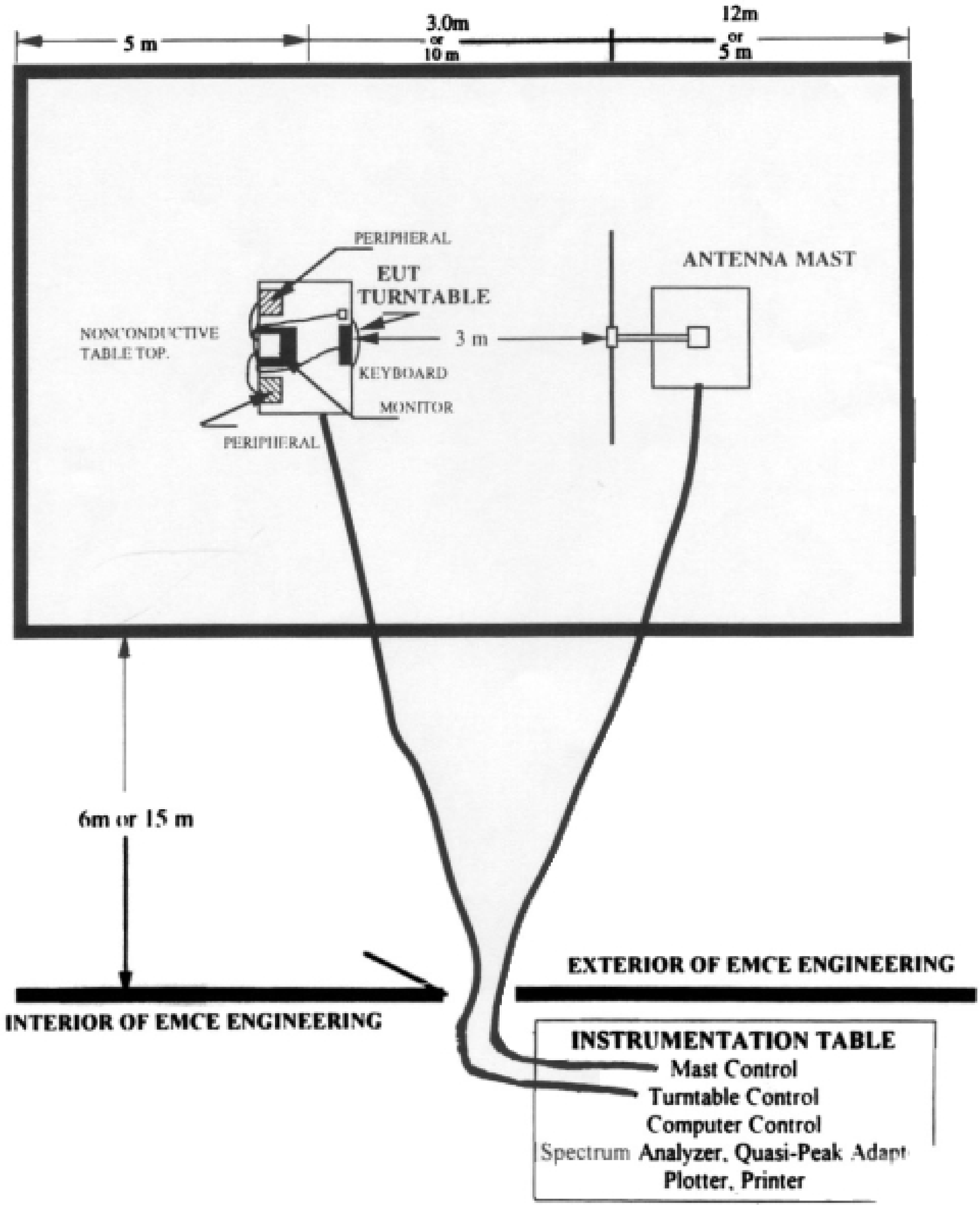

Figure 2. Radiated Emissions Test Setup.

5.2.1 Vertical Polarization Measurements (Cont'd)

A preliminary list of possible EUT frequencies was printed at the end of the second pass after the subtraction process. This list contained both EUT emissions and background ambient, particularly ambient signals which fluctuated in amplitude or which went on and off rapidly (such as communication transmitters). At this point each listed frequency was individually examined by a manual procedure. Some of these signals were ambient and some were EUT signals. They were sorted and the EUT signals were accurately measured with the quasi-peak detector after maximizing the signal in both azimuth and height. As the evaluation process continues, each signal attributed to the EUT is further examined for maximum value. The dipole antenna (for electric fields) was adjusted to the proper length, the height of the measurement antenna was searched from one to four meters, and the angle of rotation of the EUT with respect to the antennas was varied from 0 to 360 degrees.

