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Electromagnetic Emissions Test Report
In Accordance With
FCC Part 24 Subpart E
on the
SOMAport Wireless Terminal
Model: CPE-0140A-000

GRANTEE:	SOMA Networks, Inc. 400 Industrial Street, Suite 100 Reichardson, Tx 75081
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Ave Sunnyvale, CA 94086
REPORT DATE:	October 4, 2001
FINAL TEST DATE:	April 25 and 26, 2001

AUTHORIZED SIGNATORY: _____

David Bare
Chief Technical Officer

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FCC CERTIFICATION INFORMATION

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

2.1033(c)(1) Applicant:

SOMA Networks, Inc.
400 Industrial Street, Suite 100
Reichardson, Tx 75081

2.1033(c)(2) FCC ID: **POZ-CPE-0140A-000**

2.1033(c)(3) Instructions/Installation Manual

Please refer to Exhibit 7: User Manual, Theory of Operation

2.1033(c)(4) Type of emissions

W-CDMA modulation, emissions designator: 5M00FXW

2.1033(c)(5) Frequency Range

Transmit: 1850.5 – 1909.5 MHz
Receives: 1930.5 – 1989.5 MHz

2.1033(c)(6) Range of Operation Power

Maximum 1.6 Watts EIRP

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

2.5 Vdc, 20.16 mA

2.1033(c)(9) Tune-up Procedure

Refer to Exhibit 7: User Manual, Theory of Operation, and Tune-up Procedure.

2.1033(c)(10) Schematic Diagram of the Transmitter

Refer to Exhibit 6. Schematic diagram

2.1033(c)(10) Means for Frequency Stabilization

All these frequencies are inherently synchronized on the Netport, because they are all generated from a single source. A 19.2 MHz TCXO (Temperature Compensated Crystal Oscillator) located on the RF board is the master source, which feeds the frequency synthesizers on the RF board, and the two PLLs (Phase Locked Loops) on the baseband board. The RF board synthesizers control the RF carrier frequency, and the two PLLs on the baseband board generate the clock associated with the symbol rate (61.44 MHz), and the audio sample rate (4.096 MHz).

2.1033(c)(10) Means for Suppression of Spurious radiation

Anti-aliasing filtering for the IQ signals is provided on the baseband board rather than the RF board. The filtering is designed to ensure that aliases that appear at 28.8MHz (30.72 – 1.92) and above, are attenuated to the point where they are below the level mandated by the transmit mask requirements.

2.1033(c)(10) Means for Limiting Modulation

Controlled by the DSP software.

2.1033(c)(10) Means for Limiting Power

Controlled by the DSP software.

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

Refer to Exhibit 4

2.1033(c)(12) Photographs of equipment

Refer to Exhibit 5

2.1033(c)(13) Equipment Employing Digital Modulation

W-CDMA modulation employed

2.1033(c)(14) Data taken per Section 2.1046 to 2.1057

Refer to Exhibit 2

SCOPE

FCC Part 24, Subpart E testing was performed for the equipment mentioned in this report. The equipment was tested in accordance with the procedures specified in Sections 2.1046 to 2.1057 of the FCC Rules. TIA-603 may also be used as a test procedure guideline to perform the some of the required tests.

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.

OBJECTIVE

The primary objective of the manufacturer is compliance with FCC part 24 Subpart E. 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

Section 2.1046: RF Power Output

The RF Power Output was tested to Section 24.232 (b)

The following modulations were tested: W-CDMA

Procedure used: **A**

Result: 32.1 dBm

Refer to Setup Photo# 1 and 2 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1047: MODULATION CHARACTERISTICS

Section 2.1047 (d) Other types of equipment.

Other types of modulations were tested to Section 24.238 (b).

The following modulations were tested: W-CDMA

Procedure used: **D** (for this test the built-in 99% power bandwidth function of a spectrum analyzer was used)

Result: 4.183 MHz

Refer to Setup Photo# 1 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1051: SPURIOUS EMISSION AT ANTENNA TERMINAL.

The Spurious Emission at the Antenna terminal was tested to Section 24.238(a).

The following modulations were tested: W-CDMA

Procedure used: **I and J**

Result: The highest spurious emission was -29 dBm at the Bandedge.

Refer to Setup Photo# 1 and 2 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1053: FIELD STRENGTH OF SPURIOUS RADIATION.

The Field Strength was tested to Section 24.238(a).

Procedure used: **N**

Result: -20.2 dB @ 3814 MHz

Refer to Setup Photo# 1 and 2 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1055: FREQUENCY STABILITY

The Frequency Stability was tested to Section 24.235.

Procedure used: **K and L**

Result: .3 Hz for Temperature Vs. Frequency and 0 Hz for Voltage stability.

Refer to the test data in Exhibit 2: Test Measurement Data for full details.

