Elliott Laboratories Inc.
www.elliottlabs.com
684 West Maude Avenue
Sunnyvale, CA 94086-3518
408-245-7800 Phone
408-245-3499 Fax

Electromagnetic Emissions Test Report In Accordance With FCC Part 24 on the HanspringTransmitter Model: Sparky

GRANTEE: Handspring
189 Bernado Avenue
Mountian View, CA 94049

TEST SITE: Elliott Laboratories, Inc.
684 W. Maude Ave
Sunnyvale, CA 94086

REPORT DATE: September 14, 2000

FINAL TEST DATE: September 1 and September 6, 2000

AUTHORIZED SIGNATORY: _____
David W. Bare
Principal Engineer

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FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part2, Subpart J, Sections 2.1033(C).

2.1033(c)(1) Applicant: Handspring
189 Bernado Avenue
Mountian View, CA 94049

2.1033(c)(2) FCC ID: **O8FHVP-1H**

Technical Description

The Sparky transmitter is an add-on PCS module that can be used with Handspring's Visor handheld computer. This will enable the Visor to be used as a PCS portable phone. Frequency Range of the PCS module is 1850 – 1910 MHz and maximum power is 1 watt used with a –3dBi Helix antenna gain.

2.1033(c)(3) Instructions/Installation Manual

The instruction Manual is included under. The Theory of Operation is included in the manual.

2.1033(c)(4) Type of emissions

283KGXW (GSMK Modulation)

2.1033(c)(5) Frequency Range

Transmitter: 1850.28 to 1909.72 MHz

2.1033(c)(6) Range of Operation Power

1 Watt maximum power output.

2.1033(c)(7) Maximum Power Rating

Section 24.232: Mobile/Portable stations are limited 2 Watts E.I.R.P. peak power.

2.1033(c)(8) Applied voltage and currents into the final transistor elements

Sparky is powered from a Li-Ion 3.7 V battery pack. Standby current is about 8 mA. Active current is about 300 mA.

2.1033(c)(9) Tune-up Procedure

Refer to Exhibits

2.1033(c)(10) Complete Circuit Diagrams and Functional Diagram

Refer to Exhibits

2.1033(c)(10) Means for Frequency Stabilization

For the frequency control there are two dual band VCO's on the board: VCO200 and VCO400 (supplier Delta).

2.1033(c)(10) Means for Attenuating Higher Audio Frequencies

N/A. EUT uses digital modulation.

2.1033(c)(10) Means for Limiting Modulation

N/A. EUT uses digital modulation.

2.1033(c)(10) Means for Limiting Power

N/A

2.1033(c)(11) Photographs or Drawing of the Equipment Identification Plate or Label

Refer to Exhibits

2.1033(c)(12) Photographs of equipmen.

Refer to Exhibits

2.1033(c)(13) Equipment Employing Digital Modulation.

The PCS module uses GSMK modulation with a maximum 300 kHz bandwidth.

2.1033(c)(14) Data taken for Section 2.1046 to 2.1057.

Refer to Exhibits

SCOPE

FCC Part 24 testing was performed for the equipment mentioned in this report. The equipment was tested using Sections 2.1046 to 2.1057. TIA-603 was used as a test procedure guideline to perform the required test. Other EIA/TIA procedure guidelines pertaining to the equipment under test were also used.

The intentional radiator above was tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Handspring model Sparky.

OBJECTIVE

The primary objective of the manufacturer is compliance with FCC part 24. Certification of these devices is required as a prerequisite to marketing as defined in Section 2.1033.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to FCC. FCC issues a grant of equipment authorization and a certification number upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product that may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Handspring, Model: Sparky. The actual test results are contained in an exhibit of this report.

Section 2.1046: RF Power Output

The EUT tested complied with the limits detailed in Section 24.232(b).

Since the antenna is permantely attach to the PCS module, radiated measurement was performed using a Horn antenna at a distance of 3 meters. The E-field formula was used to calculate the power from a calibrated field strength measurement. All measurements were maximized to obtain the highest amplitude reading. For this measurement a Resolution and Video bandwidth of 1 MHz was used.

$$P = \frac{(E(V/m) * D)}{30 * G}$$

E= Measured calibrated field strength
D= Distance used for measurement in meters
G= antenna gain in numeric value
P= Power in watts.

Please, refer to data included under **Exhibit 2**: Test Measurement Data.