A data sheet is printed out listing the "Final FCC A Radiated Results". This lists those signals which were within X dB of the limit, where is selectable and which were actually attributed to the EUT. Along with other information the data sheet indicates signal level, limit, turntable angle and antenna height.

Data sheets and plotter charts of vertical polarized radiated emissions are shown in Appendix D. A sample calculation on the data sheet shows how antenna factors, cable loss and amplifier gain were processed by the computer.

5.2.2 Horizontal Polarization Measurements

The full electric field from 30 MHz to 1000 MHz frequency range was scanned with the EUT operating and the measurement antenna oriented in a horizontal polarization . A set of radiated emission readings were collected, evaluated, stored and printed out using the same procedure described above for vertical polarization. The data sheets and plotted graphs are contained in Appendix D.

5.2.3 Test Results

The EUT passed both vertical and horizontal radiated emissions tests.

5.2.4 Test Instrumentation

The following equipments were used for radiated emissions tests.

Name	Manufacturer	Model	Cal. Due Date
Controller/Computer	Hewlett-Packard	9836	N/A
Spectrum Analyzer	Hewlett-Packard	8568B	12/14/00
Quasi-Peak Adapter	Hewlett-Packard	85650A	12/14/00
LISN	Solar	8012-50-R-24	12/14/00
Antenna Mast	EMCO	1050	N/A
Rotating Table	EMCO	1060	N/A
Antenna, Biconical	ELME	BIA-30	5/27/00
Antenna, Log-periodic	ELME	LPA-30	4/25/00
Preamplifier	Hewlett-Packard	8447D	N/A

5.2.5 Recommendations

Because there were no test failures, there are no recommendations.

APPENDIX A

EMI Measurement with the Automatic Spectrum Analyzer

EMI Measurement with the Automatic Spectrum Analyzer

A1.0 INTRODUCTION

This document describes application of the Hewlett-Packard 8568B Automatic Spectrum Analyzer and the Hewlett-Packard 85650A Quasi-Peak Adapter for measurement of Electromagnetic Interference (EMI) emissions for FCC Compliance Testing. The measurement methods are designed to comply with FCC Measurement Procedure ANSI C63.4-1992 as well as IEC publication CISPR 22.

The measurement of EMI involves a repetitive process of collecting, analyzing and reformatting large amounts of data. It is a process which lends itself to computer controlled automation. The benefits are: reduced setup time, reduced operation time, increased accuracy and repeatability.

The detailed description, which follows, provides insight into the programming of the analyzer and computer. The steps describe how data is collected, analyzed, displayed and reproduced.

A2.0 OVERVIEW

The Hewlett-Packard 8568B is a general purpose programmable Spectrum Analyzer System and the Hewlett-Packard 85650A is a programmable accessory which sets the overall measurement bandwidth and detector time constants to those required for FCC measurements. By adding appropriate transducers such as antennas or LISNs, and with the proper software, the system becomes an interference measurement set operating under the control of Hewlett-Packard 9836 Computer. A Hewlett-Packard 7475A Plotter and a Hewlett-Packard 2673A Printer are accessories that provide hard copy output in the form of graphs and data sheets.

Several measurement sweeps are taken to characterize the interference from the Equipment under Test (EUT). The data is analyzed in the computer and later reformatted in both a semi-log graph and a measurement summary data sheet. The data sheets indicate compliance by including PASS/FAIL messages and specification limits.

A3.0 PROGRAM OPERATION

A3.1 General Operations

A stored program is loaded into the computer. This program determines whether the system is set for conducted or radiated emissions. It contains all of the necessary operational steps, the antenna factors, and any data needed for calculation of final emission values. The analyzer has a built-in self-calibration program. The Calibration Program is ran each time the analyzer is set up for testing. It checks all of the pertinent internal parameters and displays the error value for each. A calibration data sheet is normally printed out for inclusion in the test report.

The program begins by prompting the operator to provide administrative data such as date, customer name, EUT Nomenclature, model number, and serial number. The operator is prompted to check the setup to see that the equipment is properly connected before making measurements. A blinking message on the analyzer CRT reminds the operator that program execution will continue after the “Hz” key on the analyzer keyboard is pressed.