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Soma Networks model CPS-0140A-000 is a wireless terminal that is designed to provide wireless network access in homes. Normally, the EUT would be placed on a table during operation. During emissions testing the EUT was placed on a table such that it was at a height of 0.8 m above the ground plane.

The sample was received on April 25, 2001 and tested on April 25 and 26, 2001. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
Soma Networks CPE-0140A-000 Wireless Terminal	N/A

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 12 cm wide by 22 cm deep by 28 cm high.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the emission specifications.

SUPPORT EQUIPMENT

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

Manufacturer	Model	Description	Serial Number	FCC ID
HP	Pavilion 7840	PC	KR10504395	DoC
Mitsubishi	Diamond Plus 91	Monitor	011A34108	DoC
HP	5181	Keyboard	BD05106245	DoC
HP	M-S34	Mouse	LZS04915643	DoC
HP	2225C	Printer	Z714S40166	DS16XU2225

EUT INTERFACE PORTS

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

		Cable(s)		
EUT Port	Connected To	Description	Shielded or Unshielded	Length(m)
USB	Unterminated	USB	Shielded	2
Ethernet	PC	RJ-45	Unshielded	1.5
Serial	PC	RS-232	Shielded	1.5
4xTelephone	Unterminated	RJ-11	Unshielded	2

EUT OPERATION

The EUT was set to transmit continuously at the low and high bandedges.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on April 25 and 26, 2001 at the Elliott Laboratories Open Area Test Site #3 and test facility located at 684 West Maude Avenue, Sunnyvale, California. Pursuant to Section 2.948 of the FCC Rules, construction, calibration, and equipment data has been filed with the Commission.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing are 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 personal computer is utilized to record the receiver measurements of the field strength at the antenna, which is then compared directly with the appropriate specification limit. The receiver is programmed with appropriate factors to convert the received voltage into filed strength at the antenna. Results are printed in a graphic and/or tabular format, as appropriate.

The test receiver also provides a visual display of the signal being measured.

POWER METER

A power meter and thermister mount may be used for output power measurements from transmitters as they provide 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

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

TEST PROCEDURES

General: For transmitters with a detachable antenna, direct measurements for output power, modulation characterization, occupied bandwidth, and frequency stability are performed with the antenna port of the EUT connected to either the power meter, modulation analyzer, or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the transmitter fundamental will not overload the front end of the measurement instrument.

For transmitters with non-detachable antennas, field strength measurements are performed. The substitution method is also performed for the appropriate test requirement.

Procedure A – Power Measurement (Radiated Method): The following procedure is used for transmitters that do not use detachable antennas.

1) The EUT is set for maximum power and to the lowest channel.
2) A spectrum analyzer is used to measure the power output. The receiving antenna was located 3 meters from the EUT.
3) The spectrum analyzer resolution and video bandwidth are set to 1 MHz to measure the power output. No amplifier is used since the fundamental will cause the amplifier to saturate.
4) The EUT was then rotated for a complete 360 degrees and the search antenna was raised and lowered to maximize the signal strength. The receive antenna was set for both vertical and horizontal polarization to determine the maximum signal strength. All correction factors are applied to the measurement to yield a field strength value.
5) A substitution for the EUT is then performed. The substitution is performed by replacing the EUT with an antenna with factors that are referenced to a half-wave dipole and driven with a signal generator. The signal generator power level is adjusted until the level that was measured in step 4 is achieved on the spectrum analyzer. The drive level of the signal generator is added to the antenna factor, in dBi, which is equal to the equivalent isotropic radiated power from the EUT.
6) Steps 4 to 5 are then repeated for the highest channel.

Procedure D - Occupied Bandwidth (Conducted Method): Either for analog, digital, or data modulations, occupied bandwidth was performed. The EUT was set to transmit the appropriate modulation at maximum power. The bandwidth was measured using following methods:

1) The built-in 99% function of the spectrum analyzer was used.
2) If the built-in 99% is not available then the following method is used:

   26-dB was subtracted to the maximum peak of the emission. Then the display line function was used to, in conjunction with the marker delta function, to measure the emissions bandwidth.

3) For the above two methods a resolution and video bandwidth of 100 kHz was used to measure the emission's bandwidth.

Procedure H - Other Types of Equipment: Either digital or data modulated signals were simulated, by software or external sources, to performed the required tests. The EUT was set to transmit the appropriate digital modulation.

Procedure I – Bandedge (Conducted Method): Where bandedge measurements are specified the following procedure was performed:

1) Set the transmitting signal as close as possible to the edge of the frequency band/block per Section 24.238(a). Power is set to maximum.
2) Set the spectrum analyzer display line function to –13-dBm.
3) Set the spectrum analyzer bandwidth to 30 kHz. Which is approximately 1 % of the emission bandwidth.
4) Set the marker function to the FCC specified frequency band/block.
5) Set the spectrum analyzer span to show any emission within 2 MHz above or below the frequency band/block. All spurious or intermodulation emissions must not exceed the –13-dBm limit.
6) Steps 1 to 3 were repeated for all modulations and output ports that will be used for transmission.