SECTION 2.1047: MODULATION CHARACTERISTICS

Not Applicable. EUT uses digital modulation technique. The EUT was set to transmit GSM modulation.

SECTION 2.1049: OCCUPIED BANDWIDTH

The EUT was set to transmit GSM digital modulation. The 99% bandwidth was measured using the 26-dB bandwidth method. The measured value is 283 kHz.

The following procedure was used:

1. Set the spectrum analyzer to measure the maximum peak power of Fundamental signal using 300 Hz resolution bandwidth.
2. Subtracted 26dB to the measured peak and place the DISPLAY line function to the calculated value.
3. Used the MARKER functions to measure the width of the signal. The measured value was then plotted out.

Refer to plot# 3 included under **Exhibit 2**: Test Measurement Data.

SECTION 2.1051: SPURIOUS EMISSION AT ANTENNA TERMINAL.

The Bandedge emissions were tested to Section 24.238(a) and used the Resolution and Video Bandwidth instrumentation settings per Section 24.238(b) **1 percent** of the emission bandwidth of the fundamental emission. Plots# 1 and 2 of the Bandedge Blocks A and C are included with this report located under **Exhibit 2**: Test Measurement Data.

The Out-of-Band emissions were tested to Section 24.238(a) and used the Resolution and Video Bandwidth instrumentation settings per Section 24.238(b) **1 MHz**. Plots# 4 and 5 of the Out-of-Band emissions are included with this report located under **Exhibit 2**: Test Measurement Data.

SECTION 2.1053: FIELD STRENGTH OF SPURIOUS RADIATION.

The following measurements were extracted from the data recorded during the radiated electric field emissions scan and represent the highest amplitude peaks relative to the specification limit. The actual test data is contained in the appendices of this report. The field reading includes the correction factors that were applied on the Test equipment by software means. For measurements above 1 GHz a Resolution and Video bandwidth of 1MHz was used for Peak measurements. For Average measurements a Resolution Bandwidth of 1 MHz and a Video Bandwidth of 10 Hz, linear mode, was used.

Maximized Radiated Unwanted Emissions

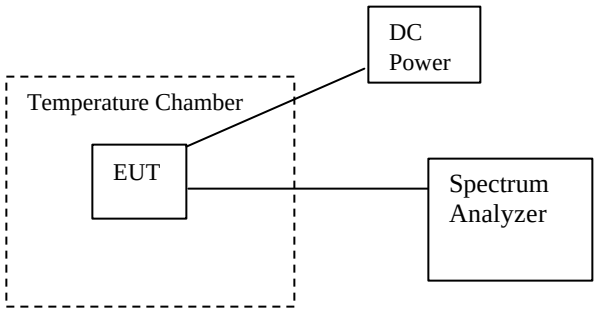
Frequency	Level	Pol	FCC Part 24		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3819.000	73.6	V	82.2	-8.6	Pk	180	1.0	

Please, refer to data included under **Exhibit 2**: Test Measurement Data. Both Low and High edges were tested.

SECTION 2.1055: FREQUENCY STABILITY

The EUT tested complies with Section 24.235.

Test Setup:



The frequency of the transmitter varied by less than 3 Hz over the temperature range of –30 to +50 degrees Celsius.

For voltage stability the EUT was set to the battery end point, which was **3Vdc**. At this voltage the EUT cease to function before it exceeded the limit.

The following test method was used:
The EUT was placed inside a temperature chamber. All support and test equipment was place outside and next to the chamber. Set the Spectrum Analyzer Res Bw and Video Bw till 6 digits are shown in the marker function section. At each frequency the MKR function of the analyzer is activated and a marker is placed where the emission mask intersected the bandedge frequency of the adjacent frequency block. During frequency stability test, if the operating frequency drifted towards band edge, the marker would appear to "crawl" up the emission mask. Amplitude level at the marker (bandedge indicator) must remain below the -13dBm limit line.

Please, refer to data included under **Exhibit 2**: Test Measurement Data

Section 2.1093: Radiofrequency radiation exposure evaluation: Portable devices.

The EUT is to be used as a portable PCS phone. A European Lab performed the SAR test for the EUT.

Please, refer to the SAR report included under **Exhibit 3**: SAR Test Report

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on June 16, 2000 at the Elliott Laboratories Open Area Test Site #3 located at 684 West Maude Avenue, Sunnyvale, California. Pursuant to section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with Section 2 of FCC Rules. Measurements are made with the EUT connected to a spectrum analyzer through an attenuator to prevent overloading the analyzer.