At this time, the analyzer frequency span, resolution bandwidth, video bandwidth and sweep time are automatically set to programmed values. The quasi-peak adapter is automatically set to programmed values at this time. The quasi-peak adapter is set to the “Normal” mode with the QP detector “OFF” (passes peak signals through the quasi-peak adapter) during the automatic scans. This allows faster scans of the analyzer and produces peak values of the data. Quasi-peak adapter scans are processed manually as described in the later paragraphs on conducted and radiated emissions testing. The programmed setup values depend upon whether conducted or radiated emissions are to be measured. The system is now ready for the first measurement sweep.

The EUT is prepared for testing and is turned on and set to the operating mode selected for test. Preliminary evaluations have already been made to determine worst case cable and equipment positioning in the EUT test setup. The analyzer sweep is started by pressing the “Hz” key on the analyzer. The total frequency range to be measured is divided into several spans, which are each swept consecutively.

A3.1 General Operations (Continued)

Table A-1 shows the sweep ranges and sweep times programmed for both conducted and radiated emissions measurements. The analyzer divides the spectrum-scanned sweep into 10001 separate incremental measurement points and stores these for processing. The range of the scan and the number of points per scan determine the width of each incremental segment. The column labeled "Bandwidth of Stored Segments" in Table A-1 shows the bandwidths programmed. These have been selected to be narrow enough for the assured sensing of all EUT emissions in the presence of typical ambient signals. Scan time is slow enough to allow EUT signals to reach a peak value and be sensed.

TABLE A-1

Analyzer Bandwidth Setting RBW-VBW **MHz**	System Bandwidth With QP (Note 1) **kHz**	Range of Band Swept **MHz**	Span of Stored Segment (Note 2) **MHz**	Range of Band Swept **MHz**	Span of Stored Segment (Note 2) **MHz**	Sweep Time (Note 3) **Seconds**
CONDUCTED EMISSIONS		**FCC**		**CISPR**		
0.1	9	0.45-1.6	1.15	0.15- 0.5	0.35	90
0.1	9	1.6- 8.0	6.4	0.5- 5.0	4.5	90
0.1	9	8.0-30.0	22.0	5.0- 30.0	25.0	90
RADIATED EMISSIONS (Same for FCC and CISPR)						
1.0	120	30- 60	30			90
1.0	120	60- 88	28			90
1.0	120	88- 108	20			90
1.0	120	108- 200	92			90
1.0	120	200- 400	200			90
1.0	120	400- 700	300			90
1.0	120	700-1000	300			90

Note 1. System Bandwidth is determined by the quasi-peak adapter when it's function is selected. The automatic scans are made with the quasi-peak adapter in the bypass mode. Data values are peak readings.

A3.1 General Operations (Continued)

Note 2. Span of stored segment is equal to the range of band scanned divided by the number of data points. The analyzer provides 10001 points. For example, the scan from 150 kHz to 1600 kHz equals the scanned range of 1450 kHz. When this is divided by 10001, the span of the stored segment is 1.45kHz.

Note 3. The analyzer system is set up to process peak signals during the automatic scan and when the quasi-peak adapter is in “normal”, signals are analyzed manually with the quasi-peak function using the procedures described in paragraphs on conducted and radiated emissions testing.

Upon completion of the first measurement sweep the analyzer sends an “End of Sweep” interrupt message along the bus which tells the computer that the analyzer is ready to output its trace data.

A fast Read/Write routine then transfers the 10001 data points from the analyzer buffer to the computer memory and the analyzer is set for a second measurement sweep. While the analyzer is collecting data during the next sweep, the computer is analyzing and reformatting the previous sweep data, ultimately reducing the number of data points in the sweep from 10001 to 100. This makes room for the processing of additional sweeps. The final formatted trace data contains up to 1000 data points overall after all of the sweeps are combined and includes all significant EUT emissions.

A3.2 Conducted Emission Measurements

Measurements of conducted emissions on the power input lines from are made using a Line Impedance Stabilization Network (LISN). A Solar 7205-0.35 high pass Filter having a cutoff frequency of 350 Hz is used to prevent power frequency harmonics from overloading the analyzer.

The LISN and high pass filter are connected through 20 feet of RG-214 coaxial cable to the Spectrum Analyzer input. The switch on the LISN is set to the Supply Line position and the power is applied to the EUT.

The computer is commanded to begin the data collection scanning process as described in Paragraph 3.1. Correction factors for filter loss are programmed and are taken into consideration. Data tabulations and graphical plots of peak values are produced by the system at the conclusion of the test scans.

A3.2 Conducted Emission Measurements (Continued)

Sample calculations of conducted emissions are shown on the data sheets. The switch in the LISN is then set to the Return Line position and the interference scan is repeated and an additional set of data sheets and plot charts are prepared. The six highest EUT emission measurement values, two from each of the three scan ranges are listed out on the data sheet.