Procedure J – Antenna Conducted Emissions (Conducted Method): For spurious emission measurements at the antenna terminal the following procedure was performed:

1) Set the transmitting signal as close as possible to the edge of the frequency band/block per Section 24.238(a). Power is set to maximum.
2) Set the spectrum analyzer display line function to –13-dBm.
3) Set the spectrum analyzer bandwidth to 1 MHz.
4) For the spectrum analyzer, the start frequency was set to 30 MHz and the stop frequency set to 20 GHz. All spurious or intermodulation emission must not exceed the –13-dBm limit.
5) Steps 1 to 3 were repeated for all modulations and output ports that will be used for transmission.

Procedure K - Frequency Stability: The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The spectrum analyzer is configured to give a 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. The Temperature chamber was varied from –30 to +50° C in 10 degree increments. The EUT was allowed to stabilize for each temperature variation.

Procedure L - Frequency Stability: For AC operated devices the nominal voltage is varied to 85% and to 115% at either room temperature or at a controlled +20°C temperature.

Procedure N - Field Strength Measurement: The EUT was set on the turntable and the search antenna positioned 3 meters away. The output antenna terminal was terminated with a 50-ohm terminator. The EUT was set at the middle of the frequency band and set at maximum output power.

For the first scan, a preliminary measurement is performed. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. One of these is with the antenna polarized vertically and one is 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.

For the final measurement, the substitution method is used for spurious emissions not being 20 dB below the calculated radiated limit. The substitution is performed by replacing the EUT with an antenna with factors that are referenced to a half-wave dipole and driven with a signal generator. The signal generator power level is adjusted until the level that was measured from the EUT is achieved on the spectrum analyzer. The drive level of the signal generator is added to the antenna factor, in dBi, which is equal to the equivalent isotropic radiated power from the EUT.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

RADIATED EMISSIONS SPECIFICATION LIMITS

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 (dBm) or one microvolt/meter (dBuV/m,). The field strength of the emissions from the EUT is measured on a test site with a receiver or spectrum analyzer.

Below is the formula used to calculate the attenuation requirement, relative to the transmitters power output when the field strength in dBuV/m is measured. For this example an operating power of 3 watts is used. The radiated emissions limit for spurious signals outside of the assigned frequency block is $43+10\text{Log}_{10}$ (mean output power in watts) dB below the measured amplitude at the operating power.

CALCULATIONS – EFFECTIVE RADIATED POWER

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

E= Field Strength in V/m
P= Power in Watts (for this example we use 3 watts)
G= Gain of antenna in numeric gain (Assume 1.64 for ERP)
d= distance in meters

$$E(V/m) = \frac{\sqrt{30 * 3 \text{ watts} * 1.64}}{3 \text{ meters}} = 4.05 \text{ V/m}$$

20 * log (4.05 V/m * 1,000,000) = 132.15 dBuV/m @ 3 meters

FCC Rules require an attenuation of 43 + 10 log (3) or 47.77 dB for all emissions outside the assigned block, the limit for spurious and harmonic emissions is:

132.15 dBuV/m – 47.77 dB = 84.38 dBuV/m @ 3 meter.

Note: For EIRP the calculation yields a value of 82.2 dBuV/m @ 3 meters. The substitution method is used for spurious emission not being 20 dB below the calculated field strength.

EXHIBIT 1: Test Equipment Calibration Data

Radiated Emissions, 1 - 19 GHz, 26-Apr-01 11:30 AM
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Horn antenna, D. Ridge 1-18GHz (SA40 system antenna)	3115	1142	12	1/29/2001	1/29/2002
Hewlett Packard	Microwave EMI test system (SA40, 30Hz - 40GHz)	84125C	1149	12	2/5/2001	2/5/2002

Radiated Output Power Measurement, 26-Apr-01 11:31 AM
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	1242	12	9/28/2000	9/28/2001
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	780	12	1/30/2001	1/30/2002

Conducted Antenna Measurements, 26-Apr-01 11:32 AM
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Hewlett Packard	Microwave EMI test system (SA40, 30Hz - 40GHz)	84125C	1149	12	2/5/2001	2/5/2002

EXHIBIT 2: Test Measurement Data

The following data includes conducted and radiated emission measurements of the Soma Networks model CPE-0140A-000.

16 Pages

EXHIBIT 3: Photographs of Test Configuration

2 Pages

EXHIBIT 4: FCC ID Label and Location

2 page

EXHIBIT 5: Internal and External Photos

External Photographs	3 Pages
Internal Photographs	6 Pages

EXHIBIT 6: Schematics and Block Diagram

Schematics	11 Pages
Block Diagram	4 Pages

EXHIBIT 7: User Manual, Theory of Operation, and Tune-Up procedure

Users Manual	55 Pages
Theory of Operation	18 Pages
Tune-Up Procedure	14 Pages