RADIATED EMISSIONS CONSIDERATIONS

Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR 16-1 defined elliptical area.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers are capable of measuring over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the particular detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. If average measurements above 1000MHz are performed, the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz is used.

INSTRUMENT CONTROL COMPUTER

A Rohde and Schwarz EZM Spectrum Monitor/Controller is utilized to convert the receiver measurements to the field strength at the antenna, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate.

The EZM provides a visual display of the signal being measured. In addition, the EZM Spectrum Monitor runs the automated data collection programs that control both receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors, are added automatically. .

POWER METER

A power meter and thermister mount are used may be used for output power measurements from transmitters as they provides a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or EUT and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transmitters and transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

The requirements of ANSI C63.4 were used for configuration of the equipment turntable. It specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An appendix of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from the lowest frequency generated in the device up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these are with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth that results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions that have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

The recorded level is then reproduced using a signal generator and antenna located where the device was on the test table. The power necessary to reproduce the amplitude of the measured emissions from the device was recorded. The effective isotropically radiated power (EIRP) is then calculated based on the signal generator level and the gain of the substitution antenna relative to an isotropic radiator.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for radiated emissions are based on the power of the transmitter at the operating frequency. Data is measured in the logarithmic form of decibels relative to one milliwatt, or dB milliwatts (dBm). The field strength of the emissions from the EUT are measured on a test site with a receiver.

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 24.238(a)

Operating Power Range	1 watts
Outside of the assigned frequency block	$43+10\log_{10}$ (mean output power in watts) dB below the measured amplitude at the operating power.

CALCULATIONS – EFFECTIVE ISOTROPICALLY RADIATED POWER

$$E(V/m) = \frac{\sqrt{30 * P * G}}{d}$$

P= Power in Watts
G= Gain of antenna in numeric gain (Assume 1 dB for E.I.R.P)
d= distance in meters

$$E(V/m) = \frac{\sqrt{30 * 1 \text{ watts} * 1 \text{ dB}}}{3 \text{ meters}} = 1.8257 \text{ V/m}$$

20 * log (1.8257 V/m * 1,000,000) = **125.2287 dBuV/m** @ 3 meters

43 + 10 log (P)

43 + 10 log (1 watt) = **43 dB** attenuation.

125.2287 dBuV/m – 43 dB = 82.2 dBuV/m @ 3 meter.

All Spurious and Harmonic emission must not exceed **82.2 dBuV/m** @ 3 meters.

EQUIPMENT UNDER TEST (EUT) DETAILS

The Handspring model Sparky is a 1900 MHz PCS phone module intended to be used with a handheld computer as a portable phone. The sample was received on September 1, 2000 and tested through September 6, 2000. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
Handspring Sparky PCS phone module	N/A

ENCLOSURE

The EUT enclosure is primarily constructed of plastic with metal shield inside.

SUPPORT EQUIPMENT

The following equipment was used as remote support equipment for emissions testing:

Manufacturer/Model/Description	**Serial Number**	**FCC ID Number**
H.P./ E3610A/ DC power supply	KR83024562	N/A
Wavetek/ 4201S/ Communication Test Set	113337	N/A

EXTERNAL I/O CABLING

The I/O cabling configuration during emissions testing was as follows:

Cable Description	Length (m)	From Unit/Port	To Unit/Port
None			

TEST SOFTWARE

During radiated emissions the Communication Test Set was used to simulate a Base Station Transmission. An antenna, which was connected to the Comm. Set, was place as close as possible to the EUT's antenna. This configuration allowed the EUT to transmit continuously for this test. This configuration was also used to test the conducted emissions at the antenna terminal output of the EUT.

TEST MODES

During emissions testing the transmitter was set to the normal operating mode using GSMK modulation.

EXHIBIT 1: Test Equipment Calibration Data

EXHIBIT 2: Test Measurement Data

The following data includes conducted and radiated emission measurements of the Handspring model Sparky.

16 Pages

EXHIBIT 3: SAR Test Report

EXHIBIT 4: Photographs of Test Configuration

2 pages

EXHIBIT 5: FCC ID Label and Location

1 Pages

EXHIBIT 6: Internal and External Photos

4 Pages

EXHIBIT 7: Schematics, Block Diagram, and Parts list

3 Pages

EXHIBIT 8: User Manual with Theory of Operation

Module Manual: 95 Pages
Visor Palm Pilot Manual: 106