This completes the automatic scans of conducted emissions. If the test results and EUT characteristics indicate a need, additional manual scans of maximum value readings will be made with the quasi-peak detector ON. If readings exceed the Conducted Emissions Limit, and if broadband noise is evident, then the provisions of MP-4, Paragraph 4.2.2.2, Note 2, will be applied.

A3.3 Radiated Emission Measurements

Radiated emissions from the EUT are measured over the frequency range of 30 MHz to 1000 MHz using a combination of automatic and manual methods, which conform to ANSI C63.4, Paragraph 6.0. The EUT is placed on a nonmetallic stand 0.8 meters above the ground plane in an open-field test site. The interface cables and equipment positions are varied within limits of reasonable applications to determine the positions producing maximum radiated emissions.

Preliminary manual scans of the frequency range are needed to determine the cable configurations and equipment positions that produce maximum emissions. These configurations are then kept intact while both angle of rotation of the EUT with respect to the antenna and antenna height is scanned for maximum readings.

Automatic scans with the antenna first vertically polarized and then horizontally polarized are made to determine a set of preliminary maximum peak values. These are then processed manually with the quasi-peak adapter to determine exact emission values from the EUT. The automatic scanning proceeds in general as described in Paragraph 3.1.

Radiated emission measurements are started with the test antenna in a vertical orientation at 1.5 meters in height and with the front of the EUT facing the antenna. The measurement antenna is connected to the preamplifier and spectrum analyzer through 75-foot long RG-214 coaxial cable. The EUT is placed in operation.

A3.3 Radiated Emission Measurements (Continued)

The automatic spectrum analyzer scanning procedure used for radiated measurements is a two-step process. Two separate scans of each frequency range are made. The test operator has the choice of selecting either the analyzer peak detector or signal sample techniques.

The first pass accumulates and stores both EUT and background ambient emissions received by the measurement antenna. The second pass is ran with the EUT turned OFF and accumulates only background ambient emissions. The quasi-peak adapter is in “Normal Mode” and the readings are peak values. The computer and analyzer are programmed to subtract the second scan from the first scan, removing steady state ambient and leaving only EUT emissions and fluctuating ambient. This reduces the total number of emissions that must be examined manually.

The automatic scanning procedure divides the total frequency range of 30 MHz to 1000 MHz into 7 sweeps, which are arranged to yield the greatest resolution possible over the entire frequency range of the test. These are listed in Table A-1. In the signal-sampling mode, each sweep consists of 260 averages done automatically by the analyzer. This tends to reduce the effect of random or short- term ambient signals. Antenna changes are made as required at the end of each sweep.

A preliminary list of residual frequencies is printed at the end of the second pass after the subtraction process. This list contains both EUT emissions and background ambient. At this point, each listed frequency is individually examined with manual procedure consisting of maximizing the signal in direction and antenna height. The dipole antenna is “cut” for the frequency of interest and the quasi-peak detector is engaged. The final reading of the signal under these conditions is then modified to account for antenna factor, cable loss and preamplifier gain.

The EUT is turned on again and the computer is set to display each frequency from the preliminary list on the spectrum analyzer starting at the 30 MHz end of the range. A manual command is used to end investigation of a listed frequency and then goes on to the next. This allows sufficient time to evaluate each suspected signal. Several methods are used to separate residual ambient from EUT signals:

A3.3 Radiated Emission Measurements (Continued)

1. If the signal disappears from the screen when the analyzer is tuned to the indicated frequency with the EUT operating, then the signal is not caused by the EUT and is considered to be an ambient.

2. With the EUT operating and the analyzer tuned to the indicated frequency, if the demodulated signal from the speaker on the quasi-peak adapter is voice or music, then the signal is recognized as a radio or TV station and is considered ambient.

3. If either step 1 or 2 above is inconclusive, then with the analyzer tuned to the indicated frequency the EUT power is turned OFF. If the signal on the analyzer remains unchanged, then the signal is considered to be an ambient.

4. Sometimes, it is helpful to decrease the analyzer resolution bandwidth so that resolution of close-together frequencies can be achieved.

As the evaluation process continues, each signal attributed to the EUT is further examined for maximum value. The dipole antenna is adjusted to the proper length, the height of the measurement antenna is searched from one to four meters, and the angle of rotation of the EUT with respect to the antenna is varied from 0 to 360 degrees.

The quasi-peak detector is engaged and the analyzer is set to a sweep time of 50 seconds. The analyzer display is cleared and signal is traced on the screen. After the maximum quasi-peak signal is displayed, the “Continue” button on the computer is pressed and the interference signal amplitude and frequency information is stored in the computer for later printout and plotter display. The angle of the EUT and height of the antenna are also stored for print out on the data sheet.

If the four steps above indicate that the signal is not an EUT signal, then that signal is passed over and not recorded for final printout. The screen is cleared and manual actuation of the “Continue” button steps the analyzer to the next signal for evaluation. Evaluation of the preliminary frequency list continues until all of the signals are confirmed, maximized and measured, or are rejected as not originating from the EUT. Then the computer prints out a final data sheet showing frequency, amplitude, Specification Limit, antenna height and angle of rotation of the EUT. A graphical plot of the data is also traced by the plotter.

APPENDIX B

Instrument Data

Antenna Factors,
Biconical ELME BIA-30
Log-periodic ELME LPA-30
Preamplifier Gain, 30 MHz –1000 MHz
75 feet of Coaxial Cable Loss, 30 MHz-1000 MHz

ANTENNA FACTORS AND GAIN
FOR
BICONICAL ANTENNA
ELECTRO-METRICS
MODEL NUMBER BIA-30
S/N 4084

3 METER CALIBRATION

FREQUENCY (MHz)	ANTENNA FACTOR (dB/m)	GAIN NUMERIC	GAIN LOGARITHMIC
20	10 .2	.04	-13.9
25	10 .2	.06	-12.0
30	14 .3	.04	-14.5
35	12 .2	.08	-11.0
40	11 .6	.12	-9.3
45	11 .4	.16	-8.1
50	10 .5	.23	-6.3
55	10 .7	.27	-5.7
60	10 .5	.34	-4.7
65	9 .1	.54	-2.6
70	7 .9	.83	-.8
75	7 .6	1.04	.2
80	7 .3	1.25	1.0
85	8 .0	1.2	0.8
90	9 .5	.95	-..2
95	10 .9	.77	-1.1
100	12 .4	.61	-2.2
105	13 .2	.55	-2.6
110	14 .5	.45	-3.5
115	15 .4	.40	-3.9
120	14 .2	.57	-2.4
125	13 .2	.79	1.0
130	13 .2	.85	-.7
135	13 .3	.90	-.5
140	13 .4	.95	-.2
145	13 .4	1 .01	.0
150	14 .9	.77	-1 .2
155	14 .5	.89	-.5
160	14 .6	.94	-.3
165	14 .8	.95	-.2
170	15 .6	.83	-.8
175	16 .1	.79	-1.0
180	16 .2	.82	-.8
185	16 .7	.77	-1.1
190	17 .2	.73	-1.4
200	17 .4	.76	-1.2

Specification Compliance Testing Factor (3 Meter Spacing) To Be Added To Receiver Meter Reading In dBuv To Convert To Field Intensity In dBuv/meter.

GAIN AND ANTENNA FACTORS

FOR

LOG PERIODIC ANTENNA

ELECTRO METRICS

MODEL LPA-30

SERIAL NO: 307

10 METER CALIBRATION

FREQUENCY (MHz)	GAIN NUMERIC	ANTENNA FACTOR (dB)	GAIN (dB)
200	2.09	13.0	3.2
225	3.55	11.8	5.5
250	3.89	12.3	5.9
275	3.80	13.2	5.8
300	3.63	14.2	5.6
325	2.75	16.0	4.4
350	4.27	14.8	6.3
375	4.57	15.1	6.6
400	4.79	15.5	6.8
425	3.63	17.2	5.6
450	4.27	17.0	6.3
475	2.82	19.2	4.5
500	3.80	18.4	5.8
525	3.09	20.1	4.9
550	3.72	19.3	5.7
575	3.89	19.5	5.9
600	4.07	19.7	6.1
625	3.80	20.3	5.8
650	3.55	21.0	5.5
675	3.63	21.2	5.6
700	3.80	21.3	5.8
725	3.47	22.0	5.4
750	4.07	21.6	6.1
775	3.72	22.3	5.7
800	3.09	23.4	4.9
825	3.47	23.1	5.4
850	3.63	23.2	5.6
875	3.80	23.3	5.8
900	3.47	23.9	5.4
925	3.47	24.1	5.4
950	3.24	24.7	5.1
975	3.31	24.8	5.2
1000	3.39	24.9	5.3

SPECIFICATION COMPLIANCE TESTING FACTOR (3 METER SPACING) TO BE ADDED TO RECEIVER METER READING IN dB(uV) TO CONVERT IT TO FIELD STRENGTH IN dB(uV/m).